invensys
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EPack™ Controller
User Guide

EPack™ Power management and control units
Versions 2.00 and later

HA031414 issue 1
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Restriction of Hazardous Substances (RoHS)

Product group Epack

Table listing restricted substances

Chinese

限制使用材料一览表						
产品	有毒有害物质或元素					
Epack	铅	汞	镉	六价铬	多溴联苯	多溴二苯醚
功率模块 16-32安培	X	X	O	O	O	O
功率模块 40-63安培	X	X	O	O	O	O
O	表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。					
X	表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006 标准规定的限量要求。					

English

Restricted Materials Table						
Product	Toxic and hazardous substances and elements					
Epack	Pb	Hg	Cd	Cr(VI)	PBB	PBDE
Power Module 16-32A	X	X	O	O	O	O
Power Module 40-63A	X	X	O	O	O	O
O	Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.					
X	Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006.					

Approval

Name:	Position:	Signature:	Date:
Martin Greenhalgh	Quality Manager	Martin Greenhalgh	19 FEB 2013

EPack Power Controller

User Guide

List of sections

Associated documents

HA028838 Printable version of iTools Help
HA025464 EMC installation guidelines

Software effectivity

This manual refers to instruments fitted with software version 2.0.

Epack Controller

User Guide

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SAFETY NOTES

WARNING

BRANCH-CIRCUIT PROTECTION AND SAFETY OVERLOAD PROTECTION

This product does not contain any branch-circuit protection or internal safety overload protection. It is the responsibility of the user to add branch-circuit protection upstream of the unit. It is also the responsibility of the user to provide external or remote safety overload protection to the end installation. Such branch-circuit and safety oveload protection must comply with applicable local regulations.

UL: The abovementioned branch-circuit protection is necessary for compliance with National Electric Code (NEC) requirements.

WARNINGS

1. Any interruption of the protective conductor inside or outside the apparatus, or disconnection of the protective earth terminal is likely to make the apparatus dangerous under some fault conditions. Intentional interruption is prohibited.
2. Before carrying out any wiring to the unit it must be ensured that all relevant power and control cables, leads or harnesses are isolated from voltage sources. Wire conductor cross sections must comply with table 1 of EN60947-1 (or with table 2.2.1 of this manual).
3. This equipment is not suitable for isolation applications, within the meaning of EN60947-1.
4. Under some circumstances, the power module heatsink temperature may rise above 50 degrees Celsius. If operators are likely to come into contact with such heatsinks, adequate warnings and barriers must be put in place in order to prevent injury.
5 EPack alarms protect thyristors and loads against abnormal operation, and provide the user with valuable information regarding the type of fault. Under no circumstances should these alarms be regarded as a replacement for proper personnel protection. It is strongly recommended that the installing authority include independent, system-safety mechanisms to protect both personnel and equipment against injury or damage, and that such safety mechanisms be regularly inspected and maintained. Consult the EPack supplier for advice.

Note:

The instrument shall have one of the following as a disconnecting device, fitted within easy reach of the operator, and labelled as the disconnecting device.

a. A switch or circuit breaker which complies with the requirements of IEC947-1 and IEC947-3
b. A separable coupler which can be disconnected without the use of a tool.

1. Before any other connection is made, the protective earth terminal shall be connected to a protective conductor.
2. Whenever it is likely that protection has been impaired, the unit shall be made inoperative, and secured against accidental operation. The manufacturer's nearest service centre should be contacted for advice.
3. Any adjustment, maintenance and repair of the opened apparatus under voltage, is forbidden for safety reasons.
4. Units are designed to be installed in a cabinet connected to the protective earth according to IEC364 or applicable national standards. The cabinet must be closed under normal operating conditions. Adequate air conditioning/ filtering/ cooling equipment must be fitted to the cabinet in order to prevent the ingress of conductive pollution, the formation of condensation etc.
5. Units are designed to be mounted vertically. There must be no obstructions (above or below) which could reduce or hamper airflow. If more than one set of units is located in the same cabinet, they must be mounted in such a way that air from one unit is not drawn into another.

SAFETY NOTES (Cont.)

6. Signal and power voltage wiring must be kept separate from one another. Where this is impractical, shielded cables should be used for the signal wiring.
7. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment might be impaired.
8. This product has been designed for environment A (Industrial). Use of this product in environment B (domestic, commercial and light industrial) may cause unwanted electromagnetic disturbances in which cases the user may be required to take adequate mitigation measures.

SELV

Safety Extra Low Voltage. This is defined (in EN60947-1) as an electrical circuit in which the voltage cannot exceed 'ELV' under normal conditions or under single fault conditions, including earth faults in other circuits. The definition of ELV is complex as it depends on environment, signal frequency etc. See IEC 61140 for further details.

SYMBOLS USED IN THE INSTRUMENT LABELLING

One or more of the symbols below may appear as a part of the instrument labelling.

	Protective conductor terminal		Risk of electric shock
	AC supply only		Precautions against static electrical discharge must be taken when handling this unit
	Underwriters Laboratories listed mark for Canada and the US		Refer to the manual for instructions
	Do not touch Heatsink Hot Surface		

USER GUIDE

1 INTRODUCTION

This document describes the installation, operation and configuration of an EPack unit. The Unit includes the following analogue and digital inputs and outputs, fitted as standard:
Two digital inputs (contact closure or voltage level)
One analogue input
One change-over relay under software control, configurable by the user.
Also fitted are a pair of RJ45 Ethernet connectors for communications with a controlling pc or with other units.

Section two of this manual gives connector locations and pinouts.

The operator interface consists of a 1.5 inch square TFT display and four push buttons for navigation and data selection.

The unit comes in two output versions: 16A to 32A and 40A to 63A. The units are identical except that the higher power unit is fitted with a more substantial heatsink.

The supply voltage for the units can be specified as either low voltage (24V ac/dc) or line voltage (85 to 550V ac). The choice is made at time of order and cannot be changed in the field.

1.1 UNPACKING THE UNITS

The units are despatched in a special pack, designed to give adequate protection during transit. If any of the outer boxes show signs of damage, they should be opened immediately, and the instrument examined. If there is evidence of damage, the instrument should not be operated and the local representative contacted for instructions.

After the instrument has been removed from its packing, the packing should be examined to ensure that all accessories and documentation have been removed. The packing should then be stored against future transport requirements.

2 INSTALLATION

2.1 MECHANICAL INSTALLATION

2.1.1 Fixing details

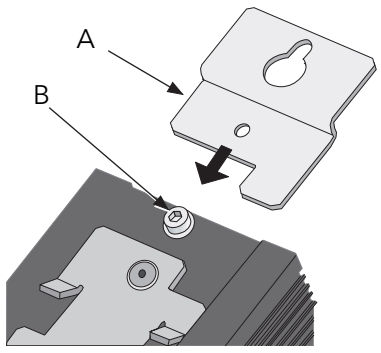
The units are designed to operate at an operating temperature not exceeding 45°C at an altitude not exceeding 1000 metres. Units must be installed in a fan-cooled cabinet (with fan failure detection or thermal safety cutout). Condensation and conductive pollution should be excluded to IEC 664 class 2. The cabinet must be closed and connected to the protective earth according to IEC 60634 or applicable national standard.

Units must be mounted with the heat sink vertical with no obstructions above or below which impede the airflow. Where more than one set of modules is enclosed in the same cabinet, they must be mounted such that air from one unit is not drawn in by another mounted above it. A minimum gap of 10mm is required between units.

Figure 2.1.1a shows dimensions for the 16A to 32A unit; figure 2.1.1b giving similar details for the 40 to 63A unit.

The units are designed for Din Rail or bulkhead mounting using the fixings supplied.

For Bulkhead mounting, fit the upper bracket 'A' to the rear of the unit by removing screw 'B' and associated shakeproof washer, offering the bracket up to the unit, and then securing it using screw 'B' ensuring that the bracket is correctly oriented (as shown) and that the shakeproof washer is fitted between the screw head and the bracket. The relevant screwdriver should have a 3mm AF hexagonal bit. The recommended tightening torque is 1.5Nm (1.1 lb-ft).



2.1.1 MECHANICAL INSTALLATION (Cont.)

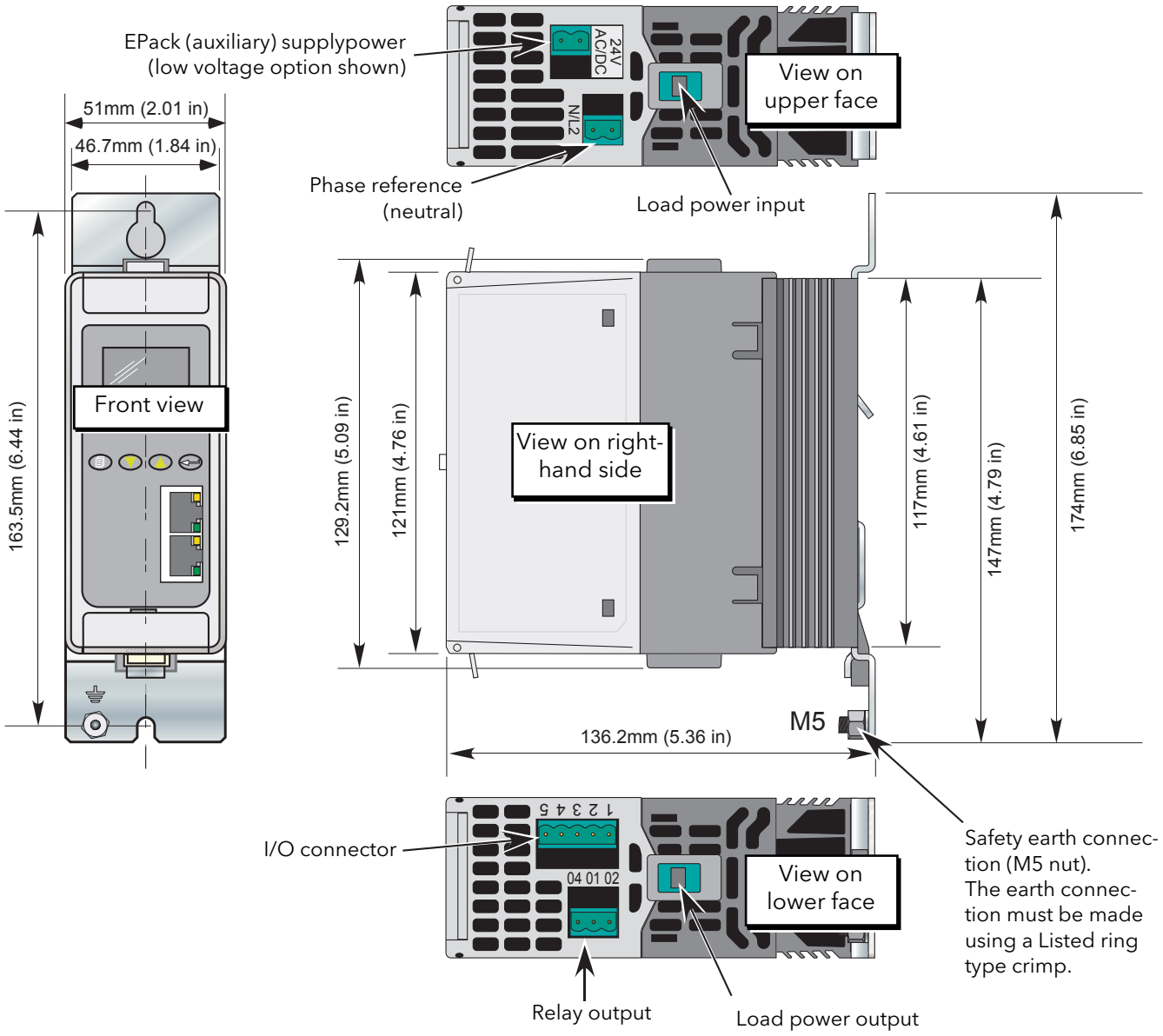


Figure 2.1.1a mechanical installation details (16A to 32A units).

2.1.1 MECHANICAL INSTALLATION (Cont.)

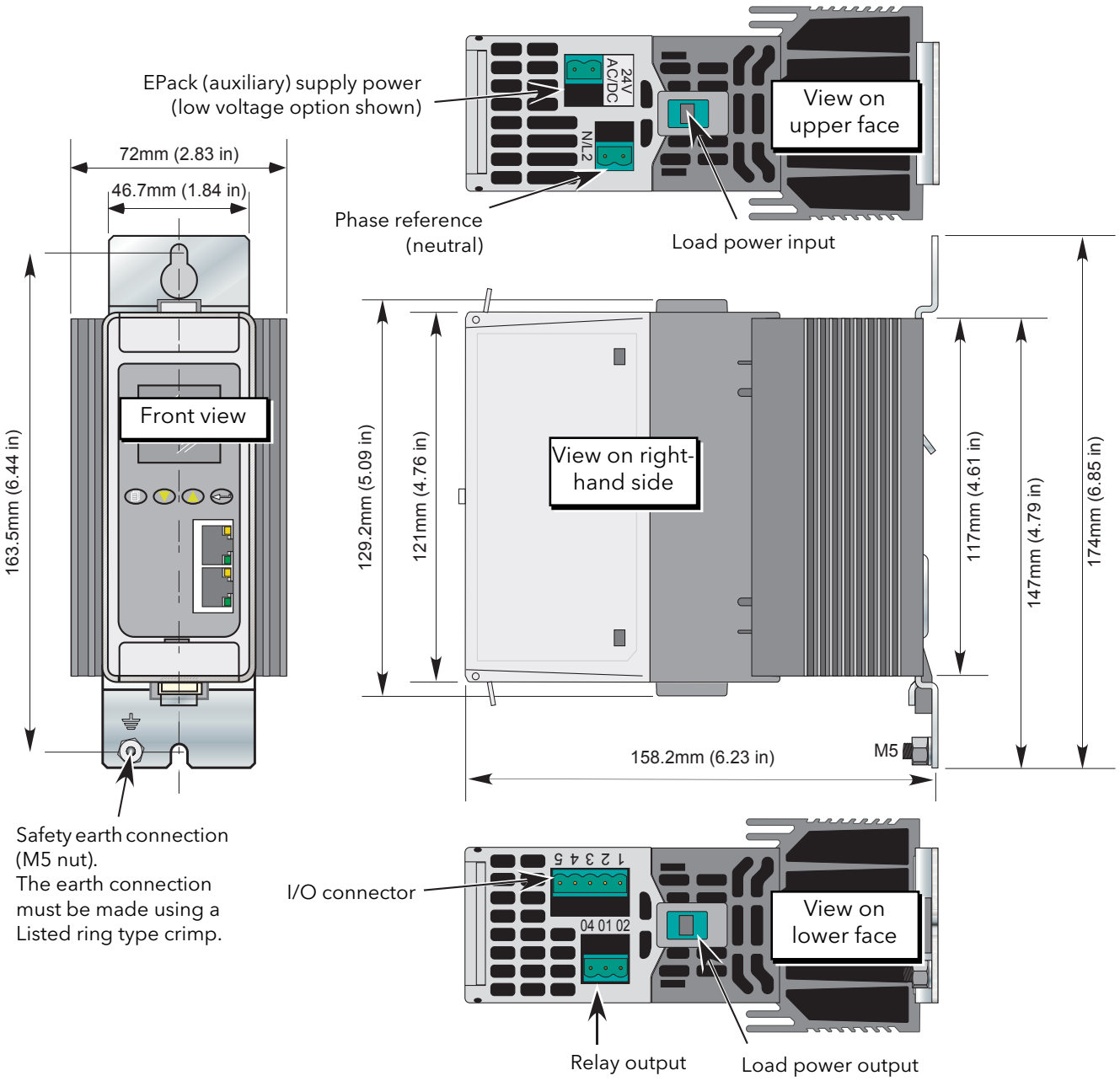


Figure 2.1.1b mechanical installation details (40A to 63A units).

2.2 ELECTRICAL INSTALLATION

CAUTION

It must be ensured that an effective strain relief mechanism (e.g. trunking) is in place for all EPack cables. Failure to ensure this may result in the unintentional disconnection of one of more connectors resulting in unexpected and possibly dangerous lack of control.

2.2.1 EPack supply voltage

The supply voltage connections (to operate the Epack unit) are terminated using a 2-way (24V ac/dc version) or 3-way (85 to 550Vac version) connector, located on the upper side of the unit, as shown in figure 2.2 , below.

The supply voltage 85Vac to 550Vac shall be protected by ATM2 rated 600Vac/dc, 2A by MERSEN/Ferraz Shawmut(E33925)

In order to protect the wiring it is recommended that a branch circuit fuse be incorporated. (1Amp for 24Vac/dc supplies and 2 Amp for 85 to 550Vac supplies)

A safety earth connection must be made to the unit with a Listed ring type crimp terminal, using the M5 nut and shakeproof washer supplied.

CONNECTION DETAILS

Table 2.2.1 below, gives details of wire sizes and tightening torques for the various supply power and signal wiring connections.

Where a range of wire sizes is given it is up to the user to select the correct cross sectional area required for the application. The safety earth cable should be, as a minimum, of the same cross sectional area as the cables used for the load (i.e. the cables terminated at the 1/L1 and 2/T1 terminals).

Connector	Cable cross section and tightening torque
Supply voltage (1/L1) and Load supply (2/T1)	16 to 32 A units: 2.5 to 6 mm² (12 to 10 AWG). Torque: 1.7 Nm 40 to 63 A units: 10 to 16 mm² (8 to 6 AWG). Torque: 1.7 Nm
Safety earth	Cross section same as above. Torque 2.5 Nm
Phase reference (N/L2) (2-way)	0.25 to 2.5 mm² (24 to 12 AWG). Torque 0.6 Nm.
EPack supply (24V ac/dc) (2-way)	0.25 to 2.5 mm² (24 to 12 AWG). Torque 0.6 Nm.
EPack supply (88 to 550V ac) (3-way)	0.25 to 2.5 mm² (24 to 12 AWG). Torque 0.6 Nm.
I/O connector (5-way)	0.25 to 2.5 mm² (24 to 12 AWG). Torque 0.6 Nm.
Relay connector (3-way)	0.25 to 2.5 mm² (24 to 12 AWG). Torque 0.6 Nm.

2.5Nm = 22.13 pound inches; 1.7Nm = 15.05 pound inches; 0.6Nm = 5.31 pound inches.

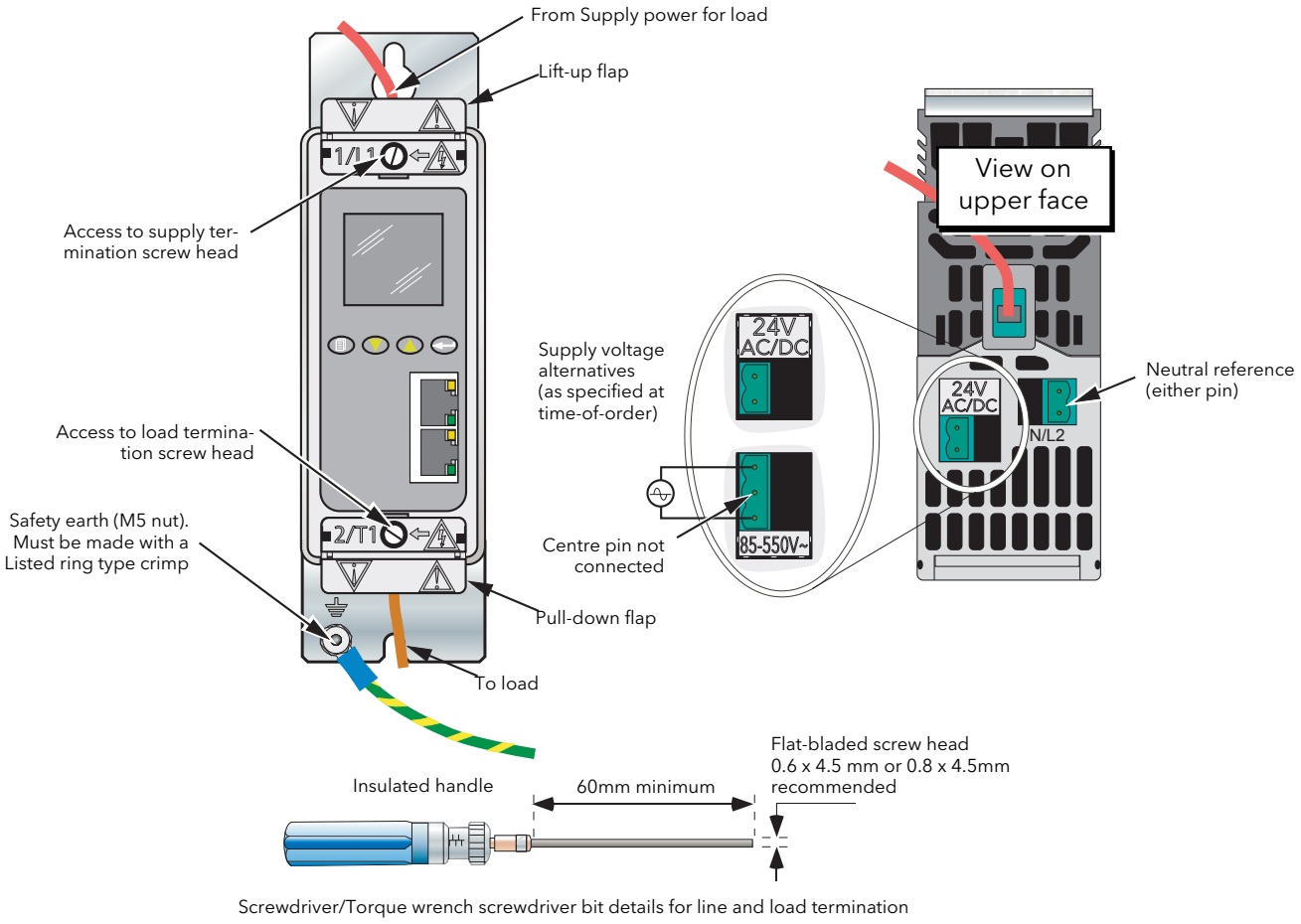
Table 2.2.1 Cable details

Notes:

1. Temperature rating of field-installed power conductors (Supply, Load and Safety earth): 90°C; Temperature rating of other wires : 75°C
2. An 0.6 x 3.5 mm flat-blade screwdriver should be used for pluggable connectors

2.2.2 Load wiring

The supply voltage for the load is connected at the terminal located in the centre of the upper side of the unit. The load is connected at the terminal located in the centre of the lower side of the unit.



Screwdriver/Torque wrench screwdriver bit details for line and load termination

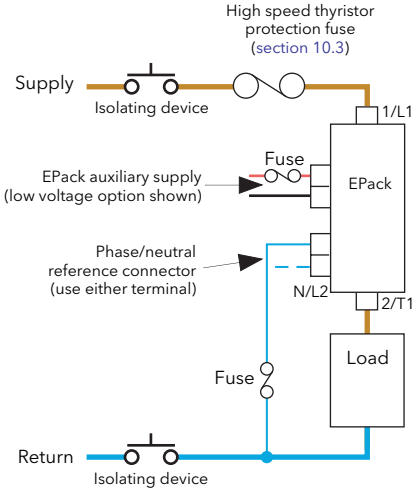


Figure 2.2.2 Supply power connection details

2.2.3 Signal wiring

Figure 2.2.3 shows the connector location, on the underside of the unit, for the digital and analogue inputs, and for the internal relay output.

ENABLE INPUT

In order for the power module thyristors to operate, the Enable input must be valid, In the default configuration, this is achieved by shorting pins 0V and DI1 of the I/O connector located on the underside of the unit (Digital input 1), or by using a User Value block to apply a logic high to the enable input to the relevant firing block in iTools.

If required, DI1 can be configured as a voltage input, and in this case it requires a high signal to be applied to D1 with the relevant zero voltage connected to 0V.

ALARM ACKNOWLEDGE

In the default configuration, shorting pins 0V and DI2 of the I/O connector located on the underside of the unit (Digital input 2) acknowledges alarms. As an alternative, a logic input can be wired to the relevant parameter using iTools.

If the graphical wiring editor option is enabled DI2 can be configured as a voltage input (if required), and in this case it requires a high signal to be applied to D2 with the relevant zero voltage connected to 0V.

MAIN SETPOINT

In the default configuration, the analogue input sets the main setpoint.

RELAY OUTPUT

In the default configuration, the relay output is operated by any alarm becoming active. The relay is normally energised (common and normally open shorted), and is de-energised (common and normally closed shorted) when active. In addition to the normal channel etc. alarms, if any of the following errors are detected, the watchdog alarm becomes active and de-energises the relay.

1. Missing mains. Supply voltage line is missing.
2. Thyristor short circuit*
3. Thyristor open circuit*
4. Network dips. A reduction in supply voltage exceeding a configurable value (VdipsThreshold), causes firing to be inhibited until the supply voltage returns to a suitable value. VdipsThreshold represents a percentage change in supply voltage between successive half cycles, and can be defined by the user in the Network.Setup menu, as described in section 6.17.2
5. Supply frequency fault. The supply frequency is checked every half cycle, and if the percentage change between successive 1/2 cycles exceeds a threshold value (max. 5%), a Mains Frequency System Alarm is generated. The threshold value (FreqDriftThold) is defined in the Network.Setup menu described in section 6.17.2
6. Supply failure to Epack unit.
7. Line under voltage (configurable between 2 and 15% of nominal voltage) (section 6.17.2).
8. Line over voltage (configurable between 2 and 15% of nominal voltage) (section 6.17.2).
9 Over current (configurable between 10 and 400% of nominal current) (section 6.17.2).

> * Note... It is not possible to detect a thyristor short circuit when the unit is delivering 100% output power. Similarly, it is not possible to detect thyristor open circuit when the unit is delivering 0% output.

It is possible, using iTools to wire the relay to become active under the control of any suitable parameter.

If the watchdog resets the unit, the relay is de-energised temporarily then re-energised at start-up.

2.2.3 SIGNAL WIRING (Cont.)

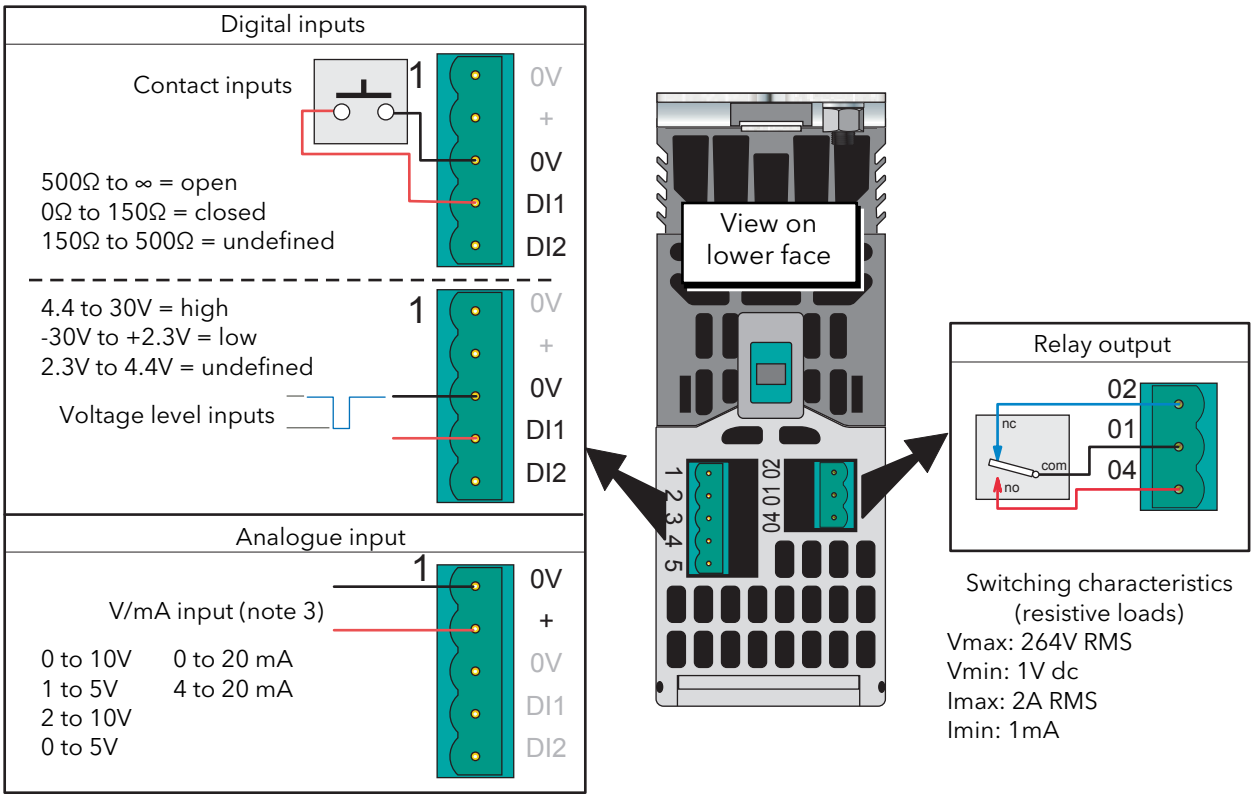


Figure 2.2.3 I/O details

Notes:

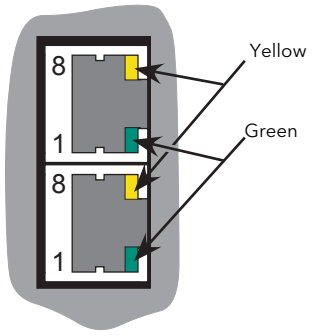
1. DI1 shown; DI2 similar
2. DI1 and DI2 can both be contact inputs or both be voltage inputs or be one of each.
3. Analogue input type (Volts or mA) is selected in I/O Analogue IP configuration (section 6.11.1). When a mA range is selected, a suitable shunt resistor is automatically connected into circuit. It is thus unnecessary for the user to fit external components.

COMMUNICATIONS PINOUTS

A pair of RJ45 connectors, wired in parallel is located on the front of the unit. Each connector has a pair of LED indicators to indicate network connection (amber LED) and network Tx activity (flashing green).

The connection is 10/100 base T, autosensing.

Pin	Signal
8	Not used
7	Not used
6	Rx-
5	Not used
4	Not used
3	Rx+
2	Tx-
1	Tx+
LEDs:	
Green = Tx activity	
Yellow = Connected	



3 OPERATOR INTERFACE

Located at the front of the Driver Module, the operator interface consists of a 26mm square display, and, four push-button switches.

3.1 DISPLAY

The display is divided vertically into three areas, which for the purposes of this manual are called the status area at thetop, the data display, in the centre, and the softkeys at the bottom. This display, together with the four pushbuttons allows full operation and configuration of the unit.

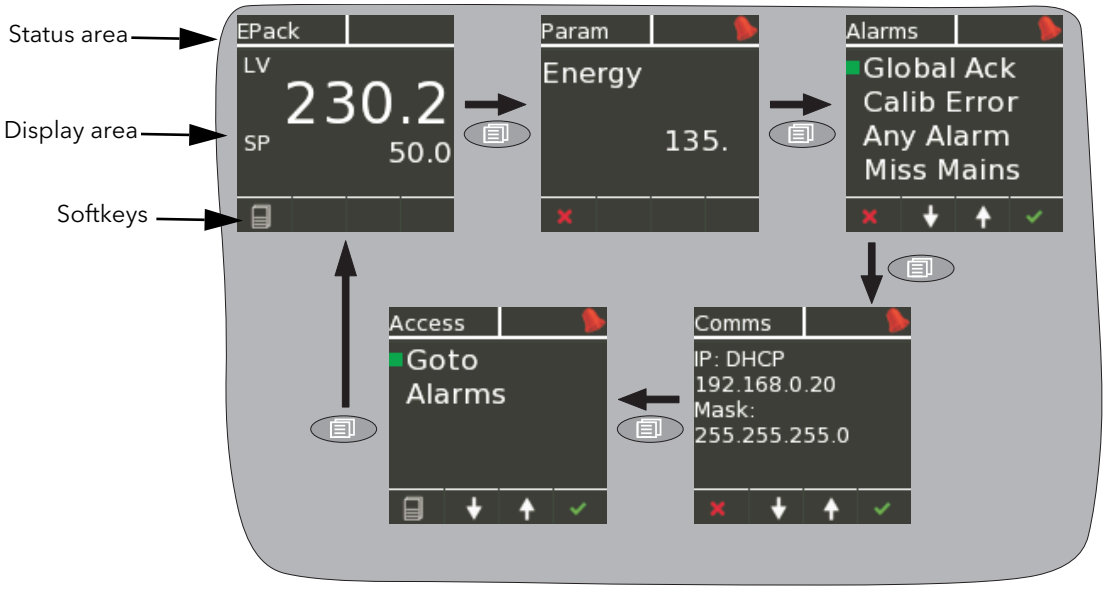


Figure 3 Operator interface

The figure above shows a typical operator mode screen set, scrolled through using the return (page) push-button.

Notes:

1. The Energy display appears only if the Energy option is fitted
2. The Alarms display appears only if there are any active alarms. The up/down arrow pushbuttons can be used to scroll through the alarm list, if there are more alarms active than can be displayed on one screen height.

The 'Goto' item allows the user to enter Engineer or Configuration mode, providing the password(s) are known. Section 5.1.3 describes the procedure, although the screen displays are different because the unit is shown in configuration mode.

3.2 PUSHBUTTONS

The functions of the four pushbuttons below the display depend on what is displayed in the softkey area. The leftmost pushbutton (Return) is associated with the leftmost softkey, the down arrow pushbutton is associated with the next softkey and so on. In the example above, the 'Return' key is used both to enter the Menu, and to return from it to the initial display.

3.2.1 Pushbutton functions

Return	Returns to previous menu (while menus are displayed), cancels editing (during parameter editing), and performs screen cycling (during operator mode).
Scroll down/up	Allows the user to scroll through the available menu items or values.
Enter	Goes to next menu item. In parameter edit mode, this button confirms the changes.

3.2.2 Menu item value selection

Menu items are scrolled through using the up/down pushbuttons. Once the required item is displayed, the Enter pushbutton is used to select it for editing. Editing of the item's value is carried out by scrolling through the available choices, using the up and down scroll keys. Once the desired value is displayed, the Enter pushbutton is used to confirm the choice.

