Contents

Introduction

This Setup Guide describes how to install and configure your instrument.

This instrument is marked with the international hazard symbol. It is important to read this Setup Guide before installing or commissioning your panel meter as it contains important information relating to safety and Electromagnetic Compatibility EMC.

The instrument provides the following features as standard:

- 4 configurable alarms.
- Programmable function keys.
- 4 or 5 digit bright LED display.
- Transducer/transmitter supplies.

The instrument provides the following features as optional:

- Scaleable analogue retransmission output.
- Dual logic/status inputs.
- RS485 serial communications interface with 3 protocols including MODBUS™ RTU.
- Dual relay output.
- Programmable transducer supply.

Installation

To install your instrument, you will need to carry out the following steps:

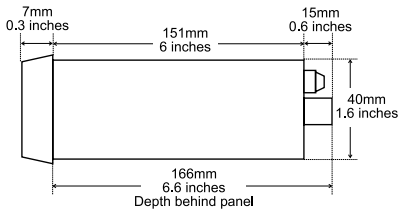
- Apply the engineering units label to the right-hand side of the display panel. A sheet of labels covering the most commonly used engineering units is supplied with all units. If the unit you require is not on the sheet, a blank label is provided on which you can use LETRASET™.
- Install the instrument into a panel.
- Make connections to the instrument.

PLEASE NOTE:

- Ensure that the power to the instrument is switched off before carrying out any installation or maintenance work.
- It is recommended that all connections to the terminals are made using ferrules to afford greater reliability and to prevent short circuits between adjacent terminals.
- Avoid installing the instrument close to switch gear, contactors or motor starters.
- Do not place signal and power supply wiring in the same loom.
- Use screened cables or wires for all signal/sensor leads with screen earthed at one point only.

Panel Mounting

Ensure that there is sufficient space behind the instrument panel for the depth of the instrument to allow for safe routing of cables. The diagram below shows a side view of the instrument's dimensions.



The instrument is supplied with an installation kit consisting of 2 mounting clamps and a panel sealing gasket. To install the instrument:

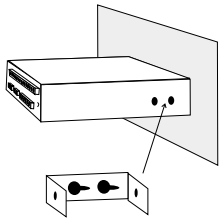
1. Make panel cut-out with the dimensions as shown below. Panel thickness from 1.5mm to 9.5mm can be accommodated.

2. Fit the rubber seal by slipping it over the unit from the rear of the box and pushing it forwards until it sits behind the front lip of the unit.

3. Insert the instrument into the panel from the front, pushing it through as far as the front lip, to ensure correct seating of the rubber seal between the panel and the unit.

4. Working from behind the panel, take the 2 mounting brackets and locate onto the case as shown below (note orientation of keyhole slots relative to instrument case). With the brackets located, slide them backwards until they lock into place.

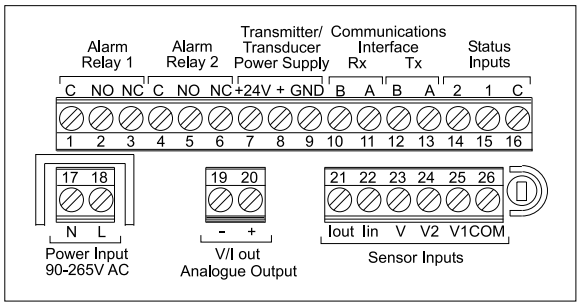
5. Tighten the screws until they bite into the panel, securing the instrument in place. Take care not to overtighten the screws as this may damage the case of the instrument.



Connections

The diagram below shows the rear panel terminal connection arrangement.

NOTE: Terminals 1 to 6 are only present on models fitted with the dual relay option and Terminals 12 to 16, 19 & 20 are only present on 5 digit models (see table on page 6).



Rear Panel Terminal Connections

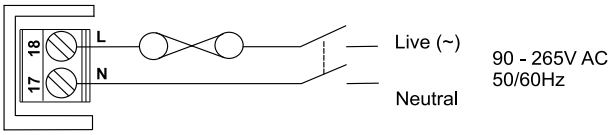
Terminal	No Alarm	Dual Relays
1	None	Relay 1 - common
2	None	Relay 1 - normally open
3	None	Relay 1 - normally closed
4	None	Relay 2 - common
5	None	Relay 2 - normally open
6	None	Relay 2 - normally closed
7	24V transmitter supply output	
8	Excitation +ve 10V transducer supply output	
9	Ground	
10	Receive B	
11	Receive A	
12	Transmit B (5 digit models only)	
13	Transmit A (5 digit models only)	
14	Status (Logic) Input 1 (5 digit models only)	
15	Status (Logic) Input 2 (5 digit models only)	
16	Status input common (ground) (5 digit models only)	
17	Power input neutral (-)	
18	Power input live (+)	
19	Analogue output - (5 digit models only)	
20	Analogue output + (5 digit models only)	
21	Current source output	
22	Current input	
23	Voltage input	
24	Auxiliary mV input	
25	Main mV input	
26	Input common	

Powering the Instrument

The instrument is designed to operate from an AC supply with voltages in the range 90 - 265V AC 50/60Hz mains supply with a maximum power consumption of 10VA when all outputs are fully loaded and the display has all segments illuminated.

WARNING - The instrument is designed for installation in an enclosure which provides adequate protection against electric shock. Access to power terminals should be restricted to authorised skilled personnel only. Application of supply voltages higher than those for which the instrument is intended may compromise safety and cause permanent damage.

The diagram below shows how the instrument should be connected to the mains supply. Isolation should be provided by a double pole switch and a time-delay 1A fuse.

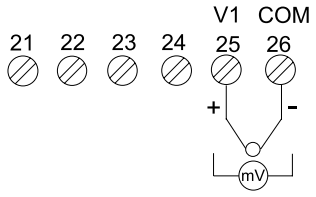


Recommended Mains Supply Connections

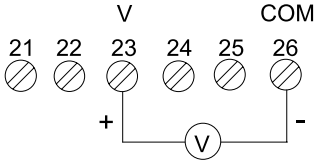
Connecting the Sensor/Transducer

The diagrams below show the connections necessary for each of the possible input types.

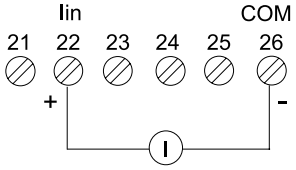
Thermocouple/mV



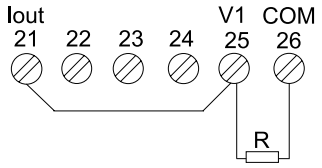
Signal in Volts (up to ±10V)



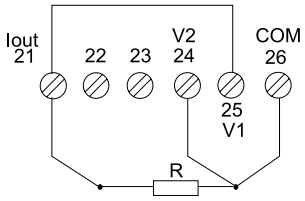
Signal in milliAmps (up to ±20mA)



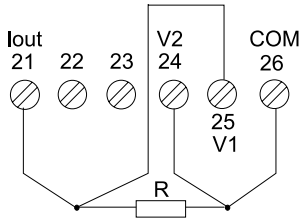
2-Wire RTD/Resistance (0 - 400Ω)



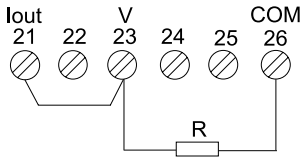
3-Wire RTD/Resistance (0 - 400Ω)



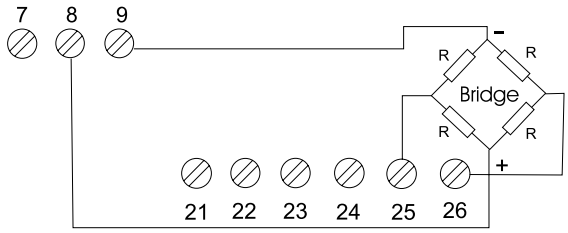
4-Wire RTD/Resistance (0 - 400Ω)



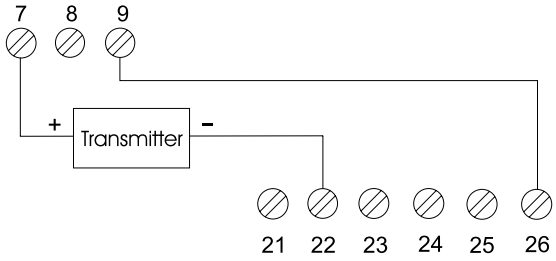
2-Wire Resistance (0 - 4000Ω)



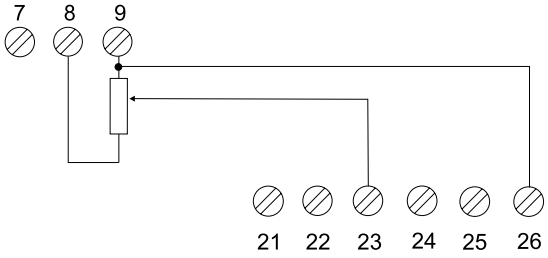
Bridge Connection



Transmitter (4 - 20mA)

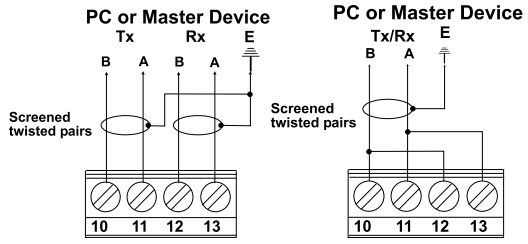


Potentiometer Connection

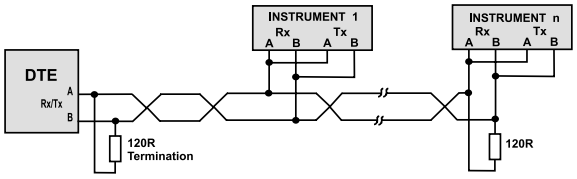


Connecting the Communications Interface

The diagrams below show the connections necessary to interface your instrument to a PC RS485/422 port or to an RS485 to RS232 converter. It is recommended that screened twisted pair cable be used for all applications requiring cable lengths greater than 3m. It is also recommended that a 120Ω termination resistor is added across each pair of wires at the furthest point from the master device. The screen of the cable should be connected to the frame ground or ground connection of the master device. The diagram below shows the wiring required for both 4-wire full duplex and 2-wire half duplex installations.



4-Wire & 2-Wire Communications Interface Connections

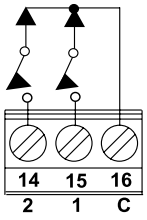


Typical RS485 Multidrop Half Duplex Application

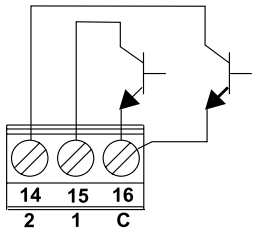
Connecting the Status Inputs

There are 2 status (logic) inputs provided by your instrument. The inputs can be used with either voltage free contacts such as relay contacts, switches, open collector transistor outputs or voltage driven. The inputs are active low, ie. apply a short circuit between the status input and status common. The diagrams below show some typical applications.

NOTE: These inputs are not isolated from the instrument's input circuit.



