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.
- Scaleable analogue retransmission output.
- Dual logic/status inputs.
- RS485 serial communications interface with 3 protocols including MODBUS™ RTU.
- 5 digit bright LED display.
- Programmable function keys.
- Optional dual relay output or quad digital (TTL) outputs.
- High speed analogue output.

Installation

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

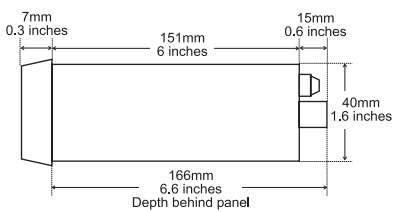
- Apply the engineering units label to the right-hand side of the display panel. A sheet of labels covering the most commonly used engineering units is supplied with all units. If the unit you require is not on the sheet, a blank label is provided on which you can use LETRASET™.
- Install the instrument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

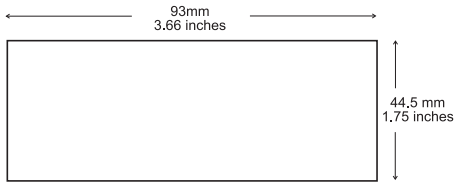
Panel Mounting

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.

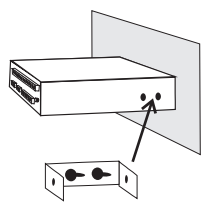


2. Fit the rubber seal by slipping it over the unit from the rear of the box and pushing it forwards until it sits behind the front lip of the unit.

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.

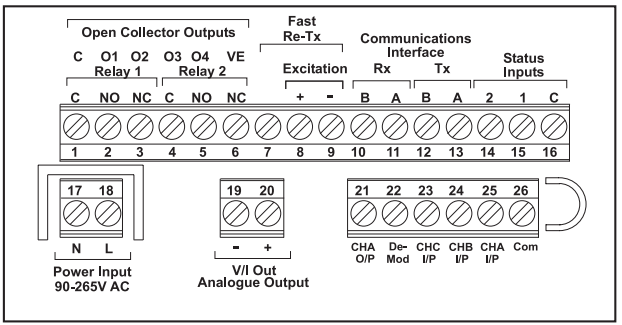
5. Tighten the screws until they bite into the panel, securing the instrument in place. Take care not to overtighten the screws as this may damage the case of the instrument.



Connections

The diagram below shows the rear panel terminal connection arrangement.

NOTE: Terminals 1 to 6 are not used on some models (see the table on page 7).



Rear Panel Terminal Connections

Terminal	No Alarm	Dual Relays	Quad TTL
1	None	Relay 1 - Common	Output GND
2	None	Relay 1 - Normally Open	Output 1
3	None	Relay 1 - Normally Closed	Output 2
4	None	Relay 2 - Common	Output 3
5	None	Relay 2 - Normally Open	Output 4
6	None	Relay 2 - Normally Closed	Output supply
7	Fast analogue retransmission		
8	Excitation +ve		
9	Excitation -ve		
10	Receive B		
11	Receive A		
12	Transmit B		
13	Transmit A		
14	Status (Logic) Input 2		
15	Status (Logic) Input 1		
16	Status input common (GND)		
17	Power input neutral (-)		
18	Power input live (+)		
19	Analogue retransmission output -		
20	Analogue retransmission output +		
21	CHA output		
22	De-modulation input		
23	CHC input		
24	CHB input		
25	CHA input		
26	Input common		

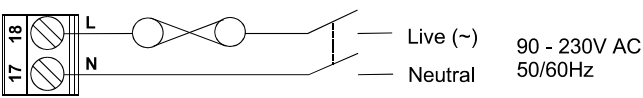
Powering the Instrument

THERE ARE 2 SUPPLY VARIANTS: a mains supply variant and a low voltage supply variant. The instrument is designed to operate from either an AC supply with voltages in the range 90 to 230V AC 50/60Hz mains supply or from a DC supply with voltages in the range 24 to 32V DC (20 to 30V AC) 50/60Hz low voltage supply with a maximum power consumption of 20VA when all outputs are fully loaded and the display has all segments illuminated.

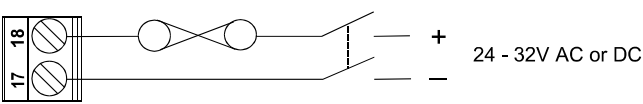
The diagrams below show how the instrument should be connected to the mains supply. Isolation should be provided by a double pole switch and a time delay 200mA fuse.

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.

Recommended Mains Supply Connections



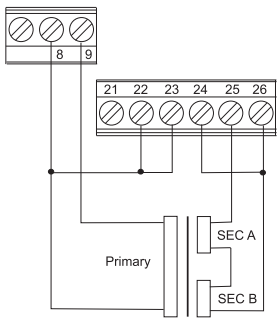
Recommended Low Voltage Supply Connections



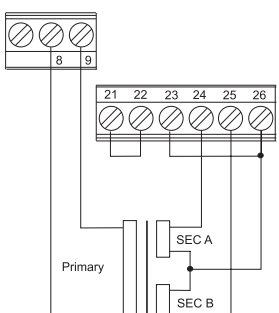
BEFORE POWERING UP THE INSTRUMENT, check the model label on the underside of the instrument for the supply variant, eg. MAINS OR LOW VOLTAGE.

Connecting the Transducer

The transducer should be connected to the instrument as illustrated in the diagrams below. The instrument is designed to operate with a wide range of LVDTs. Refer to the documentation supplied with your LVDT for the correct configuration and connection details. Your instrument provides a programmable excitation for the LVDT and supports 3 measurement configurations. Refer to **Appendix B** page 71 for an explanation of the different measurement configurations.



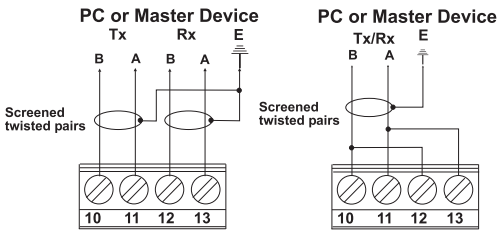
Secondary Only (SEC) &
Secondary to Primary Ratiometric (S/P) Connections



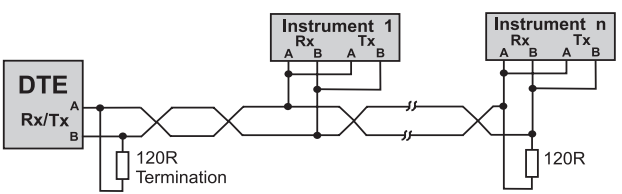
Secondary to Secondary Ratiometric (S/S) Connections

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

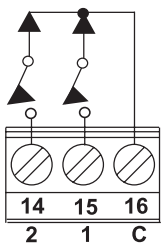


Typical RS485 Multidrop Half Duplex Application

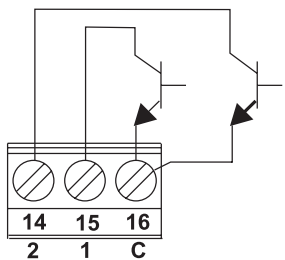
Connecting the Status Inputs

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.

