PowerDAQ Thermocouple Rack ™

PD-TCR User Manual

Isolated thermocouple rack for the PowerDAQ boards

November 1998 Edition

First Edition

November 1998 Printing

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How to Use This Manual

Introduction

This manual describes the hardware of the PowerDAQ Thermocouple Rack (PD-TCR). The following PD-TCR's are supported:

- PD-TCR-16-J
- PD-TCR-16-K

Who Should Read This Book?

This manual has been designed to benefit the users of PowerDAQ™ PD-TCR. To use the PowerDAQ™ TCR, it is assumed that you have basic PC skills, and that you are familiar with Microsoft Windows NT and 95/98 operating environments.

Organization of This Manual

The PowerDAQ™ User Manual is organized as follows:

Chapter 1 - Introduction

This chapter gives you an overview of PowerDAQ™ TCR features, the various models available and lists what you need to get started.

Chapter 2 - Installation and Configuration

This chapter explains how to install and configure your PowerDAQ™ TCR.

Chapter 3 - Interconnections

This chapter describes the I/O connections to your PowerDAQ™ TCR.

Chapter 4 - Calibration

This chapter discusses the calibration system of your PowerDAQ™ TCR.

Appendix A - Specifications

This chapter lists the PowerDAQ™ TCR hardware specifications.

Appendix B - Common Questions and Support

This appendix contains a list of commonly asked questions and their answers relating to usage and special features of your PowerDAQ™ TCR. Should you require assistance while installing or using PowerDAQ™ TCR, support service details are also listed.

Appendix C - Warranty

This appendix contains a detailed explanation of PowerDAQ™'s TCR warranty.

Index

The Index alphabetically lists topics covered in this manual.

Conventions Used in This Manual

These are the main conventions used to help you get the most out of this manual:

Tips are designed to highlight quick ways to get the job done, or good ideas you might not discover on your own.

Note Notes alert you to important information.

CAUTION! Caution advises you of precautions to take to avoid injury, data loss, or system crash.

Text formatted in **bold** typeface may also represent type that should be entered verbatim or a command, as in the following example:

You can instruct users how to run setup using a command such as **setup.exe**.

Feedback

We are interested in any feedback you might have concerning our products and manuals. A Reader Evaluation form is available on the last page of the manual.

1

Introduction

1

Introduction

This chapter describes the basic features of the PowerDAQ™ Thermocouple Rack (TCR).

About the PowerDAQ™ TCR

Thank you for purchasing a PowerDAQ™ TCR. The PowerDAQ™ TCR board was designed to work with your PowerDAQ OCI data acquisition board.

The PowerDAQ Thermocouple Rack contains sixteen isolated inputs for J or K type thermocouples. It converts the thermocouple inputs to a voltage, and then it is fed as an input to a PowerDAQ PCI board, with an input range of 0-10V.

The PD-TCR is based on a complete instrumentation amplifier and includes a thermocouple cold junction compensator for each channel. It combines an ice point reference with a precalibrated amplifier to produce a high level (10 mV/C) output directly from a thermocouple signal.

Each PD-TCR channel is precalibrated by laser wafer trimming to match the characteristic of type J or K inputs.

The temperature transducer voltages (ZERO potentiometer) and gain control (GAIN potentiometer) can be used to recalibrate the PD-TCR in the field.

The PD-TCR channel accuracy for both the J and K type is ±1% is a working temperature environment of 0°C to +50°C.

Features

The major features of the PowerDAQ™ TCR are:

- Each channel provides cold junction compensation
- Zero, and scale factor are all pre-calibrated by laser wafer trimming
- Calibrate ZERO and gain for each channel
- Differential input rejects common-mode noise voltage on the thermocouple leads
- Includes PowerDAQ SDK

- Data logging and display software with source code in Delphi
- LabVIEW for Windows VI's
- DASYLab, HP VEE and TestPoint support
- Up to 4 PD-TCR's can connect into one or more PowerDAQ 64 channel boards
- Up to 64 Non multiplexed inputs per system
- Uses PowerDAQ PCI bus DAQ boards
- Multiple PowerDAQ boards can be plugged into one PC. Only limited by PCI slots
- Can be mounted in 19" rack using PD-19RACKW
- Each PD-TCR-16-x requires an external universal power supply (PD-PSU-5/15)

