1 YEAR WARRANTY

OMEGA CARE℠ Extended Warranty Program

CE

User's Guide

Shop online at

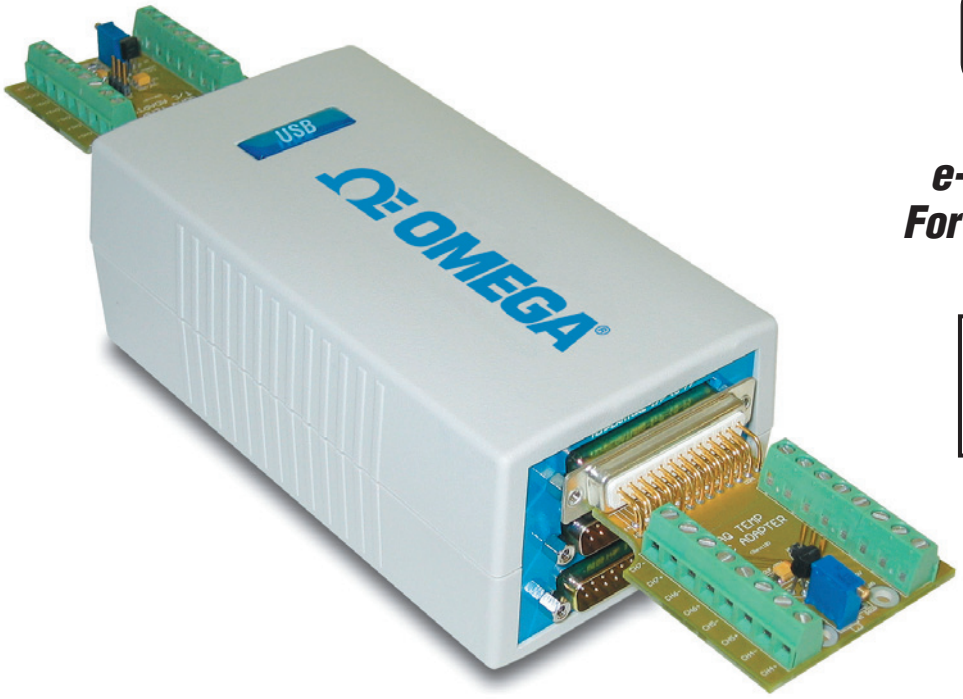
omega.com®

OMEGA®

omega.com
e-mail: info@omega.com
For latest product manuals:
omegamanual.info

ISO 9001 CERTIFIED CORPORATE QUALITY
STAMFORD, CT

ISO 9002 CERTIFIED CORPORATE QUALITY
MANCHESTER, UK



OMET-USB SERIES
8, 16 and 32 Channel Thermocouple Measurement Systems for the USB Bus

omega.com®
OMEGA®

OMEGAnet® Online Service omega.com	Internet e-mail info@omega.com

Servicing North America:

U.S.A.:
ISO 9001 Certified
One Omega Drive, P.O. Box 4047
Stamford, CT 06907-0047
TEL: (203) 359-1660 FAX: (203) 359-7700
e-mail: info@omega.com

Canada:
976 Bergar
Laval (Quebec) H7L 5A1, Canada
TEL: (514) 856-6928 FAX: (514) 856-6886
e-mail: info@omega.ca

For immediate technical or application assistance:

U.S.A. and Canada: Sales Service: 1-800-826-6342 / 1-800-TC-OMEGA®
Customer Service: 1-800-622-2378 / 1-800-622-BEST®
Engineering Service: 1-800-872-9436 / 1-800-USA-WHEN®

Mexico: En Español: (001) 203-359-7803 e-mail: espanol@omega.com
FAX: (001) 203-359-7807 info@omega.com.mx

Servicing Europe:

Benelux:
Postbus 8034, 1180 LA Amstelveen, The Netherlands
TEL: +31 (0)20 3472121 FAX: +31 (0)20 6434643
Toll Free in Benelux: 0800 0993344
e-mail: sales@omegaeng.nl

Czech Republic:
Frystatska 184, 733 01 Karviná, Czech Republic
TEL: +420 (0)59 6311899 FAX: +420 (0)59 6311114
Toll Free: 0800-1-66342 e-mail: info@omegashop.cz

France:
11, rue Jacques Cartier, 78280 Guyancourt, France
TEL: +33 (0)1 61 37 2900 FAX: +33 (0)1 30 57 5427
Toll Free in France: 0800 466 342
e-mail: sales@omega.fr

Germany/Austria:
Daimlerstrasse 26, D-75392 Deckenpfronn, Germany
TEL: +49 (0)7056 9398-0 FAX: +49 (0)7056 9398-29
Toll Free in Germany: 0800 639 7678
e-mail: info@omega.de

United Kingdom:
ISO 9002 Certified
One Omega Drive, River Bend Technology Centre
Northbank, Irlam, Manchester
M44 5BD United Kingdom
TEL: +44 (0)161 777 6611 FAX: +44 (0)161 777 6622
Toll Free in United Kingdom: 0800-488-488
e-mail: sales@omega.co.uk

Table of Contents

List of Figures

List of Tables

1 Introduction

The OMET-USB-73 products consist of two main types, a ‘T’ and ‘R’ version. The ‘T’ version is designed for reading thermocouples and the ‘R’ for reading RTDs. The main difference between the two are the fact that the ‘T’ version can only read voltage levels between ±80mV and the ‘R version inputs between ±2.5V.
The OMET-USB-73 Temperature Input series supports 8, 16 and 32 temperature inputs. The units come with external adaptors that serve as the connection point for the sensors.

Each unit also has three DIO ports of eight bits.

1.1 Features – OMET-USB-73 Commercial Version

The OMET-USB-73 series has some very unique features and are listed below:

- USB Revision 1.1 @ full speed and 2.0 compliant @ high speed
- Powered externally
- Intel 8255 compatible digital I/O ports
- 14-bit Analog resolution temperature inputs
- Quick and effortlessly to install
- ABS plastic housing

1.2 Operating Systems and API Software

The OMET-USB-73 has a complete SDK, EDR Enhanced Software Development Kit. This kit contains a driver for Microsoft® Windows™ and the Linux kernel. Please consult OMEGA Engineering for the latest information on which specific operating systems are supported.

