Quad Tc/mV Amp

Quad Amp
Tc/mV
150

isolated

Channel 1   Channel 2   Channel 3   Channel 4

Cu   +   Cu   +   Cu   +   Cu   +
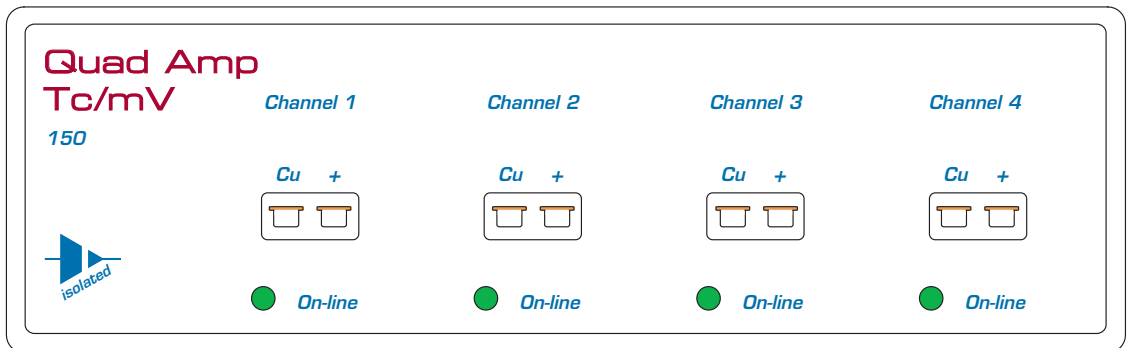
● On-line   ● On-line   ● On-line   ● On-line

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Overview

The eDAQ Quad Tc/mV Amp is designed to work with an e-corder system, recording signals from up to four thermocouples (or other low voltage sources) simultaneously.

How to Use this Manual

This manual describes how to set up and begin using your Quad Tc/mV Amp. The use of the pH/mV Amp with the Chart software Thermocouple Calibration extension is discussed. The appendices provide technical and troubleshooting information.

Checking the Quad Tc/mV Amp

Before you begin working with the Quad Tc/mV Amp, please check that:

> • all items described in the packing list are included; and that

> • there are no signs of damage that may have occurred during transit.

Contact your eDAQ distributor if you encounter a problem.

You should also become familiar with the basic features of your e-corder system, which are discussed in the *e-corder Manual* which will be installed on you hard disk.

eDAQ Amps

The Quad Tc/mV Amp is part of a family of preamplifiers known as eDAQ Amps.

The Quad Tc/mV Amp is designed for recording signals from up to four pH and other potentiometric electrodes. As with other eDAQ Amps, it is designed to be operated under full software control and is automatically recognized by Chart or Scope software which controls its gain range, signal filtering, and other settings.

The range of eDAQ Amps includes the:

- **Quad pH/mV Amp**, suitable for connection of pH, ion selective, and potentiometric (ORP) electrodes

- **Potentiostat**, a three–electrode potentiostat that can be used for voltammetric and amperometric experiments. Gain ranges of 20 nA to 100 mA in 1:2:5 steps.

- **Picostat**, a high sensitivity three–electrode potentiostat suitable for use with carbon fibre and other microelectrodes. Current gain ranges of 10 pA to 100 nA in 1:2:5 steps.

- **QuadStat**, a four channel, three electrode potentiostat suitable for use with amperometric biosensors. Current gain ranges of 2 nA to 1 mA/channel in 1:2:5 steps.

- **Bridge Amp**, suitable for sensors requiring a low drift, high gain differential amplifier. Also provides DC excitation

- **GP Amp**, suitable for high output sensors requiring a high impedance single ended or differential amplifier. Also provides DC excitation.

See our web site at www.eDAQ.com for more information.

2

The Quad Tc/mV Amp

This chapter describes how to connect and use your eDAQ Quad Tc/mV Amp.

IMPORTANT: Always make sure that the e-corder is turned off before you connect or disconnect the Quad Tc/mV Amp. Failure to do this may result in damage to the e-corder and/or the Quad Tc/mV Amp.

The Front Panel

The front panel of the Quad Tc/mV Amp is shown in Figure 2–1.

The Thermocouple Inputs

The miniature thermocouple input connectors marked 'Cu' and '+' of the Quad Tc/mV Amp provide connection for most types of thermocouple.