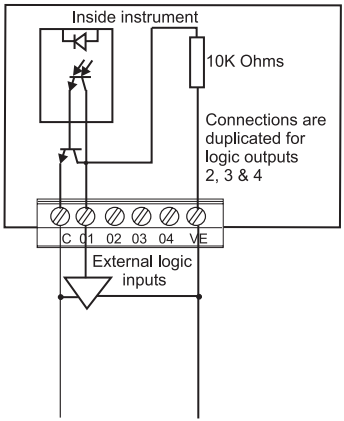


Volt Free Contacts

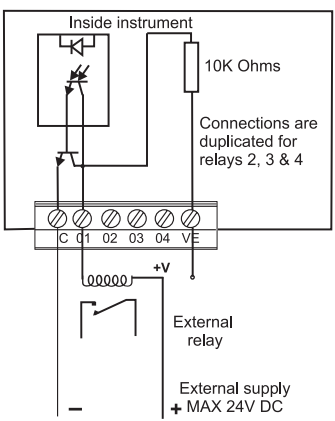


Open Collector TTL Outputs

Connecting the Logic Outputs



Connecting to External Logic Inputs



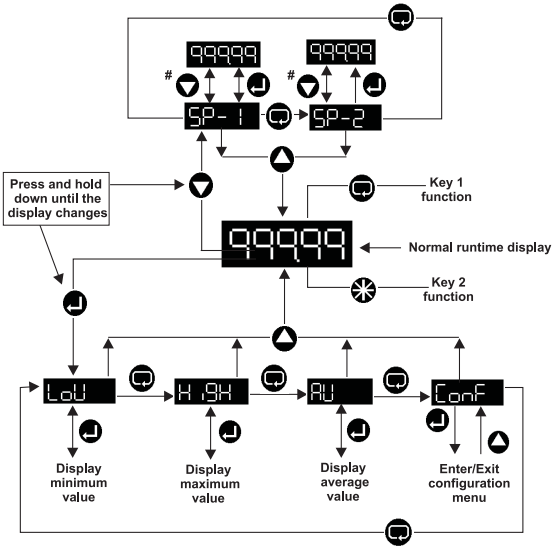
Connecting to External Relays

High Speed Analogue Output

A buffered DC output of the demodulated LVDT input signal, derived from CHA is provided by the instrument. The output level is dependent upon the transducer excitation and the sensitivity of the LVDT. The output is not calibrated or scaleable and it is recommended that it is used for diagnostic purposes only. To connect the high speed analogue output, connect Pin 7 + and Pin 9 -. Note that this output is not isolated from the LVDT.

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 or Key to edit (provided the alarm edit option is **on** - see **Front Panel Edit** page 40).

SP-1 SP-2 SP-3 SP-4 Represent Alarm Setpoints 1 - 4.

LoU Displays the lowest measured value since last reset (see **Reset** pages 56 and 60).

Displays the highest measured value since last reset (see **Reset** pages 56 and 60).

Displays the average measured value since last reset (see **Reset** pages 56 and 60).

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 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 59).

Down - Accesses the 4 alarm and 2 control setpoints for viewing and editing if enabled (see **Front Panel Edit** page 40).

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 59).

Up and **Down** - Pressed together will perform an alarm acknowledge for latched alarms (see **Latching** page 37 and **Alarm**

Acknowledge page 55) 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. **diSP**, **inPt**, **nuLL**, **CAL**, **SCLE**, **Aout**). Selecting a category may lead to a sub-category, but eventually it leads to a list of configurable instrument *parameter*s (eg. category **Aout** leads to parameters **tYPE**, **SorC** 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 of settings (eg. parameter **tYPE** has 3 settings: **0 - 10**, **4 - 20**, **0 - 20**).

Other parameters are setup by editing a multi-digit value (eg. **LoW** has a default numeric setting of [**0000.0**]).

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  .

2. Press  until  is displayed.

3. Press  to enter the **ConF** (configuration) menu.

4. Press  until  is displayed.

5. Press  to enter the **diSP** (display) menu.

6. Press  to cycle through the sub-menus of the **diSP** menu until  is displayed.

7. Press  to enter the **briL** (brilliance***)*** menu. You will know that you have successfully entered the Edit Mode if a flashing figure is displayed. This will be the currently set value for this option.

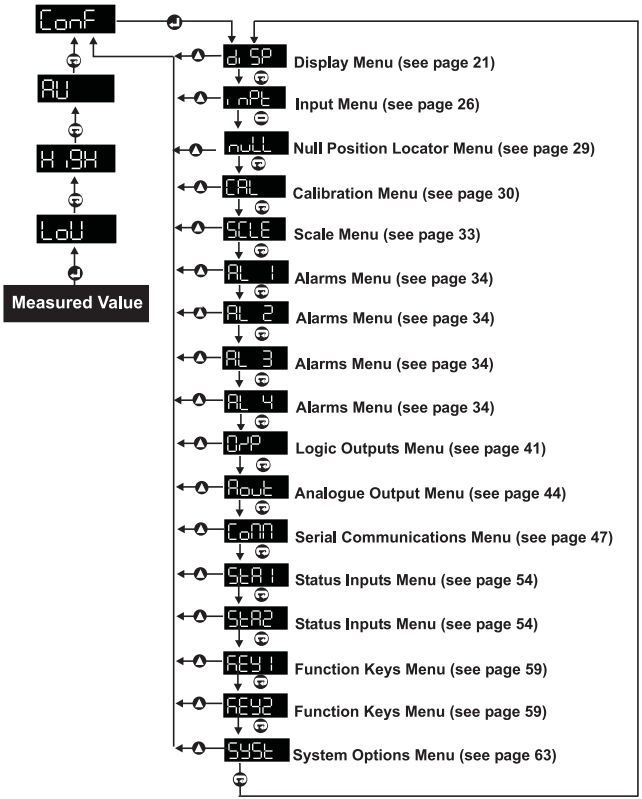
8. In the case of brilliance, there are 4 options, each numbered 1 to 4 (*the default is 4*). Press the  Key to cycle through the options available to you.

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.

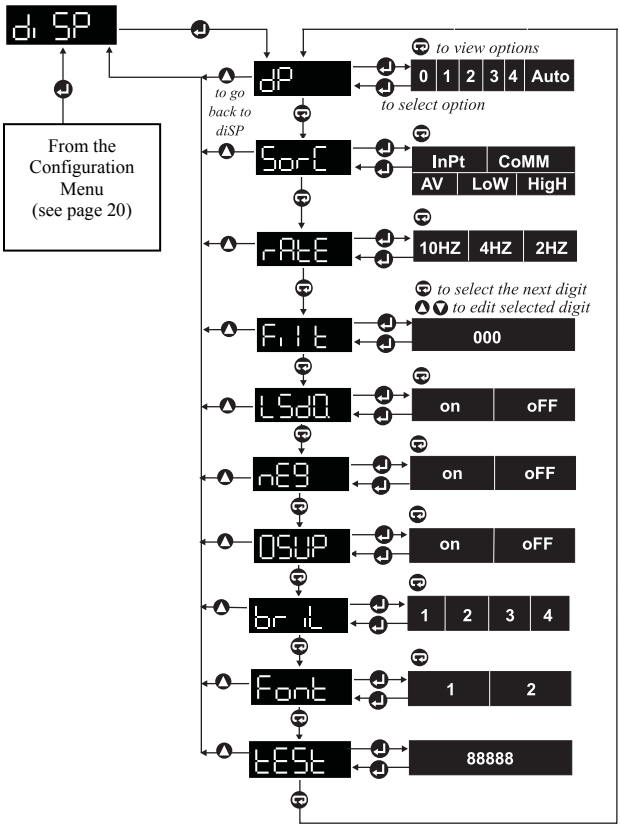
Configuration Menu Map



Configuring the Display

This menu sets up the instrument's display attributes.