Current Supported Operating System:

- Microsoft® Windows™ 2000
- Microsoft® Windows™ Millennium Edition
- Microsoft® Windows™ XP
- Microsoft® Windows™ Pocket PC 2003
- Linux Kernel 2.4 and later

The EDR Enhanced SDK serves as a common application and programming interface for all the units, no matter what the communications protocol. This single property makes the units easy to program because no knowledge is needed about the specific type of interface. It also means that the units can be controlled from the same application without any redevelopment when installing a different device. It also increases the life expectancy of the software application. The EDR Enhanced SDK comes with complete documentation and examples programs. For custom software the API is easy to learn shortening the learning curve. It also means that it's quicker to go into production.

1.3 USB 73 Versions

The tables below list the various versions that are available.

1.3.1 Temperature Input Series

- R is RTD
- T is Thermocouple

Feature	OMET-USB 73R/T8	OMET-USB 73R/T16	OMET-USB 73R/T 32
Number of digital I/O channels	24	24	24
Number of 8255 compatible ports (8-bit)	3	3	3
Number of temperature channels	8	16	32
Number of CJC channels	1	2	4
Analog input resolution	14-bit	14-bit	14-bit
Maximum sampling speed	100 Hz	100 Hz	100 Hz

Table 1-1 µDAQ Temperature Versions

1.4 Software Support

The OMET-USB-73 series is supported by EDR Enhanced 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.

1.5 Contact Details

Omega Engineering Inc.
1 Omega Drive
P.O. Box 4047
Stamford, CT 06907 USA
Telephone (800)-848-4286
Fax (203)-359-7700 -
E-Mail das@omega.com
Website http://www.omega.com

2

2 Getting Started

This chapter describes how to install and configure the OMET-USB-73 device for the first time. Minimal configuration is necessary; almost all settings are done through software.

2.1 Package Items

The package of items differs by device type. Depending on the device type accessories will be included like power supplies, USB cable and third party devices.

1. OMET-USB-73 unit
2. USB 2.0 compliant peripheral cable
3. Universal power supply
4. Software CD Rom
5. RTD or Thermocouple adaptor unit
6. Software CD Rom

2.2 Operating Systems for Specific Devices

The USB driver for Windows is a Windows Driver Model (WDM) type that will run on all modern Windows platforms. Linux has it's own driver which is exported as a character device.

OS Type	Driver Type
Windows ME/2000/XP	WDM Plug and Play
Linux 2.4 and later	Linux Character Device

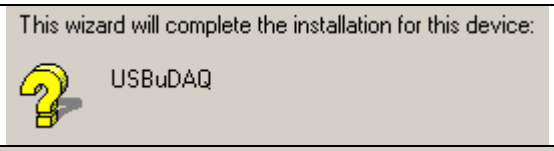
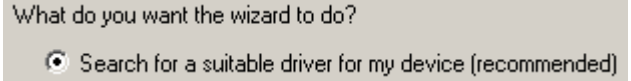
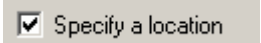
Table 2-1 USB Operating System Support

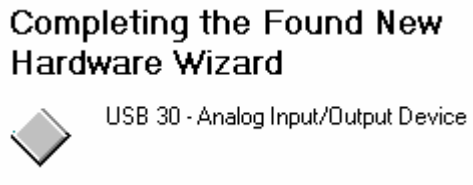
2.3 Installation

The USB installation is different on each operating system type. The installation procedure for each operating system will be discussed separately for Windows Desktop, Windows Mobile and Linux.

2.3.1 Microsoft Windows PnP Installation (Windows ME, 2000, XP)

For the Windows PnP installation you will need a PC that can accept a USB device and that is configured to work with USB devices. Depending on the version you will need either USB 1.1 or USB 2.0.

1		Find an open USB port and connect your device with the provide USB cable. Also provide power to your device if it is externally powered. Only use the provide power cable or power supply.
2		Windows will now detect that a new USB device was attached and request driver to be supplied.
3		Click on the ***next*** button to start the process.
4		The wizard will now need to be supplied with driver files to for your USB device.
5		Select the option as indicated and then the next button.
6		Only select to specification the location of the driver files.
7		The driver is located at ***<OMEGACD>\EDRE\Drivers\WDM\USB***. Select the next button to install the driver.

8		Depending on the model the last screen will show that the installation was completed successfully for your particular device.

2.3.2 Linux Installation (Kernel 2.4 and later) - Overview

The Linux installation can be a bit tricky sometimes. Make sure that the kernel supports USB devices and that the necessary modules are already loaded or can load on demand. Also make sure that all kernel source and header files are installed. The Linux driver is available with complete source and it will be best if it is recompiled to be compatible with the current kernel version. The source listing on the <OMEGACD>\EDRE\Linux should match the directory structure on the target system. Drivers can be copied manually to */usr/src/<linux kernel source>/drivers/edredaq*. The USB driver will also be located here. Copy the driver and read the documentation in the same directory to install the driver.

Also copy the EDR Enhanced shared object and examples. This should be located at */usr/src/edre.* The EDRE source directory contains the source for the API and examples. The examples directory has samples program specifically for each device. Make sure to install the EDR Enhanced before trying to build the source code. The header files are located at *usr/include/edre.* The header files is also necessary when building the drivers. Please consult the Linux documentation for complete instructions.

2.4 Application Software- OmegaLog

The EDR Enhanced Software Development Kit CD-Rom comes with OMEGALog OMET for Windows™. OMEGALog OMET has support for Analog Inputs, Analog Outputs, Digital I/O and Counter-Timers. It has an oscilloscope function to continuously display incoming analog data, a signal generator, a power supply, temperature logger and a multifunctional chart recorder to sample and control signals, analog and digital, at preset intervals.

WaveView can be found on the EDR Enhanced CD-Rom at *<OMEGACD>\EDRE\APPS\WVFW*.

3

3 Hardware Interface

The Hardware Interface chapter will discuss all connectors located on the OMET-USB-73 products. The pin assignments for each connector will also be listed.

The OMET-USB-73 series has connectors for digital I/O and temperature I/O. The OMET-USB-73s make use of only one connector type, a DB25 male. To inter-connect to application modules there are adapters modules available. A cable is used to connect to these modules. Screw terminal modules are also available for quick installations. This chapter will also discuss method of hardware operation, optional accessories and connectable application modules.