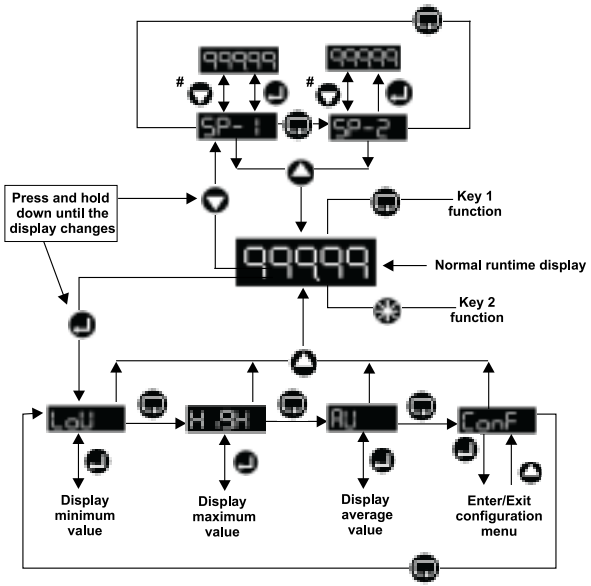
Volt Free Contacts



Open Collector TTL Outputs

Operator Functions

All of the operator functions are described in the following section along with the key actions required. The diagram below shows the facilities available directly from the Operator (Normal) Mode.



Use ▼ key to view and ↵ key to edit (provided the alarm edit option is **on** - see **Front Panel Edit** page 37).

SP-1 SP-2 Represent Alarm Setpoints 1 and 2.

LoU Displays the lowest measured value since last reset (see **Reset** pages 52 and 56).

 Displays the highest measured value since last reset (see **Reset** pages 52 and 56).

 Displays the average measured value since last reset (see **Reset** pages 52 and 56).

 Enables Configuration//Setup Mode (see **How to Navigate the Configuration Menus** page 18).

Operator Mode - Key Functions

Caution: the keys have an "auto-repeat" facility whereby holding down a key for longer than necessary will have the same effect as multiple presses. From the normal runtime display:

Enter - Allows access to the operator functions (**LoW**, **HigH** (peak) and **AV** (average) values) since last reset (see **Reset** page 56) and **ConF** (Configuration/Setup Mode). To access the operator functions, press and hold for approximately 3 seconds until **LoW** is displayed.

Next - Function Key 1 can be configured to perform various functions such as fast calibration, zeroing and tare. Details of the facilities available and how to configure the key are described later in this Guide (see **Configuring Function Keys** page 55).

Down - Accesses 2 alarm setpoints for viewing and editing if enabled (see **Front Panel Edit** page 37).

Up - Exits from menus to normal running.

Star - Function Key 2 can be configured to perform various functions. Details of the facilities available and how to configure the key are described later in this Guide (see **Configuring Function Keys** page 55).

Up and **Down** - Pressed together will perform an alarm acknowledge for latched alarms (see **Latching** page 35 and **Alarm Acknowledge** page 51) and **ACk** will be displayed.

Menu Mode - Key Functions

The instrument may be configured using the front panel keys to enter and navigate through the multi-level menu structure. Caution: the keys have an "auto-repeat" facility whereby holding down a key for longer than

necessary will have the same effect as multiple presses. When navigating through the menus, the keys perform the following functions:

Enter - Selects or accesses a sub-menu.

Next - Scrolls forward through the menus within a level.

Up - Moves back up to the parent-menu level. Multiple key presses will always return the instrument to the measured value (runtime) display.

The menu system lists *categories* (eg. **inPt**, **SCLE**, **AL1**). Selecting a category may lead to a sub-category, but eventually it leads to a list of configurable instrument *parameters* (eg. category **inPt** leads to parameters **tYPE**, **rnG** etc.).

When the **Enter** Key is pressed to change a parameter, the existing *setting* is displayed. Notice that a letter or digit always flashes when a setting is on display.

Some settings are chosen from a list (eg. parameter **tYPE** has 8 settings: **t/C, VoLt, mV** etc.).

Other parameters are setup by editing a multi-digit value (eg. **LdSP** within **SCLE** has a default numeric setting of [**0.0000**]).

Selecting a Setting from a List

When the first letter of a menu option flashes, it represents the setting for a parameter.

cycles round the list of possible settings for the parameter.

Aborts the setting selection without changing the setting.

Makes the currently displayed setting the new setting.

Editing a Value

When the last digit of a numeric value flashes, it represents the setting for a parameter.

Notice that the flashing digit is the one that is edited by the **Up** and **Down** arrow keys.

The sign is changed by editing the most significant digit.

 Selects the next flashing digit to edit. The next digit left is selected.

When the leftmost digit is reached and if the decimal point position can be changed, the decimal point flashes next.

 Clears the whole value to zero if zero is a valid value.

 Increments the flashing digit. If the decimal point is flashing, the decimal point moves left.

If negative values are allowed and the most significant digit is flashing, the digit rotates round the sequence: 0 1 2 3 4 5 6 7 8 9 -1 -.

 Decrements the flashing digit. If the decimal point is flashing, the decimal point moves right.

If negative values are allowed and the most significant digit is flashing, the digit rotates round the sequence: 9 8 7 6 5 4 3 2 1 0 - -1.

 Exits, making the edited value displayed the new setting.

How to Navigate the Configuration Menus

This example will show you how to edit one of the unit's configuration options. We will turn down the brightness (labelled **briL**) of the display. Use this example in conjunction with the **Configuration Menu Map** on page 20 to navigate your own way to the options that you wish to change.

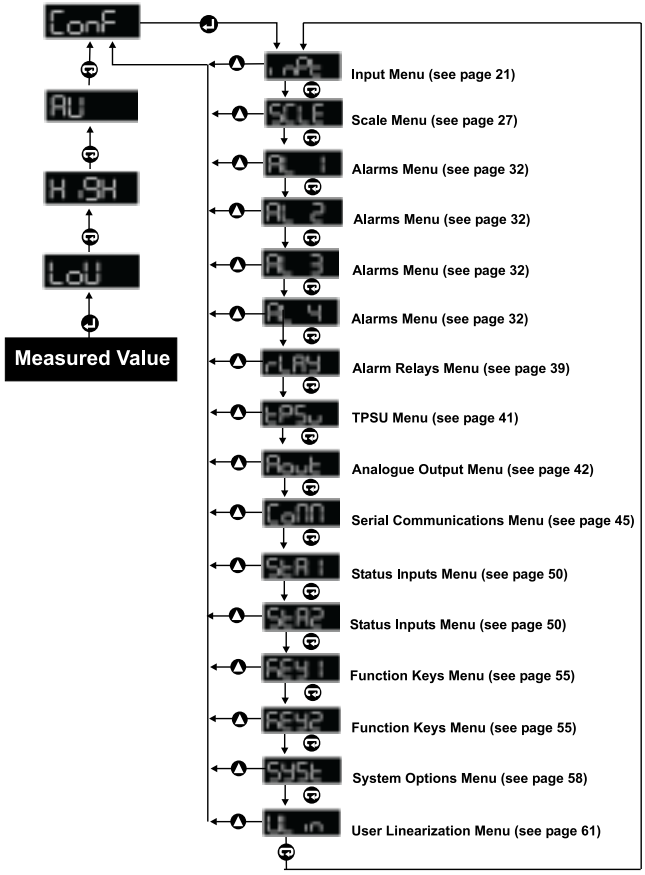
1. With the unit displaying the current measured value, press and hold ↵ until the display changes to show LoU.
2. Press ↻ until ConF is displayed.
3. Press ↵ to enter the **ConF** (configuration) menu.
4. Press ↻ until SYSt is displayed.
5. Press ↵ to enter the **SYSt** (system) menu.
6. Press ↻ to cycle through the sub-menus of the **SYSt** menu until brIL is displayed.
7. Press ↵ to enter the **briL** (brilliance) menu. You will know that you have successfully entered Edit Mode if a flashing figure is displayed. This will be the currently set value for this option.
8. In the case of brilliance, there are 4 options, each numbered 1 to 4 (*the default is 4*). Press ↻ to cycle through the options available to you.

9. If the original setting was 4, cycle to 1 by pressing  until 1 is displayed.

10. Press  to select 1, save your change and finalise editing. The display brightness will change and become darker.

11. Pressing  will move you back up the menu-tree one level for each press of the key. Press this repeatedly until the measured value display appears again.

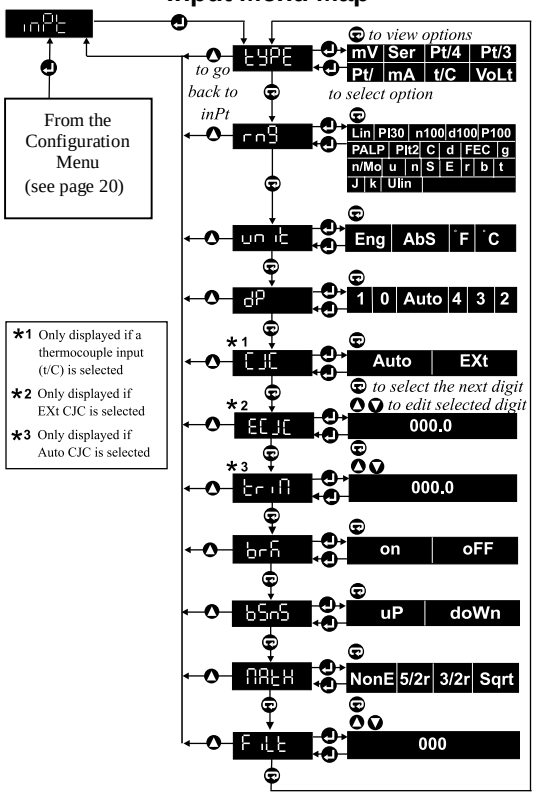
Configuration Menu Map



Configuring the Input

Before any calibration or scaling operations are performed, some operating parameters related to the use of the particular sensor/transducer need to be set. These parameters are all set up from the **inPt** (input) menu.

Input Menu Map



Type

Default: mV

Defines the type of sensor to be connected to the instrument such as a thermocouple, resistance thermometer device RTD, etc. This parameter must be set to allow the instrument to measure correctly.

The sensor wiring used will also be effected by this parameter.

Analogue 8 Comms Location		Read/Write
Integer value	Code	Input type
0	mV	A signal in millivolts, up to ±100mV
7	SEr	A value sent via the serial comms port
6	Pt/4	A signal from a 4-wire RTD/resistance sensor
5	Pt/3	A signal from a 3-wire RTD/resistance sensor
4	Pt/2	A signal from a 2-wire RTD/resistance sensor
3	mA	A signal in milliamps, up to ±20mA
2	t/C	Thermocouple input
1	VoLt	A signal in volts, up to ±10V

Range

Default: Lin

Defines the sensor range to be used for scaling the instrument.

This parameter allows the instrument to correct for any non-linear output from a sensor and display the correct value for up to 21 commonly used non-linear thermocouple and resistance thermometer ranges. The instrument also provides an optional user-definable non-linear scaling range (**uLin**).

Analogue 9 Comms Locations						Read/Write
Integer value	0	1	2	3	4	5
Code	Lin	uLin	K	J	T	B
Integer value	6	7	8	9	10	11
Code	R	E	S	N	U	N/Mo
Integer value	12	13	14	15	16	17
Code	FEC	G	D	C	Plt2	PALP
Integer value	18	19	20	21		
Code	P100	D100	N100	P130		

Unit

Default: Eng

unit Allows the user to convert between engineering units and specific temperature units of measurement. The selected unit of measurement will be displayed.

Analogue 10 Comms Location		Read/Write
Integer value	Code	Measurement unit
0	Eng	Engineering
1	°C	Temperature in Celsius
2	°F	Temperature in Fahrenheit
3	ABS	Absolute temperature (Kelvin)

NOTE: Engineering and °C have the same effect.