Note For the full list of specifications, *see Appendix A: Specifications.*

PowerDAQ™ TCR Models

- PD-TCR-16-J 16 Channel unit for type J thermocouple
- PD-TCR-16-K 16 Channel unit for type K thermocouple

Model	Thermocuple	Number of channels
PD-TCR-16-J	Type J (iron-constantan)	16 isolated
PD-TCR-16-K	Type K (chromel-alumel)	16 isolated

Table 1: PowerDAQ™ Models

Getting Started

To get your PowerDAQ™ TCR up and running, ensure that you have the following:

- A computer with a PowerDAQ PCI board installed.
- PowerDAQ™ PCI board with user manual.
- PowerDAQ™ Software for Windows 95/98 or Windows NT. (PowerDAQ Software Development Kit # PD-SDK)
- Minimum 16MB RAM for Windows95/98 and 32MB for Windows NT

2

Installation and Configuration

3

Installation and Configuration

This chapter describes the hardware and software installation and configuration of the PowerDAQ™ TCR.

Unpacking

Your PowerDAQ™ TCR is wrapped in an antistatic bag to protect against electrostatic charges that might damage the board. To avoid damage, proceed as follows:

1. Ground yourself with a grounded wrist strap or grounded source.
2. Discharge the static electricity by taking the board in the antistatic bag and touching the metal part of your PC.
3. Remove the board from the antistatic bag. We suggest you save the bag.
4. Inspect the board for any damage. If any damage is found, notify your distributor to return the board to the manufacturer. *See Appendix B: Common Questions and Support.*

Note The PowerDAQ™ TCR contain sensitive electronic components. Please make sure the proper grounding and electrostatic conditions are used.

Hardware

You can install your PowerDAQ™ TCR as a stand-alone unit or in a 19" rack. We recommend you use the following instructions:

1. Turn the PC Off.
2. Refer to your PowerDAQ PCI board hardware manual for DAQ board installation instructions.
3. The PD-TCR requires external power to be wired at the J3 EXT POWER connector. (The manufacturer suggests using the PD-PSU-5/15 power supply unit. This PSU is switchable 110/220V and can support up to 4 PD-TCR's).

Input V	Rating
+ 5V	±0.2 Volts 1.5 Amps
+15V	+0.5/-3 Volts 0.2Amps
-15V	-0.5/+3 Volts 0.2Amps

Table 2: PD-TCR Power Requirements

CAUTION! Incorrect wiring can cause permanent damage to the PD-TCR.

3

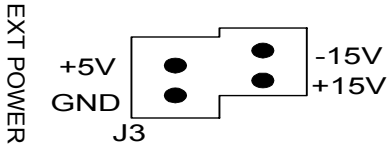


Figure 1: PD-TCR External Power Connector J3

4. Connecting the PD-TCR to the PowerDAQ board(s)

16 Channels	64 Channels
You will need a PD-CBL-96	You will need a PD-5BCONN, PD-CBL-5B and PD-CBL-96.
Connect J1 on the PD-TCR to the PowerDAQ J1 connector	Using a PD-CBL-5B cable, connect J2 to a PD-5BCONN (rack input 1 through 4). Repeat this for each PD-TCR (up to 4)
	Connect J1 on the PD-5BCONN to J1 on the PowerDAQ board.

Table 3: PD-TCR Cabling Options

5. Attach thermocouples to the screw terminal marked AIN0 through AIN15. Note the positive and negative positions.

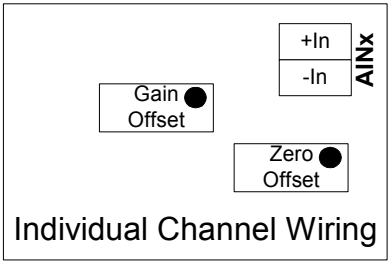


Figure 2: Attaching thermocouples

6. Turn the PC on.

The PowerDAQ™ TCR is now installed. All configuration requirements are set via software.