Display Menu Map



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:

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	Auto

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

Analogue 54 Comms Location	Read/Write
Integer range	0 to 5 (5=Auto)

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 35).
- Alarm on-hysteresis and off-hysteresis (see page 38).
- Analogue output low and high scale points (see page 46).
- Comms low and high scale points (MODBUS™ only) (see page 49).

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.

Display Value Source

Default: Input

SorC Defines the source of the displayed value. The options are:

- **inPt** The measured input value.
- **HigH** The maximum measured input value.
- **LoW** The minimum measured input value.
- **AV** The average measured input value.
- **CoMM** The value received from the communications interface.

The time over which the average value is taken is specified in the **AVti** (average time) option in the **SYSt** (system) menu (see **Averaging Time** page 64).

When set to **CoMM**, the display value is taken from Analogue Location 3. For example, a SCADA system can read the measured displacement from the instrument via Analogue Location 1, perform some operation on the value and send the processed value back to the instrument for display via Analogue Location 3.

Analogue 53 Comms Location					Read/Write
Analogue value	0	1	2	3	4
Display source	Input	High	Low	Average	Comm

Eg. Sending **;001SA53 0 <CR>** via comms, sets the display source to input.

Update Rate

Default: 2Hz

rAtE Allows the update rate of the display to be set from 10Hz to 2Hz. The 10Hz update rate may vary from 7Hz to 10Hz.

Analogue 55 Comms Location			Read/Write
Analogue value	0	1	2
Update rate	2Hz	4Hz	10Hz

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 from 0 to 999. 0 disables the filter (see also **Averaging Time** page 64).

Analogue 56 Comms Location	Read/Write
Integer range (seconds)	0 to 999

Least Significant Digit Zero

Default: Off

LSd0 **on** enables the right-hand digit to be displayed as 0. For example, 14.567 will be displayed as 14.570 when **LSd0** is **on**.

Logic 49 Comms Location	Read/Write
On	Least significant digit displayed as 0
Off	Normal display

Negative Numbers

Default: On

nEG **on** allows the display of negative numbers. When **oFF**, negative numbers are displayed as 0.

Logic 50 Comms Location	Read/Write
On	Negative values displayed
Off	Negative values displayed as 0

Leading Zero Suppression

Default: On

oFF allows leading zeros to be displayed.

Logic 48 Comms Location		Read/Write
On	Leading zeros not displayed	
Off	Leading zeros displayed	

Brilliance

Default: 4

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

Font

Default: Off

Selects one of 2 fonts for the display of numerals.

Logic 47 Comms Location		Read/Write
Off	Font 1	976
On	Font 2	976

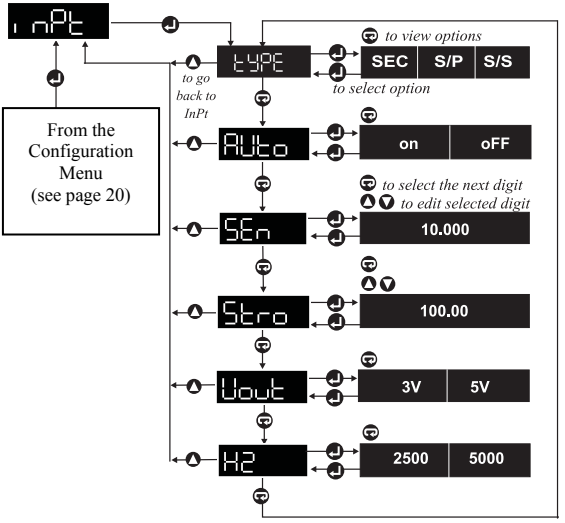
Test

Performs a display test that illuminates all display digits and segments (**8.8.8.8.8.**) when the **Enter** button is pressed. Press **Enter** again to proceed.

Configuring the Input

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

Input Menu Map



Input Type (Measurement Mode)

Default: SEC

tYPE Enables the correct measurement configuration for the your application and LVDT to be selected. The options are:

- Secondary Only (**SEC**).
- Secondary to Primary Ratiometric (**S/P**).
- Secondary to Secondary Ratiometric (**S/S**).

A more detailed explanation of each of the Measurement Modes can be found in **Appendix B** page 71.

Analogue 62 Comms Location			Read/Write
Analogue value	0	1	2
Input type	SEC	S/P	S/S

Setting Input Gain

There are 2 methods of determining the gain used by the instrument for measurements and calibration:

- The gain can be determined automatically by the instrument at the time of calibration by setting the **AUto** (automatic gain selection) option from the **inPt** menu to **on**.
- The **SEn** (sensitivity) and **Stro** (stroke) of your LVDT can be entered from the **inPt** menu. This data will normally be supplied with your LVDT. The sensitivity of the LVDT is normally quoted in mV/V/mm and is entered in this form. The stroke is set in mm and is the measurement range of the LVDT.

Automatic Gain Selection

Default: Off

AUto Allows the instrument to set its gain automatically by determining the sensitivity of the attached LVDT during calibration. This option may be enabled (**on**) or disabled (**oFF**).

A more detailed explanation of how this works can be found in **Appendix C** page 73.

Logic 57 Comms Location	Read/Write
Off	Manual gain
On	Automatic gain

Sensitivity

Default: 10mV/V/mm

SEn Allows the gain of the measurement input of the instrument to be determined from the specified sensitivity of the LVDT. Details of the sensitivity of your LVDT should be in the documentation supplied by the

manufacturer. The sensitivity is entered directly as a value in mV/V/mm (note any unit of length can be used as long as the same units are used for the stroke and sensitivity, eg. sensitivity could be mV/V/thou if the stroke is specified in thou). This menu option is not accessible when **AUto** is **on**.

Analogue 63 Comms Location	Read/Write
Range (mV/V/mm)	-19999 to 9999

Stroke

Default: 100mm

Stro Allows the stroke of the LVDT to be entered as a value directly in mm (note any unit of length can be used as long as the same units are used for the stroke and sensitivity, eg. sensitivity could be mV/V/thou if the stroke is specified in thou). This is used by the instrument in conjunction with the LVDT sensitivity to determine the appropriate gain setting. This menu option is not accessible when **AUto** is **on**.

Analogue 64 Comms Location	Read/Write
Range (mm)	-19999 to 9999

Excitation Voltage

Default: 3V

Vout Enables the correct output excitation voltage for the LVDT to be selected. The appropriate voltage will be specified in the LVDT documentation. The options are 3V AC and 5V AC (rms).

