

MATELECT PCI-3

Precision Current Indicator



INSTRUCTION MANUAL

PCI-3 PRECISION CURRENT INDICATOR

Thank you for purchasing the PCI-3 Picoammeter. Before attempting to use this instrument please read and understand this instruction manual fully. Please pay special attention to the section on mains connection and usage.

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INTRODUCTION

The Precision Current Indicator PCI-3 is an autoranging picoammeter with a resolution of 0.1 pA. The PCI-3 measures DC current over an exceptionally wide range, covering 11 decades from 0.1pA to 20mA. The accuracy with which the current is measured is better than 0.3% on the lowest range rising to 0.05% on the higher ranges. This manual applies to the new Mark II PCI-3. Extra features to enhance and improve the specification and operation of the PCI-3 have been incorporated in the new version.

A summary of the main features of PCI-3 is given below:

- The 4.5 digit LCD display can either show the current or its logarithmic value.
- Simultaneous analogue outputs of the log and linear values of the current are provided.
- The common of the input current and Earth are isolated. Provision has also been made, so that the two can very easily be connected together, if required or the common can be earthed at any other suitable location.
- The PCI-3 is supplied in an attractive, rugged instrument case which can either be used on a bench or mounted into 19 inch racks. The case dimensions permit two PCI-3 units to be rack mounted side by side. Users can either use a standard shelf or specify our 19 inch rack mounting shelf to securely anchor each instrument.

An extensive range of options are available to suit individual needs - see the option list for further details.

TYPICAL APPLICATIONS

Example applications for the PCI-3 include the measurement of the following:

- Gate leakage currents and channel currents in MOSFETS, JFETS, and numerous other circuits.
- Beam currents in electron microscopes and mass spectrometers etc.
- Ionisation currents.
- Ion chamber outputs.
- Thermally induced currents.

Figure 1: Front Panels

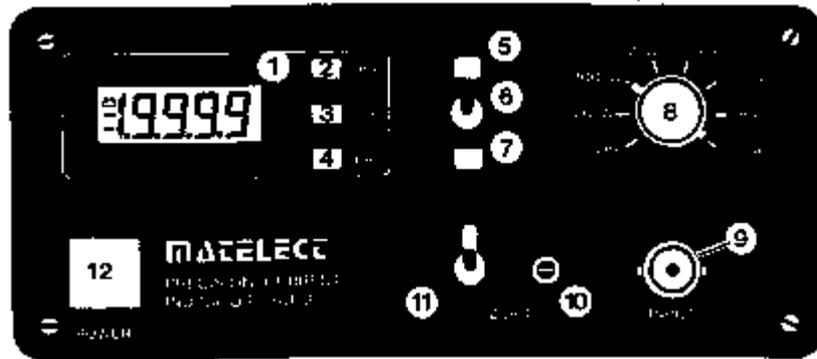
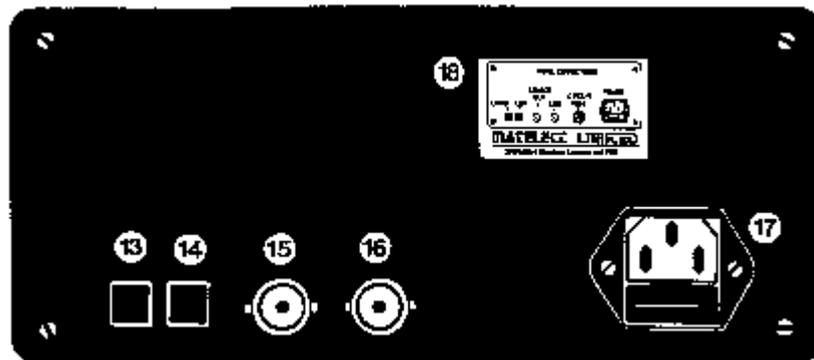


Figure 2: Rear Panels



FRONT AND REAR PANEL DESCRIPTIONS AND MODE OF OPERATION

The following section describes the function of the various front and rear panel components. Figure 1 shows a diagram of the front panel, and Figure 2 a diagram of the rear panels for reference. The components numbered on this diagram are described below.