Decimal Point Position

Default: 1 decimal place

dP Defines the position of the decimal point on the 5 digit display. The decimal point may be fixed to give 0 to 4 digits after the decimal point or it may be positioned automatically. Automatic positioning displays as many of the most significant digits as possible while allowing the decimal point and sign to remain visible. For example:

Value	Displayed as
12345.67	12346 (point not needed so not shown)
123.4567	123.46
0.1234567	0.1235
-0.1234567	-.1234

The **dP** setting limits the range of displayable values as follows:

Analogue 11 Comms Location		Read/Write
	Displayable range	Decimal point setting
Integers:	-19999 through 0 to 99999	0
	-1999.9 to 9999.9	1
	-199.99 to 999.99	2
	-19.999 to 99.999	3
	-1.9999 to 9.9999	4
Any:	-19999 through 0.0000 to 99999	5 (Auto)

The unit will display **oVEr** (over) or **undr** (under) when appropriate.

Editing Out of Range Values

Increasing the **dP** (decimal point) setting can make editable values go outside of the displayable range. For example:

dP	1
Maximum displayable range	9999.9
Alarm Setpoint 1	1234.5
When **dP** is changed to	2
Maximum displayable range	999.99
So Alarm Setpoint 1 of	1234.5 is now out of range

When this happens, it is the users' responsibility to edit such parameters so that they are within the displayable range.

Parameters effected by the displayable range are:

- Alarm setpoints (see page 33).
- Alarm on-hysteresis and off-hysteresis (see page 36).
- Analogue output low and high scale points (see page 44).
- Comms low and high scale points (MODBUS™ only) (see page 47).
- User linearization display points **dP01** to **dP24** (see page 63).

Normally, when editing one of these values, the decimal point is fixed within these values to prevent them being edited to a value that is out of the displayable range. However, if the value becomes out of range due to increasing the **dP** setting, rather than by editing the value, the decimal point may be movable within such a value.

Cold Junction

Default: Auto

Defines the type of cold (reference) junction compensation used.

When **Auto** is selected, the instrument will perform its own compensation based on the temperature of the rear terminals to which the thermocouple is connected.

EXt (external) allows an external reference junction to be used. The temperature of the external reference junction is set using the **ECJC** parameter (see below).

Logic 4 Comms Location		Read/Write
On	Automatic	
Off	External	

External Cold Junction

Default: 0

ECJC Defines the temperature of an external reference junction in °C when **CJC** type **EXt** is selected.

Analogue 12 Comms Location		Read/Write
Integer range	-19999 to +99999 (5 digit models) -19999 to 9999 (4 digit models)	

CJC Trim Value

Default: 0

trim This parameter allows any offset errors in the reference junction to be corrected by setting a **triM** value.

NOTE: As the **triM** option uses the same memory location as **SPgr** (see **Specific Gravity** page 30), whenever the input type is changed from a non-thermocouple to a **t/C**, the trim offset will be reset to 0.000.

Analogue 13 Comms Location		Read/Write
Integer range	-29 to 41	

Break Sense Detection

Default: On

brk This parameter defines whether sensor break detection is to be used. When enabled, the instrument detects an open circuit condition in the sensor normally used for thermocouples.

NOTE: It is recommended that break sensing is disabled when using high impedance sensors for best accuracy.

Logic 7 Comms Location		Read/Write
On	Enabled	
Off	Disabled	

Break Sense

Default: On

bSnS When break sense detection is enabled, this parameter defines whether upscale or downscale burnout is used. For upscale, the display will read **brku** when a sensor break condition is detected and the measured value is forced to its upscale limit causing any high alarms to be activated.

For downscale burnout, the measured value is forced to its minimum value causing any enabled low alarms to be triggered.

Logic 5 Comms Location	Read/Write
On	Upscale burnout
Off	Downscale burnout

Maths

Default: None

MAtH Defines the mathematical function used.

Analogue 14 Comms Location				Read/Write
Integer value	0	1	2	3
Maths function	None	$X^{1/2}$	$X^{3/2}$	$X^{5/2}$

Display Filtering

Default: 0 seconds

FiLt Applies a simulated rolling average filter to the displayed value. The time constant of the filter is entered in seconds. (See also **Averaging Time** page 59.)

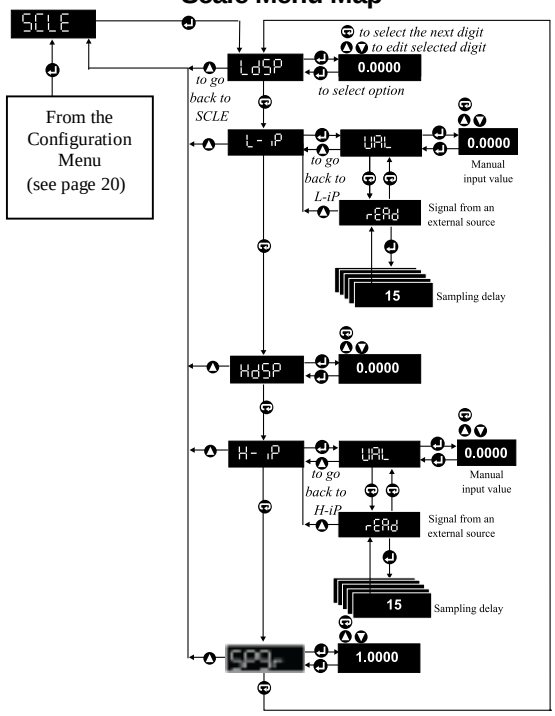
NOTE: 0 disables the filter.

Analogue 15 Comms Location	Read/Write
Integer range (seconds)	0 to 999

Scaling

If the signal input from your sensor has a linear relationship to the displayed value, and this relationship is not 1:1, you must use the scaling facility to ensure that the measured value is correctly displayed. Before using the scaling facility, the **rng** (range) parameter within the **InPt** (input) menu (see **Range** page 22) should be set. The scaling facility can be used to calibrate the instrument to a sensor .

Scale Menu Map



If the scaling is changed via comms, the instrument must be told when to use the new setup by setting Logic Location 12 On.

Logic 12 Comms Location	Write-Only
On	The instrument uses scaling changes

Scaling consists of specifying a low and a high point in the display range and a corresponding input value for each of these points. The low and high points in the input range can be specified either by manually entering the values using the front panel controls, or by sampling the sensor output or external signal source. The prompts displayed in the scale menu are described below.

Low (Zero) Display Value *Default: Variable (see* **NOTE** *below)*

LdSP Corresponds to the value (in engineering units) to be displayed when the instrument measures the low output (**L-iP**) from the sensor. Enter the value of the low calibration point in engineering units.

Analogue 20 Comms Location	Read/Write
Integer range	-19999 to 99999 (5 digit models) -1999 to 9999 (4 digit models)

NOTE: The usable range of input values will be determined by the selected input type. When the input type or range is changed, the scaling values will be defaulted to values appropriate to the input type and range, ie. the default for mV is ±100.

Low Input Value

L-iP Corresponds to the signal output value from the sensor which will cause the instrument to display the value set as **LdSP**.

Analogue 21 Comms Location	Read/Write
Integer range	-19999 to 99999 (5 digit models) -1999 to 9999 (4 digit models)

VAL rEAd There are 2 methods of setting the low input value, either by entering a signal value using the **VAL** option or by sampling the sensor output using the **rEAd** option. Values entered manually are

performed in the same way as other numeric values (see **Editing a Value** page 17). The value to be entered will usually be supplied with the data accompanying your sensor. However, if it is not available, the output from the sensor may be read from an external source by the instrument. To achieve this, set the input to the sensor to a known condition (depending on the sensor), eg. pressure, temperature, etc. and perform a **rEAd** from the menu. The instrument will sample the output from the sensor and save this as the **L-iP** scaling parameter.

Logic Location 10 must be set to On to perform a read function using comms. Note that after reading the input, Logic Location 10 returns to Off.

Logic 10 Comms Location	Read/Write
On	Reads input sample
Off	Default

High Display Value

Default: Variable (see **NOTE** *below)*

HdSP Corresponds to the value (in engineering units) to be displayed when the instrument measures the high output (**H-iP)** from the sensor. Enter the value of the high calibration point in engineering units.

Analogue 22 Comms Location	Read/Write
Integer range	-19999 to 99999 (5 digit models) -1999 to 9999 (4 digit models)

NOTE: The usable range of input values will be determined by the selected input type. When the input type or range is changed, the scaling values will be defaulted to values appropriate to the input type and range, ie. the default for mV is ±100.

High Input Value

H-,P Corresponds to the signal output from the sensor which will cause the instrument to display the value set as **HdSP**.

Analogue 23 Comms Location	Read/Write
Integer range	-19999 to 99999 (5 digit models) -1999 to 9999 (4 digit models)

VAL rEAd There are 2 methods of setting the high input value, either by entering a signal value using the **VAL** option or by sampling the sensor output using the **rEAd** option. Values entered manually are performed in the same way as other numeric values (see **Editing a Value** page 17). The value to be entered will usually be supplied with the data accompanying your sensor. However, if it is not available, the output from the sensor may be read from an external source by the instrument. To achieve this, set the input to the sensor to a known condition (depending on the sensor), eg. pressure, temperature, etc. and perform a **rEAd** from the menu. The instrument will sample the output from the sensor and save this as the **H-iP** scaling parameter.

Logic Location 11 must be set to On to perform a read function using comms. Note that after reading the input, Logic Location 11 returns to Off.

Logic 11 Comms Location	Read/Write
On	Reads input sample
Off	Default

An example of scaling the instrument for a pressure transducer is given below:

Output:	0.16mV	at	0psi	
	36.5mV	at	700psi	
Set:	**LdSP**	to	0.0	
	L-iP	to	0.16mV	using **VAL**
	HdSP	to	700.0	
	H-iP	to	36.5	using **VAL**

Specific Gravity

Default: 1

SPGr After scaling the input measurement to engineering units, the result is divided bv **SPgr** to give the displayed value.

By default **SPgr** is 1.000 in order to leave the basic scaling unchanged.

SPgr is only visible when the input type is not **t/C** (thermocouple) (see **Input Type** page 22). Furthermore, when the input type is changed from **t/C** to a non-thermocouple, **SPgr** is defaulted to 1.000.

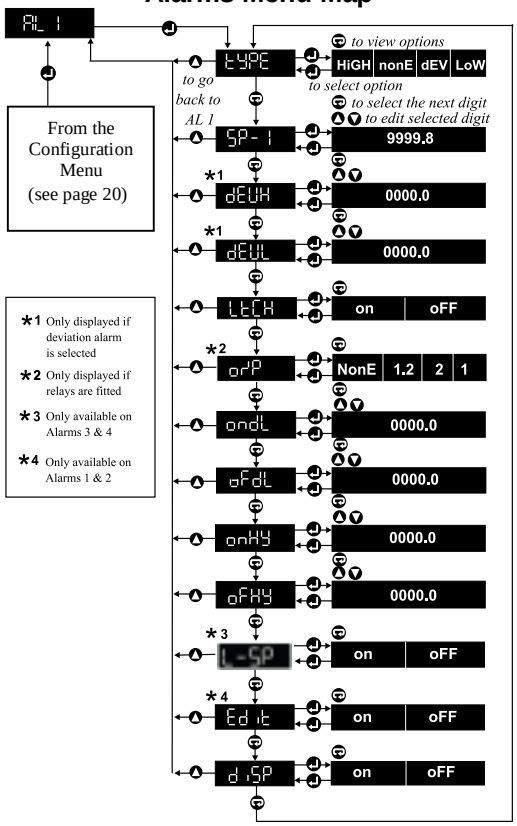
NOTE: As the **Spgr** option uses the same memory location as **triM** (see **CJC Trim Value** page 25), whenever the input type is changed from a non-thermocouple to **t/C**, the trim offset will be reset to 0.000.

