*i*R7040
Intelligent Ratemeter

7071945

User's Manual

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The information in this document describes the product as accurately as possible, but is subject to change without notice.

Printed in the United States of America.

For technical assistance, call our Customer Service Hotline at 1-800-255-6370 or email techsupport@canberra.com.

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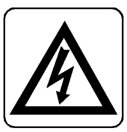
Important Safety Considerations
Read Carefully

This equipment should be installed following the mechanical and electrical information given in *Installation* on page 9 and *Electrical Connections* on page 10. Note that the ratemeter uses a supply fuse in the Live conductor only. If installation is to be carried out where there is no polarized mains supply then it is advisable to use an external double-pole protective device.

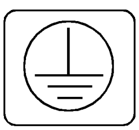
To allow for high inrush currents, a type C double-pole circuit breaker with a current rating of at least 4 A should be used.

External mains wiring to the instrument should include a method of isolation, preferably near the instrument. The use of a Residual Current device with a trip current of 30 mA should be considered for personal protection.



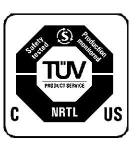
Indicates warning of mains or high voltage present at output labeled HV.
Risk of electrical shock if covers are removed.

Caution – risk of danger. Refer to documentation for detailed explanation of caution symbol wherever marked.



Earth tree symbol: indicates the connection point for the primary earth (ground) supply.

Product complies with appropriate current EU directives.



Example of "Cue" mark. Product complies with appropriate current FCC (UL)/CSA 61010-1 directives.

High Voltages Present

WARNING: The equipment operates from the mains power supply and high voltages are therefore present in certain parts of the instrument when mains power is applied.

Prior to commencing maintenance work, ensure that the instrument is disconnected from the electrical supply or that the electrical supply is isolated and cannot be switched on by others.

Manufacturer's Address

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Note

1. Introduction

The *i*R7040 Intelligent Ratemeter is an instrument designed to record, process and display signals from radiation measuring probes and related devices in areas such as nuclear plants. The instrument is designed with a considerable degree of configurability. The *i*R7040 is a wall-mounted unit for use in plant areas; it is part of a series of Intelligent Ratemeters which includes a rack-mounted instrument intended for control room use. The system is contained in a stainless steel case which is sealed to IP65. Main operation is via a front panel touch-sensitive color graphical LCD display; apart from this the only user control is a key-operated switch. The system has a front-panel status light and an light tower can be mounted on the top of the unit to provide a high-visibility status display. There is also a loudspeaker to provide audible warnings. Relays within the instrument are used to signal alarm conditions to the user's plant. The instrument can connect to a supervisory computer system using serial or Ethernet (TCP/IP) connections. The instrument maintains an internal archive where it stores measured values, alarm occurrences and other significant events; the contents of this archive can be displayed on the instrument's display and can be exported to a file for transfer to an external computer system for analysis or storage.

About this Manual

The iR7040 Ratemeter User's Manual contains the information necessary to set up, operate, and maintain the iR7040 Ratemeter.

What You Need to Know

Certain concepts are fundamental to the understanding, configuration and use of the iR7040 and these are explained in the following sections.

Probes

Normally the instrument is used to measure signals from one to four nuclear measurement probes. These probes connect to connectors on the bottom panel of the ratemeter. A wide range of CANBERRA probes can be connected; these are listed in Table 1.

Table 1 *i*R Probe Types

Probe Type	Description
GP100C2	Geiger-based dual range Gamma Probe
GP100S	Geiger-based dual range Gamma Probe
GP110S	Geiger-based dual range Gamma Probe
GSP100	Gamma-Scintillator Probe
IP100V1	Ion-Chamber Probe
IP100V2	Ion-Chamber Probe
MD455E	Beta/Gamma Scintillator Probe
MD455V5	Beta/Gamma Scintillator Probe
MD455V6	Beta/Gamma Scintillator Probe
MD55EB1	Gamma Scintillator Probe
MD55EV1	Gamma Scintillator Probe
MD55EV2	Gamma Scintillator Probe
MD55EV5	Gamma Scintillator Probe
NP100B	Neutron Probe
NP100H	Neutron Probe

Other Inputs

As well as the nuclear probes the iR7040 can accept up to five analogue inputs and up to 18 digital inputs. The analogue inputs are electrically isolated and can be configured for voltage or current input. These inputs can be used in functions such as flow measurement, sample changer control, etc.

Channels

Fundamental to the operation of the unit is the concept of a Virtual Channels™. Unlike simpler instruments there is no inherent connection between a probe and a displayed or recorded output. Instead values are grouped into channels. At its simplest a channel can consist of a single input from a nuclear measurement probe, this gives a straightforward measurement as in older, less flexible, instruments. However channels can be much more versatile than this. A channel can take values from a combination of probes, analogue and digital inputs and combine these using a set of pre-defined algorithms and user-configurable parameters to perform a wide variety of measurements such as background compensation and particulate measurement.

Each channel has three different outputs:

- The unfiltered output is the instantaneous result of the measurement.
- The filtered output is the same value but passed through a time filter to smooth out fluctuations; the system can use a simple time-mode (sometimes known as boxcar) filter, an exponential filter or a statistical filter.
- The total output is produced by summing the instantaneous values; for a probe measuring dose rate this sum will correspond to the total dose. Summed values can be reset to zero by user command or automatically at a scheduled time of day and/or day of week.

Alarms

Each measurement channel has two associated alarms. These are referred to as the low alarm and the high alarm, as these are normally set to represent a warning and emergency state, however they can be configured as required. For each alarm a threshold value can be specified and the user can also configure the alarm direction, i.e. if the alarm condition occurs when the measured value is above or below the specified threshold.

Alarms can be configured as latching or non-latching. For a non-latching alarm the alarm state is only maintained while the alarm condition is true; for a latching alarm the alarm state is set as soon as the alarm condition is true and is then maintained until it is deliberately cleared by the user.

The action to be taken on an alarm is configurable on an alarm-by-alarm basis. Possible actions include setting of relay outputs, setting digital outputs, setting the colour of the front panel lamp, setting the color of the light tower and the sounding of a user-selectable warning tone. All alarm occurrences are also logged to the instrument’s archive.

Outputs

The output value from a channel can be routed to an analogue output for connection to external units such as chart recorders. The scale, mode (logarithmic or log/linear) and offset for these outputs can be configured. The analogue outputs provide both voltage and current (4 – 20mA) outputs.

Archive

The iR7040 maintains an archive of all measured values, alarm occurrences and detected faults. Values from this archive can be displayed on the system screen or exported to a USB memory device connected to one of the USB sockets on the side of the instrument. When displaying measurement data then the data can be viewed either as a table or as a trend graph. Old archive entries can be purged to free up storage space in the instrument.

Connection to Host Computer

The iR7040 may be connected to an external host computer system using the RADACS protocol. The connection may be made via a serial interface or via an Ethernet (TCP/IP) connection. Using this interface the remote computer system can read measurement values and alarm and system status. Limited configuration, such as setting the alarm set points can also be performed by the remote computer, for security access to change the configuration in this way is controlled by the keyswitch.

Configuration

The iR7040 is a complex instrument and allows for considerable configuration to meet user’s requirements. The system can be configured via the built-in menu system; alternatively configurations may be generated using an optional PC-based configuration program which can be downloaded to the instrument using a USB storage device. Note that CANBERRA offers a service to pre-configure an instrument to meet the user’s requirement.

2. Controls and Connectors

The *i*R7040 ratemeter front panel (Figure X) consists of a vacuum fluorescent display, a four-position key switch, an audible alarm, and four indicator lamps.

Figure 1: Front View of iR Ratemeter

Display

The touch screen type display allows a wide variety of screens for both data display and configuration control. As a minimum, and as the default screen, the display will show the measured values and units from the connected probes, modified as required by analogue inputs.

Key Switch

The ratemeter provides a four-position key switch. The key switch positions are labeled OFF, ON, MAINTENANCE, and REMOTE.

Off – System is off; where no power is applied to the ratemeter, any connected probes or control outputs.

On – System is on in normal mode. Measurements are made and data are recorded to the instrument’s archive. A remote computer system can read data and configuration from the instrument but cannot make changes to the configuration. System in normal mode. Measurements are made and data are recorded to the instrument’s archive. A remote computer system can read data and configuration from the instrument but cannot make changes to the configuration.

In this mode only limited local control functions are available:

- Alarms may be acknowledged.
- Audible warnings can be muted.
- System configuration may be viewed but not changed.

Note that accumulated doses cannot be manually reset in this position however any automatic resets will take place.

Maintenance – All functions and configuration options are available locally. Measurements continue to be made and results recorded to the instrument’s archive. A remote computer system can read data and configuration from the instrument but cannot make changes to the configuration.

Remote – The instrument is under the control of a remote supervisory computer. Measurements are made and data are recorded to the instrument’s archive. Only limited local functions (as in the On state) are allowed.

The Key Switch key is removable in all positions except Maintenance. The chance of inadvertently leaving the ratemeter in Maintenance mode is thus reduced.

Status Indicator Lamp

A front panel lamp indicates the status of the system as shown in Table 2.

Table 2 Front Panel Lamp Indications

State	Priority	Meaning
Steady Green	1	Normal (no faults or alarms)
Flashing Green	2	System fault
Amber	3	Alarm (normally low alarm)
Red	4	Alarm (normally high alarm)

The front panel lamp is a single lamp and can only show one status at any time. The priority shown in this table indicates the order in which these are displayed, thus a red alarm state will take priority over an amber alarm state which will take priority over a flashing green fault state. Note that since the lamp states for alarms are configurable it cannot be guaranteed that low alarms are represented by an amber lamp and high alarms by a red lamp, however this is the normal recommended configuration. Refer to *Alarm Settings* on page 84 for details of alarm action configuration.

The ratemeter is fitted with a tricolor light tower for optimum visibility and indication of status; red, amber and green; the instrument state is shown in Table 3. Since the light tower can show multiple indications at the same time the priority system used for the front panel lamp is not appropriate.

Table 3 Light Tower Indications

State	Meaning
Steady Green	Normal (no faults or alarms)
Flashing Green	System fault
Amber	Alarm (normally low alarm)
Red	Alarm (normally high alarm)

As with the front panel lamp states the light tower states for alarms are configurable. The table shows the normal configuration.

Audible Alarm

A loudspeaker on the front panel can provide audible warning of alarm conditions. The sounds to be generated and the overall volume can be configured, refer to the chapter *System Configuration* on page 41 for details. Audible alarms can be muted, refer to *Audible Alarms* on page 66 and *Alarm Settings* on page 84 for details. The maximum alarm volume can exceed 85 dBA at 1m.

Probe, Relay, and Control Signals

The four probe connections are on the lower face of the main iR7040 ratemeter enclosure. They are high-standard military-style circular bayonet connectors allowing easy probe removal for calibration and other purposes.

Connections to the ratemeter are via multi-way connections through the bottom and right side face of the instrument. These connections connect to mating connectors on a Termination Panel that is mounted underneath the main ratemeter enclosure with simple wiring terminals inside. This allows the ratemeter to be a self-contained unit without any need for internal access for system wiring. The main ratemeter enclosure can easily be removed from the Termination Panel. This allows the ratemeter to be stored safely while wiring is implemented in the FTU. A blank termination panel cover (P/N 7073185) is available to seal the Termination Panel until the main ratemeter enclosure is replaced.

3. Installation

This chapter covers unpacking and installing the iR7040 ratemeter as well as any required electrical connections.

Unpacking

Visually inspect the ratemeter for damage due to irregular handling during shipment and check against the packing list. Report any missing or damaged items to the carrier and to CANBERRA as soon as possible.

Installing the Unit

The ratemeter is designed to mount onto a vertical flat surface (wall etc). Screw fixings are provided in the back of the instrument to allow mounting to a wall mounting plate. The wall mounting plate itself is affixed to the vertical flat surface by the use of keyhole type slots to allow simple fixing. After hanging the *i*R7040, these wall mounting fixings can be tightened.

The design of the ratemeter is such that the front, main part of the unit can be removed just leaving the rear, Field Terminal Unit (FTU). Mounting to the vertical flat surface and also the wiring into the FTU can then take place without the main part of the unit. A blank door is available that can be used to cover the FTU when wiring work is not taking place but before it is complete. The ratemeter should always be mounted vertically using the mounting bracket to make sure correct ventilation of the unit.

Use Figure X as a general guideline when mounting the ratemeter to the desired location.

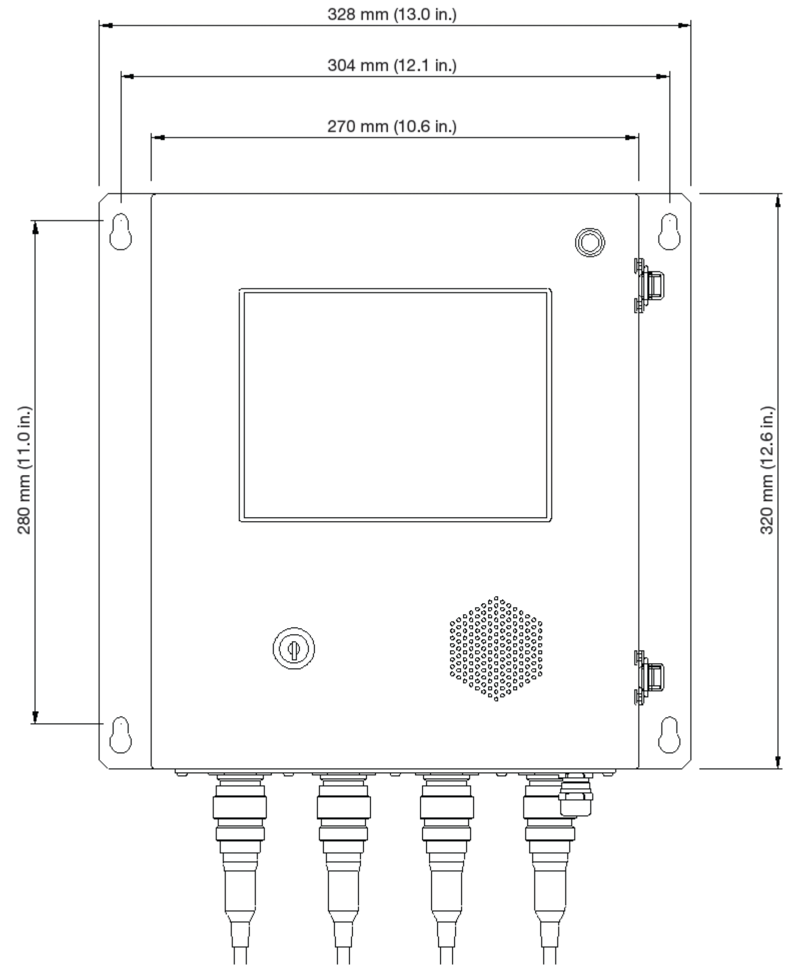


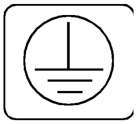
Figure 2: Mounting the Ratemeter

Electrical Connections

The iR7040 can be powered from either AC mains in the range 100 – 240 V ac, 50 – 60 Hz, or 24 V dc.

There is no AC mains or DC mechanical switching provided in the ratemeter. It is the responsibility of the installer to provide a double-pole breaker for the AC mains wiring. The external circuit breaker must be able to withstand the maximum inrush current of 4 A. Both the AC mains and the DC power are permanently wired into the ratemeter. The maximum wire sizes for both AC mains and +24V dc is 2.5 mm^2. This is the maximum size that will fit into the screw connector blocks. The minimum cable size should be 1 mm^2 for the AC mains and 1.5 mm^2 for the +24 V dc connections.

Mains Power Connection



WARNING: This ratemeter must be earthed (grounded).

The AC Mains input is connected to the screw terminal block as shown in the following photograph (Figure 1).

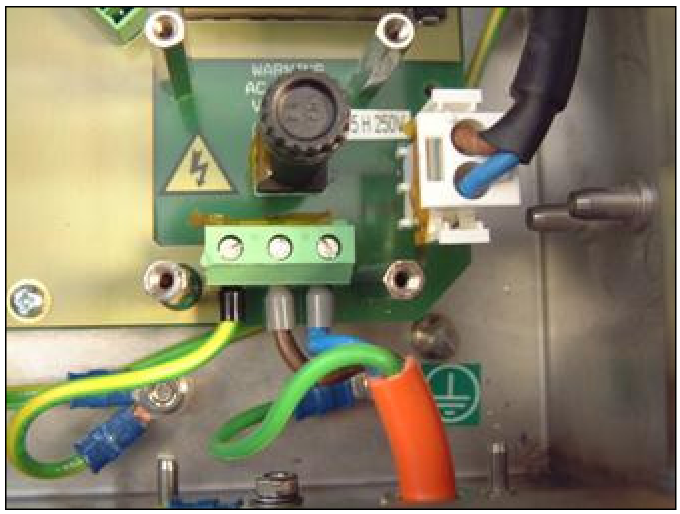


Figure 3: AC Mains Input Wiring

Incoming Live (colored brown in the photograph) and Neutral (colored blue in the photograph) are connected directly to the screw terminal block on the Termination Panel board. The incoming Earth (ground) (colored green/yellow in the photograph) is connected directly to the primary Earth (ground) connection on the case. Another green/yellow colored wire is connected from a second earth stud on the case to the Termination Panel board. All this can be seen in the photograph above.

All three AC mains connections on the Termination Panel board are shown in the photograph above.

Having made the AC mains connections, the cover board *must* be replaced. The following photograph (Figure 2) shows the cover in place.

Figure 4: AC Mains Cover Board in Place

The next photograph (Figure 3) shows the inside of the Termination Panel. The AC mains and +24V dc, as well as, other Input/Output connections are all made in this unit.

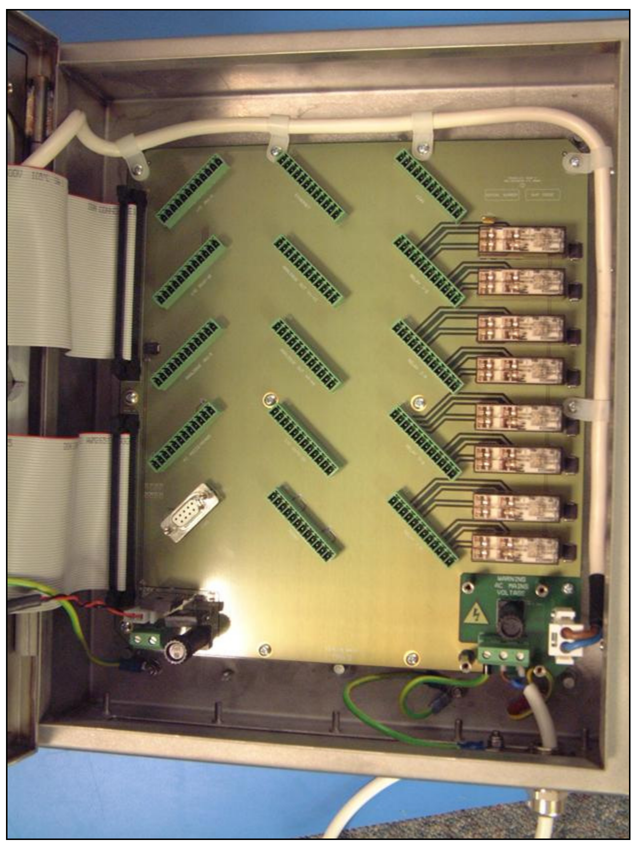


Figure 5: Connections in the FTU

The incoming AC mains power is connected via a 3-pin screw terminal block located in the bottom right hand corner. Note that the incoming earth (ground) wire is terminated with a ring terminal and is bolted directly to the metal enclosure.

The cable entry is via a gland affixed to the bottom gland plate of the enclosure. AC Mains Live and Neutral are connected via the connector with the earth (ground) connection direct to a threaded terminal post marked with the PE Earth-tree symbol.

An AC mains fuse (rating T3.15A H 250 V) is provided adjacent to the mains input connector (refer to *Spare Parts and Consumables* on page 123). This is accessible when the AC mains cover board is in place.

The mains output after the fuse is via a demountable 2-pin connector on the FTU board. This is to allow easy connection/disconnection of the FTU and main board enclosure during installation and maintenance.

An AC mains cover board is supplied which must be replaced after making the AC mains connections.

+24 V dc Power Connections

DC power is connected via a 2-pin screw terminal block in the FTU. A DC fuse is provided (rating T6.3A H 250V) as well as a demountable 24 V dc connection to the main board enclosure again for ease of installation and maintenance. The photograph below (Figure 4) shows the +24 V dc input is wired to the screw connector block located in the bottom left hand corner. The 0 V connection is on the left and the +24 V connection is on the right.

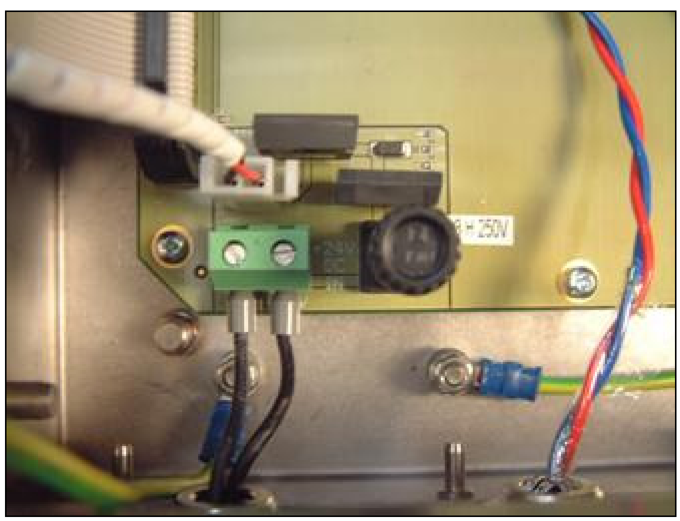


Figure 6: DC Supply Connections

Signal and Relay Connections

Apart from the probe connections, all the signal and relay connections are available via the Termination Panel board. All these connections are via 12-way demountable screw terminal blocks. The recommended wire size for these screw terminal blocks is between 0.14 and 1.5 mm^2 (28 – 16 AWG). These connections include analog inputs, analogue outputs, relay contacts, digital inputs, digital outputs, serial communication (both RS232 and RS485) and Ethernet. Another screw terminal block provides +24 V dc power (via a re-settable fuse) to allow switched power via the relay contacts if so desired. See below for more details. A 9-pin ‘D’ socket is also provided which gives access to the Control Processor (CP) Diagnostic port. Figure X below shows the physical locations of all the user Input/output connections. (This does not include the Probe connectors. These are mounted on the outside of the Ratemeter.) All the main Input/Output connections are via removable screw connector blocks, available in either straight or right angle wire entry types. The use of demountable type's means that the wiring can be made with the connector un-plugged thus being simpler to achieve than with screw connector block fixed onto the Termination Panel board.

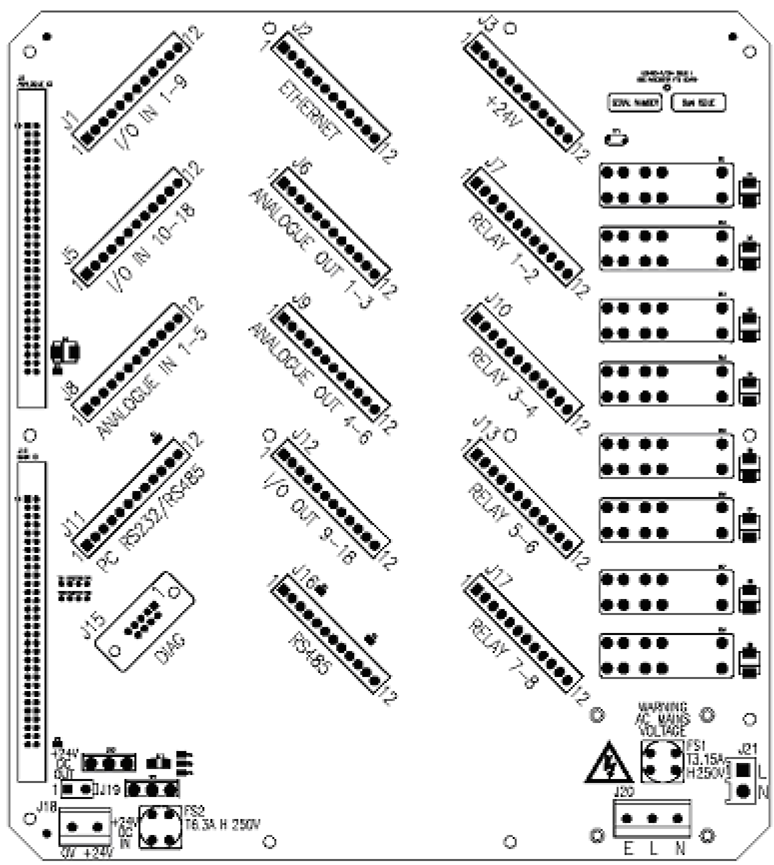


Figure 7: Termination Panel Connections

Ethernet Connections (J2)

A single 100/100 Base-TX interface is provided via 4 pins on J2. The 4 pins are labeled as they are on an Ethernet RJ45 type connector and should be connected as such.

Table 4 J2 Ethernet

Pin	Function
1	TX-
2	TX+
3	RX-
4	RX+
5	0V
6	0V
7	0V
8	0V
9	0V
10	0V
11	0V
12	0V

The following table shows the relevant inter-connections for to an RJ45 type connector.

Table 5 J2 to RJ45 Connections

J2 Pin	RJ45 Pin
1	2
2	1
3	6
4	3

Power and Ground Connections

The main system power at a nominal +24 Volts is available together with a Ground (0V) connection. The maximum current at +24V available from this connector is 0.5 A. Power drawn from here is protected by a thermal, auto-resetting fuse.

Table 6 J3 +24 Power and Ground

Pin	Function
1	0V
2	0V
3	0V
4	0V
5	0V
6	0V
7	+24V
8	+24V
9	+24V
10	+24V
11	+24V
12	+24V

Analog In Connections (J8)

Five analog inputs are available, each of which can be configured to provide a Voltage input of 0 – 10V or a current input of 4 to 20 mA. The configuration switch between Voltage and current is achieved in software as part of the Analogue Input configuration. 12-bit resolution is used to read the Analogue Inputs.

Table 7 J1 Digital Inputs 1 – 9

Pin	Function
1	0V
2	Analogue In 5
3	Analogue In 5 Common
4	Analogue In 4
5	Analogue In 3 Common
6	Analogue In 3
7	Analogue In 3 Common
8	Analogue In 2
9	Analogue In 2 Common
10	Analogue In 1
11	Analogue In 1 Common
12	0V

Analog Output Connections (J6 & J9)

All 6 analog outputs provide both Voltage and current outputs simultaneously, (although it is not recommended to wire to both the Voltage and current outputs on a output channel).

To use an analog Voltage output, the positive Voltage output is available via the ‘Out V’ pin and the reference Voltage output on the ‘Out VCOM’ pin.

Correspondingly, the positive current output is available on the ‘Out I’ pin and the reference current output on the ‘Out ICOM’ pin.

The output range is 0 to 10V for the Voltage output and 4 to 20mA for the current output. 12-bit resolution is used to create the analog outputs.

J6 carries the Voltage and current outputs for channels 1 to 3; see Table 9.

Table 8 J6 Analogue Outputs 1 – 3

Pin	Function
1	Analog Out V1
2	Analog Out VCOM1
3	Analog Out I1
4	Analog Out ICOM1
5	Analog Out V2
6	Analog Out VCOM2
7	Analog Out I2
8	Analog Out ICOM2
9	Analog Out V3
10	Analog Out VCOM3
11	Analog Out I3
12	Analog Out ICOM3

J9 carries the Voltage and current outputs for channels 4 to 6; see Table 10.

Table 9 J9 Analogue Outputs 4 – 6

Pin	Function
1	Analog Out V4
2	Analog Out VCOM4
3	Analog Out I4
4	Analog Out ICOM4
5	Analog Out V5
6	Analog Out VCOM5
7	Analog Out I5
8	Analog Out ICOM5
9	Analog Out V6
10	Analog Out VCOM6
11	Analog Out I6
12	Analog Out ICOM6

Digital Inputs (J1& J5)

Nine of the digital inputs are available on J1, (the other 9 are available on J5). All of these digital inputs use standard 0v and +5V levels to represent ‘0’ and ‘1’ respectively. The inputs are grouped into a group of 8 (inputs 1 to 8) and a group of 10 (inputs 9 to 18). Each group can have a pull-up or a pull-down resistor enabled (value 10kΩ). All the inputs are protected by clamping circuitry to help prevent damage to the Ratemeter circuits due to excessive positive or negative voltages applied to the input terminals.

Table 11 below shows the connections required for digital inputs 1 – 9 available on J1.

Table 10 J1 Digital Inputs 1 – 9

Pin	Function
1	0V
2	I/O IN1
3	I/O IN2
4	I/O IN3
5	I/O IN4
6	I/O IN5
7	0V
8	I/O IN6
9	I/O IN7
10	I/O IN8
11	I/O IN9
12	0V

Table 12 below shows the connections required for digital inputs 10 – 18 available on J5.

Table 11 J5 Digital Inputs 10 – 18

Pin	Function
1	0V
2	I/O IN10
3	I/O IN11
4	I/O IN12
5	I/O IN13

Table 11 J5 Digital Inputs 10 – 18

Pin	Function
6	I/O IN14
7	0V
8	I/O IN15
9	I/O IN16
10	I/O IN17
11	I/O IN18
12	0V

Digital Output Connections (J12)

Although the Ratemeter provides 18 digital outputs, 8 of these are used to drive the 8 relays. The remaining 10 digital outputs are available as TTL-type signals (0V and +5V) to the user. These are all buffered internally to the Ratemeter and can source and sink up to 32 mA of current. However, this level of current is not recommended and must not occur on more than one digital output connection at any one time. It is recommended that any digital output is properly buffered in the receiving system before use. This will also help to terminate the signal line from the Ratemeter to the external system.

Table 12 J12 Digital Outputs 9 to 18

Pin	Function
1	0V
2	I/O OUT9
3	I/O OUT10
4	I/O OUT11
5	I/O OUT12
6	I/O OUT13
7	I/O OUT14
8	I/O OUT15
9	I/O OUT16
10	I/O OUT17
11	I/O OUT18
12	0V

Relays 1 and 2 Connections (J7)

Eight relays are available. One is used for a fail relay and the other seven are available for alarm conditions. All 8 relays provide 3-off volt-free contacts to the user. Of the 3-off contact pairs 2 are Normally Open contacts (NO) and the third one is Normally Closed (NC). When a relay is activated, both NO contacts close and the NC contact opens. The single NC contact and one of the NO contacts can be wired to produce a Change-Over contact (CO) if required.

J7 provides all three contacts pairs for relays 1 and 2; see Table 14.

Table 13 J7 Contacts for Relays 1 and 2

Pin	Function
1	Relay 1 NO 1
2	Relay 1 NO 1
3	Relay 1 NO 2
4	Relay 1 NO 2
5	Relay 1 NC 1
6	Relay 1 NC 1
7	Relay 2 NO 1
8	Relay 2 NO 1
9	Relay 2 NO 2
10	Relay 2 NO 2
11	Relay 2 NC 1
12	Relay 2 NO 1

Relays 3 and 4 Connections (J10)

J10 provides all three contacts pairs for relays 3 and 4; see Table 15. These relays operate in the same way as relays 1 and 2 described in *Relays 1 and 2 Connections* on page 21.