3.1 OMET-USB-73 External Application Connectors

The OMET-USB-73 is fitted with various DB25 male connectors. The illustrations below show the different box types. There are two-tier and three-tier models. Depending on the number of connectors required the box would be either one. The OMET-USB-73 devices use a standard USB type B connector. The side with the power connector is the rear side of the device. The pin assignments are the same for all models.

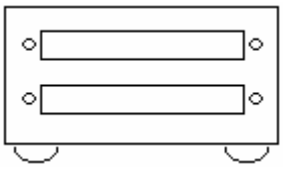


Figure 3-1 OMET-USB-73 Front Side 2-Tier

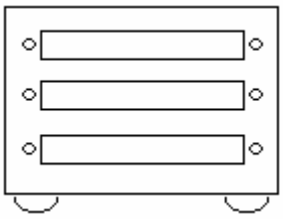


Figure 3-2 OMET-USB-73 Front Side 3-Tier

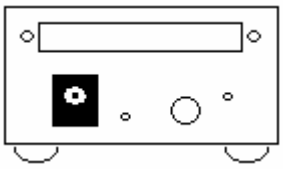


Figure 3-3 OMET-USB-73 Rear Side 2-Tier

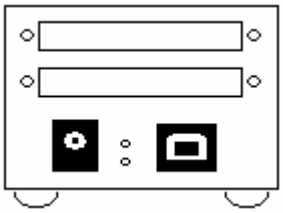


Figure 3-4 OMET-USB-73 Rear Side 3-Tier

B = Bottom, M = Middle, T = Top
F = Front, R = Rear

Device Type	DB25 (M) Digital I/O Port Assignment	DB25(M) Analog I/O	Box Type
OMET-USB-73T/R8	FB (0-2)	FT (CH0-7, CJC0)	
OMET-73T/R16	FB (0-2)	FT (CH0-7, CJC0) RT (CH8-15, CJC1)	
OMET-73T/R32	FB (0-2)	FM (CH0-7, CJC0) RM (CH8-15, CJC1) FT (CH16-23, CJC2) RT (CH24-31, CJC3)	

Table 3-1 μDAQ Connectors

3.2 Pin Assignments

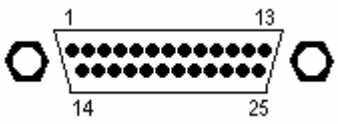


Figure 3-5 OMET-USB-73 DB25 Male Connector

3.2.1 OMET-USB-73 DIO Connector – DB25 (M)

The table below shows the pin assignments for the DB25(M) digital I/O connectors found on the OMET-USB-73 devices.

Pin	Name	Pin	Name
1	PA0	14	PA1
2	PA2	15	PA3
3	PA4	16	PA5
4	PA6	17	PA7
5	PB0	18	PB1
6	PB2	19	PB3
7	PB4	20	PB5
8	PB6	21	PB7
9	PC0	22	PC1
10	PC2	23	PC3
11	PC4	24	PC5
12	PC6	25	PC7
13	DGND		

Table 3-2 OMET-USB-73 DIO Connector – DB25 (M)

3.2.2 OMET-USB-73 Temperature Input – DB25 (M)

The table below shows the pin assignments for the DB25(M) temperature input connectors found on the OMET-USB-73 device.

Pin	Name	Pin	Name
1	AGND	14	+8.4V
2	AGND	15	+12V
3	AGND	16	CJC
4	AGND	17	-12V
5	AGND	18	TCH7-
6	TCH7+	19	TCH6-
7	TCH6+	20	TCH5-
8	TCH5+	21	TCH4-
9	TCH4+	22	TCH3-
10	TCH3+	23	TCH2-
11	TCH2+	24	TCH1-
12	TCH1+	25	TCH0-
13	TCH0+	26	SHELL – DGND

Table 3-3 OMET-USB-73 Input – DB25 (M)

3.3 Pin Descriptions

3.3.1 Digital Inputs/Outputs (PA0-7, PB0-7, PC0-7)

These lines are connected to the 3 ports of the 8255 PPI. Each port can be configured as either an input or an output.

3.3.2 Digital Ground (DGND)

All digital ground signals should be connected to this pin.

3.3.3 Analog Ground (AGND)

All analog inputs should be referenced to AGND. Do not connect AGND and DGND together. This will create ground loops and instability in the hardware.

3.3.4 Analog Inputs (ACH0-15)

The analog input channels are connected to the analog input sub-system and are used to measure analog voltages. These signals are referenced to analog ground (AGND).

3.3.5 Temperature Inputs (TCH0-7)+-

Each temperature channel has two input lines for positive and negative. However in all temperature applications there are always and external modules for thermocouple or RTD inputs. Their user never connects directly to these pins.

3.4 Bus Connectors

The OMET-USB-73 uses a standard USB Type B connector. The device is supplied with a USB 2.0 compliant cable. When viewing the OMET-USB-73 device from the rear the USB B Type connector is located on the right side. In the middle are the indicator light and the power connector on the left. When the USB device is connected to the PC the USB indicator light will light up, indicating that USB bus power is present.

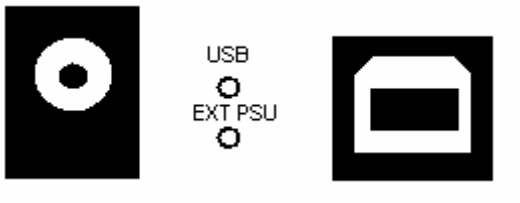


Figure 3-6 OMET-USB-73 Connectors

3.5 Power Supplies, Power Connectors

The commercial OMET-USB-73 units are supplied with an AC power supply.
The AC power supply is a wide AC input voltage range type, 110V to 250V. The AC power supply also contains a universal socket kit, which makes it possible to connect to any international power socket. The output voltage is 9V @ 1A maximum.
The polarity of the output connector must be positive on the outside and negative in the middle.
There is an indicator light to show of the power is present.

Figure 3-7 μDAQ Power Connector Pin Assignment

Figure 3-8 μDAQ Power Socket

3.6 Application Modules & Accessories

The OMET-USB-73 devices support a wide range of standard applications modules. These application modules can help to simply or easily duplicate installations that can save allot of time. Application modules and accessories come in many forms. It has support for digital output control and digital input monitoring for AC and DC.