Logic 56 Comms Location	Read/Write
Off	3V
On	5V

Excitation Frequency

Default: 2.5kHz

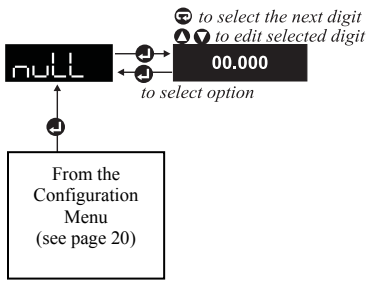
H2 Sets the correct excitation frequency as specified in the LVDT documentation. The options are 2500Hz or 5000Hz.

Logic 55 Comms Location	Read/Write
Off	2.5kHz
On	5kHz

Null Position Locator

It is important that the LVDT operates around the midpoint of its stroke as this gives the best results by minimising any errors due to non-linearity. A feature of this instrument, is the ability to locate the midpoint of the LVDT's measurement range (null point). To do this, select **nuLL** from the main menu and a value will be displayed (flashing). The nearer the value to zero, the nearer the LVDT is to its null position. The LVDT should be mounted so that the required measurement range transverses the null point approximately equally.

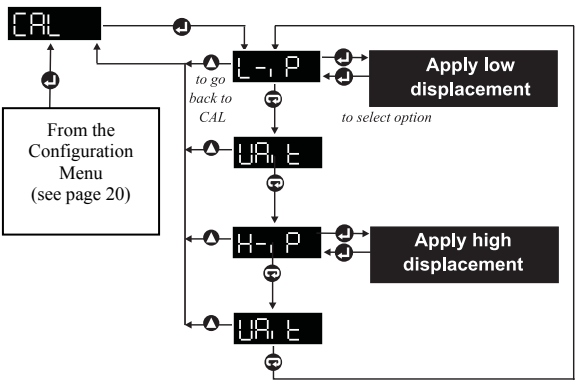
Null Position Locator Menu Map



Calibration Sequence

Use this facility to calibrate the instrument to a known displacement. Before the instrument can measure displacement accurately, it must know exactly what output from the LVDT corresponds to 2 known displacements.

Calibration Menu Map



LVDT output CAL (calibration) menu	Displacement represented SCLE (scale) menu
L-,P low input	LoSP low display
H-,P high input	HaSP high display

The calibration procedure prompts for the LVDT to be set to a known displacement: firstly the low known displacement (**L-ip**), and secondly, the high known displacement (**H-ip**). The instrument is recalibrated to the displacements only if the displacements are acceptable. If they are unacceptable (over range or equal), the calibration is unchanged. The 2 points (displacements of the LVDT) used to calibrate the instrument

should be as different as possible, ideally, the maximum stroke of the LVDT.

NOTE: For best results, power the system for a minimum of 30 minutes before calibrating to allow the LVDT and instrument to stabilise.

To access the **CAL** prompt from Normal Operating Mode:

1. Press the **Enter** Key and hold down for approximately 3 seconds until **LoW** is displayed.

2. Press the **Next** Key 3 times until the **ConF** (configuration) menu is displayed.

3. Press the **Enter** Key once to access the **ConF** menus.

4. Press the **Next** Key twice until **CAL** is displayed.

To calibrate the instrument:

1. CAL Press **Enter** to begin the **CAL** procedure.

2. L-1 P Apply low displacement or load to transducer and allow the output to settle. Press the **Enter** Key.

3. UAIt Wait while the LVDT output is being measured.

4. H-1 P Apply high scale displacement or load to transducer and allow the output to settle. Press the **Enter** Key.

5. UAIt Wait while the LVDT output is being measured. If the instrument has detected an error during calibration, 1 of the 3 error messages (6a to 6c below) will be displayed. The original calibration values will be retained.

6a. H=L The measured output from the LVDT at the 2 calibration points were too close together. Press **Enter** to return to the menu.

6b. oUEr or HIGH The instrument input was too high during the calibration process. Press **Enter** to return to the menu.

6c. undr or LoU The instrument input was too low during the calibration process. Press **Enter** to return to the menu.

Should calibration fail (6a to 6c displayed), press the **Enter** Key to continue and the unit returns to **CAL**.

1. CAL The instrument has completed the calibration process with no errors detected and the new calibration data will be used for all subsequent measurements.

Logic Comms Locations for remote operations		
Logic 25 (Read/Write)	Write On	To trigger first and subsequent steps of calibration procedure
	Test Off	To ensure previous calibration step finished (Off) before writing (On) again
Logic 24 (Read-Only)	Test On	On indicates that more calibration steps need to be carried out before calibration is complete

Calibration using Status Input 1

The unit can be configured to perform an automatic calibration sequence in response to a status or logic input. When this facility is enabled, the calibration is initiated by holding the status input active for a minimum of one second. The sequence followed is similar to the calibration sequence described on pages 30 to 32.

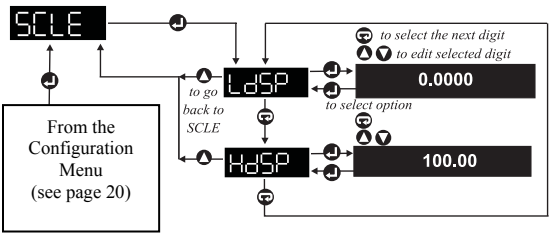
Calibration using Function Keys

The **Next** or **Star** Keys can be assigned to perform a calibration sequence. This facility can be enabled or disabled from the **KEy1** or **KEy2** menus. To instigate a calibration, press the function key and the display should flash the message **CAL**. To continue, the same function key must be pressed again within 5 seconds. If the key is not pressed (to confirm) within 5 seconds, the unit will revert to normal operation. Once instigated, the procedure is the same as for the menu initiation as described on pages 30 to 32.

Scaling

If the system is calibrated to known displacements, as described previously, do not change **H-ip** and **L-ip**. Enter displacements for **HdSP** and **LdSP** only.

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 44 On.

Logic 44 Comms Location	Write-Only
On	Makes the instrument use scaling changes

Low (Zero) Display Value

Default: 0

LdSP Enter the value, in engineering units, of the low calibration point (eg. 0mm). If the system has not been calibrated to a known displacement, set this parameter to zero.

Analogue 73 Comms Location	Read/Write
Integer range	-19999 to 99999 to 5 decimal places

High Display Value

Default: 100

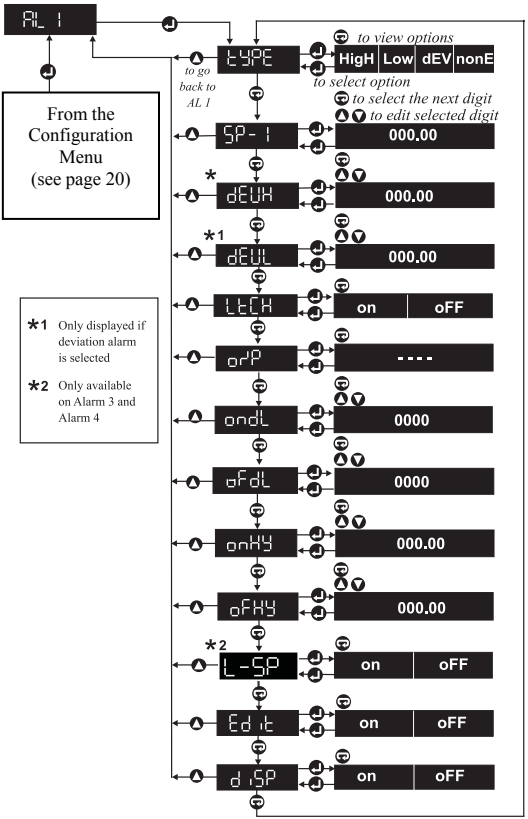
HdSP Enter the value, in engineering units, of the high calibration point (eg. 50mm). If the system has not been calibrated to a known displacement, enter the stroke of the LVDT.