Table 14 J10 Contacts for Relays 3 and 4

Pin	Function
1	Relay 3 NO 1
2	Relay 3 NO 1
3	Relay 3 NO 2
4	Relay 3 NO 2

Table 14 J10 Contacts for Relays 3 and 4

Pin	Function
5	Relay 3 NC 1
6	Relay 3 NC 1
7	Relay 4 NO 1
8	Relay 4 NO 1
9	Relay 4 NO 2
10	Relay 4 NO 2
11	Relay 4 NC 1
12	Relay 4 NC 1

Relays 5 and 6 Connections (J13)

J13 provides all three contacts pairs for relays 5 and 6; see Table 16. These relays operate in the same way as relays 1 and 2 described in *Relays 1 and 2 Connections* on page 21.

Table 15 J13 Contacts for Relays 5 and 6

Pin	Function
1	Relay 5 NO 1
2	Relay 5 NO 1
3	Relay 5 NO 2
4	Relay 5 NO 2
5	Relay 5 NC 1
6	Relay 5 NC 1
7	Relay 6 NO 1
8	Relay 6 NO 1
9	Relay 6 NO 2
10	Relay 6 NO 2
11	Relay 6 NC 1
12	Relay 6 NC 1

Relays 7 and 8 Connections (J17)

J17 provides all three contacts pairs for relays 7 and 8; see Table 17. These relays operate in the same way as relays 1 and 2 described in *Relays 1 and 2 Connections* on page 21.

Table 16 J17 Contacts for Relays 7 and 8

Pin	Function
1	Relay 7 NO 1
2	Relay 7 NO 1
3	Relay 7 NO 2
4	Relay 7 NO 2
5	Relay 7 NC 1
6	Relay 7 NC 1
7	Relay 8 NO 1
8	Relay 8 NO 1
9	Relay 8 NO 2
10	Relay 8 NO 2
11	Relay 8 NC 1
12	Relay 8 NC 1

PC RS232 and RS485 Connections (J11)

The internal Embedded PC (EPC) provides three RS232 and one RS485 connections to the user. These can provide serial communication to the Ratemeter EPC using a protocol such as RADACS. The existing RADACS protocol does not communicate to the Ratemeter very well as it has limited data channel capability (RADACS provides communication for 3 simple data channels and 1 difference channel. The Ratemeter has 32 channels.) However, a different, more suitable protocol could be used, or RADACS expanded. At present, the Ratemeter will communicate with the RADACS protocol, providing data from data channels 1 to 3 (from a total of 32).

None of these serial communication connections are optically isolated. Isolated RS485 communication connections are available on J16; see Table 18.

Table 17 J11 PC RS232 and RS485

Pin	Function	PC COM Port
1	0V	COM2
2	PC_RS232_IN1	COM2
3	PC_RS232_OUT1	COM2
4	0V	COM3
5	PC_RS232_IN2	COM3
6	PC_RS232_OUT2	COM3
7	0V	COM4
8	PC_RS232_IN3	COM4
9	PC_RS232_OUT3	COM4
10	PC_RS485_TERM	COM5
11	PC_RS485B	COM5
12	PC_RS485A	COM5

CP Diagnostic Connections (J15)

The CP diagnostic connector is a standard 9-pin ‘D’ socket available on the FTU board itself. This connector is not available externally as it would only be used for maintenance purposes. As the connector is inside, access is only by opening the case, which can be secured for security purposes, thus providing secure access to the CP diagnostic port.

The pin connections are such that a straight 9-9 cable is all that is required to connect it to a PC; see Table 19.

Table 18 J15 CP Diagnostic

Pin	Function
1	PC Carrier Detect
2	PC Received Data
3	PC Transmitted Data
4	PC Data Terminal Ready
5	Signal Ground
6	PC Data Set Ready
7	Signal Ground

Table 18 J15 CP Diagnostic

Pin	Function
8	PC Data Set Ready
9	PC Clear To Send

CP RS485 Connections (J16)

J16 provides access to the two isolated RS485 serial ports which are controlled by the CP. At present these ports are uncommitted but they can be used for long distance data communication using, if required, a subset of the RADACS protocol.

The two ports are the same in that they both provide the same connections. The ‘A’ and ‘B’ connections are the normal signal connections. The ‘C’ connection is a signal common for that port only (the 2 ports are isolated from each other). The ‘TERM’ connection allows a 120Ω termination resistor to be connected across the RS485 bus. A terminating resistor should be placed at each end of an RS485 network, but not at any of the intermediate nodes. Connecting the ‘TERM’ pin to the ‘B’ pin enables the termination. (The ‘B’ pin will also have one of the signal wires connected to it.)

For example, to use the RS485 port 1, connect the signal lines to pins 4 and 5. If a termination is required, also connect pins 3 and 4 together.

Table 19 J7 CP RS485 (Isolated)

Pin	Function
1	0V
2	RS485_C1
3	RS485_TERM1
4	RS485_B1
5	RS485_A1
6	0V
7	0V
8	RS485_C2
9	RS485_TERM2
10	RS485_B2
11	RS485_A2
12	0V

Probe Connections

Four probe connections are available on the lower front part of the *i*R7040 enclosure. All four probe connections are the same and use a 19 pin circular bayonet type connector. (62GB - series.) The pin connections are shown in Table 23.

Table 20 Probe Signals

Pin Designation	Signal
A	+5V Probe Power
B	0V (Gnd)
C	EECLK – to Probe
D	LOWEN~ – to Probe
E	HIGHEN~ – to Probe
F	EEEN – to Probe
G	EVENT~ – from Probe
H	F1 – Either EVENT (from probe) or Check Source *(to Probe)*[1]
J	0V (Gnd)
K	Analog – from Probe
L	–15V Probe Power
M	+15V Probe Power
N	Pulser – to Probe
P	RS422 TX+ (to Probe)
R	RS422 TX- (to Probe)
S	RS422 RX+ (from Probe)
T	RS422 RX- (from Probe)
U	+24V power (fused)
V	0V *(Gnd)*[2]

[1] This signal is switched to be the 'other' signal for a balanced drive EVENT or a +24V control signal to a check source mechanism within the probe. The switching is implemented automatically based on the probe type selected.
[2] This signal is the 0V (Gnd) return for the check source mechanism.

The connector used for the probe connections is a military-style 62GB type. The following photograph (Figure X) shows the external view of one of the connectors. All four are the same. The view shown in the photograph is of the outside of the connector – which will be the same as the view of the solder pins of the mating item.

Figure 8: Probe Connector

The existing ADM series of Ratemeters and their associated probes use a 12 pin connector of the same style. Although there is no requirement to connect to an ADM Ratemeter, the existing probes are compatible with the iR7040 Ratemeter and will be used with it. To simplify this, the first 12 signals used on the 19 pin connector for the iR7040 Ratemeter are the same as the signals on the ADM Ratemeter. That is pin1 has the same signal, as does pin 2 etc. An adapter cable is available that allows a probe with an existing 12 pin connector to be connected to the iR7040 Ratemeter.

Pin A - +5V Probe Power

+5V power is generated within the Ratemeter to power the probes connected to it. This +5V is generated within the Ratemeter independently from the +5V used within the Ratemeter. This is to ensure that a fault in a probe or probe cable does not load the power lines used by the Ratemeter to the extent that Ratemeter operation is compromised. A total of 2W of power is available at +5V for *all* the probes. This allows at least 100% more power than the worst case condition when using four probes. The +5V probe power is monitored by the Ratemeter and a fault will be generated if it is detected out of range.

Pin B - 0V (Gnd)

This is the 0V connection from the probe power and common for the probe signals.

Pin C - EECLK

This is a TTL-type (0V - +5V) signal and provides the clock to the probe EEPROM. Data in this EEPROM is read by the Ratemeter and used to verify the probe type and for individual probe calibration.

Pin D - LOWEN~

This is another TTL-type signal which when LOW enables the *low* range (high sensitivity) detector within a probe. Some probes support range changing and these probes use two control lines to control which range is in use. Probe which do not support range changing (I.E. single range probes) will ignore this signal. However, it will still be driven low by the Ratemeter.

Pin E - HIGHEN~

This is another TTL-type signal which when LOW enables the *high* range (low sensitivity) detector within a probe. Refer to *Pin D - LOWEN~* on page 28 for more details on probe range changing. However, unlike the LOWEN~ signal, when using probes that do not support range changing, HIGHEN~ will stay high.

HIGHEN~ is also used for communication to the probe EEPROM. When the EEPROM is enabled (with the EEEN signal – see below), the HIGHEN~ line becomes the data line to the EEPROM. In this state, the *i*R7040 Ratemeter uses this line to communicate to and control the probe EEPROM.

Pin F - EEEN

This is another TTL-type signal which enables the probe EEPROM when HIGH. The probe EEPROM can then be read from or written to by the iRW Ratemeter.

Pin G - EVENT~

This is the pulse-train from the probe to the Ratemeter counter. For most probes, this is a single-ended signal but for some probes, the pulses are generated as a balanced drive signal. EVENT~ is one half of the balanced signal with F1 being the other. See below.

Pin H - F1

This is a dual-purpose signal that is either used to control a check source mechanism (for those probes that support this facility) or is the ‘other’ signal line for the balanced drive pulse-train from the probe. It is obvious, therefore, that probes that have an internal check source mechanism must use a single-ended pulse-train drive, and those that have a balanced pulse-train drive cannot have an internal check source mechanism.

Pin J - 0V (Gnd)

This pin is used as the return current path for the internal check source mechanism.

Pin K – Analogue Signal from the Probe

Some probes (mainly the PA300E/MD series detector) provide a monitor of the probe High Voltage. This monitor signal is routed to the Ratemeter via pin K. It has a voltage range of 0 to +10V and the Ratemeter will scale this voltage by a factor such that the displayed value is the same as the High Voltage generated within the PA300E.

Pin L – -15V Probe Power

In a similar fashion as described in *Pin A - +5V Probe Power* on page 27, this pin provides -15V power to the probe. Again, it is generated by the Ratemeter independently from any other supplies within the Ratemeter and is only used to power the probes. The maximum power available at -15V is 6W, again which is at least 100% more than the worst case requirement with four probes connected. Also like the +5V probe power, it is monitored by the Ratemeter and a fault will be generated if the supply is detected out of range.

Pin M – +15V Probe Power

In a similar fashion as described in *Pin A - +5V Probe Power* on page 27, this pin provides +15V power to the probe. Again, it is generated by the Ratemeter independently from any other supplies within the Ratemeter and is only used to power the probes. The maximum power available at +15V is 12W, again which is at least 100% more than the worst case requirement with four probes connected. In fact two separate +15V, 6W supplies are generated, each of which supplying two probes. Also like the +5V probe power, they are monitored by the Ratemeter and a fault will be generated if either supply is detected out of range.

Pin N – Pulser

The Ratemeter can generate a pulse train of varying PRF independently for each probe. Each pulse can be configured to be connected either direct to the relevant counter within the Ratemeter or to the probe via the probe connector. The latter is a useful feature which allows the checking of the complete signal path from the detector to the counter. However, no current probe supports this feature, but the pulser can still be used connected directly to the probe channel counter. This selection and the frequency required are both configurable while the Ratemeter is in *Maintenance* mode.

Pin P – RS422 TX+

Each probe has a dedicated serial port. The communication is via RS422 thus allowing cable lengths of up to ~5000 ft. RS422 is a balanced drive system so each of the transmit and receive signals require two lines. This line is the Transmit + line (that is from the Ratemeter to the Probe).

Currently no existing probes use a serial interface so these probe serial ports are unused. However, new developments of Smart-smart probes will use a serial port and these ports can then be programmed to suit.

Pin R – RS422 TX-

This line is the Transmit - line (that is from the Ratemeter to the Probe).

Pin S – RS422 RX+

This line is the Receive + line (that is from Probe to the Ratemeter).

Pin T – RS422 RX-

This line is the Receive - line (that is from Probe to the Ratemeter).

Pin U – +24V power (fused)

Power at the main system +24V is also available to probes if they require more power, or power at other voltages than already supplied. This pin can supply up to 0.5 A maximum and is protected by an auto-resettable thermal fuse.

Pin V – 0V (Gnd)

This is another 0V (Gnd) pin. The use of this pin is mainly to provide another ground return path when the +24V power line is used.

Network Connections

A 10/100-BaseTX interface with MAC which complies with both the IEEE802.3u 10/100-BaseTX and the IEEE 802.3x full-duplex flow control specifications is provided via the screw terminal blocks on the Termination Panel.

4. Basic Operations

This section describes normal routine (basic) operation of the iR7040 ratemeter. It assumes that the instrument has been installed in accordance with the chapter *Installation* on page 9 and configured for the user's individual application in accordance with the instructions contained in *System Configuration* on page 41. Note that CANBERRA can provide a full installation and configuration service if required.

Turning the Unit On

Switch the iR7040 ratemeter on by turning the front panel key switch to the ON position. The ratemeter will then perform a series of self tests to make sure correct operation. Note that the graphical display functions are provided by an internal computer that takes some time to start up, however the operation of the system's monitoring and alarm generation (with the exception of audible alarms) is independent of this computer and will start more quickly. If the instrument fails any of its start-up tests this will be indicated by warnings displayed on the graphical display and/or by a flashing green light on the front panel and on the optional light tower. Refer to the chapter *Self Test Functions* on page 115 for details of troubleshooting.

The ratemeter will communicate with any connected probes (where possible) to ascertain any required measurement units etc, and then start displaying those details on the ratemeter display.

Graphical Display

The main display of the system is a color LCD screen mounted at the top of the unit. This not only acts as a display for all system data, it is also touch-sensitive and provides the main user interface to the instrument. For the convenience of those operating the instrument within nuclear plants the touch-sensitive display is designed to be operable by users wearing gloves.

Note that the iR7040 is a configurable instrument and many aspects of the unit, including the display, can be set up using the built in menu system or the PC configuration tool. Configurable options include the number of display elements, the data displayed for each channel, the range and color of the bargraph displays etc. Because of this configurability each instrument is likely to be different; the examples shown below are typical but may not exactly match your particular instrument.

Normal Display

Figure XMain shows the display of a typical unit in normal operation. In this case the display has been configured to display four display 'segments' with one channel displayed in each segment. The status bar at the top of the display indicates the instrument fault status, showing an red icon if there is any faults in the instrument or a green check mark if there are no faults. The latest error message, if any, is also displayed in this status bar. In the figure shown there are no faults present.

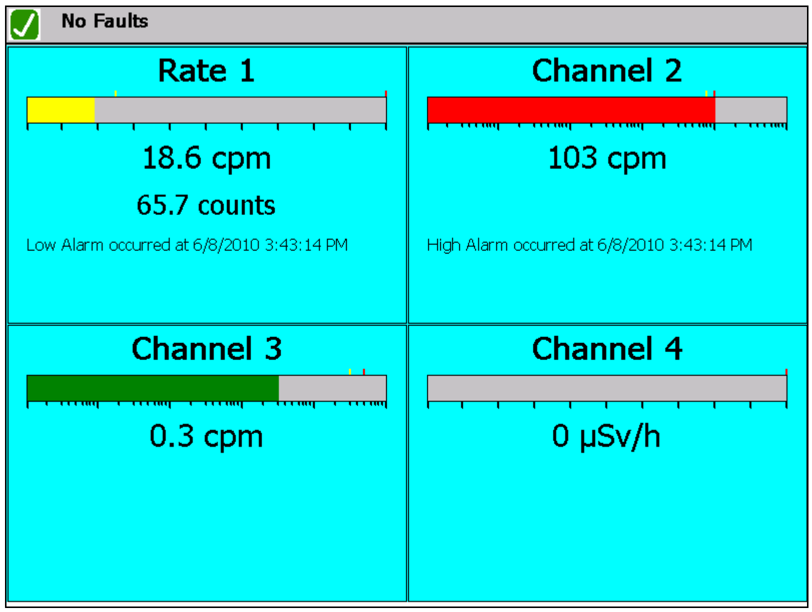


Figure 9: Main Display - Normal Operation

Where the display has been configured for up to eight display segments it will be similar to Figure XMain in that in normal display mode all segments are displayed simultaneously.

Once the display is configured for more than eight segments it is no longer practical to do this and instead the display has a 'scroll bar' at the right, see Figure X2. In this mode only eight channels are shown simultaneously, to view the other channels touch the blank area of the scroll bar or the up and down arrows at the top and bottom respectively and the next 'page' of eight channels will be displayed.

Figure 10: Main Display with Scroll Bar

Information displayed in each of the four display segments follows a similar pattern:

- At the top of each segment the channel title is displayed, this may be configured to display a meaningful label according to the application.

- Below the title a bargraph is displayed. This provides an 'at a glance' indication of the measured value for a channel. Bargraphs may be configured to show the instantaneous data from a channel (either filtered or unfiltered) or the summed total of the data values for a channel or may be turned off entirely if not required.

  For a channel displaying nuclear radiation data the instantaneous value is typically a dose rate whereas the summed value is a total dose. The range of the bargraph and the axis type (linear or logarithmic), are configurable.

  The bargraph color is used to indicate the alarm status of a channel, Figure XMain shows channels 3 and 4 are in a clear (no alarm) state, channel 1 is indicating a low level alarm and channel 2 a high level alarm. The colors used are configurable.

  The black tick marks below the bar indicate the scale; the colored tick marks above the bar indicate the alarm set points. Note that, to avoid crowding the display, the bargraph scale values are not shown when multiple channels are displayed, they are shown when an individual channel is displayed full screen, refer to *Single Channel Display* on page 34.

- Below the bargraph is the main numeric display. This displays a measured value as a number. Like the bargraph this display can show filtered or unfiltered instantaneous rates or summed values and can be turned off if not required. The units used can be configured.

- Below the main numeric display is the secondary numeric display. This can be configured to show the same values as the main numeric display; typically this display may be configured to show dose information where the main display is displaying dose rate, or vice versa. In the example shown only the first channel is making use of the secondary display, it has been turned off for all the other channels.

Below the secondary numeric display is a message area, this is used to display messages such as the time of occurrence of alarm conditions.

Whenever the display is in a multi-channel mode (i.e. similar to the above figures) then the following areas of the screen act as touch-sensitive controls:

- Touching any of the display segments will display that segment in ‘single channel’ mode. Refer to *Single Channel Display* on page 34.

- Touching the status bar, i.e. the strip at the top of the screen that says “No Faults” in the examples shown, will display the status screen. Refer to *Status Display* on page 36.

- Touching the scroll bar, if shown, will scroll the display as described above.

The system can also switch automatically to the single channel and status displays.

Single Channel Display

As described above the instrument will switch to single channel display if any display segment is touched. It will also switch from multi-channel to single channel display if any channel goes into an alarm condition. Figure X shows a typical display in single channel mode. It can be seen that this is very similar to a single segment of the multi-channel display, however note that in this mode a set of touch-sensitive command buttons are displayed along the bottom of the screen. In addition note that the scale limits for the bargraph are displayed in this mode.

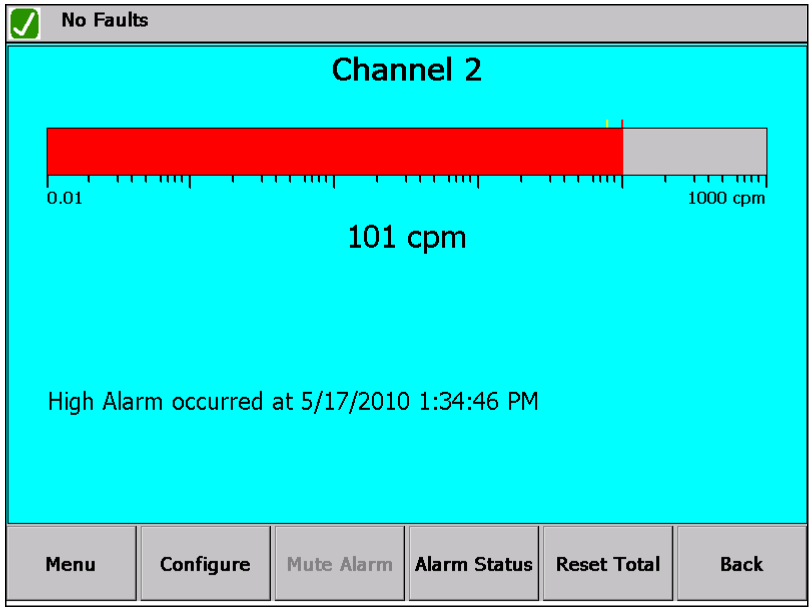


Figure 11: Single Channel Display

A button bar is displayed at the bottom of the screen, this button bar is not available in multi-display mode. Note that where buttons are displayed in grey text, such as the "Mute Alarm" button then the button is disabled and will have no effect when touched. In this particular case the "Mute Alarm" button is disabled as no alarm was sounding at the time.

From left to right, they are:

- **Menu** displays the main system menu. Refer to *System Settings* on page 59.
- **Configure** displays the Configuration menu for the selected channel, this is a short cut into the menu system for this channel. Refer to *Channel Settings* on page 78.
- **Mute Alarms** silences any audible alarm sounding. Will be disabled if no alarm is sounding.
- **Alarm Status** displays the Alarm Status. Refer to *Alarm Status Display* on page 37.
- **Reset Totals** will reset the total (i.e. summed) count for this channel to zero. This occurs even if the total is not displayed. The button is only available if the keyswitch is in Maintenance mode, in all other modes this button will be disabled. Refer to *Key Switch* on page 6.
- **Back** button returns the display to the multiple-segment mode.

Status Display

The status bar at the top of the normal operating screen will display the most recent fault to occur in the unit or “No Faults” if there are currently no faults. Touching this status bar will bring up the status display which will show all faults in the system, see Figure XStatus for an example. The status display will also be displayed automatically by the ratemeter whenever a new fault occurs, in this case the status screen will be hidden again after a period of approximately 20 seconds.

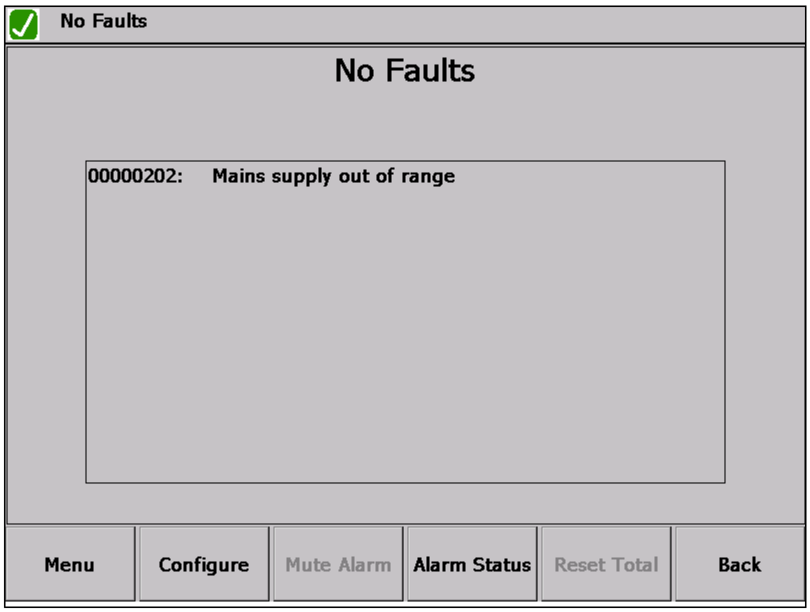


Figure 12: Status Display

Where there are more messages to show then can fit on the screen at once then a scroll bar will be displayed on the right of the message area, this may be used to scroll the display to show all messages. Each message has a number as well as the text, this may be used to look up the message and find the appropriate remedial action, refer to *Self Test Functions* on page 115.

Note that not all messages are considered to be faults, the example shown in Figure XStatus is a case in point. This was taken from a unit that was operating on an external 24 V supply and therefore had no mains supply. Normally instruments will be run from either an external 24 V supply or a mains supply, and therefore one or other of these supplies is likely to be absent. The only condition that would constitute a fault is if both supplies were absent, in this case there would be no power to the system and therefore no display at all.

Alarm Status Display

Touching the **Alarm Status** button will cause the instrument to display the alarm status screen, Figure X. This display serves two functions, it provides a summary of the overall alarm status of all 32 channels on a single screen and it allows latching alarms to be cleared. The concept of latching alarms is explained briefly in *Alarms* on page 3 and is covered in more detail in *Alarm Settings* on page 84.

The Alarm Status display shows a colored block for each of the 32 channels; these blocks are actually touch-sensitive buttons which are used to reset latched alarms. The color of each block represents the alarm state, using the same colors that are used for the bargraph display. The text in each button, as well as providing a label, indicates if the button is enabled to perform a reset function; those buttons that are enabled (channels 1 and 2 in the example shown) are displayed with the text in black, disabled buttons are displayed with the text in grey. Buttons are only enabled if the associated alarm is configured as a latching alarm and the alarm is in the latched state, i.e. the alarm condition has been true but is no longer true.

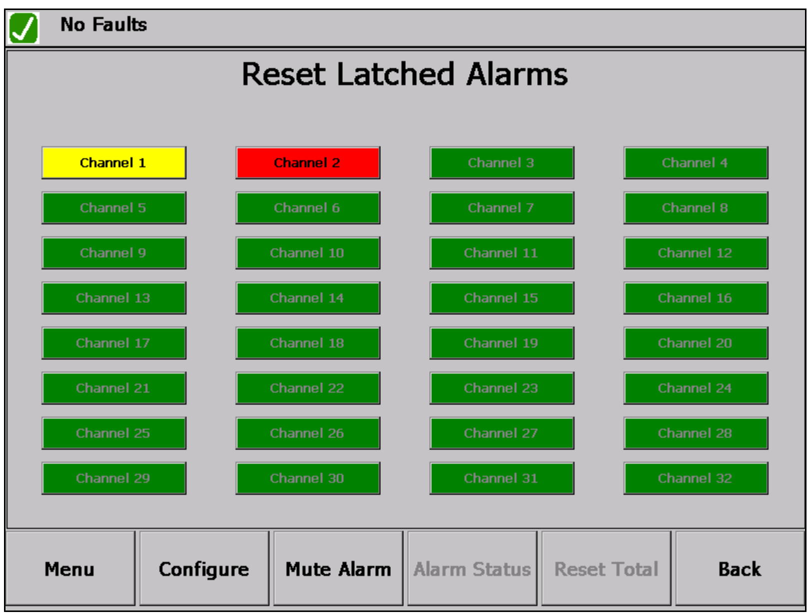


Figure 13: Alarm Status Display

Menu Display

The system menu can be displayed by touching the **Menu** or **Configure** buttons, the Configure button acts as a short cut to the Channel Configuration Menu, refer to *Channel Settings* on page 78, for the selected channel. Note that normal operation of the instrument does not require use of the menu; it is only needed for such functions as configuring the unit, viewing or exporting measurement data or for maintenance functions such as updating the unit software. Thus only the overall operation of the instrument's menu system is described here, the individual menu options are described in the chapter *System Configuration* on page 41.

Figure X1 shows the system main menu. Menu items are selected by touching the screen within the box surrounding the item. Menu items either lead to other menus or to other functions, such as screens to allow parameter values to be set. Some menu items, particularly those that lead to parameter setting screens, show a parameter value on the right hand half of the menu item's box; the main menu has no such items but an example can be seen in the System Information menu (Figure X2).

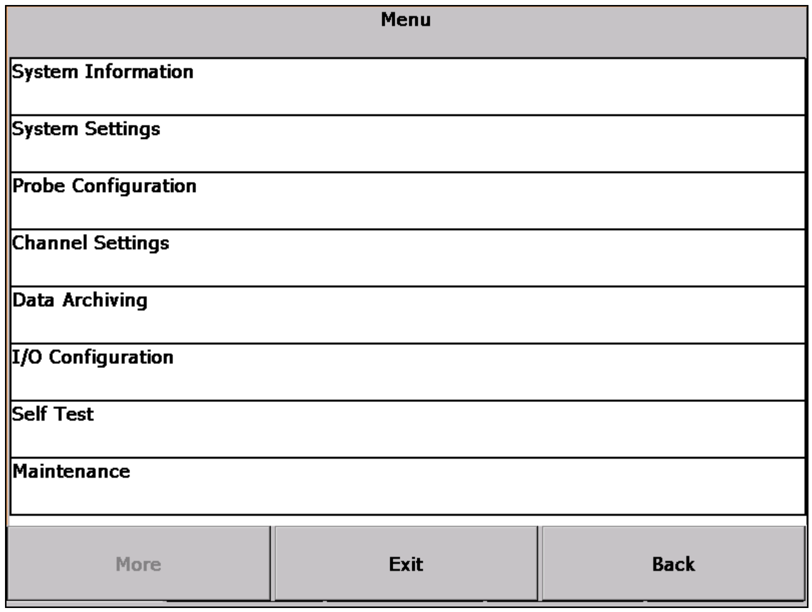


Figure 14: The Main Menu

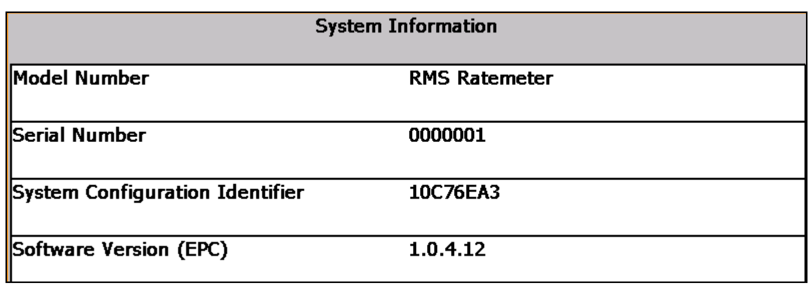


Figure 15: System Information Menu Showing Parameters

The touch buttons at the bottom of the display are standard for all menus. The **More** button is only active if the menu has more items than can be displayed on a single screen, the **Exit** button will exit the menu and return to the Main display and the **Back** button will return to the previous menu. When at the top menu touching the **Back** button is equivalent to touching the **Exit** button.

The Calendar Control

You can select the date and time using the calendar control. The date range will be automatically set to the start and finish of the current day on initial selection of this item; these values should be set to the date/time range required. The starting and ending dates may be set by touching the downward pointing arrow to the right of the date, the system will then display a calendar from which the date can be selected. The day can be selected by touching it; to select previous or later months touch the left and right arrows respectively in the month title bar.

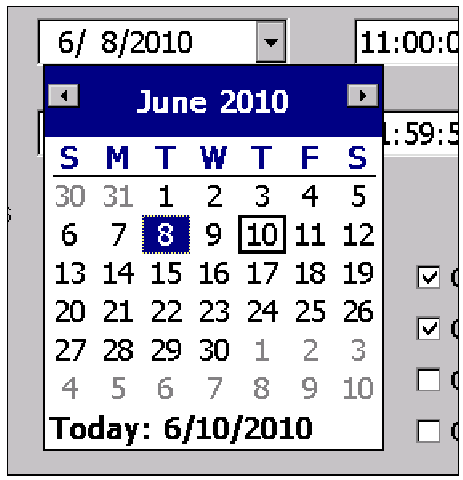


Figure 16: Selecting a Date From the Calendar

Times are selected by touching the required field (hour, minute or second) within the associated time display, this will cause the field to be displayed in 'reverse video'. Figure X2 shows the hour field selected. The value may then be changed by using the left and right facing arrow keys to the right of the displayed time.

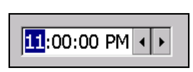


Figure 17: Changing the Time

Diagnostic Functions

A number of self-diagnostic functions are provided. On start-up, the embedded Microcontrollers will perform the usual data and code memory tests. If these tests fail, no further operation will take place with suitable indications to the user. During normal operation, either under manual control, or automatically at preset times, self-tests can be performed. These self-tests utilize BITE within the Ratemeter to check the continual correct calibration of the whole signal chain. In addition to these checks, calibration of 'smart' probes, (either 'new smart' probes or old probes with a 'smart' adapter) can take place with corrected calibration data being written into the probes as necessary.