Installing Multiple Boards

You can install multiple PowerDAQ™ TCR's using one or more 64 channel PowerDAQ board. See item 4 above in the installation instructions.

Software

PowerDAQ™ TCR software is supplied for Windows 95/98 and Windows NT 4.0 or greater. This is the PowerDAQ SDK (software development kit).

Installation

From the floppy disk or CD, run the **SETUP.exe** program. The setup program will take you through the installation process.

As the installation process modifies your Windows registry, you must only install or uninstall the software using the appropriate programs.

Note Once the installation is complete, the PC must be rebooted for the proper operation.

Note Windows NT users must be logged in as an administrator or have equivalent access.

3

TRACK software

The TRACK software is part of the PD-SDK. It is installed with the standard PowerDAQ software.

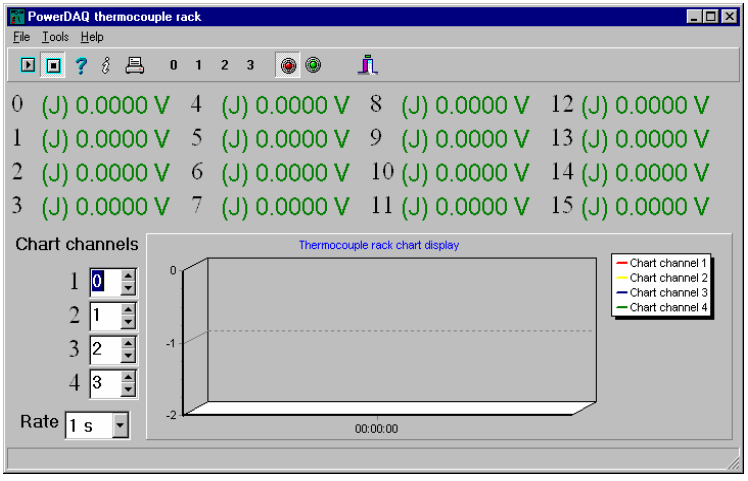


Figure 3: TRACK software- online help is included

Features of TRACK:

- Used for calibration of the PD-TCR
- Independent channel selection for Volts, Deg C or Deg F
- Can log data to text file
- Import log file into Excel