Analogue 13 Comms Location		Read/Write
Integer range	0.001 to 9.999	

Configuring Alarms

AL 1 AL 2 AL 3 AL 4 Instruments have 4 alarms.

Alarms Menu Map



Each alarm can be high or low acting or a deviation alarm. When an alarm occurs:

- An optional message can be displayed.
- Outputs may be optionally activated.

Care should be taken to ensure the same outputs are not unintentionally used by other facilities such as another alarm.

Type

Default: High (Alarms 1 & 3), low (Alarms 2 & 4)

Sets the alarm type:

- **nonE** Alarm disabled.
- **dEV** Deviation alarm.
- **LoW** Low acting alarm.
- **HigH** High acting alarm.

When a deviation alarm type is chosen, the options **dEVH** and **dEVL** (see **Deviation Setpoints** page 34) appear after **SP-** (see **Setpoint** below). A deviation alarm is activated when the measured value falls outside a deviation band. The alarm setpoint plus the **dEVH** deviation represents the top of the deviation band and similarly, the alarm setpoint minus the **dEVL** deviation represents the bottom of the deviation band.

A high/low alarm is activated when the measured value rises above/falls below the respective setpoints.

Analogue Comms Locations		Read/Write
Analogue	Alarm	Type
30	Alarm 1	0=High 1=Low 2=Deviation 3=None (disabled)
40	Alarm 2	0=High 1=Low 2=Deviation 3=None (disabled)
50	Alarm 3	0=High 1=Low 2=Deviation 3=None (disabled)
60	Alarm 4	0=High 1=Low 2=Deviation 3=None (disabled)

Setpoint

Default: 9999.9 (Alarms 1 & 2), -1999.9 (Alarms 3 & 4)

Specify the alarm setpoint. The setpoint is ignored if the alarm type is **nonE**.

A **HigH** alarm is activated when the measurement is higher than the

setpoint.

A **LoW** alarm is activated when the measurement is lower than the setpoint.

A **dEV** (deviation) alarm is activated when the measurement falls outside the deviation band. The top of the deviation band is at **SP-** plus **dEVH**. The bottom of the deviation band is at **SP-** minus **dEVL**. Therefore, moving the setpoint, moves the whole deviation band.

SP- can be any measurement in the displayable range. Take care setting the display's decimal point position (see Displayable range page 23) as this can reduce the displayable range and leave the setpoint at an unreachable level.

It is possible to setup the instrument so that the setpoints can be edited quickly from the front panel during normal operation. To access the edit facility, set the **Edit** option in the **AL1** or **AL2** (Alarm 1 or Alarm 2) menu to **on** (see **Front Panel Edit** page 37).

SP-3 (Setpoint 3) will always be the same as **SP-1** (Setpoint 1) if **L-SP** for Alarm 3 is **on**. **SP-4** (Setpoint 4) will always be the same as **SP-2** (Setpoint 2) if **L-SP** for Alarm 4 is **on** (see **Linked Setpoint** page 37).

Analogue Comms Locations				Read/Write
Location	31	41	51	61
Setpoint for Alarm	1	2	3	4
Integer range	Displayable range (see page 23)			

Deviation Setpoints

Default: 0

dEUH dEUL Allow the difference between the alarm setpoint and the high and low deviation levels to be defined. These menu options are only displayed (and valid) when the alarm type is set to deviation.

Analogue Comms Locations								Read/Write
Analogue	32	33	42	43	52	53	62	63
Deviation	High	Low	High	Low	High	Low	High	Low
Alarm	1		2		3		4	

Latching

Default: Off

LtCH **on** sets up the alarm to remain activated when the alarm condition has gone. Any output(s) and display message associated with the alarm stay latched too.

When the alarm condition has gone, latched alarms can be cleared via a status input or key function (see **Operator Mode - Key Functions** page 15) to perform the **ACk** (acknowledge function) (see **Alarm Acknowledge** page 51). Latched alarms can be acknowledged by pressing the **Up** and **Down** panel keys together.

Logic Comms Locations				Read/Write
Logic	15	20	25	30
On enables latching for Alarm	1	2	3	4

Output

Default: None

O/P The output facility specifies which relay outputs, if any, are activated by each alarm when the alarm condition occurs.

An output selected within an alarm menu takes priority over relay control from the relay menu. For example, if **O/P** (output) within the **AL4** (Alarm 4) menu has been setup to activate Relay 2, and the **rEL2** (Relay 2) menu has been setup to activate the relay only when all alarms are activated, only Alarm 4 will be required to activate Relay 2. (See also **Relays 1 & 2** page 40.)

Check used outputs are not unintentionally used by other facilities such as other alarms.

This option is only available on instruments with 2 relay outputs.

Analogue Comms Locations		Read/Write
Analogue	Alarm	Outputs
34	1	0=None 1=1 2=2 3=1&2
44	2	0=None 1=1 2=2 3=1&2
54	3	0=None 1=1 2=2 3=1&2
64	4	0=None 1=1 2=2 3=1&2

Delay

Default: 0 seconds

Define the time in seconds that an alarm condition must persist, ranging from 0 to 9999 seconds (see diagram page 37).

ondL (On-delay) defines the time an alarm condition must persist before the alarm is activated.

oFdL (Off-delay) defines the time an alarm condition must be clear before the alarm is de-activated.

Analogue Comms Locations					Read/Write
Alarm	1	2	3	4	Range (seconds)
On-delay	35	45	55	65	0 to 9999
Off-delay	36	46	56	66	0 to 9999

Hysteresis

Default: 0

(See diagram page 37).

onHy (On-hysteresis) defines how far a measurement must go beyond the activation level to activate the alarm.

oFHy (Off-hysteresis) defines how far a measurement must go beyond the de-activation level to de-activate the alarm.

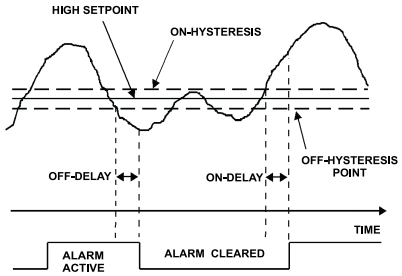
The effect of hysteresis on a high alarm, is to raise the activation level by the on-hysteresis value and lower the de-activation level by the off-hysteresis value.

The effect of hysteresis on a low alarm, is to lower the activation level by the on-hysteresis value and raise the de-activation level by the off-hysteresis value.

The effect of hysteresis on a deviation alarm is to broaden the activation band by the on-hysteresis and narrow the de-activation band by the off-hysteresis.

Hysteresis is normally used to prevent an alarm being activated and de-activated at high frequency when a noisy measurement dithers around a setpoint.

Analogue Comms Locations					Read/Write
Alarm	1	2	3	4	
On-hysteresis	37	47	57	67	Displayable range (see page 23)
Off-hysteresis	38	48	58	68	Displayable range (see page 23)



Effect of Delay and Hysteresis on a High Alarm

Linked Setpoint Alarms 3 & 4

Default: Off

L-SP This option is useful for associating 2 alarms with the same setpoint. When invoked from the **AL3** (Alarm 3) menu, turning this option **on**, will make the Alarm 3 Setpoint the same as the Alarm 1 Setpoint. When invoked from the **AL4** (Alarm 4) menu, turning this option **on**, will make the Alarm 4 Setpoint the same as the Alarm 2 Setpoint.

Logic Comms Locations		Read/Write
Logic	26	31
On enables setpoint linking for Alarm	3 (to 1)	4 (to 2)

Front Panel Edit Alarms 1 & 2

Default: On

Edit **on** allows setpoint editing from the front panel during normal operation. Press the **Down** key to access the setpoint editor during normal operation. A password is never needed to access the setpoint editor.

Logic Comms Locations		Read/Write
Logic	16	21
On enables setpoint editor for Alarm	1	2

Message Display

Default: On (for all alarms)

di SP **on** programs the instrument to determine and display a message when the alarm occurs during normal operation. Messages are 3 letters followed by the alarm number. The 3 letter codes are:

- **HiA-** High alarm.
- **LoA-** Low alarm.
- **Hid-** High deviation alarm.
- **Lod-** Low deviation alarm.

Eg. **HiA4** indicates high Alarm 4 has been activated.

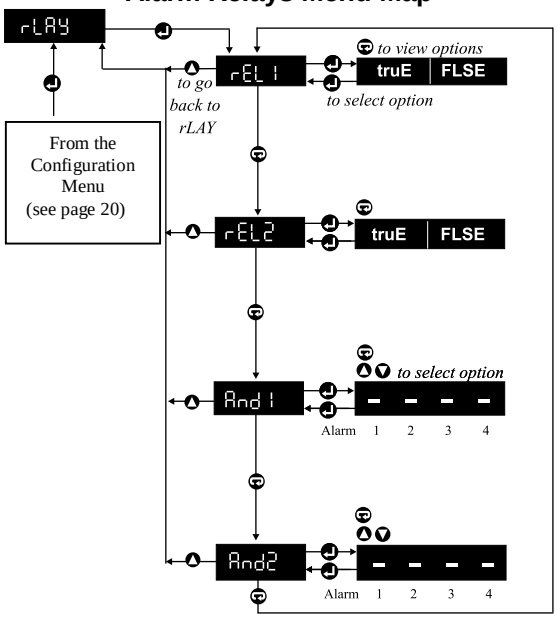
When more than one alarm is activated, messages are prioritised so the highest high alarm or the lowest low alarm is reported.

Logic Comms Locations				Read/Write
Logic	17	22	27	32
On enables message display for Alarm	1	2	3	4

Configuring the Alarm Relays

The options in this menu effect the way outputs work when activated by alarms. Certain models are fitted with 2 alarm relays; **rEL1** (Relay 1) and **rEL2** (Relay 2). These instruments can be configured to change the state of the alarm relays either when a single alarm is triggered or when a specific combination of alarms is triggered.

Alarm Relays Menu Map



The outputs available depend on the instrument type. The instrument type and the options fitted can be found on the connections label. The instrument type is displayed on power up, after the test display and software version.

From the **rLAY** menu, it is possible to reverse the sense of the relays or make them change state for a set time rather than for as long as the activation condition exists.

To configure the instrument to change the state of an alarm relay when a single alarm is triggered, use the output facility (see **Output** page 35) available from each of the individual alarm menus (see page 32).

Relays 1 & 2

Default: True

rEL1 rEL2 Select the alarm state for Relay 1 and Relay 2 respectively. To configure the instrument to change the state of an alarm relay when a specific combination of alarms is triggered, use the **rLAY** (alarms relay) menu illustrated on page 39. The alarm state of each of the relays can also be specified using this menu, ie. whether the relay is energised or de-energised when an alarm is triggered.

truE programs the instrument so that the output is energised in the alarm state. **FLSE** ensures the output is de-energised in the alarm state.

FLSE might be used in a failsafe application so that power failure to the instrument outputs results in the abnormal output state.