Where multiple changes have to be made (as in editing an IP address for example), the Enter pushbutton acts as a right cursor key, moving from the field just edited to the next field. (The Return key moves the cursor left). Once all fields have been edited, the enter key is used a final time to confirm the choice.

3.3 FRONT PANEL EVENT INDICATION

A number of instrument alarms and events can occur, and these are indicated by icons appearing on the display screen. The events and alarms are listed below. See section 9 for a more details.

3.3.1 Instrument events

Conf Entry	The instrument has been placed in configuration mode (cogwheel symbol).
Conf Exit	The instrument has been taken out of configuration mode (no icon).
GlobalAck	A global acknowledgement of all safe latched alarms has been performed.
Quick Code Entry	The Quick Code menu is active (cogwheel icon + 'QCode' in display area).

The following alarms all cause a red bell icon to appear in the top right hand corner of the screen.

3.3.2 Indication alarms

LimitAct	One or more limits are active in the control block
LoadOverI	An over current alarm has become active in one or more Network blocks.
PrcValTfr	Process value transfer is active inthe control block.

3.3.3 System alarms

FuseBlown	There is no internal fuse, but it is possible to use DI2as a 'fuse-blown' input wired to the alarm block in iTools.
MainsFreq	Mains Frequency is outside the acceptable range.
Missmains	One or more supply phases is missing.
NetwDip	One or more 'network dip' alarms has been detected.

3.3.4 Process alarms

ChopOff	One or more 'Chop-off' alarm has been detected.
ClosedLp	One or more Control block 'Closed Loop' alarm has been detected.
InputBrk	Over current in shunt.
MainVFault	One or more 'Mains Voltage Fault' (over or under) has been detected.
PLF	One or more 'Partial Load Failure' alarm has been detected.
TLF	One or more 'Total Load failure' alarm has been detected.

4 QUICKCODE

At first switch-on, the Driver Module enters the 'QuickCode' menu which allows the user to configure the major parameters without having to enter the full configuration menu structure of the unit. Figure 4 shows an overview of a typical QuickCode menu. The actual displayed menu items will vary according to the number of software features purchased. When 'Finish' is selected, the instrument cold starts.

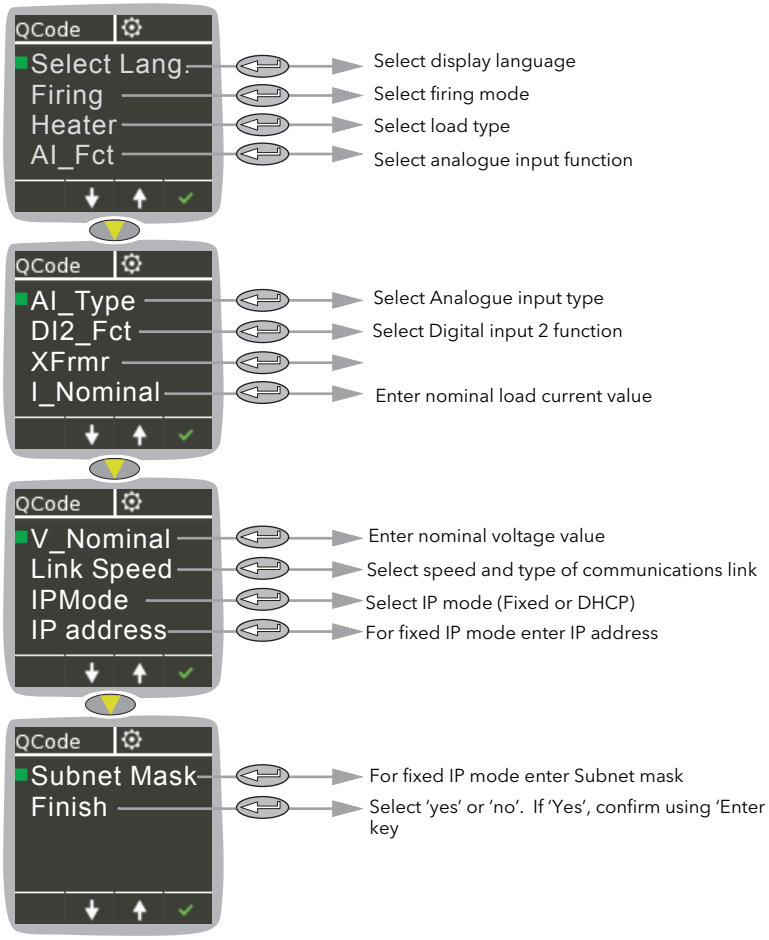


Figure 4a Typical QuickCode menu

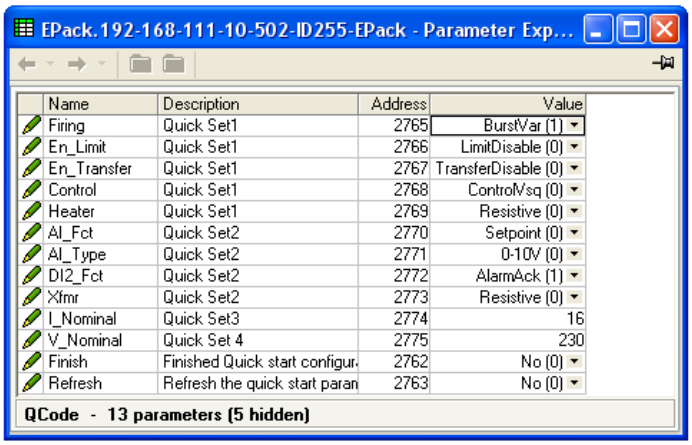


Figure 4b iTools Qcode page

4 QUICKCODE MENU (Cont.)

Notes:

1. If the unit has been fully configured at the factory, the Quickcode menu will be skipped, and the unit will go into operation mode at first switch on.
2. Once quit, the Quickcode menu can be returned to at any time from the Access menu (described later in this document (section 6)). Returning to the Quickcode menu cold-starts the unit.

4.1 QUICKCODE MENU PARAMETERS

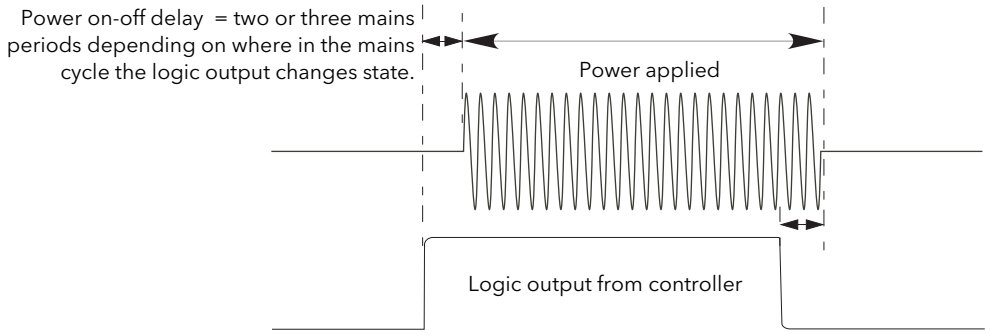
Language	Initially, English, French, German and Italian may be selected. Other languages may be added during the lifetime of this issue of the manual. Once confirmed all further displays appear in the selected language.
Firing Mode	Select from LG (Logic), BF (Burst Variable), FX (Burst Fixed), HC (Hal fCycle) or PA (Phase Angle).
Heater	Select from R (Resistive), IR (Infra red), CS (Silicon carbide) or MO (Molybdenum disilicide)
En_Limit	Used to enable/disable threshold limit.
En_Transfer	Select Transfer Enable (Proportional limit) as 'Yes' (enabled) or 'No' (not enabled).
Control	Select VSq or Power
AI Fct	Select SP (setpoint), HR (setpoint limit), CL (current limit), TS (transfer limit) or XX (no function) as Analogue Input function
AI Type	Select 0V (0 to 10V), 1V (1 to 5V), 2V (2 to 10V), 5V (0 to 5V), 0A (0 to 20mA) or 4A (4 to 20 mA) as analogue input type.
DI2 Fct	AK (Alarm acknowledge), RS (Remote setpoint), FB (Fuse Blown), or XX (none)
XFRMR	XX (Resistive load type) TR (Transformer primary)
I Nominal	A value, normally between the maximum current the unit can safely sustain and a quarter of this value. (Lower values are not recommended as in such cases, the resulting accuracy and linearity are not guaranteed to be within specification.) Default value appears. Use up/down arrow buttons to edit.
V Nominal	A value between the maximum permanent supply voltage (+10%) to the modules, and a quarter of this value. Default value appears. Use up/down arrow buttons to edit.
Link Speed	Select from 'AutoNego', 100Mb, 100 Mb Half duplex, 10 Mb, 10Mb Half duplex.
IP Mode	Choose 'Fixed' or 'DHCP'
IP Address	For fixed mode, allows the IP address to be edited, one section at a time. Use the up-down arrow pushbuttons to edit the first section (XXX.xxx.xxx.xxx), then 'Enter' to move to the next section (xxx.XXX.xxx.xxx) and repeat until all four sections are as required
SubNetMask	As for IP address above, but for the subnet mask.
Finish	If confirmed, Finish quits quick start and the instrument restarts.

4.2 SOME DEFINITIONS

4.2.1 Firing modes

LOGIC

Power switches on, two or three zero crossings of the supply voltage after the logic input switches on. Power switches off two zero crossings of current after the logic input switches off. For resistive loads, voltage and current cross zero simultaneously. With inductive loads, a phase difference exists between the voltage and current, meaning that they cross zero at different times. The size of the phase difference increases with increasing inductance.



Figue 4.2.1a Logic firing mode

BURST FIXED FIRING

This means that there is a fixed 'cycle time' equal to an integer number of supply voltage cycles as set up in the Modulator menu. Power is controlled by varying the ratio between the on period and the off period within this cycle time (figure 4.2.1b).

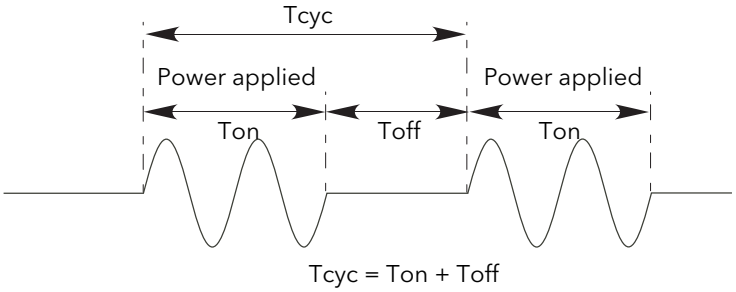


Figure 4.2.1b Burst Fixed mode

4.2.1 FIRING MODES (Cont.)

BURST VARIABLE FIRING

Burst Firing Variable is the preferred mode for temperature control. Between 0 and 50% of setpoint, the on time is the 'Min on' time set in the modulator menu and the off time is varied to achieve control. Between 50% and 100%, the off time is the value set for 'Min on' and power is controlled by varying the number of on cycles.

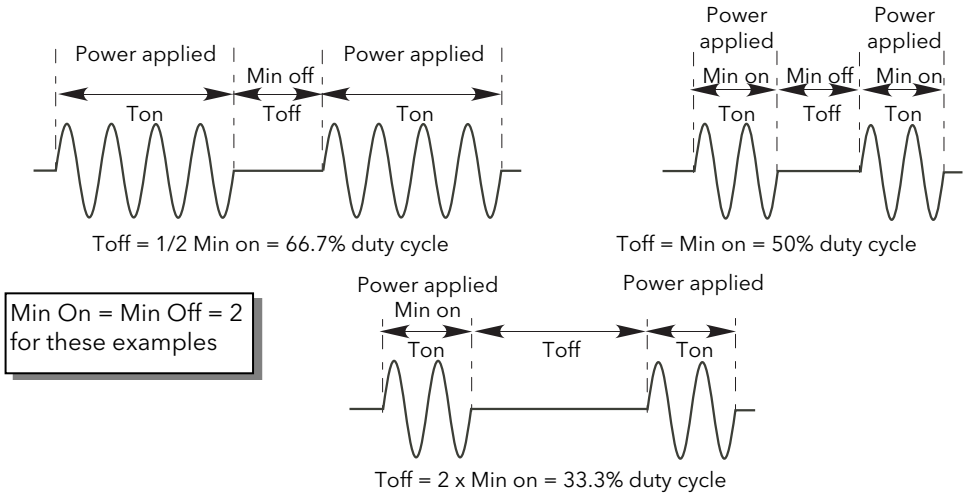


Figure 4.2.1c Burst variable firing

PHASE ANGLE CONTROL

This mode of firing controls power by varying the amount of each cycle which is applied to the load, by switching the controlling thyristor on part-way through the cycle. Figure 4.2.1d shows an example for 50% power.

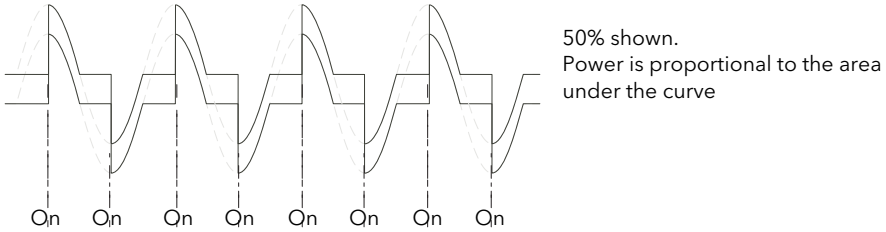


Figure 4.2.1d Phase angle mode

HALF CYCLE MODE

Burst mode firing with a single firing (or non-firing) cycle is known as 'Single cycle' mode. In order to reduce power fluctuations during firing time, Intelligent half-cycle mode uses half cycles as firing/non-firing periods. Positive and negative going cycles are evened out, to ensure that no dc component arises. The following examples describe half-cycle mode for 50%, 33% and 66% duty cycles.

50% DUTY CYCLE

The firing and non-firing time corresponds to a single supply cycle (figure 4.2.1e).

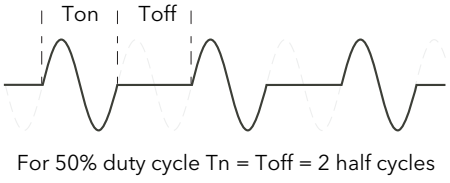
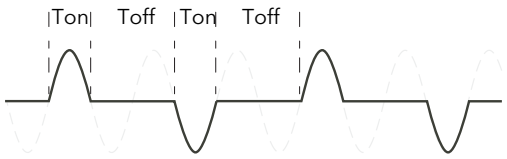


Figure 4.2.1e Half cycle mode: 50% duty cycle

4.2.1 FIRING MODES (Cont.)

33% DUTY CYCLE

For duty cycles less than 50%, the firing time is one half-cycle. For a 33% duty cycle, firing time is one half cycle; the non-firing time is two half-cycles (figure 4.2.1f).

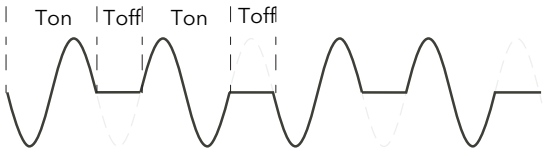


For 33% duty cycle
Ton = 1 half cycle; Toff = 2 half cycles

Figure 4.2.1f Half cycle mode: 33% duty cycle

66% DUTY CYCLE

For duty cycles of greater than 50%, the non-firing time is one half-cycle. For 66% duty cycle, the firing time is two half cycles; the non-firing time is one half cycle (figure 4.2.1g).



For 66% duty cycle
Ton = 2 half cycles; Toff = 1 half cycle

Figure 4.2.1g Half cycle mode: 66% duty cycle

4.2.2 Feedback type

All feedback types (except 'Open Loop') are based on real-time measurement of electrical parameters that are normalised to their equivalent Nominal values.

V^2	Feedback is directly proportional to the square of the RMS voltage measured across the load. For two- or three-phase systems, feedback is proportional to the average of the squares of the individual phase-to-phase or phase-to-Neutral RMS voltage across each load.
Power	Feedback is directly proportional to the total true power delivered to the load network.
I^2	Feedback is directly proportional to the square of the RMS current through the load. For two- or three-phase systems, feedback is proportional to the average of the squares of the individual RMS load currents.
Open loop	No measurement feedback. The thyristor firing angle in Phase angle mode, or the duty cycle in burst-firing mode, are proportional to the setpoint.

4.2.3 Transfer Mode

The control system can use automatic transfer of certain feedback parameters. For example with loads with very low cold resistance, I^2 feedback should be used to limit inrush current, but once the load has started to warm up, Power feedback should be used; the control program can be configured to change feedback mode automatically.

The Transfer mode can be selected as I^2 to P or I_{rms} to P as appropriate to the type of load being controlled.

None	No feedback parameter transfer to the control program.
I^2	Selects transfer mode: I^2 to the selected Feedback Mode (above).

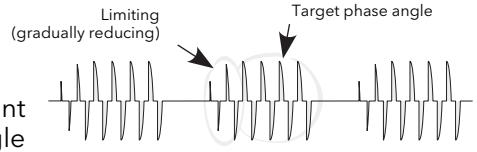
4.2.4 Limitation features

In order, for example, to prevent potentially damaging inrush currents, it is possible to set a value for power or Current squared which is not to be exceeded. For loads exhibiting a low impedance at low temperatures but a higher impedance at working temperature, the current drawn reduces as the load warms, and limiting gradually becomes unnecessary.

Section 6.6.3 describes the configuration parameters which allow the user to enter a Process Variable (PV) and a setpoint (SP), where the PV is the value to be limited (e.g. I^2) and the SP is the value that the PV must not exceed.

FIRING ANGLE LIMITING

For phase angle control, limiting is achieved by reducing the firing angle on each half mains cycle such that the limit value of the relevant parameter is not exceeded. As limiting is reduced so the phase angle tends to its target value.



DUTY CYCLE LIMITING

For Burst Firing only, limiting reduces the 'On' state of the burst firing driving the load. Load current, voltage and active power are calculated over the period of each (Ton + Toff) period.

CAUTION

When applied to load current, duty cycle limiting does not limit the peak current value, and under some circumstances this may allow an overheating hazard in the load and/or Power Module to develop.

CHOP OFF

This is a limiting technique which detects an over-current alarm state and stops further thyristor firing for the duration of that alarm state. All the relevant parameters are to be found in the Network Setup menu (section 6.17.2).

There are two alarms which may trigger Chop Off, as follows:

1. The chop-off alarm becomes active when a current threshold is exceeded for more than a pre-defined number of mains period. This current threshold is user- adjustable from 100% to 400% of unit's nominal current (INominal).
2. The alarm is active if ChopOff2Threshold is exceeded more than a specified number of times (Number Chop Off)) within a specified time period (Window Chop Off). ChopOff2Threshold is adjustable between 100% and 350% inclusive, of Inominal; Number Chop Off can be selected to any value between 1 and 16 inclusive; Window Chop Off can be set to any value between 1 and 65535 seconds (approximately 18 hours 12 mins.).
   Each time the threshold is exceeded, the unit stops firing, raises a chop off condition alarm, then after 100ms, restarts using an up-going safety ramp. The condition alarm is cleared if the unit successfully restarts. If the alarm is raised more than the specified number of times within the specified window, then the Chop Off alarm is set and the unit stops firing. Firing is not resumed until the operator acknowledges the Chop Off alarm.

5 CONFIGURATION FROM THE FRONT PANEL

At power up or after quitting the Quickcode menu, the unit initialises and then enters the summary page (figure 5.1) showing the real-time values of the two parameters selected in Instrument Display configuration (section 6.10.2).

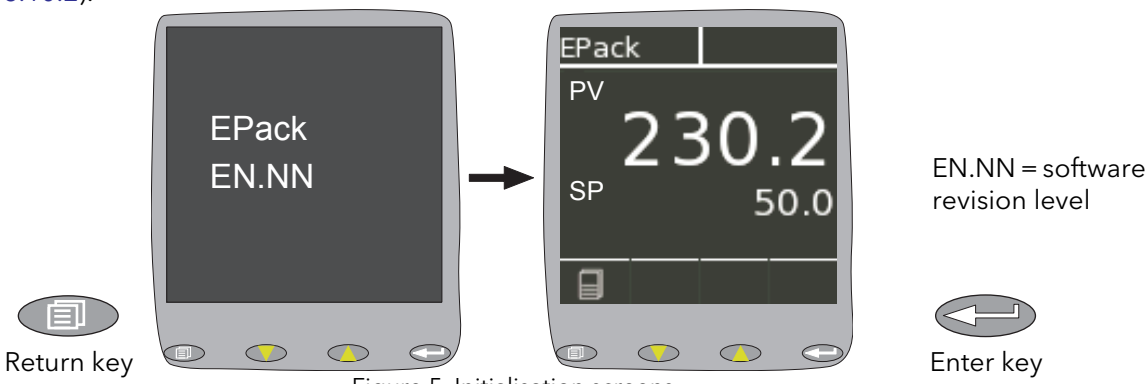


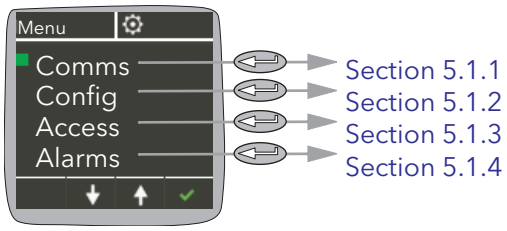
Figure 5 Initialisation screens

If any faults are detected during initialisation (e.g. supply voltage missing), then error messages appear on the display screen.

5.1 MENU PAGES

Operating the return key opens the first page of the menu, the content of which depends on the current access level and on the number of options enabled.

The description below assumes 'Configuration' level access.



5.1.1 Comms menu

This allows the following communications parameters to be viewed or configured:

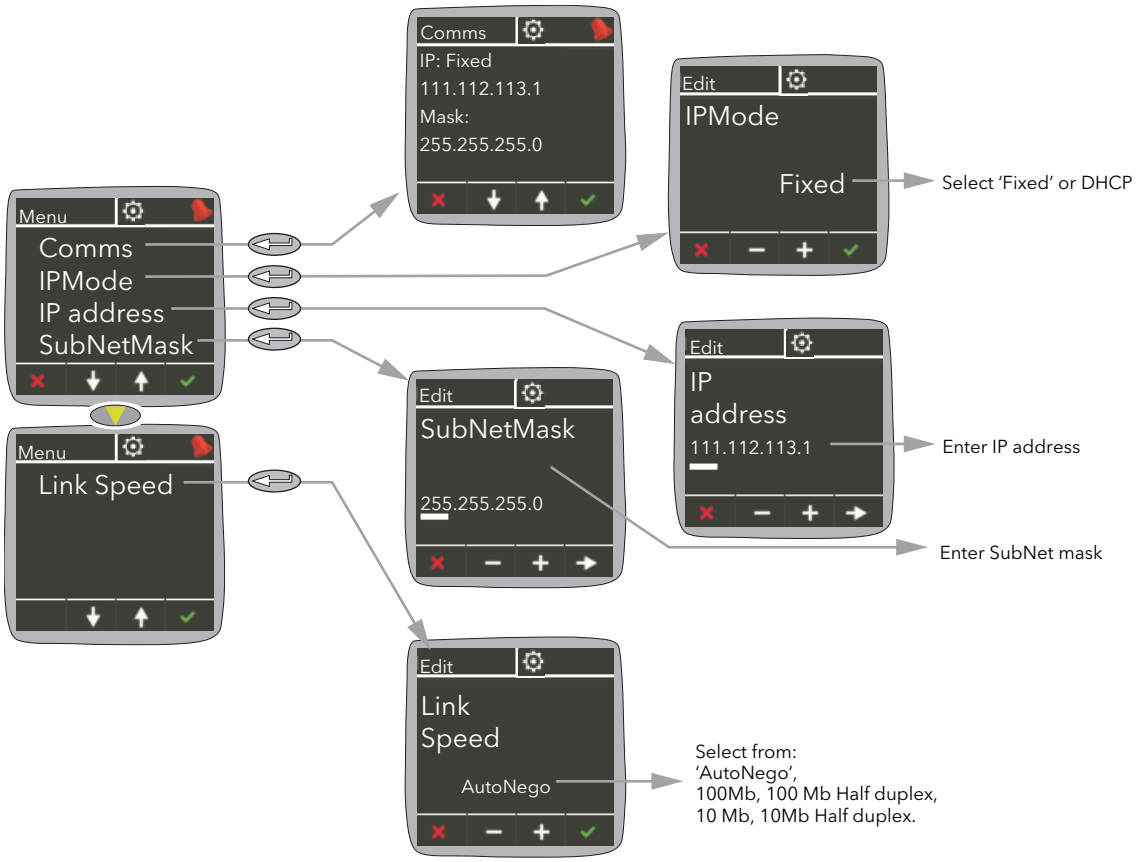


Figure 5.1.1 Comms menu

Comms	Displays (read only) the current IP and Subnet mask addresses.
IP Mode	Allows the user to select 'Fixed' or 'DHCP' as the IP address source. If 'Fixed' is selected, then the Address and Subnet Mask can be edited in the following fields. It must be ensured that the address is unique to the network. If DHCP is selected, the IP Address and SubNetMask parameters described below do not appear. DHCP will be successful only if there is a suitable DHCP server on the network to which the unit is connected.
IP Address	Appears only if 'Fixed' is selected as IP Mode (above). Allows the user to edit the current IP address. Example: To set an IP address of 111.112.113.1, use the up and down arrow pushbuttons to set the first section of the address to 111. Use the enter key, and then the up and down pushbuttons to set the second section to 112. Use the enter key, and then the up and down pushbuttons to set the third section to 113. Use the enter key, and then the up and down pushbuttons to set the fourth section to 1 (not 01 or 001). Use the Enter key to quit Edit mode. If any section is already as required, it can be skipped by using the Enter key.
SubNetMask	Set the subNet mask as described above for the IP address.
Link Speed	Select the required link type and speed.

Note... For details about subnet masks, see section 7.1.3 (iTools wiring).

5.1.2 Config menu

This menu allows a number of network and firing output parameters to be set up, as well as Analogue input and IP mode types

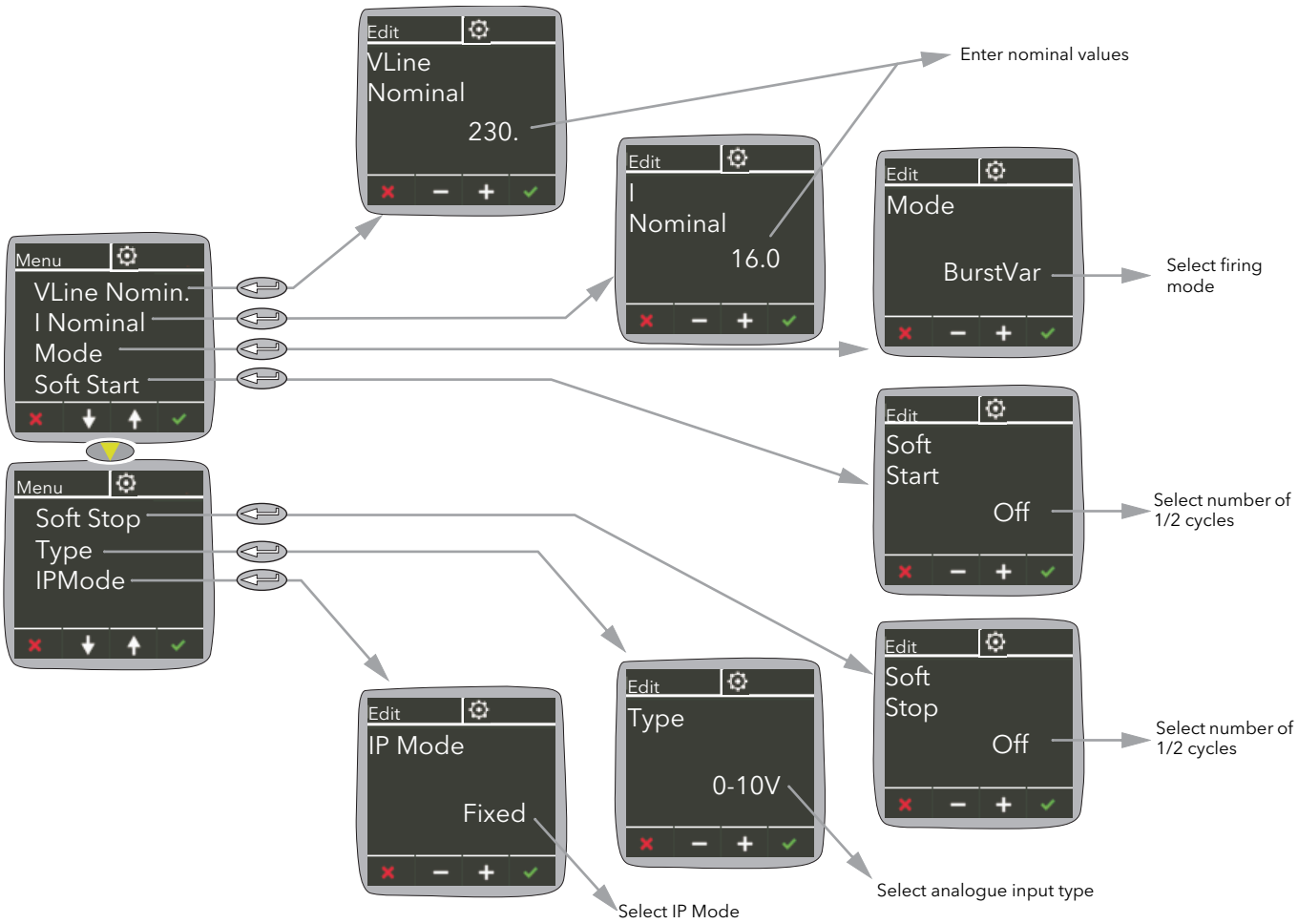


Figure 5.1.2 Config menu

VLine Nominal	Line voltage nominal value (Line to neutral)
I Nominal	Nominal current supplied to the load
Mode	Firing Mode. Allows the firing mode to be selected as Burts Var, Burst Fix, Logic, Phase Angle (PA) or Intelligent half cycle (IHC). See section 6.9 for more details.
Soft Start	For Burst Firing only, this is the soft start duration, in supply voltage 1/2 cycles, applying a phase angle ramp at the beginning of each on period. See section 6.9 for more details.
Soft Stop	In Burst Firing, the soft stop duration, in supply voltage 1/2 cycles, applying a phase angle ramp at the end of each on period. See section 6.9 for more details.
Type	Select the Analogue Input type as 0 to 10V, 1 to 5 V, 2 to 10V, 0 to 5V, 0 to 20mA,4 to 20mA.
IP Mode	Fixed or DHCP.

5.1.3 Access menu

Allows access to the Operator, Engineer, Configuration and Quick Code menus and allows passwords to be set up. Alarms can also be viewed in this menu.

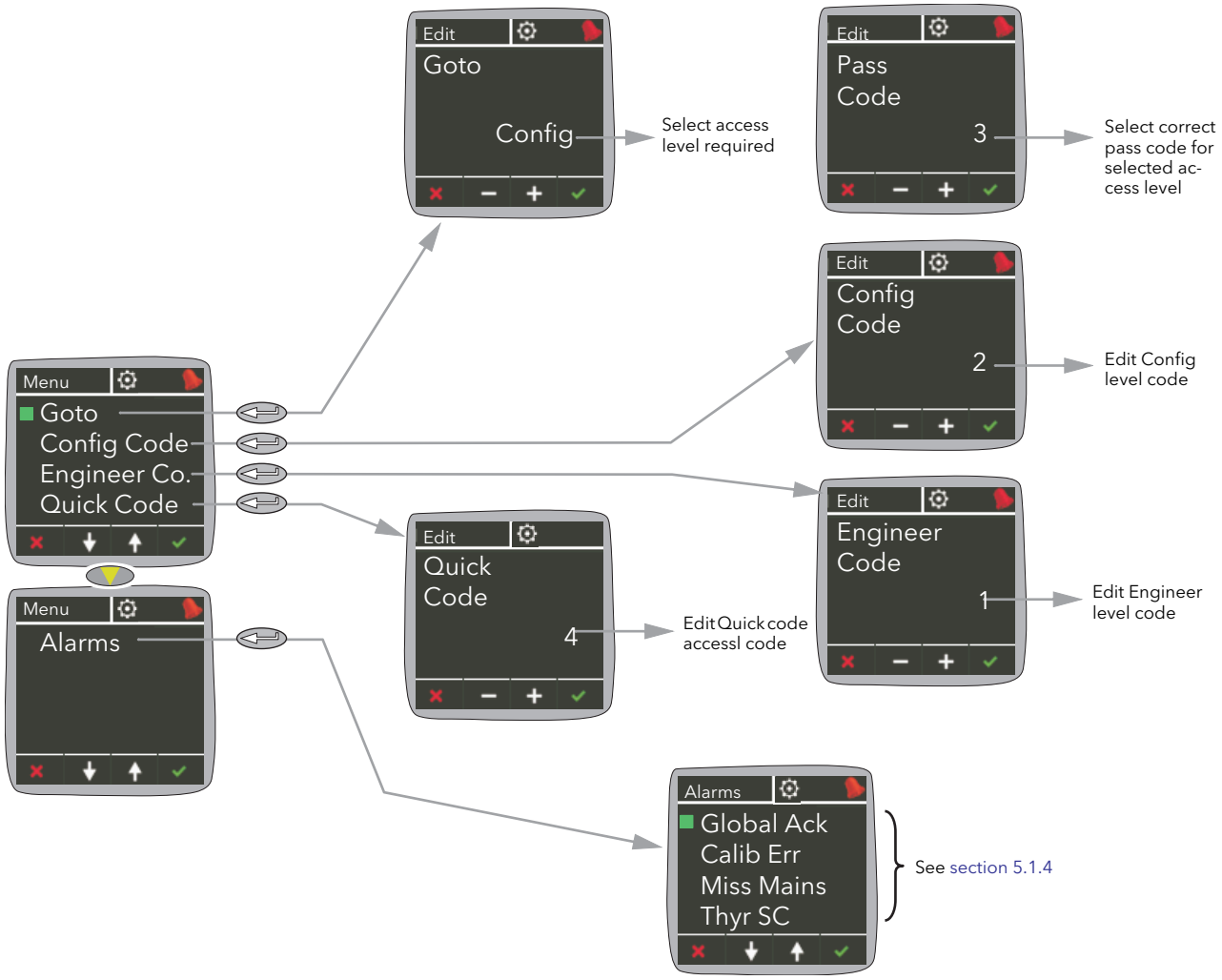


Figure 5.1.3 Access menu

Goto	Allows access level to be selected.
Pass Code	Allows the user to enter the code for the access level required.
Config Code	Allows the user to edit the Configuration access level code
Engineer Code	Allows the user to edit the Engineer access level code
Quick Code	Allows the user to edit the Quik code access code
Alarms	Any active alarms appear, and details can be found by selecting the relevant alarm and using the Enter push button (Section 5.1.4).