Refer to the chapter *Self Test Functions* on page 115 for more information.

Data Storage

Data from probes can be logged in internal non-volatile memory. This internal data log can be extracted either via the network system or by plugging in a USB flash memory device. The USB flash memory may also be used for software and/or configuration updates.

Although the USB connection to the EPC is easily accessible on the outside of the enclosure, a simple lockable USB plug provides access denial to the unauthorized user.

Network Connections

A 10/100-BaseTX interface with MAC which complies with both the IEEE802.3u 10/100-BaseTX and the IEEE 802.3x full-duplex flow control specifications is provided via the screw terminal blocks on the Termination Panel.

Turning the Unit Off

When the Key Switch on the Ratemeter front panel is moved to the OFF position, the Ratemeter will go through a controlled shutdown procedure, saving data to non-volatile memory as required (including both the data and event logs), shutting down the probes and any high-voltage supplies, finally indicating on the display the shutdown state before blanking the display and shutting all power off. For any Ratemeter connected into a network system the movement to shutdown state is communicated to the network system.

5. System Configuration

The iR7040 ratemeter is a very flexible instrument and can be configured for a wide variety of applications. There are two main ways to perform this configuration, the system can be configured using the built-in menus or the PC-based configuration tool can be used to perform the configuration and the results downloaded to the ratemeter using a USB storage device. Configurations can also be saved from an instrument to a USB storage device; this facility may be used to ‘clone’ an instrument. Some limited configuration can be performed from a remote controlling computer system using the RADACS protocol, but this is restricted to changing alarm thresholds, system date and time etc.

Configuring the System

Configuration consists of selecting from a number of options thus specifying the function of the ratemeter. A large number of items can be individually configured and the major ones are described in the sections below.

System Settings

The **System Settings** menu item on the Main menu provides access to setting which overall operation of the ratemeter.

Initial Settings

When the ratemeter is first put into service, you must enter the following settings:

- System Name
- Language
- Date and Time (setting)

Refer to *Initial Settings* on page 60 for more information.

Display Configuration

To setup the display, the following settings are entered:

- Number of display segments (1 to 32). These correspond to the Virtual Data Channels (VDC)
- Segment Configuration. Select what is displayed in each segment (from its VDC)

- Background color
- Normal Bar color
- Low alarm color
- High alarm color
- Calibrate display (sets up the touchscreen)

Refer to *Display Configuration* on page 63 for more information.

Audible Alarms

The following alarm settings are entered:

- Audio volume
- High alarm sound
- Low alarm sound

Refer to *Audible Alarms* on page 66 for more information.

Unit Definitions

The system is configured with a basic set of units used for the display and archiving of measured values. In addition to these pre-defined units using the Units Editor to select, create, and/or edit these units.

Refer to *Unit Definitions* on page 68 for more information.

Sample Periods

Sets the sampling periods used on the system.

- Acquisition interval
- Archive interval

Refer to *Sample Periods* on page 71 for more information.

Preamp Settings

A selection of which preamp is given and then within each selection their:

- Preamp setting mode
- Low energy threshold

- High energy threshold
- Preamp mode

See the *Preamp Settings* on page 72 for more information.

Probe Configuration

From the **Probe Configuration** menu one of four probes can be selected and then the following items can be configured. See Probe Configuration for more information.

Probe Type

A number of different probe types are available to select from.

Probe Serial Number

A text entry form used to enter the probe serial number.

Probe Filter Type

Select of one of three filter types or no filter is available.

Time-mode filtering creates a time average by adding up the last ‘n’ entries and dividing by ‘n’. The value of ‘n’ is set in the Filter Parameter Menu and can be in the range 1 to 500.

Statistical filtering creates a time average in the same way as Time-mode, but the number of entries ‘n’ varies according to the statistical accuracy required. The incoming entries are added up until a defined limit is reached. The average is then taken by dividing this total by the number of entries. The defined limit varies with the accuracy required and the figures used are shown below.

% Accuracy Required	Defined Limit
1	10,000
3	1,000
10	100

Exponential filtering produces a filter that mimics a 1^{st} order analogue RC filter with the RC time constant varying to produce a dynamic exponential filter. If the difference between the current average and a new data point is large, then the ‘time constant’ is reduced so that the large change is seen immediately. As the difference becomes smaller, the ‘time constant’ increases so the smaller difference is filtered to a greater extent. With a constant small difference between the average and a new data point, the ‘time constant’ slowly increases to a maximum.

Probe Filter Parameter

A filter parameter is set here. For Time-Mode filtering this is the number of ‘bins’ used in the filtering. For Statistical, this parameter refers to the % accuracy required. Only values of 1%, 3% or 10% are allowed. Any other value is used as a 10% accuracy figure.

Probe No-Count Timeout Time

This menu allows setting of the no data timeout time. If no event pulses are received for this time from this probe, the Probe Zero Count detect fault is raised.

Probe Memory

This menu shows the contents of the bottom half of the probe non-volatile memory. Selection of a single byte followed by a press on **Edit** will allow changes to be made and subsequently saved to the probe non-volatile memory. The upper half of the probe non-volatile memory is used to store the complement of the lower half. This is used to guard against corrupted non-volatile memory and is done automatically by the Probe Processor.

Channel Settings

Up to 32 Virtual Channels™ are available. All channels are the same and each can be configured to perform the same or different functions. The function can be as simple as indicating the rate from a probe or it can be as complex as performing a mathematical algorithm using the rate data from more than one probe combined with an analogue input and a number of constants.

From the Channel Settings menu page, the channel is first selected. On channel selection, the configuration menu for that channel is shown. Refer to *Channel Settings* on page 78 for more information.

Channel Description

The **Channel Description** menu item provides access to a free-text field which appears on that channel screen. This can be edited by selecting this field.

Channel Types

The **Channel Type** can be selected from a list. The **More** button is used to move through the list.

Not Used

This channel type does nothing and indicates that this channel is not in use.

Single Probe Rate

This channel type uses the rate from one of the probe inputs. The probe to be used is specified as *Primary Probe* in the **Resources** menu.

Single Probe Rate of Rise

This channel type creates the rate of change of a probe rate. The probe to be used is specified as *Primary Probe* in the **Resources** menu.

Analog Input

This channel type uses an analogue input, scaled and offset as required. The analogue input to be used is specified as *Primary Analog Input* in the **Resources** menu.

Note: The readings from an analog input are intended to be used with probe data in one of the algorithms. Due to this, the analog data is closely tied with probe data so that the two are time-related. If no probe data is being produced, then no analog data is produced. If an analogue only VDC is required, then a probe input must also be defined thus allowing the analogue data to be produced.

Probe Analog Input

This channel type uses the analog input from the specified probe. The probe analogue input to be used is specified as *Primary Probe* in the **Resources** menu.

Fixed Analog Output

This channel type uses an analogue output set to a fixed value. The analog output to be used is specified as *Analog Output* in the **Resources** menu and the value to be set is specified using the constant *ks* in the **Parameters** menu.

Variable Analog Output

This channel type uses an analogue output set to a value equal to the product of a specified analog input and a constant. The Analog Input and the Analog Outputs to be used are specified in the Resources menu. The constant to be used is *ks* and is specified in the **Parameters** menu.

Digital Inputs

Currently not implemented.

Fixed Digital Outputs

Currently not implemented.

Pump Control Module

Currently not implemented.

Sample Control Module

Currently not implemented.

Tape Control Module

Currently not implemented.

Algorithm A

This channel type uses a mathematical formula using specified resources. It is typically used for Net Iodine calculations. The formula is:

$$(K_S * P_1) – P_2$$

K_S is a constant which is represented by the value K_S in the **Parameters** menu.

P_1 and P_2 are the rates from two probes which are selected by *Primary Probe* and *Secondary Probe* respectively in the **Resources** menu.

Algorithm B

This channel type uses a mathematical formula using specified resources. It is typically used for Net Particulate calculations. The formula is:

$$P_1 – (P_2 * K_S)$$

K_S is a constant which is represented by the value K_S in the **Parameters** menu.

P_1 and P_2 are the rates from two probes which are selected by *Primary Probe* and *Secondary Probe* respectively in the **Resources** menu.

Algorithm C

This channel type uses a mathematical formula using specified resources. It is typically used for Net Noble Gas calculations. The formula is

$$(P_1 – (P_2 * K_S)) * K_{VS} * A_S$$

K_S and K_{VS} are constants which are represented by the values K_S and K_{VS} in the **Parameters** menu.

P_1 and P_2 are the rates from two probes which are selected by *Primary Probe* and *Secondary Probe* respectively in the **Resources** menu.

A_S is the value read from an analog input selected by *Primary Analog Input* in the **Resources** menu.

Algorithm D

Currently not used.

Algorithm E

Currently not used.

Algorithm F

Currently not used.

Algorithm G

This channel type uses a mathematical formula using specified resources. It is typically used for Iodine Concentration on a Moving Filter. The formula is:

$$(L_1 – K_{CS}) * K_{C0}$$

L_1 (uses the same formula, Resources and Parameters as is used by Algorithm A. Note that although the same formula is used as in algorithm A, it is calculated independently for algorithm G. This means that a VDC does not have to be allocated using algorithm A to create an output for algorithm G.

L_1 is equal to:

$$(K_S * P_1) – P_2$$

K_S is a constant which is represented by the value K_S in the **Parameters** menu.

P_1 and P_2 are the rates from two probes which are selected by *Primary Probe* and *Secondary Probe* respectively in the **Resources** menu.

K_{CS} is a constant which is represented by the value K_{CS} in the **Parameters** menu

K_{C0} is a constant which is represented by the value K_{C0} in the **Parameters** menu

Algorithm H

This channel type uses a mathematical formula using specified resources. It is typically used for Iodine Concentration on a Fixed Filter calculations. The formula is:

$$(((L_{1(t2)} – (L_{1(t1)} * K_D)) / (A_S * K_U)) * K_{CS}) - K_{CO}$$

L_1 uses the same formula, Resources and Parameters as is used by Algorithm A. Note that although the same formula is used as in algorithm A, it is calculated independently for algorithm H. This means that a VDC does not have to be allocated using algorithm A to create an output for algorithm H.

L_1 is equal to:

$(K_S * P_1) – P_2$

K_S is a constant which is represented by the value K_S in the **Parameters** menu.

P_1 and P_2 are the rates from two probes which are selected by *Primary Probe* and *Secondary Probe* respectively in the **Resources** menu.

$L_{1(t1)}$ refers to the value for L_1 for the *previous* time frame.

$L_{1(t2)}$ refers to the value for L_1 for the *current* time frame.

K_D is a constant which is represented by the value K_D in the **Parameters** menu.

A_S is the value read from an analogue input selected by the value *Primary Analog Input* in the **Resources** menu.

K_U is a constant which is represented by the value K_U in the **Parameters** menu.

K_{CS} is a constant which is represented by the value K_{CS} in the **Parameters** menu.

K_{CO} is a constant which is represented by the value K_{CO} in the **Parameters** menu.

Algorithm I

This channel type uses a mathematical formula using specified resources. It is typically used for Particulate Concentration on a Moving Filter calculations. The formula is

$(L_2 * K_{CS}) – K_{CO}$

L_2 uses the same formula, Resources and Parameters as is used by Algorithm B. Note that although the same formula is used as in algorithm B, it is calculated independently for algorithm I. This means that a VDC does not have to be allocated using algorithm B to create an output for algorithm I.

L_2 is equal to:

$P_1 – (P_2 * K_S)$

K_S is a constant which is represented by the value K_S in the **Parameters** menu.

P_1 and P_2 are the rates from two probes which are selected by *Primary Probe* and *Secondary Probe* respectively in the **Resources** menu.

K_{CS} is a constant which is represented by the value K_{CS} in the **Parameters** menu

K_{C0} is a constant which is represented by the value K_{C0} in the **Parameters** menu

Algorithm J

This channel type uses a mathematical formula using specified resources. It is typically used for Particulate Concentration on a Fixed Filter calculations. The formula is:

$$(((L_{2(t2)} – (L_{2(t1)} * K_D)) / (A_S * K_U)) * K_{CS}) - K_{CO}$$

L_2 uses the same formula, Resources and Parameters as is used by Algorithm B. Note that although the same formula is used as in algorithm B, it is calculated independently for algorithm J. This means that a VDC does not have to be allocated using algorithm B to create an output for algorithm J.

L_2 is equal to:

$$P_1 – (P_2 * K_S)$$

K_S is a constant which is represented by the value K_S in the **Parameters** menu.

P_1 and P_2 are the rates from two probes which are selected by *Primary Probe* and *Secondary Probe* respectively in the **Resources** menu.

$L_{2(t1)}$ refers to the value for L_1 for the *previous* time frame.

$L_{2(t2)}$ refers to the result of algorithm B for the *current* time frame.

K_D is a constant which is represented by the value K_D in the **Parameters** menu.

A_S is the value read from an analogue input selected by the value *Primary Analog Input* in the **Resources** menu.

K_U is a constant which is represented by the value K_U in the **Parameters** menu.

K_{CS} is a constant which is represented by the value K_{CS} in the **Parameters** menu.

K_{CO} is a constant which is represented by the value K_{CO} in the **Parameters** menu.

Algorithm K

This channel type uses a mathematical formula using specified resources. It is typically used for Noble Gas Concentration calculations. The formula is:

$$(L_3 * K_{CS}) – K_{CO}$$

L_3 uses the same formula, Resources and Parameters as is used by Algorithm C. Note that although the same formula is used as in algorithm C, it is calculated independently for algorithm K. This means that a VDC does not have to be allocated using algorithm C to create an output for algorithm K.

L_3 is equal to:

$$(P_1 – (P_2 * K_S)) * K_{VS} * A_S$$

K_S and K_{VS} are constants which are represented by the values K_S and K_{VS} in the **Parameters** menu.

P_1 and P_2 are the rates from two probes which are selected by *Primary Probe* and *Secondary Probe* respectively in the **Resources** menu.

A_S is the value read from an analog input selected by *Primary Analog Input* in the **Resources** menu.

K_{CS} is a constant which is represented by the value K_{CS} in the **Parameters** menu.

K_{CO} is a constant which is represented by the value K_{CO} in the **Parameters** menu.

Algorithm Formula

The above algorithms can be divided into Compensated Probe Algorithms and Net Concentration Algorithms.

The algorithms are defined in the following tables. Table 22 shows the general form for the Compensated Probe Algorithms. A number of symbols are used and Table 23 shows these symbols and their meanings.

Table 21 Compensated Probe Rate Algorithms

Calculation Name	Formula	Comments
Net Iodine Calculation (Algorithm ‘A’)	$(Ks * P_1) – P_2$	For Iodine Channels P_1 = (Pk+Bkg) reading P_2 = (Pk+2Bkg) reading The typical units for this calculations are cpm or cps
Net Particulate Gas Concentration (Algorithm ‘B’)	$[P_1 – (P_2 * Ks)]$	For Noble Particulate Channels P_1 = Total Beta reading P_2 = Bkg reading The typical units for this calculations are cpm or cps
Net Noble Gas Concentration (Algorithm ‘C’)	$[P_1 – (P_2 * Ks)] * [KVS * AS]$	For Noble Gas Channels P_1 = Total Beta reading P_2 = Bkg reading As = Scaled Analogue input for the Vacuum Sensor The typical units for this calculations are cpm or cps

Table 23 Compensated Probe Symbol Definitions

Symbol	Symbol Definition
P_1	First Probe Reading
P_2	Second Probe Reading
Ks	Scale Factor (User Configurable)
Kvs	Constant Vacuum Compensation (User Configurable)
As	Scaled Analogue Input

Table 24 shows the general form for the Net Concentration Algorithms. A number of symbols are used and Table 25 shows these symbols and their meanings.

Table 25 Net Concentration Algorithms

Calculation Name	Formula	Comments
Iodine Concentration Moving Tape Filter (Algorithm ‘G’)	(L_1 * Kcs) - Kco	For Iodine Channels L_1 = NET Iodine CPM reading.
Iodine Concentration Fixed Filter (Algorithm ‘H’)	{{[$L_{1(t2)}$ – ($L_{1(t1)}$ * Kd)] / [As * Ku]} * Kc_s} –- Kc_o	$L_{1(t2)}$ = The current NET Iodine CPM Reading. $L_{1(t2)}$ = The previous 2 S NET Iodine CPM Reading. A_s = Scaled Analogue input for the Sample Flow
Particulate Concentration Moving Tape Filter (Algorithm ‘I’)	(L_2 * Kc_s) - Kc_o	For Particulate Channels L_2 = NET Particulate CPM reading.
Particulate Concentration Fixed Filter (Algorithm ‘J’)	{{[$L_{2(t2)}$ – ($L_{2(t1)}$ * K_d)] / [A_s * K_u]} * Kc_s} – Kc_o	$L_{2(t2)}$ = The current NET Particulate CPM Reading. $L_{2(t2)}$ = The previous 2 S NET Particulate CPM Reading. A_s = Scaled Analogue input for the Sample Flow
Noble Gas Concentration (Algorithm ‘K’)	(L_3 * Kc_s) - Kc_o	For Particulate Channels L_3 = NET Noble GAS Reading.

Table 27 Net Concentration Algorithms Symbol Definitions

Symbol	Symbol Definition
L_1	The result of algorithm 'A' in Table 5 above
L_2	The result of algorithm 'B' in Table 28 above
L_3	The result of algorithm 'C' in Table 28 above
Kcs	Concentration Scale Factor (User Configurable)
Kco	Concentration Scale Factor (User Configurable)
As	Scaled Analogue Input
Kd	Constant Decay Factor (User Configurable)
Ku	Constant Units Converter (User Configurable)

Units

This Channel Settings menu item allows the selection of the units used for the displays. As well as the built-in units, custom units can be created via the System Settings → Unit Definition menu.

Refer to *Units Definitions* on page 68 for more information.

Resources

The **Resources** menu item allows configuration of probes, analogue inputs and output to be used for this VDC. They are described in *Channel Types* on page 44.

Parameters

The **Parameters** menu item allows the configuration of the constants used in the algorithms described in *Algorithm Formula* on page 50.

Bargraph Settings

The **Bargraph Settings** menu item allows the configuration of the displayed bargraph. A linear or logarithmic bargraph can be selected as well as maximum and minimum (or decades in the case of a logarithmic bargraph).

Alarm Settings

The **Alarm Settings** menu item allows setting of both low and high alarm thresholds, alarm direction (low or high going) as well as alarm actions. A single or multiple alarm actions can be selected as well as latching or non-latching alarms.

Accumulated Dose Reset

The **Accumulated Dose Reset** menu item allows the setting of the automatic accumulated dose reset.

Data Archiving

The **Data Archiving** menu item on the Main menu allows viewing, export and purging of the archive. Please refer to the chapter *Data Review and Display* on page 100 for details.

I/O Configuration

The **I/O Configuration** menu item on the Main menu allows settings for the various I/O devices. These include parameters controlling TCP/IP communication, the analog inputs and outputs, the digital inputs, the relay settings, and RADACS Host communication.

Refer to *I/O Configuration* on page 87 for more information.

I/P Configuration

The **I/P Configuration** menu item provides access to the settings for the Ethernet connection.

Analog Input Configuration

The **Analog Input Configuration** menu item provides access to configuration settings for each of the five Analogue inputs. These settings included:

Input Type

Each Analogue input can be configured for Voltage or current input. The input ranges are 0 – 10V for Voltage and 4 – 20mA for current.

Scale

Each Analogue input can have a scale factor applied to it before use within any algorithm or reporting of the value.

Offset

Each Analogue input can have an offset value added from it before use within any algorithm or reporting of the value.

Analog Output Configuration

The **Analogue Output Configuration** menu item provides access to configuration settings for each of the six Analogue inputs. These settings include:

Scale

Each Analogue output can have a scale factor applied to it before it is converted and made available on the Analogue Output connections in the FTU.

Offset

Each Analogue output can have an offset applied to it before it is converted and made available on the Analogue Output connections in the FTU.

Mode

Either Log-Linear or Log-Log modes can be selected.

Starting Offset

The Analogue output starting point can be set.

Number of Decades

The number of decades can be set.

Digital Inputs

The **Digital Inputs** menu item is used to control the pull-up/pull-down state of the digital inputs.

Relay Settings

The **Relay Settings** menu item allows each relay to be configured as Failsafe or Non-Failsafe.

Host I/O Configuration

The **Host I/O Configuration** menu item provides settings that determine how the ratemeter communicates with the host computer.

Self Test

The **Self Test** menu item on the Main menu allows various self-tests to be initiated. Please refer to the chapter *Self Test Functions* on page 115 for details.

Maintenance

The **Maintenance** menu item on the Main menu gives access to various maintenance functions. See *The Maintenance Menu* on page 96 for more details.

For customers that do not choose to perform their own configurations, CANBERRA offers a configuration service.

Menu Operation

Use the System menu to view or change the instrument’s configuration using the facilities built-in to the iR7040 ratemeter. The configuration can be viewed in any state of the front-panel keyswitch but can only be changed via the touchscreen if the keyswitch is set to the Maintenance position.

Displaying the Menu

To display the Main menu (Figure X) touch the **Menu** button on the button bar. The button bar is only displayed when the instrument's display is in single channel mode, refer to *Single Channel Display* on page 34. If the display is in normal, multi-channel mode then touch any display segment to switch to single channel mode. The **Configure** button displays the Channel Settings menu for the displayed channel, see *Channel Settings* on page 78 for details.

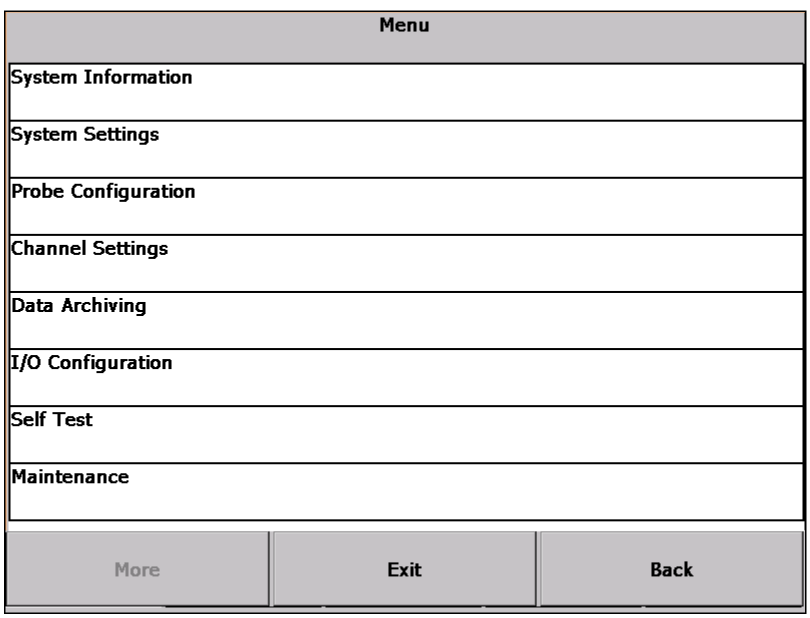


Figure 18: The Main Menu

A brief explanation of the menu system was given in the *Menu Display* on page 37 but is repeated here for convenience. Menu items are selected by touching within the box surrounding the menu. Selecting a Menu items can display either subsidiary menus or parameter editing screens allowing the system's controlling parameters to be edited.

The buttons at the bottom of the screen are the same for all menus. The **More** button is only active if the menu has more items than can be displayed on a single screen, the **Exit** button will exit the menu and return to the Main display in the normal operation and the **Back** button will return to the previous menu. When at the top menu touching the **Back** button is equivalent to touching the **Exit** button.

Entering of Parameter Values

A number of the menus lead to screens where operating parameters of the ratemeter can be edited. Some of these, e.g. Alarm Actions, see *Alarm Settings* on page 84, have dedicated screens for parameter entry and these will be fully described as they are encountered. However many of these screens are for the entry of numerical or alphanumerical parameters, or for the editing of a parameter whose values are chosen from a list of possible values. These all behave in a similar way and will be described in this section.

Figure X1 shows a typical screen for alphanumeric parameter entry, this particular example is to set the system name. The name of the parameter being edited is always displayed at the top of the screen. The current value is displayed in the text box below this. The value can be changed using the displayed on-screen keypad which is touch-sensitive. Keys in the first four rows of this keypad are standard keys, touching any of these keys will append the selected character to the end of the current value. Keys in the bottom row perform special functions. The **A->a** key switches between upper and lower case letters. The **Mode** key switches the keypad through its various modes, these are standard alphabetic character entry (as shown), accented alphabetic character entry and special symbol entry. The **1 2 3** key switches to numeric entry mode. The **<-** key deletes the last character. Touching the **Save** button saves your changes and exits from the screen. Touching the **Cancel** button will cancel any changes and return to the previous screen.

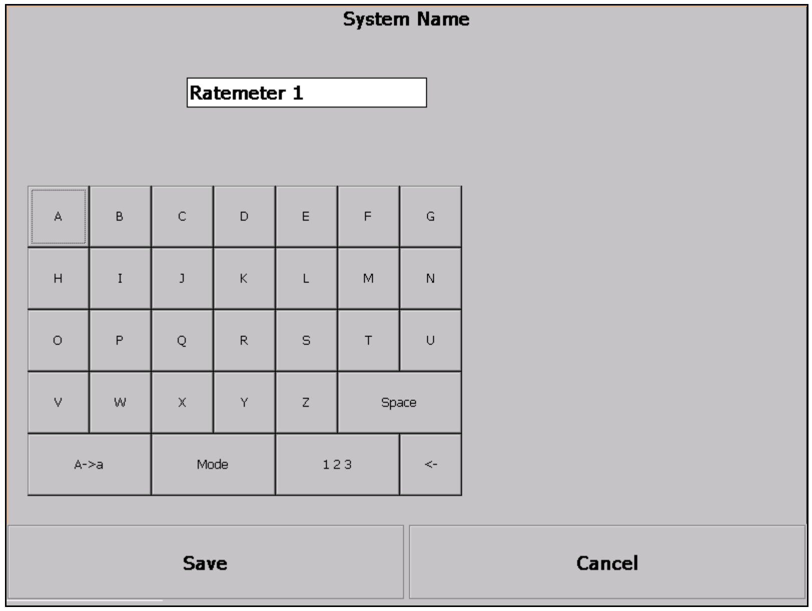


Figure 19: Alphanumeric Parameter Entry

Figure X2 shows a typical numerical parameter entry screen. This is very similar to the alphanumeric version except that the keypad is set in numeric mode and the other modes are not available (the buttons are not available).

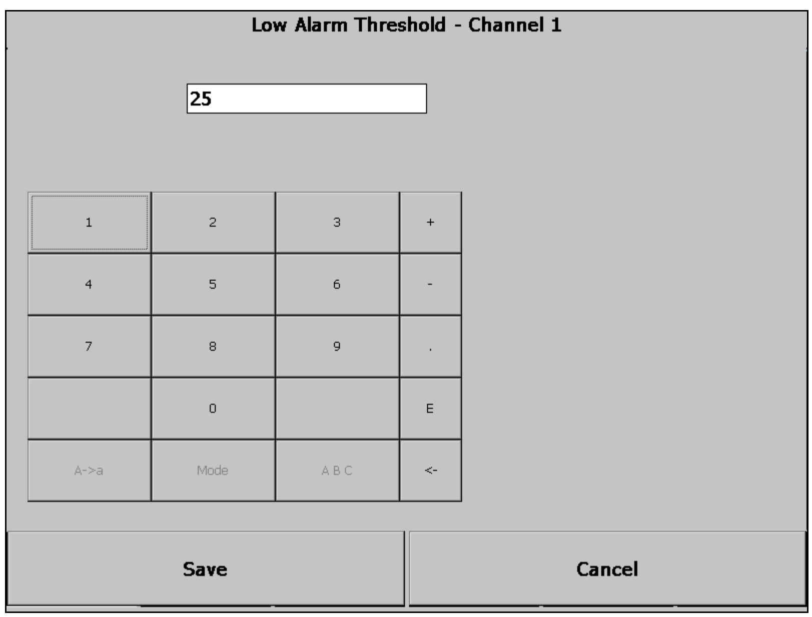


Figure 20: Numeric Parameter Entry

Figure X3 shows a typical parameter entry screen for parameters whose value is selected from a list, these are sometimes known as enumerated parameters. When the screen is first shown the currently selected parameter value is indicated by the filled circle next to it. A different value may be selected by touching the value required. Where there are more values than can fit on a screen, as in the example shown, the **More** button will be displayed at the bottom of the screen; touching this button will cycle through the various 'pages' of options. As with other similar screens touching **Save** saves and changes and returns to the previous screen, they are not intended to be indicative of real values.

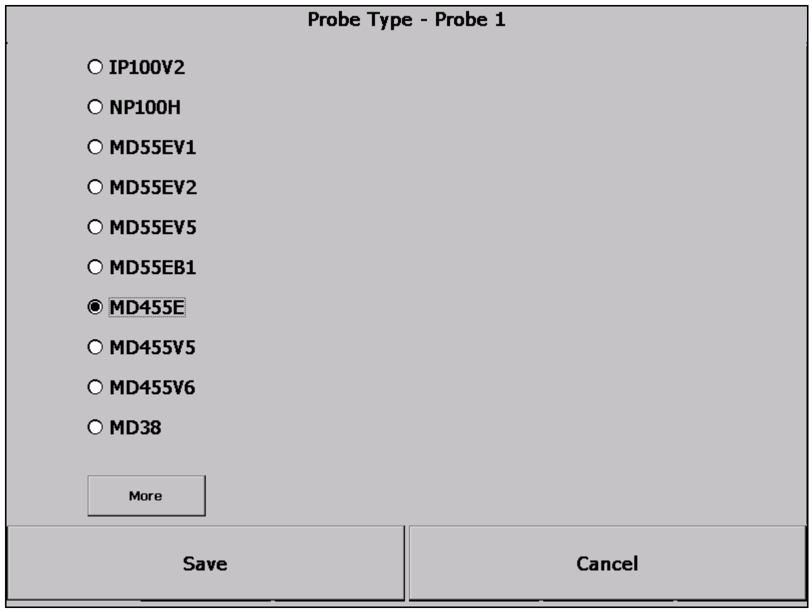


Figure 21: List Parameter Entry

System Configuration Menus

The system menu allows you to view and/or edit the operation parameters of the Ratemeter, to view and export data in the instrument's archive, to initiate and terminate self test operations and to perform maintenance functions such as updating the system software and save and restore the system configuration.

This section describes each of the configuration menus of the system. It does not describe other menus such as the Data Review and Display menu, which is described in *Data Review and Display* on page 100 or the Self Test menu, which is described in *Self Test Functions* on page 115. Note that values shown on the menu examples in this document are for illustrative purposes only, they are not intended to be indicative of real values.

System Information

Select the **System Information** menu option to display information about the system. This is unusual in that it is a read-only menu, it is not possible to change any of the values on this screen (Figure X). It contains such information as the unit serial number and the internal firmware version numbers, this information is mainly intended for service personnel. The system configuration identifier is a 'hash code' generated from the controlling parameters of the system, this serves to identify the configuration of a particular ratemeter. Any change to the parameters will change this value. Though it is not guaranteed to be unique it is very unlikely that two different parameter configurations will have the same code. Some 'trivial' parameters, such as audio volume, are excluded from this code.