Logic Comms Locations		Read/Write
Logic	40	45
On sets Output type to true	1	2

And1 And2 Specify the combination of alarms which are to change the state of Relay 1 and Relay 2 respectively. When set to **on**, the AND function includes both an alarm and a relay. For example, within **And1**, "**1 2 - 4**" means that the state of Relay 1 is only changed when Alarms 1, 2 and 4 are all triggered.

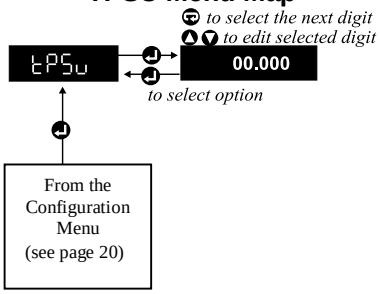
Logic Comms Locations				Read/Write
Alarm	1	2	3	4
And1	41	42	43	44
And2	46	47	48	49

Configuring the Transmitter/ Transducer Power Supply

All instruments are fitted with a 24 volt power supply intended to power a transmitter and either a fixed 10V or adjustable 0 - 12V supply (5 digit models) for powering a transducer.

For the adjustable supply, enter the **tPSu** menu and select a voltage in the range 0.00 to 12.00. The available resolution is 0.01 volts.

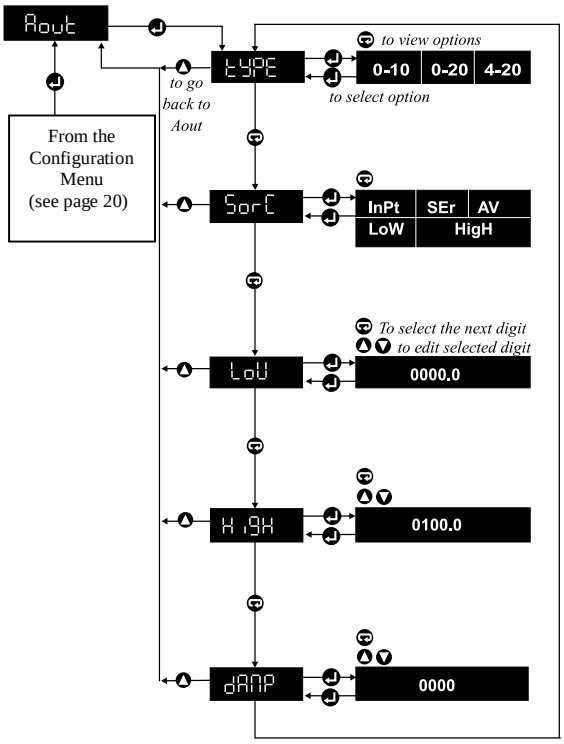
TPSU Menu Map



Configuring the Analogue Output

This menu sets up the scaleable analogue retransmission.

Analogue Output Menu Map



Type

Default: 4 - 20mA

tyPE Selects the output range from:

- **0 - 10** 0 to 10V (volts).
- **0 - 20** 0 to 20mA (milliamperes).
- **4 - 20** 4 to 20mA.

Analogue 71 Comms Location			Read/Write
Integer value	0	1	2
Sets output type	0 to 10V	0 to 20mA	4 to 20mA

Source of Output Level

Default: Input

SorC Defines the source of the retransmission level from:

- **inPt** Measurement.
- **SEr** Serial comms interface.
- **AV** Average measurement.
- **LoW** Lowest measurement.
- **HigH** Highest measurement.

Whatever the source, the value controlling the retransmission level should lie between the **LoW** and **HigH** settings declared next in the **Aout** (analogue output) menu (see **Low & High Scaling** page 44). For example, if **LoW** is 0 and **HigH** is 20, a source value of 10 will set the analogue output level to halfway up the output range. This would be 12mA when the **Aout tyPE** is 4 - 20mA.

InPt is the displayed measurement, but before the display filter (see **Display Filtering** page 26) is applied.

SEr requires values to be sent to the instrument via the serial interface. They should be stored in Analogue Location 76. They control the output level during normal operation. For example, sending **;001SA76 10.000<CR><LF>** sends 10 to Analogue Location 76. **NOTE:** When values have been sent via comms, the output will be dependent on the values which have been set for low and high scaling.

The **AV** (average) measurement is a simulated rolling average taken over

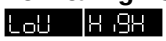
the period specified by the **AVti** option in the **SySt** (system) menu (see **Averaging Time** page 59).

The **AV, HigH** and **LoW** values are all reset to the current measured value on activating a status input or function key that has been setup to perform the reset function (see **Reset** pages 52 & 56).

Analogue 72 Comms Location					Read/Write
Integer value	0	1	2	3	4
Sets source to	Input	High	Low	Average	Ser

Low & High Scaling

Default: Low 0, high 100



Define the low and high display and input scaled values which correspond to the maximum and minimum output from the retransmission.

For example, to retransmit 4 - 20mA type from the input source where 4mA is output for a measured value of 20 and 20mA is output for a measured value of 400, set **LoW** to 20 and **HigH** to 400.

NOTE: When using 4 - 20mA output type, the output will not fall below 4mA.

Analogue Comms Locations			Read/Write
Low	High	Range	
73	74	Both may be any value in the displayable range (see page 23)	

Damping Filter

Default: 0 seconds

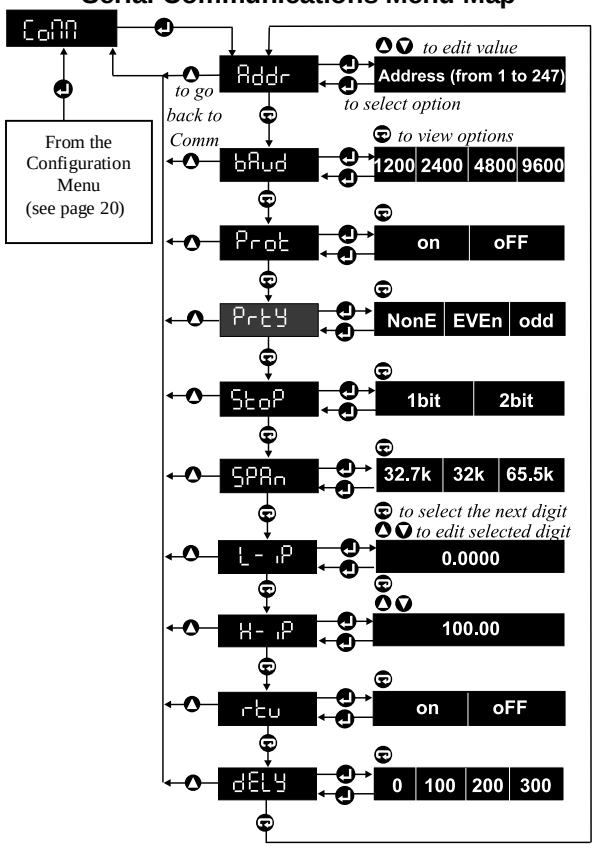
Defines a time constant in seconds over which a simulated rolling average is applied to the analogue output. Longer times make the analogue output more stable but give the analogue output a slower step response. 0 = **oFF**.

Analogue 75 Comms Location		Read/Write
Integer damping time (seconds)	0 to 999 0 = Off/no damping	

Configuring Serial Communications

This menu sets up the instrument's RS485/422 communications interface.

Serial Communications Menu Map



Instrument Address

Default: 001

Addr Defines a unique communications address for the instrument. It may range from 001 to 247.

When more than one instrument is connected to a master via a multidrop bus, each instrument must have a different address.

The instrument can use 3 protocols:

- ASCII Native .. .. (easy to use - no checksums).
- ASCII MODBUS™.
- Binary MODBUS™ RTU (JBUS).

By default, instruments handle commands in either ASCII protocol.

Unique addresses mean commands can be directed to one instrument. They also stop all instruments replying at the same time. A command is sent to a particular address by ensuring the address field in the command equals the address of the instrument the command is intended for:

Eg. The command: ;**001 SA 76 10<CR><LF>**

Addresses instrument **001** because the address field is **001**.

This command **S**tores to **A**nalogue Location **76**, the value **10**.

The instrument responds with **OK<CR><LF>**

During normal operation, a master may send commands to address 000. This is a broadcast address used only for store commands (see page 72) such as the example above. Instruments obey but never reply to broadcasts.

Analogue 80 Comms Location	Read/Write
Instrument's communications address range	1 to 247

Baud Rate

Default: 9600bps

bAud Sets the communications speed.

Analogue 81 Comms Location				Read/Write
Integer value	0	1	2	3
Communications baud rate	1200	2400	4800	9600

Protection

Default: Off

Prot **on** protects the instrument's setup from any changes via the communications interface. **oFF** allows any analogue or logic location to be changed unless it is a read-only location.

Logic 50 Comms Location	Read/Write
On enables protection	Off disables protection

Attempts to write to a protected or read-only location using the native protocol causes the instrument to reply with **#2** (see **Errors** page 74).

Parity

Default: Even

PrtY Defines the parity setting for all communications.

Always set parity to **nonE** when **rtu** is **on** (see **Remote Terminal Unit** page 48).

Analogue 82 Comms Location			Read/Write
Integer value	0	1	2
Parity	Odd	Even	None

Stop Bits

Default: 1bit

StoP Defines the number of stop bits for all communications.

Always set stop bits to **1bit** when **rtu** is **on** (see **Remote Terminal Unit** page 48).

Logic 51 Comms Location	Read/Write
On=2 bits	Off=1 bit

Scaling (MODBUS™ only)

Default: Span 32k, L-ip 0, H-ip 100

SPAn L-iP H-iP Allow transmission of values normally outside

the range of MODBUS™ integers.

SPAn defines the integer range used to transmit values ranging from **L-ip** to **H-ip** as follows:

L-ip to **H-ip** is transmitted

as: 0 .. to..32000 when **SPAn** is **32k**.
or: 0 .. to..65536 when **SPAn** is **65.5k**.
or: 0 .. to..32767 when **SPAn** is **32.7k**.

Analogue Comms Location		Read/Write
83	Span	0=32k 1=32.7k 2=65.6k
84	Low	Any value in the displayable range (see page 23)
85	High	Any value in the displayable range (see page 23)

Remote Terminal Unit

Default: Off

on makes the instrument use only MODBUS™ **rtu** protocol. When **rtu** is **on**:

- Parity must be set to **nonE**.
- Stop bits should be **1bit**.
- Delay before transmission is ignored. (see **Transmit Delay** below).

MODBUS™ **rtu** is a binary protocol requiring 8 data bits per byte.

Logic 55 Comms Location	Read/Write
On enables rtu	Off disables rtu

Transmit Delay

Default: 0mS

Defines a delay in milliseconds before the instrument replies to commands received over the communications interface. It is ignored if **rtu** is **on**.