Note...The default access codes are Operator = 0; Engineer = 1, Config = 2, Quickcode = 3.

5.1.3 ACCESS MENU (Cont.)

ACCESS TO MENUS

1. Open the Access menu item.
2. Open the Goto menu item and select the access level required.
3. Enter the access code for the level required. If this access code is correct the relevant menu appears.

> Note... The above applies only when the user attempts to access a higher level than that current. If accessing a lower level, the user needs only to open the Goto item and select the required level. After doing this, the instrument will probably restart.

5.1.4 Alarms menu

Allows the user to view Global acknowledgement enable status, and calibration error (if any). Any active alarms appear, and details can be found by selecting the relevant alarm and using the Enter push button. Active alarms can be acknowledged, if applicable, by a further operation of the Enter button.

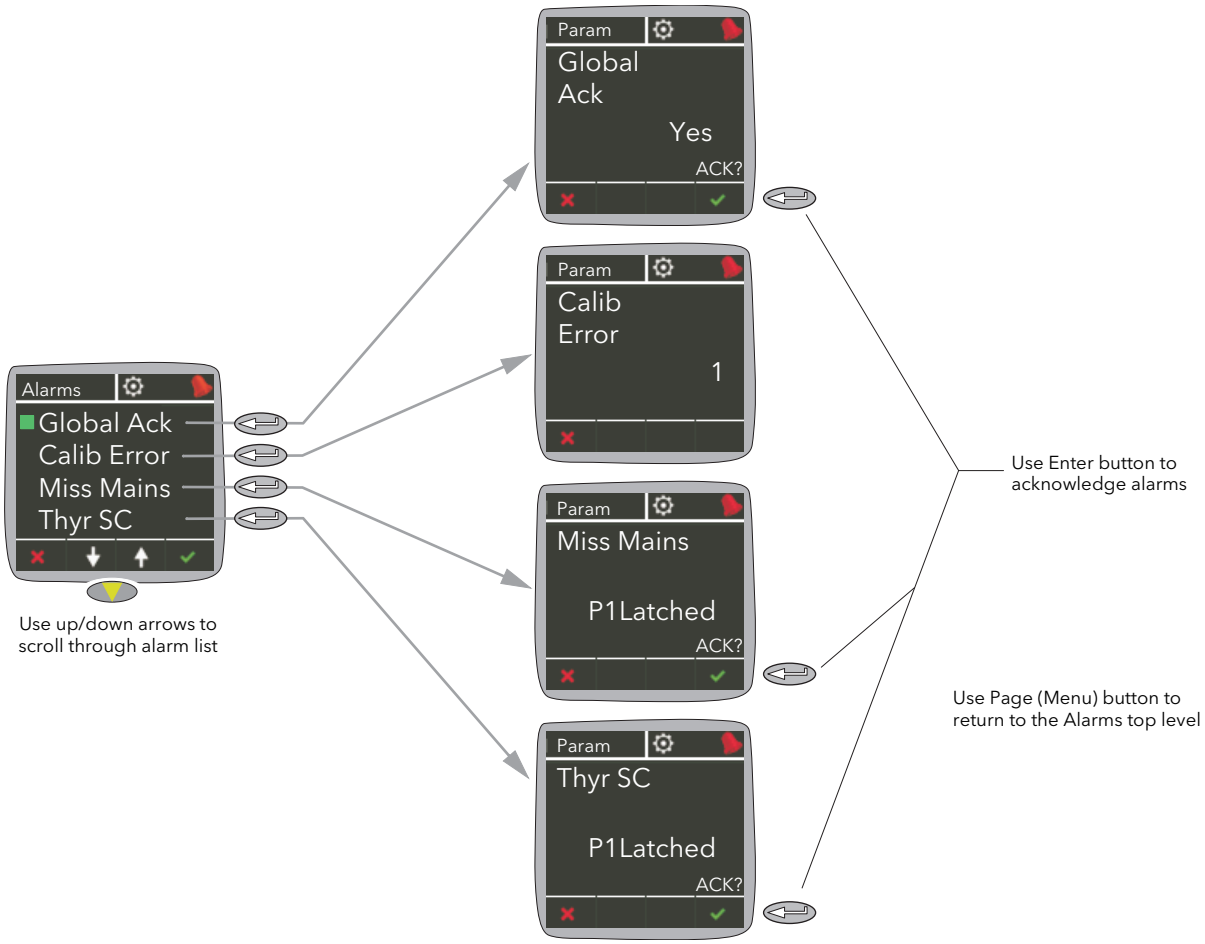


Figure 5.1.4 Alarms menu

6 CONFIGURATION USING ITOOLS

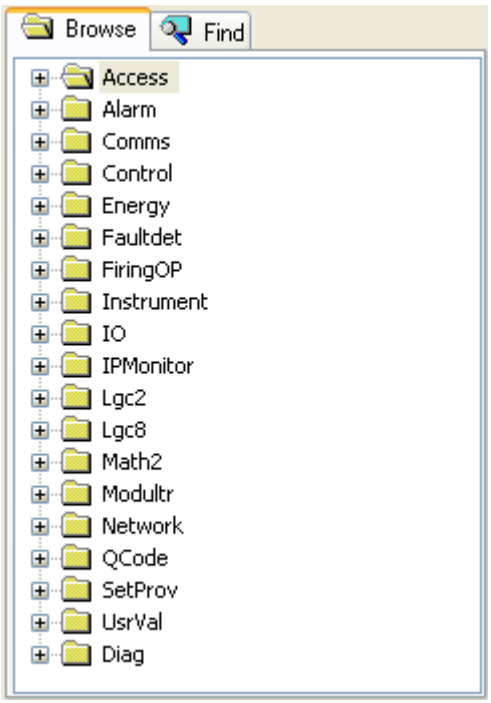
6.1 INTRODUCTION

Note: Section 6 contains descriptions of all the menus which can appear. If an option or a feature is not fitted and/or enabled, then it does not appear in the top level menu.

Section 7 details how to connect using iTools and gives details of the features available from this instrument.

6.2 OVERVIEW

The configuration of the unit is divided into a number of separate areas as follows:



iTools tree

Notes:

1. Current rating, limitation, transfer control, power control, energy counter and the graphical wiring editor (GWE) are chargeable options. iTools secure can be used to upgrade units.
2. 32A unit are set on 16A and 63A unit are on 40A by default.

6.3 ACCESS MENU

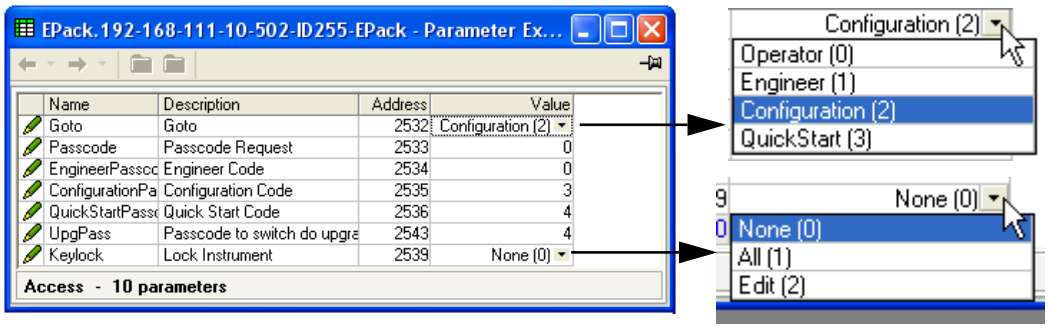


Figure 6.3 iTools Access menu

Goto	Select access level	
Passcode	Select relevant pass code for the access level required.	
EngineerPasscode	Passcode for Engineer level access	
ConfigurationPasscode	Passcode for Configuration level access	
QuickCodePasscode	Access code for Quickcode menu	
UPGPass	PassCode for upgrading device	
Keylock	None	No restriction. All parameters at the current access level may be viewed and edited.
	All	All editing and navigation is prevented. All keys are locked so it is not possible to 'undo' this action from the Operator interface. Once 'All' is selected, the keyboard can be released only via iTools.
	Edit	Parameter editing is possible only in Configuration level; parameters are Read Only in other levels. In the Operator or Engineer level menus, the 'Back' key is still active allowing access to the 'Goto' menu so that the access level may be changed if the relevant Pass code is known.
Clear memory	When available and set to 'yes', the device clears all configuration data, performs a cold-start and enters the Quickcode mode.	

6.4 ALARM CONFIGURATION

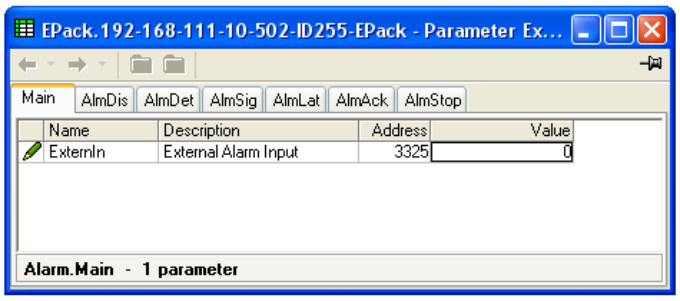


Figure 6.4 Alarm configuration

Main	'ExternIn' is the input of this block. When connected to digital input 2 (DI2) and DI2 connected to a fuse blown detection contact, this alarm is considerd as a 'fuse blown' alarm
AlarmDis	This allows the listed alarm to be enabled or disabled. 0 = Enable; 1 = Disable
AlmDet	This parameter indicates whether the alarms has been detected and is currently active. 0 = Inactive; 1 = Active
AlmSig	Signals that the alarm has occurred and is possibly latched by the Alarm Latch settings. If the user wishes to assign an alarm to, for example, a relay then it is the appropriate AlmSig parameter that should be wired. 0 = Not Latched; 1 = Latched.
AlmLat	The alarm can be configured as latching or non-latching, the latched state being shown in the Alarm Signal (AlmSig) register. 0 = Non-Latching; 1 = Latching.
AlmAck	Allows the alarm to be acknowledged. When an alarm is acknowledged, its related signalling (AlmSig) parameter is cleared. If the alarm is still active (as shown by the detection (AlmDet) parameter) then the alarm cannot be acknowledged. The acknowledge parameters automatically clear after being written. 0 = Do not acknowledge; 1 = Acknowledge
AlmStop	Allows the alarm to be configured such that it stops the related power channel firing. AlmStop is activated by the signalling parameters and thus may be latching. 0 = Do not stop; 1 = Stop.

6.5 COMMUNICATIONS CONFIGURATION

The communications menu allows the user to view, and in some cases, to edit communications parameters associated with the communications option.

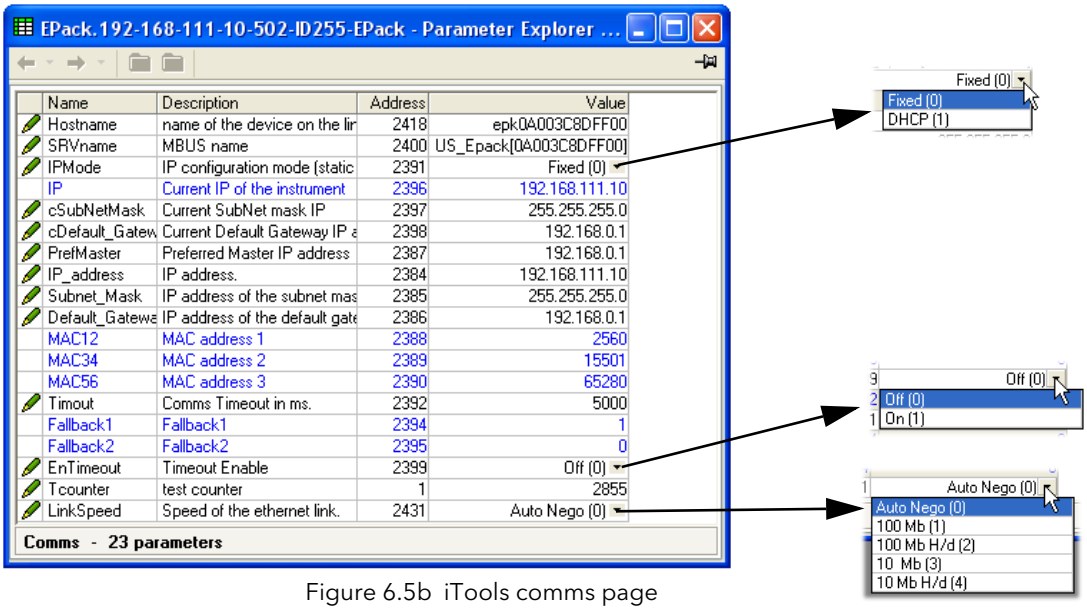


Figure 6.5b iTools comms page

Host name	The name of the device on the link-local network. For convenience, the device can declare itself on the pseudo-domain .local. If the host-name of the device is changed, it must be ensured that the name is unique on the net-work. In this is not the case, the instrument will transparently try to find another unique name automatically. The default value is related to the MAC address of the device and thus should already be unique.
SRV name	MBUS name. The name of the device, as shown by iTools
IP Mode	The IP configuration mode of the instrument. 0: Static. The IP parameters are taken from the parameter IPaddr, SubNetMark and NetGateway. 1: DHCP. The IP address of the instrument is automatically assigned by an external DHCP server. If the instrument fails to acquire an IP address, the auto IP mech-anism assigns an IP to the instrument in the range 169.254.xxx.xxx with subnet mask 255.255.0.0.
IP Status	This (hidden) parameter describes the current status of the IP address of the instrument.
IP	This is the current IP address of the device which may be different from the configured IP address.
cSubnetMask	The current subnet mask associated with 'IP' above.
cDefault Gateway	The current default gateway associated with 'IP' above.
Pref Master	The IP address of the preferred host.
Address	On a network of instruments this address is used to specify a particular instrument. Each instrument on a network must be set to a unique address, the available address range depending upon the network protocol. (For Modbus/TCP, this is the modbus address of the device (255 by default).)
IP address	The configured IP address of the device
Subnet Mask	The subnet mask associated with 'IP address' above.
Default Gateway	The default gateway associated with 'IP address' above.

6.5 COMMUNICATIONS MENU (Cont.)

MAC12	First two Bytes of the MAC Address **11-22**-33-44-55-66
MAC34	Second two Bytes of the MAC Address 11-22- **33-44**-55-66
MAC56	Third two Bytes of the MAC Address 11-22-33-44- **55-66**
Timeout	Comms timeout value in ms. If no usercomms request arrives twithin the time specified in this parameter, the Fallback values will change.
Fallback1	Set to 1 when a communication timeout has not occured; set to zero if a timeout occurs.
Fallback2	Inverse value of the Fallback1 parameter.
En Timeout	If set to ON (1), the timeout of the comms requests will be monitored. The outputs Fallback1 and Fallback2 will be adjusted accordingly. 0 =Off. 1= On
Protocol	Main communication protocol to access the instrument over ethernet comms. 0 = Modbus TCP
IO gateway	IP address of IO gateway.
Link Speed	Select a link speed from Auto negotiate, 100MB, 100MB half duplex, 10 MB or 10MB 1/2 duplex.

6.6 CONTROL CONFIGURATION

The control menu provides the control algorithm to perform power control and transfer, threshold limiting and phase angle reduction (in the case of burst firing). Figure 6.6, below, gives an overview of the menu, which is described in the following sections:

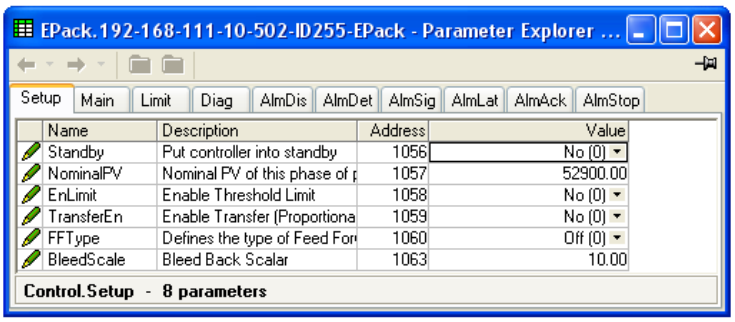


Figure 6.6 Control menu overview

6.6.1 Control setup menu

This contains parameters for setting the type of control to be performed.

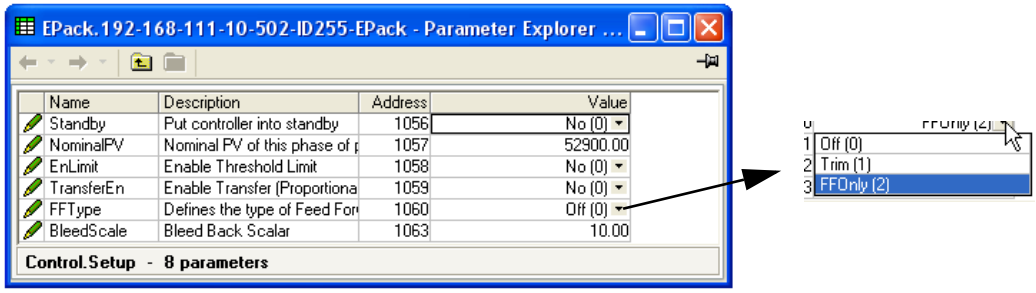


Figure 6.6.1 Control setup page

PARAMETERS

Standby	If Yes (1), the controller enters Standby mode and zero % power is demanded. When removed from Standby (0) the unit returns to operating mode in a controlled manner.
Nominal PV	Normally the nominal value for each control type. For example, for feedback mode = V^2, Vsq should be wired to the Main PV, and Nominal PV set to the nominal value expected for V^2 (usually $VLoadNominal^2$).
En Limit	Used to enable/disable threshold limit.
Transfer En	Select Transfer Enable (Proportional limit) as 'Yes' (enabled) or 'No' (not enabled).
FF Type	Feedforward Type. Off (0). Feedforward is disabled Trim (1). Feedforward value is the dominant element of the output. Trimmed by the control loop based on the Main PV and setpoint. FFOnly (2). The feedforward value is the output from the controller. Open loop control may be configured by this means.
FF Gain	The entered gain value is applied to the Feedforward input.
FF Offset	The entered value is applied to the Feedforward input after the Gain value has been applied to it.
Bleed Scale	Internal parameter for use by service personnel

6.6.2 Control Main menu

This menu contains all the parameters associated with the Main control loop.

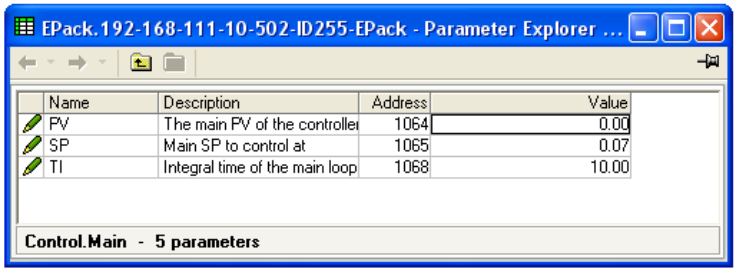


Figure 6.6.2 Control 'Main' menu

PARAMETERS

PV	Displays the main Controller Process Variable (PV). Wired to the measurement which it is to be controlled. For example, to perform V^2 control. Vsq should be wired to this (PV) parameter and Nominal PV configured appropriately.
SP	The Setpoint to control at, as a percentage of Nominal PV (the upper range of the loop in engineering units). For example, if Vsq = 193600, and SP is set to 20%, the controller attempts to regulate at 193600 x 20/100 = 38720.
Trans PV	Transfer PV. This is the PV measurement for transfer. For example, if a V2 to I2 transfer is required, the Vsq should be wired to MainPV and Isq to TransferPV. Appears only if Trans Enable (section 6.6.1) is set to 'Yes'.
Trans SP	The span of operation for transfer. Appears only if Trans Enable (section 6.6.1) is set to 'Yes'.
TI	Allows the user to define an integral time for the main PI control loop.

6.6.3 Control limit configuration

This area configures parameters relating to the limit control loop.

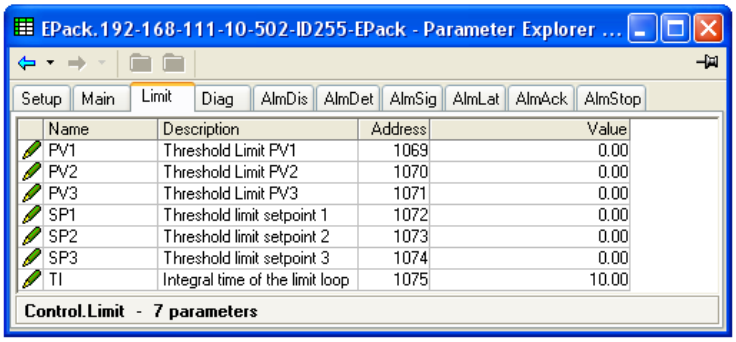


Figure 6.6.3 Control limit menu

PARAMETERS

PV1 to PV3	Threshold value for limit loops 1 to 3 respectively. This is the value to perform threshold limit control. 'Limit Enable' must be set to 'Yes' in the Setup menu (section 6.6.1).
SP1 to SP3	The setpoint for limit loops 1 to 3 respectively.
TI	The integration time for the limit PI control loop.

Example:

If I^2 threshold limiting is required, Isq is wired to PV1, and the required threshold value is entered at SP1. In phase angle configuration, the phase angle is reduced to achieve the limit setpoint; in burst firing, the unit continues to fire in bursts, but these bursts are of phase angle in order to achieve the limit setpoint. The modulation continues to attempt to reach the main setpoint.

Also known as phase angle reduction burst firing.

6.6.4 Control diagnostic menu

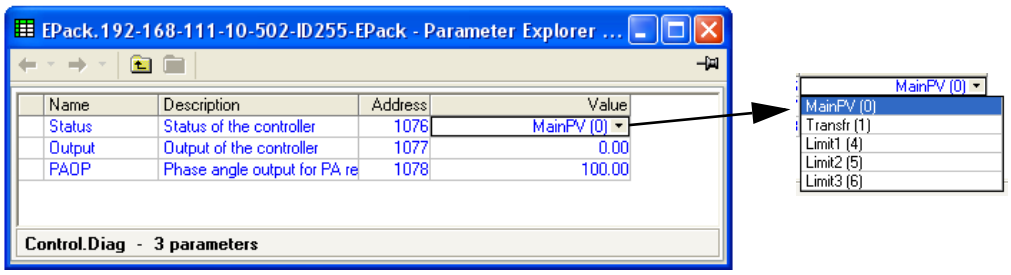


Figure 6.6.4b iTools diagnostic menu

PARAMETERS

Status — Indicates the current operating state of the controller:
- Main PV — The control strategy is using Main PV as the control input
- Transfr — The transfer input us being used as the input to the control strategy.
- Limit1(2)(3) — Control limiting is currently active using limit PV1(2)(3) and limit SP 1(2)(3).

Output — The current output demand in percent. Normally wired to Modulator.In or FiringOP.In

PAOP — Applies only to Burst Firing control modes. If this parameter is wired to Firing.limitIn, the power module will deliver bursts of phase angle firing depending both on the Main Set-point and on the Limit Setpoint.

6.6.5 Control Alarm disable menu

Allows each alarm of the control block to be disabled, individually.

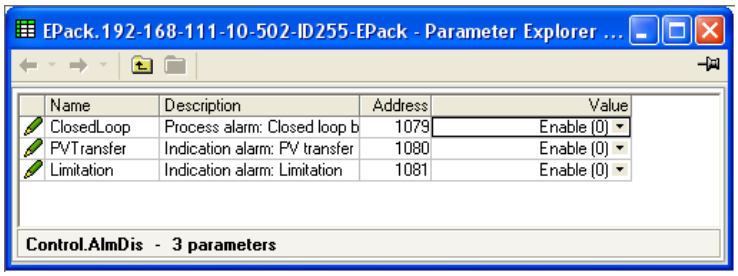


Figure 6.6.5 Alarm disable page

PARAMETERS

Closed Loop — Select Enable (0) or Disable (1) for loop break alarm.

PV Transfer — As for Closed Loop, but for the 'Transfer active' alarm.

Limitation — As for Closed Loop, but for the 'Control limit active' alarm.

6.6.6 Control Alarm detection parameters

Indicates whether each alarm has been detected and whether or not it is currently active.

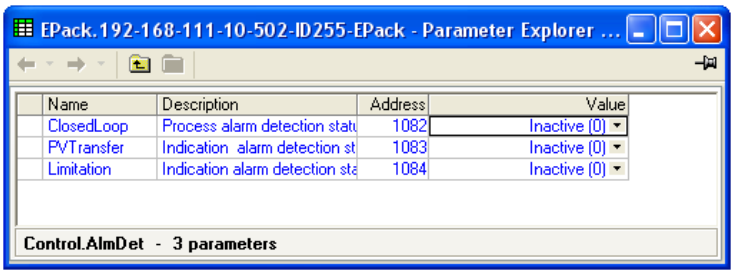


Figure 6.6.6 Control Alarm detection page

PARAMETERS

Closed Loop	Displays whether or not the closed loop alarm is currently active.
PV Transfer	As for Closed Loop, but for the 'Transfer Active' alarm.
Limitation	As for Closed Loop, but for the 'Control limit active' alarm.

6.6.7 Control Alarm signalling parameters

Signals that an alarm has occurred and has been latched (if so configured in 'Alarm Latch' (section 6.6.8). If it is required that an alarm is to be assigned to a relay (for example), then the appropriate alarm signalling parameter should be used.

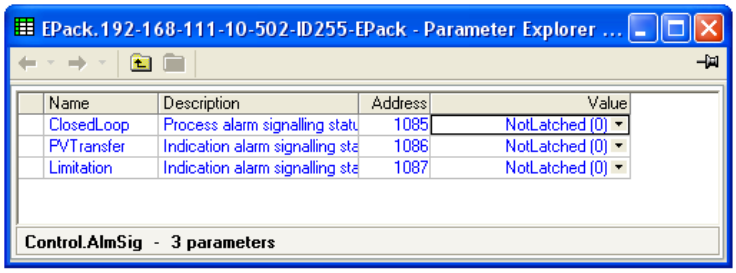


Figure 6.6.7 Control Alarm Signalling page

PARAMETERS

Closed Loop	Indicates whether the closed loop break alarm is currently active.
PV Transfer	As for Closed Loop, but for the 'Transfer Active' alarm.
Limitation	As for Closed Loop, but for the 'Control limit active' alarm.

6.6.8 Control Alarm Latch parameters

Allows each alarm to be configured as latching or not latching.

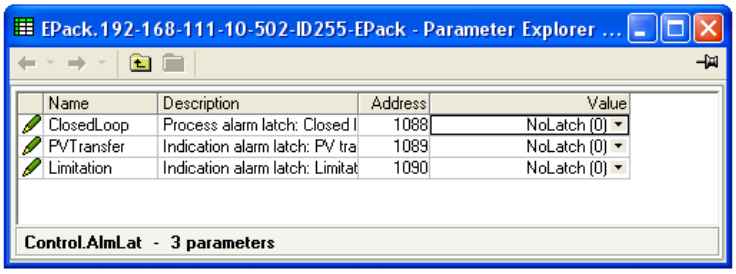


Fig 6.6.8 Control Alarm latching page

PARAMETERS

Closed Loop	Set the latching status of the alarm.
PV Transfer	As for Closed Loop, but for the 'Transfer Active' alarm.
Limitation	As for Closed Loop, but for the 'Control limit active' alarm.

6.6.9 Control Alarm Acknowledgement parameters

This menu allows individual alarms to be acknowledged. On acknowledgement, the related Signalling parameter is cleared. The Acknowledge parameters automatically clear after being written.

If the alarm is still active (as shown by the Alarm Detection display) it cannot be acknowledged.

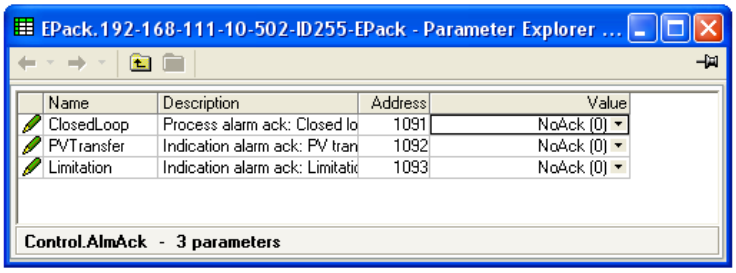


Figure 6.6.9 Control Alarm Acknowledge page

Closed Loop	Displays whether the closed loop alarm has been acknowledged or not.
PV Transfer	As for Closed Loop, but for the 'Transfer Active' alarm.
Limitation	As for Closed Loop, but for the 'Control limit active' alarm.

6.6.10 Control Alarm Stop parameters

Allows individual channels to be configured such that it will stop the associated power channel from firing whilst the alarm is active. This feature is activated by the signalling parameters, so the alarm stop may be latching.

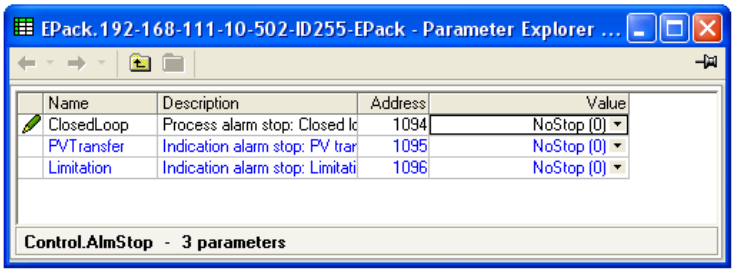


Figure 6.6.10b iTools Control Alarm Stop page

PARAMETERS

Closed Loop	Shows whether the closed loop alarm has been configured to disable firing or not.
PV Transfer	As for Closed Loop, but for the 'Transfer Active' alarm.
Limitation	As for Closed Loop, but for the 'Control limit active' alarm.

6.7 ENERGY CONFIGURATION

Provides a number of energy counters to totalise consumed energy. The power consumed can be displayed in one of number of units, ranging from W to GW.

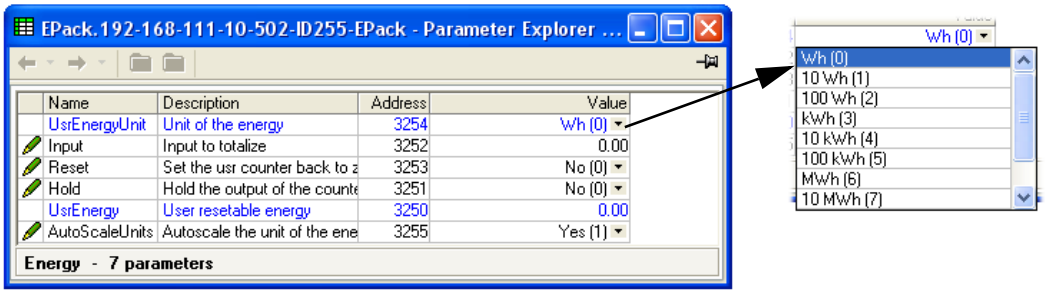


Figure 6.7 Energy configuration page

PARAMETERS

UsrUnit — Allows a scaling units value to be entered for the energy display. Selectable as '1Wh', '10Wh', '100Wh', '1kWh', '10kWh', '100kWh', '1MWh', '10MWh', '100MWh' or '1GWh'.

Input — Shows the instantaneous power input from the measuring source. Normally wired to the Meas.P output of the Network block.

Reset — 1 = Energy counter output goes to zero and immediately starts accumulating.

0 = Energy counter not reset.

Hold — 1 = Hold output value. This freezes the output value for the block at the current value. The input continues to be totalised, so when the Hold input returns to 0, the output value is instantaneously updated to the new current value.

0 = output value is not held, and represents the current accumulated Energy value.

UsrEnergy — Shows the current value for the selected Energy Counter block.

Autoscale — No = Use UsrUnit setting.

Yes = Autoscale power value display (table 6.7, below).

Power range (Watt-hours)	Scaler value
0 to 65535	1
65,535 to 65,535,000	1k
65,535,000 to 655,350,000	10k
655,350,000 to 6,553,500,000	100k
6,553,500,000 to 65,535,000,000	1M
65,535,000,000 to 655,350,000,000	10M
655,350,000,000 to 6,553,500,000,000	100M
6,553,500,000,000 upwards	1G

Table 6.7 Scaler values

6.7.1 Resolution

The resolution of the stored energy value varies according to the totalised value, as shown in table 6.7.1 below. For example, for stored values between 33,554,432 watt-hours and 67,108,863 watt-hours, the value increases in 4 watt-hour increments.