The On-line Indicators

When lit, these indicate that the Chart software has located and initialized the Quad Tc/mV Amp. If the light does not go on when the software is run, check that the Quad Tc/mV Amp is properly connected.
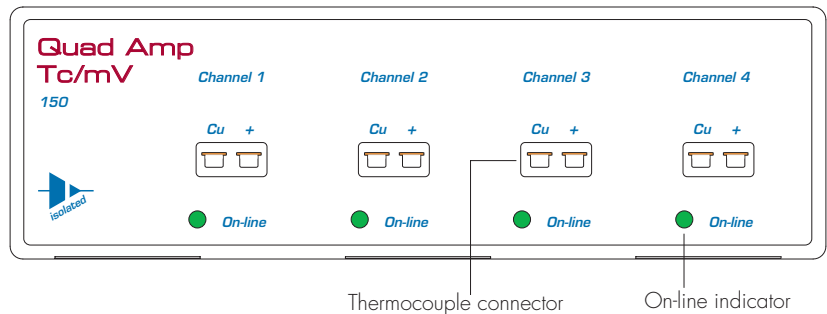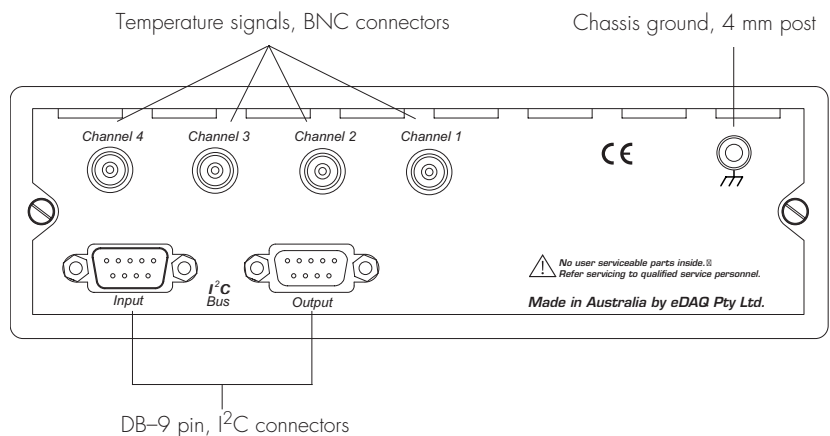
Thermocouple connector   On-line indicator

Temperature signals, BNC connectors   Chassis ground, 4 mm post

DB–9 pin, I²C connectors

The Back Panel

The back panel of the Quad Tc/mV Amp is shown in Figure 2–2.

The Signal Outputs

The Quad Tc/mV Amp provides four signals, one for each sensing thermocouple. These signals are accessed on the Quad Tc/mV Amp back panel via four BNC connectors labelled Channel 1 — Channel 4.

I²C Connector

The back panel, Figure 2–2, has two DB-9 pin 'I²C bus' connectors labelled Input and Output. The Input connector enables connection to the e-corder (or to the output of other eDAQ Amps). This connection provides power to the Quad Tc/mV Amp and carries the various control signals (for gain range and filter selection) to and from the e-corder. The pin assignments are shown in Figure 2–3.

Connecting to the e-corder

Your Quad Tc/mV Amp will have been supplied with an I²C cable (DB-9 pin connectors at either end), and four cables with BNC connectors at either end.

Figure 2–3
I²C connector pin assignments
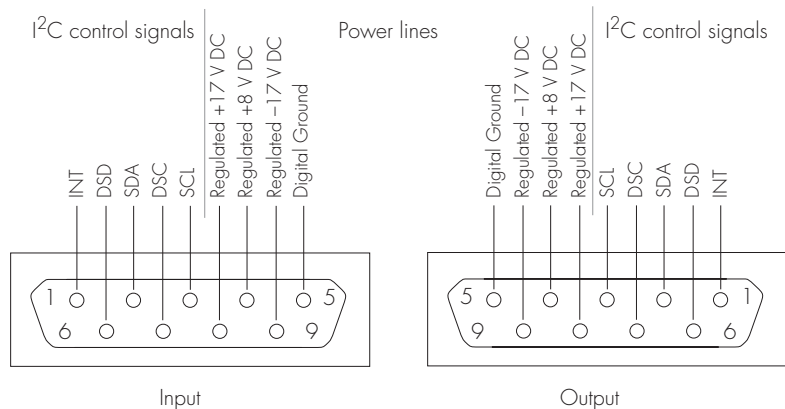
First make sure that the e-corder is turned off. Then connect the I^2C cable to the I^2C connector on the back panel of the e-corder, and the other end to the I^2C Input connector on the back panel of the pH/mV Amp. Use BNC cables to connect the signal outputs on the back panel of the Quad Tc/mV Amp to the front panel of the e-corder as shown in Figure 2–4 and Figure 2–5.