The delay is useful if there is difficulty handling the instrument's fast response to commands using a 2-wire (half duplex) connection. For example, this is likely if a simple program is being written in Visual Basic

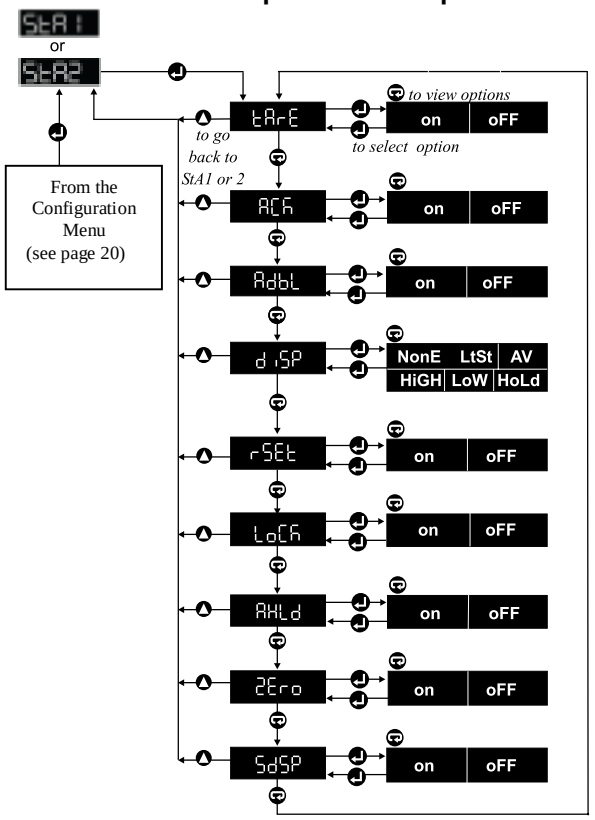
under Windows to talk to the instrument via a 2-wire (half duplex) connection.

Analogue 79 Comms Location				Read/Write
Integer value	0	1	2	3
Delay before transmit (mS)	0	100	200	300

Configuring Status Inputs

These menus allow the user to program the optional effects of activating Status Inputs 1 and/or 2 respectively.

Status Inputs Menu Map



Status Input 1 is activated by connecting Terminal 15 (Status 1) to Terminal 16 (common). Similarly, Status Input 2 is activated by connecting Terminal 14 (Status 2) to Terminal 16 (common). (See **Connections** page 5 and **Connecting the Status Inputs** page 12).

Status inputs and function keys have several effects in common (see **Configuring Function Keys** page 55).

Tare

Default: Off

tArE **on** programs the status input to tare the display. When the status input is first activated, the display is zeroed. While the status input remains activated, the display shows only value changes since it was zeroed. The display also flashes **tArE** every 2.5 seconds. When the status input is de-activated, the display is restored to show normal measurements again.

Logic Comms Locations			Read/Write
Logic	60	70	On enables tare function
Status Input	1	2	Off disables tare function

Alarm Acknowledge

Default: Off

ACA **on** programs the status input so that a momentary activation de-activates active latched alarms. Alarms only clear if the cause of the alarm no longer exists (see **Latching** page 35).

Logic Comms Locations			Read/Write
Logic	61	71	On enables alarm acknowledge
Status Input	1	2	Off disables alarm acknowledge

Alarm Disable

Default: Off

AdbL **on** programs the status input to disable Alarms 1 to 4 while the status input remains activated.

Logic Comms Locations			Read/Write
Logic	62	72	On enables alarm disable
Status Input	1	2	Off disables alarm disable

Display

Default: None

di SP Selects one of various displays to be shown while the status input is activated. The choices are:

- **nonE** Display unchanged. No display function selected.
- **LtSt** Lamptest; all display segments light-up showing [**8.8.8.8.8.**].
- **AV** Display the average measurement over **AVti** (see page 59) and since last **rSEt** (see below).
- **HigH** Display the highest measurement since last **rSEt** (see below).
- **LoW** Display the lowest measurement since last **rSEt** (see below).
- **HoLd** Holds the displayed measurement.

Analogue Comms Locations		Read/Write
Analogue	Status Input	Range
86	1	0=None 1=Hold 2=Low 3=High 4=Average 5=Lamptest
87	2	0=None 1=Hold 2=Low 3=High 4=Average 5=Lamptest

Reset

Default: Off

rSEt **on** programs the status input so that a momentary activation:

- Resets the **HigH**, **LoW** and **AV** values to the current display value.

Logic Comms Locations			Read/Write
Logic	63	73	On enables reset function
Status Input	1	2	Off disables reset function

Disable Panel Keys

Default: Off

LoCk **on** programs the status input to disable the keys on the instrument panel while the status input remains activated.

Logic Comms Locations			Read/Write
Logic	64	74	On enables key lock function
Status Input	1	2	Off disables key lock function

Analogue Output Hold

Default: Off

AHLd **on** programs the status input to hold the analogue output level while the status input remains activated.

Logic Comms Locations			Read/Write
Logic	65	75	On enables analogue output hold
Status Input	1	2	Off disables analogue output hold

Zero

Default: Off

2Er0 **on** programs the status input to zero the display when the status input is momentarily activated.

When the display is zeroed, the value displayed becomes zero and the instrument displays measurement changes since zeroing.

Logic Comms Locations			Read/Write
Logic	66	76	On enables zeroing function
Status Input	1	2	Off disables zeroing function

Status Message Display

Default: On

SdSP **on** causes the instrument to display the status messages listed below every 2 seconds, while the status input stays active and it is setup to:

- **ACk** Acknowledge alarms.
- **AdbL** Disable alarms.
- **AHLd** Hold the analogue output.
- **LoCk** Lock the front panel keys.
- **tArE** Tare the display.
- **AV** Display the average measurement over **AVti** (see page 59).
  and since last **rSEt** (see page 52).
- **HigH** Display the highest measurement since **rSEt** (see page 52).
- **LoW** Display the lowest measurement since **rSEt** (see page 52).
- **HoLd** Hold the displayed measurement.

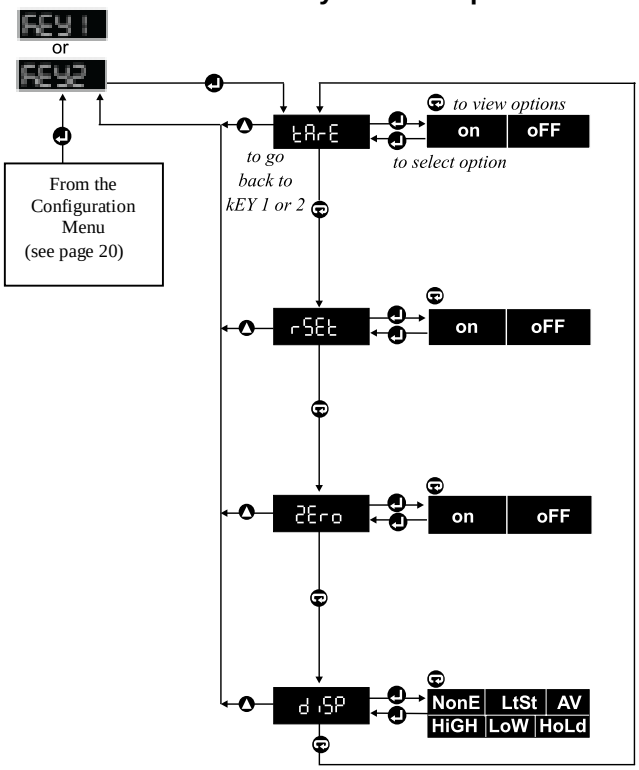
If an alarm is also active, and alarm messages are enabled, both alarm and status messages are displayed in sequence with the displayed value.

Logic Comms Locations			Read/Write
Logic	67	77	On enables status message display
Status Input	1	2	Off disables status message display

Configuring Function Keys

The function key menus allow users to program the optional effects of pressing Function Key 1 and Function Key 2 .

Function Keys Menu Map



Many function key and status input effects are the same.

The following functions may be assigned to either or both keys unless stated:

Tare

Default: Off

 **on** programs the function key to tare the display.

When this function key is first pressed, the display is zeroed. The display continues to show only measurement changes since zeroing, and flashes **tArE** every 2.5 seconds.

When the key is pressed again, the total un-zeroed display is restored.

Logic Comms Locations			Read/Write
Logic	80	85	On enables tare function
Function Key	1	2	Off disables tare function

Reset

Default: Off

 **on** programs the function key to:

- Reset the **HigH**, **LoW** and **AV** values to the current display value.

Logic Comms Locations			Read/Write
Logic	81	86	On enables reset function
Function Key	1	2	Off disables reset function

Zero

Default: Off

 **on** programs the function key to zero the display.

When the display is zeroed, the value displayed becomes zero and the instrument displays measurement changes since zeroing.

Logic Comms Locations			Read/Write
Logic	82	87	On enables zero function
Function Key	1	2	Off disables zero function

Display

Default: None

Selects one of various displays to be shown while the function key remains pressed. The choices are:

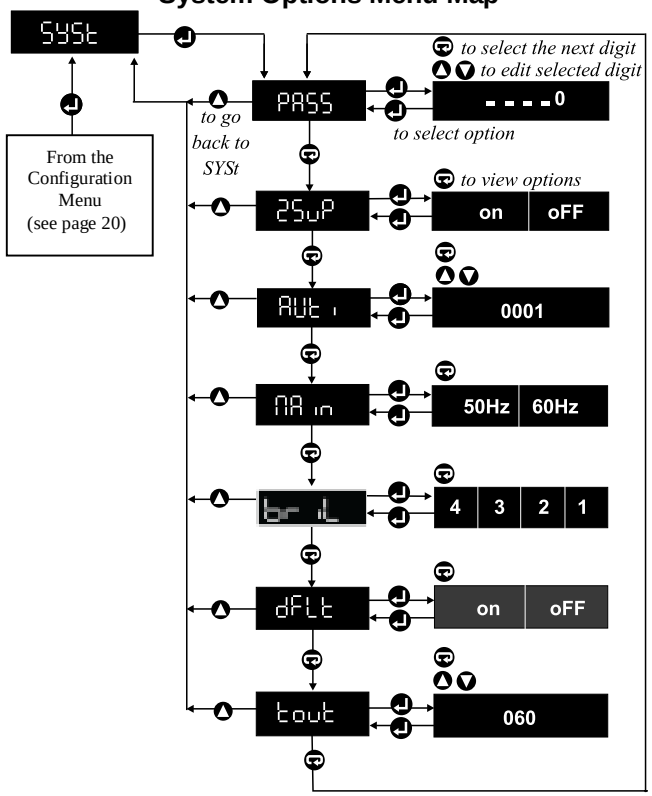
- **nonE** Display unchanged. No display function selected.
- **LtSt** Lamptest; all display segments light-up showing [**8.8.8.8.8.**].
- **AV** Display the average measurement over **AVti** (see page 59) and since last **rSEt** (see page 56).
- **HigH** Display the highest measurement since last **rSEt** (see page 56).
- **LoW** Display the lowest measurement since last **rSEt** (see page 56).
- **HoLd** Hold the displayed measurement.

Analogue Comms Locations		Read/Write
Analogue	Function key	Range
88	1	0=None 1=Hold 2=Low 3=High 4=Average 5=Lamptest
89	2	0=None 1=Hold 2=Low 3=High 4=Average 5=Lamptest

Configuring System Options

This menu configures system wide parameters and performs other miscellaneous actions.

System Options Menu Map



Password

Default: ----0 (disabled)

PASS Defines an optional password. Its value may range from 00000 to 99999. If the password is not 00000, it is requested whenever the instrument enters the **ConF** (configuration) menu.

Password prompts show only the value of one highlighted digit at a time. Other digits, represented by hyphens, can only be viewed and edited by moving the highlight to the digit concerned. This stops anyone seeing the whole password.

DO NOT FORGET THE PASSWORD, OR THE INSTRUMENT SETUP CANNOT BE ACCESSED FROM THE PANEL.

Leading Zero Suppression

Default: On

2SUP **on** enables leading zeros to be suppressed and **oFF** allows leading zeros to be displayed.