Analogue 75 Comms Location	Read/Write
Integer range	-19999 to 99999 to 5 decimal places

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: None

Sets the alarm type:

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

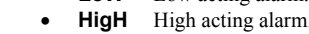
When a deviation alarm type is chosen, the options **dEVH** and **dEVL** (see **Deviation Setpoints** page 36) appear after **SP** (see **Setpoint** below). A deviation alarm is activated when the measured displacement falls outside a deviation band. The alarm setpoint plus the **dEVH** deviation displacement represents the top of the deviation band and similarly, the alarm setpoint minus the **dEVL** displacement deviation represents the bottom of the deviation band.

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

Analogue Comms Locations		Read/Write
Analogue	Alarm	Type
110	Alarm 1	0=High 1=Low 2=Deviation 3=None (disabled)
125	Alarm 2	0=High 1=Low 2=Deviation 3=None (disabled)
140	Alarm 3	0=High 1=Low 2=Deviation 3=None (disabled)
155	Alarm 4	0=High 1=Low 2=Deviation 3=None (disabled)

Setpoint

Default: 0.0



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

A **HigH** alarm is activated when the measured displacement is higher than the setpoint.

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

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

SP can be any displacement in the displayable range. Take care setting the display's decimal point position (see Displayable range page 22) 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 **AL-** (alarm) menu to **on** (see **Front Panel Edit** page 40).

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 39).

Analogue Comms Locations				Read/Write
Analogue	111	126	141	156
Setpoint for Alarm	1	2	3	4
Integer range	Displayable range (see page 22)			

Deviation Setpoints

Default: 0

dEVH dEVL Allows 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	112	113	127	128	142	143	157	158
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 55). Latched alarms can be acknowledged by pressing the **Up** and **Down** panel Keys together.

Logic Comms Locations				Read/Write
Logic	65	75	85	95
On enables latching for Alarm	1	2	3	4

Output

Default: "----" (No outputs activated for all alarms)

OuP Defines optional output(s) activated when the alarm condition occurs. This option is only available on instruments with 2 relay outputs or 4 TTL (open collector) outputs.

When setting up, each illuminated digit position may be a digit or a hyphen. Digits indicate enabled outputs. For example **1-3-** enables Outputs 1 and 3 to be activated when the alarm occurs. The flashing digit/hyphen can be edited with the **Up**/**Down** Keys. Advance to the next output position with the **Next** Key.

Only 2 digit positions are illuminated for instruments with 2 relay outputs. 4 digit positions are illuminated for instruments with 4 open-collector outputs.

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

Logic Comms Locations				Read/Write
On activates	Alarm 1	Alarm 2	Alarm 3	Alarm 4
Output 1	61	71	81	91
Output 2	62	72	82	92
Output 3	63	73	83	93
Output 4	64	74	84	94

Delay

Default: 0 seconds (for both delay and all alarms)

Define the time in seconds that an alarm condition must persist, ranging from 0 to 9999 seconds (see diagram page 39).

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	114	129	144	159	0 to 9999
Off-delay	115	130	145	160	0 to 9999

Hysteresis

Default: 000.00 (For on and off and all alarms)

(See diagram page 39).

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

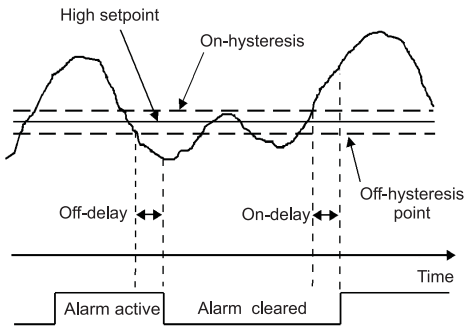
oFHy (Off-hysteresis) defines how far a measurement must go beyond the de-activation level to de-activate the alarm.

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 value and narrow the de-activation band by the off-hysteresis value.

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	116	131	146	161	Displayable range (see page 22)
Off-hysteresis	117	132	147	162	Displayable range (see page 22)



Effect of Hysteresis & Delay on a High Alarm

Linked Setpoint Alarms 3 & 4

Default: Off (both alarms)

L-SP When invoked from the **AL-3** (Alarm 3) menu, turning this option **on**, will make the Alarm 3 Setpoint the same as the Alarm 1 Setpoint. When invoked from the **AL-4** (Alarm 4) menu, turning this option **on**, will make the Alarm 4 Setpoint the same as the Alarm 2 Setpoint.

This option is useful for associating 2 alarms with the same setpoint.

Logic Comms Locations		Read/Write
Logic	88	98
On enables setpoint linking for Alarm	3 (to 1)	4 (to 2)

Front Panel Edit *Default: On for alarms 1 & 2, off for alarms 3 & 4*

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

Logic Comms Locations				Read/Write
Logic	66	76	86	96
On enables the setpoint editor for Alarm	1	2	3	4

Message Display *Default: On (for all alarms)*

diSP **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.

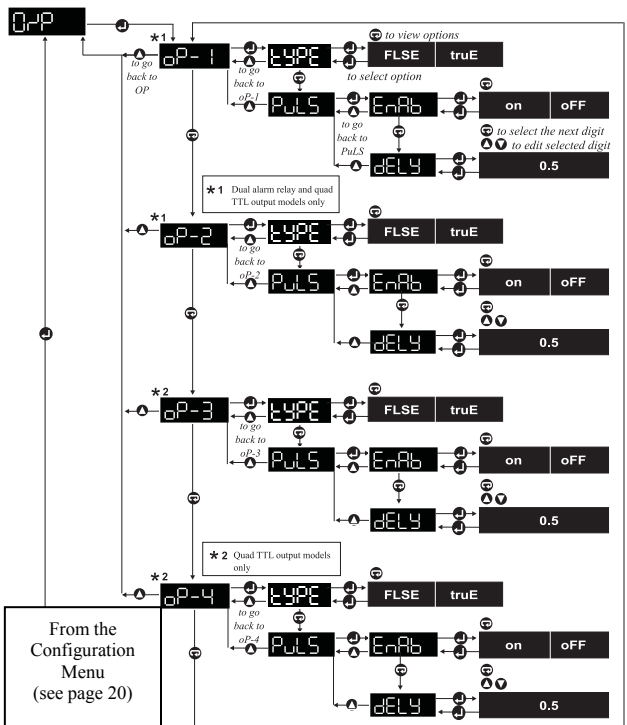
When more than one alarm is activated, messages are prioritised so the highest high alarm or the lowest low alarm is reported.

Logic Comms Locations				Read/Write
Logic	67	77	87	97
On enables message display for Alarm	1	2	3	4

Configuring Logic Outputs

The options in this menu effect the way outputs work when activated by alarms.

Logic Outputs 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 **O/P** (output) 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.