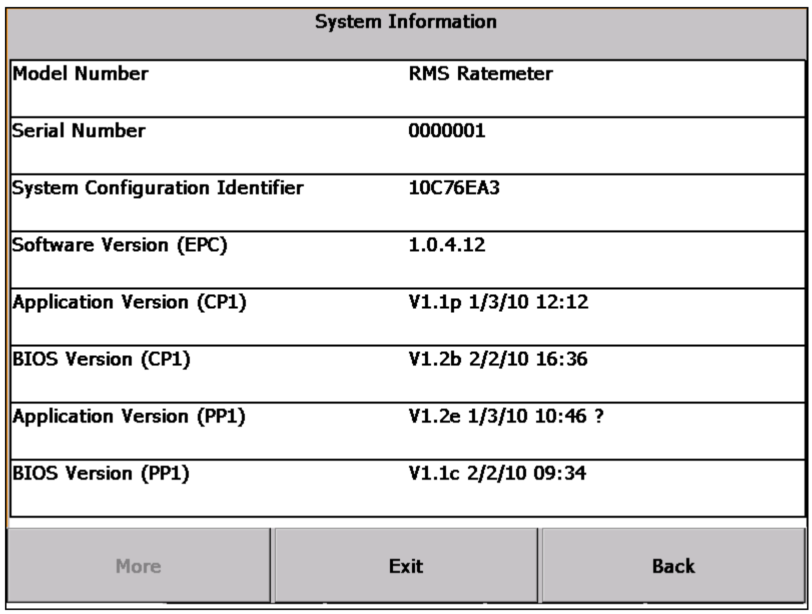


Figure 22: System information Screen

System Settings

The **System Setting** menu (Figure X) consists entirely of links to other menus which control the operation of the instrument as a whole.

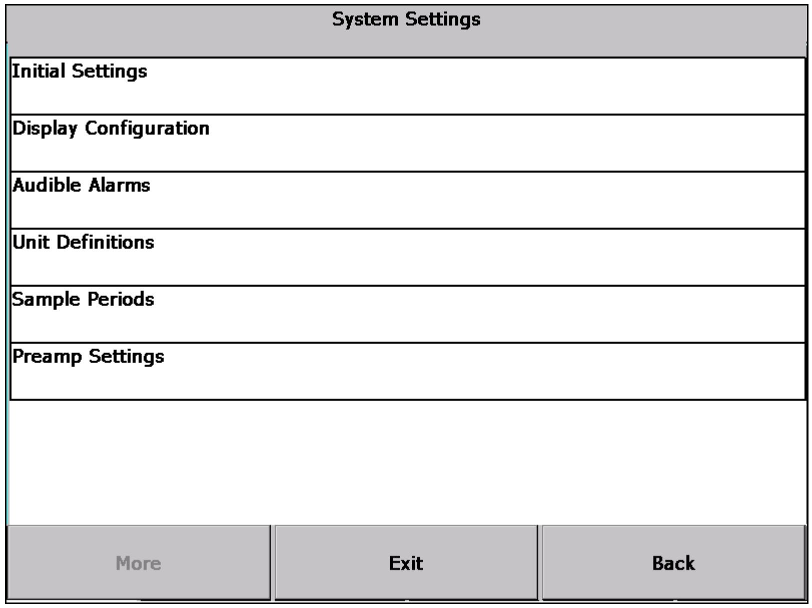


Figure 23: System Settings Menu

Initial Settings

The **Initial Settings** parameters (Figure X1) are normally only set when the instrument is first put into service this includes the system name, language, and date and time.

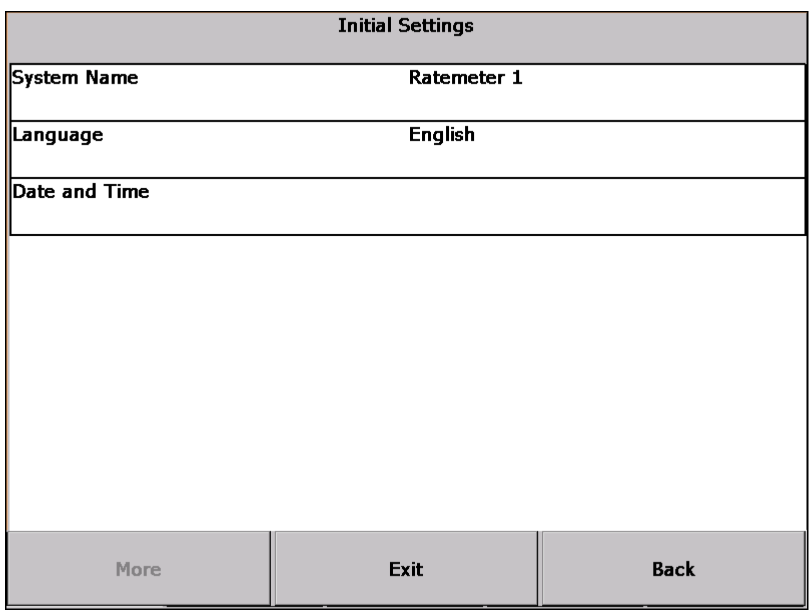


Figure 24: Initial Settings Screen

System Name

The **System Name** is the name by which the unit is known, a suitable description should be entered. Refer to *Entering of Parameter Values* on page 56.

Language

The **Language** option is determines the language to use for all displays, including menus and button captions. Select the language from the list.

Date and Time

The **Date and Time** option displays a screen (Figure X3) from where the formats used for dates and times to be set and also allows the system clock to be set. For dates the allowable options are "dd/mm/yyyy" or "mm/dd/yyyy" where "dd" represents the day of the month, "mm" the month number and "yyyy" the year. Permissible time formats are 12 or 24 hour clock systems.

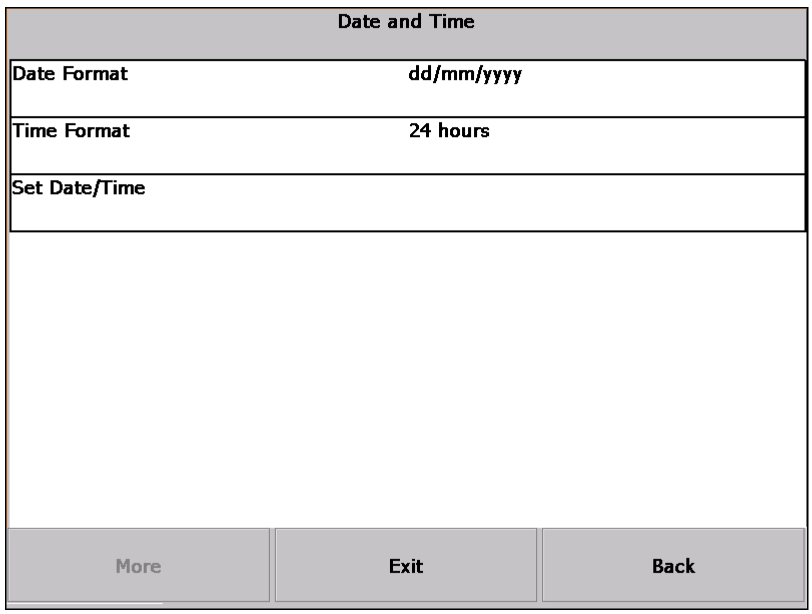


Figure 25: Date and Time Screen

Selecting the **Set Date/Time** menu item displays the Set Date/Time screen (Figure X4), where the system date and time may be set. Touching the down arrow to the right of the date will display a calendar from which the current date can be selected. To set the time first touch the field (hours, minutes or seconds) to be changed then touch the left or right arrows to decrease or increase the value respectively. The procedure for adjusting displayed time values is explained in more detail in the *Calendar Control* on page 39.

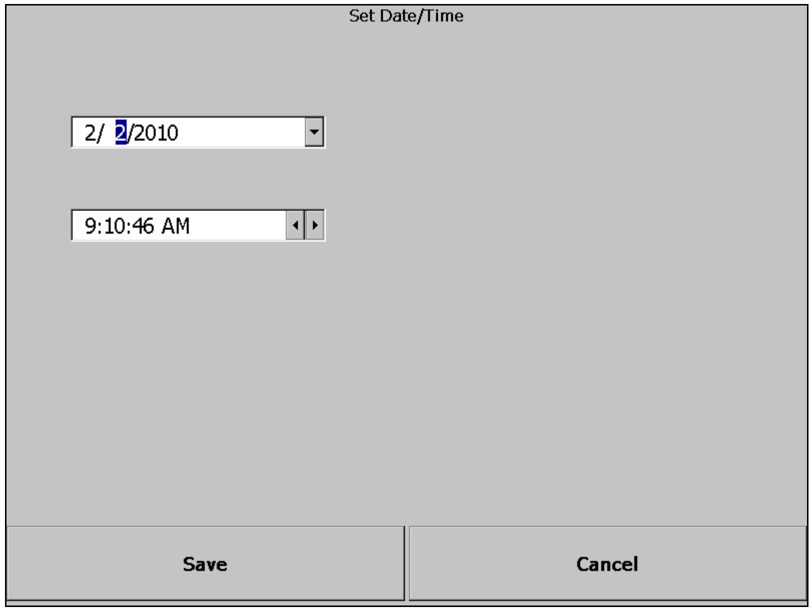


Figure 26: Entering the System Date and Time

Display Configuration

The **Display Configuration** menu option displays a screen (Figure X) which is used to set the number of display segments of the normal operating display and the colors used for the segment background and the bargraph. A touch screen recalibration may also be initiated from this screen.

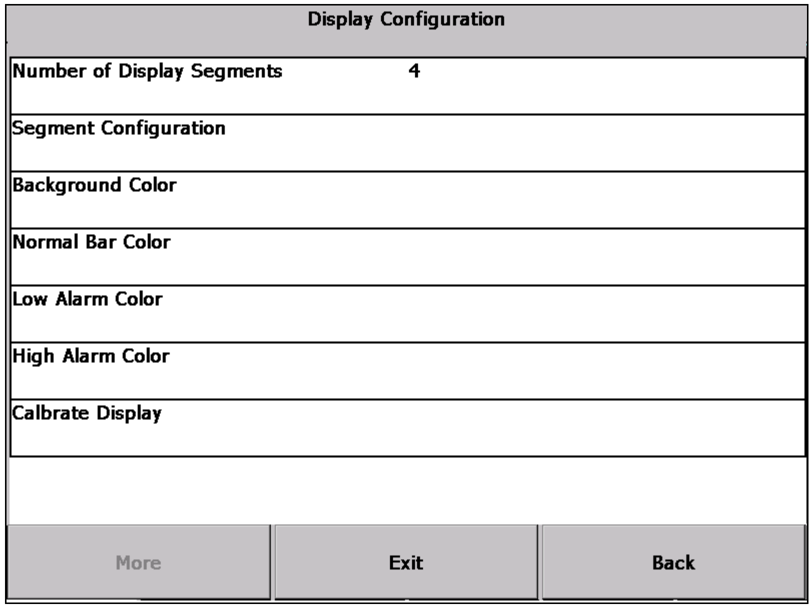


Figure 27: Display Configuration Screen

Number of Display Segments

The **Number of Display Segments** option allows the number of segments displayed on the ‘normal’ display when in multiple channel mode to be set. The choice is restricted to 1, 2, 4, 6, 8, 16, 24 or 32 segments. Refer to *Normal Display* on page 32 for more information.

Segment Configuration

The **Segment Configuration** option displays a screen (Figure X1) that allows the allocation of channels to display segments and the values to be displayed for each segment to be configured. This is a physical map of the display segments with the text in each segment indicating the channel allocated to that segment. Up to eight segments can be shown, if there are more the screen will have a vertical scroll bar to select the individual display pages.

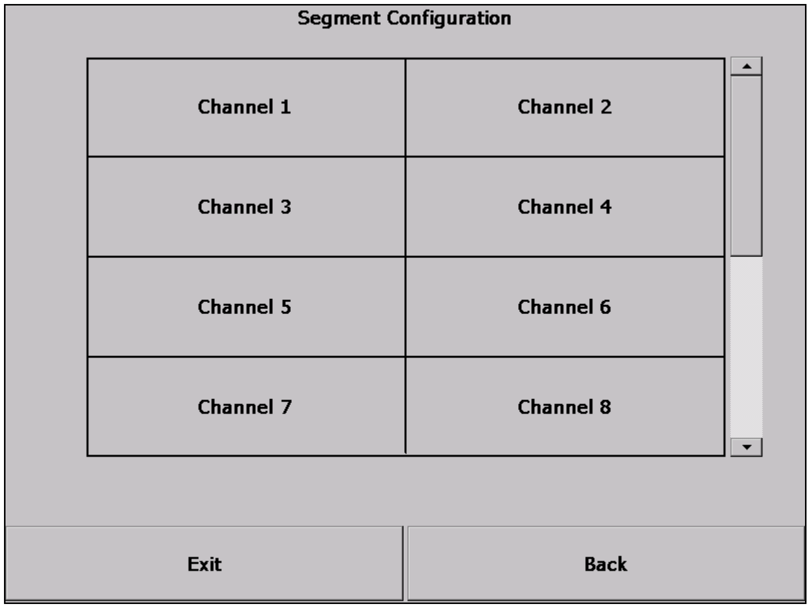


Figure 28: Segment Configuration Screen

Touching a segment within this screen will display the configuration screen for that segment, see Figure X2.

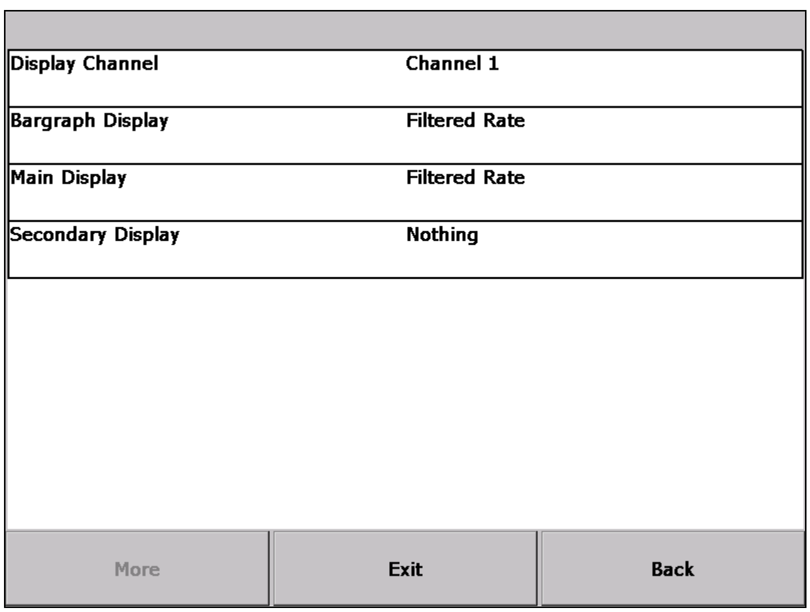


Figure 29: Segment Settings Screen

The **Display Channel** menu item allows the channel to be displayed in this segment to be selected; any one of the 32 channels may be chosen. Allocation of the same channel to more than one segment is permitted.

The remaining items on this menu allow what value is displayed for the Bargraph, Main Display and Secondary Display. The options are ‘Filtered Rate’, ‘Unfiltered Rate’, ‘Totals’ or ‘Nothing’. If ‘Nothing’ is selected then the associated element is not displayed at all.

Color Options

Background Color

The **Background Color** option displays a screen (Figure X) that sets the background color of the segments. The square in the top right area (blue in the example shown) shows the currently selected color. The color may be adjusted by touching and dragging the red, green and blue sliders, to control the red, green and blue components of the color; the numerical value of each slider, in the range 0 – 255 is shown to its right. Alternatively touching one of the color swatches below the sliders will select that value.

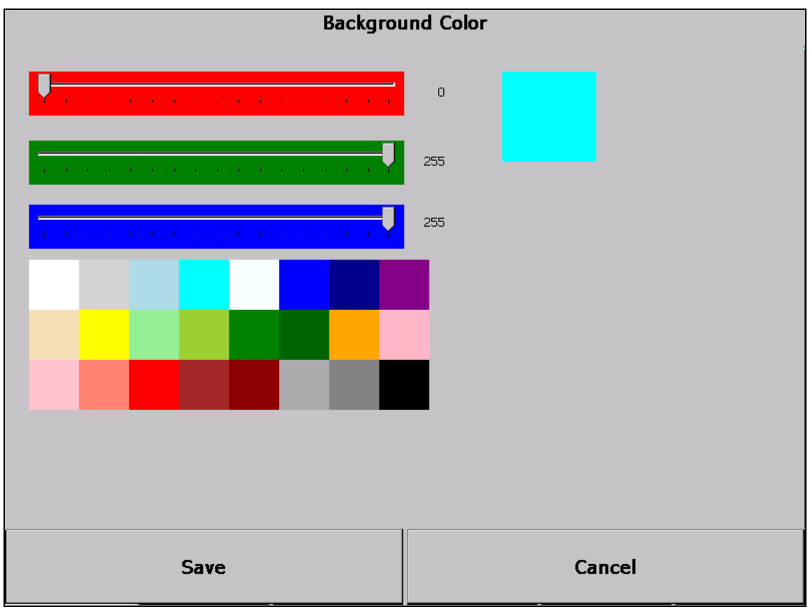


Figure 30: Background Color Settings

Alarm Color

The Normal Bar Color, Low Alarm Color and High Alarm Color options set the color of the bargraphs when the associated channel is in a no alarm, low alarm or high alarm state respectively. Colors are set in the same manner as for the background color.

Calibrating the Display

The **Calibrate Screen** option performs a calibration of the touch sensitive mechanism of the screen. The screen of the system will have been calibrated initially but this operation should be performed if the screen calibration becomes inaccurate as evidenced by the unit not recording screen touches correctly. Follow the instructions displayed on the screen (Figure X). You will be asked to touch the centre of a cross displayed in various locations on the screen, then to check the calibration by moving a pointer round the screen with your finger. Finally, if satisfied with the calibration you should touch **Save** to save it or **Re Calibrate** to repeat the operation. When performing the calibration take care to touch the centre of the displayed cross as precisely as possible or the calibration will be inaccurate.

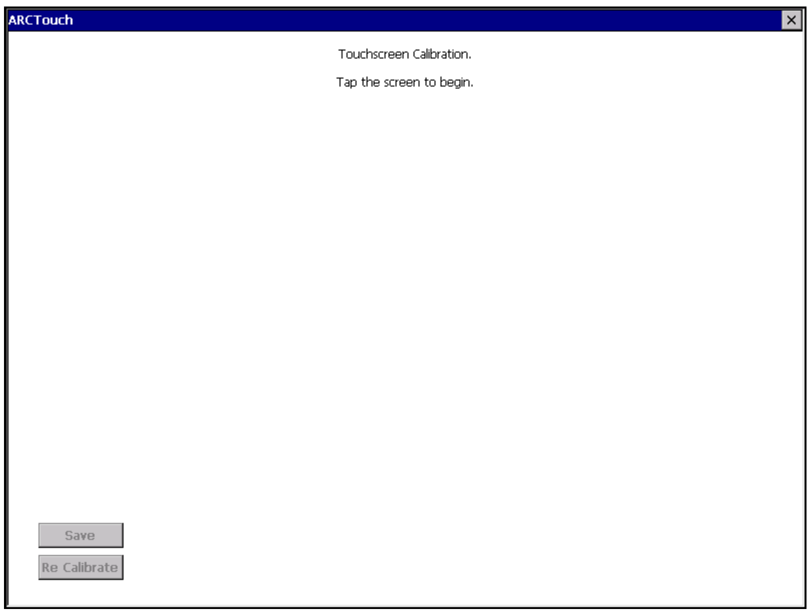


Figure 31: Screen Calibration

Audible Alarms

The **Audible Alarms** menu option displays a screen (Figure X1) which is used to set the audio volume and the sounds to be generated for an alert and an alarm.

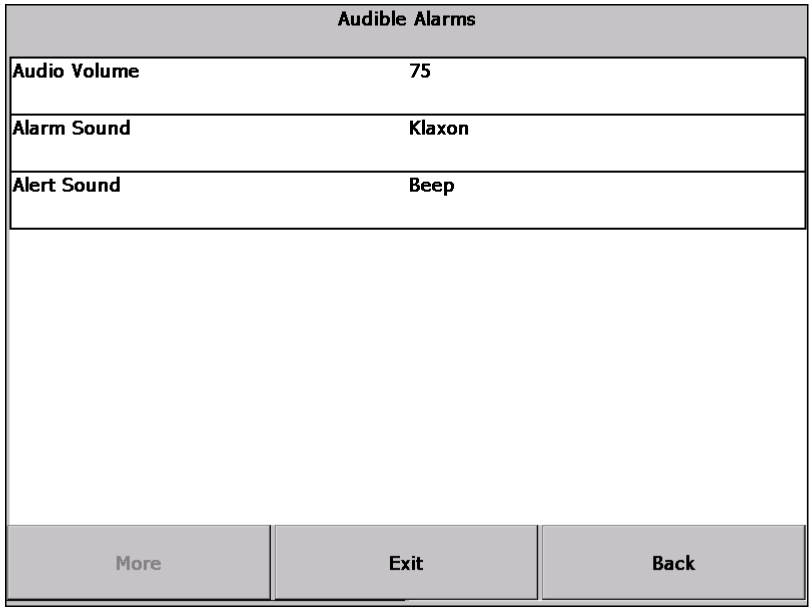


Figure 32: Audible Alarms Screen

The Audio Volume option uses a slider control to set the volume, see Figure X2. As the slider is dragged to the desired setting, the volume is displayed numerically on a scale of 0 – 100. The sounds are selected from a ‘library’ of possible sounds; this library will be factory-configured to suit various international markets.

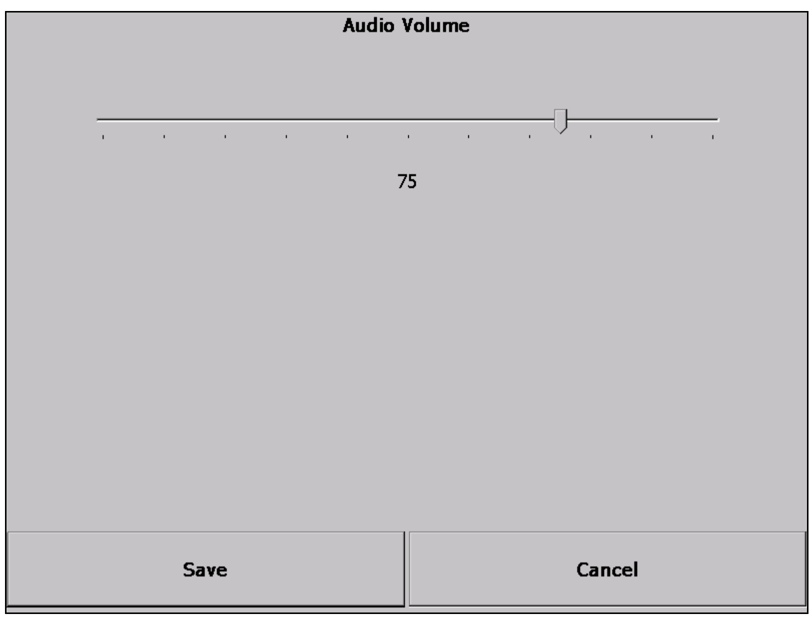


Figure 33: Audio Volume Adjust Screen

Note that this option only specifies the sounds to be generated for an alert or an alarm. It does not specify which, if any, of these sounds is generated for a particular alarm on a particular channel, this is specified in the Alarm Settings menus, refer to *Alarm Settings* on page 84. Though the instrument is often configured such that a low alarm generates an alert audible warning and a high alarm generates an alarm audible warning this is not a requirement, any alarm can generate either sound or no sound at all.

Unit Definitions

The **Unit Definition** menu option selects the **Units Editor** which is used to edit the units used to display the various measured values.

Before describing how the unit editor works it is useful to have and understanding of how units are handled in the iR7040 ratemeter. Each probe or other data source has a fundamental unit that it reports its values in. For a radiation probe this is frequently μSv/h or cps; for an analog input it might be volts. These units can be converted for display by the application of a scaling factor and offset, for example mSv/h might be converted to mrem/h by applying a factor of 0.1 or, for a analog input connected to a flow meter, volts could be converted to liters/min by applying conversion factors dependent on the scaling of the flow meter. The previous applies to the instantaneous values from an input.

Totalized values can also be displayed for all inputs; these are obtained by summing the instantaneous value over time. For instance for a probe measuring radiation dose rate the totalized value would be a total dose, for an analog input connected to a flow meter the instantaneous value would be flow rate and the totalized value total would be total volume. Separate scale and offset factors for each unit are used to convert these totalized values into meaningful units for display. Internally the totalized values are obtained by summing the instantaneous value every second, therefore if the instantaneous values are defined on a different time scale, e.g. μSv/h then the scaling factor for the totalized unit has to take this into effect. For example the scaling factor for converting summed values measured in μSv/h to give an output in μSv/h is 1/3600 or 2.77777 x 10-4 since there are 3600 seconds in an hour.

In addition units can be defined as auto-scaling units. For an auto-scaling unit an appropriate metric prefix, e.g. M, k, m, μ, n, p, is added to the front of the unit name and the appropriate scaling factor applied, so as to render the value in a convenient form, e.g. if the measured value from a probe was 0.000123 Sv/h and auto-scaling was in use then this would be displayed as 123 μSv/h. Auto-scaling is normally only appropriate for metric units, it is almost never used with imperial units.

Therefore to completely define a unit we have eight parameters and these are described in Table 26.

Table 29 Measurement Unit Parameters

Parameter	**Example**	**Description**
Name	Sv/h	Name of the (instantaneous) unit.
Scale Factor	1.0	Scaling factor for the instantaneous unit.
Offset	0.0	Offset for the instantaneous unit.
Auto-scale	Yes	Should unit be auto-scaled (yes or no).
Totals Name	Sv	Name for the totalized value unit.
Totals Scale Factor	2.7778E-04	Scaling factor for totalized value unit.
Totals Offset	0.0	Offset for the totalized value unit.
Totals Auto-scale	Yes	Should totalized value unit be auto-scaled (yes or no).

The ratemeter comes with a number of such units pre-defined; these are referred to as system units and cannot be changed or deleted by the user. Using the Unit Editor a user can define their own units. The Units Editor (Figure X1) can also be used to examine, but not change, the definition of system units.

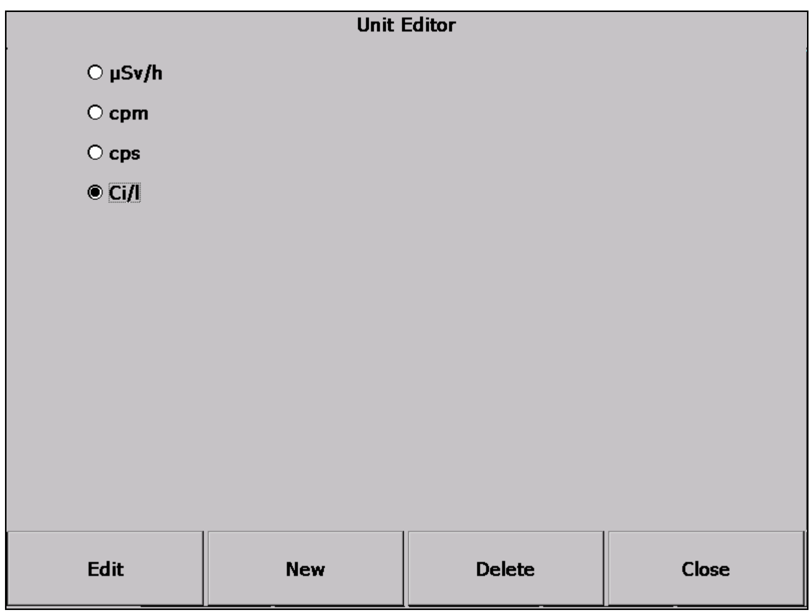


Figure 34: The Units Editor

The current set of units is listed down the left hand side of the screen. A filled circle indicates the unit which is selected for editing etc. Note that the screen changes slightly depending on whether a system or non-system unit is selected. In the example shown a non-system unit is selected therefore the left -most button is labeled **Edit** and the **Delete** button is enabled. When a system unit is selected the left-most button will be labeled **View**, since system units can only be viewed not edited, and the **Delete** button will be disabled.

Touching the **Edit/View** button will display the definition for the currently selected unit, see Figure X2. The parameters for the unit are as shown in Table 8. If the unit is a non-system unit then these parameters will be editable; touching any parameter will bring up the editing screen. Touch **Save** to save any changes and return to the Unit Editor screen, touch **Cancel** to exit without saving anything.

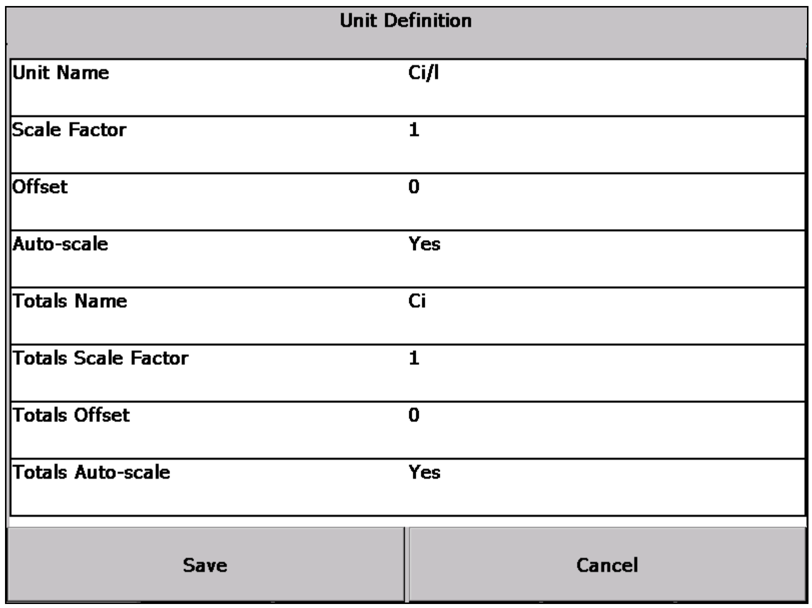


Figure 35: Unit Definition Screen

To create a new unit touch the **New** button on the Unit Editor screen. A screen similar to Figure X2 will be displayed with default values for all unit parameters, these parameters should be changed as appropriate and the definition saved. Creating two units with the same name is permitted but is likely to cause confusion and is not recommended.

To delete a (non-system) unit first select the unit then touch the **Delete** button. Problems can occur if a unit that is currently being used for any channel is deleted, therefore the instrument will check if this is so before deleting the unit. If the unit is in use then a warning will be displayed and the unit will not be deleted.

To return to the System Settings menu touch the **Close** button.

Sample Periods

The **Sample Periods** menu option displays a screen (Figure X) which is used to set the sampling periods used on the system. There are two of these. The **Acquisition Interval** parameter controls how often readings are taken from a probe or other input and displayed on screen, permissible values are 0.5 s and 2 s; normally 2 s should be sufficient. The **Archive Interval** parameter controls how often values are written to the instrument's archive store, permissible values are 2 s, 10 s and 1 min. At then end of each period the average value for the channel during that period is written to the archive. The shorter the period the more data are written to the archive and therefore the faster this fills up. An interval of 1 min is recommended for normal operation, shorter values should only be set when there is a need to follow fast-changing inputs.