1. Panel Meter 4.5 digit liq. crystal panel meter. Depending on the position of the mode switch (see Mode Selection Switch), this meter displays either the measured current or its logarithm.
2. mA LED If a mA range is selected, either manually or automatically, then the green mA LED will light up.
3. μ A LED If a μ A range is selected, either manually or automatically, then the green μ A LED will light up.
4. nA LED If a nA range is selected, either manually or automatically, then the green nA LED will light up.
5. Auto LED This red LED will light up if the PCI-3 is in autoranging mode, (see Mode Selection Switch).
6. Mode Selection Switch This three position toggle switch selects the mode of operation of the PCI-3. The function of the three positions are as follows:
 - a) Upper toggle position - Autoranging Mode: The PCI-3 automatically selects the best current range to measure the input current.
 - b) Central toggle position - Manual Mode: The current measurement range is selected manually using the rotary "Range Selector Switch", (see below).
 - c) Lower toggle position - Log Mode: In this mode the picoammeter autoranges (as described above) and shows on the panel meter the logarithm (base 10) of the input current.
7. Log LED This red LED lights up if Log Mode has been selected (see Mode Selection Switch).
8. Range Selection Switch This eight position rotary switch is operative only when the PCI-3 is in Manual Mode (see Mode Selection Switch). By rotating the switch the appropriate current measurement range can be selected.
9. Current Input Socket The current to be measured is fed into the PCI-3 via the current inputs socket. Connection to the socket should be made using a standard BNC type plug.
10. Zero Adjustment Potentiometer This is used when the PCI-3 is in Zero Mode (Zero Switch). Using a small screwdriver or trimming tool, the potentiometer should be altered until the display panel reads zero.
11. Zero Switch The Zero Switch is a biased toggle switch. To zero the PCI-3 the toggle should be held in the down position. Adjustment is then made using the zero adjustment potentiometer, as described above.

- | | | |
|---------------------------------|-------|---|
| 12. Mains Switch | | Mains On/Off button switch. On battery powered this version does not disable power to the built in charger. |
| 13. Functional Connector | Earth | This terminal is internally connected to the case of the PCI-3 circuit. If the instrument is connected to an earthed mains supply then this terminal will be at earth potential. Connections are effected by compressing the sprung button, then inserting the appropriate lead and releasing the button. |
| 14. Common Terminal | | This terminal is internally connected to the circuit common of the PCI-3. Connections to this are made as for Functional Earth Connector, above. Use of the Functional Earth Connector and the Common Terminal is described later. |
| 15. Linear Output | | This BNC connector provides the user with access to the linear output of the PCI-3. This linear output is an analogue voltage which varies linearly with the input current for any given current range. |
| 16. Logarithmic Output Terminal | | This BNC connector provides the user with access to the logarithmic output of the PCI-3. This is an analogue voltage which varies linearly with the logarithm (Base 10) of the input current. Log output = Log (current) / 10 volts. |
| 17. Mains Inlet Socket | | 240/220 V 50 Hz or 110 V 60 Hz IEC input socket with integral fuse (250 mA quick blow (F)) and spare fuse. |
| 18. Back Connection Diagram | Panel | Describes rear connections, model number and voltage ratings. |

Some models have optional connectors/feature which, if fitted, are separately described in annexes to this manual.

USING THE PCI-3

Mains Operation

This section applies to all the mains operated units. It also applies to battery operated units undergoing recharging.

Before use make sure that the instruments supply ratings are correct for the location it will be used in. For mains connection the instrument **MUST** be fitted with an IEC mains lead terminated with the appropriate local mains plug.

The instrument is housed in a metal case for strength and screening purposes and therefore PLEASE ENSURE that the instrument is correctly earthed via the IEC connector.

Ensure that the PCI-3 does not come into contact with fluids or corrosive gases and that its ambient temperature limits (see specifications) are not exceeded.

Please call Matelect or your local representative if you are unsure about any of the above aspects.

1. Switch on the PCI-3. Before using the instrument it should be left on for approximately 30 minutes. During this period the PCI-3 will warm up to operating temperature and have reached thermal equilibrium.
2. Earth and common Connection: Before taking any measurements it must be decided whether the earth and common should be connected together. If the common of the current source that is to be measured is earthed then **no** connection should be made at the PCI-3. However, if the current source is fully floating (i.e. it's common is not earthed), then the earth of the PCI-3 should be connected to the common. Push terminals on the back panel of the instrument allow this connection to be made (see section 3).
3. Zero the PCI-3. This is achieved using the Zero Switch and Zero Adjustment Potentiometer on the front panel and is described in section 3. If the temperature of the environment in which the PCI-3 operates varies significantly during its use, then the user is advised to zero the PCI-3 before taking each reading. However, if the temperature remains constant, within $\pm 5^{\circ}\text{C}$, then no further alteration to the zero will be needed.
4. Connect the current source to the input of the PCI-3. To avoid "noise pickup" the user is advised to use screened cable. Make sure this is of the low noise type as piezoelectric effects, occurring when cables are flexed can generate appreciable noise at picoamp levels.
5. Using the Mode Selection Switch (see section 3) choose the appropriate mode of operation for the PCI-3. If manual mode was selected then the measuring range must be selected using the Range Selection Switch (see section 3).
6. Current readings can now be taken from the LCD panel meter, the range being indicated by the appropriate LED annunciator.
7. If a hard copy output of the current is required, then connection can be made to the Log output or the linear output or both. The Log output allows the current to be monitored over the entire measurement range of the PCI-3 and is therefore useful when a large variation in the input current is expected.