Power range (Watt-hours)	Resolution (W-h)	Power range (Watt-hours)	Resolution (W-h)
0 to 16,777,215	1	17,179,869,184 to 34,359,738,367	2048
16,777,216 to 33,554,431	2	34,359,738,368 to 68,719,476,736	4096
33,554,432 to 67,108,863	4	68,719,476,736 to 137,438,953,471	8192
67,108,864 to 134,217,727	8	137,438,953,472 to 274,877,906,943	16384
134,217,728 to 268,435,455	16	274,877,906,944 to 549,755,813,887	32768
268,435,456 to 536,870,911	32	549,755,813,888 to 1,099,511,627,776	65536
536,870,912 to 1,073,741,823	64	1,099,511,627,776 to 2,199,023,255,551	131072
1,073,741,824 to 2,147,483,647	128	2,199,023,255,552 to 4,398,046,511,103	262144
2,147,483,648 to 4,294,967,295	256	4,398,046,511,104 to 8,796,093,022,207	524288
4,294,967,296 to 8,589,934,591	512	8,796,093,022,208 to 17,592,186,044,415	1048576
8,589,934,592 to 17,179,869,183	1024		

Table 6.7.1 Energy counter resolution

6.8 FAULT DETECTION MENU

This manages Alarm logging and provides an interface for the General Alarm Acknowledgement

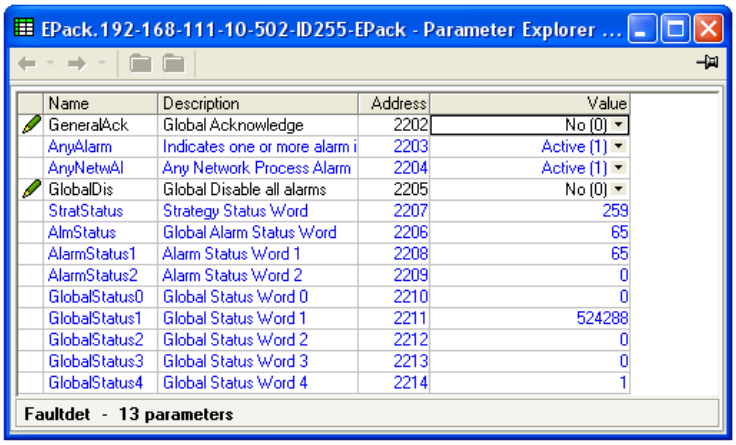


Figure 6.8 Fault detection menu page

PARAMETERS

Global Ack	Performs a global acknowledgement of alarms. Latched alarms are cleared if their trigger sources are no longer in an alarm state.
Any Alarm	'Active' indicates that there is one or more System, Process or 'Chop Off' alarm active. If the relevant alarms are enabled, System alarms and Chop Off alarms always cause the power module to stop firing. Process alarms can also be configured to prevent firing in 'Alarm stop'.
Network Alarm	Indicates that a process alarm has occurred in the power network.
Global Disable	Allows the user to disable/enable all alarms.
StratStatus	A coded status word giving strategy information as shown in table 6.8a
Alarm Status 1(2)	Two 16-bit words containing alarm status information as shown in tables 6.8b and 6.8c.

Bit	Value	Description
0	1	Network not firing
1	2	Network not synchronising
2	4	Reserved
3	8	Reserved
4	16	Reserved
5	32	Reserved
6	64	Reserved
7	128	Reserved
8	256	Strategy in standby mode
9	512	Strategy in Telemetry mode
10	1024	Reserved
11	2048	Reserved
12	4096	Reserved
13	8192	Reserved
14	16384	Reserved
15	32768	Reserved

Table 6.8a Strategy status

6.8 FAULT DETECTION MENU (Cont.)

Bit	Value	Description
0	1	Missing mains
1	2	Thyristor short circuit
2	4	Over temp*
3	8	Network dips
4	16	Frequency fault
5	32	Total Load Failure
6	64	Chop off
7	128	Partial load failure
8	256	Partial load unbalance*
9	512	Over voltage
10	1024	Under voltage
11	2048	Pre temp*
12	4096	Over current
13	8192	Reserved
14	16384	Analogue input over C
15	32768	External input

Table 6.8b Alarm status word 1

Bit	Value	Description
0	1	Closed loop
1	2	Transfer active
2	4	Limit active
3	8	Reserved
4	16	Reserved
5	32	Reserved
6	64	Reserved
7	128	Reserved
8	256	Any bit in Global Status 0
9	512	Any bit in Global Status 1
10	1024	Any bit in Global Status 2
11	2048	Any bit in Global Status 3
12	4096	Reserved
13	8192	Reserved
14	16384	Reserved
15	32768	Reserved

Table 6.8c Alarm status word 2

* Note... These alarms not applicable at this release but are reserved for future development.

6.9 FIRING OUTPUT MENU

This forms the link between the control strategy and the physical load. This block also supplies Phase-Angle Ramp (Soft start) and Safety Ramp.

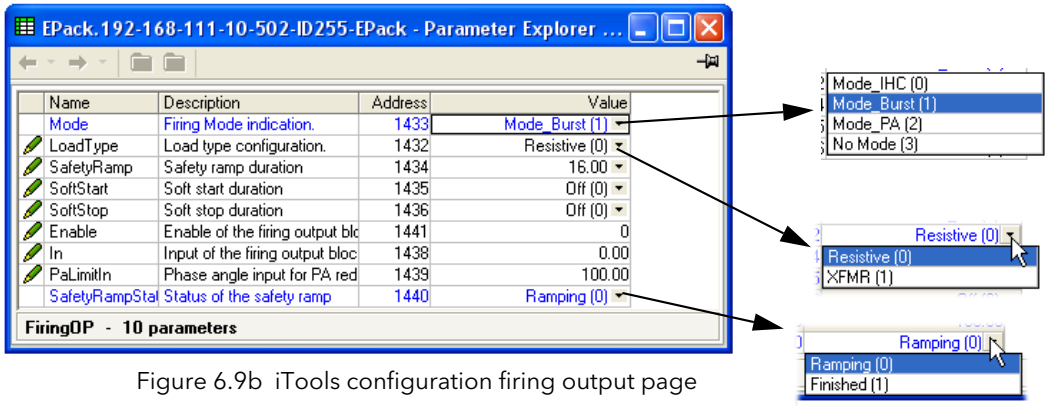


Figure 6.9b iTools configuration firing output page

Mode	Displays the current firing mode as Intelligent half cycle (IHC), Burst firing, Phase angle firing or no mode. Configured in the 'Modultr', menu described below.
Load Type	Allows the load type to be selected as 'Resistive' or 'Transformer'. For Load type = Resistive, the load must be connected directly to the power module and only resistive loads may be so connected. For Load Type = Transformer, the load is connected to the power module via a transformer, and may be resistive or reactive.
Safety Ramp	Displays the safety ramp duration, in supply voltage cycles (0 to 255), to be applied at startup. The ramp is either a phase angle ramp from zero to the requested target phase angle or, for Burst Firing, from 0 to 100%. See figure 6.9.1a. Safety Ramp is not applicable to Half cycle Mode.
Soft Start	For Burst Firing only, this is the soft start duration, in supply voltage cycles, applying a phase angle ramp at the beginning of each on period (figure 6.9.1b).
Soft Stop	In Burst Firing, the soft stop duration, in supply voltage cycles, applying a phase angle ramp at the end of each on period
Delayed Trigger	Appears only if Mode = Burst, Soft Start = Off, and Load Type = TxFormer. Delayed Trigger specifies the triggering delay, in phase angle, when delivering power into a transformer load. Used to minimise inrush current. the value is configurable between 0 and 90 degrees inclusive (figure 6.9.1c).
Enable	Enables/disables firing. Must be wired to a non-zero value to enable firing (typically a digital input).
In	Displays the input power demand value that the power module is to deliver.
PA Limit	Phase angle limit. This is a phase angle reduction factor used in Burst Firing. If lower than 100% the power module will deliver a burst of phase angle firing. Used, typically, to perform threshold current limiting in Burst Firing.
Ramp Status	Displays the safety ramp status as 'Ramping' or 'Finished'.

6.9.1 Examples

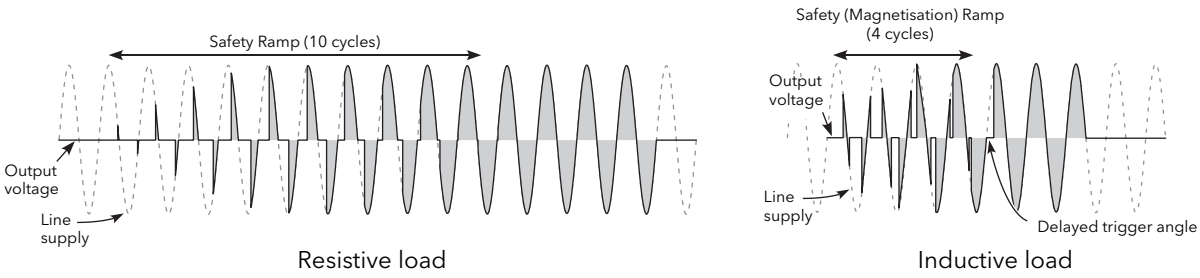


Figure 6.9.1a Safety ramp (burst firing) examples

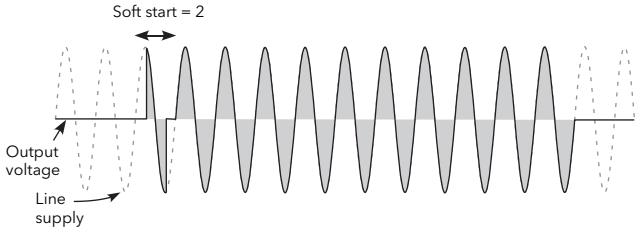


Figure 6.9.1b Soft start example

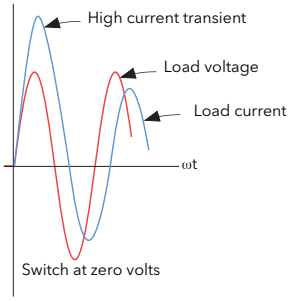


Figure 6.9.1c Delayed trigger definition

Note: Waveforms have been idealised for clarity.

6.10 INSTRUMENT CONFIGURATION MENU

Instrument configuration is divided into the following sections:

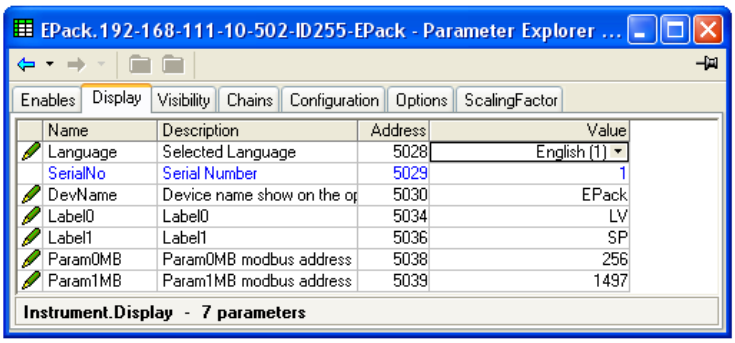


Figure 6.10 Top level instrument configuration page

6.10.1 Instrument display configuration

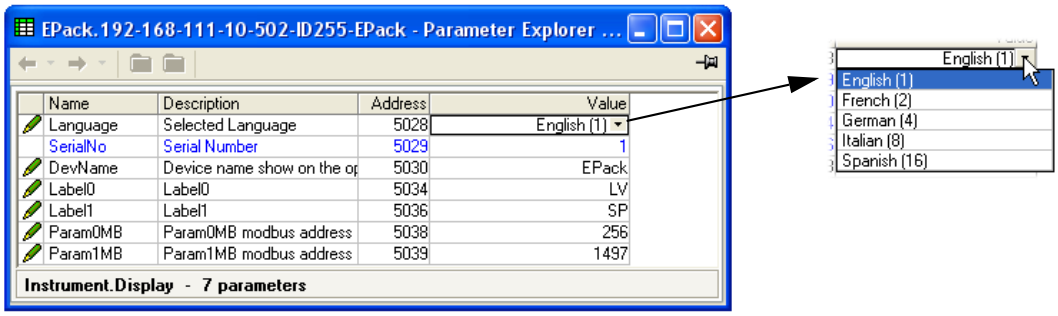


Figure 6.10.1 Instrument display configuration page

PARAMETERS

Language	Select required language for subsequent displays.
Serial No	Read only. Displays the factory-set Serial number of the unit.
Dev Name	The device name as it appears at the user display.
Label 0(1)	The text that appears on the home page for the two parameters defined by the addresses listed in Param0 and Param1. User-definable 3 characters (maximum).
Param0(1)MB	This is the modbus address of the first (second) parameter to be displayed in the home screen of the instrument.

6.10.2 Instrument Config configuration

The current hardware configuration

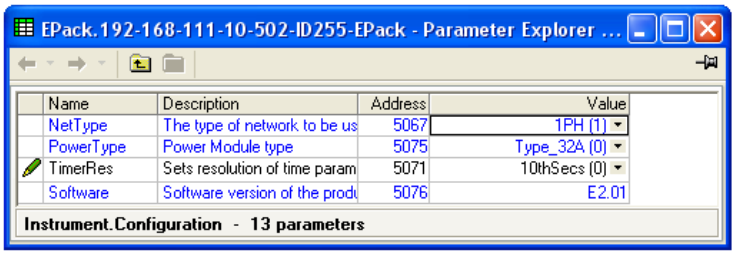


Figure 6.10.2 Instrument configuration

PARAMETERS

Net Type	Network type. This is set at the factory and cannot be changed by the user. 1 = Single phase
Power Type	0 = 32A; 1 = 63A This is set at the factory and cannot be changed by the user.
Timer Res	Resolution of time parameters 0 = 10ths of seconds (100ms); 1 = 10ths of minutes (6 seconds)
Software	Software version of the product.

6.10.3 Instrument options configuration

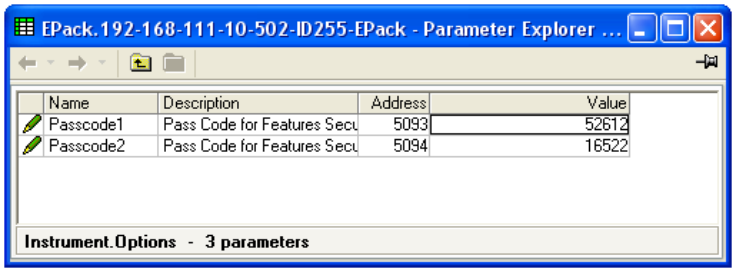


Figure 6.10.3 Instrument options configuration page

PARAMETERS

Passcode1 (2)(3) Pass Code for Features Secure Word 1(2)(3).

6.10.4 Scaling Factor

Allows scaling factors to be entered for a number of parameters. In iTools, the scaling factors are arranged in 'tabs' of which, for the sake of clarity, this document depicts only one (SetProv).

These scaling factors are applied in modbus transactions when access to relevant parameters is made using low range address (i.e. not the IEEE region)

]

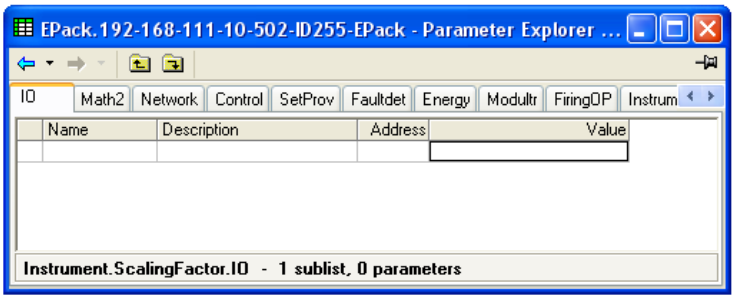
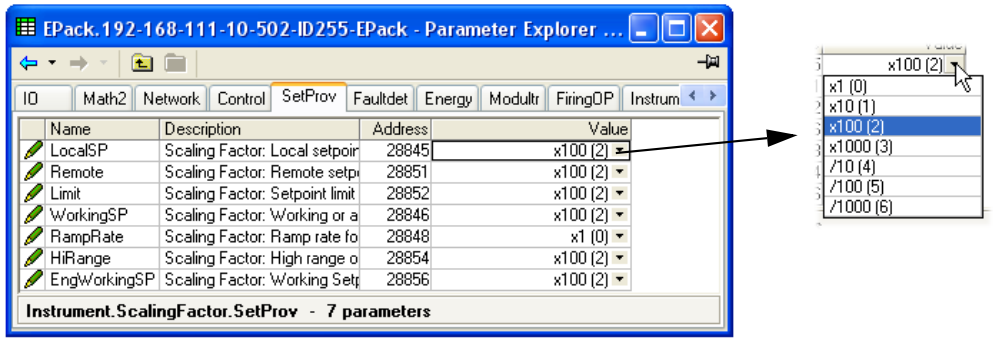


Figure 6.10.4 Scaling factor top level menu.

SETPROV EXAMPLE



In the above example it can be seen that all the Set point provider parameters are scaled x100, except for Ramp Rate which is not scaled (i.e. the scaling factor = 1). As can also be seen, the scaling factors available are x1, x10, x100, x1000, ÷10, ÷100, ÷1000.

If the LocalSP, for example, has a scaling factor of x100, as above, then a value of say 5000 means in fact that the real value is 50.00.

Notes:

1 The above example shows the default scaling formats set - they are User configurable.

2 Values are rounded up/down.

6.11 INPUT/OUTPUT (IO) CONFIGURATION

This area of configuration allows the user to configure the analogue and digital inputs and to view the status of the Relay output. The configuration is separated into the following areas:

AI (analogue inputs) Section 6.11.1
Digital inputs 1 and 2 Section 6.11.2
Relay output Section 6.11.3.

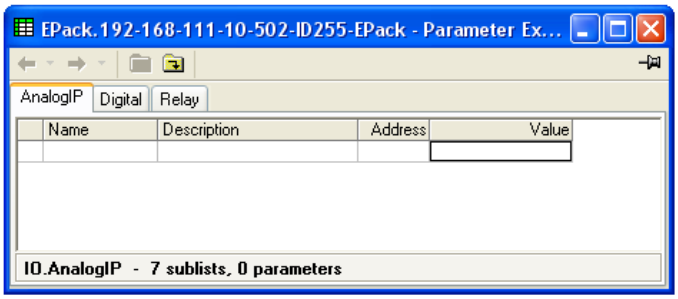


Figure 6.11 Top level IO menu

6.11.1 Analogue input configuration

The configuration for the analogue input is divided into a number of areas:

Main,
AlmDis,
AlmDet,
AlmSig,
AlmLat,
AlmAck,
AlmStop.

AI MAIN

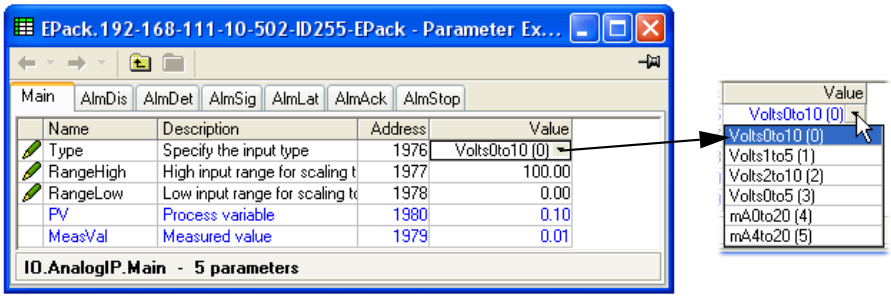


Figure 6.11.1b iTools analogue input page

PARAMETERS

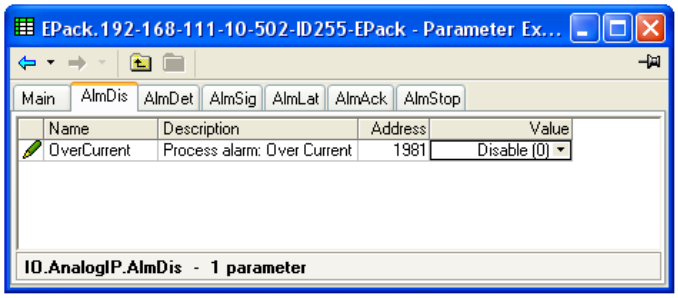
Type	Allows the type of input to be set as one of: 0 to 10V, 1 to 5V, 2 to 10V, 0 to 5V, 0 to 20mA, 4 to 20mA. For pinout details, see figure 2.2.3.
RangeHigh	High range of input for scaling from measurement units to process units. PV is clipped to range high if input goes over range.
RangeLow	Low range of input for scaling from measurement units to process units. PV is clipped to range low if input goes under range.
PV	The scaled value in process units. Clipped to the Range High or Range Low value if the signal goes over range or under range respectively.
MeasVal	The value at the instrument terminals in electrical units.

ALMDIS

Allows the user to enable or disable alarms individually

EXAMPLE

The figure below shows an iTools page for ALMDIS. Pages for the other ALM parameters are similar.



ALMDET

Indicates whether each individual alarm has been detected and is currently active.

ALMSIG

Signals that an alarm has occurred, and whether or not it is a latched. If the user wishes to assign an alarm to for example a relay then the appropriate signalling parameter should be wired.

ALMLAT

Allows each individual alarm to be configured as latching, the latched state is shown in the alarm signalling parameter

6.11.1 ANALOGUE INPUT CONFIGURATION (Cont)

ALMACK

Allows each individual alarm to be acknowledged. On an alarm being acknowledged the related signalling parameter (ALMSIG) is cleared. If the alarm is still active as shown by the detection parameter (ALMDET) the alarm may not be acknowledged. The acknowledge parameters automatically clear after being written.

ALMSTOP

Allows each individual alarm type to be configured to stop the power channel firing. ALMSTOP is activated by the signalling parameter (ALMSIG) and may be latching or not according to the ALM LAT setting for the alarm.

6.11.2 Digital input configuration

This allows the user to configure each of the digital inputs.

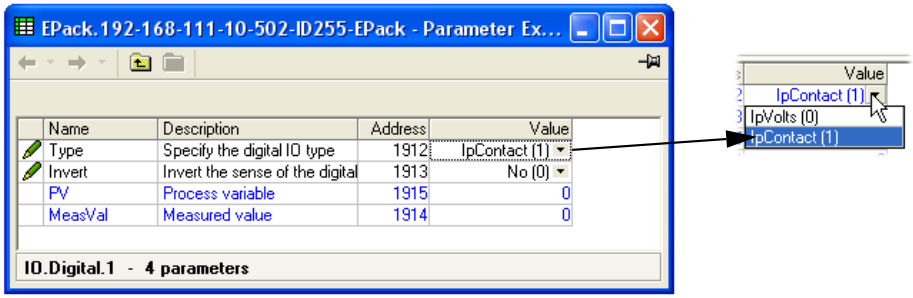


Figure 6.11.2b iTools Digital input configuration page

PARAMETERS

Type	Select Logic Input (IP Volts) or IPContact. For pinout details, see figure 2.2.3.
Invert	Sets the inversion status to 'No' or 'Yes'. When set to 'No', there is no inversion (e.g. if MeasVal = 0 then PV = 0). When set to 'Yes', an inversion takes place (e.g. if MeasVal = 0 then PV = 1)
PV	The current state of the input, after any inversion has been applied.
MeasVal	For inputs, this shows the value measured at the instrument terminals, in electrical units.

6.11.3 Relay status

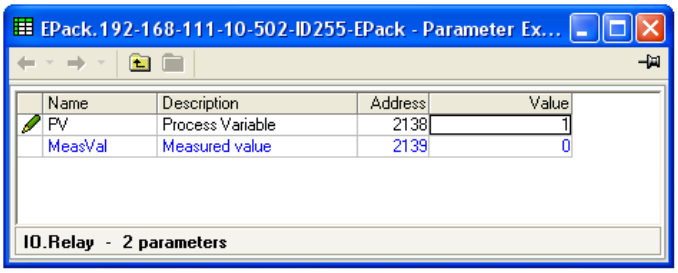


Figure 6.11.3b iTools relay status page

PARAMETERS

PV	This shows the status of the input to the relay as either 'On' (True) or 'Off' (False).
Meas Val	Shows the current state of the relay coil. 1 = energised; 0 = de-energised, where 'energised' is 'off' and 'de-energised' is 'on'.

For pinout details, see figure 2.2.3.

6.12 IP MONITOR CONFIGURATION

This monitors a wired parameter and records its maximum value, minimum value and the cumulative time that its value spends above a configurable threshold. An alarm can be set up to become active when the time-over-threshold exceeds a further threshold.

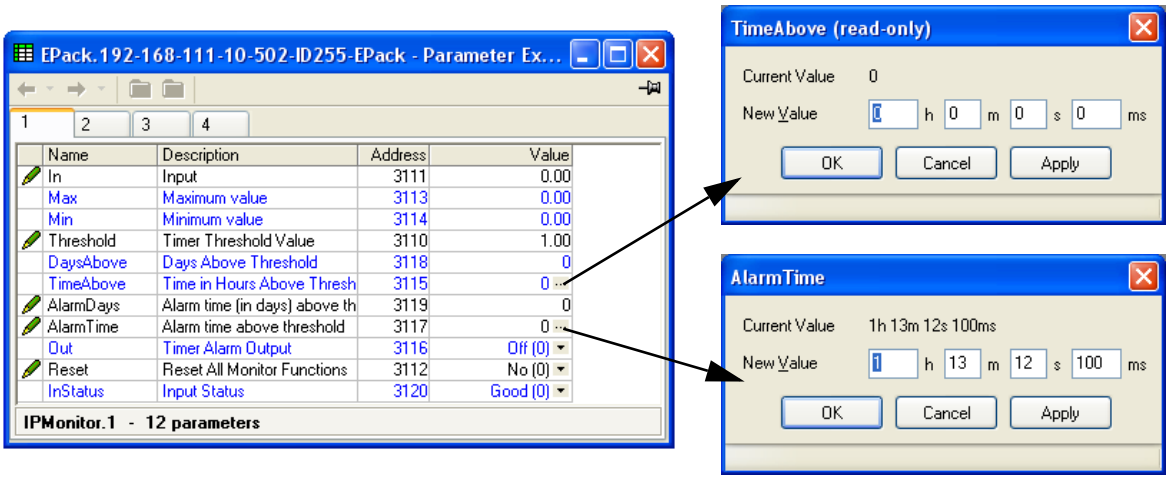


Figure 6.12b iTools input monitor page (IPMon1)

PARAMETERS

In	The parameter to be monitored. Normally wired (using iTools) to a parameter, but a numeric entry can be made for testing purposes.
Max	The maximum value reached by the parameter since last reset.
Min	The minimum value reached by the parameter since last reset.
Threshold	This value acts as a trigger for the 'Time Above' measurement.
Days above	Shows how many complete days the parameter value has spent above the Threshold value (continuously or intermittently) since last reset. The 'Time Above' value should be added to 'Days Above' in order to find the total time.
Time Above	Shows how many hours, minutes and tenths of minutes that the parameter value has spent above the threshold value (continuously or intermittently) since last reset, or since the last complete day. (once the value exceeds 23:59.9, the 'Days Above' value is incremented and 'Time Aboveis reset to 00:00.0.) The 'Time Above' value should be added to 'Days Above' in order to find the total time.
Alarm Days	Together with 'Alarm Time' this defines a 'total time above threshold' value, which, when exceeded, sets the Alarm out parameter 'On'.
Alarm Time	See 'Alarm Days' above.
Reset	Resetting causes the Max. and Min. values to be set to the current value, sets the 'Days Above' value to zero, and the 'Time Above' value to 00:00.0.
Status	Shows the status of the input parameter as either 'Good' or 'Bad'.

6.13 LGC2 (TWO INPUT LOGIC OPERATOR) MENU

This logic operator block provides a number of two-input logic operations. The output is always a 'Boolean' (logic 0 or 1) no matter whether the inputs are analogue or digital. For analogue inputs, any value below 0.5 is deemed to be logic 0 (off). A value equal to or greater than 0.5 is treated as a logic 1 (on).

Either input can be 'inverted' as a part of the configuration (that is, a high input is treated as a low input and *vice-versa*.)

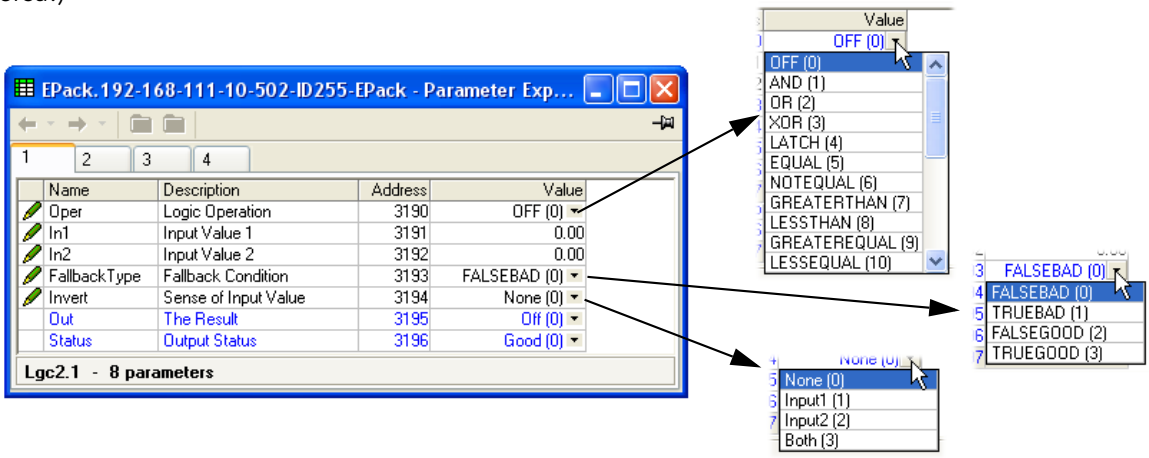


Figure 6.13 Lgc2 page (Lgc2 1)

6.13.1 Lgc2 Parameters

Oper	Allows the user to select a logic operation for the block. The descriptions below assume neither input is inverted. High = 1 or on; Low = 0 or off.	
	Off	No logic operation selected.
	AND	Out is high if both inputs high, otherwise Out is low.
	OR	Out is high if either or both inputs high, otherwise Out is low.
	XOR	Output high if either (but not both) inputs high. Low if neither or both inputs are high.
	Latch	If In2 low, Out latches next transition of In1. Value remains latched until In2 goes low, when Out = In1 (see figure 6.13.1).
	Equal	Out high if both inputs are equal, otherwise output is low.
	Not Equal	Out is high if inputs are unequal. Out is low if inputs are equal.
	Greater than	Out is high if In1 value greater than In2 value, otherwise Out is low.
	Less than	Out is high if In1 value less than In2 value, otherwise Out is low.
	GreaterEqual	Out is high if In1 value is equal to or greater than In2 value, otherwise Out is low.
	LessEqual	Out is high if In1 value is less than or equal to In2 value, otherwise Out is low.
In1	If wired, shows the value of In1; if not, allows the user to enter a value.	
In2	If wired, shows the value of In2; if not, allows the user to enter a value.	
Fallback type	Allows a fallback type to be selected. This defines the output value and status displays if the status of one or both inputs is 'bad'.	
	FalseBad	Output value displays 'False' ; Status displays 'Bad'
	TrueBad	Output value displays 'True' ; Status displays 'Bad'
	FalseGood	Output value displays 'False' ; Status displays 'Good'
	TrueGood	Output value displays 'True' ; Status displays 'Good.
Invert	Allows none, either or both inputs to be inverted.	
Out	Shows the current output value	

6.13.1 LGC2 PARAMETERS (Cont.)

Status — Shows the status of the output ('Good' or 'Bad').

Hysteresis — For comparison operators only (e.g. Greater than) this allows a hysteresis value to be entered. For example, if the operator is 'Greater than' and hysteresis is H, then the output goes high when In1 exceeds In2, and remains high until In1 falls to a value less than (In2 - H). Not applicable to the 'Equal' function.

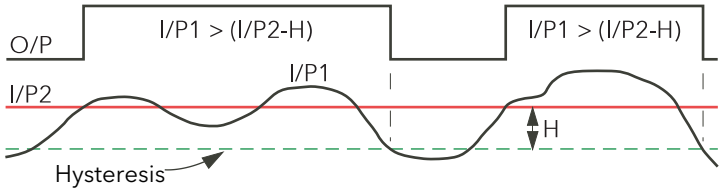
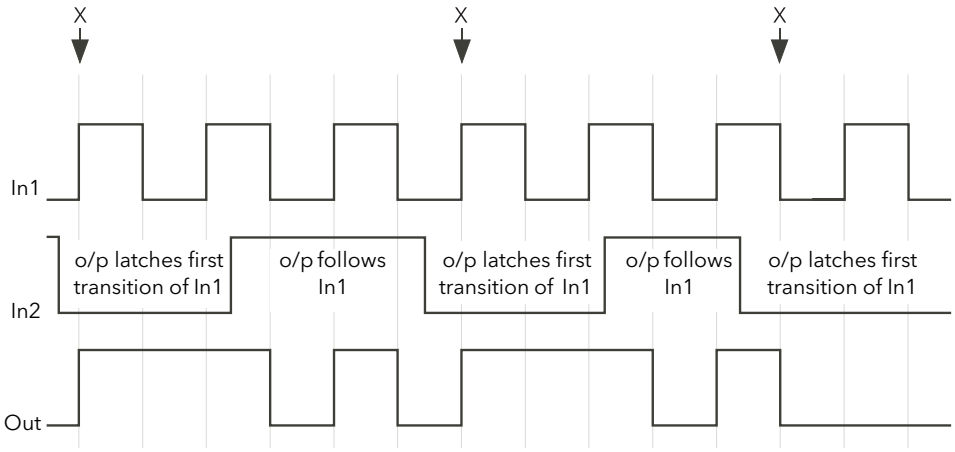


Figure 6.13.1 Hysteresis



When In2 goes low, Out follows the next positive or negative transition of In1 (points 'X') and latches at this value until In2 goes high. When In2 is high, Out follows In1.

Figure 6.13.2 Latch operation

6.14 LGC8 (EIGHT-INPUT LOGIC OPERATOR) CONFIGURATION

This allows between 2 and 8 inputs to be combined using an AND, OR or Exclusive OR (EXOR) logic function. The inputs may be individually inverted, and the output can also be inverted, thus allowing the full range of logic functions to be implemented.