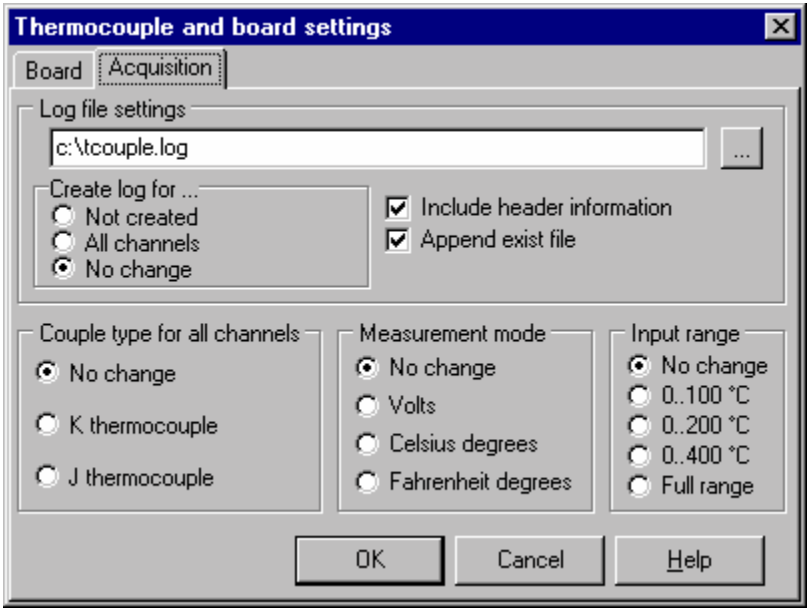


Figure 4: TRACK standard settings

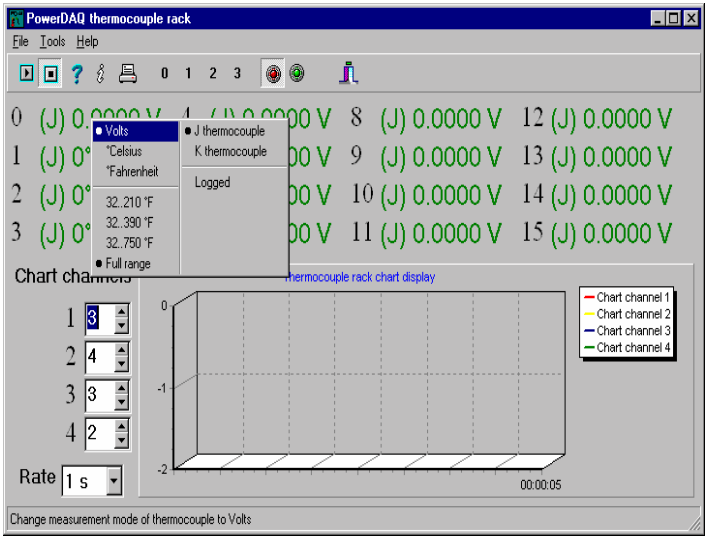


Figure 5: Configuring individual channels

Individual channels can be set to display Volts, Celsius or Fahrenheit. This setup information is stored in a configuration .INI file. (File name: tcouple.ini Located: Windows system directory) This file can be retrieved to reset the system setup.

4

Interconnections

Interconnections

Connectors

Note The PowerDAQ™ TCR are supplied with no cables

The PowerDAQ™ TCR has four connectors:

- 96-contact pin-less main connector (J1) - used to connector directly to 16 channel PowerDAQ boards.
- 24-way header connector (J2) - used to connect to PD-5BCONN distribution panel
- 5 by 2 header connector (J20) - triggering capabilities
- 4 header External power Connector (J3)

J1 Connector

AIN0	48	96	AIN32
AIN1	47	95	AIN33
AIN2	46	94	AIN34
AIN3	45	93	AGND
AIN4	44	92	AIN35
AIN5	43	91	AIN36
AGND	42	90	AIN37
AIN6	41	89	AIN38
AIN7	40	88	AIN39
AIN8	39	87	AIN40
AIN9	38	86	AGND
AIN10	37	85	AIN41
AIN11	36	84	AIN42
AGND	35	83	AIN43
AIN12	34	82	AIN44
AIN13	33	81	AIN45
AIN14	32	80	AIN46
AIN15	31	79	AGND
AIN16	30	78	AIN47
AIN17	29	77	AIN48
AGND	28	76	AIN49
AIN18	27	75	AIN50
AIN19	26	74	AIN51
AIN20	25	73	AIN52
AIN21	24	72	AIN53
AIN22	23	71	AGND
AIN23	22	70	AIN54
AGND	21	69	AIN55
AIN24	20	68	AIN56
AIN25	19	67	AIN57
AIN26	18	66	AIN58
AIN27	17	65	AIN59
AIN28	16	64	AGND
AIN29	15	63	AIN60
AIN30	14	62	AIN61
AIN31	13	61	AIN62
DGND	12	60	AIN63
AGND	11	59	ADC Channel List Start Input / Burst Clock
AGND	10	58	+12V
DGND	9	57	AGND
AOUT1	8	56	AGND
AGND	7	55	-12V
AGND	6	54	ADC Conversion Start Input / Pacer Clock
AGND	5	53	ADC Conversion Start Output / Pacer Clock out
AOUT0	4	52	+5V
AGND	3	51	DSP Trigger Input / External Clock
AGND	2	50	AGND
AGND	1	49	AGND

Table 4: Connector Pin Assignments for J1

J2 Connector to PD-5BCONN

This connector is compatible with the 5B type 42-way IDC header.

AIN0	1	2	AIN8
AGND	3	4	AIN9
AIN1	5	6	AGND
AIN2	7	8	AIN10
AGND	9	10	AIN11
AIN3	11	12	AGND
AIN4	13	14	AIN12
AGND	15	16	AIN13
AIN5	17	18	AGND
AIN6	19	20	AIN14
AGND	21	22	AIN15
AIN7	23	24	AGND

Table 5: Connector Pin Assignments for J2

J3 External Power Connector

Input V	Rating
+ 5V	±0.2 Volts 1.5 Amps
+ 12V or +15V	+0.5/-1.5 Volts 0.2Amps
- 12 or -15V	-0.5/+1.5 Volts 0.2Amps

Table 6: PD-TCR Power Requirements

CAUTION! Incorrect wiring can cause permanent damage to the PD-TCR.