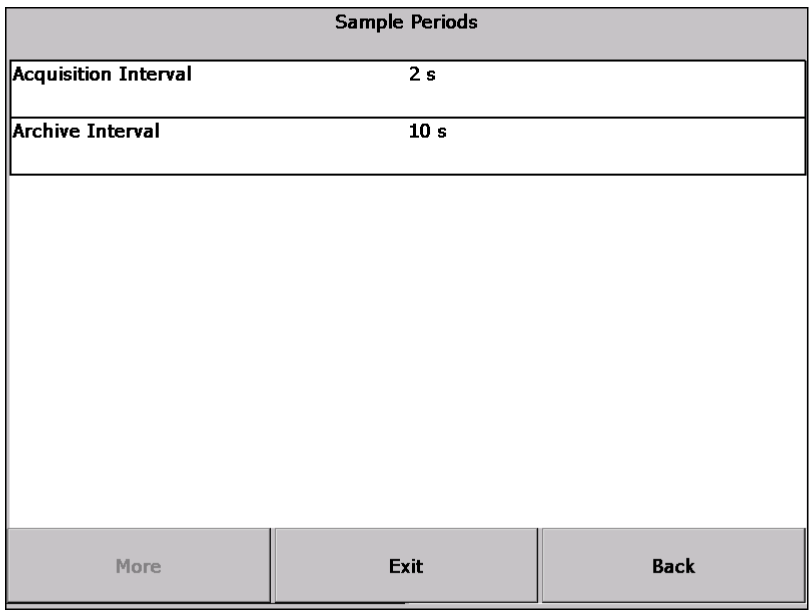


Figure 36: Sample Periods Screen

Preamp Settings

The **Preamp Settings** menu option controls settings for an optional PA300E preamplifier. The iR7040 ratemeter can support one such preamplifier. The preamplifier has three internal channels (these should not be confused with ratemeter channels), each of these channels connects to a probe input on the instrument. Probe connectors 1, 2 and 3 should be used.

Selecting this option displays a selection screen (Figure X1) to select which of the preamp channels is to be configured. Note that, though there can only be one preamp on the ratemeter this screen identifies the preamp as “Preamp 1”; this is because the same firmware is used on the sister instrument, the rack mounting ratemeter and this can have two preamps.

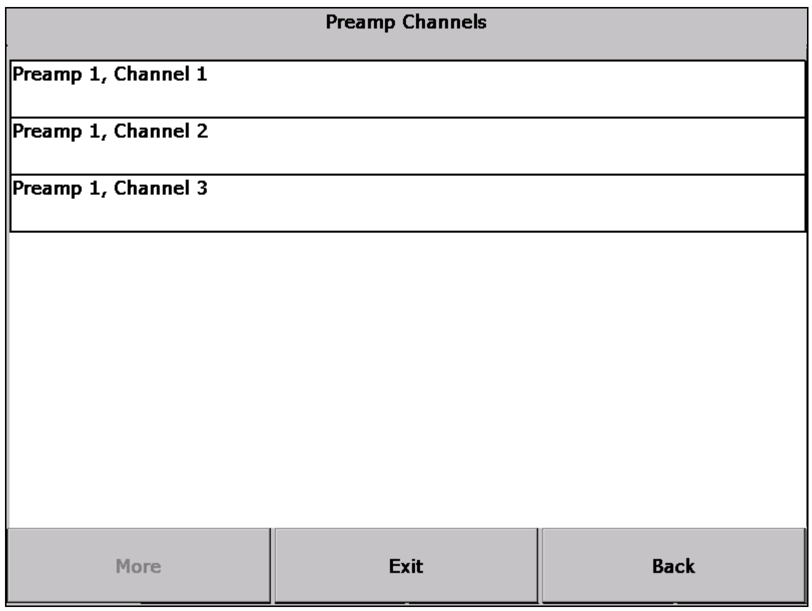


Figure 37: Preamp Channel Selection Screen

Selecting a preamp channel from this screen will display the settings for this channel. This screen can be displayed in two modes, depending on how you choose to specify the channel boundaries that control the channel; these can either be specified as low and high channel limits, Figure X2, or as a centre channel and a width, Figure X3. The mode is selected by the first option on the menus. Note that the data are identical between the two options; two options are provided as some users find it easier to working a particular way.

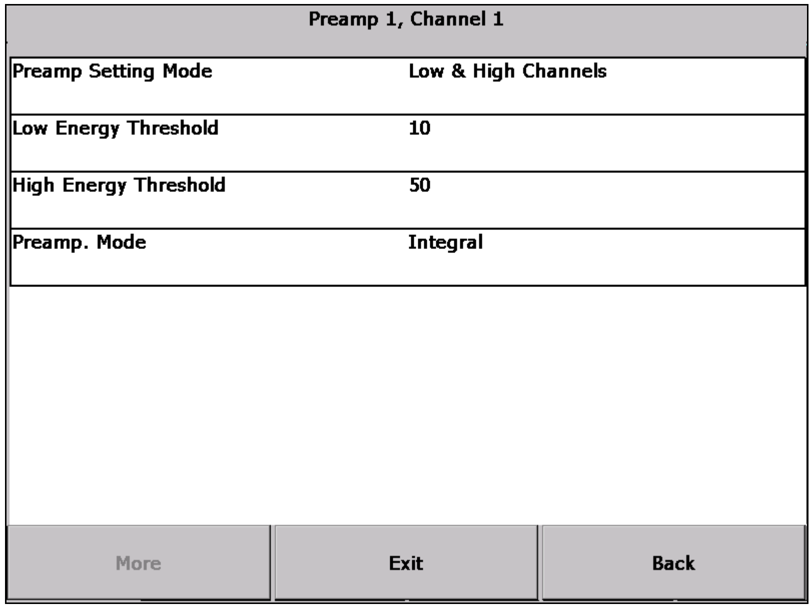


Figure 38: Preamp Settings, Low & High Channel Mode

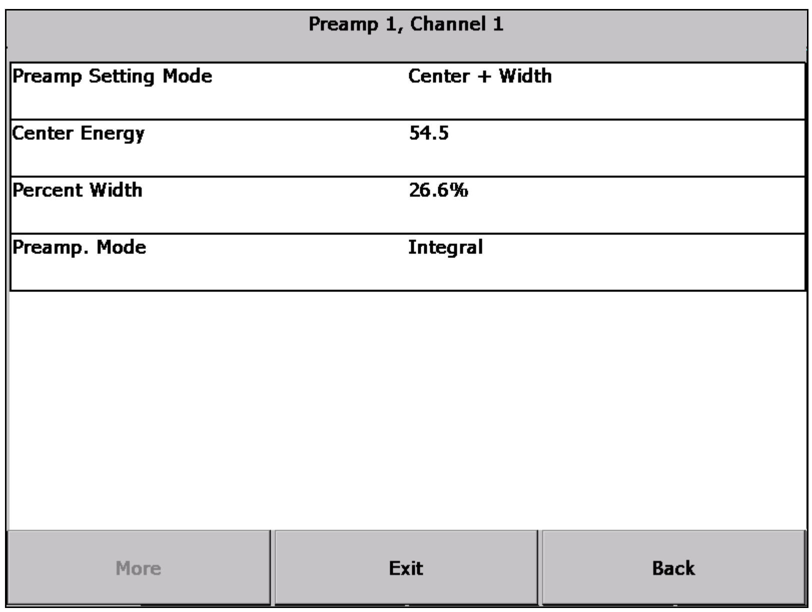


Figure 39: Preamp Settings, Center + Width

The channel limits, however specified, set the energy boundaries of the region. The Preamp Mode can be set to be *Integral* or *Differential*. In *Differential* mode the instrument will count only those events which are between the lower and upper channel limits, in *Integral* mode the system counts all events above the lower boundary and the upper limit is ignored.

Probe Configuration

The **Probe Connections** menu controls settings that affect the radiation measuring probes connected to the ratemeter. An iR7040 can have up to four such probes and choosing this menu option will display a probe selection screen (Figure X1).

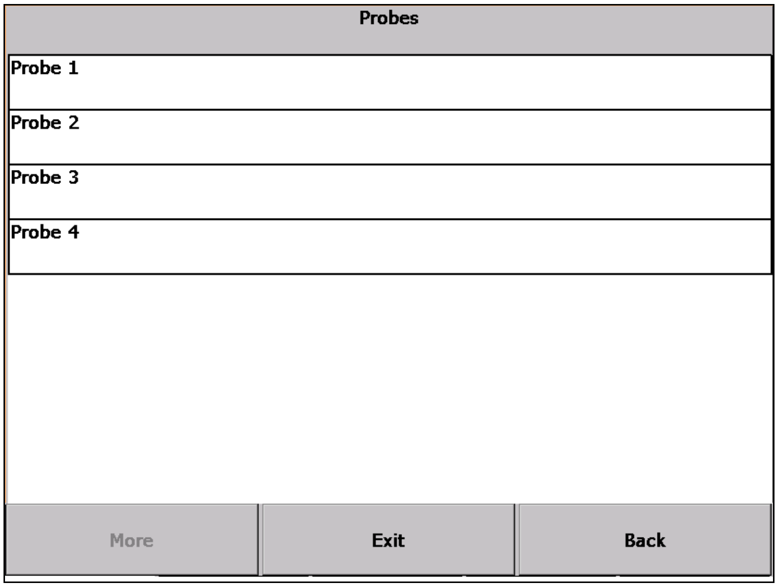


Figure 40: Probe Selection Screen

Selecting a probe from this screen will display the **Probe Settings** screen (Figure X2) for that probe.

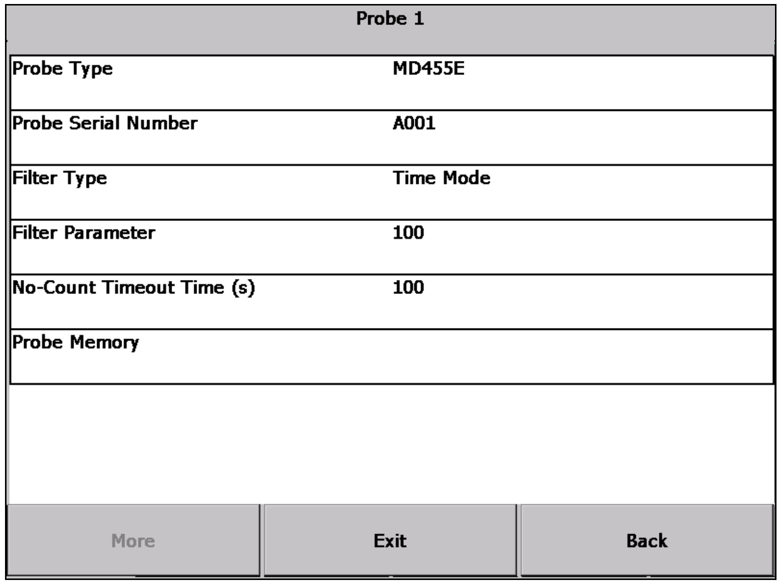


Figure 41: Probe Settings Screen

The **Probe Type** specifies the type of probe connected to the input. See the table in *Probes* on page 1 for a list of supported probes. In addition to the probes listed in this table the probe type may also be set to *None* if no probe is connected; any unused probe inputs should be set up this way. If the probe type is set to *None* then all other settings are ignored.

The **Probe Serial Number** provides a way to record the serial number of the connected probe, note that this needs to be entered manually; currently, the instrument cannot itself determine the serial number of a connected probe.

The **Filter Type** and **Filter Parameter** control the operation of the filter used to smooth out fluctuations in probe readings. Interpretation of the filter parameter depends on the filter type chosen. Filter types and associated parameters are described in Table 27.

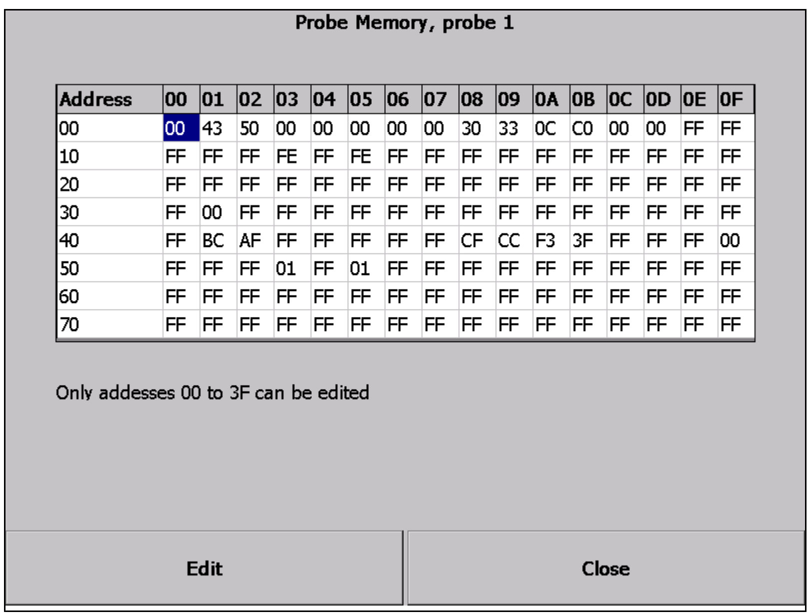
Table 31 Filter Types

Type	Filter Parameter	Description
None	Not used	No filtering.
Time Mode	Number of bins	Time mode, also known as 'boxcar' filtering. Samples are placed in a series of time bins, the number of bins is set by the filter parameter and the width of the bins is set by the acquisition interval, see *Sample Periods* on page 71. The

		output of the filter is the average of the bins.
Exponential	Not Used	An adaptive algorithm that mimics a simple R-C filter. The filter parameter is not used in this mode.
Statistical	Required % accuracy (1, 3 or 10).	Similar to time mode filtering except that the number of bins is selected by the instrument to meet the specified statistical accuracy. This requires more bins at low count rate and fewer bins at higher count rates. The filter parameter is not used in this mode.

The **No-Count Timeout** parameter specifies a period, in seconds, that the instrument waits before deciding that the probe is not counting, i.e. if no counts are received from the probe in this period then the instrument will decide that the probe is not counting and will raise a warning. This helps detect probes that have become disconnected or have otherwise gone faulty. The period should be set dependent on the lowest expected count rate from the probe, allowing for statistical variations in the count rate. If false warnings of probe zero counts are indicated then the value should be increased.

The **Probe Memory** option allows the EEPROM memory internal to the probe to be viewed and edited. Figure X3 shows the **Probe Memory Editor** which is displayed when this option is selected.



Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
00	00	43	50	00	00	00	00	00	30	33	0C	C0	00	00	FF	FF
10	FF	FF	FF	FE	FF	FE	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
20	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
30	FF	00	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
40	FF	BC	AF	FF	FF	FF	FF	FF	CF	CC	F3	3F	FF	FF	FF	00
50	FF	FF	FF	01	FF	01	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
60	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
70	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF

Figure 42: Probe Memory Editor

The table displayed shows the current value, in hexadecimal, of every byte within the probe memory, the address being specified by the sum of the row and column addresses, thus the highlighted byte in the example shown is at address 00 and the bottom right byte would be at address 7F. The interpretation of the various memory bytes depends on the probe and is outside the scope of this document; see the individual probe documentation for details. Values can be edited by first selecting the byte to be changed by touching it within the table then touching the **Edit** button, which will display a standard alphanumeric edit screen where the value can be changed as required. Caution is required when editing probe memory contents as some changes could adversely affect the operation of the probe, it is therefore recommended that this option is only used by CANBERRA service technicians or under directions from CANBERRA.

Only addresses 0 to 3F can be edited. Addresses 40 to 7F are automatically written by the ratemeter with the complement of the equivalent address contents in the range 0 to 3F. When reading the Probe memory, the ratemeter can determine if a value is corrupt and flag a fault accordingly.

Channel Settings

The **Channel Settings** menu controls the settings for the 32 virtual data channels within the ratemeter. This menu provides a textual description of the channel, this is displayed on the appropriate segment of the Main screen when a channel is displayed. The channel type defines the type of the channel, Units allows the units to be used to display the channel to be selected. Resources are the various probes and analogue inputs and outputs needed to define a channel. Refer to *Channels* on page 2 for an introduction to the concept of these virtual data channels.

Selecting this option from the main menu the ratemeter will display a list of the channels, see Figure X1. Use the **More** button on this screen to access channels 9 – 32.

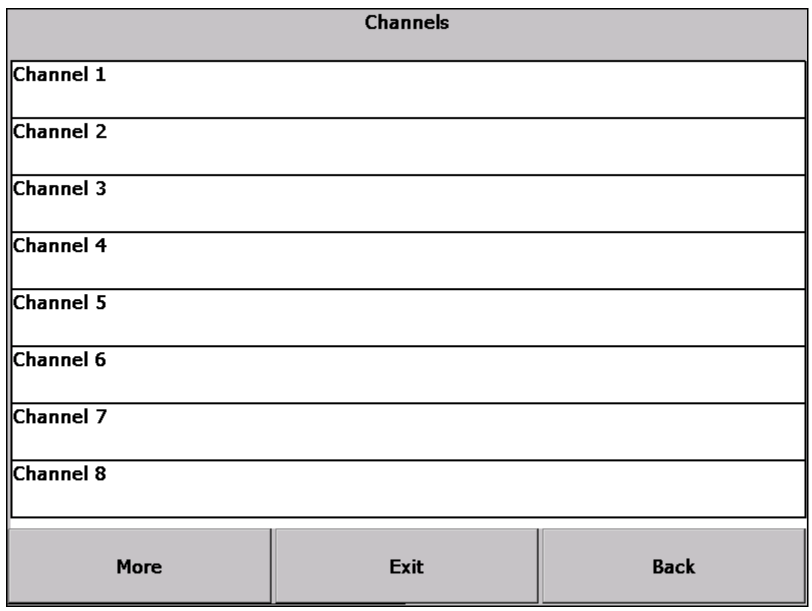


Figure 43: Channel Selection Screen

Selecting a channel will display the Channel Configuration screen (Figure X2) for that channel. Alternatively this screen may be displayed for a particular channel by touching the **Configure** button when that channel is displayed in single channel mode, refer to *Single Channel Display* on page 34.

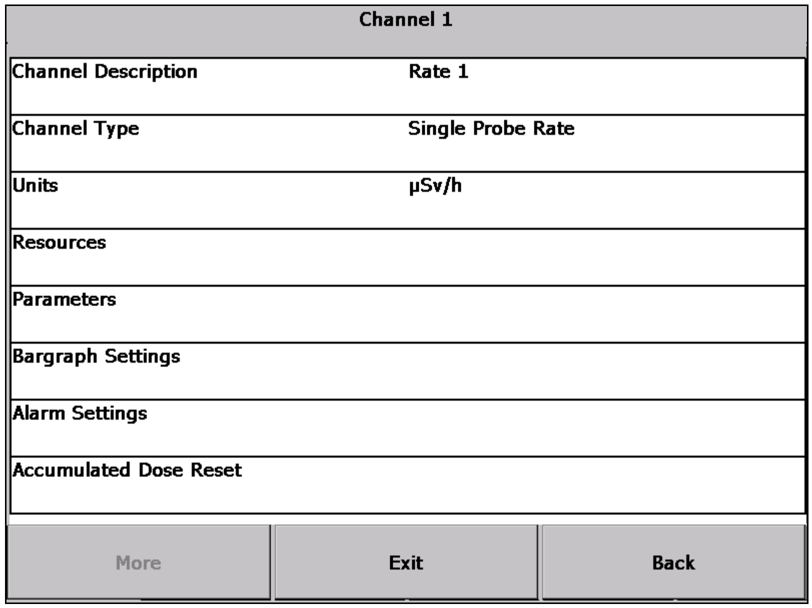


Figure 44: Channel Settings Screen

Channel Description

Select the **Channel Description** option to enter a textual description for the channel, the text entered here will be displayed on-screen whenever the channel is displayed.

Channel Type

The **Channel Type** option allows the channel type to be set. Table 28 lists the possible channel types and the resources (e.g. probes, analogue inputs and outputs) and parameters they use. For more information refer to *Resources* on page 81 and *Parameters* on page 82 respectively.

Table 33 Channel Types

Channel Type	Description
Single Probe Rate	Count rate and totals from a single probe. The probe number should be specified as the primary probe.
Single Probe Rate of Rise	The rate of change of a probe rate is calculated.
Analogue Input	Displays the value read from one of the instrument's analogue inputs. Input number specified by Primary Analogue Input.
Probe Analogue Input	Displays the value read from the analogue input associated with a probe. Probe number specified by Primary Probe number.
Fixed Analogue Output	Outputs a constant analogue value (voltage and current). Output specified by Analog Output number and value to set by parameter K_s.
Variable Analogue Output	Outputs an analogue value (voltage and current) depending on an analogue input multiplied by a constant. Output is specified by the Analog Output, input is the Primary Analog Input and parameter K_s sets the multiplier used.
Digital Inputs	Not currently implemented.
Fixed Digital Outputs	Not currently implemented.
Pump Control Module	Not currently implemented.
Sample Control Module	Not currently implemented.
Tape Control Module	Not currently implemented.
Algorithm A (Net Iodine)	Net Iodine calculation. Uses primary and secondary probes and parameter K_s.
Algorithm B (Net Particulate)	Net particulate calculation. Uses primary and secondary probes and parameter.
Algorithm C (Net noble gas)	Net noble gas calculation. Uses the primary and secondary probes, the primary analogue input and parameters K_s and Kv_s.
Algorithm G (Iodine concentration, moving filter)	Iodine concentration calculation using a moving filter arrangement. Uses the primary and secondary probes and parameters K_s, Kc_s and Kc_0.
Algorithm H (Iodine concentration, fixed filter)	Iodine concentration calculation using a fixed filter arrangement. Uses the primary and secondary probes, the primary analog input and parameters K_s, Kc_s and Kc_0, K_d

Table 33 Channel Types

Channel Type	Description
	and K_u.
Algorithm I (Particulate concentration, moving filter)	Particulate concentration calculation using a moving filter arrangement. Uses the primary and secondary probes and parameters K_s, Kc_s and Kc_0.
Algorithm H (Particulate concentration, fixed filter)	Particulate concentration calculation using a fixed filter arrangement. Uses the primary and secondary probes, the primary analog input and parameters K_s, Kc_s and Kc_0, K_d and K_u.
Algorithm K (Noble gas concentration)	Noble gas concentration calculation. Uses the primary and secondary probes, the primary analogue input and parameters K_s, Kv_s, Kc_s and Kc_s.

Units

The **Units** option specifies the units to be used to display measured values. Selecting this option lists all the units known to the system, both system and user-defined. More information on units can be found in *Unit Definitions* on page 68.

Resources

The **Resource** menu option displays a screen (Figure X) which controls the various hardware resources, i.e. probes, analog inputs and analog outputs, associated with a channel. The use of the various inputs depends on the channel type, see Table 10. Probes are selected from probes 1 to 4, Analog Inputs from analogue inputs 1 to 5 and the Analog Output from analogue outputs 1 to 6. Each of these also has an option of *None* and this should be selected where the resource is not required. Note that it is not an error to use a particular probe or analog input in more than one channel definition, but it would be an error to use the same analog output for more than one channel.

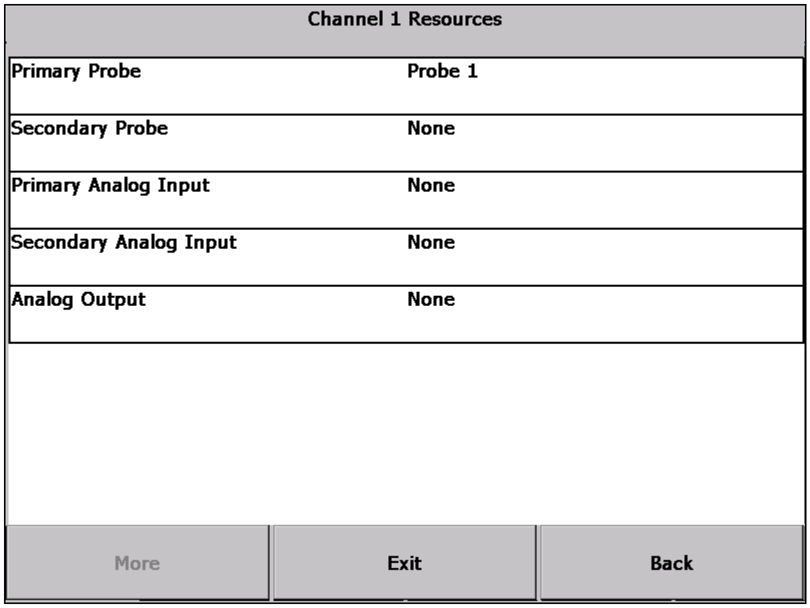


Figure 45: Channel Resources Screen

Parameter

The **Parameters** menu option displays a screen (Figure X) which holds the values for various numerical parameters that are used by some of the channel calculation algorithms. See Table 10 for details of what channel types use what parameters.

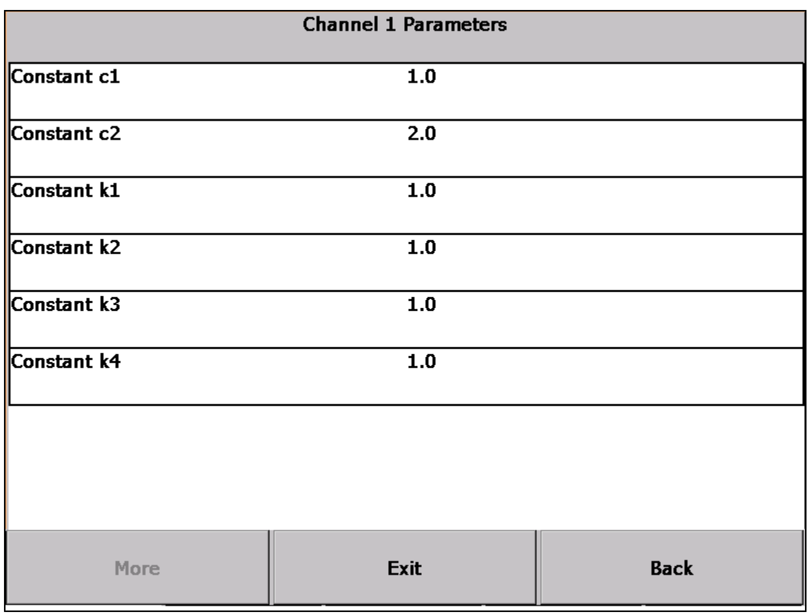


Figure 46: Channel Parameters Screen

Bargraph Settings

The **Bargraph Setting**s menu option displays a screen (Figure X) which controls the scale and scaling mode for the bargraph for the channel.

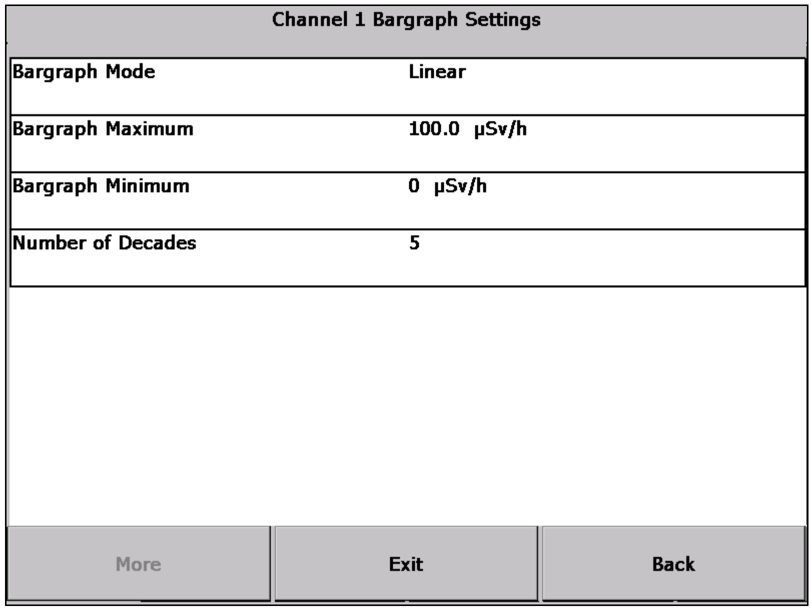


Figure 47: Bargraph Settings Screen

The **Bargraph Mode** may be set to *linear* or *logarithmic* as desired. For both linear and logarithmic bargraphs the **Bargraph Maximum** value should be set as appropriate for the expected values. For logarithmic bargraphs the maximum is traditionally set to a power of 10, however this is not a requirement. The **Bargraph Minimum** value is only appropriate for linear bargraphs, it will be ignored if the bargraph mode is set to logarithmic. On the other hand, the **Number of Decades** is only appropriate for logarithmic bargraphs. If the maximum scale of a logarithmic bargraph is not set to a power of ten then the bargraph will cover somewhat less than the full number of decades specified.

Alarm Settings

The **Alarm Settings** menu option displays a screen (Figure X) which is used to specify the conditions which lead to an alarm being raised and the actions to take when the alarm is raised. The menu has two identical sections for the low and high alarms.

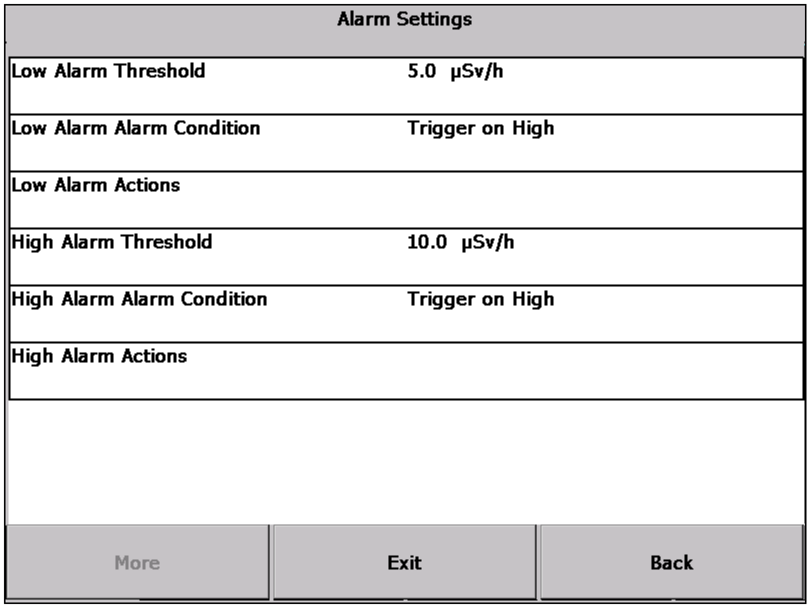


Figure 48: Alarm Settings Screen

Alarm Thresholds/Conditions

The Threshold specifies the value of the measured value at which the alarm occurs. The condition specifies the condition which triggers the alarm, Table 29 shows the possible conditions.

Table 35 Alarm Conditions

Condition	Description
Trigger on Low	Alarms when the filtered instantaneous (i.e. rate) value is below the specified threshold.
Trigger on High	Alarms when the filtered instantaneous value is above the specified threshold.
Trigger on Total	Alarms when the totalized value is above the specified threshold.

Alarm Actions

The **Alarm Actions** options allow the actions to be taken when the alarms occur to be specified. Figure X shows the screen displayed when these options are selected, the example is for the Low Alarm Action, but the High Alarm Action screen is of identical form. Using this screen you can specify which relay output(s), digital output(s), LEDs, beacons and sounds are set when the alarm occurs. You can also specify if the alarm is a latching alarm or not.