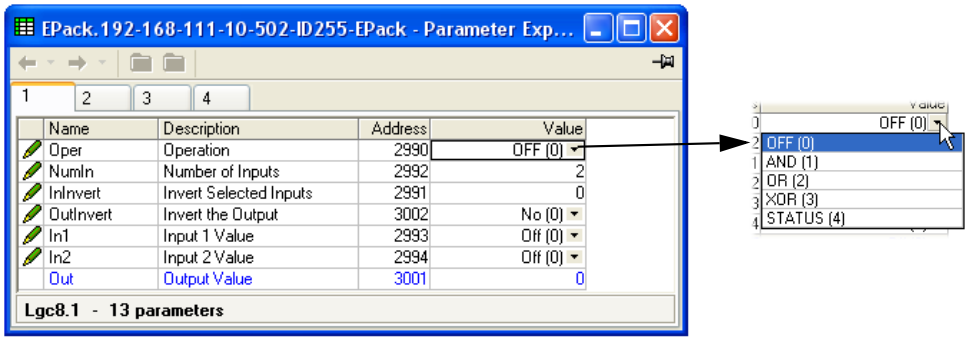


Figure 6.14 Lgc8 configuration page

6.14.1 Parameters

Oper	Allows selection of AND, OR or Exclusive OR functions (or OFF). AND = output is high only if all inputs are high OR = output is high if any or all inputs are high XOR = output is high if an odd number of inputs are high, and low if an even number of inputs are high. Logically, a cascaded XOR function: (((((((In1 ⊕ In 2) ⊕ In 3) ⊕ In 4).... ⊕ In 8) Status =Bit to bit OR of the inputs concatenated into a word.
Numin	Set the number of inputs to between two and eight inclusive. This number defines how many invert keys appear in 'Invert', and how many Input value pages appear.
InInvert	Allows the user to invert individual inputs, as described below.
Out Invert	No = normal output; 'Yes' means that the output is inverted, allowing NAND and NOR functions to be implemented.
In1	The state (on or off) of the first input
In2 onwards	The state of the remaining inputs
Out	The Output value of the function (i.e. On or Off)

6.14.2 Inversion schematic

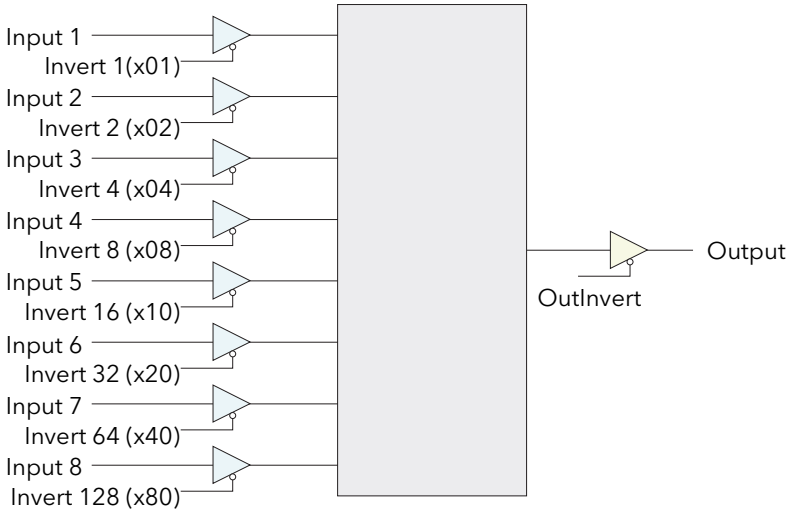


Figure 6.14.2 LGC8 inversion Schematic

6.14.3 Invert input decoding table

The inversion status can be encoded/decoded using the following table

Input 8	7	6	5	4	3	2	1	Hex	Dec	Input 8	7	6	5	4	3	2	1	Hex	Dec	Input 8	7	6	5	4	3	2	1	Hex	Dec	Input 8	7	6	5	4	3	2	1	Hex	Dec
N	N	N	N	N	N	N	N	00	0	N	**7**	N	N	N	N	N	N	40	64	**8**	N	N	N	N	N	N	N	80	128	**8**	**7**	N	N	N	N	N	N	C0	192
N	N	N	N	N	N	N	**1**	01	1	N	**7**	N	N	N	N	N	**1**	41	65	**8**	N	N	N	N	N	N	**1**	81	129	**8**	**7**	N	N	N	N	N	**1**	C1	193
N	N	N	N	N	N	**2**	N	02	2	N	**7**	N	N	N	N	**2**	N	42	66	**8**	N	N	N	N	N	**2**	N	82	130	**8**	**7**	N	N	N	N	**2**	N	C2	194
N	N	N	N	N	N	**2**	**1**	03	3	N	**7**	N	N	N	N	**2**	**1**	43	67	**8**	N	N	N	N	N	**2**	**1**	83	131	**8**	**7**	N	N	N	N	**2**	**1**	C3	195
N	N	N	N	N	**3**	N	N	04	4	N	**7**	N	N	N	**3**	N	N	44	68	**8**	N	N	N	N	**3**	N	N	84	132	**8**	**7**	N	N	N	**3**	N	N	C4	196
N	N	N	N	N	**3**	N	**1**	05	5	N	**7**	N	N	N	**3**	N	**1**	45	69	**8**	N	N	N	N	**3**	N	**1**	85	133	**8**	**7**	N	N	N	**3**	N	**1**	C5	197
N	N	N	N	N	**3**	**2**	N	06	6	N	**7**	N	N	N	**3**	**2**	N	46	70	**8**	N	N	N	N	**3**	**2**	N	86	134	**8**	**7**	N	N	N	**3**	**2**	N	C6	198
N	N	N	N	N	**3**	**2**	**1**	07	7	N	**7**	N	N	N	**3**	**2**	**1**	47	71	**8**	N	N	N	N	**3**	**2**	**1**	87	135	**8**	**7**	N	N	N	**3**	**2**	**1**	C7	199
N	N	N	N	**4**	N	N	N	08	8	N	**7**	N	N	**4**	N	N	N	48	72	**8**	N	N	N	**4**	N	N	N	88	136	**8**	**7**	N	N	**4**	N	N	N	C8	200
N	N	N	N	**4**	N	N	**1**	09	9	N	**7**	N	N	**4**	N	N	**1**	49	73	**8**	N	N	N	**4**	N	N	**1**	89	137	**8**	**7**	N	N	**4**	N	N	**1**	C9	201
N	N	N	N	**4**	N	**2**	N	0A	10	N	**7**	N	N	**4**	N	**2**	N	4A	74	**8**	N	N	N	**4**	N	**2**	N	8A	138	**8**	**7**	N	N	**4**	N	**2**	N	CA	202
N	N	N	N	**4**	N	**2**	**1**	0B	11	N	**7**	N	N	**4**	N	**2**	**1**	4B	75	**8**	N	N	N	**4**	N	**2**	**1**	8B	139	**8**	**7**	N	N	**4**	N	**2**	**1**	CB	203
N	N	N	N	**4**	**3**	N	N	0C	12	N	**7**	N	N	**4**	**3**	N	N	4C	76	**8**	N	N	N	**4**	**3**	N	N	8C	140	**8**	**7**	N	N	**4**	**3**	N	N	CC	204
N	N	N	N	**4**	**3**	N	**1**	0D	13	N	**7**	N	N	**4**	**3**	N	**1**	4D	77	**8**	N	N	N	**4**	**3**	N	**1**	8D	141	**8**	**7**	N	N	**4**	**3**	N	**1**	CD	205
N	N	N	N	**4**	**3**	**2**	N	0E	14	N	**7**	N	N	**4**	**3**	**2**	N	4E	78	**8**	N	N	N	**4**	**3**	**2**	N	8E	142	**8**	**7**	N	N	**4**	**3**	**2**	N	CE	206
N	N	N	N	**4**	**3**	**2**	**1**	0F	15	N	**7**	N	N	**4**	**3**	**2**	**1**	4F	79	**8**	N	N	N	**4**	**3**	**2**	**1**	8F	143	**8**	**7**	N	N	**4**	**3**	**2**	**1**	CF	207
N	N	N	**5**	N	N	N	N	10	16	N	**7**	N	**5**	N	N	N	N	50	80	**8**	N	N	**5**	N	N	N	N	90	144	**8**	**7**	N	**5**	N	N	N	N	D0	208
N	N	N	**5**	N	N	N	**1**	11	17	N	**7**	N	**5**	N	N	N	**1**	51	81	**8**	N	N	**5**	N	N	N	**1**	91	145	**8**	**7**	N	**5**	N	N	N	**1**	D1	209
N	N	N	**5**	N	N	**2**	N	12	18	N	**7**	N	**5**	N	N	**2**	N	52	82	**8**	N	N	**5**	N	N	**2**	N	92	146	**8**	**7**	N	**5**	N	N	**2**	N	D2	210
N	N	N	**5**	N	N	**2**	**1**	13	19	N	**7**	N	**5**	N	N	**2**	**1**	53	83	**8**	N	N	**5**	N	N	**2**	**1**	93	147	**8**	**7**	N	**5**	N	N	**2**	**1**	D3	211
N	N	N	**5**	N	**3**	N	N	14	20	N	**7**	N	**5**	N	**3**	N	N	54	84	**8**	N	N	**5**	N	**3**	N	N	94	148	**8**	**7**	N	**5**	N	**3**	N	N	D4	212
N	N	N	**5**	N	**3**	N	**1**	15	21	N	**7**	N	**5**	N	**3**	N	**1**	55	85	**8**	N	N	**5**	N	**3**	N	**1**	95	149	**8**	**7**	N	**5**	N	**3**	N	**1**	D5	213
N	N	N	**5**	N	**3**	**2**	N	16	22	N	**7**	N	**5**	N	**3**	**2**	N	56	86	**8**	N	N	**5**	N	**3**	**2**	N	96	150	**8**	**7**	N	**5**	N	**3**	**2**	N	D6	214
N	N	N	**5**	N	**3**	**2**	**1**	17	23	N	**7**	N	**5**	N	**3**	**2**	**1**	57	87	**8**	N	N	**5**	N	**3**	**2**	**1**	97	151	**8**	**7**	N	**5**	N	**3**	**2**	**1**	D7	215
N	N	N	**5**	**4**	N	N	N	18	24	N	**7**	N	**5**	**4**	N	N	N	58	88	**8**	N	N	**5**	**4**	N	N	N	98	152	**8**	**7**	N	**5**	**4**	N	N	N	D8	216
N	N	N	**5**	**4**	N	N	**1**	19	25	N	**7**	N	**5**	**4**	N	N	**1**	59	89	**8**	N	N	**5**	**4**	N	N	**1**	99	153	**8**	**7**	N	**5**	**4**	N	N	**1**	D9	217
N	N	N	**5**	**4**	N	**2**	N	1A	26	N	**7**	N	**5**	**4**	N	**2**	N	5A	90	**8**	N	N	**5**	**4**	N	**2**	N	9A	154	**8**	**7**	N	**5**	**4**	N	**2**	N	DA	218
N	N	N	**5**	**4**	N	**2**	**1**	1B	27	N	**7**	N	**5**	**4**	N	**2**	**1**	5B	91	**8**	N	N	**5**	**4**	N	**2**	**1**	9B	155	**8**	**7**	N	**5**	**4**	N	**2**	**1**	DB	219
N	N	N	**5**	**4**	**3**	N	N	1C	28	N	**7**	N	**5**	**4**	**3**	N	N	5C	92	**8**	N	N	**5**	**4**	**3**	N	N	9C	156	**8**	**7**	N	**5**	**4**	**3**	N	N	DC	220
N	N	N	**5**	**4**	**3**	N	**1**	1D	29	N	**7**	N	**5**	**4**	**3**	N	**1**	5D	93	**8**	N	N	**5**	**4**	**3**	N	**1**	9D	157	**8**	**7**	N	**5**	**4**	**3**	N	**1**	DD	221
N	N	N	**5**	**4**	**3**	**2**	N	1E	30	N	**7**	N	**5**	**4**	**3**	**2**	N	5E	94	**8**	N	N	**5**	**4**	**3**	**2**	N	9E	158	**8**	**7**	N	**5**	**4**	**3**	**2**	N	DE	222
N	N	N	**5**	**4**	**3**	**2**	**1**	1F	31	N	**7**	N	**5**	**4**	**3**	**2**	**1**	5F	95	**8**	N	N	**5**	**4**	**3**	**2**	**1**	9F	159	**8**	**7**	N	**5**	**4**	**3**	**2**	**1**	DF	223
N	N	**6**	N	N	N	N	N	20	32	N	**7**	**6**	N	N	N	N	N	60	96	**8**	N	**6**	N	N	N	N	N	A0	160	**8**	**7**	**6**	N	N	N	N	N	E0	224
N	N	**6**	N	N	N	N	**1**	21	33	N	**7**	**6**	N	N	N	N	**1**	61	97	**8**	N	**6**	N	N	N	N	**1**	A1	161	**8**	**7**	**6**	N	N	N	N	**1**	E1	225
N	N	**6**	N	N	N	**2**	N	22	34	N	**7**	**6**	N	N	N	**2**	N	62	98	**8**	N	**6**	N	N	N	**2**	N	A2	162	**8**	**7**	**6**	N	N	N	**2**	N	E2	226
N	N	**6**	N	N	N	**2**	**1**	23	35	N	**7**	**6**	N	N	N	**2**	**1**	63	99	**8**	N	**6**	N	N	N	**2**	**1**	A3	163	**8**	**7**	**6**	N	N	N	**2**	**1**	E3	227
N	N	**6**	N	N	**3**	N	N	24	36	N	**7**	**6**	N	N	**3**	N	N	64	100	**8**	N	**6**	N	N	**3**	N	N	A4	164	**8**	**7**	**6**	N	N	**3**	N	N	E4	228
N	N	**6**	N	N	**3**	N	**1**	25	37	N	**7**	**6**	N	N	**3**	N	**1**	65	101	**8**	N	**6**	N	N	**3**	N	**1**	A5	165	**8**	**7**	**6**	N	N	**3**	N	**1**	E5	229
N	N	**6**	N	N	**3**	**2**	N	26	38	N	**7**	**6**	N	N	**3**	**2**	N	66	102	**8**	N	**6**	N	N	**3**	**2**	N	A6	166	**8**	**7**	**6**	N	N	**3**	**2**	N	E6	230
N	N	**6**	N	N	**3**	**2**	**1**	27	39	N	**7**	**6**	N	N	**3**	**2**	**1**	67	103	**8**	N	**6**	N	N	**3**	**2**	**1**	A7	167	**8**	**7**	**6**	N	N	**3**	**2**	**1**	E7	231
N	N	**6**	N	**4**	N	N	N	28	40	N	**7**	**6**	N	**4**	N	N	N	68	104	**8**	N	**6**	N	**4**	N	N	N	A8	168	**8**	**7**	**6**	N	**4**	N	N	N	E8	232
N	N	**6**	N	**4**	N	N	**1**	29	41	N	**7**	**6**	N	**4**	N	N	**1**	69	105	**8**	N	**6**	N	**4**	N	N	**1**	A9	169	**8**	**7**	**6**	N	**4**	N	N	**1**	E9	233
N	N	**6**	N	**4**	N	**2**	N	2A	42	N	**7**	**6**	N	**4**	N	**2**	N	6A	106	**8**	N	**6**	N	**4**	N	**2**	N	AA	170	**8**	**7**	**6**	N	**4**	N	**2**	N	EA	234
N	N	**6**	N	**4**	N	**2**	**1**	2B	43	N	**7**	**6**	N	**4**	N	**2**	**1**	6B	107	**8**	N	**6**	N	**4**	N	**2**	**1**	AB	171	**8**	**7**	**6**	N	**4**	N	**2**	**1**	EB	235
N	N	**6**	N	**4**	**3**	N	N	2C	44	N	**7**	**6**	N	**4**	**3**	N	N	6C	108	**8**	N	**6**	N	**4**	**3**	N	N	AC	172	**8**	**7**	**6**	N	**4**	**3**	N	N	EC	236
N	N	**6**	N	**4**	**3**	N	**1**	2D	45	N	**7**	**6**	N	**4**	**3**	N	**1**	6D	109	**8**	N	**6**	N	**4**	**3**	N	**1**	AD	173	**8**	**7**	**6**	N	**4**	**3**	N	**1**	ED	237
N	N	**6**	N	**4**	**3**	**2**	N	2E	46	N	**7**	**6**	N	**4**	**3**	**2**	N	6E	110	**8**	N	**6**	N	**4**	**3**	**2**	N	AE	174	**8**	**7**	**6**	N	**4**	**3**	**2**	N	EE	238
N	N	**6**	N	**4**	**3**	**2**	**1**	2F	47	N	**7**	**6**	N	**4**	**3**	**2**	**1**	6F	111	**8**	N	**6**	N	**4**	**3**	**2**	**1**	AF	175	**8**	**7**	**6**	N	**4**	**3**	**2**	**1**	EF	239
N	N	**6**	**5**	N	N	N	N	30	48	N	**7**	**6**	**5**	N	N	N	N	70	112	**8**	N	**6**	**5**	N	N	N	N	B0	176	**8**	**7**	**6**	**5**	N	N	N	N	F0	240
N	N	**6**	**5**	N	N	N	**1**	31	49	N	**7**	**6**	**5**	N	N	N	**1**	71	113	**8**	N	**6**	**5**	N	N	N	**1**	B1	177	**8**	**7**	**6**	**5**	N	N	N	**1**	F1	241
N	N	**6**	**5**	N	N	2	N	32	50	N	**7**	**6**	**5**	N	N	**2**	N	72	114	**8**	N	**6**	**5**	N	N	**2**	N	B2	178	**8**	**7**	**6**	**5**	N	N	**2**	N	F2	242
N	N	**6**	**5**	N	N	**2**	**1**	33	51	N	**7**	**6**	**5**	N	N	**2**	**1**	73	115	**8**	N	**6**	**5**	N	N	**2**	**1**	B3	179	**8**	**7**	**6**	**5**	N	N	**2**	**1**	F3	243
N	N	**6**	**5**	N	**3**	N	N	34	52	N	**7**	**6**	**5**	N	**3**	N	N	74	116	**8**	N	**6**	**5**	N	**3**	N	N	B4	180	**8**	**7**	**6**	**5**	N	**3**	N	N	F4	244
N	N	**6**	**5**	N	**3**	N	**1**	35	53	N	**7**	**6**	**5**	N	**3**	N	**1**	75	117	**8**	N	**6**	**5**	N	**3**	N	**1**	B5	181	**8**	**7**	**6**	**5**	N	**3**	N	**1**	F5	245
N	N	**6**	**5**	N	**3**	**2**	N	36	54	N	**7**	**6**	**5**	N	**3**	**2**	N	76	118	**8**	N	**6**	**5**	N	**3**	**2**	N	B6	182	**8**	**7**	**6**	**5**	N	**3**	**2**	N	F6	246
N	N	**6**	**5**	N	**3**	**2**	**1**	37	55	N	**7**	**6**	**5**	N	**3**	**2**	**1**	77	119	**8**	N	**6**	**5**	N	**3**	**2**	**1**	B7	183	**8**	**7**	**6**	**5**	N	**3**	**2**	**1**	F7	247
N	N	**6**	**5**	**4**	N	N	N	38	56	N	**7**	**6**	**5**	**4**	N	N	N	78	120	**8**	N	**6**	**5**	**4**	N	N	N	B8	184	**8**	**7**	**6**	**5**	**4**	N	N	N	F8	248
N	N	**6**	**5**	**4**	N	N	**1**	39	57	N	**7**	**6**	**5**	**4**	N	N	**1**	79	121	**8**	N	**6**	**5**	**4**	N	N	**1**	B9	185	**8**	**7**	**6**	**5**	**4**	N	N	**1**	F9	249
N	N	**6**	**5**	**4**	N	**2**	N	3A	58	N	**7**	**6**	**5**	**4**	N	**2**	N	7A	122	**8**	N	**6**	**5**	**4**	N	**2**	N	BA	186	**8**	**7**	**6**	**5**	**4**	N	**2**	N	FA	250
N	N	**6**	**5**	**4**	N	**2**	**1**	3B	59	N	**7**	**6**	**5**	**4**	N	**2**	**1**	7B	123	**8**	N	**6**	**5**	**4**	N	**2**	**1**	BB	187	**8**	**7**	**6**	**5**	**4**	N	**2**	**1**	FB	251
N	N	**6**	**5**	**4**	**3**	N	N	3C	60	N	**7**	**6**	**5**	**4**	**3**	N	N	7C	124	**8**	N	**6**	**5**	**4**	**3**	N	N	BC	188	**8**	**7**	**6**	**5**	**4**	**3**	N	N	FC	252
N	N	**6**	**5**	**4**	**3**	N	**1**	3D	61	N	**7**	**6**	**5**	**4**	**3**	N	**1**	7D	125	**8**	N	**6**	**5**	**4**	**3**	N	**1**	BD	189	**8**	**7**	**6**	**5**	**4**	**3**	N	**1**	FD	253
N	N	**6**	**5**	**4**	**3**	**2**	N	3E	62	N	**7**	**6**	**5**	**4**	**3**	**2**	N	7E	126	**8**	N	**6**	**5**	**4**	**3**	**2**	N	BE	190	**8**	**7**	**6**	**5**	**4**	**3**	**2**	N	FE	254
N	N	**6**	**5**	**4**	**3**	**2**	**1**	3F	63	N	**7**	**6**	**5**	**4**	**3**	**2**	**1**	7F	127	**8**	N	**6**	**5**	**4**	**3**	**2**	**1**	BF	191	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	FF	255

Example: Decimal 146 means that inputs 8, 5 and 2 are inverted.

6.15 MATH2 MENU

This feature allows a range of two-input mathematical functions to be performed. The available functions are listed below.

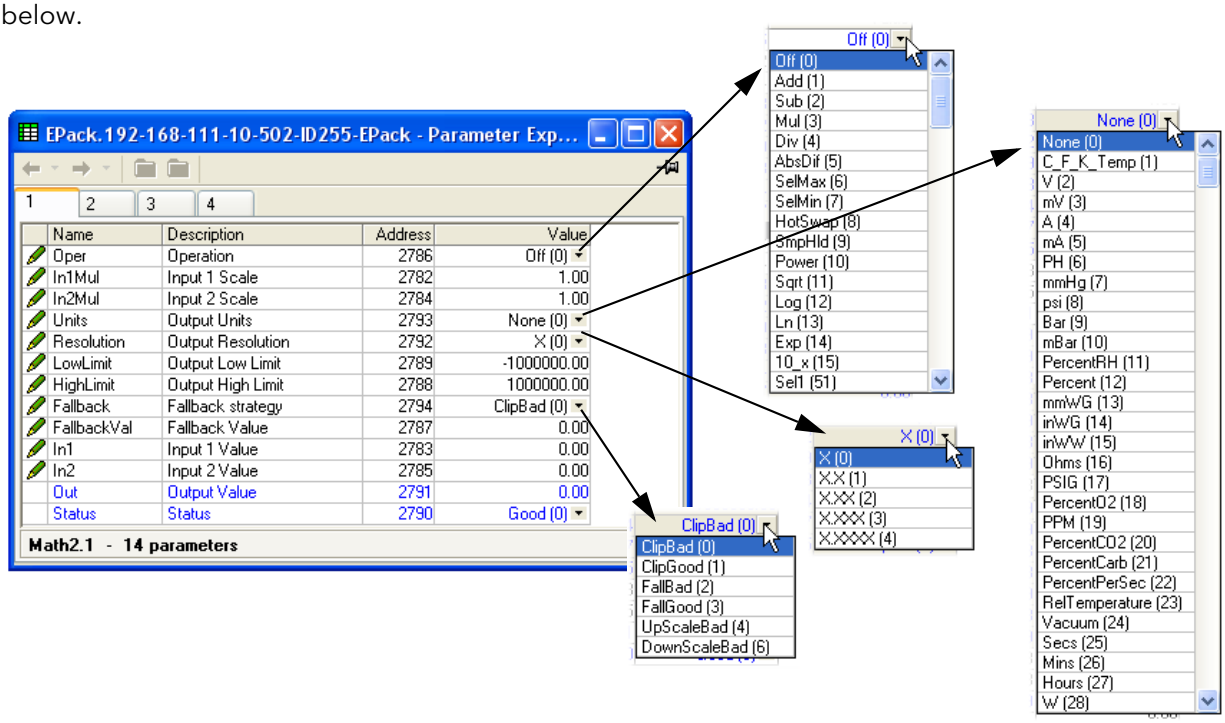


Figure 6.15 Maths2 configuration page

6.15.1 Math 2 Parameters

Note: For the sake of this description, 'High', '1' and 'True' are synonymous, as are 'Low', '0' and 'False'.

Oper — Defines the mathematical function to be applied to the inputs

None	No operation.
Add	Adds input one to input two.
Sub	Subtracts input two from input one.
Mul	Multiplies inputs one and two together.
Div	Divides input one by input two.
AbsDif	The difference in value between inputs one and two, ignoring sign.
SelMax	Output = the higher of inputs one and two.
SelMin	Output = the lower of inputs one and two.
HotSwap	Input one appears as the output for as long as input one is 'good'. If input one status is bad, input two appears as the output instead.
SmpHld	Sample and Hold. The output follows input one, for as long as input two is high (sample). When input two goes low (hold), the output is held, at the value current when the output went low, until input two goes high again. Input two is normally a digital value (low = 0 or high =1); when it is an analogue value, then any positive non-zero value is interpreted as a high.
Power	Output = Input one raised to the power of input two ($In1^{In2}$). For example if input one has the value 4.2, and the value of input two is 3, then output = 4.2^3 = 74.09 (approx.).
Sqrt	The output is the square root of input one. Input two is not used.
Log	Log base 10: Output = {Log_{10} (In 1)}. Input two is not used.

6.15 MATH2 PARAMETERS (Cont.)

Oper (Cont.)	Ln	Log base e: Output = {Log_n (In1)}. Input two is not used.
	Exp	Output = $e^{(input\ one)}$. Input two is not used.
	10_x	Output = $10^{(input\ one)}$. Input two is not used.
	Sel1	If the Select input is high, input two appears at the output; if the Select input is low, input one appears at the output.
In1(2) Mul	The scaling factor to be applied to input one (two).	
Units	Allows the user to choose units for the output (figure 6.15b, above).	
Resolution	Use the up and down arrows to position the decimal point as required.	
Low Limit	The low limit for all inputs to the function and for the fallback value.	
High Limit	The high limit for all inputs to the function and for the fallback value.	
Fallback	The fallback strategy comes into play if the status of the input value is 'Bad', or if its value lies outside the range (High limit- Low limit).	
	Clip Bad	The output is set to the high or low limit as appropriate; output status is set to 'Bad'.
	Clip Good	The output is set to the high or low limit as appropriate; output status is set to 'Good'.
	Fall Bad	The output is set to the fallback value (below); output status is set to 'Bad'.
	Fall Good	The output is set to the fallback value (below); output status is set to 'Good'.
	Upscale Bad	The output is set to the high limit and Status is set to 'Bad'.
	Downscale Bad	The output is set to the low limit and Status is set to 'Bad'.
Fallback value	Allows the user to enter the value to which the output is set for Fallback = Fall Good, or Fall Bad.	
Select	Editable only if Oper = Select. Allows input one or input two to be selected for output.	
In1	Input one value	
In2	Input two value	
Out	The output value resulting from the configured mathematical operation. If either input is 'Bad', or if the result is out of range, the fallback strategy is adopted.	
Status	Indicates the status of the operation as 'Good' or 'Bad'. Used to flag error conditions and can be used as an interlock for other operations.	

6.16 MODULATOR CONFIGURATION

This function implements the modulation type firing modes such as fixed and variable period modulation.

Note... For the sake of completeness, all Modulator parameters are shown in the figure below. Normally, for the sake of clarity, non-relevant (shaded) parameters should be hidden using the 'Options>Parameter Availablity Settings...>Hide Parameters and Lists when Not Relevant' menu item.

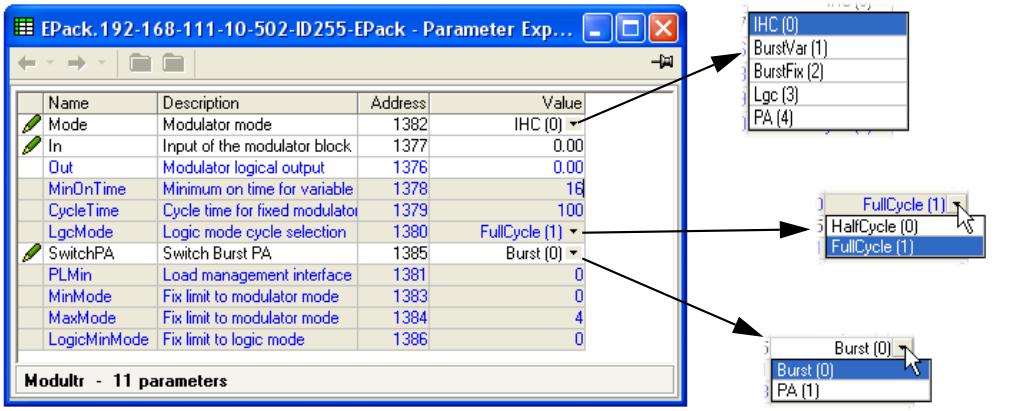


Figure 6.16 Modulator menu page

6.16.1 Modulator parameters

Mode	Select the required firing mode from 'Logic', 'PA' (Phase angle) 'Half cycle', 'BurstVar' (Burst firing - minimum on time) or 'BurstFix' (Burst firing - cycle time).
In	This is the value that the modulator is required to deliver.
Out	The output logic signal controlling the power module on and off times, normally wired to the input of the firing block. For Mode = Phase angle, this is a phase angle demand.
Min On Time	For Variable Period Modulation, this sets the minimum on time in supply voltage periods. At 50% demand from the modulator, Ton = Toff = Minimum on time, and Cycle time is 2 x Minimum on time = Modulation period. The minimum off time is equal to 'Min on time'.
Cycle Time	For Fixed Period Modulation, this is the cycle time in supply voltage periods.
Logic Mode	For Logic Firing Modulation, Half cycle sets firing stop to the next zero crossing; Full cycle sets firing stop at the zero crossing of the next full cycle.
Switch PA	Allows the user to impose Phase Angle firing, overriding the configured Burst Mode as displayed in 'Mode', above.

6.17 NETWORK CONFIGURATION

This identifies the type of electrical network to be controlled, and this, in turn defines how the network's electrical measurements are presented. The configuration is divided into a number of areas:

Meas,
Setup
AlmDis,
AlmDet,
AlmSig,
AlmLat,
AlmAck,
AlmStop.

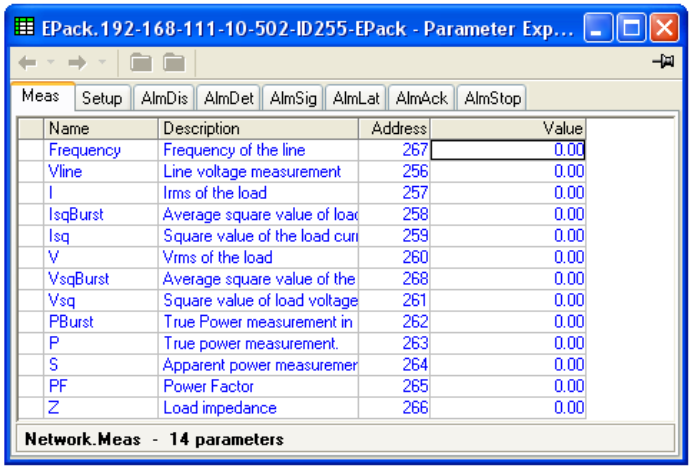


Figure 6.17 Network configuration - top level

6.17.1 Network Meas Menu

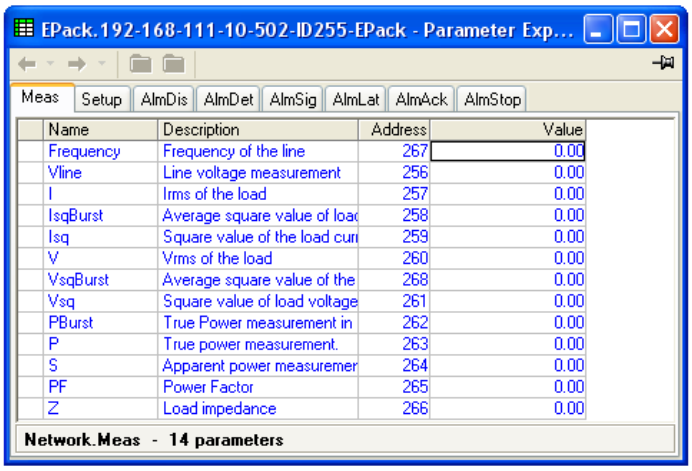


Figure 6.17.1 Network Meas configuration page

PARAMETERS

This submenu presents power network measurements, according to the network type. All available measurements are listed below, but which values actually appear depends on the network configuration.

Frequency	Displays the calculated frequency of the supply voltage of the power channel associated with this network.
Vline	Supply voltage measurement.
I	Load Irms measurement on primary power module. The time base measurement is the main period in Phase Angle, and the modulation period in Burst Mode.
IsqBurst	Average square value of load current in burst firing. The average Isq in burst firing, the average is taken over the duration of the burst period. This is typically used for monitoring and alarming over the burst period.
Isq	Square value of load current in Burst Firing and over the main period in phase angle.
V	Load Vrms measurement. The time base measurement is the main period in phase angle, and the modulation period in burst mode.
VsqBurst	Average square value of load voltage in burst firing taken over the duration of the burst period. Typically used for monitoring and alarm strategies over the burst period.
Vsq	Square value of load voltage in Burst Firing and on main period in Phase Angle Firing. Typically used for V^2 control.
P Burst	Measurement of true power on the network. This is calculated over the modulation period in Burst Firing mode. Typically used for monitoring and alarm strategy.
P	True power measurement in Burst Firing and over the modulation period in Phase Angle firing. Typically used for true power control.
S	Apparent power measurement. For phase angle firing S=Vline x I_{RMS}; for burst firing S=V_{RMS} x I_{RMS}
PF	Calculation of power factor. Defined as Power Factor = True Power / Apparent Power. In phase angle this is PF=P/S; in burst firing PF = PBurst/S = Cosϕ(Load)
Z	Load impedance measurement on first power module, defined as:- Z=Vrms/Irms. Measurement uses line current and load voltage
HSink Temp	Reserved for future development.

6.17.2 Network Setup configuration

This displays the setup of the network and associated functions.