The linear output voltage is equal to $I V$ for every 10,000 counts. This output provides a more accurate reading of the current than can be obtained using the Log output. However, the linear output gives no indication of the current range on which measurements are being taken. The linear output is therefore very useful when the current range does not change. If the high resolution afforded by this output is required across a number of ranges, then this can be achieved by also monitoring the Log output. The mantissa of the Log providing the current range.

8. If it is anticipated that the input to the PCI-3 will be subjected to high voltages then users must consult the protection section in the specification list. As with all current measurers, connection of voltages sources can often lead to internal circuitry damage. Where a risk of overvoltage application is present, users are warned to fit a series resistor to limit the maximum current through the PCI-3 to

50mA. If this current is exceeded then the 50mA rear panel protection fuse will blow. ***Never replace this fuse with one of a higher rating.***

If the user is in doubt about any aspects of PCI-3 usage then please contact Matelect Limited or your local representative who will be pleased to advise and assist.

MOUNTING THE PCI-3 IN A 19 INCH RACK

The PCI-3 can be used as either a bench instrument or as a rack mounted unit. In the latter mode, two PCI-3 Units can be fitted alongside each other on a standard 19" rack shelf. If it is desired, users can specify the Matelect Rack Mounting Kit (RMK-1). This kit consists of a tray assembly and fixing screws.

The tray is designed to accommodate two PCI-3's side by side and fits into a standard 19 inch system cabinet. The tray securely holds each PCI-3 unit and prevents it moving whilst in use. If only one PCI-3 is to be rack mounted then a blanking plate (RBP-1) is also available for use with the tray.

CARE OF THE MATELECT PCI-3

Please Note: There are no user serviceable parts in the PCI-3. Opening the instrument, unless under Matelect's direction may disturb its calibration and invalidate the warranty.

Please do not hesitate to contact our offices if any faults should occur.

Please do not allow the case of the units to come into contact with organic solvents such as acetone or methanol. Cleaning should be carried out gently with a soft, damp cloth using soapy water solution, if necessary.

SPECIFICATION OF THE PCI-3

a) Sensitivity: See Table 1

b) Ranges: See Table 1

Table 1: Range Specification

	Range Setting	Accuracy (% of RDG) 20°C, 5°C	Resolution (Sensitivity)
1.	2nA	0.3% ± 3 Counts	0.1pA
2.	20nA	0.1% ± 2 Counts	1pA
3.	200nA	0.1% ± 1 Counts	10pA
4.	2µA	0.05% ± 1 Counts	100pA
5.	20µA	0.05% ± 1 Counts	1nA
6.	200µA	0.05% ± 1 Counts	10nA
7.	2mA	0.05% ± 1 Counts	100nA
8.	20mA	0.05% ± 1 Counts	1 µA

- c) Display: 4.5 digit LCD
- d) Overrange indication: A “1” or “-1” only, is displayed at the far left hand side of the display if there is a positive or negative overrange respectively.
- e) Range indication: The range setting of the PCI-3 is indicated by front LED annunciators.
- f) Input connector: BNC 50 Ohm silver plated
- g) Maximum Common Mode Voltage: 100 volts rms from dc to 50 Hz.
- h) Input protection
- | | | |
|---------|------------|---|
| Maximum | Continuous | 500 volts on range settings of 2nA to 2μA |
| Input: | | 160 volts on 20μA and 200μA ranges |
| | | 25 volts on 2mA and 20mA ranges |
- i) Maximum input voltage burden: 100 microvolts
- j) Linear output: 1 volt for a display of 10000. Output resistance less than 10 ohms.
- k) Log output: $\text{Voltage out} = \log_{10}(\text{measured current}) / 10 \text{ volts}$
- l) Maximum loading of outputs: 5mA.
- m) Manual or Autoranging: Selected by front panel controls.
- n) Autoranging time: 400 milliseconds.
- o) Display modes: Panel meter either displays a direct, linear reading of the current, or a logarithmic (base 10) reading of the current. The different modes are selected by a front panel switch.
- p) **Accuracy: See table 3: should this be “see table 1”?**
- q) Isolation (earth to common): 500 volts, 10 ohms shunted by 0.1μF
- r) Dimensions: The dimensions of the PCI-3 in its rugged instrument case are shown in figure 2.
- s) Mass: Net mass of PCI-3 in standard instrument case is 3.0kg
- t) Power requirements: 220-240V 50Hz or 110-120V 60Hz 2W (including options unless otherwise stated). Fused at 250mA unless otherwise stated on read panel.
- u) Operating temperature range: 0-50°C, Relative Humidity less than 70%.