Logic 90 Comms Location	Read/Write
On	Leading zeros not displayed
Off	Leading zeros displayed

Averaging Time

Default: 1 second

AVE, Defines the time in seconds over which a simulated rolling average is taken. During normal operation, this average can be viewed by:

a) Activating a status input or function key assigned the **diSP**, **AV** function.
b) Holding the **Enter** Key down when the **AV** option is reached in the **LoW** - **HigH** - **AV** - **ConF** menu (this menu is also reached by holding the **Enter** Key down).

(See also **Display Filtering** on page 26 and **Reset** on pages 52 & 56).

Analogue 90 Comms Location	Read/Write
Averaging time range (seconds)	0 to 9999 0 performs no averaging at all

Mains Frequency

Default: 50Hz

MA in Enables the mains frequency to be set.

Logic 91 Comms Location	Read/Write
On	50Hz
Off	60Hz

Brilliance

Default: 4

br iL Allows the brightness of the display to be adjusted to match other instruments or ambient lighting conditions. The brightness may range 1 (dimmest) to 4 (brightest).

Analogue 24 Comms Location				Read/Write
Integer value	0	1	2	3
Brilliance setting	1	2	3	4

Default

Default is an action, not a setup item

dFLt **on** defaults the instrument's whole setup to the factory defaults shown in this manual in italics to the right of each setup item title. **oFF** leaves the instrument's setup unchanged.

Logic 92 Comms Location	Write-Only
On	Defaults the instrument's setup

Time-out

Default: 60 seconds

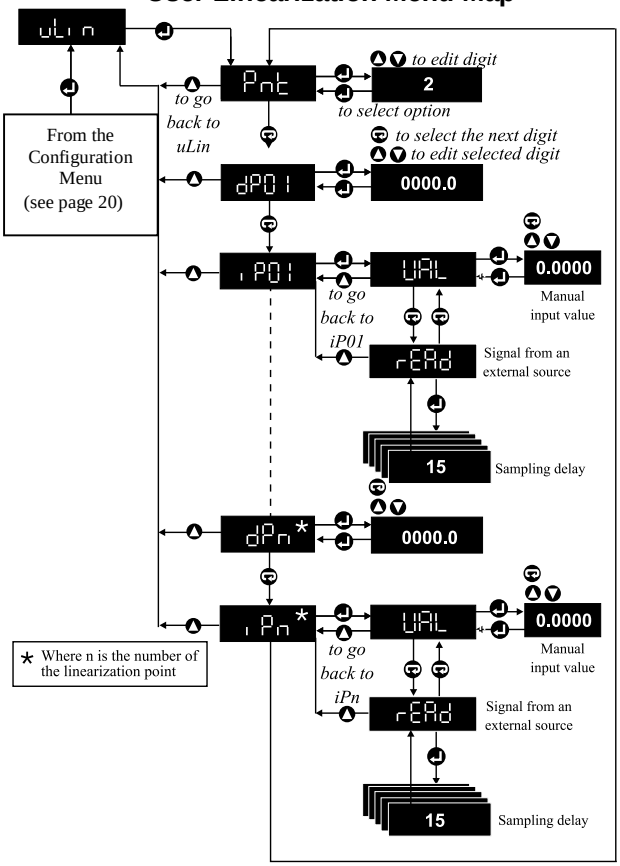
tout Specifies the maximum number of seconds the instrument will wait for a key press before it returns to normal operation from a **ConF** (configuration) sub-menu.

Analogue 91 Comms Location	Read/Write
Time-out range (seconds)	15 to 255

The **SCLE** (scale) sub-menus do not time-out.

Configuring User Linearization

User Linearization Menu Map

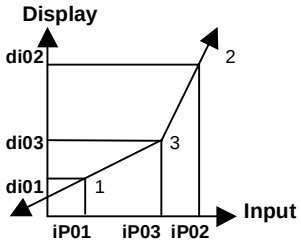


The instrument can automatically linearize most types of thermosensor signals, as long as the **rng** (range) parameter (see **Range** page 22) has been correctly set within the **inPt** (input) menu.

If the range required by your sensor is not one of those provided, you must set the **rng** parameter to **uLin** and use the user linearization facility described here to define a non-linear relationship between the input and the display.

If the relationship between signal input and displayed value is linear, you should use the scaling facility (see **Scaling** page 27) rather than the user linearization facility to define it.

Up to 24 calibration points may be defined in terms of sensor input and the corresponding displayed value. A 3-point relationship is illustrated below:



Notice that:

- The points do not need to be declared in any order, the last point declared may lie between 2 other points. The instrument joins the points in order of ascending input as illustrated.
- The input value may not be the same for 2 or more points.
- The display value may be the same for 2 or more points.

If user linearization is changed via comms, the instrument must be told when to use the new setup by setting Logic Location 93 On.

Number of Points

Default: 2

PnE Defines the number of user linearization points. This may range from 2 to 24. 2 points would define a linear scale.

Analogue 100 Comms Location	Read/Write
Integer range	2 to 24

Display Values

Default: 0

d.01 to d.08 Define the displayed value corresponding to the input value for the point. Together **di01** and **iP01** define Point 1. Similarly **di02** and **iP02** define Point 2, etc.

Display values may be any value in the displayable range. This is dictated by the decimal places (see **Decimal Point Position** page 23).

Analogue Comms Locations								Read/Write
Analogue	101	103	105	107	109	111	113	115
Display value	di01	di02	di03	di04	di05	di06	di07	di08
Analogue	117	119	121	123	125	127	129	131
Display value	di09	di10	di11	di12	di13	di14	di15	di16
Analogue	133	135	137	139	141	143	145	147
Display value	di17	di18	di19	di20	di21	di22	di23	di24

Input Values

Default: 0

iP01 to iP08 Define the input value corresponding to the displayed value for the point. Together **di01** and **iP01** define point 1. Similarly **di02** and **iP02** define point 2, etc.

Input values are expressed in mV, mA or V. They represent the signal from the sensor. The input value can be specified using **VAL** or measured using **rEAd** .

VAL Enters the input value manually via the front panel keys. To select **VAL**, press **Enter** when **VAL** is displayed. The existing input value for the point is presented for editing. The value given should be expressed to as many decimal places as possible.

rEAd Samples the sensor output. To **rEAd**, the output from the sensor should be applied before pressing **Enter** to begin a read. To read via comms:

- Apply the input.
- Set Analogue Location 149 to input to be sampled, eg. to read **iP02** (Input 2).
- Set Logic Location 98 to On to begin sampling.
- Sampling is complete when Logic Location 98 reads as Off.

Analogue Comms Locations								Read/Write
Analogue	102	104	106	108	110	112	114	116
Input value	iP01	iP02	iP03	iP04	iP05	iP06	iP07	iP08
Analogue	118	120	122	124	126	128	130	132
Input value	iP09	iP10	iP11	iP12	iP13	iP14	iP15	iP16
Analogue	134	136	138	140	142	144	146	148
Input value	iP17	iP18	iP19	iP20	iP21	iP22	iP23	iP24

If setup via comms, Logic Location 93 must be set to On to make the instrument use the new setup.

Product Specification

Power Requirements

Standard Units	90V AC to 265V AC 7 to 10VA. Typically Ω 40mA @ 250V AC.
Low Voltage Units	10V AC to 32V AC rms 7 to 10VA. 12 to 28V DC.

Operating Conditions

Ambient Temperature	Storage -10°C to 70°C. Operating 10°C to 50°C.
Humidity	10% to 95% RH non-condensing.

Display

Type	0.56" high brightness 7 segment LED red or green.
Range	-19999 to +99999 (5 digit models). -1999 to + 9999 (4 digit models).

A/D Converter

Type	Dual slope integrating converter.
Conversion Rate	10Hz (10 conversion/s).
Converter Resolution	16bits + sign (1μV).
Common Mode Rejection	>150dB.
Series Mode Rejection	>70dB (50Hz or 60Hz).
Drift	50ppm/°C.

Voltage Inputs

Ranges	±100mV. ±10V.
Accuracy	0.05% reading ± 20μV.
Resolution	100mV range 1.52μV. 10V range 152μV.
Input Impedance	mV input >10MΩ. 10V input >1MΩ.

Current Input

Range	±20mA.
Accuracy	0.05% reading ±4µA.
Resolution	0.5µA.
Input Impedance	5Ω typical.
Maximum Burden	±100mV typical.

Reference Junction Compensation

Accuracy	±0.5°C.
Resolution	0.1°C.

RTD/Resistance Thermometer Inputs

Input Configuration		2, 3 or 4-wire.	
Excitation Current		0.25mA typical.	
Ranges	Resistance	0 - 400Ω.	
		Accuracy	0.4Ω.
		Resolution	0.01Ω.
	Resistance	0 - 4000Ω using 10V input (2-wire).	
		Accuracy	0.5%.
		Resolution	1Ω.

Sensor Type	Range	Accuracy (±)	Code
Pt100 (alpha = 385) (BS1904 : 1984)	-200°C to 850°C	0.5°C	P100
Pt100 (alpha = 392)	-100°C to 457°C	0.5°C	d100
Pt130 (B.S.2G.148)	-200°C to 500°C	0.5°C	P130
Ni100 (DIN 43760)	-60°C to 250°C	0.5°C	n100

Thermocouple Inputs

Sensor Type	Range	Accuracy(±)	Code
Type B (Pt30%Rh/Pt6 %Rh) (BS 4937 part 7)	0°C to 1820°C linearization from 400°C	1.5°C	b
Type C (W5%Rh/W26%Rh)	0°C to 2320°C	1°C	C
Type D (W3%Rh/W26%Rh)	0°C to 2320°C	1°C	d
Type E (NiCh/CuNi) (BS 4937 part 6)	-270°C to 1000°C	0.5°C	E
Type G (W/W26%Rh)	0°C to 2320°C	1°C	g
Type J (Fe/NiCu) (BS 4937 part 3)	-210°C to 1200°C	0.5°C	J
Type K (NiCh/NiAl) (BS 4937 part 4)	-270°C to 1372°C	0.5°C	k
Type L (Fe/Con) (DIN 43710)	-200°C to 900°C	0.7°C	FEC
Type N (Nicrosil/Nisil) (BS 4937 part 8 : 1986)	-200°C to 1300°C	0.5°C	n
Type R (Pt13%Rh-Pt) (BS 4937 part 2)	-50°C to 1767°C	1°C	r
Type S (Pt10%Rh-Pt) (BS 4937 part 1)	-50°C to 1767°C	1°C	S
Type T (Cu/CuNi) (BS 4937 part 5)	-270°C to 400°C	0.5°C	t
Type U (Cu/CuNi) (DIN43710)	-200°C to 400°C	0.7°C	u
Ni/Ni 18%Moly	0°C to 1370°C	1°C	n/Mo
Platinel II	0°C to 1370°C	1°C	Plt2
Palaplat	0°C to 240°C	1°C	PALP

Thermosensor Break Detection

On or off, up or downscale.

Transducer/Transmitter Supply

Outputs	24V unregulated transmitter power supply. 10V fixed transducer supply (4 digit models). 0 - 12V programmable transducer supply (5 digit models).
Resolution	0.01V.
Accuracy	±0.05V (programmable supply). ±0.2V (fixed supply).
Temperature Drift	<100ppm / °C.
Output Ripple	<5mV.
Update Rate	30Hz.
Output Current	35mA maximum total load current.

Analogue Output

Ranges	0 - 10V, 0 - 20mA or 4 - 20mA.
Accuracy	0.2% of span.
Temperature Drift	100ppm / °C.
Update Rate	30Hz.
Output Ripple	< 10mV or <50µA at <30Hz.
Response	63% within 32ms. 99% within 100ms. Output damping programmable.
Resolution	0.05% of span 5mV or 0.01mA.
Maximum Output	18V @ 25mA.