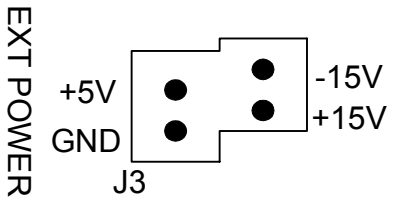
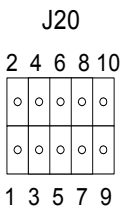


Figure 6: PD-TCR External Power Connector J3

J20 Header Connector

This connector supports:

- Clocking and triggering
- Analog Output (AOut0 and AOut1)



J20 legends:
1 - DSP Trigger In
2 - Digital Ground
3 - Digital Ground
4 - Conversion Clock Input
5 - ADC Clock Output
6 - Channel List Clock Input
7 - Analog Ground
8 - Analog Ground
9 - Analog Output #0
10 - Analog Output #1

Figure 7: PD-TCR J20 connector

For complete information on using this connector, please refer to the PowerDAQ hardware users manual.

5B Mounting Panels (PD-5BCONN)

To accommodate popular 5B type signal conditioning panels, we offer a simple but practical breakout terminal panel. (PN PD-5BCONN). These panels connect the PowerDAQ™ board J1 connector to the breakout panel. The connections are then distributed in four groups of 16 channels to the header connector (5B).

The PD-5BCONN can be mounted in a 19" rack (PN PD-19RACK) or used standalone.

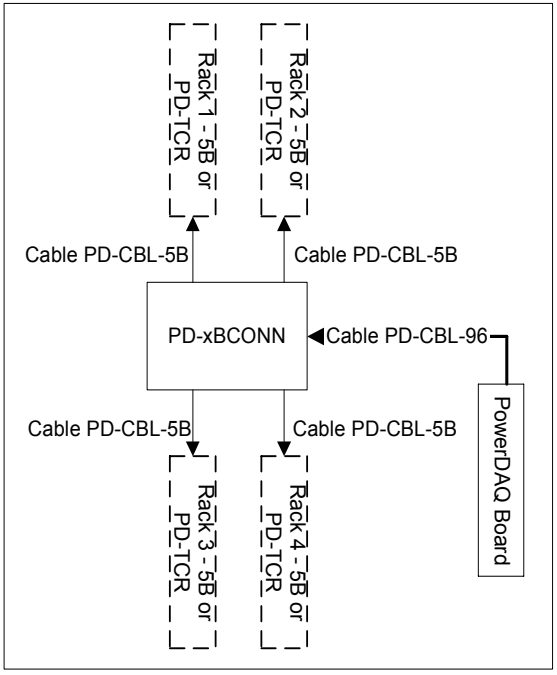


Figure 8: PD-5BCONN wiring diagram

5

Calibration

A

Calibration

Overview

This chapter contains information on the calibration procedures for the PowerDAQ TCR

When to calibrate

The PD-TCR is calibrated for 0 to 200 Celsius degrees, but for best precision, you should recalibrate the board in the actual working environment.

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

Equipment required

Thermocouple calibrator for the type of thermocouples you with to use.

B

A

Calibration Procedure

1. Install and connect PowerDAQ board and Thermocouple Rack
2. Run **TRack.exe** program located in the PowerDAQ group
3. Open Tools/Settings dialog and select “Acquisition”
4. Set the temperature range , thermocouple type and **Volts** measurement mode
5. Run acquisition
6. Connect calibration device for each channel that requires calibration
7. Set 0 Deg. C on calibration device
8. Starting with **ZERO** on the potentiometer(blue) on the rack, set voltage input range to 0.0001-0.003 Volts (0.0001-0.0008 recommended) to calibrate each channel.