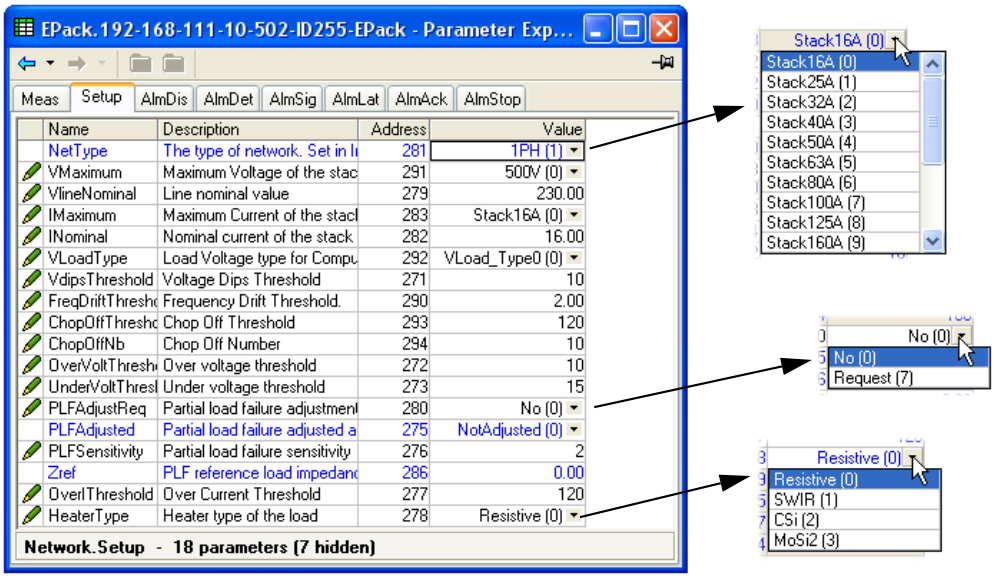


Figure 6.17.2 Network setup menu page

PARAMETERS

NetType	The type of network to which the unit can be connected. This is set at the factory and cannot be changed
VMaximum	Indicates the maximum voltage (physical rating) of the stack (500V)
Vline Nominal	Line voltage nominal value (Line to neutral)
IMaximum	Indicates the maximum current of the stack (16A, 25A, 40A, 63A). Further values (80A, 100A, 125A, 160A) are reserved for future development.
INominal	Nominal current supplied to the load (limited by IMaximum).
VLoadType	Defines the computation method for load voltage (Vload). 0: Vload = Vline as long as I > Ithreshold (internal definition) 1: Compute Vload using the formula $V^2load=P^2/I^2$.
VdipsThreshold	Voltage dips threshold. This is a percentage difference (relative to Vline Nominal) between 2 consecutive half cycles. Each half cycle voltage measurement is integrated and at the end of each half cycle the last two voltage integrals are compared.
FreqDriftThold	The supply frequency is checked every half cycle, and if the percentage change between 1/2 cycles exceeds this threshold value, a Mains Frequency System Alarm is generated. The threshold may be set to a maximum of 5% to cater for the effects of heavily inductive networks.
ChopOffThreshold	The 'Chop-off' alarm becomes active if load current exceeds this threshold for more than a pre-defined number of mains periods (Number Chop Off parameter). Threshold values lie between 100% and 400% of the unit's nominal current (INominal).
NumberChopOff	Definition of the number of mains periods in which Chop Off events can occur before a Chop Off alarm is enabled. Only used with Chop Off Threshold .
OverVoltThreshold	The threshold for detecting an over voltage condition as a percentage of VLineNominal. If Vline rises above the threshold an OverVolt alarm is set.
UnderVoltThreshold	This is the threshold for detecting an under voltage condition as a percentage of VLineNominal. If Vline falls below the threshold an UnderVolt alarm is set

6.17.2 NETWORK SETUP CONFIGURATION (Cont.)

PARAMETERS (Cont.)

Heatsink PreTemp	Reserved for future development.
PLFAdjustReq	Partial load failure adjustment request. To make the Partial Load Failure (PLF) alarm operate correctly, the normal steady-state condition must be known to the instrument. This is done by activating the PLF Adjust Req once the controlled process has achieved a steady state condition. This causes a load impedance measurement to be made which is used as a reference for detecting a partial load failure. If the load impedance measurement is successful PLFAdjusted (below) is set. The measurement fails if the load voltage (V) is below 30% of (VNominal) or the current (I) is below 30% of (INominal). The PLF alarm becomes active as setup in 'PLF Sensitivity', below.
PLFAdjusted	Partial load failure adjusted acknowledge. Indicates that the user requested a PLF adjustment and that the adjustment was successful.
PLFSensitivity	Partial load failure sensitivity. This defines how sensitive the partial load failure detection is to be as the ratio between the load impedance for a PLFadjusted load and the current impedance measurement. For example for a load of N parallel, identical elements, if the PLF Sensitivity (s) is set to 2, then a PLF alarm will occur if N/2, or more elements are broken (i.e. open circuit). If PLF Sensitivity is set to 3, then a PLF alarm occurs if N/3 or more elements are broken. If (N/s) is non-integer, then the sensitivity is rounded up. E.G. if N = 6 and s= 4, then the alarm is triggered if 2 or more elements are broken.
Zref	Reference load impedance, as measured when PLF adjust is requested.
OverIThreshold	The threshold for detecting an over current condition as a percentage of INominal. If I is above the threshold a Mains Current Alarm occurs (DetoverCurrent).
HeaterType	Shows the type of heater used in the load as: 'Resistive', 'SWIR' (Short wave infra-red), 'CSi' (Silicon Carbide), 'MoSi2' (Molybdenum Disilicide).

6.17.3 Network alarms

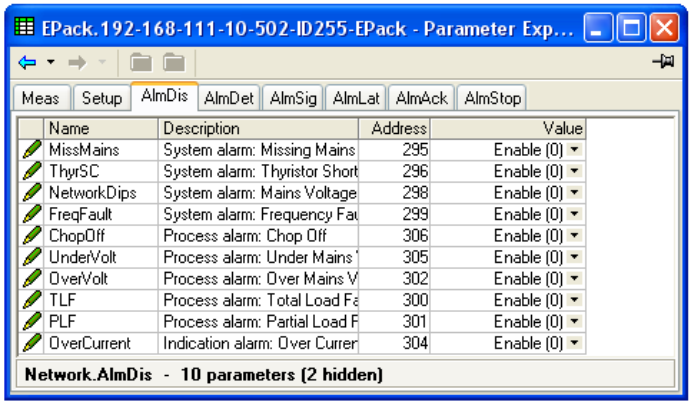


Figure 6.17.3 Network alarms page

ALMDIS

This menu allows individual network block alarms (listed below) to be enabled/disabled. Section 9 gives more details of these alarms.

Missing Mains	Mains frequency fault	Total load failure
Thyristor short circuit	Chop Off	Partial load failure
Over temperature	Under voltage	Pre Temperature
Mains voltage (Network) dips	Over voltage	Over current

NETWORK ALMDET SUBMENU

As for 'Alarm Disable', above, but this Alarm detect submenu indicates whether any of the network alarms has been detected and is currently active.

NETWORK ALMSIG SUBMENU

These displays show whether an alarm has occurred and also contains latching information. The relevant AlarmSig parameter is used when wiring (to a relay for example). The alarm list is as given above.

NETWORK ALMLAT SUBMENU

As for 'Alarm Disable', above, but this Alarm Latch submenu allows each individual network block alarm to be defined as latching or non-latching.

NETWORK ALMACK SUBMENU

As for 'Alarm Disable', above, but this Alarm Acknowledge submenu allows each individual network block alarm to be acknowledged. Once acknowledged, the associated signalling parameter is cleared. Acknowledge parameters automatically clear after being written.

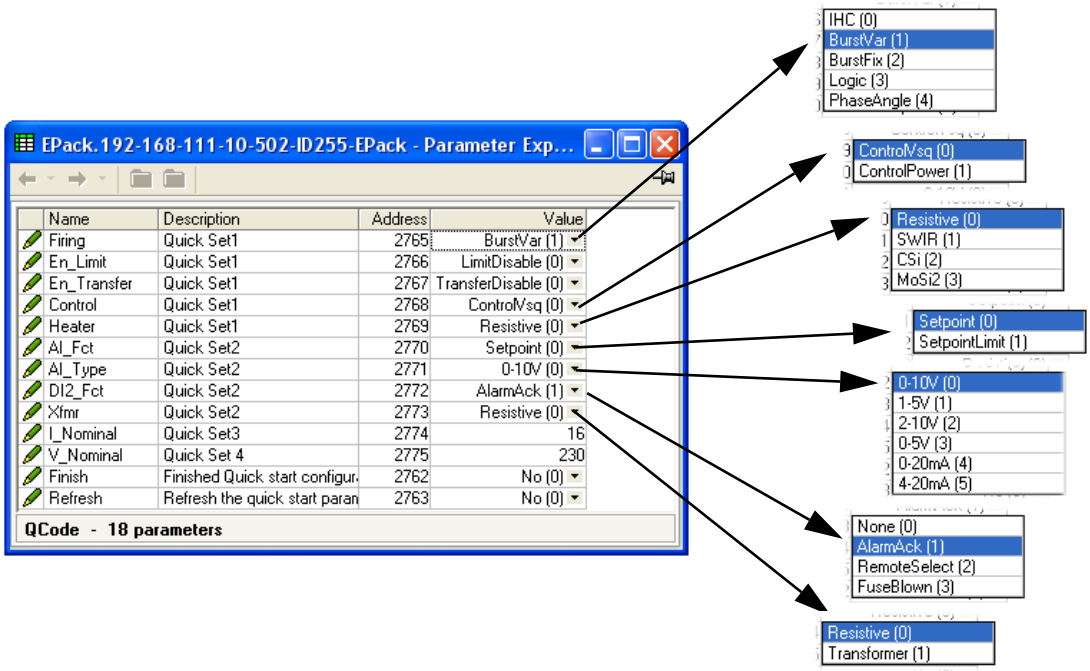
> Note... Alarms may not be acknowledged whilst the trigger source is still active.

NETWORK ALMSTOP SUBMENU

Allows each individual alarm type to be configured to stop the related power module from firing. Activated by the related Signalling parameter. The alarm list is as given above.

6.18 QCODE

Quick code parameters, settable when in Quickcode configuration mode as well as here.



Figuire 6.18 Quick code parameters

6.18.1 Parameters

Firing	Select firing mode from IHC (Intelligent half cycle), Burst firing (fixed or variable), Logic or Phase angle.
En_Limit	Enable or disable threshold limit.
En_Transfer	Enable or disable transfer enable (Proportional limit).
Control	Select 'Power' or 'Vsq' (V^2) as the control mode.
Heater	Select Resistive, Short wave infra red (SWIR), Silicon carbide (CSi) or Molybdenum disilicide (MoSi2) as the heating element type.
AI_Fct	Select the Analogue Input function as 'Setpoint' or 'Setpoint limit'.
AI_Type	Select the required Volt or mA range (as shown above) for the analogue input.
DI2_Fct	Select the funtion of Digital Input 2 as 'None', Alarm acknowledge ('AlarmAck'), Select remote setpoint ('RemoteSelect') or Fuse Blown ('FuseBlown').
XFmr	Select output as suitable for resistive loads or for transformer primary loads.
I_Nominal	The nominal output currect expected to be drawn.
V_Nominal	The nominal output voltage to be supplied.
Finish	Quit quick code.
Refresh	Refresh quick code parameters.

6.19 SETPROV CONFIGURATION MENU

The Setpoint provider supplies one local and one remote setpoint.

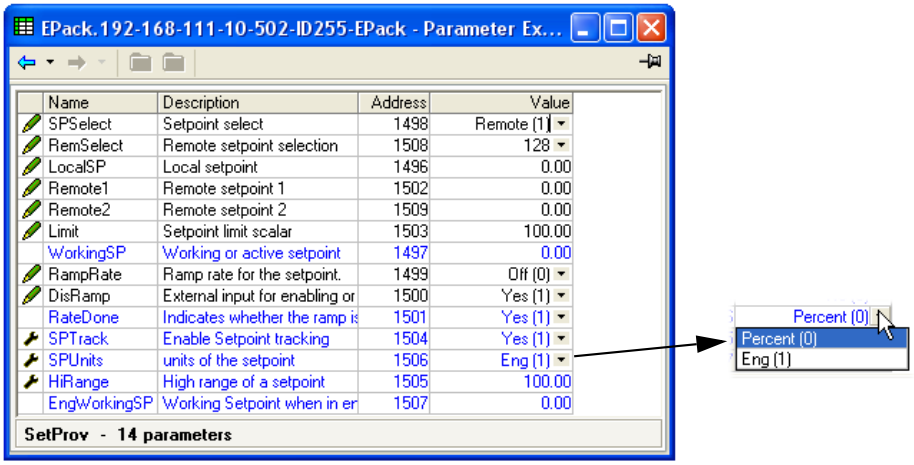


Figure 6.19 SetProv configuration page

6.19.1 Setpoint provider parameters

SPSelect	Allows the user to select between Remote or Local as the setpoint source.
RemSelect	Select Remote1 or Remote2 as the remote setpoint.
LocalSP	Allows entry of a setpoint value to be used when SPSelect (above) is set to 'Local'.
Remote1	The Remote setpoint value (normally wired from an analogue input) for use when SPSelect = Remote and RemSelect = Remote1.
Remote21	The Remote setpoint value (normally wired from an analogue input) for use when SPSelect = Remote and RemSelect = Remote2.
Limit	Allows the target setpoint to be scaled such that 'scaled target SP' = (target SP x limit)/100. Thus, when limit = 100, the setpoint is unscaled.
WorkingSP	The active value being provided as a setpoint output. This might be the current target setpoint or the rate-limited target setpoint.
RampRate	This applies a rate limit to the working setpoint, until the target setpoint has been achieved. The 'RateDone' parameter (below) is set to 'No' for the duration of the rate limiting, then set to 'Yes' when rate limiting is complete.
DisRamp	This is an external control used to enable/disable ramp rate limiting and to write the target setpoint directly to the working setpoint. The 'RateDone' parameter (below) is set to 'Yes' when DisRamp is 'Yes'.
RateDone	Set to 'No' if ramp rate limiting (above) is in operation. Otherwise set to 'Yes'.
SPTrack	If enabled ('Yes') the local setpoint tracks the remote setpoints, so that if the setpoint is subsequently set to 'Local', the local setpoint will be the same as the last known value of the remote setpoint, thus ensuring a bumpless transfer.
SPUnits	Allows the user to select % or 'Eng' (Engineering units) as Setpoint units. If 'Eng' is selected, 'HiRange' and 'Eng workingSP' appear at the user interface.
HiRange	Appears only if SP units set to 'Eng'. This value is the high range of the setpoint used to scale the setpoint into % of High Range.
EngWorkingSP	Appears only if SP units set to 'Eng'. This value is an indication of the working setpoint in Engineering units. The parameter must not be used for control because control loops accept setpoints only as % values.

6.20 USER VALUE CONFIGURATION MENU

This provides storage for up to four user-defined constants. Typical uses are as a sources for maths functions, or as storage for values written over the communications link.

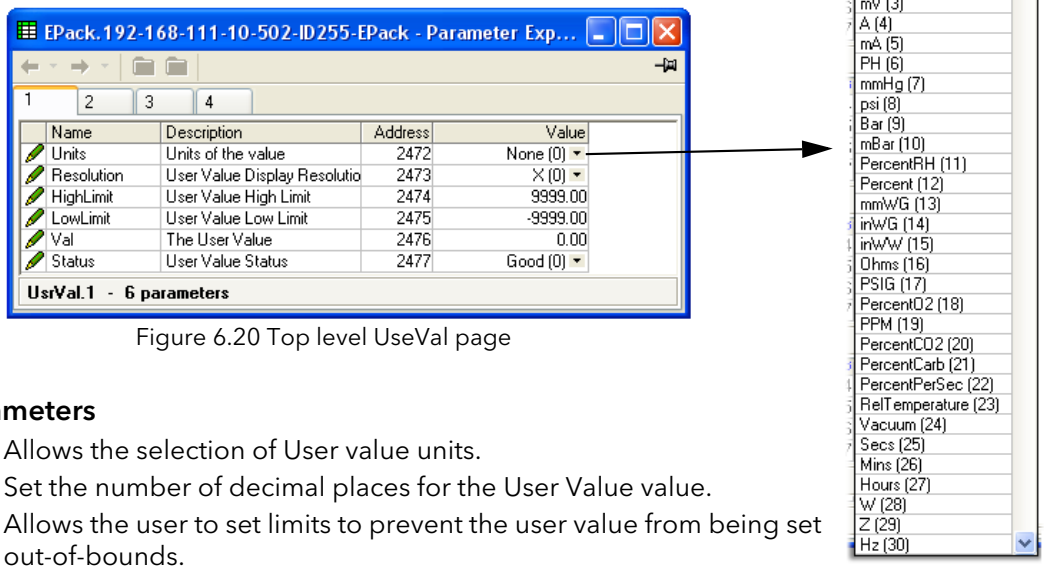


Figure 6.20 Top level UseVal page

6.20.1 User Value parameters

Units	Allows the selection of User value units.
Resolution	Set the number of decimal places for the User Value value.
High/Low Limit	Allows the user to set limits to prevent the user value from being set out-of-bounds.
Value	Allows the user to enter a value, or the value if wired to a suitable parameter.
Status	If this parameter is wired, it can be used to force a Good or Bad status onto the User Value for test purposes (e.g. fallback strategy). If not wired, it reflects the status of the Value input if this input is wired.

7 USING ITOOLS

iTools software running on a pc allows quick and easy access to the configuration of the unit. The parameters used are the same as those described in section 6 above, with the addition of various diagnostic parameters.

iTools also gives the user the ability to create software wiring between function blocks, something that is not possible from the operator interface. Such wiring is carried out using the Graphical wiring Editor feature.

In addition to the guidance given here, there are two on-line Help systems available within iTools: Parameter help and iTools help. Parameter help is accessed by clicking on 'Help' in the toolbar (opens the complete parameter help system), by right-clicking on a parameter and selecting 'Parameter Help' from the resulting context menu, or by clicking on the Help menu and selecting 'Device Help'. iTools help is accessed by clicking on the Help menu, and selecting 'Contents'. iTools help is also available in manual format under part number HA028838, either as a physical manual or as a pdf file.

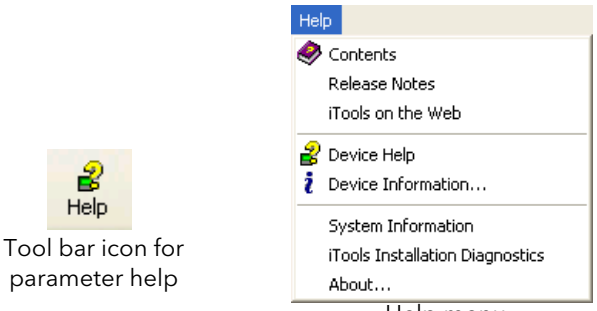


Figure 7 Help access

7.1 iTools CONNECTION

7.1.1 Automatic detection

The following descriptions assume that the latest version iTools software as been correctly installed on the pc.

For EPack units only (at time of publication), if the desktop/laptop and EPack are IP compatible (same subnet mask) then, Plug & Play allows easy connection as follows.

1. Set correct IP mode and or IP address to the instrument and Personal Computer.
2.. Launch iTools, click on the button 'Add' a popup window appears showing you all EPack instruments on the network.
3. Double click on one or more units to add them to iTools.

> Note...'Eurotherm discovery' mechanism is based on 'Zero Configuration Networking' which is generic name used to group protocosl together in order to create communication networks automatically (Plug & Play)

Alternatively, if there is a mix of EPack and other instruments on the network, the following procedure can be used:

7.1.2 Ethernet (Modbus TCP) communications

> Note: the following description is based on windows XP. Windows 'Vista' is similar.

It is first necessary to determine the IP address of the unit, as described under 'Comms menu' in section 6.5. This can be done from either the Config or Quickcode menu.

Once the Ethernet link has been correctly installed, carry out the following actions at the pc:

1. Click on 'Start'
2. Click on 'Control Panel'. (If Control Panel opens in 'Category View' select 'Classic View' instead.)
3. Double-click on 'iTools'.

(Continued)

7.1.2 ETHERNET (MODBUS TCP) COMMUNICATIONS (Cont.)

4. Click on the TCP/IP tab in the Registry settings configuration.
5. Click on Add... The 'New TCP/IP Port' dialogue box opens.
6. Type-in a name for the port, then click Add...
7. Type the IP address of the unit in the 'Edit Host' box which appears. Click OK.
8. Check the details in the 'New TCP/IP Port' box, then click on 'OK'.

Click on 'OK' in the 'Registry settings' box to confirm the new port.

)

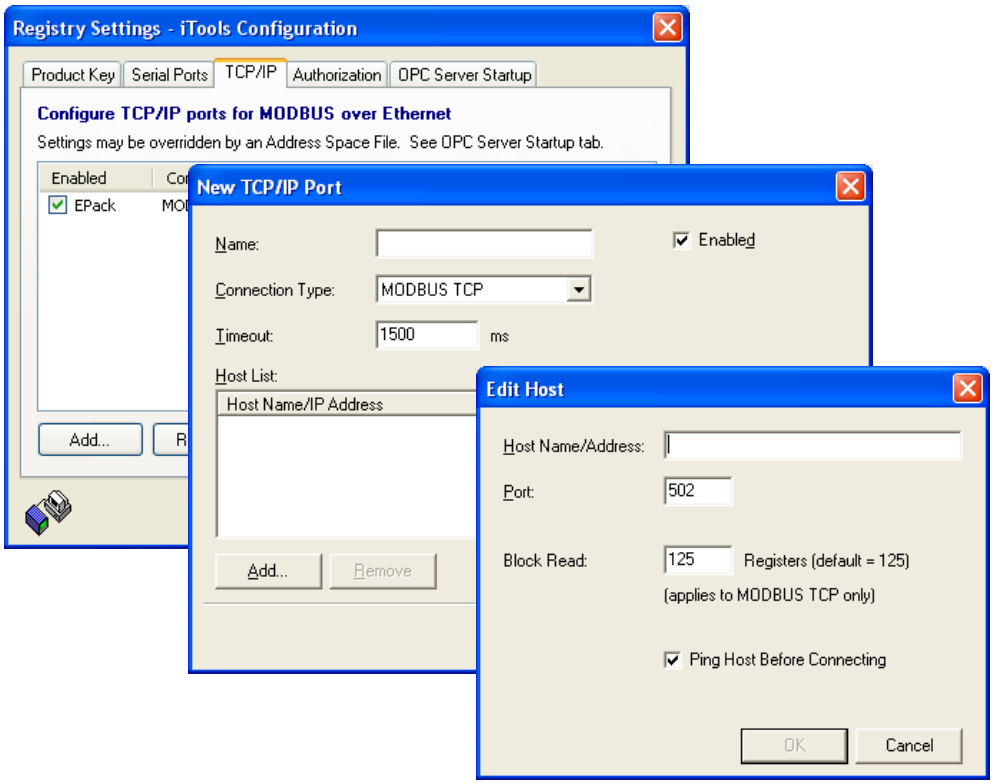


Figure 7.1.2a Adding a new Ethernet port

7.1.2 ETHERNET (TCP/IP) COMMUNICATIONS (Cont.)

To check that the pc can now communicate with the instrument, Click 'Start'. 'All Programs', 'Accessories', 'Command Prompt'

when the Command Prompt box appears, type in : Ping<Space>IP1.IP2.IP3.IP4<Enter> (where IP1 to IP4 are the IP address of the instrument).

If the Ethernet link to the instrument is operating correctly, the 'successful' reply arrives. Otherwise, the 'failed' reply arrives, in which case, the Ethernet link, IP address, and pc port details should be verified.

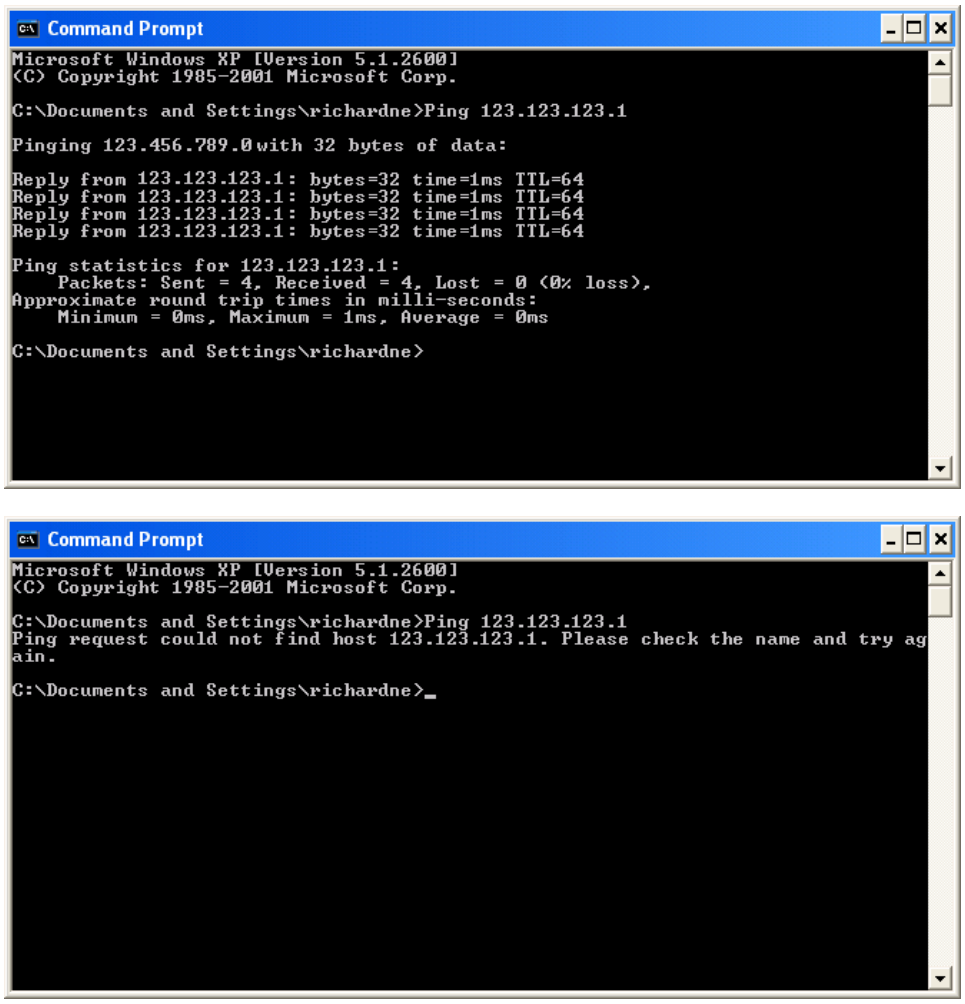


Figure 7.1.2b Command prompt 'Ping' screens (typical)

Once the Ethernet link to the instrument has been verified, iTools can be started (or shut down and restarted), and the Scan toolbar icon used, to 'find' the instrument. The scan can be stopped at any time by clicking on the Scan icon a second time.

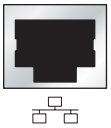
See section 7.2 for more details of the scan procedure.

7.1.3 Direct Connection

This section describes how to connect a pc directly to a Driver Module which, for this purpose, must be fitted with the Ethernet communications option.

WIRING

Connection is made from the Ethernet connector on the front of the Driver Module to an Ethernet RJ45 connector, usually located at the rear of the pc.



PC Ethernet connector.

Once wired correctly, and powered up, it is necessary to enter a suitable IP address and subnet mask into the Comms configuration. This information can be found as follows:

1. At the pc, click 'Start'. 'All Programs', 'Accessories', 'Command Prompt'
2. When the Command Prompt box appears, type in :IPConfig<Enter>

   The response is a display, such as that shown below, giving the IP address and Subnet mask of the pc. Choose an address in the range covered by these two values.

   A subnet mask element of 255 means that the equivalent element of the IP address must be used unchanged. A subnet mask element of 0 means that the equivalent element of the IP address may take any value between 1 and 255 (0 is not allowed). In the example below, the range of IP addresses which may be chosen for the Driver Module is 123.123.123.2 to 123.123.123.255. (123.123.123.0 is not allowed and 123.123.123.1 is the same as the pc's address, and may therefore not be used.)

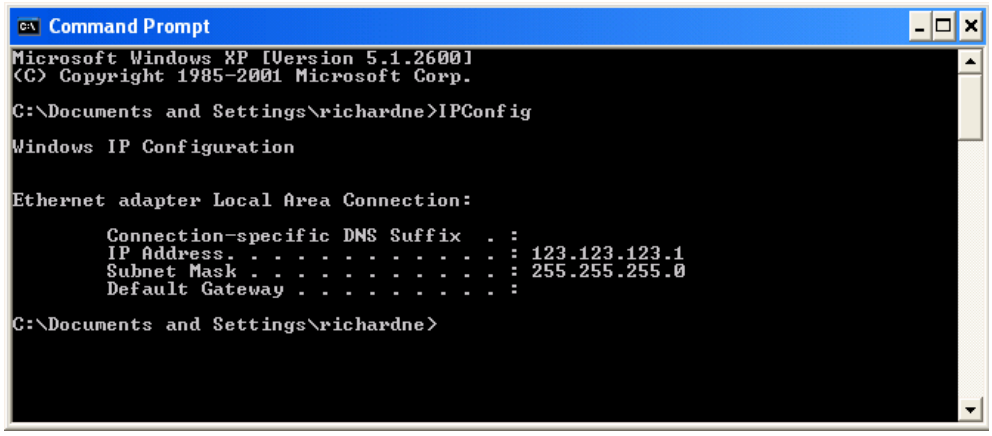


Figure 7.1.3 IP Config command

3. In Comms configuration (section 6.5) enter the selected IP address and the subnet mask (as it appears in the command prompt window) in the relevant parts of the configuration menu.
4. Check communications by 'pinging' as described in section 7.1.2, above.

Once the link to the instrument has been verified, iTools can be started (or shut down and re-started), and the 'Add' button used to add the instrument. Alternatively, the Scan toolbar icon can be used, to 'find' the instrument. The scan can be stopped at any time by clicking on the Scan icon a second time.

See section 7.2, below for more details of the scan procedure

.

Subnet Masks and IP addresses.

Subnet Masks are most readily understood when looked at in binary format.
For example, a mask of 255.255.240.10 can be re-written as:
11111111.11111111.11110000.00001010. In such a case, IP addresses
11111111.11111111.1111xxxx.xxxx1x1x would be recognised (where x can be either a 0 or a 1).

Subnet mask	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	1	0
IP addresses (Binary)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	x	x	x	x	x	x	x	x	1	x	1	x
IP addresses (decimal)	255								255								240 to 255				10, 11, 14, 15, 26, 27, 30, 31, 42, 43, 46, 47 etc.											

7.2 SCANNING FOR INSTRUMENTS

'Clicking on the 'Scan' toolbar icon causes a dialogue box (shown below) to appear. This allows the user to define a search range of addresses.

Notes:

1. Scanning is necessary only when the 'Plug & Play is not available for the instrument type being searched for.
2. The relevant instrument address is that entered in the Communications menu 'Address' item, and it can take any value between 1 and 254 inclusive, as long as it is unique to the comms link.
3. The default selection (Scan all device addresses...) will detect any instrument on the serial link, which has a valid address.

As the search progresses, any instruments detected by the scan appear as thumbnails (faceplates) in the 'Panel Views' area, normally located at the bottom of the iTools screen. (options/Panel Views position allows this area to be moved to the top of the window, or the Close icon can be used to close it. Once closed it can be re-opened by clicking on 'Panel Views' in the 'View' menu.)

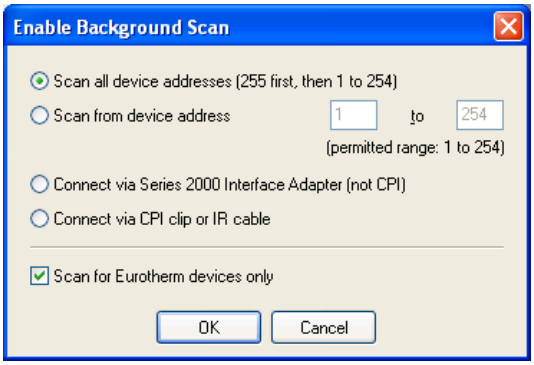


Figure 7.2a Scan range enable

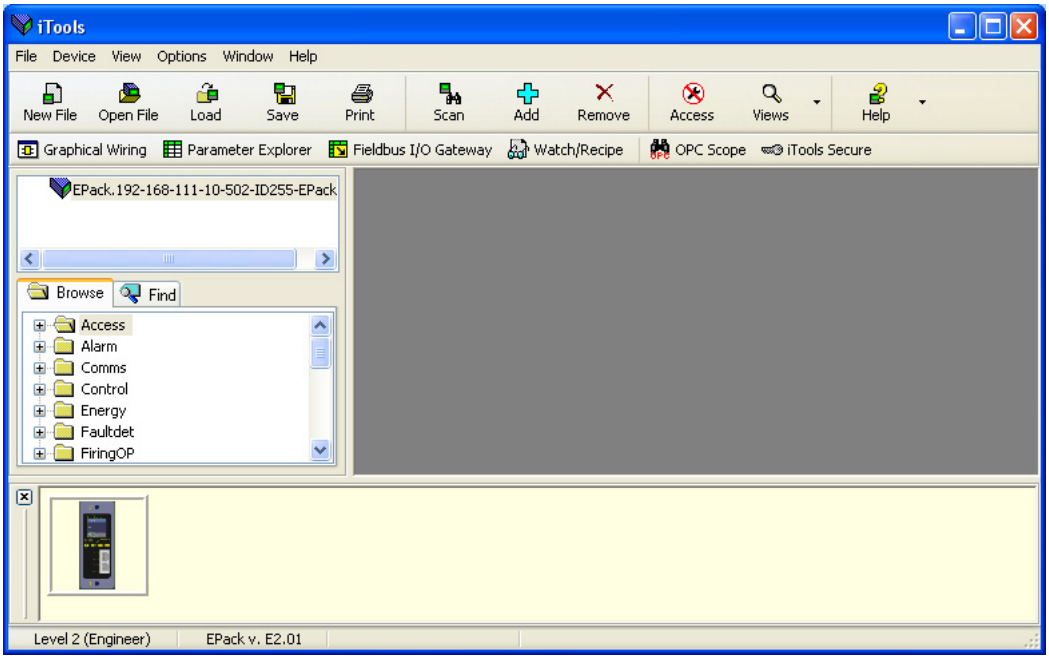


Figure 7.2b iTools initial window with one instrument detected

7.3 GRAPHICAL WIRING EDITOR Graphical Wiring

> Note... The Graphical wiring editor is a chargeable option, and the toolbar icon appears only if the option has been purchased and is enabled.

Clicking on the Graphical Wiring Editor (GWE) toolbar icon causes the Graphical wiring window for the current instrument configuration to open. Initially, this reflects the preset factory default block wiring..