3.6.1 Digital I/O Adapter Module – OMET-PC43A2

The digital I/O adapter module is used to map digital I/O ports to a usable form. The OMET-PC43A2 adapter module makes it possible to connect to application modules, such as solid relays modules and optical-isolated modules. The OMET-PC43A2 output the 3 x 8-bit ports (A,B,C) into a combination of port A and B and three separate ports A,B and C. To connect to the OMET-PC43A2 use a standard DB25M/F cable. Port AB is a standard IDC20 connecter and port A,B and C standard IDC10 connecters. The OMET-PC43A2 can also be used to provide external power to application modules. Connect +5V to the external power screw terminal and it will distribute it to all child models through the various connecters. The table below shows the pin mappings for the module. When externally powered the power indicator will light up.

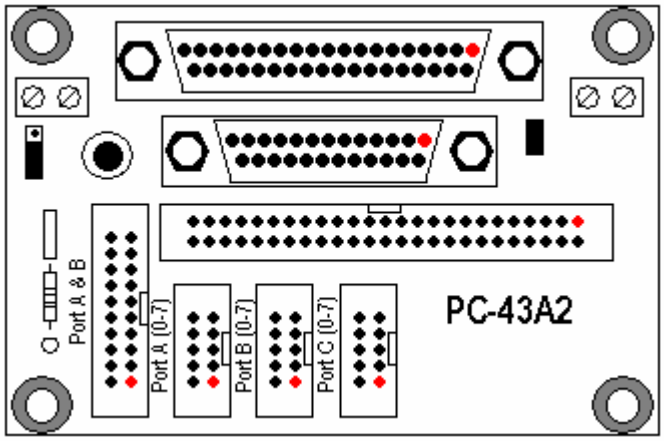


Figure 3-9 OMET-PC43A2 Digital I/O Adapter

3.6.2 Thermocouple Adapter

The thermocouple adapter is used to interconnect the OMET-USB-73 unit and thermocouple temperature sensors. The adapter has cold junction compensation (CJC) built-on, which is necessary to make thermocouple connections. The CJC needs to be calibrated before being used. The illustration below shows the thermocouple adapter. The adapter has DB25 female connector that connects directly to the OMET-USB-73 unit. Care must be taken to only connect to a temperature input connector.

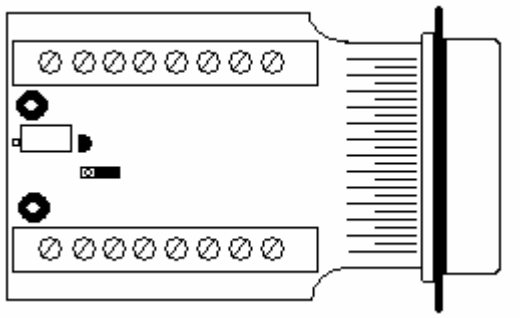


Figure 3-10 Thermocouple Adapter

4

4 Software

The OMET-USB-73 series are supplied with a complete software package called the EDR Enhanced Software Development Kit (EDRE SDK). The SDK is supplied with many operating system drivers, an application program interface (EDRE API), complete documentation and programming examples for most programming languages.

The software development kit also contains OMEGALog OMET
to provide a generic application solution for data capturing and simple process control. Third party Interface drivers are also provided for Labview, TestPoint and Agilent VEE Pro.

The Software chapter serves as reference for the EDR Enhanced API exported functions. It explains how to do common operations to program and control the OMET-USB-73 hardware. Each supported function is listed for each type of interface. The parameters for each function are also listed. There are only a few functions, so make sure to have a thorough understanding of how to use them.

4.1 EDR Enhanced Application Program Interface (EDRE API)

The EDR Enhanced API consist of operating system drivers, Windows dynamic link libraries, Windows ActiveX controls, Windows .Net components and Linux shared objects. EDRE Enhanced API has support for Windows 2000/XP/.Net and the Linux kernel.

The EDR Enhanced SDK contains example code to use as reference or starting point for a custom application. The examples covers topics such as digital I/O reads and writes, and reading the analog inputs.

The EDRE API hides the complexity of the hardware and makes it really easy to program the OMET-USB-73 devices. It has functions for each basic sub-system and is real easy to learn.

The EDR Enhanced Application Programming Interface currently support four interface types:

1. Shared Object with exported functions via dynamic link library and shared object
2. EDR Enhanced ActiveX package for Windows platform
3. EDR Enhanced Object interface for Linux and .Net platform
4. EDR Enhanced Device Object interface for Linux and .Net platform

The illustration below shows the EDR Enhanced Application Program Interface design. The next sections will discuss each sub-system's functions separately. It will show which functions each type of interface supports and what parameters are used.

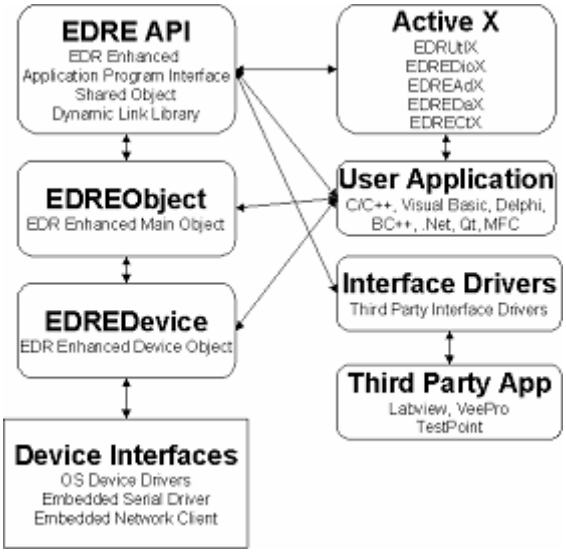


Figure 4-1 EDR Enhanced API Design

4.2 The Query Command – EDRE_Query

The query API function is used to retrieve useful information about your device. Appendix C has a list of query codes that will operate on the OMET-USB-73 devices. The query function is the most powerful function of the EDR Enhanced API and can tell a lot about your device, like manufacturing date, the serial number, bus type, revision and device driver version. The query function can also supply information about the API itself like release version and number of devices installed.