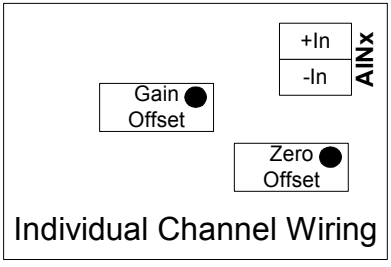


Figure 9: PD-TCR Channel wiring

B

9. Stop acquisition
10. Open Tools/Settings dialogue and select “Acquisition” and change measurement mode to **Celsius degrees**.
11. Set calibration device to most useful temperature
12. Run acquisition
13. Using the **GAIN** potentiometer (gray) for calibrated channel on the rack, set temperature in accordance with settings in step 11.
14. Repeat steps 2-13 for each channel or connect calibration device to all channels before calibration (only iron wires allowed)

A

Appendix A: Specifications

PD-TCR-xx

Isolated thermocouple rack

Number of channels	16 single ended
Channel isolation	1000 V per channel
Calibration Error @ 25 °C.	± 3°C
Stability vs. Temperature	± 0.05°C./ °C
Gain error	± 1.5%
Operating Temperature Range	-55 to +125 °C
Input range to PowerDAQ	0 – 10V
Dimensions (with feet, No rack)	17.4" L x 1.87" H x 7.00" W
19" rack option available	PD-19RACKW
PD-19RACKW dimensions	17.6" L x 3.62" H x 7.00" W

PD-PSU-5/15

External power supply

Number of PD-TCR that can be powered	4
DC output voltage	*CH1:* +5V, *CH2:* +15V, *CH3:* -15V
Output current	*CH1:* 10A, *CH2:* 2.5A, *CH3:* 1A

B

Input voltage range	85 ~ 132 VAC / 170 ~ 254 VAC Selected by swtich
Dimensions	190 x 110 x 50 mm
Weight	0.83 Kg
Safety Standards	Meets UL10112
EMC Standards	Meets FCC Part 15 J Class B

B

Appendix B: Common Questions and Support

Q THERMOCOUPLE BASICS

A *Thermocouples are economical and rugged; they have reason-ably good long-term stability. Because of their small size, they respond quickly and are good choices where fast response is important. They function over temperature ranges from cryogenics to jet-engine exhaust and have reasonable linearity and accuracy.*

Because the number of free electrons in a piece of metal depends on both temperature and composition of the metal, two pieces of dissimilar metal in isothermal and contact will exhibit a potential difference that is a repeatable function of temperature. The resulting voltage depends on the temperatures, T1 (unknown temperature) and T2 (ice point reference) , in a repeatable way.

Since the thermocouple is basically a differential rather than absolute measuring device, a known reference temperature is required for one of the junctions if the temperature of the other is to be inferred from the output voltage. Thermocouples made of specially selected materials have been exhaustively characterized in terms of voltage versus temperature compared to primary temperature standards. Most notably the water-ice point of 0°C is used for tables of standard thermocouple performance.

C

An alternative measurement technique, is used in most practical applications where accuracy requirements do not warrant maintenance of primary standards. The reference junction temperature is allowed to change with the environment of the measurement system, but it is carefully measured by some type of absolute thermometer. A measurement of the thermocouple voltage combined with a knowledge of

the reference temperature can be used to calculate the measurement junction temperature. Usual practice, however, is to use a convenient thermoelectric method to measure the reference temperature and to arrange its output voltage so that it corresponds to a thermocouple referred to 0°C. This voltage is simply added to the thermocouple voltage and the sum then corresponds to the standard voltage tabulated for an ice-point referenced thermocouple.

The temperature sensitivity of silicon integrated circuit transistors is quite predictable and repeatable. This sensitivity is exploited in the PD-TCR to produce a temperature related voltage to compensate the reference of "cold" junction of a thermocouple.