Alarms/Relays

Alarms	4 off programmable low, high or deviation.
Relays	2 off change over (if fitted).
Contact Rating	1A @ 250V.

Communications Interface

Type	EIA RS485 (RS 422 Compatible).
Isolation	500V DC / Peak AC.

Appendix A - Display Messages

Error Messages

brkd The input circuit has broken. The break sense detection option has been set to "down".

brku The input circuit has broken. The break sense detection option has been set to "up".

undr The measured value is too large negatively to be displayed on the instrument, or is below the specified range for the connected sensor.

oUEr The measured value is too large positively to be displayed on the instrument, or is above the specified range for the connected sensor.

Err1 Err2 Err3 Indicate an error occurred accessing the instrument's memory. The unit should be returned to your supplier.

Alarm Messages

Alarm messages are 3 letters followed by the alarm number. The codes are:

HiA1 HiA2 HiA3 HiA4 High alarm. Eg. **HiA4** indicates high Alarm 4 has been activated.

LoA1 LoA2 LoA3 LoA4 Low alarm.

Hid1 Hid2 Hid3 Hid4 High deviation alarm.

Lod1 Lod2 Lod3 Lod4 Low deviation alarm.

When more than one alarm is activated, messages are prioritised so the highest high alarm or the lowest low alarm is reported.

uCAL The instrument has lost its factory calibration constants in non-volatile memory. Could be non-volatile memory failure. Return unit to factory.

Appendix B - Connecting the Serial Interface

Four instrument Terminals: 10, 11, 12 & 13 are used for serial communications. These can be used to establish a 2-wire or 4-wire RS485 connection with a master device (usually a PC). The interconnecting wires are collectively known as a "BUS".

A strict rule governs how the bus is routed. Obviously it must be connected from the master to one instrument, but if there is a second instrument, the bus should continue only from the terminals of the first instrument to the second. Similarly, if there is a third instrument, the bus should continue only from the terminals of the second instrument to the third, and so on. This is called a "multidrop bus". There should be no T-junctions in the bus.

A 120Ω resistor should be connected between Terminals 10 & 11 on the last instrument furthest from the master.

Half Duplex - 2-Wire Communications

One of the bus wires must be connected to Terminals 10 & 12 of each instrument, and the other wire must be connected to Terminals 11 & 13 of each instrument as described above.

A 2-wire bus can communicate in only one direction at a time. So the direction of communication is controlled by the master. Masters must:

a) Know how to switch from transmit to receive (RTS goes low).
b) Avoid switching to receive before transmit is finished.
c) Avoid switching to receive after some/all of the reply is missed.

For example, Windows Terminal transmits via a 2-wire bus okay, but the instrument's replies are not received because the terminal does not know it should switch from transmit to receive, or how, or when.

Full Duplex - 4-Wire Communications

One bus wire must be connected to Terminal 10 of each instrument, the second wire to Terminal 11, the third wire to Terminal 12, and the fourth

wire to Terminal 13 of each instrument, as described above.

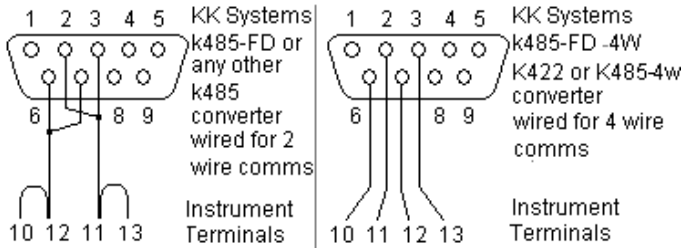
One pair of wires is used for transmitting and the other pair listens. This avoids the problems of how and when to switch from transmit to receive as described above.

4-wire links are useful for experimenting with the Windows Terminal

The instruments have an RS485/RS422 compatible interface with the additional ability to release the instrument-to-master communication channel when not transmitting. This allows other instruments wanting to transmit to do so.

PC Setup Program

The program runs on a PC running Windows 3.1, 95 or NT4.0 or later. It transmits and receives whole setups between the PC and an instrument. The setups can also be saved and retrieved from disk. The program automatically adapts to a 2 or 4-wire bus. Only a KK Systems K485-FD, wired as shown below, is recommended with the program:



KK Systems can be contacted by telephone on +44 (0) 1273 857 185.

Appendix C - Using the Native Communications Protocol

Throughout this Guide, analogue and logic locations corresponding to setup parameters have been documented. These locations can be read and written to via the serial interface. All locations can be write-protected by setting **Prot** to **on** in the **CoMM** (communications) menu (see page 47). Some read-only locations, eg. the displayed value, can never be written to via comms.

Listings in location order are given in the index.

Command Structure

Here is an example of a command sent to an instrument:

;001 SA 54 2<CR><LF>

and here is the normal reply:

OK<CR><LF>

This is what each piece of the command does (and each piece must be present):

; Start of the command.

01 Instrument Address
May range from 000 to 247. There must always be 3 digits. These 3 digits must match the instrument's address as setup in the **CoMM**, **Addr** (communications, address) menu. 000 can only be used in write commands to broadcast to all instruments simultaneously.

<space> This space character after the Address is optional.

SA Action

SA = Store Analogue	RA = Read Analogue
SL = Store Logic	RL = Read Logic

54 Data Location
May range 0 to 255. Some locations are not used. Unused analogue locations only read/write as 0.0000. Unused logic locations only read/write as Off.

<space>

2 Data
For read commands RA and RL, this is the number of consecutive parameters to read from the instrument.
For write commands, it is the data to be written. If more values follow, separated by spaces, these are written to consecutive data locations following the Data Location. If an error occurs during a multiwrite, only writes up to the error are completed.
For logic writes only, the data may only be On or Off.

Eg. **;001 SL 154 ON<CR><LF>**

<CR> End-of-line carriage return
(ASCII 13 decimal).

<LF> Linefeed
(ASCII 10 decimal).

Here is an example of a read command which reads **4** analogues from Location **0**:

;001RA0 4<CR><LF>

and here is the reply:

+244.00 -3723.5 -03723 ?99999<CR><LF>

The **?99999** indicates the value was over range. **?19999** would indicate an under range value (see **Troubleshooting Comms** page 77).

Errors

#1 Invalid command action, only SA, SL, RA, RL allowed. Check address field is 3 digits. Also check you have not used On or Off as data for a Store Analogue command. Ensure numeric data, eg. 0, or 1 has not been used in a Set Logic SL command.

#2 Attempted a write to a read-only or protected location. Some locations are permanently read-only. However, this message also occurs for any location if the **Prot** option in the **Comm** menu has been turned **on** (see page 47).

#3 Data location specified does not exist. Start location or number of locations could be invalid.

#4 Invalid data value, or no space before the data value, or syntax error.

#5 Attempt to change a location while instrument is in the **ConF** (configuration) menu. Instrument will normally exit from menu after one minute (default).

#7 Attempted to write to write a non-zero value to an unused location.

Appendix D - Realtime Comms Locations

(RO indicates location can be Read-Only, RW indicates Read/Write)

Analogue Locations

0	RO	Instrument type, ie. +221.00, 222.00, 223.00 or +224.00 or +265.00.
1	RO	Measured value unfiltered.
2	RO	Displayed value filtered.
3	RO	Low display value (minimum peak since reset - see **Reset** pages 52 and 56).
4	RO	High display value (maximum peak since reset - see **Reset** pages 52 and 56).
5	RO	Average display value (over **AVti** - see **Averaging Time** page 59).
6	RO	Zero offset in display units (+0.0000 if display is not zeroed).
7	RO	Tare offset in display units (+0.0000 if display is not tared).
16	RO	Source of displayed value when display sourced from comms (ie. when Analogue Location 8 is set to 7 - see **Type** page 22).

Logic Locations

Status

18	RO	Alarm 1 state	On = activated.
23	RO	Alarm 2 state	On = activated.
28	RO	Alarm 3 state	On = activated.
33	RO	Alarm 4 state	On = activated.
40	RO	Relay 1 alarm state	On = abnormal.
45	RO	Relay 2 alarm state	On = abnormal.
68	RO	Status Input 1 state	On = contacts closed.
78	RO	Status Input 2 state	On = contacts closed.
83	RO	Function Key 1 (leftmost key) state	On = pressed.
88	RO	Function Key 2 (rightmost key) state	On = pressed.

Commands

0	RW	On Performs the reset function (see **Reset** pages 52 and 56).
1	RW	On Resets the high value (maximum peak) to the current display value.
2	RW	On Resets the low value (minimum peak) to the current display value.
3	RW	On Resets the average value to the current display value.
26	RW	On Acknowledges any/all active latched alarms.
94	RW	On Zeros display.
95	RW	On Unzeros display (not recommended: use Tare/Untare instead).
96	RW	On Tares display.
97	RW	On Untares display.

Appendix E - Troubleshooting Comms

1. When using 2-wire comms with a KK Systems converter on a PC serial port, it is necessary to:

   a) Assert the RS232 RTS output in order to TRANSMIT.
   b) Send the command and monitor its progress in order to:

      i) Clear the RTS immediately after the **<LF>** has been sent, and
      ii) Only then, read the reply from the instrument.

2. When checking for an **OK** response, look for **K** anywhere in the response and not just in a set position. Garbage can precede it.

3. When a reply is out of range, the first character is a question mark.

4. Early evaluation instruments have comms Terminals 10 & 11 and Terminals 12 & 13, the wrong way round. These are "Issue B" instruments. The revision letter can be seen by removing the circuit from its case and looking along the back edge of the circuit board.

5. If you are having difficulty with comms, try sending a command which resets the instrument, such as:

   ;001 SL 155 ON<CR><LF>

   This way, it is possible to tell if the instrument is receiving okay even if it cannot transmit. This may narrow down the possible reasons for the problem. This test can be performed using Windows Terminal (not Hyperterminal). Terminal will never be able to show responses from the instrument if connected in 2-wire mode. In this case, if the above test passes, it is likely comms between instrument and PC are okay. Terminal must be setup to match the instrument comms setting which defaults to:

Communications:

- Baud: 9600.
- Parity: Even.
- Stop bits: 1.
- Parity check: [Yes].
- Comm port: (As applicable).
- Flow control: None.

Terminal Preferences:

- **CR →CR/LF outbound, enabled**

6. The most common comms problems are:

a) Connected to the wrong comm port or not connected at all!
b) Setup mismatch. Baud, parity, stop bits different. Make sure the address in the command match the **COMM**, **Addr** of the instrument. If using MODBUS™ RTU, ensure Parity = none, Stop bits = 1.
c) Incorrect wiring. Wires of a pair the wrong way round; whole set of 4 wires shifted along one terminal position; terminals not screwed up tightly, wire dropped off fragile home-made cable.
d) RTS (at master RS232 end) not asserted when master transmits, or cleared when master is to receive (2-wire comms).
e) Comms converter has inadequate supply. Self-powered converters require DTR to be high. If laptop used, ensure POWER.EXE is DISABLED.
f) 120Ω resistor not fitted across Terminals 10 & 11 of last instrument in daisy chain.

NOTE: The instruments' use of the MODBUS™ protocol differs from the norm in that there is no requirement to subtract one from a data location accessed.

Eg. If x is the data location to access, specify location x and not x-1.

Index

A

C

D

E

F

H

I

K

M

N

O

P

R

S

T

U