4.2.1.1 Shared Object and Linked Library Interface

Function Name	EDRE_Query		
Object	Edrapi.dll / edrapi.so		
Platform	Linux, Microsoft Windows, Pocket PC 2003		
Parameters	32-bit unsigned integer		Serial Number
	32-bit unsigned integer		Query Code
	32-bit unsigned integer		Parameter
Return Error	32-bit signed integer		
Error Codes	>=0	Query return value	No error
	-1	EDRE_FAIL	General failure
	-3	EDRE_BAD_SN	Device with serial number does not exist
	-18	EDRE_BAD_QUERY	Invalid query code

4.2.1.2 ActiveX Interface

Function Name	Query		
Object	EDREUTLX		
Platform	Microsoft Windows		
Related Property	SerialNumber		
Parameters	32-bit unsigned integer		Query Code
	32-bit unsigned integer		Parameter
Return Value	32-bit signed long		
Error Codes	>=0	Query return value	No error
	-1	EDRE_FAIL	General failure
	-3	EDRE_BAD_SN	Device with serial number does not exist
	-18	EDRE_BAD_QUERY	Invalid query code

4.2.1.3 EDR Enhanced Main Object Interface

Function Name	Query		
Object	EDREObject		
Platform	Linux		
Parameters	32-bit unsigned integer		Serial Number
	32-bit unsigned integer		Query Code
	32-bit unsigned integer		Parameter
Return Value	32-bit signed integer		
Error Codes	>=0	Query return value	No error
	-1	EDRE_FAIL	General failure
	-3	EDRE_BAD_SN	Device with serial number does not exist
	-18	EDRE_BAD_QUERY	Invalid query code

4.2.1.4 EDR Enhanced Device Object Interface

Function Name	Query
Object	EDREDevice
Platform	Linux
Parameters	32-bit unsigned integer — Query Code 32-bit unsigned integer — Parameter
Return Value	32-bit signed integer
Error Codes	>=0 — Query return value — No error -1 — EDRE_FAIL — General failure -3 — EDRE_BAD_SN — Device with serial number does not exist -18 — EDRE_BAD_QUERY — Invalid query code

4.2.1.5 Query example

This example queries the number of devices installed and the serial number of each device.

PSEUDO START

```
Define APINUMDEV = 5   “See appendix C for list of query codes”
NumDevices of type 32-bit integer
SerialNumber of type 32-bit integer
  NumDevices = EDRE_Query(0, APINUMDEV,0)
  For d = 0 to NumDevices-1 do
    SerialNumber = EDRE_Query(0, APIDEVSN,d)
  Next d
```

PSEUDO STOP

4.3 Digital Inputs/Outputs

The table below shows all the assigned ports to each device. The digital port makes out an important part of any automated system. The digital I/O ports are used to control external equipment logically or to monitor logical conditions. The digital I/O port can be used to switch high voltage external equipment through controlling external relays and contactors. It can also be connected external monitoring circuit that indicates conditions logically.

XXX = USB
T=TOP, M=MIDDLE, B=BOTTOM
F=FRONT, R=REAR
2 = 2 TIER BOX, 3 = 3 TIER BOX

Port	PPI No	Assigned Number	Port Width	OMET-USB-73 Connector	Description
XXX 73R/T					
A	0	0	8-bits	FB2	Port A
B	0	1	8-bits	FB2	Port B
C	0	2	8-bits	FB2	Port C

Table 4-1 Digital I/O Assigned Ports

4.3.1 Reading the Digital Inputs – EDRE_DioRead

A single call is necessary to read a digital I/O port. Depending on the interface the result is either passed through a reference parameter or by the returned code. The digital I/O ports a self managed, meaning it will automatically configure as inputs when read from. Please note that due to the identity of the digital I/O devices the output ports will looses its output value when the a port is configured differently. It's very important to do the appropriate reads and writes to ensure the device is in proper configuration before using it. Each interface function is showed separately in the next section.

4.3.1.1 Shared Object and Linked Library Interface

Function Name	EDRE_DioRead		
Object	Edrapi.dll / edrapi.so		
Platform	Linux, Microsoft Windows, Pocket PC 2003		
Parameters	32-bit unsigned integer		Serial Number
	32-bit unsigned integer		Port
	Pointer to 32-bit unsigned integer		Value
Return Error	32-bit signed integer		
Error Codes	0	EDRE_OK	No error
	-1	EDRE_FAIL	General failure
	-3	EDRE_BAD_SN	Device with serial number does not exist
	-14	EDRE_BAD_PARAMTER	Port value is incorrect

4.3.1.2 ActiveX Interface

Function Name	Read		
Object	EDREDioX		
Platform	Microsoft Windows		
Related Property	SerialNumber		
Parameters	32-bit signed integer		Port
Return Value	32-bit signed long		
Error Codes	>=0	Value read from port	No error
	-1	EDRE_FAIL	General failure
	-3	EDRE_BAD_SN	Device with serial number does not exist

	-14	EDRE_BAD_PARAMTER	Port value is incorrect

4.3.1.3 EDR Enhanced Main Object Interface

Function Name	DioRead
Object	EDREObject
Platform	Linux
Parameters	32-bit unsigned integer – Serial Number 32-bit unsigned integer – Port Pointer to 32-bit unsigned integer – Value
Return Value	32-bit signed integer

Error Codes			
	0	Value read from port	No error
	-1	EDRE_FAIL	General failure
	-3	EDRE_BAD_SN	Device with serial number does not exist
	-14	EDRE_BAD_PARAMTER	Port value is incorrect

4.3.1.4 EDR Enhanced Device Object Interface

Function Name	DioRead
Object	EDREDevice
Platform	Linux
Parameters	32-bit unsigned integer – Port Pointer to 32-bit unsigned integer – Value
Return Value	32-bit signed integer

Error Codes			
	0	Value read from port	No error
	-1	EDRE_FAIL	General failure
	-3	EDRE_BAD_SN	Device with serial number does not exist
	-14	EDRE_BAD_PARAMTER	Port value is incorrect

4.3.2 Writing to the Digital Outputs – EDRE_DioWrite

A single call is necessary to write to a digital I/O port. Depending on the interface type a port number and value is passed to the function. A returned error code will tell if the function passed or not. . Please note that due to the identity of the digital I/O devices the output ports will looses its output value when the a port is configured differently. It's very important to do the appropriate reads and writes to ensure the device is in proper configuration before using it. Each interface function is showed separately in the next section.