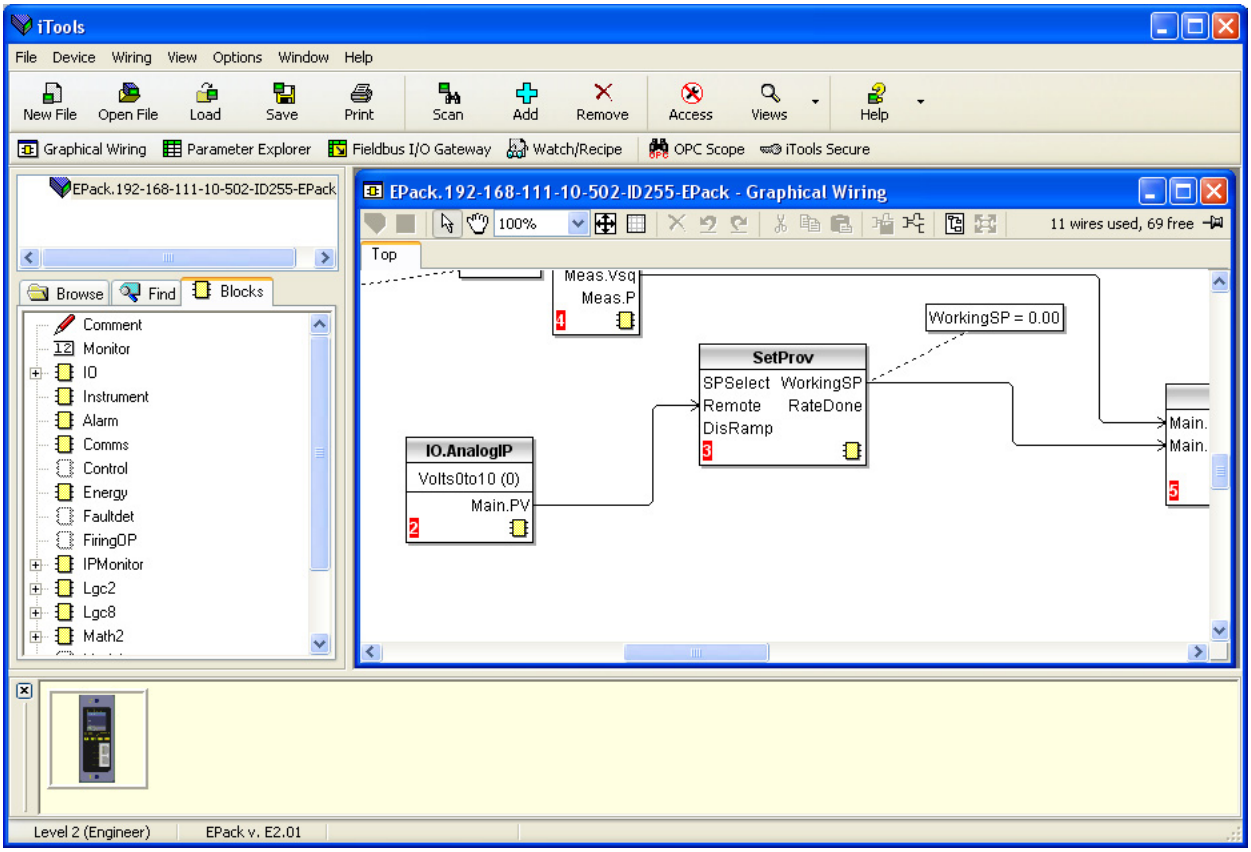
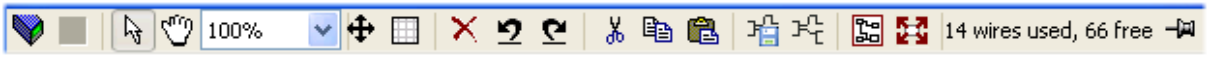


Figure 7.3 Graphical wiring Editor

The graphical wiring editor allows:

1. Function blocks, notes, comments etc. to be 'drag and dropped' into the wiring diagram from the tree list (left pane).
2. Parameters to be wired to one another by clicking on the output, the clicking on the required input.
3. Viewing and/or editing of parameter values by right-clicking on a function block and selecting 'Function Block View'.
4. The user to select parameter lists and to switch between parameter and wiring editors.
5. Completed wiring to be downloaded to the instrument (function blocks and wiring items with dashed outlines are new, or have been edited since the last download).

7.3.1 Toolbar



Download wiring to Instrument.

Mouse Select. Select nor mal mouse operation. Mutually exclusive with 'Pan', below.

Mouse Pan. When active, this causes the mouse cursor to become a hand-shaped icon. Allows the graphical wiring diagram to be click-dragged within the GWE window aperture.

Zoom. Allows the magnification of the wiring diagram to be edited.

Pan tool. Whilst left-clicked, the cursor appears as a rectangle, representing the position of GWE window aperture over the whole wiring diagram. Click dragging allows this aperture to be moved freely about the diagram. Rectangle size depends on Zoom (magnification) factor.

Show/Hide grid. This icon toggles a background alignment grid on and off.

Undo, Redo. Allows the user to undo the last action, or once an undo action has taken place, to undo the undo. Short cuts are <Ctrl>+<Z> for undo; <Ctrl>+<R> for re-do.

Cut, Copy, Paste. Normal Cut (copy and delete), Copy (copy without delete) and Paste (insert into) functions. Short cuts are <Ctrl>+<X> for cut; <Ctrl>+<C> for copy and <Ctrl>+<V> for Paste.

Copy diagram fragment; Paste diagram fragment. Allows a part of the wiring diagram to be selected, named and saved to file. The fragment may then be pasted into any wiring diagram, including the source diagram.

Create compound; Flatten compound. These two icons allow compounds to be created and 'uncreated' respectively.

7.3.2 Wiring editor operating details

COMPONENT SELECTION

Single wires are shown with boxes at 'corners' when selected. When more than one wire is selected, as part of a group, the wire colour changes to magenta. All other items have a dashed line drawn round them when selected.

Clicking on a single item selects it. An Item can be added to the selection by holding down the control key (ctrl) whilst clicking on the item. (A selected item can be deselected in the same way.) If a block is selected, then all its associated wires are also selected.

Alternatively, the mouse can be click-dragged on the background to create a 'rubber band' round the relevant area; anything within this area being selected when the mouse is released.

<Ctrl>+<A> selects all items on the active diagram.

BLOCK EXECUTION ORDER

The order in which the blocks are executed by the instrument depends on the way in which they are wired. The order is automatically worked out so that the blocks use the most recent data. Each block displays its place in its sequence in a coloured square in the bottom left-hand corner (figure 7.3.2a).

7.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

FUNCTION BLOCKS

A Function Block is an algorithm which may be wired to and from other function blocks to make a control strategy. Each function block has inputs and outputs. Any parameter may be wired from, but only parameters that are alterable in Operator Mode may we wired to. A function block includes any parameters that are needed to configure or operate the algorithm. The inputs and outputs which are considered to be of most use are always shown. In most cases all of these need to be wired before the block can perform a useful task.

If a function block is not faded in the tree (left hand pane) it can be dragged onto the diagram. The block can be dragged around the diagram using the mouse.

A Maths block is shown below as an example. When block type information is alterable (as in this case) click on the box with the down arrow in it to display a dialogue box allowing the value to be edited.

If it is required to wire from a parameter, which is not shown as a recommended output, click on the 'Click to Select Output' icon in the bottom right hand corner to display a full list of parameters in the block (figure 7.3.2c, below). Click on one of these to start a wire.

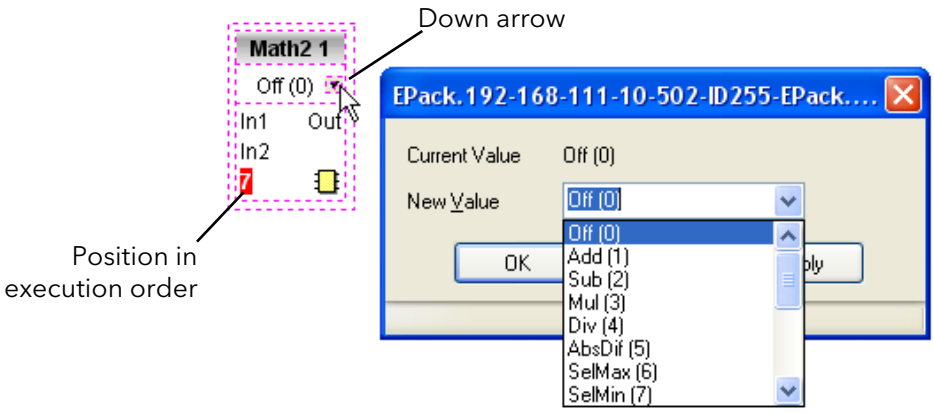


Figure 7.3.2a Function block example

Function Block context menu

Right click in the function block to display the context menu.

Function block View	Displays a list of parameters associated with the function block. 'Hidden' parameters can be displayed by de-selecting 'Hide Parameters and Lists when not Relevant' in the Options menu 'Parameter availability Settings...' item.
Re-Route wires	Redraws all wiring associated with the function block.
Re-Route Input wires	Redraws all Input wiring associated with the function block.
Re-Route Output wires	Redraws all Output wiring associated with the function block.
Show Wires Using Tags	Wires are not drawn, but their Start and End destinations are indicated by tags instead. Reduces wire 'clutter' in diagrams, where source and destination are widely separated.

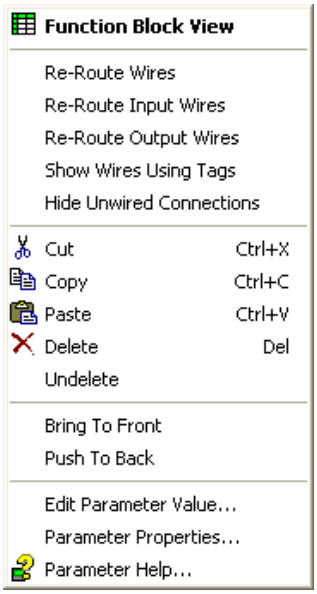
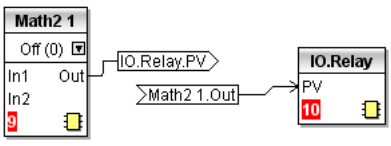


Figure 7.3.2b Function block context menu



7.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

FUNCTION BLOCK CONTEXT MENU (Cont.)

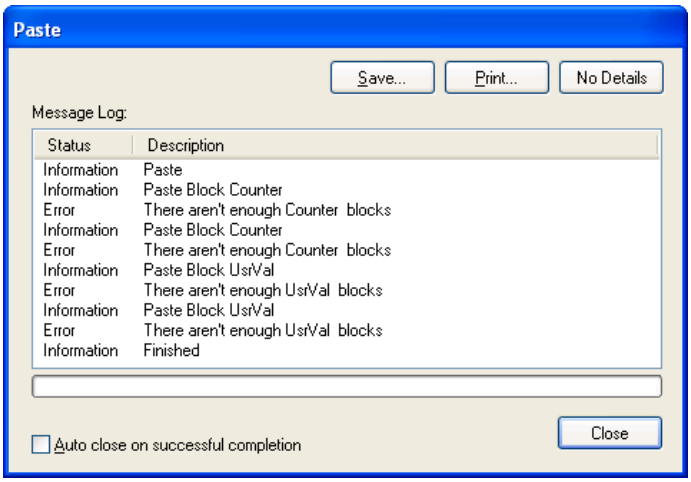
Hide Unwired Connections

Displays only those parameters which are wired.

Cut — Allows one or more selected items to be moved to the Clipboard ready for pasting into another diagram or compound, or for use in a Watch window, or OPC scope. The original items are greyed out, and function blocks and wires are shown dashed until next download, after which they are removed from the diagram. Short cut = <ctrl>+<X>. Cut operations carried out since the last download can be 'undone' by using the 'Undo' toolbar icon, by selecting 'Undelete' or by using the short cut <ctrl>+<Z>.

Copy — Allows one or more selected items to be copied to the Clipboard ready for pasting into another diagram or compound, or for use in a Watch window, or OPC scope. The original items remain in the current wiring diagram. Short cut = <ctrl>+<C>. If items are pasted to the same diagram from which they were copied, the items will be replicated with different block instances. Should this result in more instances of a block than are available, an error display appears showing details of which items couldn't be copied.

Paste — Copies items from the Clipboard to the current wiring diagram. <Ctrl>+<V>. If items are pasted to the same diagram from which they were copied, the items will be replicated with different block instances. Should this result in more instances of a block than are available, a Paste error display appears showing details of which items couldn't be copied.



Delete — Marks all selected items for deletion. Such items are shown dashed until next download, after which they are removed from the diagram. Short cut = <Del>.

Undelete — Reverses 'Delete' and 'Cut' operations carried out on selected item(s) since the last download.

Bring To Front — Brings selected items to the front of the diagram.

Push To back — Sends the selected items to the back of the diagram.

Edit Parameter Value...

This menu item is active if the cursor is hovering over an editable parameter. Selecting this menu item causes a pop-up window to appear, which allows the user to edit the parameter value.

Parameter Properties...

This menu item is active if the cursor is hovering over an editable parameter. Selecting this menu item causes a pop-up window to appear, which allows the user to view the parameter properties, and also, to view the parameter Help (by clicking on the 'Help' tab.

Parameter Help... — Produces Parameter Properties and Help information for the selected function block or parameter, depending on the hover position of the cursor, when the right-click occurs.

7.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

WIRES

To make a wire

1. Drag two (or more) blocks onto the diagram from the function block tree.
2. Start a wire by either clicking on a recommended output or clicking on the 'Click to Select output' icon at the bottom right corner of the block to bring up the connection dialogue, and clicking on the required parameter. Recommended connections are shown with a green plug symbol; other parameters which are available being shown in yellow. Clicking on the red button causes all parameters to be shown. To dismiss the connection dialogue either press the escape key on the keyboard, or click the cross at the bottom left of the dialogue box.
3. Once the wire has started a dashed wire is drawn from the output to the current mouse position. To complete the wire click on the required destination parameter.
4. Wires remain dashed until they are downloaded

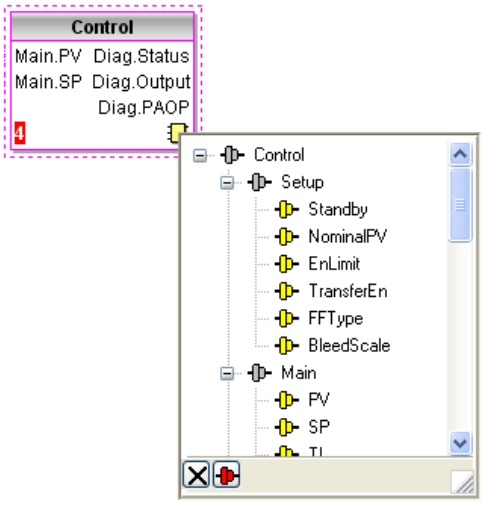


Figure 7.3.2c Output selection dialogue box

Routing wires

When a wire is placed it is auto-routed. The auto routing algorithm searches for a clear path between the two blocks. A wire can be auto-routed again using the context menus or by double clicking the wire. A wire segment can be edited manually by click-dragging. If the block to which it is connected is moved, the end of the wire moves with it, retaining as much of the path as possible.

If a wire is selected by clicking on it, it is drawn with small boxes on its corners.

Wire Context Menu

Right click on a wire to display the wire block context menu:

Force Exec Break	When wires form a loop, a break point must be introduced, where the value written to the block comes from a source which was last executed during the previous cycle. A break is automatically placed by iTools, and appears in red. Force Exec Break allows the user to define where a break must be placed. Surplus breaks appear in black.
Re-Route wire	Replaces the current wire route with a new route generated from scratch.
Use Tags	Toggles between wire and tag mode between parameters. Tag mode is useful for sources and destinations which are widely separated.
Find Start	Goes to the source of the wire.
Find End	Goes to the destination of the wire.
Cut, Copy, Paste	Not used in this context.
Delete	Marks the wire for deletion. The wire is redrawn as a dashed line (or dashed tags) until next download. Operation can be reversed until after next download.
Undelete	Reverses the effect of the Delete operation up until the next download, after which, Undelete is disabled.
Bring to Front	Brings the wire to the front of the diagram.
Push to Back	Sends the wire to the back of the diagram.

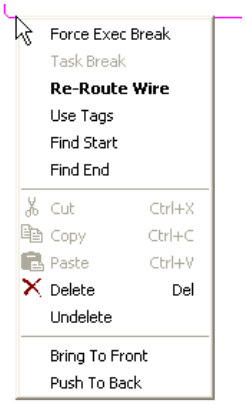


Figure 7.3.2d
Wire context menu

7.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

WIRE COLOURS

Black	Normal functioning wire
Red	The wire is connected to a non-changeable parameter. Values are rejected by the destination block.
Magenta	A normal functioning wire is being hovered-over by the mouse cursor.
Purple	A red wire is being hovered-over by the mouse cursor.
Green	New Wire (dashed green wire changes to solid black after being downloaded.)

THICK WIRES

When attempting to wire between blocks which are located in different tasks, if no task break is inserted, then all the affected wires are highlighted by being drawn with a much thicker line than usual. Thick wires still execute, but the results are unpredictable, as the unit cannot resolve the strategy.

COMMENTS

Comments are added to a wiring diagram by click-dragging them from the Function Block tree onto the diagram. As soon as the mouse is released, a dialogue box opens to allow the comment text to be entered.

Carriage returns are used to control the width of the comment. Once text entry is complete, 'OK' causes the comment to appear on the diagram. There are no restrictions on the size of a comment. Comments are saved to the instrument along with the diagram layout information.

Comments can be linked to function blocks and wires by clicking on the chain icon at the bottom right-hand corner of the comment box and then clicking again on the required block or wire. A dashed line is drawn to the top of the block or to the selected wire segment (Figure 7.3.2f).

Note: Once the comment has been linked, the Chain icon disappears. It re-appears when the mouse cursor is hovered over the bottom right-hand corner of the comment box, as shown in figure 7.3.2f, below.

Comment Context Menu

Edit	Opens the Comment dialogue box to allow the comment text to be edited.
Unlink	Deletes the current link from the comment.
Cut	Moves the comment to the Clipboard, ready to be pasted elsewhere. Short cut = <ctrl>+<X>.
Copy	Copies the comment from the wiring diagram to the Clipboard, ready to be pasted elsewhere. Short cut = <ctrl>+<C>.
Paste	Copies a comment from the Clipboard to the wiring diagram. Short cut = <ctrl>+<V>.
Delete	Marks the comment for deletion at next download.
Undelete	Undoes the Delete command if download has not taken place since.

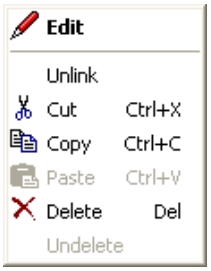


Figure 7.3.2e
Comment context menu

7.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

MONITORS

Monitor points are added to a wiring diagram by click-dragging them from the Function Block tree onto the diagram. A monitor shows the current value (updated at the iTools parameter list update rate) of the parameter to which it is linked. By default the name of the parameter is shown. To hide the parameter name either double click on the monitor box or 'Show Names' in the context (right-click) menu can be used to toggle the parameter name on and off.

Monitors are linked to function blocks and wires by clicking on the chain icon at the bottom right-hand corner of the box and then clicking again on the required parameter. A dashed line is drawn to the top of the block or the selected wire segment.

Note: once the monitor has been linked, the Chain icon disappears. It re-appears when the mouse cursor is hovered over the bottom right-hand corner of the monitor box.

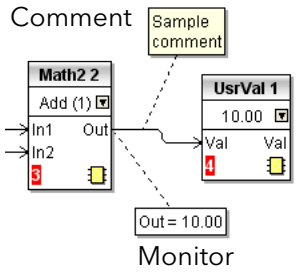


Figure 7.3.2f Comment and Monitor appearance

Monitor Context Menu

Show names	Toggles parameter names on and off in the monitor box.
Unlink	Deletes the current link from the monitor.
Cut	Moves the monitor to the Clipboard, ready to be pasted elsewhere. Short cut = <ctrl>+<X>.
Copy	Copies the monitor from the wiring diagram to the Clipboard, ready to be pasted elsewhere. Short cut = <ctrl>+<C>.
Paste	Copies a monitor from the Clipboard to the wiring diagram. Short cut = <ctrl>+<V>.
Delete	Marks the monitor for deletion at next download.
Undelete	Undoes the Delete command if download has not taken place since.
Bring to Front	Moves the item to the 'top' layer of the diagram.
Push to Back	Moves the item to the 'bottom' layer of the diagram.
Parameter Help	Shows parameter help for the item.

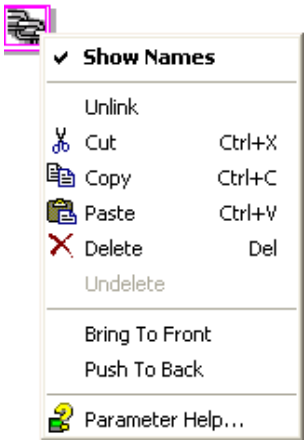


Figure 7.3.2g
Monitor context menu

DOWNLOADING

When the wiring editor is opened the current wiring and diagram layout is read from the instrument. No changes are made to the instrument function block execution or wiring until the download button is pressed. Any changes made using the operator interface after the editor is opened are lost on download.

When a block is dropped onto the diagram, instrument parameters are changed to make the parameters for that block available. If changes are made and the editor is closed without saving them there is a delay while the editor clears these parameters.

During download, the wiring is written to the instrument which then calculates the block execution order and starts executing the blocks. The diagram layout including comments and monitors is then written into instrument flash memory along with the current editor settings. When the editor is reopened, the diagram is shown positioned as it was when it was last downloaded.

7.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

COLOURS

Items on the diagram are coloured as follows:

Red	Items which totally or partially obscure other items and items which are totally or partially obscured by other items. Wires that are connected to unalterable or non-available parameters. Execution breaks. Block execution orders for Task 1.
Blue	Non-available parameters in function blocks. Block execution orders for Task 4. Task breaks.
Green	Items added to the diagram since last download are shown as green dashed lines. Block execution orders for Task 2.
Magenta	All selected items, or any item over which the cursor is hovering.
Purple	Red wires when being hovered over by the mouse cursor.
Black	All items added to the diagram before the last download. Block execution orders for Task 3. Redundant execution breaks. Monitor and comment text.

DIAGRAM CONTEXT MENU

Cut	Active only when the right click occurs within the bounding rectangle which appears when more than one item is selected. Moves the selection off the diagram to the Clipboard. Short cut = <ctrl>+<X>.
Copy	As for 'Cut', but the selection is copied, leaving the original on the diagram. Short cut = <ctrl>+<C>.
Paste	Copies the contents of the Clipboard to the diagram. Short cut = <ctrl>+<V>.
Re-Route wires	Reroutes all selected wires. If no wires are selected, all wires are re-routed.
Align Tops	Aligns the tops of all blocks in the selected area.
Align Lefts	Aligns the left edges of all blocks in the selected area.
Space Evenly	Spaces selected items such that their top left corners are spaced evenly across the width of the diagram. Click on the item which is to be the left-most item, then <ctrl>+<left click> the remaining items in the order in which they are to appear.
Delete	Marks the item for deletion at next download time. Can be 'Undeleted' up until download occurs.
Undelete	Reverses the action of 'Delete' on the selected item.
Select All	Selects all items on the current diagram.
Create Compound	Active only when the right click occurs, in the top level diagram, within the bounding rectangle which appears when more than one item is selected. Creates a new wiring diagram as described in 'Compound', below.
Rename	Allows a new name to entered for the current wiring diagram. This name appears in the relevant tab.
Copy Graphic	Copies the selected items (or the whole diagram if no items are selected) to the clipboard as a Windows metafile, suitable for pasting into a documentation application. Wiring entering/leaving the selection (if any) are drawn in tag mode.
Save Graphic...	As for 'Copy Graphic' above, but saves to a user-specified file location instead of the clipboard.
Copy Fragment To File...	Copies selected items to a user-named file in folder 'My iTools Wiring Fragments' located in 'My Documents'.
Paste Fragment From File	Allows the user to select a stored fragment for inclusion in the wiring diagram.
Centre	Places the display window at the centre of the selected items. If 'Select All' has previously been clicked-on, then the display widow is placed over the centre of the diagram.

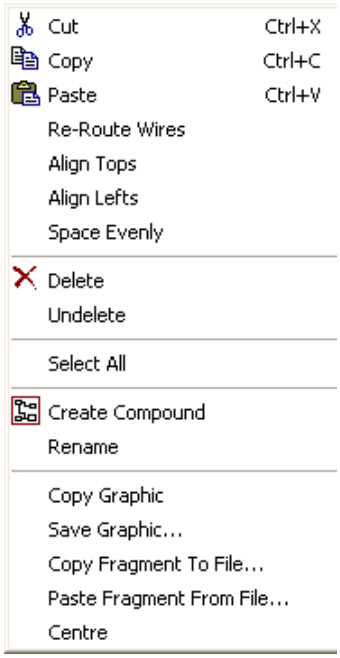


Figure 7.3.2h
Diagram context menu

7.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

COMPOUNDS

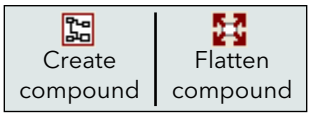
Compounds are used to simplify the top level wiring diagram, by allowing the placing of any number of function blocks within one 'box', the inputs and outputs of which operate in the same way as those of a normal function block.

Each time a compound is created, a new tab appears at the top of the wiring diagram. Initially compounds and their tabs are named 'Compound 1', 'Compound 2', etc. but they can be renamed by right clicking either on the compound in the top level diagram, or anywhere within an open Compound, selecting 'Rename' and typing in the required text string (16 characters max.).

Compounds cannot contain other compounds (i.e. they can be created only in the top level diagram).

Compound creation

1. Empty compounds are created within the top level diagram by clicking on the 'Create Compound' toolbar icon.
2. Compounds can also be created by highlighting one or more function blocks in the top level diagram and then clicking on the 'Create Compound' toolbar icon. The highlighted items are moved from the top level diagram into a new compound.



3. Compounds are 'uncreated' (flattened), by highlighting the relevant item in the top level menu and then clicking on the 'Flatten Compound' toolbar icon. All the items previously contained within the compound appear on the top level diagram.
4. Wiring between top level and compound parameters is carried out by clicking on the source parameter, then clicking on the compound (or the compound tab) and then clicking on the destination parameter. Wiring from a compound parameter to a top level parameter or from compound to compound is carried out in similar manner.
5. Unused function blocks can be moved into compounds by dragging from the tree view. Existing blocks can be dragged from the top level diagram, or from another compound, onto the tab associated with the destination compound. Blocks are moved out of compounds to the top level diagram or to another compound in a similar way. Function blocks can also be 'cut and pasted'.
6. Default compound names (e.g. 'Compound 2') are used only once, so that if, for example, Compounds 1 and 2 have been created, and Compound 2 is subsequently deleted, then the next compound to be created will be named 'Compound 3'.
7. Top level elements can be click-dragged into compounds.

7.3.2 WIRING EDITOR OPERATING DETAILS (Cont.)

TOOL TIPS

Hovering the cursor over the block displays 'tooltips' describing that part of the block beneath the cursor. For function block parameters the tooltip shows the parameter description, its OPC name, and, if downloaded, its value. Similar tooltips are shown when hovering over inputs, outputs and over many other items on the iTools screen.

A Function Block is enabled by dragging the block onto the diagram, wiring it, and finally downloading it to the instrument. Initially blocks and associated wires are drawn with dashed lines, and when in this state the parameter list for the block is enabled but the block is not executed by the instrument.

The block is added to the instrument function block execution list when the 'Download' icon is operated and the items are redrawn using solid lines.

If a block which has been downloaded is deleted, it is shown on the diagram in a ghosted form until the download button is pressed. (This is because it and any wires to/from it are still being executed in the instrument. On download it will be removed from the instrument execution list and the diagram.) A ghosted block can be 'undeleted' as described in 'Context menu', above.

When a dashed block is deleted it is removed immediately.

7.4 PARAMETER EXPLORER

This view is displayed:

1. by clicking on the 'Parameter Explorer' toolbar icon, Parameter Explorer
2. by double clicking on the relevant block in the tree pane or in the graphical wiring editor
3. by selecting 'Function Block View' from the Function block context menu in the Graphical wiring Editor.
4. by selecting 'parameter Explorer from the 'View' menu
5. by using the short cut <Alt>+<Enter>

In each case the function block parameters appear in the iTools window in tabular form, such as the example in figure 7.4a, below.

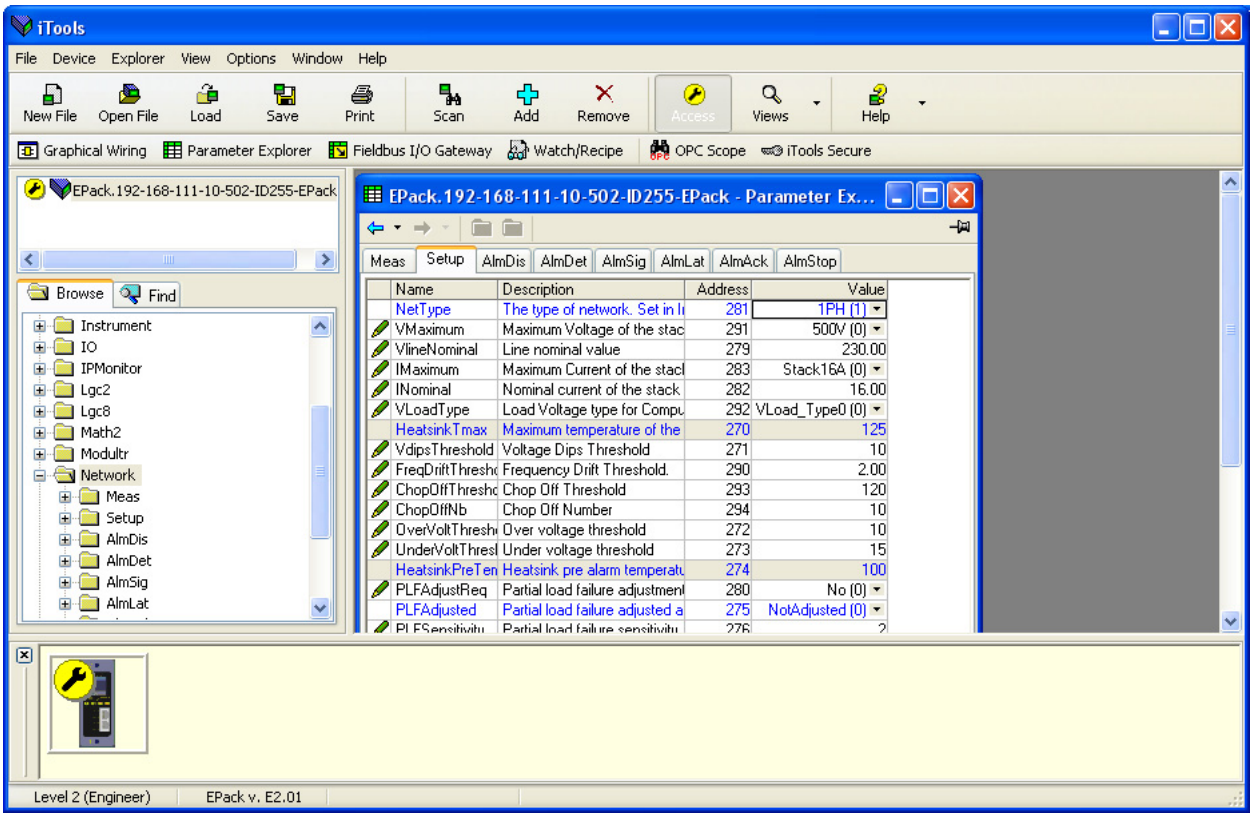


Figure 7.4a Parameter table example

The figure above shows the default table layout. Columns can be added/deleted from the view using the 'Columns' item of the Explorer or context menus (figure 7.4b).

7.4 PARAMETER EXPLORER (Cont.)

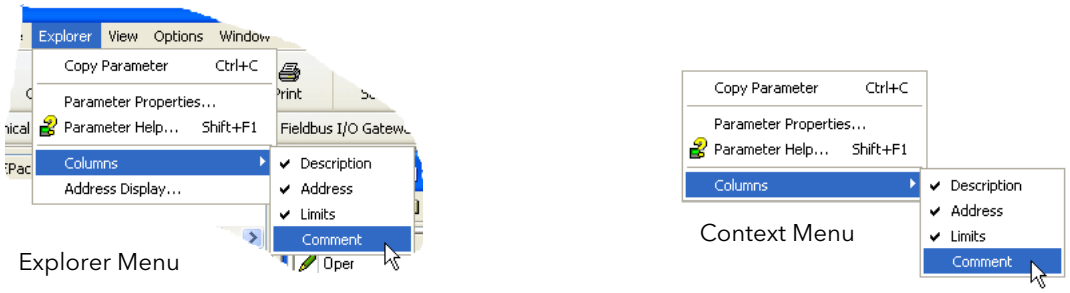
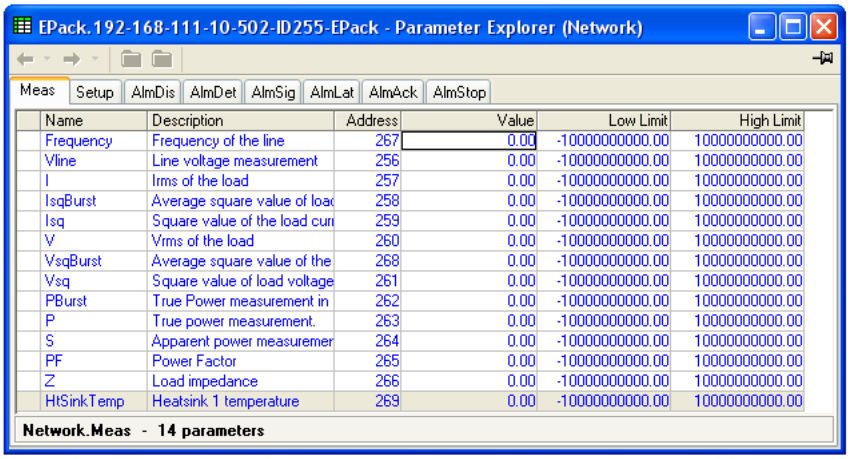


Figure 7.4b Column enable/disable

Figure 7.4.1 Parameter explorer detail

Figure 7.4.1a shows a typical parameter table. This particular parameter has a number of subfolders associated with it, and each of these is represented by a 'tab' across the top of the table.