Check that all connections are firm. Loose connections may cause failure to recognize the eDAQ Amp by the software, erratic behavior, or loss of signal.

Multiple eDAQ Amps can be connected to an e-corder. The number that can be connected depends on the number of input channels on the e-corder. The initial eDAQ Amp should be connected as shown in Figure 2–5. The remainder are linked via I^2C cables, connecting the I^2C output of one eDAQ Amp to the I^2C input of the next. The signal outputs of each eDAQ Amp are connected to an input channel of the e-corder.

Figure 2–4
Four thermocouples shown connected to a Quad Tc/mV Amp and e-corder 401
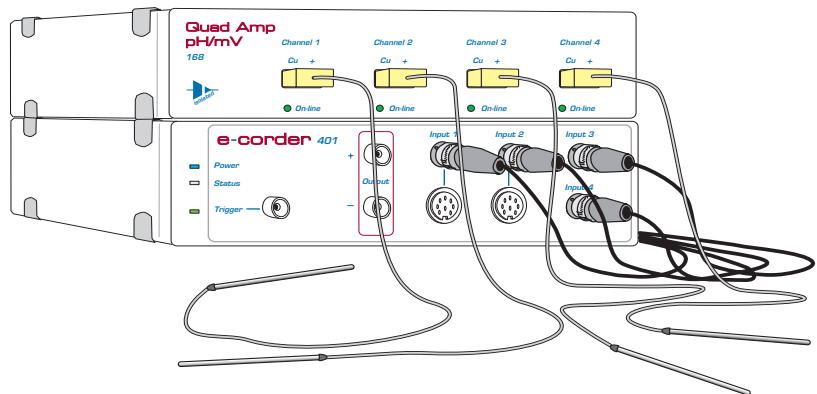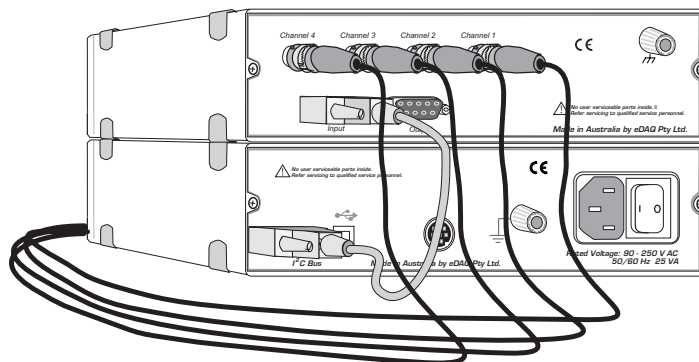

Figure 2–5
Back view of Quad Tc/mV Amp connected to e-corder

The Quad Tc/mV Amp Self Test

After you have installed the software, connected the e-corder to a computer as described in your *e-corder Manual*, and connected the Quad Tc/mV Amp as described above, a quick check can be performed:

> • Turn on the e-corder and check that it performs its normal diagnostic tests, as described in the *e-corder Manual*

> • Once the e-corder is ready, open Chart software.

> • During initialization, you should see these indicators flash briefly and then remain lit — the Quad Tc/mV Amp is ready for use.

If the indicators do not light, check your cable connections and repeat the procedure. If this does not solve the problem, contact your eDAQ distributor.

Using Chart software

Setting up the Quad Tc/mV Amp

When the Quad pH/mV Amp is connected to an e-corder input and successfully installed, the Quad Thermocouple… menu command appears in the Chart software Channel Function pop-up menu, Figure 2–6.