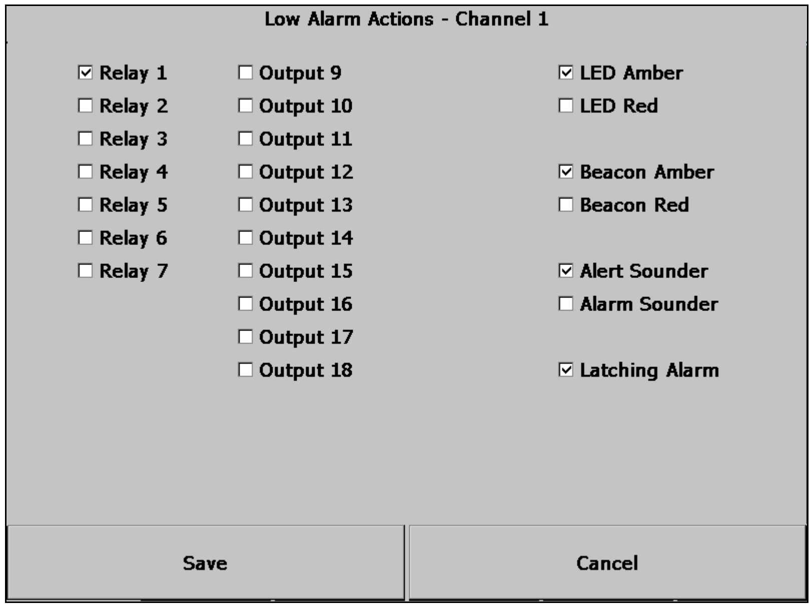


Figure 49: Alarm Actions Selection Screen

The alarm system is very flexible. Relays, digital outputs, LEDs, beacons and sounds can be allocated to multiple alarms and the associated condition will be set when any of the allocated alarm conditions is true. For example, it is possible to allocate one relay to be set if any channel goes into a low alarm condition and another to be set when any channel goes into a high alarm condition. Alternatively a separate relay could be allocated to each channel, subject of course to the number of relays available. The optional beacon can display both a red and amber lamp at the same time, however the front panel LED can only show a single color, therefore a priority system is used where an alarm that calls for a red lamp to be lit takes priority over one that calls for an amber one. Similarly the sounder can only generate one sound at once; in this case a High Alarm sound takes priority over a Low Alarm sound.

Alarms can be configured as latching or non-latching. For a non-latching alarm the alarm state is only maintained while the alarm condition is true; for a latching alarm the alarm state is set as soon as the alarm condition is true and is then maintained until it is cleared by the user using the Alarm Status display. Refer to *Alarm Status Display* on page 37 for more information.

Relays may be configured so that they are energized on an alarm condition or de-energized on an alarm condition, however, since this affects all uses of a relay, this option is not set by this menu, instead it is a part of the I/O Configuration menu. Refer to *I/O Configuration* on page 87 for more information.

Accumulated Dose Reset

The **Accumulated Dose Reset** menu option displays a screen (Figure X) which allows the automatic reset of the accumulated (i.e. summed) values to be set up. These values typically represent a dose, though this is not necessarily so, for instance for a channel reading flow rates from a flow meter the accumulated value would represent total volume. The values can be reset at a specified time, either every day or on a specified day of the week. Note that this reset is specific to the channel being configured; if it is desired to reset all channels at the same time then each will have to be configured individually. Manual reset of the accumulated values is not performed using this menu, instead the **Reset Total** button on the button bar is used. Refer to *Single Channel Display* on page 34 for more information.

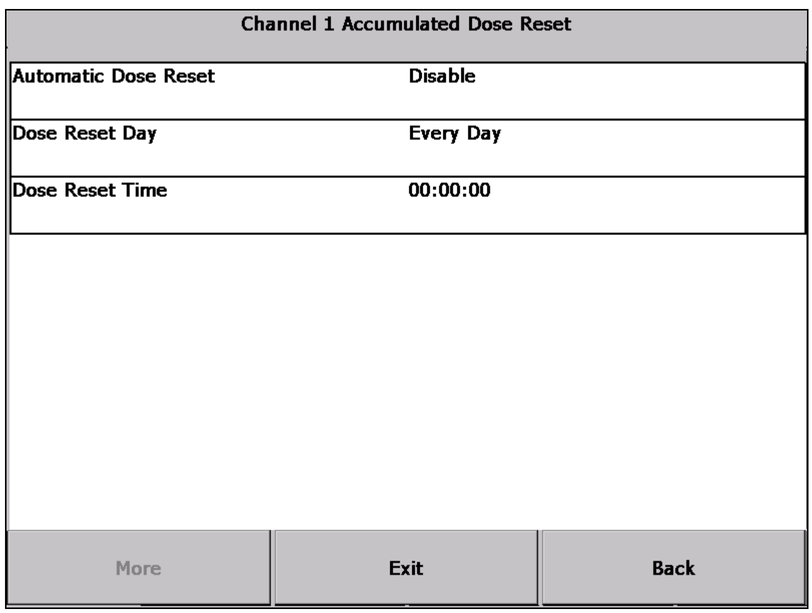


Figure 50: Accumulated Dose Reset Screen

The **Automatic Dose Reset** option on the menu controls if the automatic reset occurs at all, options are *Enable* and *Disable*.

The **Dose Reset Day** option controls on which day the reset occurs, the options are *Every Day* or a named day of the week.

The **Dose Reset Time** controls the time of day at which the reset occurs. Figure X2 below shows the screen displayed when this option is chosen. Use the left and right arrow keys to set time.

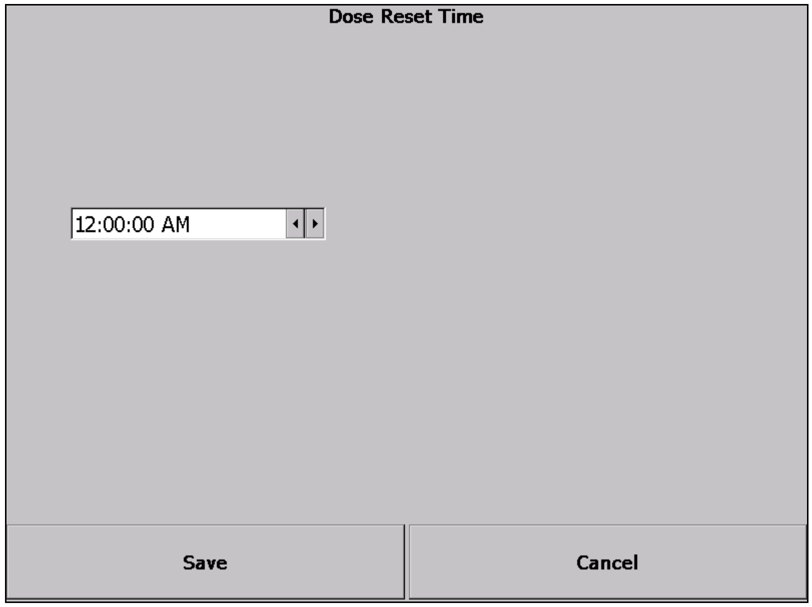


Figure 51: Setting the Dose Reset Time

I/O Configuration

The **I/O Configuration** menu displays a screen (Figure X) which controls the configuration of all input/output devices in the Ratemeter with the exception of the radiation measuring probes. Probes have their own configuration menu, refer to Probe Configuration.

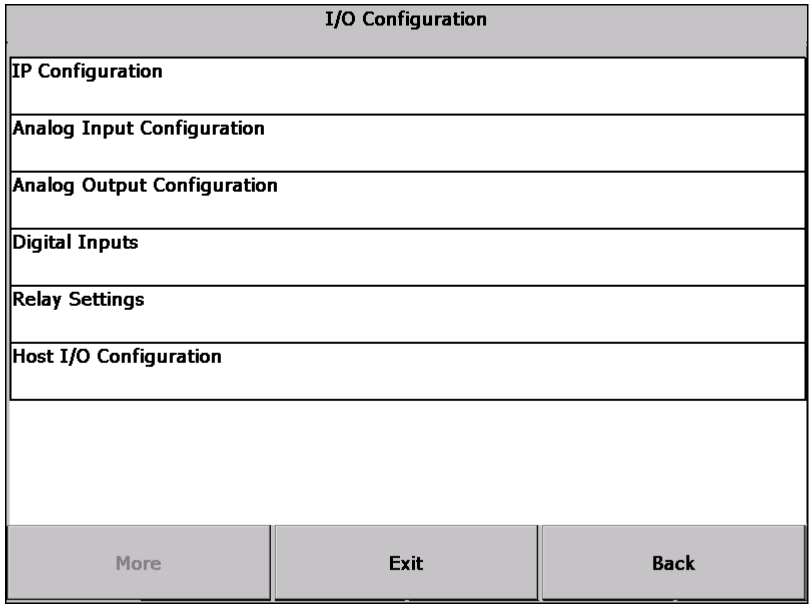


Figure 52: I/O Configuration Menu

IP Configuration

The **IP Configuration** option displays a screen (Figure X) that provides access to those settings that control how the instrument connects to an Ethernet network. These settings are ignored if the instrument is not connected to an Ethernet network.

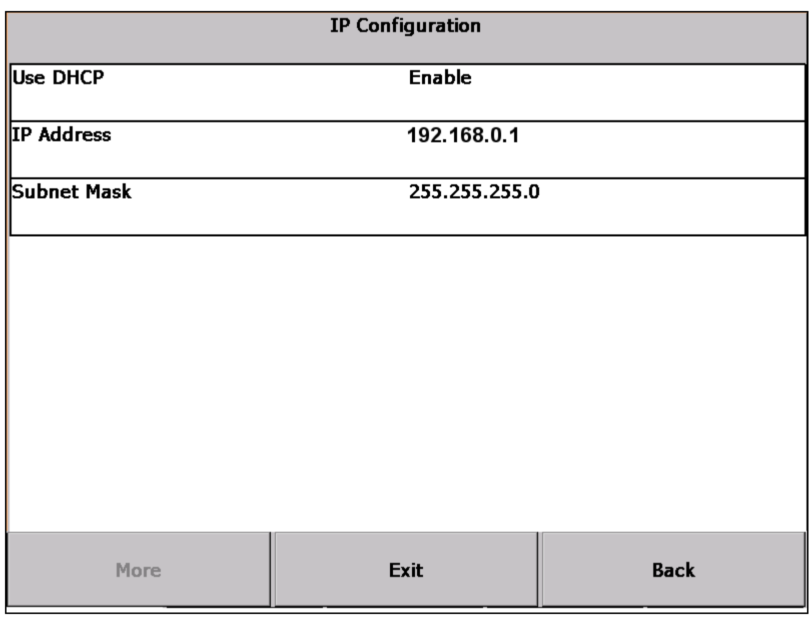


Figure 53: IP Configuration Screen

The **Use DHCP** setting controls if the instrument will use a DHCP server to provide it with an IP address. If this is set to *Enable* then the instrument will attempt to obtain an IP address from the network's DHCP server on start up. If this setting is enabled then there is no need to set an IP address or subnet mask as these will be overwritten by the values supplied by the server and these values will be displayed on this screen.

If **Use DHCP** is set to *Disable* then it is necessary to enter an IP address and Subnet mask manually. Take care to enter these correctly as the instrument is not capable of verifying values you enter.

You should consult your network administrator to obtain the settings that you should specify on this menu.

Note that any changes only take place once the system has been restarted, thus, after making changes here switch the instrument off then on again. Make certain that the instrument is connected to the network before switching on, particularly if DHCP is used.

Analog Input Configuration

The **Analog Input Configuration** option allows configuration of the five analogue inputs to the system. Note that these analog inputs are not the same as the probe analog inputs, the former are general-purpose inputs which may be used by the user for various purposes; the latter are dedicated inputs measuring probe parameters such as the probe bias voltage.

Selecting this option displays a list of all analog inputs as shown in Figure X.

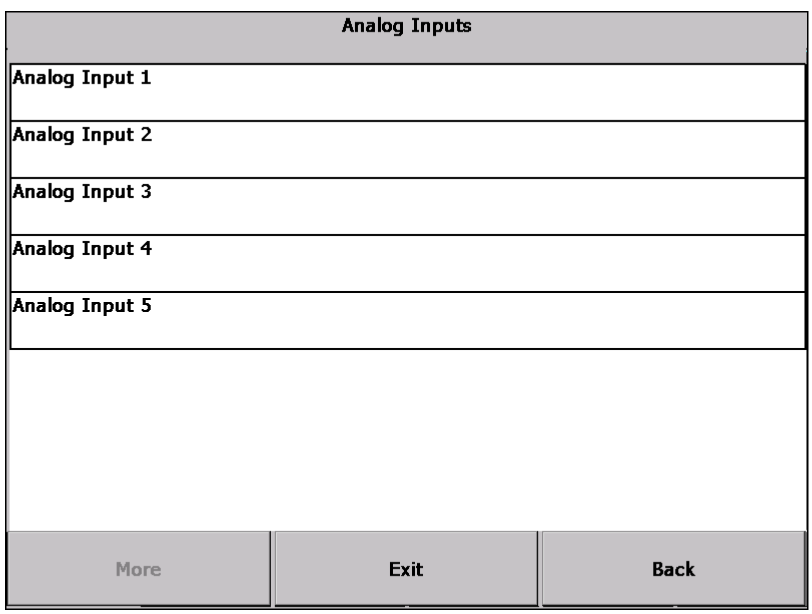


Figure 54: Analog Input Selection Screen

Selecting an input on this screen will display the Analog Input configuration screen (Figure X) for that input.

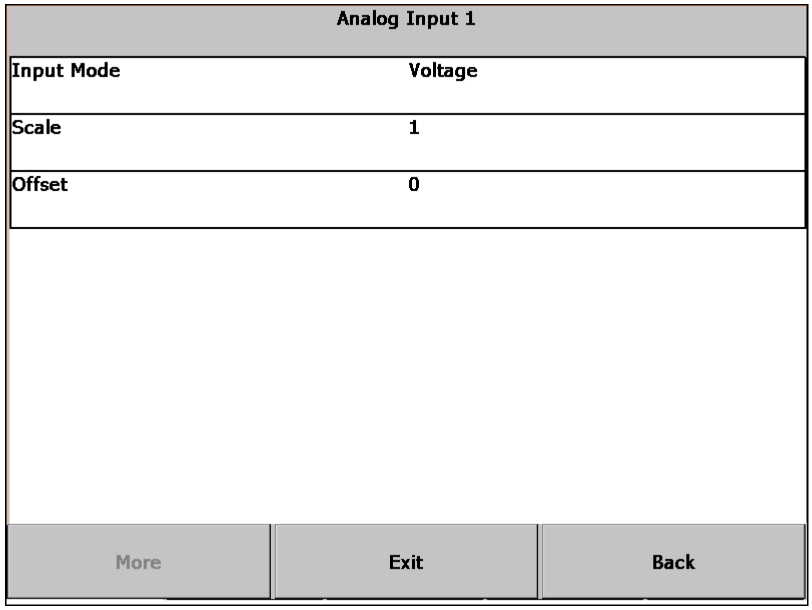


Figure 55: Analog Input Configuration Screen

The **Input Mode** may be set to *Voltage* or *Current* as desired. The numerical Scale and Offset for the output should be set here. The **Scale** and **Offset** values are applied to the measured value by the CP before it is used in any algorithm or reported to the EPC. The value is multiplied by the scale value before having the offset added.

Analog Output Configuration

The **Analog Output Configuration** option allows the six analogue outputs from the system to be configured. Note that this option is restricted to configuring the scaling and output mode for these outputs. Configuration of what data are routed to the outputs is performed as part of channel configuration, refer to *Channel Settings* on page 78.

Selecting this option will display a list of the analogue outputs as shown in Figure X1.

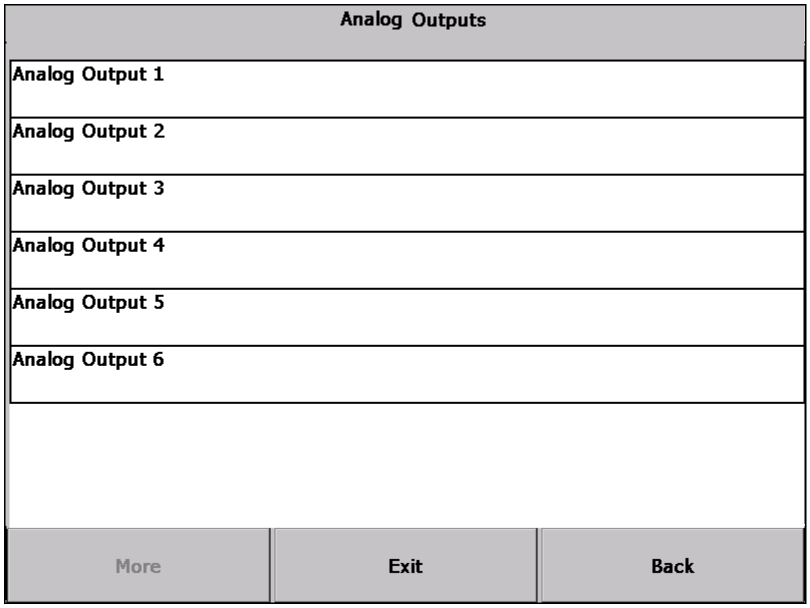


Figure 56: Analog Output Selection Screen

Selecting an output from this screen (Figure X) will display the configuration screen for that output.

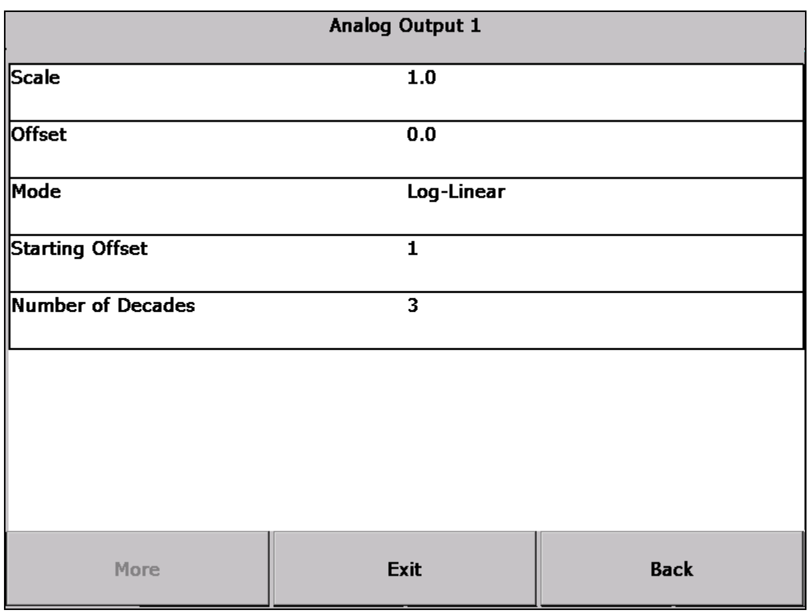


Figure 57: Analog Output Configuration Screen

Scale and **Offset** are the scale and offset for the digital to analogue converter, these are real numbers.

The **Mode** may be set to *Log-Log* or *Log-Linear*.

The **Starting Offset** (Decade) may be set to one of 10000, 1000, 100, 10, 1, 0.1, 0.01 or 0.001.

The **number** of decades may be set to any whole number between 1 and 7.

Log-log gives a true logarithmic output. Log-linear has log points for the decades, but the progression between decades is linear.

The formula used for calculating the outputs are:

Log-Log:

$$\mathrm{Vout} = \frac{10}{d} \times \log\left(\frac{r}{s}\right)$$

where: *r* is the current reading,

s is the starting decade (0.001, 0.01,….,10000).

d is the number of decades.

Log-Linear:

$$\mathrm{Vout} = \frac{10}{d} \times \frac{\left(r - 10^{re}\right)}{9 \times 10^{re}} + \log\left(10^{re - se}\right)$$

where: *re* is the exponent of the current reading,

se is the exponent of the starting decade.

Digital Inputs

The **Digital Inputs** option displays a screen (Figure X) which is used to control the pull-up/pull-down state of the digital inputs. There are two groups of inputs and the status may be set for each group. The iR7040 ratemeter has only one main circuit board, therefore all inputs are on board 1.

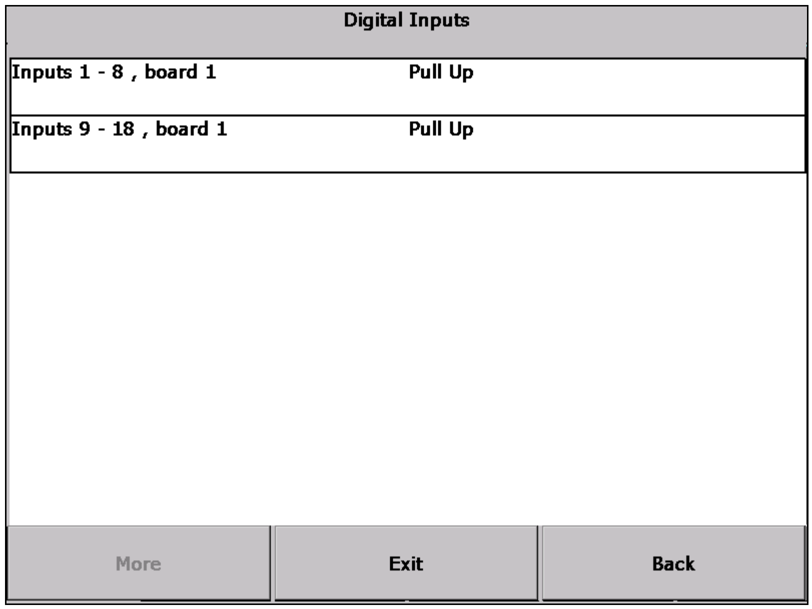


Figure 58: Digital Input Configuration Screen

Relay Settings

Relays within the ratemeter may be configured as Failsafe or Non-Failsafe. A Failsafe relay is de-energized when the associated alarm condition occurs and energized during the ‘safe’ (i.e. non-alarm) condition. A Non-Failsafe relay works the other way round, it is energized in the alarm condition and de-energized in the safe condition. All relays have two make contact pairs and one break contact pair, so the main effect of this setting is what occurs if power to the instrument is removed. In this state all relays will be de-energized. For a Failsafe relay this represents an alarm condition, therefore the external systems using the relay contacts will register an alarm should the Ratemeter be powered off.

Selecting the **Relay Settings** option displays a screen (Figure X) used to set configure the relay settings.

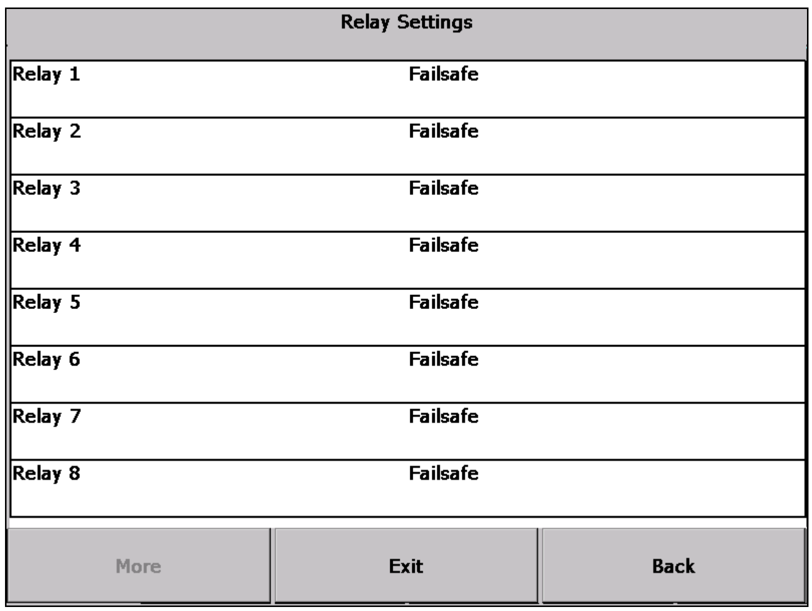


Figure 59: Relay Settings Screen

Host I/O Configuration

The **Host I/O Configuration** menu displays a screen (Figure X) which controls how the unit communicates with a host system using the RADACS protocol. The unit can communicate using RADACS in two ways, either over a serial interface (as in the older ADM606/616 ratemeters) or over TCP/IP. This screen controls the settings for both means of communication.

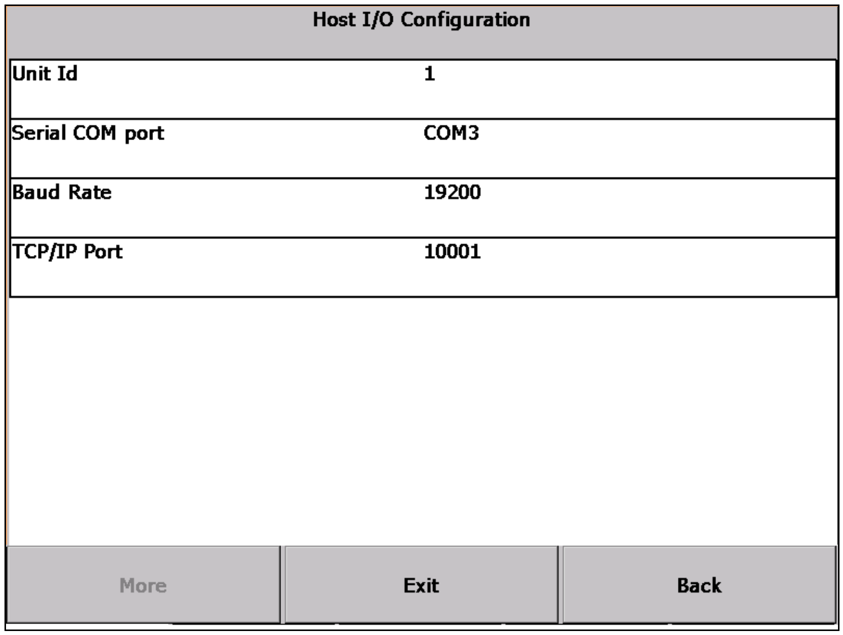


Figure 60: Host I/O Configuration Screen

The **Unit Id** is the RADACS unit id for the instrument; this is used by both serial and TCP/IP communication. The instrument will only respond to messages addressed to this unit id.

Serial COM Port sets the serial port to be used for serial communications; options are None, COM3, COM4 or COM5.

The **Baud Rate** parameter sets the baud rate to use on this port, rates from 1200 to 115200 baud may be specified. Both these parameters are only relevant to serial RADACS communication. If serial communication is not desired then the port should be set to *None*. The serial baud rate chosen must obviously match that set on the RADACS client software used.

The **TCP/IP Por**t parameter sets the TCP/IP port number used for communication via RADACS over TCP/IP. When setting the port number the so-called ‘well-known’ port numbers, 0 – 1023 must be avoided or conflicts may occur with other systems on the network. Ideally a port number in the private port range 49152 – 65535 should be used. The port number used must match that used by the RADACS client.

The Maintenance Menu

The **Maintenance** menu provides facilities to perform the following maintenance functions:

- Save the Ratemeter configuration to a file on a USB storage device.
- Load the Ratemeter configuration from a file on a USB storage device.
- Update the internal software within the Ratemeter.

These options are described in the following sections.

Save Configuration

The Ratemeter configuration can be saved to an XML-format file on a USB storage device. The resulting file may be used for a number of functions:

- As a back up in case of failure of the instrument. The configuration can be re-loaded onto the same Ratemeter following repair or onto a replacement instrument. It is strongly recommended that such a backup is taken once the instrument has been configured and that this backup is updated if subsequent changes are made to the configuration. Configuration files may be transferred from the USB storage device to some more permanent form of storage, such as CD-ROM, using a PC.

- To ‘clone’ a Ratemeter. Where a number of instruments with identical or similar functions are required then one can be configured initially and then this configuration saved and then loaded onto the other instruments. If minor changes are then required they can be made afterwards.

- To enable the configuration to be changed using the PC-based Ratemeter Configuration Tool. This can be easier to use than configuring the unit using the built-in menu system. To configure an instrument in this way the configuration is first saved to a USB device using this menu option. The USB device is then plugged into to a PC loaded with the configuration tool and the configuration file loaded, edited and re-saved to the USB device. Finally the configuration is re-loaded to the instrument, refer to Load Configuration.

Note that it is not recommended that configuration files are edited ‘by hand’ using a standard text editor. Though the files are standard text files editing them in this way does not give the protection against incorrect settings and formats that use of the Configuration Tool does.

Selecting the **Save Configuration** option displays a screen (Figure X) used to save the ratemeter's configuration settings. The name of the file used to save the settings to is automatically chosen by the instrument and cannot be changed; this filename is composed from the instrument’s name (refer to *Initial Settings* on page 60) and the system identifier. The system identifier identifies a particular instrument configuration and is described in more detail in *System Information* on page 59. The device to which the settings are to be saved is shown on the screen. Normally USB Device is the correct device to use, but this can be changed under special circumstances, e.g. where more than one USB storage device has been connected. To change the device first make sure that the device to be used is connected then touch the Choose Device button and select the device to use from the list displayed. Note that settings are always written to the *root folder* of the device.

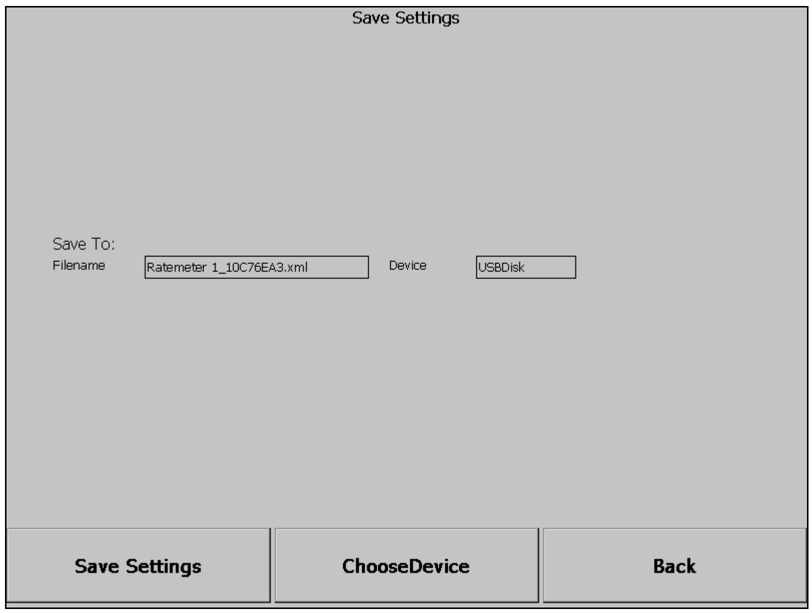


Figure 61: Save Settings Screen

To save the current settings to the file and device shown first make sure that the device to be used is connected, for a USB storage device this consists of plugging it into one of the instrument’s USB sockets, then touch **Save Settings**. The ratemeter will save the settings and then return to the Maintenance menu, this may take a short time. Should any error occur, e.g. if the instrument cannot find the storage device selected, then an appropriate error message will be displayed.

Load Configuration

The **Load Configuration** option will load a configuration file from a storage device connected to the Ratemeter. Before choosing this option, first connect the device containing the file to be loaded. Selecting this option displays a screen (Figure X) used to load the configuration file.

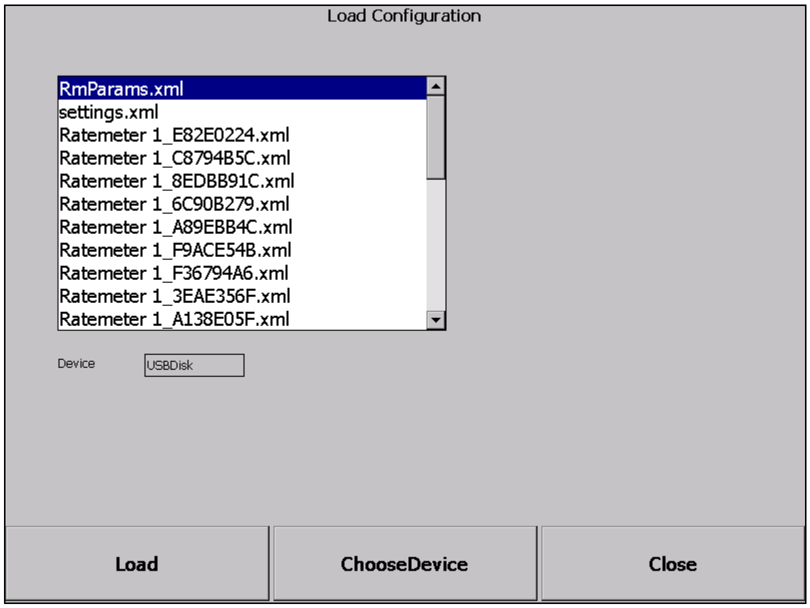


Figure 62: Load Settings Screen

Update System Software

The **Update System Software** option is used to update the internal software of the iR7040. Updates may be provided by CANBERRA via the website or on physical media such as CD. These will need to be transferred to a USB storage device before the update is performed; full instructions on how to do this will be provided with the update. It is important that the files contained the update are placed on the USB device exactly as instructed or the instrument may not recognize the update.