4.3.2.1 Shared Object and Linked Library Interface

Function Name	EDRE_DioWrite
Object	Edrapi.dll / edrapi.so
Platform	Linux, Microsoft Windows, Pocket PC 2003
Parameters	32-bit unsigned integer – Serial Number 32-bit unsigned integer – Port 32-bit unsigned integer – Value
Return Error	32-bit signed integer

Error Codes			
	0	EDRE_OK	No error
	-1	EDRE_FAIL	General failure
	-3	EDRE_BAD_SN	Device with serial number does not exist
	-14	EDRE_BAD_PARAMTER	Either the port or value is incorrect

4.3.2.2 ActiveX Interface

Function Name	Write
Object	EDREDioX
Platform	Microsoft Windows
Related Property	SerialNumber
Parameters	32-bit signed integer — Port 32-bit signed integer — Value
Return Value	32-bit signed integer
Error Codes	0 — EDRE_OK — No error -1 — EDRE_FAIL — General failure -3 — EDRE_BAD_SN — Device with serial number does not exist -14 — EDRE_BAD_PARAMTER — Either the port or value is incorrect

4.3.2.3 EDR Enhanced Main Object Interface

Function Name	DioWrite
Object	EDREObject
Platform	Linux
Parameters	32-bit unsigned integer — Serial Number 32-bit unsigned integer — Port 32-bit unsigned integer — Value
Return Value	32-bit signed integer
Error Codes	0 — EDRE_OK — No error -1 — EDRE_FAIL — General failure -3 — EDRE_BAD_SN — Device with serial number does not exist -14 — EDRE_BAD_PARAMTER — Either the port or value is incorrect

4.3.2.4 EDR Enhanced Device Object Interface

Function Name	DioWrite
Object	EDREDevice
Platform	Linux
Parameters	32-bit unsigned integer — Port 32-bit unsigned integer — Value
Return Value	32-bit signed integer
Error Codes	0 — EDRE_OK — No error -1 — EDRE_FAIL — General failure -3 — EDRE_BAD_SN — Device with serial number does not exist -14 — EDRE_BAD_PARAMTER — Either the port or value is incorrect

4.3.3 Query Codes

The digital I/O sub-system can be queried for the number of ports available and the property of each port. The following query codes are relevant to the digital I/O system.

Name	Value	Description
DIONUMPORT	400	Query the number of digital I/O ports installed
DIOQRYPORT	401	Query a specific port for its properties. Use PARAM to specify the port. 0 — DIOOUTPUT — Port is output only 1 — DIOINPUT — Port is input only 2 — DIOINOROUT — Port is either in or out 3 — DIOINANDOUT — Port is in and out
DIOPORTWIDTH	402	Query a specific port width. Use PARAM to specify the port. The value returned is the bit width of the port.

4.3.3.1 Query number of ports

PSEUDO START
Dioports of type 32-bit integer
  Dioport = EDRE_Query(serialnumber, DIONUMPORT,0)
PSEUDO STOP

4.3.3.2 Query port type

“Port type can be output, input, in-and-out, in-or-out
PSEUDO START
Port_type of type 32-bit integer
  For p = 0 to Dioports-1 do
    Port_type = EDRE_Query(serialnumber, DIOQRYPORT,p)
  Next p
PSEUDO STOP

4.3.3.3 Query port width in bits

PSEUDO START
Port_width of type 32-bit integer
  For p = 0 to Dioports-1 do
    Port_width = EDRE_Query(serialnumber, DIOPORTWIDTH,p)
  Next p
PSEUDO STOP

4.4 Temperature Input – 73 Model

The OMET-USB-73 has three different basic temperature models. The OMET-USB-73 is available in an 8, 16, and 32-channel model.

There are eight channels available on a single DB25 male connector and one cold junction compensation (CJC) channel. Only a genuine Eagle Technology thermocouple adapter can be used to interface to the thermocouple inputs. This adapter has a build CJC device and is necessary to read thermocouple temperatures.

The OMET-USB-73 temperature units also support RTD inputs. If RTDs are used a RTD adapter must be connected. The RTD adapter has build in support for a 1mA and 10mA current source. It supports both the two wire and four wire system.

Note that the OMET-USB-73 units are manufactured for either thermocouples or RTD and cannot be changed by swapping the adapter modules.

4.4.1 Thermocouple Procedure

To read a thermocouple channel a sequence needs to be followed. The steps below shows what steps to follow the read a thermocouple channel.

1. Read CJC channel
2. Calculate ambient temperature
3. Read thermocouple channel
4. Calculate temperature

4.4.2 Reading CJC Channel

To be able to read and calculate a thermocouple voltage the CJC channel need to be read. This value is used to calculate the cold-junction-compensation for a thermocouple channel. A thermocouple adapter's CJC channel has a circuit that will supply a voltage of 10mV per 1 degree Celsius. The CJC channel is read in the same way as a normal analog channel. The index of the channel is very important as for a unit can have more than one CJC channel. The CJC channel must always be read before reading a number of channels on a thermocouple adapter. The table below shows the CJC channel index for a particular type of device.

XXX = USB

Devices	CJC Channels	
XXX 73T8	CJC	Value Assigned
	0	8
XXX 73T16 R-XXX 73T16	CJC	Value Assigned
	0	16
	1	17
XXX 73T32 R-XXX 73T32	CJC	Value Assigned
	0	32
	1	33
	2	34
	3	35

Table 4-2 CJC Channels Assigned

4.4.2.1 Query the CJC channel index

The index of each CJC channel can be queried

PSEUDO START

```
CJC_channel of type 32-bit integer
  Do
   CJC_channel = EDRE_Query(serialnumber, ADAMBCHAN,0)
  Until CJC_channel < 0
```

PSEUDO STOP

4.4.2.2 Read CJC channel

To read a CJC channel use the EDRE_ADSingle command. For further reference on this command see the analog input section. The channel must be the CJC channel index. The Gain and Range parameter are not used.

PSEUDO START
CJC_value of type 32-bit signed integer
CJC_channel of type 32-bit unsigned integer
  CJC_channel = 8
  error = EDRE_ADSingle(serialnumber, CJC_channel,0,0,pointer of CJC_value)
  if error = 0 print CJC_value
  else print “Error reading CJC channel”
PSEUDO STOP

4.4.3 Types of Thermocouples

The EDR Enhanced application program interface supports the conversion of many thermocouple types. The table below lists all the supported types. Each type has its purpose like wide temperature range or very accurate in a certain range. The constant value is used when calculating the temperature.