Figure 2–6
Accessing the Quad Tc/mV Amp controls
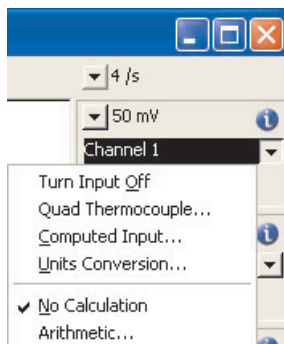
Choosing the Quad Thermocouple… menu command will access the Quad Thermocouple dialog box (which replaces the normal e-corder

Input Amplifier dialog box for that e-corder channel — your *Chart Software Manual* have details on the Input Amplifier dialog box).

Previewing the Signal

The Quad Thermocouple dialog box, Figure 2–6, allows you to preview a signal so that you can select the amplification and filter settings.

Figure 2–7
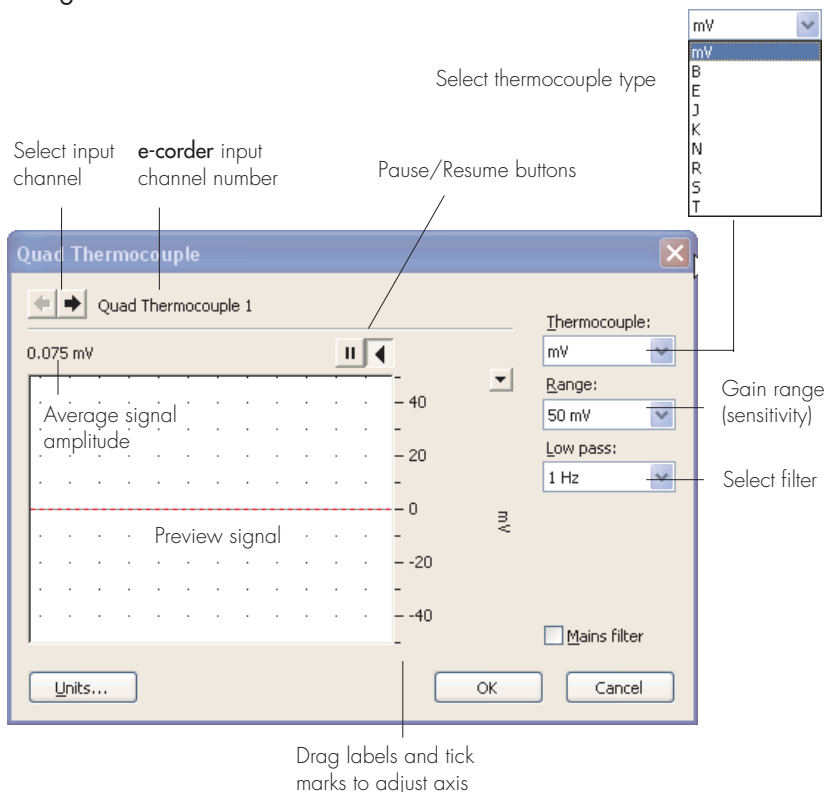The Quad Tc/mV Amp dialog box, for previewing a signal (Chart software on a Windows Computer)

Select thermocouple type

Select input channel

e-corder input channel number

Pause/Resume buttons

Gain range (sensitivity)

Select filter

Drag labels and tick marks to adjust axis

The incoming signal is displayed in real time, but is not recorded to hard disk (once the signal moves across the display area it is lost). Click the OK button to apply the selected settings.

Signal Display

The input signal is displayed so that you can see the effect of changing the settings. The average signal value is displayed at the top left of the display area.

You can stop the signal scrolling by clicking the Pause button at the top right of the display area ❚❚ . Click the Scroll button ◀ to resume scrolling.

You can shift and stretch the vertical Amplitude axis to make the best use of the available display area (see the Input Amplifier dialog in the *Chart Software Manual* for further details). Changes made here update settings in the main window of the program.

Thermocouple Type

Select the appropriate thermocouple type from this menu. If 'mV' is chosen then the raw millivolt signal will be shown. If any other selection is made then the ice point corrected thermocouple signal will be shown in units of mV corresponding to the emf values listed in the NIST ITS–90 thermocouple tables, see http://srdata.nist.gov/its90/main/.

Setting the Range

Use the Range pop-up menu to select the input range (sensitivity) of the channel. Available ranges are shown in Table 2–1. Signals in excess of the range value will be truncated.

Filtering
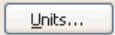
The low pass filter will remove high frequency noise. For most thermocouple probes filter values of 1 – 10 Hz will be appropriate.