Figure 3: Side Dimensions

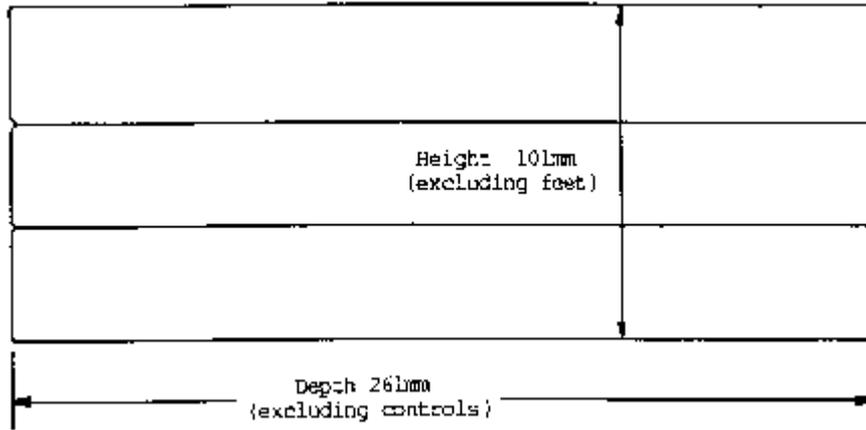
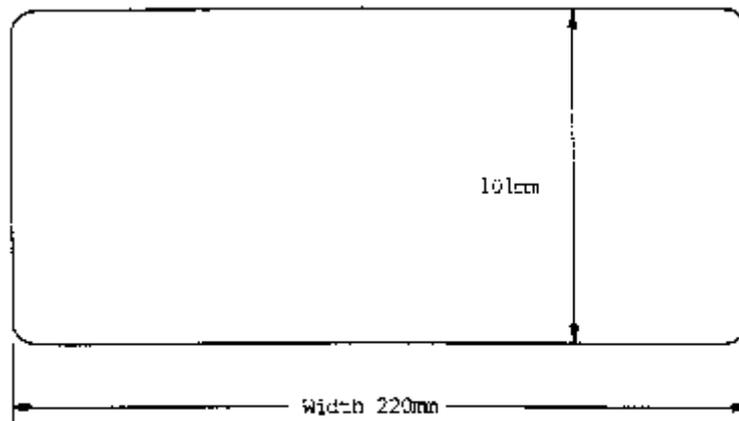


Figure 4: Front Dimensions



Overall Depth 280mm
Overall Height 105mm
Overall Width 220

List of Options

The PCI-3 can be supplied with a range of accessories to enhance and increase its versatility. These are detailed below. If you do not see your requirement listed then please contact Matelect Ltd. Our strength as a scientific instrument company lies in our ability to modify our standard items to suit individual needs and to achieve this at a reasonable and realistic cost. This has benefited many of our previous customers who have had their requirements fulfilled in a cost effective manner.

Battery Power (PCI-bat): For use away from the mains supply, a built-in rechargeable battery pack and re-charger can be specified. Over 8 hours continuous use is possible between overnight charges. Direct mains operation is also possible.

Filter Facility (PCI-fil): This option allows the user to selectively switch different degrees of filtering so that very noisy signals can be measured. The filters will operate on either the display, or on the analogue output, or if desired, on both.

RS232 Data Output (PCI-rs2): Either the analogue, Log, or both, outputs can be internally converted to RS232 format for transmission via a serial link to an IBM compatible PC. Basic control of the PCI-3 can be also be achieved via this link.

Acquisition Software (PCI-log): Used in conjunction with the optional RS232, PCI-log allows users to access, store and display data from the PCI-3.

Scanners (PCS series): These units allow the user to use a single PCI-3 to monitor several current sources. The scanners have been designed to be compatible with the low currents being switched and are of a low leakage design. Software is also available to control these units (PCI-scan).

Rack Mounting Kit (PCI-rmk11): Allows the secure mounting of up to 2 PCI units side by side in a 19" Rack.

Rack Blanking Plate (PCI-rbpl): Used to cover unused PCI instrument site in PCI-rmk1.

Isolated, 4-20mA Current Loop (PCI-clpl): Provides an isolated loop output of the analogue or Log signal. Especially designed for industrial applications where 4-20mA is used extensively.

Loop Adjustment Kit (PCI-lakl): Used to alter the settings of the 4-20mA Loop option PCI-clp1.

Further options are available on requests

Other products in Matelect's low current range include:

The PCI-5 picoammeter (with 10fA resolution)

The ISM-5 induced signal monitor - a high accuracy specimen current amplifier with a 100fA resolution

For further details or assistance please contact Matelect Limited or your local Matelect Representative

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