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

Table 4-3 Thermocouple Type Table

4.4.4 Reading a Thermocouple Channel

Reading the thermocouple channel is the same as reading an analog channel or CJC channel. The channels on the OMET-USB-73models are zero indexed. If the device is a hybrid that has normal analog channels and temperature channels, the temperature channels will follow the analog channels. As with the reading of the CJC channel the range and gain parameter of the EDRE_ADSingle command is not used.

The example below will read thermocouple channel 0.
PSEUDO START
TC_value of type 32-bit signed integer
  error = EDRE_ADSingle(serialnumber, 0,0,0,pointer of TC_value)
  if error = 0 print TC_value
  else print “Error reading termocpuple channel”
PSEUDO STOP

4.4.5 Calculating Ambient Temperature

After reading the CJC channel the ambient temperature can be calculated. The voltage read from the CJC channel must be passed to this conversion function. The returned value will be the temperature in millidegrees.

4.4.5.1 Shared Object and Linked Library Interface

Function Name	EDRE_CalcCJCmC	
Object	Edrapi.dll	
Platform	Microsoft Windows	
Parameters	32-bit signed integer	CJC microvolt
Return Value	32-bit signed integer	
Value	Millidegrees	

4.4.5.2 ActiveX Interface

Function Name	CalcCJCmC	
Object	EDREADX	
Platform	Microsoft Windows	
Related Property	None	
Parameters	32-bit signed integer	CJC microvolt
Return Value	32-bit signed integer	
Value	Millidegrees	

4.4.5.3 EDR Enhanced Main Object Interface

Function Name	CalcCJCmC	
Object	EDREObject	
Platform	No support	
Parameters	32-bit signed integer	CJC microvolt
Return Value	32-bit signed integer	
Value	Millidegrees	

4.4.5.4 EDR Enhanced Device Object Interface

Function Name	CalcCJCmC	
Object	EDREDevice	
Platform	No support	
Parameters	32-bit signed integer	CJC microvolt
Return Value	32-bit signed integer	
Value	Millidegrees	

4.4.6 Calculating Temperature for Thermocouples

After the CJC channel and thermocouple channel was read and the CJC value converted to millidegrees, the thermocouple temperature can be calculated. The thermocouple type, thermocouple channel voltage and ambient temperature need to be supplied in order to do this. The returned value will be in millidegrees.

4.4.6.1 Shared Object and Linked Library Interface

Function Name	EDRE_CalcTCmC	
Object	Edrapi.dll	
Platform	Microsoft Windows	
Parameters	32-bit signed integer array	Thermocouple type
	32-bit signed integer array	Thermocouple channel voltage
	32-bit signed integer array	Ambient temperature in millidegrees
Return Value	32-bit signed integer	
Value	Millidegrees	

4.4.6.2 ActiveX Interface

Function Name	CalcTCmC	
Object	EDREADX	
Platform	Microsoft Windows	
Related Property	None	
Parameters	32-bit signed integer	Thermocouple type
	32-bit signed integer	Thermocouple channel voltage
	32-bit signed integer	Ambient temperature in millidegrees
Return Value	32-bit signed integer	
Value	Millidegrees	

4.4.6.3 EDR Enhanced Main Object Interface

Function Name	CalcTCmC	
Object	EDREObject	
Platform	No support	
Parameters	32-bit signed integer	Thermocouple type
	32-bit signed integer	Thermocouple channel voltage
	32-bit signed integer	Ambient temperature in millidegrees
Return Value	32-bit signed integer	
Value	Millidegrees	

4.4.6.4 EDR Enhanced Device Object Interface

Function Name	CalcTCmC	
Object	EDREDevice	
Platform	No support	
Parameters	32-bit signed integer	Thermocouple type
	32-bit signed integer	Thermocouple channel voltage
	32-bit signed integer	Ambient temperature in millidegrees
Return Value	32-bit signed integer	
Value	Millidegrees	

4.4.6.5 Example of calculating a thermocouple temperature

The temperature
PSEUDO START
Define TYPE_K 1
CJC_millideg of type 32 signed integer
TC_value of type 32-bit signed integer
TC_millideg of type 32-bit signed integer

```
  TC_millideg = EDRE_CalcTCmC(TYPE_K, TC_value, CJC_millideg)
  Print TC_millideg
```

PSEUDO STOP

5

5 Calibration Procedure

This chapter deals with calibrating your hardware. Please follow the instruction carefully to properly calibrate your device.

5.1.1 Calibration - USB 73

If the USB device needs to be calibrated, the software can be found on the EDR Enhanced SDK CD-Rom. This application provides step-by-step information of how to calibrate your device. Make sure that you have a high precision calibration voltage source. This will help to configure your device more accurately.

5.1.2 Equipment

The following calibration equipment is required to calibrate the analog OMET-USB-73 device. If the calibration equipment does conform to these specifications it will not be possible to calibrate the device accurately.

5.1.2.1 High Precision Voltage Source

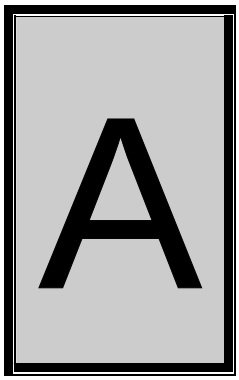
A high precision voltage source is required to generate input analog voltages. The Burster Digistant Typ 4405 is am example of such a device. The device is used as standard test equipment to calibrate the μDAQ and Rugged μDAQ device. Make sure the device conform to its own calibration requirements and 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 5-1 Analog Source Requirements

5.1.3 Calibration Procedure – USB 73

1. Install the USB Calibration Software <EDRECD>\EDRE\APPS\OMET-USB-73 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.