Note that during the update normal operation of the instrument, including generation of alarms, may be suspended. As a result the instrument should not be relied upon for safety and monitoring purposes until the upgrade has completed successfully. Some upgrades may require that the instrument is switched off then on again to complete the upgrade, instructions supplied with the upgrade should warn you if this is the case and the instrument itself will display a message asking you to turn it off then on again once the update has been loaded. Once the upgrade has been started do not turn the instrument off or disconnect the storage device until the operation has been completed, doing so may leave the instrument in an unusable state and may require that it is returned to CANBERRA for repair. It is strongly recommended that no USB storage device other than the device containing the upgrade is connected to the instrument while the update is taking place. It is also recommended that the USB storage device used contains no files other than those containing the update.

To perform the update follow the instructions on screen (Figure X), i.e. connect the device and touch **Update**. When complete the instrument will display a message, this may ask you to turn the unit off and on again to complete the operation.

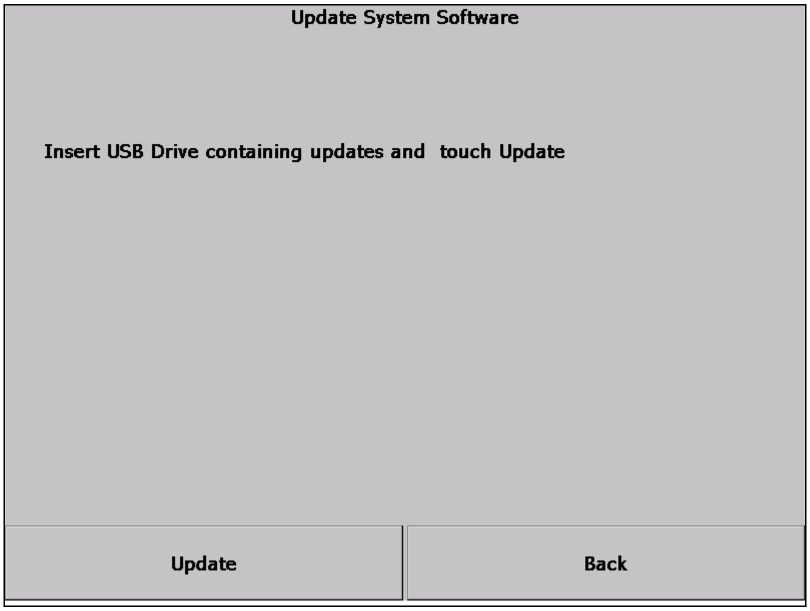


Figure 63: Update System Software Screen

6. Data Review and Display

The iR7040 ratemeter maintains an archive of measured values, alarm occurrences, faults and other system events such as key state changes and initiation of test functions. The contents of this archive may be viewed by the user on-screen and/or exported to a USB memory device for storage and analysis on a separate computer system. When viewing of exporting these data the user can set criteria to restrict the amount of data displayed, e.g. by specifying a time and date range to view, selecting which channels to view data for, etc. All data may be displayed in tabular form, in addition measurement data may be displayed as a trend graph. Old data may be purged from the archive to free up space.

Data review and display functions are accessed from the **Main** menu by selecting the **Data Archiving** menu item. Selecting this menu option will display the **Data Archiving** menu (Figure X). Options on the menu are described in the following sections.

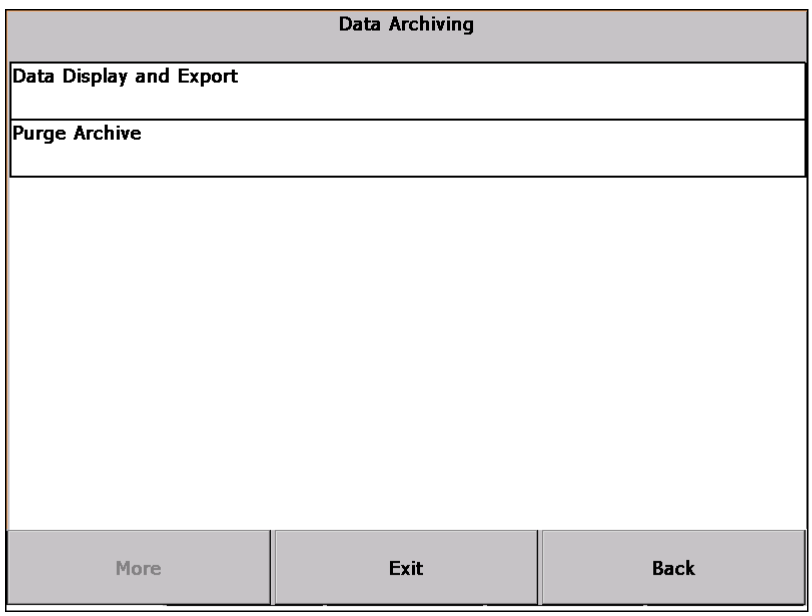


Figure 64: Data Archiving Menu

Data Display and Export

Selecting the **Data Display and Export** item on the **Data Archiving** menu will display the **Data Display and Export** menu (Figure X). From this menu you can view or export rate (i.e. measurement) data, alarm events and the system error log.

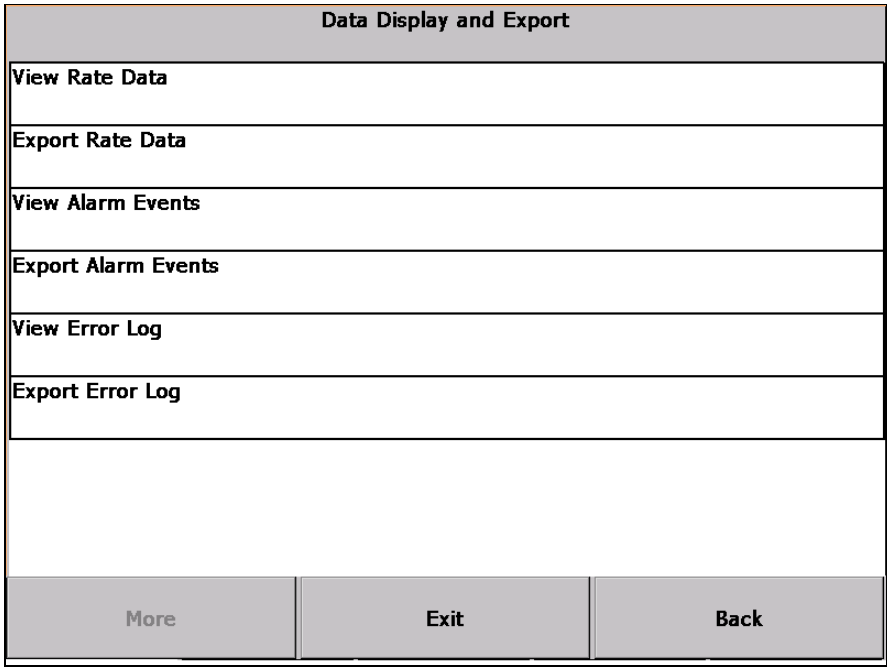


Figure 65: Data Display and Export Menu

View Rate Data

Select the **View Rate Data** option to view rate (i.e. measurement) data, either as a table or as a trend chart. From this screen (Figure X1) you can select the date range for the data and the channels to be viewed. To select the date/time range, refer to the *Calendar Control* on page 39.

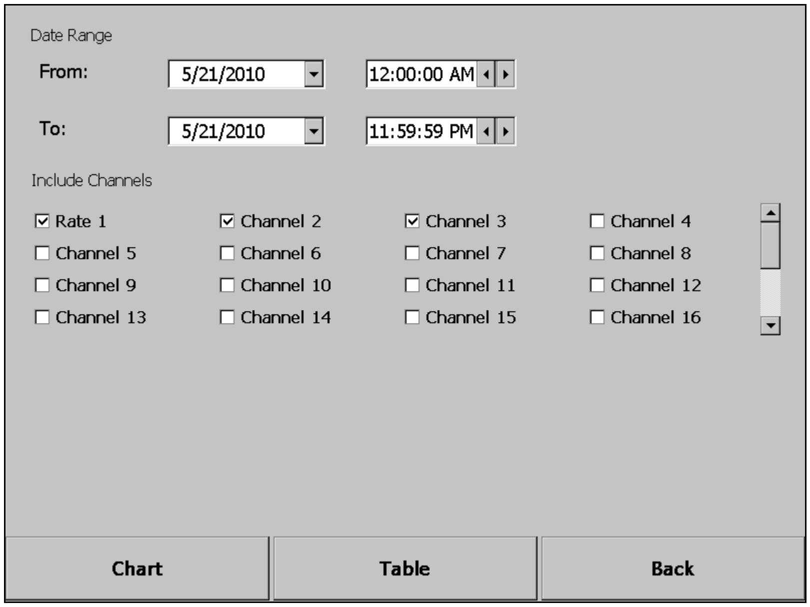


Figure 66: Rate Data View Selection Screen

Touch the check box next to each channel name to display the channel's data. The scroll bar to the right of the allows the check boxes for channels 17 – 32 to be selected. By default the instrument will select all channels currently in use when you first display this screen.

To display the selected data as a chart touch the **Chart** button. Figure X3 shows a typical chart. By default the vertical axis is linear, it may be toggled between linear and logarithmic by touching the **Log/Linear** button.

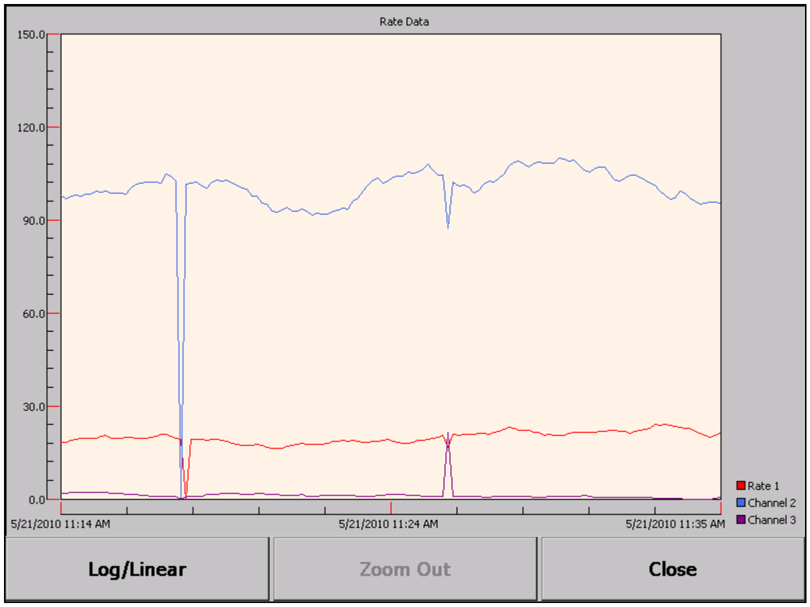
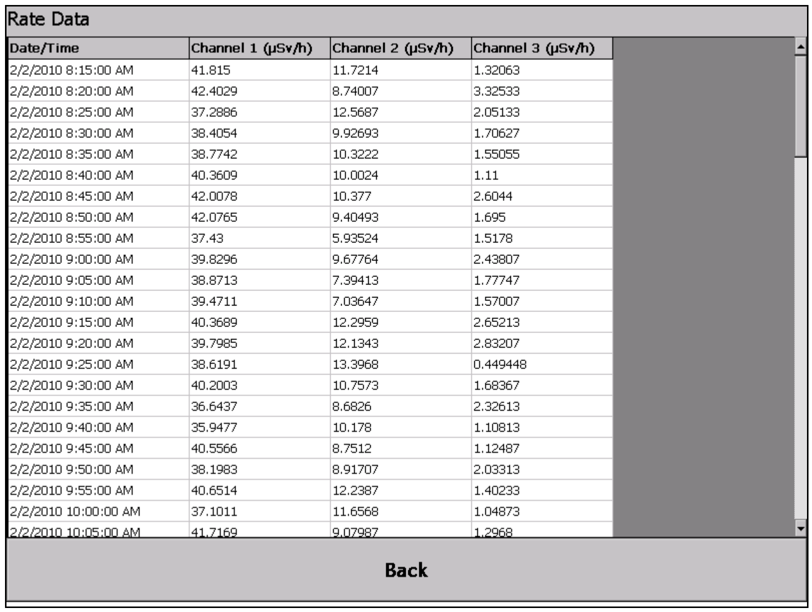


Figure 67: Trend Chart Display

It is possible to zoom in on areas of interest on this display by 'dragging' a zoom rectangle on the display. To do this touch the display in the chart area at one corner of the region that you choose to expand then, while keeping your finger on the display, drag it to the diagonally opposite corner. A 'shadow' rectangle will be drawn on the display as you drag. When you lift your finger off the display then the region within this rectangle will be expanded to fill the entire area. To return to the standard display touch the **Zoom Out** button. The **Close** button will return you to the Rate Data View Selection screen.

To display the data as a table touch the Table button; Figure X4 shows a typical display. Where there are more rows than will fit on a single screen a scroll bar is displayed on the right. Where a large date/time range is selected there could potentially be a very large number of rows if every measured data point were to be displayed; to avoid this the instrument actually gathers the measurements into ‘time bins’ and displays the average value for each bin. The width of these bins is set automatically dependent on the time range selected in order to give a manageable number of rows in the table.



Rate Data

Date/Time	Channel 1 (μSv/h)	Channel 2 (μSv/h)	Channel 3 (μSv/h)
2/2/2010 8:15:00 AM	41.815	11.7214	1.32063
2/2/2010 8:20:00 AM	42.4029	8.74007	3.32533
2/2/2010 8:25:00 AM	37.2886	12.5687	2.05133
2/2/2010 8:30:00 AM	38.4054	9.92693	1.70627
2/2/2010 8:35:00 AM	38.7742	10.3222	1.55055
2/2/2010 8:40:00 AM	40.3609	10.0024	1.11
2/2/2010 8:45:00 AM	42.0078	10.377	2.6044
2/2/2010 8:50:00 AM	42.0765	9.40493	1.695
2/2/2010 8:55:00 AM	37.43	5.93524	1.5178
2/2/2010 9:00:00 AM	39.8296	9.67764	2.43807
2/2/2010 9:05:00 AM	38.8713	7.39413	1.77747
2/2/2010 9:10:00 AM	39.4711	7.03647	1.57007
2/2/2010 9:15:00 AM	40.3689	12.2959	2.65213
2/2/2010 9:20:00 AM	39.7985	12.1343	2.83207
2/2/2010 9:25:00 AM	38.6191	13.3968	0.449448
2/2/2010 9:30:00 AM	40.2003	10.7573	1.68367
2/2/2010 9:35:00 AM	36.6437	8.6826	2.32613
2/2/2010 9:40:00 AM	35.9477	10.178	1.10813
2/2/2010 9:45:00 AM	40.5566	8.7512	1.12487
2/2/2010 9:50:00 AM	38.1983	8.91707	2.03313
2/2/2010 9:55:00 AM	40.6514	12.2387	1.40233
2/2/2010 10:00:00 AM	37.1011	11.6568	1.04873
2/2/2010 10:05:00 AM	41.7169	9.07987	1.2968

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Figure 68: Rate Table Display

Export Rate Data

Select the **Export Rate Data** option to display a screen (Figure X) to export selected rate data to a file on a USB storage device plugged into one of the sockets on the side of the instrument. To select the date/time range, refer to the *Calendar Control* on page 39. Channel selection items on this screen work in exactly the same way as for the Rate Data View screen, refer to *View Rate Data* on page 102.

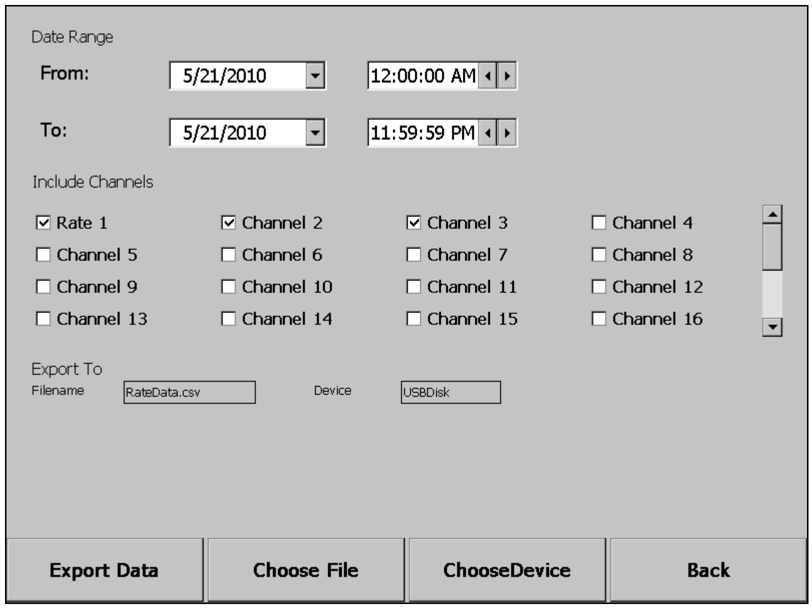


Figure 69: Rate Data Export Selection Screen

The **Filename** and **Device** text fields identify the file and device that the result file will be written to. If the values displayed are not suitable they may be changed by touching the **Choose File** and **Choose Device** buttons respectively. Note that the file is always written to the root folder of the chosen device, it is not possible to write to a sub-folder. The USB storage device must be formatted according to the FAT or FAT32 standard; this is the normal standard for USB storage devices. NTFS formatted devices are not supported.

Touching the **Choose File** button will display a screen (Figure X2) with an on-screen touch keypad that is used to edit the file name. This is typical of screens used to edit alphanumeric values within the ratemeter. The current filename is displayed in the text box at the top of the screen. Letters may be entered by touching the buttons on the keypad. The **<-** key deletes the last character. The **1 2 3** key switches the keypad for numeric entry. The **Mode** key cycles the keypad between normal character entry, special character entry (including a range of accented characters) and symbol entry. It is not recommended to use accented characters or symbols in the filename. The **A->a** key switches between upper case and lower case entry, note however that filenames are not case sensitive. Filenames should follow the standard Microsoft Windows™ rules for filenames. The file name is saved by touching **Save** or changes may be cancelled by touching **Cancel**; both these buttons will return you to the Rate Data Export screen.

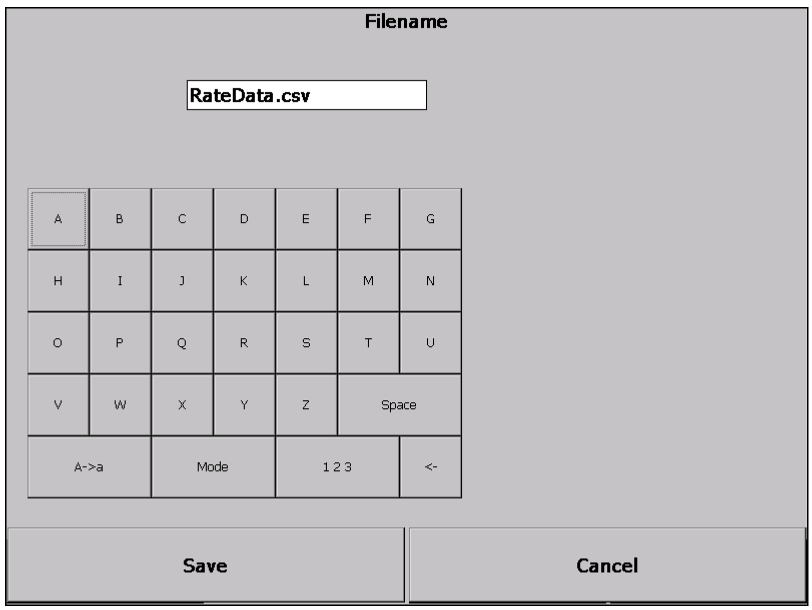


Figure 70: Filename Entry Screen

The selected device will normally be “USBDisk”, however it may be necessary to change this under special circumstances such as if two USB devices are connected at the same time or an ‘unusual’ device was connected. If you need to select the device then first connect the USB storage device then touch the **Choose Device** button.

The system will display a list of all devices, see Figure X3, with the selected device marked with a black dot. Touch the name of an alternative device to select it. Note that devices will not show on this screen if they were not connected before the **Choose Device** button was selected, if this is the case then connect the device, touch **Cancel** to return to the previous screen and try again. The devices “Network”, “Flashdisk” and “SDIODisk” refer to internal devices and should not be chosen.

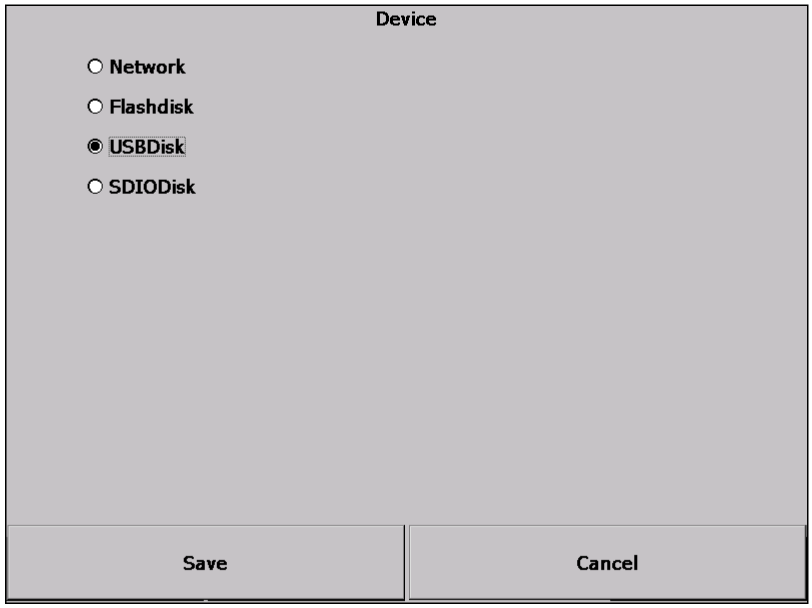


Figure 71: Select Device Screen

Once the filename and device are set as required and the USB device is connected touch the **Export Data** button to start the export of data. Note that this operation may take a long time if a lot of data are to be exported. If the file chosen already exists then a message will be displayed warning that the file will be overwritten with the new data, you can choose to cancel the operation.

Data are written in ‘CSV’ format, this is a common format that can be imported into a wide range of programs including Microsoft Excel™ and Access™. Data are written one sample per line of the file; for each sample the following are recorded:

- Sample date and time
- Channel number
- Sample value (filtered value)

A header line, which lists the field names, is written at the top of the file. Table 30 shows an example of the file format.

Table 37 Rate Data Format

```
SampleTime,Channel,SampleValue
2/3/2010 8:02:12 AM,1,37.4099998474121
2/3/2010 8:02:12 AM,2,12.4700002670288
2/3/2010 8:02:12 AM,3,0.889999985694885
2/3/2010 8:02:22 AM,1,37.3099994659424
2/3/2010 8:02:22 AM,2,11.4333335558573
2/3/2010 8:02:22 AM,3,0.889999985694885
2/3/2010 8:02:32 AM,1,38.0899993896484
2/3/2010 8:02:32 AM,2,10.9980003356934
2/3/2010 8:02:32 AM,3,0.889999985694885
```

View Alarm Events

Alarm log entries may be viewed by selecting the **View Alarm Events** option to display the screen in Figure X. To select the date/time range, refer to the *Calendar Control* on page 39. Channel selection items on this screen work in exactly the same way as for *View Rate Data* on page 102.

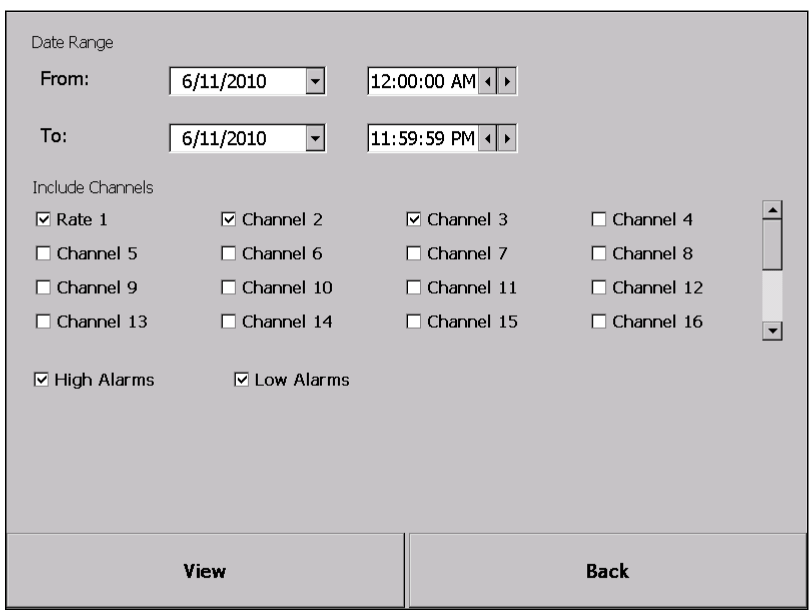
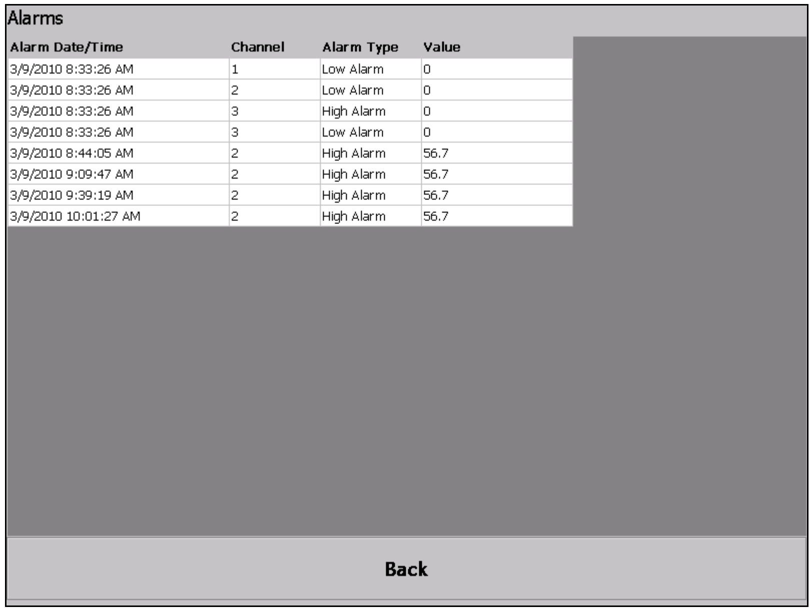


Figure 72: Alarm View Selection Screen

The **High Alarms** and **Low Alarms** check boxes select what classes of alarms are displayed. Touching the **View** button displays the selected alarms in a tabular form

(Figure X2). Data included in this display are the date and time of the alarm, the channel on which it occurred, the alarm type and the (filtered) measured value at the time of the alarm.


Alarms

Alarm Date/Time	Channel	Alarm Type	Value
3/9/2010 8:33:26 AM	1	Low Alarm	0
3/9/2010 8:33:26 AM	2	Low Alarm	0
3/9/2010 8:33:26 AM	3	High Alarm	0
3/9/2010 8:33:26 AM	3	Low Alarm	0
3/9/2010 8:44:05 AM	2	High Alarm	56.7
3/9/2010 9:09:47 AM	2	High Alarm	56.7
3/9/2010 9:39:19 AM	2	High Alarm	56.7
3/9/2010 10:01:27 AM	2	High Alarm	56.7

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Figure 73: Alarm Log Display

Export Alarm Events

Select **Export Alarm Events** option displays a screen (Figure X) to export selected alarm log data to a USB storage device. Selection of the alarm dates, channels and alarm types is identical to *View Alarm Events* on page 108. Setting of the filename and device for export are similar to that for *Export Rate Data* on page 105.

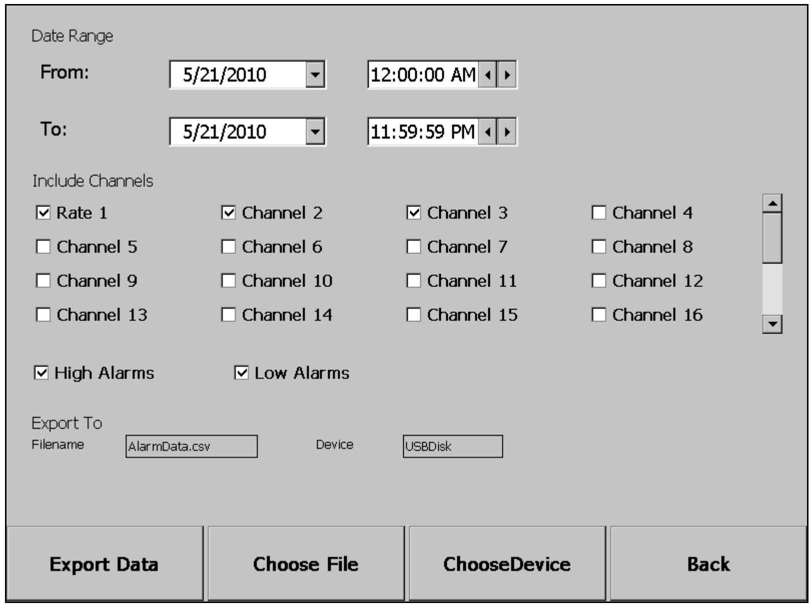

Figure 74: Alarm Export Selection Screen

Ensure that a suitable storage device is plugged into one of the instrument's USB sockets then touch "Export Data" to write the data to the device.

Data are written in CSV format, one alarm event per line, with a header, see Table 31 for an example. Values written are the date/time of the alarm, the channel number, the alarm type and the (filtered) data value at the time of the alarm.

Table 38 Alarm Data Example

```
AlarmTime,Channel,AlarmType,Value
3/9/2010 8:33:26 AM,1,Low Alarm,1.25
3/9/2010 8:33:26 AM,2,Low Alarm,40.2
3/9/2010 8:33:26 AM,3,High Alarm,10.2
3/9/2010 8:33:26 AM,3,Low Alarm,3.1
3/9/2010 8:44:05 AM,2,High Alarm,56.7
3/9/2010 9:09:47 AM,2,High Alarm,56.7
3/9/2010 9:39:19 AM,2,High Alarm,56.7
3/9/2010 10:01:27 AM,2,High Alarm,56.7
```

View Error Log

The **View Error Log** option displays a screen (Figure X) that allows you to view the log of errors and other occurrences for the system.