Q USING TYPE T THERMOCOUPLES WITH THE PD-TCR

A *Because of the similarity of thermal EMFs in the 0℃ to +50℃ range between type K and type T thermocouples, the PD-TCR can be directly used with both types of inputs. Within this temperature range the PD-TCR should exhibit no more than an additional 0.2℃ output calibration error when used with type T inputs. The error arises because the ice point is trimmed to type K characteristics at 25℃.*

Q ALARM CIRCUIT (OPEN THERMOCOUPLES)

A *The PD-TCR software will detect open thermocouple channels. This occurs when the value read by the software is random.*

Q THERMAL ENVIRONMENT EFFECTS

A *The inherent low power dissipation of the PD-TCR and the low thermal resistance of the channel make self-heating errors almost negligible. For example, in still air the channel to ambient thermal resistance is about 80□C/watt. At the nominal dissipation of 800 □W the self-heating in free air is less than.065□C. Submerged in fluorinert liquid (unstirred) the thermal resistance is about 40□C/watt, resulting in a self-+T heating error of about 0.032□C.*

Q STABILITY OVER TEMPERATURE

A *Each PD-TCR is tested for error over temperature with the measuring thermocouple at 0□C. The combined effects of cold junction compensation error, amplifier offset drift and gain determine the stability of the PD-TCR output over the rated ambient temperature range.*

B

Service and Support

If you have technical problems using PowerDAQ™, our Technical Support department can be reached by:

Telephone: (617) 924 1155

Fax: (617) 924 1441

Email: support@Omegadaq.com

Web Site: www.Omegadaq.com

For the most efficient service, please be available at your computer and be prepared to answer several questions listed on the following page when you call for technical support. This information helps us identify specific system and configuration-related problems.

C

B

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware. Completing this form accurately before contacting us for technical support helps our application engineers answer your questions more efficiently.

What is the name and version number of the product?

_____

What version of Windows are you using? _____

What programming language and version?

_____

Is the board set at factory configuration? _____

Have you run the board diagnostics? What were the results?

_____

Did the system ever work ? If so, what changed (moved location, installed other boards, software etc..)

_____

Have you run the sample programs? What were the results?

_____

Have you verified that all your connections are made properly and are secure?

_____

Have you been able to isolate the source of your problem: input or output device, board, software?

_____

What other boards or applications are installed in your system?

_____

How much RAM do you have? _____

What size hard disk are you using? _____

How fast is your CPU? _____

How fast is your host data bus?

_____

If you are on a network, what type of network are you using and approximately how many users are on the network?

_____

Please specify whether or not the problem occurred more than once

_____

D

Appendix D: Warranty

Overview

IBM, IBM PC/XT/AT and IBM PS/2 are trademarks of International Business Machine Corporation.

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Microsoft is a trademark of Microsoft Corporation.

LabVIEW, LabWindows/CVI is a trademark of National Instruments Corporation

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- EN55011
- EN50082-1

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to effect its safety or effectiveness.

D

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Upon request by Omega Engineering, the product or part claimed to be defective shall immediately be returned at the customer's expense to Omega Engineering.

There shall be no warranty or liability for any products or parts which have been subject to misuses, accident, negligence, failure or electrical power or modification by the Customer without Omega Engineering' approval. Final determination of warranty eligibility shall be made by Omega Engineering. If a warranty claim is considered invalid for any reason, the Customer will be charged for services performed and expenses incurred by Omega Engineering in handling and shipping the return item.

As to replacement parts supplied or repairs made during the original warranty period, the warranty period of the replacement or repaired part shall terminate with the termination of the warranty period with respect to the original product or part.

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Index

Reader Evaluation

We are committed to improving the quality of our documentation, in order to serve you better. Your feedback will help us in the effort. Thanks for taking the time to fill out and return this form.

Is the manual well organized? (PD-TCR)	☐ Yes	☐ No
Can you find information easily?	☐ Yes	☐ No
Were you able to install the PowerDAQ™ boards?	☐ Yes	☐ No
Were you able to connect the PowerDAQ™ board to the accessories?	☐ Yes	☐ No
Did you find any technical errors?	☐ Yes	☐ No
Is the manual size appropriate?	☐ Yes	☐ No
Are the design, type style, and layout attractive?	☐ Yes	☐ No
Is the quality of illustrations satisfactory?	☐ Yes	☐ No

How would you rate this manual? ☐ Excellent ☐ Good ☐ Fair ☐ Poor

Why?_____

_____

Suggested improvements: _____

_____

Other Comments: _____

_____

_____

Your background (optional)

Your application: _____