A Specifications

A.1 Digital Input/Output Characteristics

Number of Digital Channels:
Models are: USB

Device	Channels
73	24

Number of Grouped Channels:
Models are: USB

Device	PPI Channels
73	3

Compatibility: Intel® 82C55/TTL

D.C Characteristics – PPI 8255 Compatible Ports

Level	Min	Max
Input Low Voltage	-0.5V	0.8V
Input High Voltage	2.0V	5.0V
Output High Voltage	2.4V	
Output Low Voltage		0.45V
Output Current		2mA

A.2 Temperature Input Characteristics

Number of Channels
Models are: USB, SRL, BT and Rugged

Device	Differential Channels
73T8	8
73T16	16
73T32	32

Resolution 14-bits

Maximum Update Rate – USB 1.1 & USB 2.0 2 milliseconds

Data Transfer – USB 1.1 & USB 2.0 Programmed I/O – USB Bulk Transfer

Input Programmable Ranges

Channel Gain	Model	Bipolar Range
1	R	±2.5V
30	T	±83mV

Input Coupling DC

Relative Accuracy ±1 LSB

Gain x 1 Offset Error ±0.305 millivolts

Gain x 30 Offset Error ±0.011 millivolts

A.3 Bus Interface

A.3.1 USB 1.1

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
Endpoints	1 x Control Transfer Endpoint 1 x Bulk Transfer Endpoint 1 x Interrupt Transfer Endpoint 1 x Isochronous Transfer Endpoint @ 512kB/s

A.3.2 USB 2.0

Bus Type	Universal Serial Bus Revision 2.0
Bus Speed	USB High Speed – 480 Mega bit per second.
Controller	USB Serial Interface Endpoint Compliant
Voltage	5V
Endpoints	1 x Control Transfer Endpoint 1 x Bulk Transfer Endpoint 1 x Interrupt Transfer Endpoint 1 x Isochronous Transfer Endpoint @ 512kB/s

A.4 Power Requirements

A.4.1 USB Devices

Device	Minimum	Typical	Maximum	Power Source
OMET-USB-73T8		400 mA	450 mA	External PSU
OMET-USB-73T16		420 mA	470 mA	External PSU
OMET-USB-73T32		820 mA	870 mA	External PSU

A.5 Environmental / Physical

A.5.1 USB

Relative Humidity	0% to 90% (non-condensing)
Operating Temperature	0°C to 70°C
Storage Temperature	-25°C to 120°C
Housing Type	Plastic Casing
Weight – OMET-USB-73T8, OMET-USB-73T16	280g
Weight – OMET-USB73-T32	400g
Dimensions – OMET-USB73-T8, OMET-USB-73T16	Height: 45mm Width: 80mm Length: 148mm
Dimensions – OMET-USB-73T32	Height: 60mm Width: 80mm Length: 148mm

A.6 Power Supplies

Input Type	AC
Input Range	110V – 240V
Input Connector Type	Multiple to comply with all international wall sockets
Power	DC
Output Type	DC
Output Voltage	9V
Maximum Output Current	1A
Output Connector Type	5mm DC plug
Regulator Type	Switch Mode
Location	External/Separate
Indicators	Power

B

B Related Products and Accessories

A whole range of external connectable accessories and application modules supports the OMET-USB-73 series. These modules are easy to connect too and support DINRAIL installations. Below is a list of products that are compatible with the OMET-USB-73 devices. They are broken up sub-sections to cover each type of application.

B.1 General Adapters

There are general adapters that can be used with the OMET-USB-73 devices. These modules simple map a cable-connector to a screw terminal block.

Adapter	Entry Connector	Cable	Possible Usage
OMET-ADPT-2526	DB25 Female	DB25M/F	To map the main connector to a screw terminal clock. This adapter is used to make simple connections to the unit.
OMET-ADPT-20	IDC 20	IDC 20	To connect to digital I/O port A-B on the OMET-PC43A2. To connect 8 channels on the PC52A2
OMET-ADPT-910	IDC 10 DB9 Female	IDC 10 DB9 Female	For connecting to digital I/O ports or analog channels on the OMET-PC43A2 and PC52A2. Also for connecting to the DB9 on the serial units.

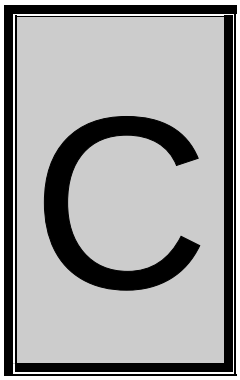
Table 5-2 General Adapters

B.2 Digital I/O Application Modules

All Digital I/O application modules are DINRAIL mountable. They are supplied with standard cables and are easy to connect too. Wide variety is available and care must be taken to select the correct module for the application.

Adapter	Entry Connector	Cable	Application
PC-37 Series	IDC10	IDC10	Opto 22 solid state relay modules
	IDC20	IDC20	
	DB25	DB25M/F	
PC-51-8	IDC10	IDC10	8CH Opto 22 G4 Carrier module
PC-38G	IDC10	IDC10	8CH Electro-Mechanical relay module
PC-38H	IDC10	IDC10	8CH Reed relay module
PC-38V	IDC10	IDC10	8CH TTL Driver module
PC-38W	IDC20	IDC20	16CH TTL Driver module
PC-38X	DB25	DB25M/F	24CH TTL Driver module
PC-43B	IDC20	IDC20	16CH Opto-Isolated inputs
PC-43C	DB25	DB25F/M	24CH Opto-Isolated inputs
PC-43E	IDC10	IDC10	8CH Opto-Isolated inputs

Table 5-3 Digital I/O Application Modules



C Configuration Constants

C.1 Query Codes

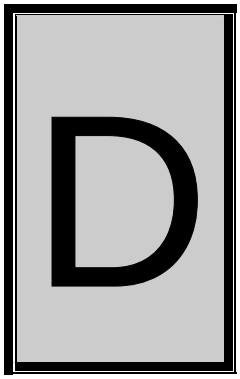
Name	Value	Description
APIMAJOR	1	Query EDRE API major version number.
APIMINOR	2	Query EDRE API minor version number.
APIBUILD	3	Query EDRE API build version number.
APIOS	4	Query EDRE API OS type.
APINUMDEV	5	Query number of devices installed.
BRDTYPE	10	Query a board's type.
BRDREV	11	Query a board's 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

C.2 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

C.3 Digital I/O Return Query 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.



D Ordering Information

For ordering information please contact Omega Engineering directly or visit our website www.omega.com.

Device	USB 1.1	USB 2.0	Description
OMET-73T8	✓	✓	8 Channel Thermocouple input device
OMET-73T16	✓	✓	16 Channel Thermocouple input device
OMET-73T32	✓	✓	32 Channel Thermocouple input device
OMET-73R8	✓	✓	8 Channel RTD input device
OMET-73R16	✓	✓	16 Channel RTD input device
OMET-73R32	✓	✓	32 Channel RTD input device

Table D-1 OMET-USB-73 Ordering Information

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

Shop online at omega.com

TEMPERATURE

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

PRESSURE, STRAIN AND FORCE

- Transducers & Strain Gages
- Load Cells & Pressure Gages
- Displacement Transducers
- Instrumentation & Accessories

FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Datalogging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M4248/1005