The Mains Filter, ☐ Mains filter , removes 50 or 60 Hz interference due to mains hum. See the *Chart Software Manual* for more information. For most applications it is recommended to have the Mains Filter on.

Table 2–1
Ranges available for different input settings.

mV	Available ranges (°C) for various thermocouple types							
	B	E	J	K	N	R	S	T
±20	1820	290	360	485	585	1680	1760	250
±10	1500	150	180	250	320	960	1040	115
±5	1020	80	95	120	170	550	580	60
±2	630	35	40	50	75	260	265	30

Units Calibration

Clicking the [Units...] button access the Units Conversion dialog box. For more information about Units Conversion, see the *Chart Software Manual*. This type of calibration should only be used for small temperature ranges that can be calibrated with only two accurately known temperature sources.

See the next section for calibration of probes, without the need of accurately known temperature sources.

When calibration is required over a wide range of temperature and several accurately known temperature sources are to be employed then use the Multiple Point Calibration extension.

Calibration

Automatic Calibration

The Thermocouple extension is a Chart software plug-in that adds the 'Thermocouple...' command to the Chart channel pop-up menus. The latest version of the extension is available at http://www.edaq.com/chart_extns_list.html

This extension:

- allows the user to select the type of thermocouple (B, E, J, N, K, R, S or T) being used;

- applies a polynomial correction to convert the voltage signal to degrees (°C, °F, or K) according to the thermocouple ITS-90 tables, see http://srdata.nist.gov/its90/main/

The resulting temperature values will usually be accurate within the tolerance of the thermocouple being used — consult your thermocouple probe documentation. In most cases thermocouples conform to either the ANST/ANSI E230 Standard, or Special, Limits of Error, see Table 2–2. In some cases, especially over limited temperature ranges, manufacturers may guarantee better tolerances.

Tc Type	Temperature Range		Limits of Error	
	°C	°F	Standard	Special
T	–200 to –66	–328 to –87	±1.5%	—
	–66 to 0	–87 to +32	±1°C, ±2°F	—
	0 – 133	32 – 270	±1°C, ±2°F	±0.5°C, ±1°F
	133 – 350	270 – 662	±0.75%	±0.4%
J	0 – 293	32 – 559	±2.2°C, ±4°F	±1.1°C, ±2°F
	293 – 750	559 – 1382	±0.75	0.4%
E	–200 to –100	–328 to –148	±1%	—
	–100 to 0	–148 to +32	±1.1°C, ±3°C	—
	0 – 340	32 – 644	±1.7°C, ±3°F	±1°C, ±2°F
	340 – 900	644 – 1652	±0.5%	±0.4%
K	–200 to –110	–328 to –166	±2%	—
	–110 to 0	–166 to +32	±2.2°C, ±4°F	—
	0 – 293	32 – 559	±2.2°C, ±4°F	±1.1°C, ±2°F
	293 – 1250	559 – 2282	±0.75%	±0.4%
N	0 – 293	32 – 559	±2.2°C, ±4°F	±1.1°C, ±2°F
	0 – 1250	559 – 2282	±0.75%	±0.4%
R, S	0 – 600	32 – 1112	±1.5°C, ±3°C	±0.6°C, ±1°F
	600 – 1450	1112 – 2642	±0.25%	±0.1%
B	870 – 1700	1598 – 3092	±0.5%	—

Manual Calibration

If known temperature sources are available then very accurate calibration can be achieved using the raw mV signal setting. The signal can be calibrated over small ranges with a linear function using the Chart software Units Conversion feature (see the *Chart Software Manual*). Over wider ranges the Multipoint Calibration extension software plug-in can be used, see
http://www.edaq.com/chart_extns_list.html

A

Technical Aspects

This appendix describes the some of the important technical aspects of the Quad Tc/mV Amp. You do not need to know the material here to use the Tc/mV Amp. Please remember that user modification of the equipment voids your rights under warranty.

Quad Tc/mV Amp Operation

The Quad Tc/mV Amp, and other eDAQ Amps, have been designed to be used with an e-corder system. The Tc/mV Amp provides:

- high impedance, electrically isolated inputs suitable for direct connection to most thermocouples;

- cold junction compensation;

- software controlled filtering of the signal;

- software selectable gain ranges.