Output Selection Menu

oP-1 oP-2 oP-3 oP-4 Select the output to be setup. **oP-3** and **oP-4** are not available for instruments with 2 relay outputs.

Sense

Default: True (for all outputs)

tyPE **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 or output results in the abnormal output state.

Logic Comms Locations				Read/Write
Logic	160	165	170	175
On sets type to true for Output	1	2	3	4

Pulsed Operation Menu

PuLS A pulsed output can be enabled and setup from this menu.

It should be noted that during operation:

- Once a pulse starts, it continues even if the original cause disappears.
- Maintaining the original cause of the pulse does not extend it.
- A second pulse occurs only if the original cause disappears and another one occurs after the end of the first pulse.

Pulse Enable

Default: Off (for all outputs)

EnAb **on** enables and **oFF** disables pulsed output.

Logic Comms Locations				Read/Write
Logic	161	166	171	176
On enables pulsed output for Output	1	2	3	4

Pulse Duration

Default: 0.5 seconds

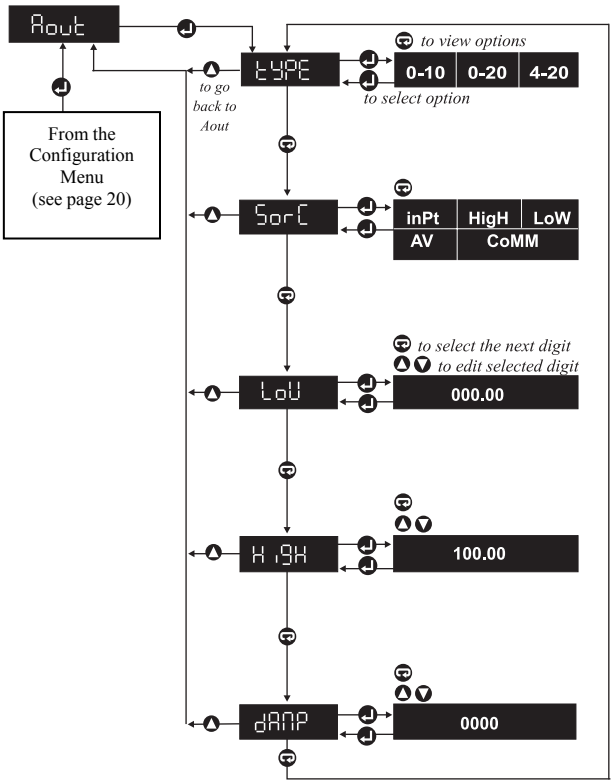
dELY Defines the output pulse duration. It may range from 0.1 to 5.0 seconds.

Analogue Comms Locations				Read/Write
Analogue	219	221	223	225
For Output	1	2	3	4
Integer range (seconds)	5 to 250 (20mS ticks) (eg. 50=1 second)			

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 - 20mA.
- **4 - 20** 4 to 20mA (milliamperes).

Analogue 170 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** Measured displacement.
- **CoMM** Serial comms interface.
- **AV** Average measured displacement.
- **LoW** Lowest measured displacement.
- **HigH** Highest measured displacement.

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 46). 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 displacement, but before the display filters (**Filt, LSd0** or **nEg**) are applied (see **Filtering, Least Significant Digit Zero** and **Display Negative Numbers** page 24).

CoMM requires values to be sent to the instrument via the serial interface. They should be stored in Analogue Location 175. They control the output level during normal operation. For example, sending **;001SA175 10.000<CR><LF>** sends 10 to Analogue Location 175.

NOTE: When values have been sent via comms, the output will be

dependent on the values which have been sent for low and high scaling.

The **AV** (average) measured displacement is a simulated rolling average taken over the period specified by the **AVti** option in the **SySt** (system) menu (see **Averaging Time** page 64).

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 56 & 60).

Analogue 171 Comms Location					Read/Write
Integer value	0	1	2	3	4
Sets source to	Input	High	Low	Average	Comm

Low & High Scaling

Default: Low 0, high 100

LoU HiGH Define the analogue output source values corresponding to the bottom and top of the range for the analogue output type:

Source: **LoW** to **HigH** Kg
Outputs: 4mA to 20mA when type is: **4 - 20**.
0mA to 20mA when type is: **0 - 20**.
0V to 10V when type is: **0 - 10**.

Analogue Comms Locations		Read/Write
Low	High	Range
172	173	Both may be any value in the displayable range (see page 22)

Damping Filter

Default: 0 seconds (no damping)

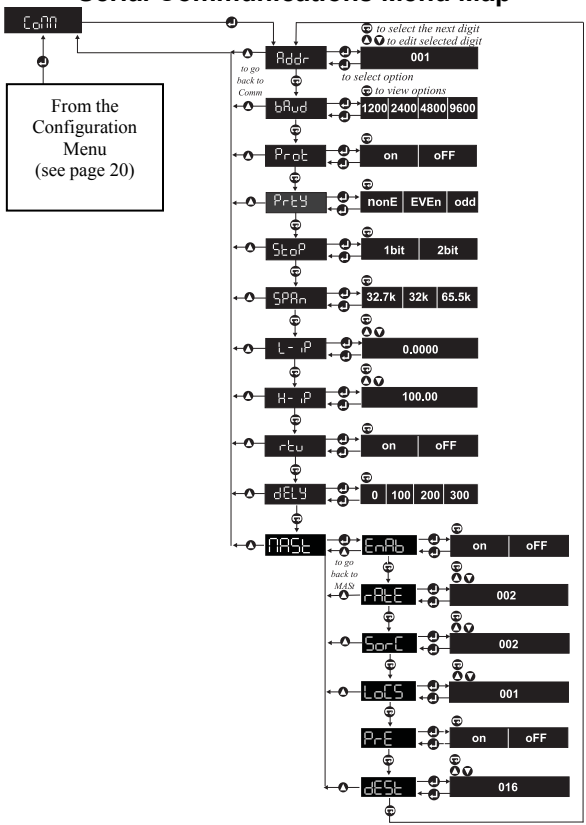
dAMP Defines a time constant in seconds over which a simulated rolling average is applied to the analogue output. Longer times make the analogue output more stable but give the analogue output a slower step response. The time may range from 0 to 9999 seconds. 0 = **oFF**.

Analogue 174 Comms Location	Read/Write
Integer damping time (seconds)	0 to 9999 0=no damping

Configuring Serial Communications

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

Serial Communications Menu Map



The instrument can use 3 prototcols:

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

By default, instruments handle commands in either ASCII protocol.

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.

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 175 10<CR><LF>**

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

This command **S**tores to **A**nalogue Location 175, 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 77) such as the example above. Instruments obey but never reply to broadcasts.

Analogue 182 Comms Location	Read/Write
Instruments communications address range	1 to 247

Baud Rate

Default: 9600bps

bAud Sets the communications speed.

Analogue 183 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 102 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 79).

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 50).

Analogue 184 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 50).