Name	Description	Address	Value	Low Limit	High Limit
Frequency	Frequency of the line	267	0.00	-10000000000.00	10000000000.00
Vline	Line voltage measurement	256	0.00	-10000000000.00	10000000000.00
I	Irms of the load	257	0.00	-10000000000.00	10000000000.00
IsqBurst	Average square value of loa	258	0.00	-10000000000.00	10000000000.00
Isq	Square value of the load cur	259	0.00	-10000000000.00	10000000000.00
V	Vrms of the load	260	0.00	-10000000000.00	10000000000.00
VsqBurst	Average square value of the	268	0.00	-10000000000.00	10000000000.00
Vsq	Square value of load voltage	261	0.00	-10000000000.00	10000000000.00
PBurst	True Power measurement in	262	0.00	-10000000000.00	10000000000.00
P	True power measurement.	263	0.00	-10000000000.00	10000000000.00
S	Apparent power measuremer	264	0.00	-10000000000.00	10000000000.00
PF	Power Factor	265	0.00	-10000000000.00	10000000000.00
Z	Load impedance	266	0.00	-10000000000.00	10000000000.00
HtSinkTemp	Heatsink 1 temperature	269	0.00	-10000000000.00	10000000000.00

Figure 7.4.1a Typical parameter table

Notes:

1. Parameters in blue are non-editable (Read only). In the example above all the parameters are read only. Read/write parameters are in black and have a 'pencil' symbol in the 'read/Write access column at the left edge of the table. A number of such items are shown in figure 7.4a, above.
2. Columns. The default explorer window (figure 7.4a) contains the columns 'Name', 'Description', 'Address' and 'Value'. As can be seen from figure 7.4b, above, the columns to be displayed can be selected, to a certain extent, using either the 'Explorer' menu or the context menu. 'Limits' have been enabled for the example above.
3. Hidden Parameters. By default, iTools hides parameters which are considered irrelevant in the current context. Such hidden parameters can be shown in the table using the 'Parameter availability' settings item of the options menu (figure 7.4.1b). Such items are displayed with a shaded background.
4. The full pathname for the displayed parameter list is shown at the bottom left hand corner of the window.

7.4.1 PARAMETER EXPLORER DETAIL (Cont.)

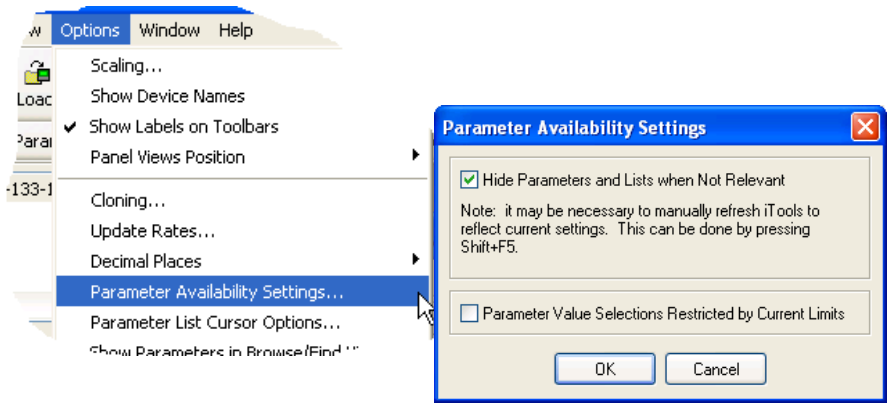


Figure 7.4.1b Show/Hide parameters

7.4.2 Explorer tools

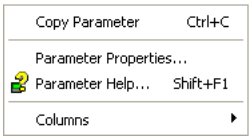
A number of tool icons appear above the parameter list:

Back to: and Forward to:. The parameter explorer contains a history buffer of up to 10 lists that have been browsed in the current instance of the window. The 'Back to: (list name)' and 'Forward to: (list name)' icons allow easy retracing or repeating of the parameter list view sequence.
If the mouse cursor is hovered over the tool icon, the name of the parameter list which will appear if the icon is clicked-on appears. Clicking on the arrow head displays a pick list of up to 10 previously visited lists which the user can select. Short cut = <ctrl>+<B> for 'Back to' or <ctrl>+<F> for 'Forward to'.

Go Up a Level, Go Down a Level. For nested parameters, these buttons allow the user to navigate 'vertically' between levels. Short cut = <ctrl>+<U> for 'Go Up a Level' or <ctrl>+<D> for 'Go Down a Level'.

Push pin to give the window global scope. Clicking on this icon causes the current parameter list to be permanently displayed, even if another instrument becomes the 'current device'.

7.4.3 Context Menu



Copy Parameter	Copies the clicked-on parameter to the clipboard
Parameter properties	Displays parameter properties for the clicked-on parameter
Parameter Help...	Displays help information for the clicked-on parameter
Columns	Allows the user to enable/disable a number of parameter table columns (figure 7.4b).

7.5 FIELDBUS GATEWAY Fieldbus I/O Gateway

EPack controller units contain a greatnumber of parameters, so it is necessary for the user to define which Input and Output parameters are to be available for block read and write. The Input/Output definitions are configured using the 'Fieldbus I/O Gateway'.

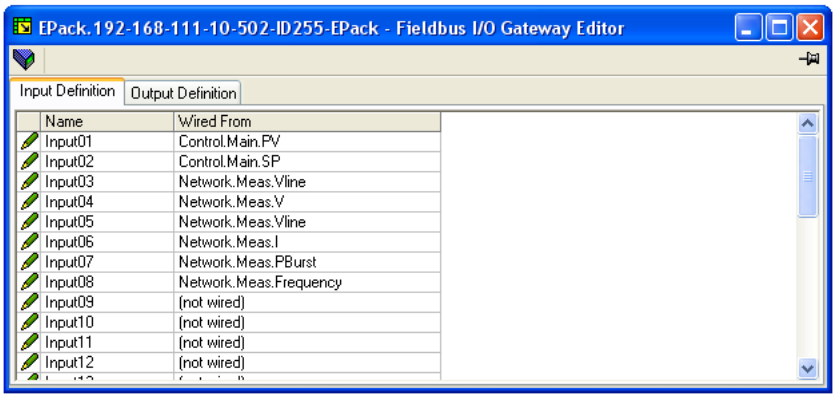


Figure 7.5a Typical Fieldbus Gateway Parameter list

As shown in figure 7.5a, above, there are two tabs within the editor, called 'Input definition' and 'Output definition'. 'Inputs' are values sent from the controller to the Profibus master. 'Outputs' are values received from the master and used by the controller, (e.g. set points written from the master).

The procedure for selecting variables is the same for both input and output definition tabs:

1. Double click the next available position in the input or output data table and select the variable to assign to it. A pop-up (figure 7.5b) provides a browser from which a list of parameters can be opened.
2. Double click the parameter to assign it to the input definition.

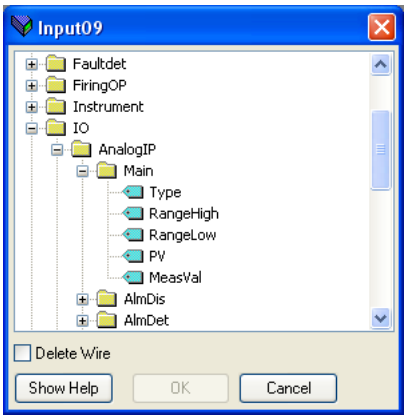


Figure 7.5b Browser window

Notes:

1. By setting the same parameter contiguously (e.g. main.sp for inputs 2 and 3) the data will be sent in IEE format. See chapter 4 of the Comms manual for more details.
2. The Master must request the same number of parameters as there are in the table.
3. The tables are saved to Flash memory when the user quits configuration mode and returns to Operator mode.

7.5 FIELDBUS GATEWAY(Cont.)

When all the required parameters have been added to the lists, notes of how many 'wired' entries are included in the input and output areas should be made as this information is needed when setting up the Master.

Notes:

1. A maximum of 32 input and 16 output parameters may be set using the Gateway Editor.
2. No checks are made that output variables are writeable, and if a read only variable is included in the output list any values sent to it will be ignored with no error indication.
3. For Modbus only:
   As shown in figure 7.5c, 'Block Read' and 'Block Write' requests both access the same memory location (Dec:4744; hex:1288), which 'points' to the relevant input definition table or output definition table according to whether the instruction is a read or a write. The value for a parameter in the input table may differ from the value of the same parameter in the output table.

Once the changes have been made to the Input and Output definition lists, they must be downloaded to the controller unit. This is done (for both tables simultaneously) by clicking on the 'Update device Flash Memory' button on the top left of the Fieldbus Gateway Editor window. The controller performs a restart after this operation.

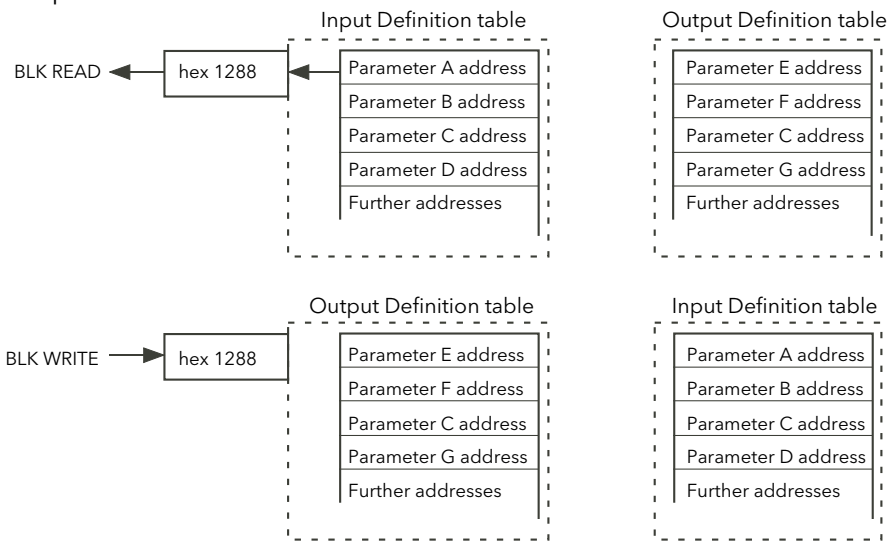


Figure 7.5c Block read and block write (note 3)

7.6 WATCH/RECIPE EDITOR Watch/Recipe

The watch/recipe editor is opened by clicking on the Watch/Recipe tool icon, by selecting 'Watch/Recipe' in the 'Views' menu or by using the short cut <ctrl>+<A>. The window is in two parts: the left part containing the watch list; the right-hand part containing one or more data sets, initially empty and unnamed.

The Watch/Recipe window is used:

1. To monitor a list of parameters. This list can contain parameters from many different, and otherwise unrelated parameter lists within the same device. It cannot contain parameters from different devices.
2. To create 'data sets' of parameter values which can be selected and downloaded to the device in the sequence defined in the recipe. The same parameter may be used more than once in a recipe.

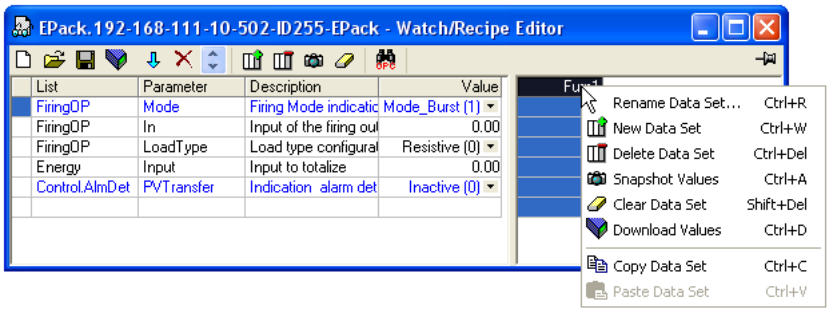


Figure 7.6 Watch/Recipe Editor window (with context menu)

7.6.1 Creating a Watch List

After opening the window, parameters can be added to it as described below. The values of the parameters update in real-time, allowing the user to monitor a number of values simultaneously.

ADDING PARAMETERS TO THE WATCH LIST

1. Parameters can be click-dragged into the watch list from another area of the iTools window (for example, the parameter explorer window, the graphical wiring editor, the browse tree). The parameter is placed either in an empty row at the bottom of the list, or if it is dragged on top of an already existing parameter, it is inserted above this parameter, with the remaining parameters being moved down one place.
2. Parameters can be dragged from one position in the list to another. In such a case, a copy of the parameter is produced, the source parameter remaining in its original position.
3. Parameters can be copied <ctrl>+<C> and pasted <ctrl>+<V> either within the list, or from a source external to it, for example the parameter browse window or the graphical wiring editor.
4. The 'Insert item...' tool button the 'Insert Parameter' item in the Recipe or context menu or the short cut <Insert> can be used to open a browse window from which a parameter is selected for insertion above the currently selected parameter.

DATA SET CREATION

Once all the required parameters have been added to the list, select the empty data set by clicking on the column header. Fill the data set with current values using one of the following methods:

1. Clicking on the 'Capture current values into a data set' tool icon (also known as the 'Snapshot Values' tool).
2. Selecting 'Snapshot Values' from the Recipe or Context (right-click) menu.
3. Using the short cut <ctrl>+<A>.

7.6.1 CREATING A WATCH LIST (Cont.)

DATA SET CREATION (Cont.)

Individual data values can now be edited by typing directly into the grid cells. Data values can be left blank or cleared, in which case, no values will be written for those parameters at download. Data values are cleared by deleting all the characters in the cell then either moving to a different cell or typing <Enter>.

The set is called 'Set 1' by default, but it can be renamed by either by using the 'Rename data set...' item in the Recipe or context menus, or by using the short cut <ctrl>+<R>.

New, empty data sets can be added using one of the following:

1. Clicking on the 'Create a new empty data set' toolbar icon.
2. Selecting 'New Data Set' in the Recipe or context menus
3. Using the short cut <ctrl>+<W>

Once created, the data sets are edited as described above.

Finally, once all the required data sets have been created, edited and saved, they can be downloaded the instrument, one at a time, using the Download tool, the 'Download Values' item in the Recipe or context menus, or the short cut <ctrl>+<D>.

7.6.2 Watch Recipe toolbar icons

Create a new watch/recipe list. Creates a new list by clearing out all parameters and data sets from an open window. If the current list has not been saved, confirmation is requested. Short cut <ctrl>+<N>

Open an existing watch/recipe file. If the current list or data set has not been saved, confirmation is requested. A file dialogue box then opens allowing the user to select a file to be opened. Short cut <ctrl>+<O>

Save the current watch/recipe list. Allows the current set to be saved to a user specified location. Short cut <ctrl>+<S>.

Download the selected data set to the device. Short cut <ctrl>+<D>

Insert item ahead of selected item. Short cut <Insert>.

Remove recipe parameter. Short cut <ctrl>+<Delete>.

Move selected item. Up arrow moves selected parameter up the list; down arrow move the selected parameter down the list.

Create a new empty data set. Short cut <ctrl>+<w>.

Delete an empty data set. Short cut <ctrl>+<Delete>

Capture current values into a data set. Fills the selected data set with values. Short cut <ctrl>+<A>.

Clear the selected data set. Removes values from the selected data set. Short cut <Shift>+<Delete>.

Open OPC Scope. Opens a separate utility that allows trending, data logging and Dynamic Data Exchange (DDE). OPC Scope is an OPC explorer program that can connect to any OPC server that is in the windows registry.
(OPC is an acronym for 'OLE for Process Control, where OLE stands for 'Object Linking and Embedding'.)

7.6.3 Watch/Recipe Context Menu

The Watch/Recipe Context menu items have the same functions as described above for toolbar items.

8 PARAMETER ADDRESSES (MODBUS)

8.1 INTRODUCTION

The iTools address fields display each parameter's Modbus address to be used when addressing integer values over the serial communications link. In order to access these values as IEEE floating point values, the calculation: IEEE address = {(Modbus address x 2) + hex 8000} should be used.

Notes:

1. Certain parameters may have values which exceed the maximum value that can be read from or written to using a 16-bit integer communications. Such parameters have a scaling factor applied to them as described in section 8.3.
2. When using 16-bit scaled integer modbus addressing, time parameters can be read from or written to in 10ths of minutes, or in 10ths of seconds as defined in the parameter Instrument.config.TimerRes.

8.2 PARAMETER TYPES

The following parameter types are used:

bool	Boolean
uint8	Unsigned 8-bit integer
int16	Signed 16-bit integer
uint16	Unsigned 16-bit integer
int32	Signed 32-bit integer
uint32	Unsigned 32-bit integer
time32	Unsigned 32-bit integer (time in milliseconds)
float32	IEEE 32-bit floating point
string	String - an array of unsigned 8-bit integers.

8.3 PARAMETER SCALING

Some parameters might have values which exceed the maximum value (32767) that can be read/written via 16-bit scaled integer comms. Such parameters are assigned a scaling factor as described in section 6.10.4.

8.4 PARAMETER LIST

The full list of parameters available via the communications link is to be found the the SCADA table supplied as a part of the iTools help system. Individual parameter addresses also appear in each iTools configuration page along with 'enumerations' showing all the possible values that the parameter can take).

9 ALARMS

9.1 SYSTEM ALARMS

System alarms are considered to be 'Major Events' which prevent proper operation of the system, and the unit is placed in standby mode.

The following subsections describe each of the possible system alarms.

9.1.1 Missing mains

Supply power is missing.

9.1.2 Thyristor short circuit

A thyristor short circuit leads to current flow even when not firing.

9.1.3 Thyristor open circuit

This fault means that no current flow occurs, even when the thyristor(s) should be firing.

9.1.4 Over temperature

Reserved for future development.

9.1.5 Network dips

This detects a reduction in supply voltage, and if this reduction exceeds a configurable measured value (VdipsThreshold), firing will be inhibited until the supply voltage returns to a suitable value. VdipsThreshold represents a percentage change in supply voltage between successive half cycles, and can be defined by the user in the Network.Setup menu, as described in section 6.17.2.

9.1.6 Mains frequency fault

Triggered if the supply voltage frequency strays out of the range 47 to 63 Hz, or if the mains frequency changes, for one cycle to the next, by more than the threshold defined in theNetwork.Setup menu described in section 6.17.2

The value can be adjusted between 0.9% and 5%, the default value is 2%.

9.1.7 Chop Off alarm

Chop-off alarm will be active when a current threshold is exceeded for more than a pre-defined number of mains periods. This current threshold is user- adjustable from 100% to 400% of unit's nominal current. (to be found in the Network.setup area of configuration (section 6.17.2)).

9.2 PROCESS ALARMS

Process Alarms are related to the application and can be configured either to stop the unit firing (Standby Mode) or to allow operation to continue. Process alarms can also be configured to be latched and if so, they have to be acknowledged before the alarm is considered to be non-active. Alarms cannot be acknowledged until the trigger source has returned to a non-active state.

9.2.1 Total Load Failure (TLF)

No load is connected.

9.2.2 Closed Loop alarm

Closed loop break alarm is currently active.

9.2.3 Alarm input

The alarm input associated with the alarm block is active.

9.2.4 Over current detection

The analogue input over current detection alarm is active.

9.2.5 OverVoltage Alarm

An 'OverVoltThreshold' can be configured in the Network.Setup area of configuration (section 6.17.2) as a percentage of VLineNominal. If the VLine voltage rises above this threshold the OverVoltage alarm is set.

Note...This Alarm is returned FALSE if the MissingMains Alarm is set.

9.2.6 UnderVoltage Alarm

An 'UnderVoltThreshold' can be configured in the Network.Setup area of configuration (section 6.17.2) as a percentage of VLineNominal. If the VLine voltage falls below this threshold the UnderVoltage alarm is set.

Note...This Alarm is returned FALSE if the MissingMains Alarm is set.

9.2.7 Partial Load Failure (PLF)

This alarm detects a static increase in load impedance by comparing the reference load impedance (as configured by the user) with the actual measured load impedance over a mains cycle (for phase angle firing) and over the burst period (for burst and logic firing).

The sensitivity of the partial load failure measurement can be set to any value between 2 to 6 inclusive, where an entry of 2, for example, means that one half of the elements (or more) must be open circuit in order to trigger the alarm; an entry of 3 means that one third of the elements (or more) must be open circuit in order to trigger the alarm, and so on down to one sixth. All elements must have identical characteristics and identical impedance values and must be connected in parallel).

The relevant parameters (PLFAdjustReq, and PLFSensitivity) are both to be found in Network.Setup, as described in section 6.17.2.

9.3 INDICATION ALARMS

Indication Alarms signal events for operator action if required. Indication alarms cannot be configured to stop power module firing, but they may be latched if required, and if latched, they must be acknowledged for the Signaling Status to return to the normal (non-alarm) state.

9.3.1 Process Value Transfer active

Indicates when a transfer control mode (e.g. V^2 <> I^2 P <> I^2 or V^2 <> I^2) is active.

9.3.2 Limitation active

Indicates when the internal firing control loop limits the firing output (I^2 or V^2) (in order not to exceed the adjusted maximum value)

9.3.3 Load Over-Current

Indicates when a configurable RMS load current threshold (OverIthreshold) is reached or exceeded. The parameter is found in the Network.Setup area of configuration (section 6.17.2) and is configurable as 10% to 400% of Nominal Current.

10 MAINTENANCE

10.1 SAFETY

WARNING

BRANCH-CIRCUIT PROTECTION AND SAFETY OVERLOAD PROTECTION

This product does not contain any branch-circuit protection or internal safety overload protection. It is the responsibility of the user to add branch-circuit protection upstream of the unit. It is also the responsibility of the user to provide external or remote safety overload protection to the end installation. Such branch-circuit and safety oveload protection must comply with applicable local regulations.
UL: The abovementioned branch-circuit protection is necessary for compliance with National Electric Code (NEC) requirements.

WARNINGS

1. The manufacturer shall not be held responsible for any damage, injury, losses or expenses caused by inappropriate use of the product or by failure to comply with the instructions in this manual. It is the responsibility of the user to check, before commissioning the unit, that all nominal characteristics correspond to the conditions under which it is to be installed and used.
2. The product must be commissioned and maintained by suitably qualified personnel, authorized to work in an industrial low voltage environment.
3. Voltage of over 500V RMS may exist in and around the units, even when they are not 'running'. Ensure that all sources of hazardous voltages are isolated from the units before carrying out any work on the units.
4. The heat sink becomes hot whilst the unit is running, and it can take up to 15 minutes to cool after the unit is shut down. Touching the heat sink, even briefly, must be avoided whilst the unit is operating.

10.2 PREVENTIVE MAINTENANCE

Please read the warnings above, before attempting to carry out any work on the unit(s).

1. Every six months check that all power and protective earth cable connections are correctly tightened (Section 2.2.1). This check should include the safety earth connections to the cabinet.
2. To maintain maximum cooling efficiency, the Power Module heat-sink must be cleaned regularly. Periodicity depends on the local environment, but should not exceed six months.

10.3 FUSING

It is recommended that in-line thyristor protection fuses are fitted, according to table 10.3a below. These should beused in conjunction with suitable fuse holders and contact kits (if required) as shown in table 10.3b. The coloured areas indicate which fuses use which fuse holders.

		Fuse body size (mm)		Fuse part number		Invensys part number	
EPack nominal current	Fuse rating	Without blown fuse indicator	With blown fuse indicator	Without blown fuse indicator	With blown fuse indicator	Without blown fuse indicator	With blown fuse indicator
≤25A	32A	10 x 38	14 x 51	H1014583 G1014582	Q1017189 FWP32A14FI	CS031505	CS031506
32A	40A	14 x 51	14 x 51	J1017206 FWP40A14F	S1017191J FWP40A14FI	CS031507	CS031508
40A	50A	14 x 51	14 x 51	B093910 FWP50A14F	V100137 FWP50A14FI	CS031509	CS031510
50A	63A	22 x 58	22 x 58	T094823	K093803	CS031511	CS031512
63A	80A	27 x 60	27 x 60		W076310 N081294		CS031513

Table 10.3a Fuse details

Fuse part number (Invensys)	Fuse holder part no. (Invensys)	Fuse holder catalogue no.	Fuse holder part no.	Contact kit part no. (Invensys)	Contact kit catalogue number	Contact kit part number	Blown fuse indication
CS031505	CP018525	US101	B305050				No
CS031506	CP171480	US141	Z331153F	CP177220	USMSW1	Y227928A	Yes
CS031507	CP171480	US141	Z331153F				No
CS031508	CP171480	US141	Z331153F	CP177220	USMSW1	Y227928A	Yes
CS031509	CP171480	US141	Z331153F				No
CS031510	CP171480	US141	Z331153F	CP177220	USMSW1	Y227928A	Yes
CS031511	CP173083	US221	E331158				No
CS031512	CP173083	US221	E331158	CP177221	USMSWA	G227959A	Yes
CS031513	CP173245	US2711	J226420C				No
CS031513	CP173245	US2711	J226420C	CP177222	US27W1	E227612A	Yes

Table 10.3b Fuse holders and contact kits

EPACK LICENCE NOTICE

FreeRTOS
Epack is powered by an original FreeRTOS from version v7.1.0 .
FreeRTOS is available at http://www.freertos.org

microutf8

/* microutf8.c
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*/

lwip
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Appendix A: TECHNICAL SPECIFICATION

A1 STANDARDS

STANDARDS

The product is designed and produced to comply with EN60947-4-3 (Low voltage switch gear and control gear) and with UL60947-4-1A and CAN/CSA C22.2 . Other applicable standards are cited where appropriate.

INSTALLATION CATEGORIES

General installation category details for the driver and power modules are summarized in the table below.

	Installation Category	Rated impulse withstand voltage (Uimp)	Rated insulation voltage
Communications	II	0.5 kV	50 V
Standard IO	II	0.5 kV	50 V
Relays	II	2.5 kV	230 V
Unit Power	III	6 kV	500 V

Table A1 Installation categories

A2 SPECIFICATION

POWER (at 45°C)

Voltage range	Load:	100 to 500V (+10% -15%)
	Auxiliary:	24V ac/dc (+20% -20%) or 100 to 500V (+10% -15%)
Frequency range		47 to 63 Hz for line and ac auxiliary supplies)
Power requirement	24V dc	12W
	24V ac	18VA
	500V ac	20VA
Installation category		See table A1 above.
Nominal load current		16 to 63 Amps
Rated short-circuit conditional current		100kA
Pollution degree		Pollution degree 2
Utilization categories (Load types)		AC51: Non-inductive or slightly inductive loads, resistance furnaces AC56a: Transformer Primary or MOSI (Molybdenum Silicide) Time temperature dependant loads (Silicon Carbide, Carbon)
Duty cycle		Uninterrupted duty / continuous operation
Short circuit protection		None within the unit
Load Types		Single phase control of resistive loads (low/high temperature coefficient and non-aging/aging types) and transformer primaries.

PHYSICAL

Dimensions and fixing centres		See figures 2.2.1a and 2.2.1b for details
Weight	16 to 32A units	800g + user connectors
	40 to 63A units	950g + user connectors

ENVIRONMENT

Temperature limits	Operating:	0°C to 45°C
	Storage:	-25°C to +70°C
Humidity limits		5% to 95% RH (non-condensing)
Altitude		1000 metres maximum at 45 degrees.
Protection		IP10 (EN60529)
Atmosphere		Non-explosive, non-corrosive, non-conductive
External wiring	General:	Must comply with IEC 364
	UL:	Wiring must comply with NEC and all applicable local regulations
Shock		To (EN60068-2-27) and IEC60947-1 Annex Q
Vibration (EN60068-2-6)*		To (EN60068-2-6) and IEC60947-1 Annex Q

EMC

Standard	EN60947-4-3:2000 (2000-01-12), EN60947-4-3:2000/A1:2006 (2006-12-08), EN60947-4-3:2000/A2:2011 (2011-09-02) This product has been designed for environment A (Industrial). Use of this product in environment B (domestic, commercial and light industrial) may cause unwanted electromagnetic disturbances in which cases the user may be required to take adequate mitigation measures.

OPERATOR INTERFACE

Display	1.5" square TFT colour display allowing viewing of selected parameter values in real time, plus configuration of instrument parameters for users with adequate access permission.
Pushbuttons	Four push buttons provide page and item entry and scroll facilities.

A2 SPECIFICATION (Cont.)

INPUTS/OUTPUTS

All figures are with respect to 0V, unless otherwise stated.

Number of inputs/outputs	1 Analogue input; 2 Digital inputs; 1 Relay output
Update rate	Twice the mains frequency. Defaults to 55 Hz (18 ms) if the supply frequency lies outside the range 47 to 6 3Hz.)
Termination	Removable 5-way connector. (5.08 mm. pitch) located as shown in figure 2.2.3.

ANALOGUE INPUT

Performance		See tables A2a and A2b
Input type		Configurable as one of: 0 to 10V, 1 to 5V,2 to 10V, 0 to 5V, 0 to 20mA, 4 to 20mA
Absolute input maxima	:	±16V or ±40mA

Analogue input: Voltage input performance		
Parameter	Typical	Max/Min
Total voltage working input span		0V to +10V
Resolution (noise free) (note 1)	11 bits	
Calibration error (notes 2, 3)	<0.1%	<0.1%
Linearity error (note 2)		±0.1%
Ambient temperature error (note 3)		<0.01%/°C
Input resistance (terminal to 0V)	142kΩ	±0.2%
Note 1: w.r.t. total working span Note 2: % of effective range (0 to 5V, 0 to 10V)	Note 3: After warm up. Ambient = 25 °C	

Table A2a Analogue input specification (voltage inputs)

Analogue input: Current input performance		
Parameter	Typical	Max/Min
Total current working input span		0 to +25mA
Resolution (noise free) (note 1)	11 bits	
Calibration error (notes 2, 3)		<0.2%
Linearity error (note 2)		±0.1%
Ambient temperature error (note 2)		±0.01%/°C
Input resistance (terminal to 0v)	<102Ω	±1%
Note 1: w.r.t. total working span Note 2: % of effective range (0 to 20mA)	Note 3: After warm up. Ambient = 25 °C	

Table A2c Analogue input specification (current inputs)

A2 SPECIFICATION (Cont.)

DIGITAL Inputs

Voltage inputs		
	Active level (high)	4.4V<Vin<30V
	Non-active level (low)	-30V<Vin<+2.3V
	Input impedance:	27kΩ (typ.) for voltage input mode
Contact closure inputs		
	Source current:	10mA min; 15mA max
	Open contact (non active) resistance:	>500Ω
	Closed contact (active) resistance:	<150Ω
Absolute Maxima		±30V or ±25mA

Note... Absolute maximum ratings refer to externally applied signals.

RELAY SPECIFICATION

The relay has gold plated contacts suitable for 'dry circuit' (low current) use. Pinout given in figure 2.2.3.

Contact life	Resistive loads:	100,000 operations
	Inductive loads:	Derate as per accompanying graph (figure A2)
High power use	Current:	2A (resistive loads)
	Voltage:	<264V RMS (UL: voltage 250Vac.)
Low power use	Current:	>1mA
	Voltage:	>1V
Contact configuration		Single pole change-over (one set of Common, Normally Open and Normally Closed contacts)
Termination		Removable 3-way connector. (5.08 mm. pitch) located as shown in figure 2.2.3.
Installation Category		Installation category III, assuming that nominal phase to earth voltage is ≤ 300V RMS.
Absolute max. switching capability		<2A at 240V RMS (resistive loads)

Note... 'Normally Closed' and 'Normally Open' refer to the relay when the coil is not energised.

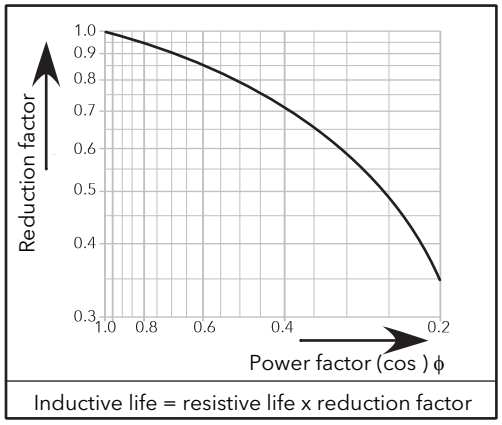

Figure A2 Relay derating curves

A2 SPECIFICATION (Cont.)

MAINS NETWORK MEASUREMENTS

All network measurements are calculated over a full mains cycle, but internally updated every half-cycle. For this reason, power control, current limits and alarms all run at the mains half-cycle rate. The calculations are based on waveform samples taken at a rate of 20kHz. The phase voltage referred to is the line voltage referenced to N/L2 input potential.

The parameters below are directly derived from measurements for each phase

Accuracy (20 to 25°C)	
Line frequency (F):	±0.02Hz
Line RMS voltage (Vline):	±1% of Nominal Vline.
Load RMS voltage (V):	±1% of Nominal V for voltage readings >1% of Nominal V. Unspecified for readings lower than 1%Vnom.
Load current (I_{RMS}):	±1% of Nominal I_{RMS} for current readings > 3.3% of Nominal I_{RMS}. Unspecified for readings ≤ 3.3% of Nominal I_{RMS}
Load RMS voltage squared (Vsq):	±2% of (Nominal V)^2
Thyristor RMS current squared (Isq):	±2% of (Nominal I)^2
True load power (P):	±2% of (Nominal V) × (Nominal I)
Frequency resolution	0.1 Hz
Measurement resolution	11 bits of Nominal value (noise free)
Measurement drift with ambient temp.	<0.02% of reading / °C

Further parameters (S, PF, Z, IsqBurst, Vsq Burst, and PBurst) are derived from the above, for the network (if relevant). See section 6.17.1 (Network Meas submenu) for further details.

COMMUNICATIONS

Connection	Dual port Ethernet - RJ45
Cable type	Shielded RJ45 CAT5+
Protocol	Modbus TCP
Baud rate	10/100 full or half duplex
Indicators	Tx activity (green) and communications activity (yellow)

INDEX

Numerics

A

B

C

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