Technical Description

As with other eDAQ Amps, all internal functions of the Quad Tc/mV Amp are controlled from the e-corder by sending information on a special communications connection called the I^2C (eye-squared-sea) bus. This connection supplies power to the eDAQ Amp as well. eDAQ Amps are connected to the analog input channels of the e-corder via BNC-to-BNC cables, through which the amplified and filtered signal is

sent to the e-corder. The overall operation of the pH/mV Amp can be better understood by referring to Figure A–1.

The thermoucouple signal is first amplified (× 100) and then passed though an isolation transformer. The signal is then ice point corrected, low pass filtered and then sent to the e-corder for secondary amplification and filtering.

Figure A–1
Block Diagram of the
Quad Tc/mV Amp
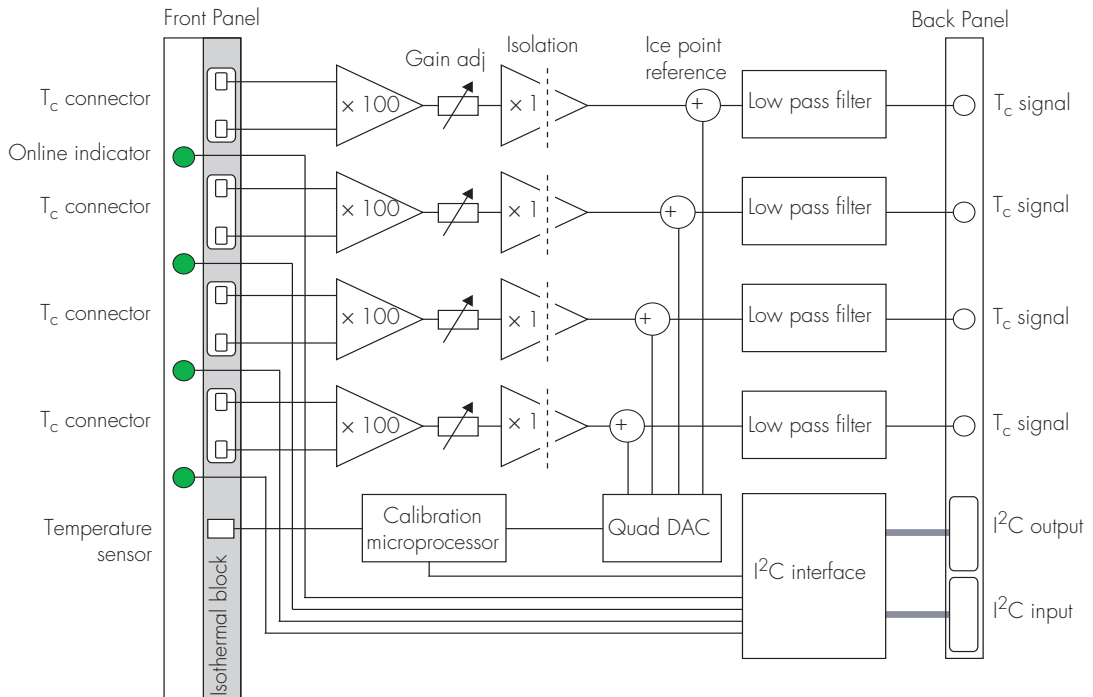
B

Troubleshooting

If you experience any difficulty with the Quad pH/mV Amp use this section to try to resolve the problem. In the majority of cases, the problem can usually be fixed by ensuring that the connecting cables are correctly connected and firmly attached and the re starting the Chart or Scope software.

The On-Line indicator fails to light when Chart or Scope is opened

• If the e-corder is off check switches and power connections.

• The BNC to BNC cables from the Tc/mV Amp to the analog input channels of the e-corder may not be properly connected. Check that each cable is firmly connected to the BNC connector on the back panel of the pH/mV Amp and to a BNC input on the front panel of the e-corder.

All or some of on-line indicators fail to light when the Chart software is opened, and the pH/mV Amp controls are not accessible

• If all the lights are off, then the I^2C cable from the Tc/mV Amp to the e-corder may not be properly connected. Check to see that the I^2C cables are firmly seated and screwed in.

• Try a new cable to check that the BNC and/or I^2C cables are working correctly.

• If you have tried the above suggestions and still cannot get the Quad Tc/mV Amp to work properly, then try using it on another e-corder if you have access to one. If the on-line indicators still fail to light on the second e-corder, the Quad Tc/mV Amp unit may be faulty and should be returned for repair.