Logic 103 Comms Location	Read/Write
On=2bits	Off=1bit

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** Kg 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
185	Span	0=32k 1=32.7k 2=65.6k	
186	Low	Any value in displayable range (see page 22)	
187	High	Any value in displayable range (see page 22)	

Remote Terminal Unit

Default: Off

rtu **on** makes the instrument use <u>only</u> 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 104 Comms Location	Read/Write
On enables rtu	Off disables rtu

Transmit Delay

Default: 0mS

dEL4 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 188 Comms Location				Read/Write
Integer value	0	1	2	3
Delay before transmit (mS)	0	100	200	300

Master Mode

MASt This menu sets up the instrument as a master. Masters transmit without being asked for data.

Master Mode does not work when **rtu** (binary MODBUS™) is enabled. Instruments do not always respond to commands when Master Mode is **on**.

A message is composed of:

- An optional prefix ("**;000SA016<space>**" by default).
- A programmable number of values (1 by default), starting from a specified analogue location (2 by default), separated by commas.
- An end of line sequence **<CR><LF>**.

Eg. **;000SA016 +0.0000<CR><LF>**

Enabling the default Master Mode setup allows another instrument connected via comms to act as a remote display unit. The other instrument must be setup so the displayed value is sourced from comms (see **Display Value Source** page 23).

Master Mode Enable

Default: Off

EnAb **on** enables Master Mode. Notice that Master Mode transmissions will not take place when enabled if the **MASt** option in a **StA1/2** (status input) menu is **on**, and the status input(s) concerned are not activated (see **Master Trigger/Enable via Status Input** page 57).

Logic 105 Comms Location	Read/Write
On enables Master Mode	Off disaables Master Mode

Interval Between Transmissions

Default: 2 seconds

rAtE Defines the number of seconds between each transmission from the instrument. 0 to 999 may be entered. 0 causes transmissions at the display update rate (2, 4 and 10 Hz) (see **Update Rate** page 24).

Analogue 192 Comms Location	Read/Write
Integer range	0 to 999 (0=display update rate - see page 24)

Source Analogue Location

Default: 002 (displayed value)

SorC Defines the (first) analogue location transmitted.

Analogue 189 Comms Location	Read/Write
Source Analogue Location (integer)	0 to 255

Locations to Transmit

Default: 1 location

LoCS Specifies the number of consecutive analogue locations to transmit, starting from the source analogue location defined above. 1 to 19 can be entered.

Long messages at low baud rates can not be sent as fast as the display is updated. In these circumstances the messages are sent as fast as possible and they are never truncated.

NOTE: A T220 instrument can only receive one location per message and this location must not be read-only.

Analogue 190 Comms Location	Read/Write
Analogue Locations to transmit (integer)	1 to 19

Prefix Enable

Default: On

PrE **on** enables the message prefix discussed above. **oFF** disables it.

Eg. Whole default message with prefix:
;000SA016 +0.1000 <CR><LF>

Whole default message with no prefix:
+0.1000<CR><LF>

(see also **Destination Location** below).

Logic 106 Comms Location	Read/Write
On enables prefix	Off disables prefix

Destination Location

Default: 016 (display source)

dEST Defines the analogue location that the first value sent should be stored in by the receiving instrument. This analogue location number makes up the last 3 digits of the optional message prefix as underlined below:

;000SA<u>016</u><space>

0 to 255 can be entered, but the valid range depends on the instrument receiving the message. The destination location can only receive one location per message and this location must not be read-only.

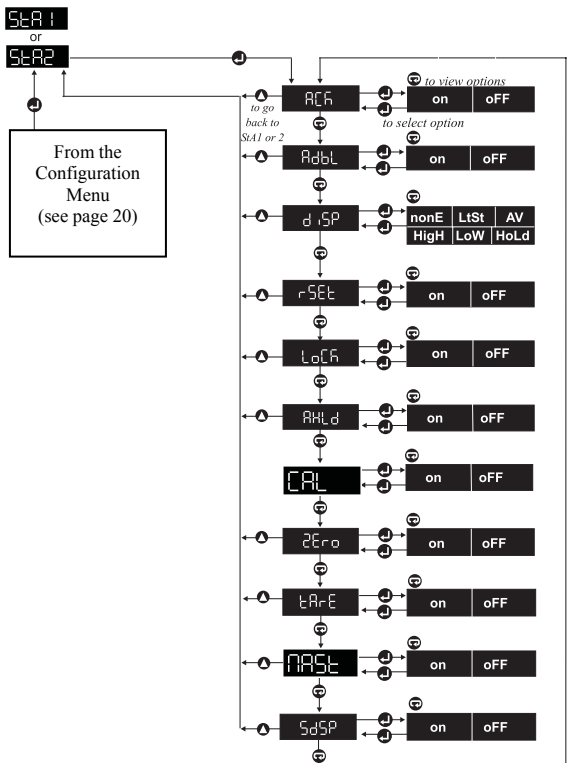
Only 0 may be written to an <u>unused</u> location.

Analogue 191 Comms Location	Read/Write
Destination Analogue Location in target (integer)	0 to 255

Configuring Status Inputs

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

Status Inputs Menu Map



Many function key and status input effects are the same.

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 6 and **Connecting the Status Inputs** page 11).

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 37).

Logic Comms Locations			Read/Write
Logic	113	126	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	114	127	On enables alarm disable
Status Input	1	2	Off disables alarm disable

Display

Default: None

di SP Selects one of several 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 displacement over **AVti** (see page 64) and since last **rSEt** (see page 56) .
- **HigH** Display the highest displacement since last **rSEt** (see page 56).
- **LoW** Display the lowest displacement since last **rSEt** (see page 56).
- **HoLd** Hold the displayed displacement.

Analogue Comms Locations		Read/Write
Analogue	Status Input	Range
197	1	0=None 1=Hold 2=Low 3=High 4=Average 5=Lamptest
201	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	115	128	On enables reset function
Status Input	1	2	Off disables reset function

Disable Panel Keys

Default: Off

LoCA **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	116	129	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	117	130	On enables analogue output hold
Status Input	1	2	Off disables analogue output hold

Calibration

Default: Off

CAL The unit can be configured to perform an automatic calibration sequence in response to a status or logic input. When this facility is enabled, the calibration is initiated by holding the status input active for a minimum of 1 second. The sequence followed is similar to the calibration sequence described on pages 30 to 32.

Logic Comms Locations			Read/Write
Logic	120	133	On enables auto calibration
Status Input	1	2	Off disables auto calibration

Zero

Default: Off

ZEro **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 displacement changes since zeroing.

Logic Comms Locations			Read/Write
Logic	118	131	On enables zeroing function
Status Input	1	2	Off disables zeroing function

Tare

Default: Off

tArE **on** programs the status input to tare the display. When the status input is first activated, the display is zeroed, normally to ignore the displacement of a container. While the status input remains activated, the display shows only displacement 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 total displacement again.

Logic Comms Locations			Read/Write
Logic	112	125	On enables tare function
Status Input	1	2	Off disables tare function

Master Trigger/Enable via Status Input

Default: Off

MASt **on** causes activation of the status input to enable Master Mode transmissions, but only if Master Mode is also enabled via the **CoMM**, **MASt**, **EnAb**, **on** option (see **Master Mode Enable** page 51).

Notice that as soon as the status input is activated, a transmission occurs, and transmission timing is resynchronised to the event. So if the transmission rate is slow, a momentary closure of the status input contacts can be used as a single transmission trigger. Further transmissions occur only if the status input remains activated. If both status inputs are setup to

activate Master Mode transmissions, only one need be activated to enable transmissions.