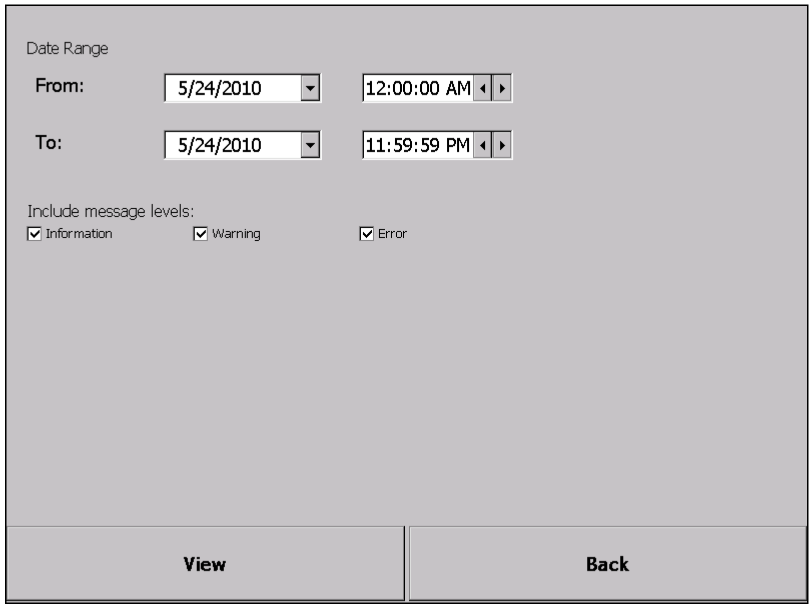

Figure 75: Log View Selection Screen

To select the date/time range, refer to the *Calendar Control* on page 39. The “Include message Levels” section allows you to choose which message levels to include, from ‘Information’, the lowest-level message up to ‘Error’, the most severe. The selected log entries will be displayed when you touch **View**.

An example display (Figure X) shows for each log entry the time, message number, level and message are shown.

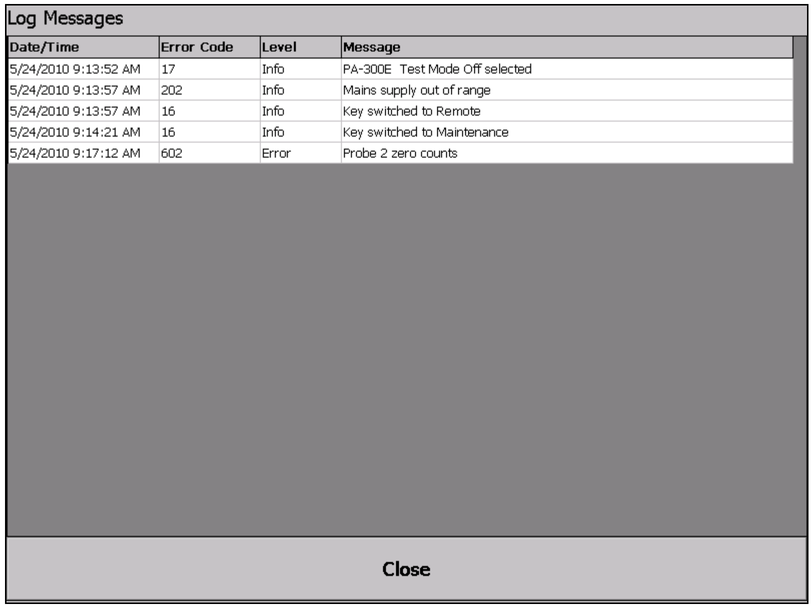

Figure 76: Error Log Display Screen

Export Error Log

Select the **Export Error Log** option to displays a screen (Figure X) to export the log of errors and other occurrences to a USB storage device.

Selecting the date/time range and message levels are similar to that of *View Error Log* on page 111. Setting of the filename and device for export are similar to that for *Export Rate Data* on page 105.

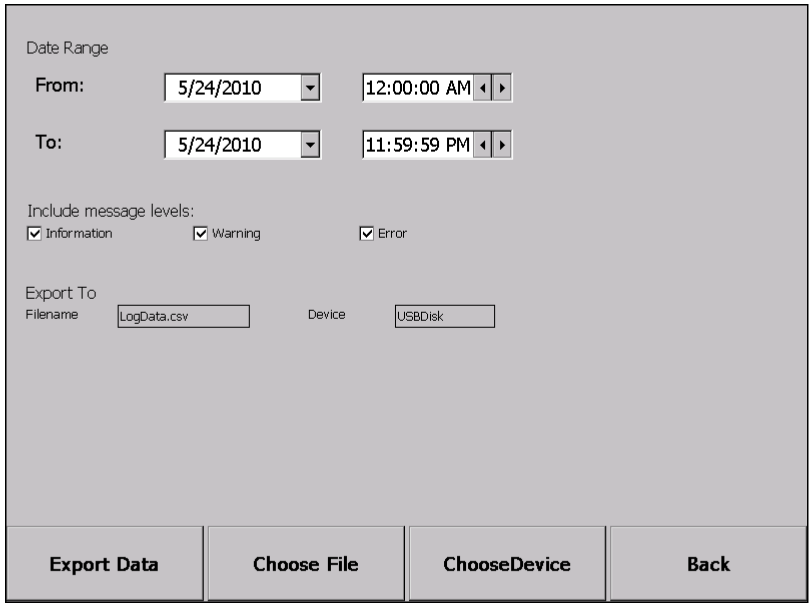

Figure 77: Log Export Selection Screen

Make sure that a suitable USB device is connected before touching the **Export Data** button.

Values are written in CSV format, one message per line, with a header. For each message the date and time of occurrence, message code, level and message text are given, see the example in Table 32.

Table 39 Error Log Data Example

```
LogTime,MessageCode,Level,Message
6/11/2010 8:29:32 AM,17,Info,PA-300E  Test Mode Off selected
6/11/2010 8:29:35 AM,202,Info,Mains supply out of range
6/11/2010 8:32:15 AM,16,Info,Key switched to maintenance
6/11/2010 9:07:22 AM,602,Probe 2 zero counts
```

Purge Archive

The iR7040 ratemeter will retain all archive data in its internal memory until it is deliberately purged by the user. It is therefore recommended that the archive be purged on a regular basis. Data in the archive can be exported to a USB storage device and then transferred to long term storage on another media by using the facilities described in *Export Rate Data* on page 105 prior to purging of the archive if required. The instrument will raise a warning message when less than 5% of the available storage space is free.

To perform the purge operation select the **Purge Archive** option to display the screen in Figure X.

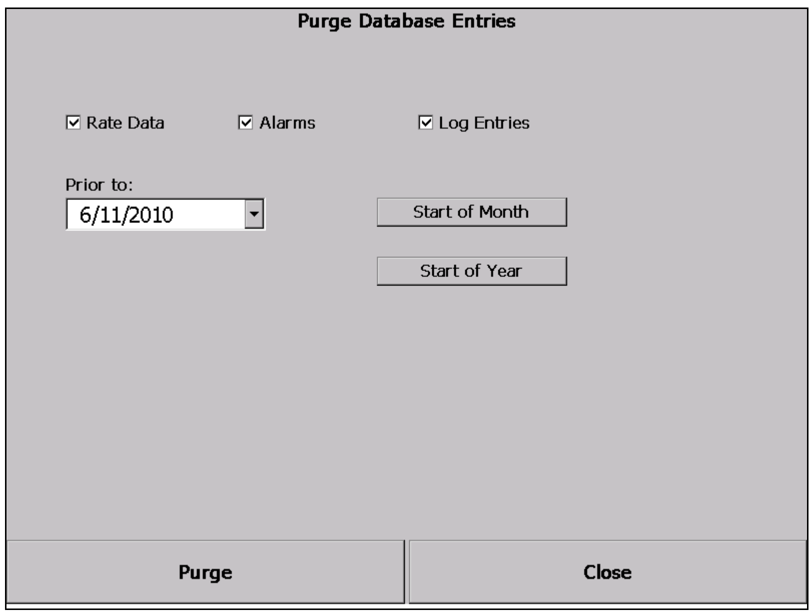

Figure 78: Purge Archive Entries

The **Rate Data**, **Alarms** and **Log Entries** check boxes determine what data are to be purged. Note that, under normal circumstances, most of the archive space will be taken up with rate data entries, therefore if the intention is to free up space then rate data should be purged.

On touching the **Purge** button all entries in the log prior to the date shown will be purged. The desired date may be selected by touching the downward facing arrow next to the date shown; this will display a calendar. As a shortcut this date may be set to the start of the current month or year by touching the **Start of Month** or **Start of Year** buttons respectively. Refer to the *Calendar Control* on page 39 for more information.

7. Self Test Functions

The iR7040 has a number of built-in facilities to check for correct operation of the unit and the attached radiation measuring probes. These checks include:

- A built-in pulser that can inject test pulses into the system, either directly to the probe (for certain probes only) or to the internal counter within the instrument that counts pulses from the probe.

- Check sources fitted to certain probes. These are small radioactive sources that can be moved, under the control of the instrument, from a shielded position to a position where the probe will detect the radiation emitted by the source.

- External check sources, similar to the above but external to the probe and controlled by a relay within the ratemeter.

- Test functions built in to the optional PA-300E Preamplifier.

It is recommended that checks are carried out using these facilities, as part of the routine maintenance of the system. Note that carrying out these checks may raise spurious alarm conditions during the test; maintenance procedures should therefore take this into account.

Tests may only be performed when the front-panel keyswitch is in the Maintenance position. As far as possible all tests will be terminated when the keyswitch is turned away from this position, due to technical limitations this is not possible for external check source tests, refer to *External Check Source Tests* on page 120, so these should always be terminated manually.

To perform tests, from the **Main** menu select the **Self Test** menu item. Selecting this menu item will display the **Self Test** menu (Figure X).

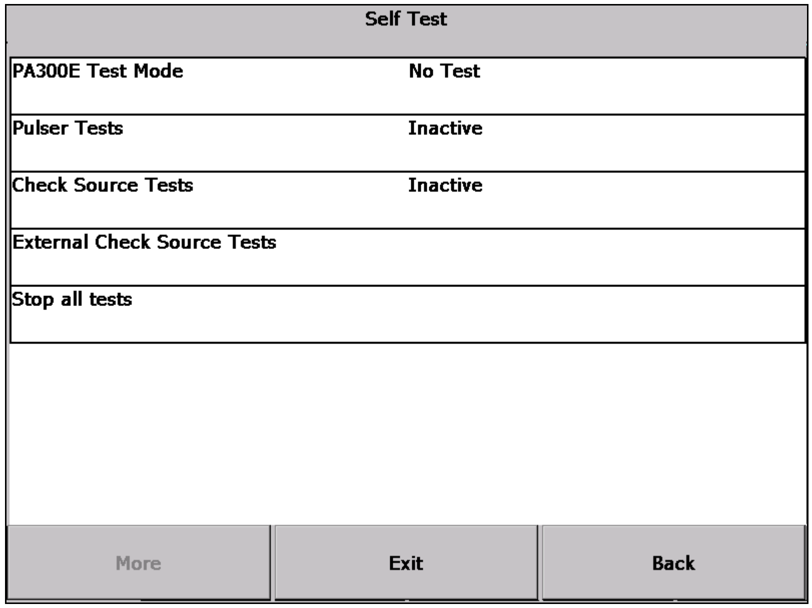

Figure 79: Self Test Menu

PA300E Test Mode

These tests are only appropriate if the ratemeter is connected to a PA300E preamplifier.

The PA300E has built in facilities to pulse an LED fitted to the detector connected to it so as to generate test pulses from the probe. These pulses will be routed through the electronics in the same way as pulses caused by the detection of radiation and will as a result be recorded by the ratemeter. This internal test can operate in one of two modes, known as Test 1 and Test 2; these correspond to different pulse rates on the LED with Test 1 being the lower frequency.

Figure X shows the PA300E test mode screen. The currently selected mode is indicated by a filled circle. To set the mode touch the required option then touch **Save**. Touching **Cancel** will exit from the screen without changing the test mode.

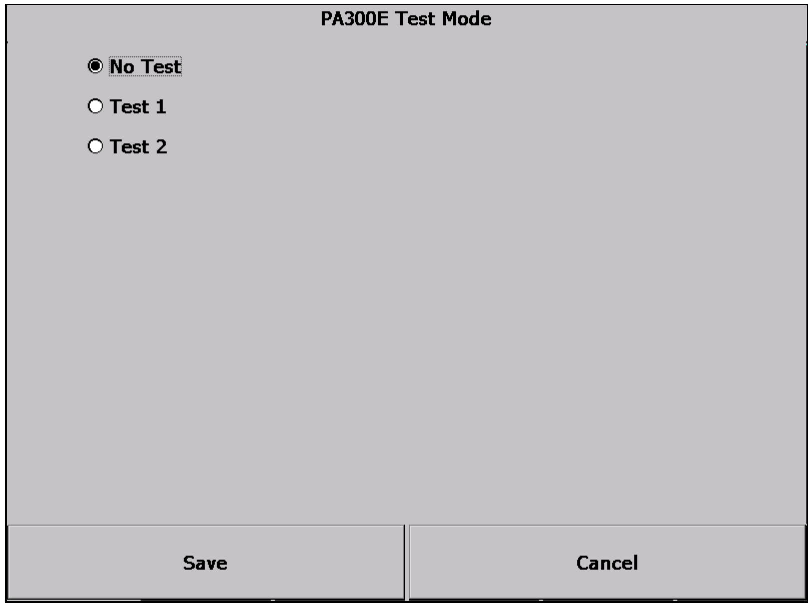

Figure 80: PA300E Test Mode

Pulser Tests

These tests use a pulse generator within the ratemeter to inject test pulses into the system, thereby simulating pulses from radiation detectors. Pulses may either be routed to the probe itself or to the pulse counter within the ratemeter. Note that the facility to route pulses to the probe requires probes designed for this mode of operation; this facility is provided for future expansion as no current probes have this capacity. The pulse rate may be set to one of a number of preset values between 5 Hz and 500 kHz. The pulser settings may be individually controlled for the four probes in the system.

When the **Pulser Tests** option is selected the first menu displayed shows the pulser status for the four probe, see Figure X1. For each probe this shows the pulser state (either Off or the pulse frequency if on) and the routing of the pulser, which may be either Probe or Counter as explained below.

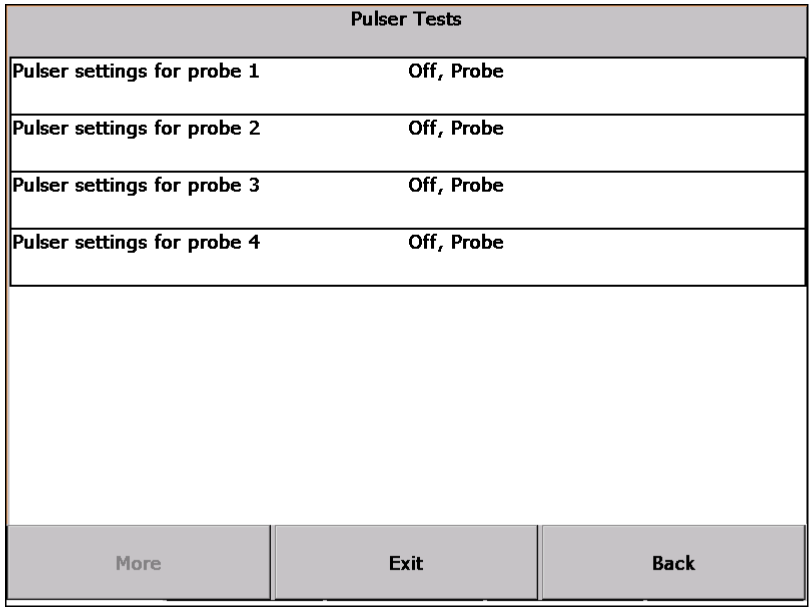

Figure 81: Pulser Tests Screen

To change the settings for the pulser for a particular probe touch the associated entry in this menu. A second menu will be displayed that shows the settings for that probe, see Figure X2.

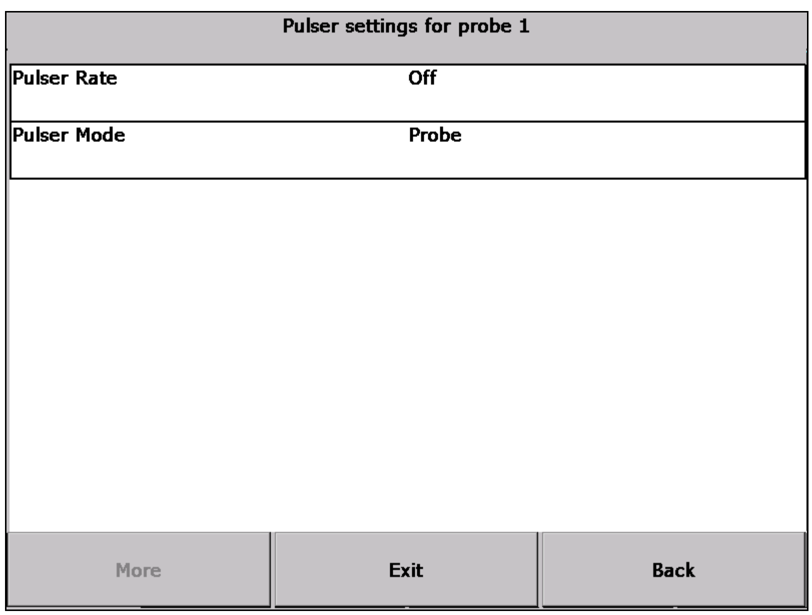

Figure 82: Pulser Settings Screen

To set the **Pulser Rate** touch the first option on this menu to display a screen (Figure X3) allowing the rate to be set. Select the rate from the options shown and touch **Save** to save the change. Note that if the pulser rate is set to *Off* then the instrument will automatically set the pulse routing mode to *Probe*.

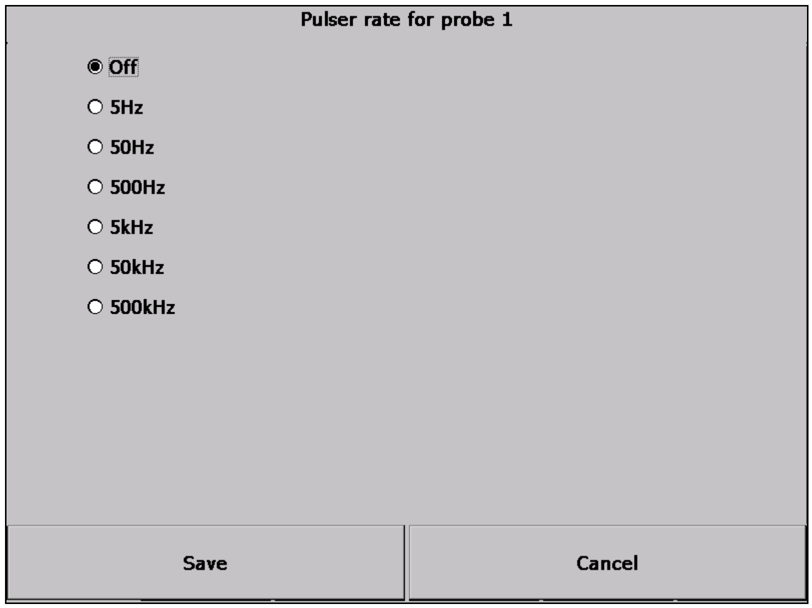

Figure 83: Pulse Rate Settings Screen

To set the pulse routing mode, touch the **Pulser Mode** option on the Pulser settings menu. A screen will be displayed on which you can set the mode to *Probe* or *Counter*. Note that if *Counter* mode is selected then the pulser pulses will replace any inputs from the probe, thus the system will not measure incoming radiation in this mode. A result of this is that if the mode is set to *Counter* and the pulser rate to *Off* then there will be on reading on the system and no alarms will be generated; this is why setting the pulser rate to *Off* automatically sets the mode to *Probe*. In any case it is vitally important to make sure that the system is not left with the pulser mode set to *Counter*. Choosing the All tests off option on the top-level self-test menu will force all pulsers to *Off* and all pulser modes to *Probe*.

Check Source Test

The **Check Source Test** option controls tests using check sources built into the probes. It does not control external check sources controlled by relays within the ratemeter, refer to *External Check Source Tests* on page 120 for this.

Selecting this option will display the Check Source Tests Screen, Figure X. This shows the current state for each check source; this is reported as *Inactive*, meaning that the source is shielded, or *Active*, meaning that the source is exposed to the probe. Touching an option on this menu will lead to a screen where the state of the source can be set. Note that setting a check source to *Active* for a probe that does not have an internal check source will have no effect and will not cause an error.

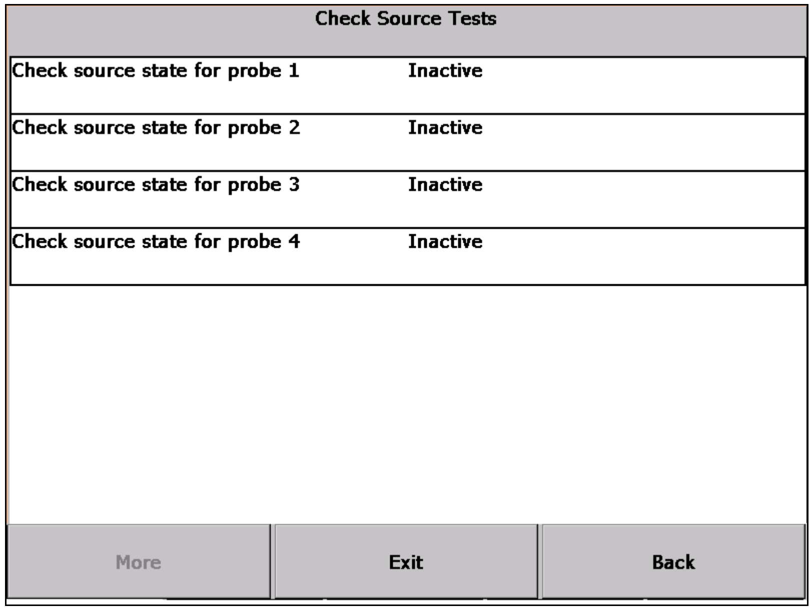

Figure 84: Check Source Tests Menu

External Check Source Tests

These tests use a check source mechanism external to the probe and controlled by one of the relays within the ratemeter. Complications arise because these are general-purpose relays and are not dedicated to check source control; they are also used for purposes such as signaling alarm conditions. This is why it is not possible to provide the same automatic facility to cancel external check source tests in the same way as is done for all other tests. As a result care should be taken to turn off all external check source tests at the end of the testing session and before the instrument is returned to normal use.

Selecting the **External Check Source Tests** option displays a screen (Figure X) which shows all the relays in the instrument and their state (Active or Inactive). The instrument will attempt to determine which relays are in use for alarm purposes, it does this by scanning the alarm settings for all channels (including channels that are not in use) to check which relays, if any, they use to signal alarms. Any relay found to be used for alarm purposes by this check is not available for use as a check source relay and will be indicated as such on this menu by being disabled and displayed in grey text. In the example shown relays 1 and 2 are so indicated. Relays used for alarm purposes may be shown as *Active* or *Inactive* on this screen, these indications are not relevant and should be ignored.

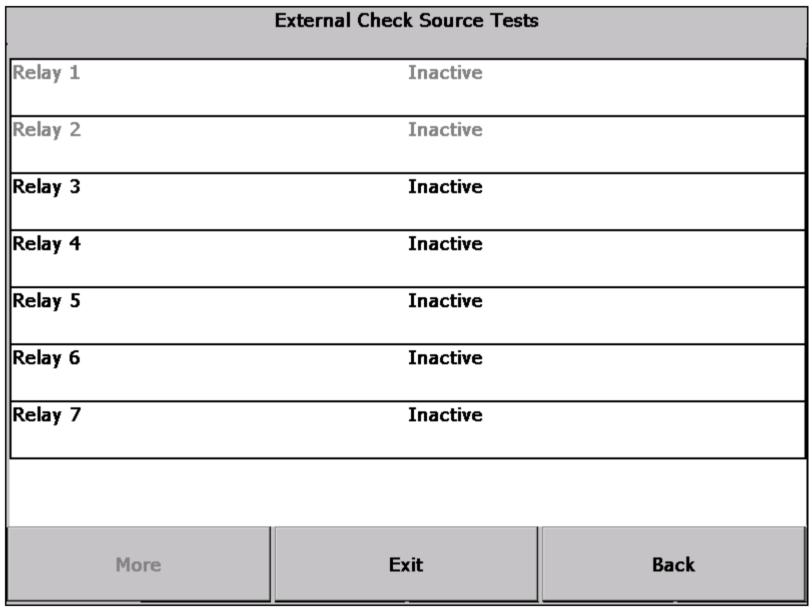

Figure 85: External Check Source Tests

Note also that, since these are general purpose relays and are not dedicated to source control, the instrument is not able to associate them with particular probes. Thus relays have to be identified by their number and the operator needs to know which relay is connected to which probe; documentation on this should have been provided by the installer.

To set a relay state touch the associated option on the menu and a screen will be displayed where you can set the state to Active or Inactive. Any attempt to set the state of a 'disabled' relay will be ignored.

8. Maintenance

In normal operation, the Ratemeter should require very little maintenance. There are two batteries internally which are used to keep the Real Time Clock operating and the Control Processor memory alive during power off conditions.

The Control Processor memory contains, among other things, the filter averages so in the event of a short power failure, the average is not lost. The battery that powers the Control Processor memory when the Ratemeter is not powered is also used for initial powering up of the instrument.

When switched Off, the whole instrument is shut down, including the AC mains power supply. On switching to one of the On modes, this battery is used to initially power-on the AC mains power supply. Once up and running the battery is no longer required to power the AC main power supply as that power can now come from the power supply itself.

When the battery becomes flat it does not have sufficient power to be able to achieve this state and so the Ratemeter will not power up. An indication of this is when the front panel LED produced a brief flash when the Key switch is turn from Off to one of the On positions. At this point, the battery should be changed.

Batteries used:

- BT1 (on the main board behind the front panel), either a ½AA 3.6V Lithium cell or a CR2 3.0V ‘Photo Power’.

- Coin cell on the small Embedded PC board – CR2032.

Cleaning/Decontamination

The ratemeter enclosure is constructed of stainless steel with a smooth finish to aid decontamination should it become necessary.

Cleaning the ratemeter can be performed by using a mild soap and water mixture applied to a damp cloth only on the external surfaces. Do not allow water to enter the unit.

CAUTION: Turn off the power and remove the mains power before cleaning the unit.

Spare Parts and Consumables

Spare Parts

Description	Part Number
Mains fuse, FS1, 20mm x 5mm	T3.15A H 250V
DC Supply fuse, FS2, 20mm x 5mm	T6.3A H 250V

Replacement of Consumable Materials

Fuse Replacement: The user may find it necessary to replace the main fuse mains input connector on the Termination Panel. Please see Specifications appendix for fuse ratings and characteristics. The fuse description and replacement instructions are printed on the label next to the fuse holder.

9. System Troubleshooting

A. Installation Consideration

This unit complies with all applicable US (UL/FCC) and Canadian (CSA) requirements for Safety & EMC regulations.

During the design and assembly of the module, reasonable precautions were taken by the manufacturer to minimize the effects of RFI and EMC on the system. However, care should be taken to maintain full compliance. These considerations include:

- Single point external cable access
- Compliant grounding and safety precautions for any internal power distribution
- The use of NRTL compliant accessories such as fans, UPS, etc.

Operating Protection Impairment

Canberra is not liable for any operational malfunctions or personal injuries due to mishandling or unauthorized repair and maintenance not detailed in this manual.

B. Specifications

Range

Dependant on probe(s) attached.

Microprocessors

- One Embedded PC (EPC) running Windows® CE, display operations.
- One Control Processor, receives and processes probe and analog data from probe processor.
- One Probe Processor, processes probe inputs.

Channels

- Four external detector inputs.
- Thirty-two virtual channels, user configurable incorporating any ratemeter input, external input or algorithm.

Communications

- User input and configurations served by:
    - ▶ Direct input from the touch sensitive screen.
    - ▶ Via USB, from a laptop computer or keyboard.
    - ▶ For Ratemeters integrated into a system, from the system.
- One Ethernet (10Base-T).
- Three RS-485 serial, two isolated.
- Two RS-232 serial

Controls

- Easily configured with key switch security.
  - Key switch selects ratemeter modes, off/on, remote or maintenance.
- Installed Pulser for test (manual or automatic).

Activates and Log Test

- Internal or external check source.
- Scintillator LED test rate.
- Adjustable pulser.
- Adjusts regions of interest for MD series scintillators.

Inputs/Outputs

INPUTS

- Four detectors (any of CANBERRA's line of RMS detectors including, GM detector, ion chamber, scintillation, PIPS®, gas proportional and specialty), each with:
  - TTL /current signal.
  - Analog 0-10 V, 10 bit resolution.
  - RS-422 serial.
  - 24 V dc power.
  - Switched 24 V dc (check source control).
- Each channel uses a 12-bit DAC capable of high resolution and good linearity.
- Five analog, fully isolated: 4-20 mA or 0-10 V 12 bit resolution. (Flow measurement, temperature, etc.)
- Eighteen digital (flow, control, sample changers, etc.) logic.

OUTPUTS

- TEN DIGITAL – TTL 0-5 V. (Flow control, sample changers, etc.).
- SIX ISOLATED ANALOG – 4-20 mA or 0-10 V.

- (Data reporting, flow control, temperature, etc.).
- Eight safety relays. One for faults, seven for alarms, test, etc.
- Each safety relay has four contacts that mechanically move together with one monitored to detect failure. Remaining three contacts consist of two normally open (form A) and one normally closed (form B). Form C function is met using one Form A and one Form C. Relays may be configured to be normally energized or deenergized.

Communications

- Two External USB ports (for exporting log data, importing and exporting system configuration and for internal firmware updates).
- Two GB Flash Memory (histogram).

Displays and Alarms

- Large, 21 cm (8.25 in.), diagonal industrial, hardened, color touch-screen display.
- Bright, tricolor LED; red, amber and green.
- Front panel embedded audible alarm annunciator with adjustable volume and local or remote silencing.
- Tricolor light tower for optimum visibility and indication of status; red, amber and green.

Power

AC (100 to 240 V, 50 to 60 Hz at 100 VA) or DC, 24 V dc (±10% at 120 W).

Physical

CONFIGURATION – wall-mounted.

CONSTRUCTION – stainless steel, IP65 enclosure, NEMA4X.

Termination panel for connecting plant wiring interface is located in the rear of the ratemeter in a separate hinged, IP65 enclosure to conserve wall space. Opening the termination panel does not open the main Ratemeter case, which has a separate hinged and sealed door.

SIZE – 320 mm high x 275 mm wide x 250 mm deep (13 x 11 x 10 in.); light tower adds 263 mm (10.4 in.) height.

WEIGHT – 10 kg (22 lb).

Environmental

OPERATING TEMPERATURE – Range: –0 to +60 °C (32 to 140 °F), ambient.

HUMIDITY – Up to 95%, non-condensing. Meets the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2.

SEISMIC – Qualification in accordance with IEEE Std 344-2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.

SAFETY – Tested to IEC 61010-1:2001 (Second Edition) / EN 61010-1:2001.

EMC – Tested to IEC 61326-1:2006..

Quality

iR series ratemeters are designed and manufactured under a quality system in compliance with the following standards and requirements:

- ISO 9001.
- 10CFR21.
- 10CFR50, Appendix “B”.
- IEEE-730.
- ANSI/ASME NQA-1, ANSI/ASME NQA-2, Part 2.7.
- CE.
- TUV SUD America is a listed NRTL.
- IEC 60532
- IEC 61513, class 2 and 3

Optional versions available for safety-related, SIL2, safety category B.

Ordering Information

iR7040 Intelligent Ratemeter includes the ratemeter, wall mounting bracket and manual.

Options

7068398 – Termination Panel Cover.

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