C

Specifications

Quad Tc/mV Amp

Tc/mV Amplifier: Four.
                                     High impedance, electrometer type.
                                     Galvanically isolated.

Input range: ±20 mV

Secondary ranges: ±10, 5, 2 mV, supplied by e-corder

Input resolution: 16 bits, 0.0015% of range

Input impedance: 10^{13} Ω typical

Amplifier noise: < 1µV rms (4 µV p–p) @ DC – 10 Hz

Maximum Input: ±10 V

Input Connection type: miniature thermocouple

Bandwidth/Low pass filter: -3 dB @ 10 Hz
                                     3 pole Bessel

Secondary filters: 5, 2, 1 Hz (digital filters of e-corder)

Control Port

I^2C input and output: Male and female DB–9 pin connectors. Provides control and power.

Power requirements: ±17 V DC
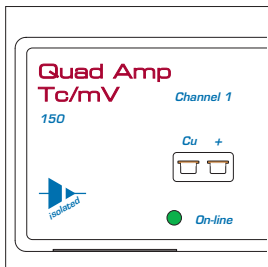+8 V DC
~3 W

Physical Configuration

Dimensions (h × w × d):   60 × 150 × 200 mm
2.4 × 5.9 × 7.9 inches

Weight: 1.5 kg (3.3 lb)

Operating conditions: 0 – 35°C
0 – 90% humidity (non–condensing)

eDAQ reserves the right to alter these specifications at any time.

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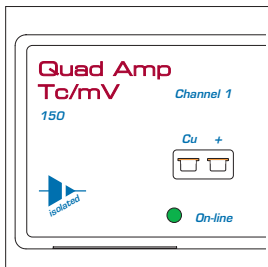
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Responsibilities

You and any others using any eDAQ product agree to use it in a sensible manner for purposes for which it is suited, and agree to take responsibility for their actions and the results of their actions.

If problems arise with an eDAQ product, eDAQ will make all reasonable efforts to fix them. This service may incur a charge, depending on the nature of the problems, and is subject to the other conditions in this Agreement.

Hardware Warranty

eDAQ Pty Ltd warrants the Quad Tc/mV Amp, to be free of defects in material and workmanship for one year from the date of purchase. eDAQ Pty Ltd will repair or replace defective equipment as appropriate.

To obtain a warranty repair/replacement you must first notify us before return of the instrument and we will issue you with a RAN (return authorization number). You must ship the defective product at your expense. We will pay return shipping. The product should be packed safely (preferably in its original packaging) and have the RAN on the shipping label. Returns sent without a RAN may be refused delivery.

This warranty does not cover hardware that has:

- been modified by the user in any way;

- been subjected to unusual physical, electrical, or environmental stress. This includes damage due to faulty power sockets, inadequate earthing, or power spikes or surges;

- been damaged because of incorrect wiring to ancillary equipment, or because of substandard, connectors or cables; or

- had the original identification marks removed or altered.

Software License

You have the non-exclusive right to use the supplied eDAQ software (Chart, Scope etc). Your employees or students, for example, are entitled to use it, provided they adhere to this agreement. Each separate purchase of the eDAQ software licenses it to be used on two computers at any given time (on one computer for data acquisition with a e-corder hardware unit, and on a second computer for the analysis of existing data files). Although multiple copies of a program may exist on several computers, more than two copies must not be used simultaneously. Departmental/company licences are

available if you wish to run more than two copies simultaneously.

Technical Support

Please register your unit to receive technical support. Technical assistance is available via email. Please describe the problem with as much detail as possible. Include a small example data file, if appropriate. Please also state:

- the model and serial number of your e-corder unit and Quad Tc/mV Amp.

- the type of computer and operating system being used (for example Windows XP, or Macintosh OS 10.2)

- the software version you are using (for example Chart v5.1.2)

We endeavor to answer all your questions, but in some cases, for example where the problem relates to the other equipment that you are using, a nominal fee may be charged.

Jurisdiction

eDAQ Pty Ltd is bound by the laws of New South Wales in Australia, and any proceedings shall be heard by the Supreme Court of New South Wales in Australia.

Disclaimer

eDAQ reserves the right to alter specifications of hardware and software without notice.

No liability can be accepted for consequential damages resulting from use of eDAQ products.