Logic Comms Locations		Read/Write
Logic 121	Status Input 1	On activation enables/triggers Master Mode
Logic 134	Status Input 2	Off activation enables/triggers Master Mode

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 displacement over **AVti** (see page 64) and since last **rSEt** (see page 56).
- **HigH** Display the highest displacement since last **rSEt** (see page 56).
- **LoW** Display the lowest displacement since last **rSEt** (see page 56).
- **HoLd** Hold the displayed displacement.

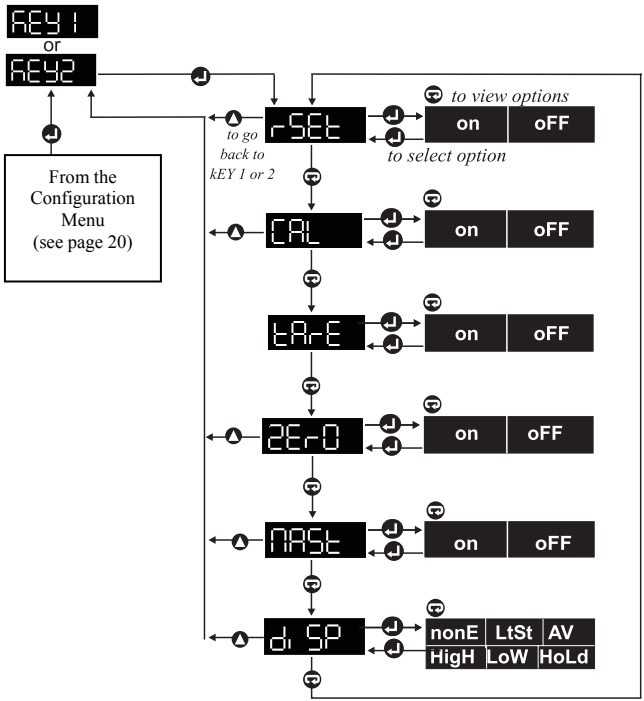
If an alarm is also active, and alarm messages are enabled, both alarm and status messages are displayed in sequence with the displayed value.

Logic Comms Locations			Read/Write
Logic	119	132	On enables status message display
Status Input	1	2	Off disables status message display

Configuring Function Keys

These 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:

Reset

Default: Off

rSEt **on** programs the function key to:

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

Logic Comms Locations			Read/Write
Logic	138	146	On enables reset function
Function Key	1	2	Off disables reset function

Auto Fast Calibration

Default: Off

CAL If this parameter is **on**, Function Key 1 or 2 will initiate the automatic calibration process. When pressed, the display will flash the message **CAL.** The key must be pressed again whilst the display is flashing to perform the function.

Logic Comms Locations			Read/Write
Logic	141	149	On enables auto fast calibration
Function Key	1	2	Off disables auto fast calibration

Tare

Default: Off

tArE **on** programs the function key to tare the display as follows:

When this function key is first pressed, the display is zeroed. The display continues to show only displacement 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	139	147	On enables tare function
Function Key	1	2	Off disables tare function

Zero

Default: Off

ZEr0 **on** programs the function key to zero the display.

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

Logic Comms Locations			Read/Write
Logic	140	148	On enables zero function
Function Key	1	2	Off disables zero function

Master Trigger/Enable via Function Key

Default: Off

MASt ***on*** causes the function key to trigger just one Master Mode transmission, but only if Master Mode is also enabled via the **CoMM**, **MASt, EnAb**, **on** option (see **Master Mode Enable** page 51).

Notice that as soon as the function key is pressed, a transmission occurs and transmission timing is resynchronised to the event.

Logic Comms Location		Read/Write
142	Function Key 1	On key triggers Master Mode transmission
150	Function Key 2	Off key has no effect on Master Mode

Display

Default: None

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

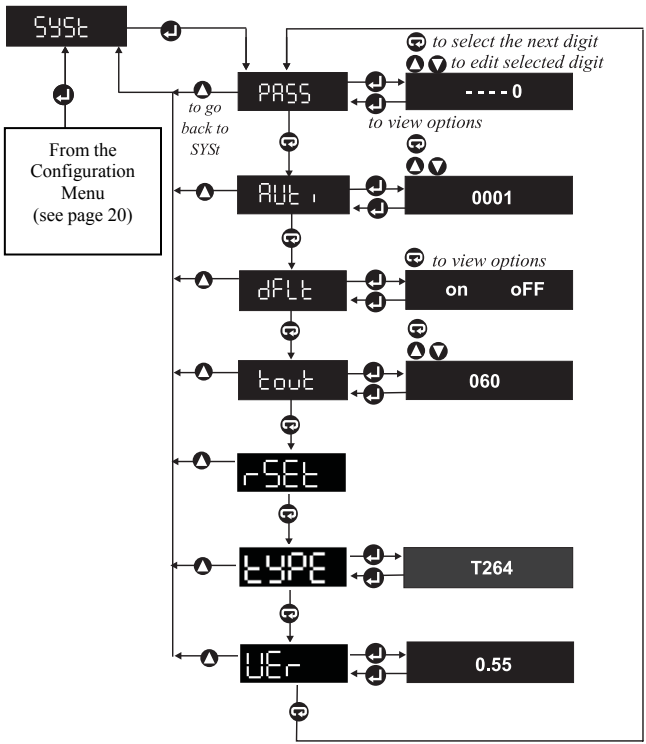
- **nonE** Display unchanged. No display function selected.
- **LtSt** Lamptest; all display segments light-up showing [**8.8.8.8.8.**].
- **AV** Display the average displacement over **Avti** (see page 64) since last **rSEt** (see page 60).
- **HigH** Display the highest displacement since last **rSEt** (see page 60).
- **LoW** Display the lowest displacement since last **rSEt** (see page 60).
- **HoLd** Hold the displayed displacement.

Analogue Comms Locations		Read/Write
Analogue	Function Key	Range
206	1	0=None 1=Hold 2=Low 3=High 4=Average 5=Lamptest
210	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.

Averaging Time

Default: 1 second

AVEr 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 reached by holding the **Enter** Key down).

(See also **Filtering** on page 24 and **Reset** on pages 56 & 60).

Analogue Comms Location 214	Read/Write
Averaging time range (seconds)	0 - 9999 0 performs no averaging at all

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 Comms Location 154	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 Comms Location 215	Read/Write
Time-out range (seconds)	15 - 255

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

Reset

Reset is an action, not a setup item

rSEt **on** makes the instrument perform a power up reset.

The instrument displays **WAit** for a moment while the hardware is reset, followed by the power on display sequence:

- Test display **8.8.8.8.8.**
- Version (eg.) **9.99**
- Instrument type (eg.) **t244**

Logic Comms Location 155	Write-Only
On	Resets the instrument

Instrument Type

Type is an action, not a setup item

tYPE Displays the instrument type:

- **t263** Displacement instrument with no logic outputs.
- **t264** Displacement instrument with 2 relay outputs.
- **t265** Displacement instrument with 4 open collector outputs (TTL).

Analogue Comms Location 0	Read-Only
Value may be 263, 264 or 265	

Software Version

Version is an action, not a setup item

UEr Displays the instrument's software version, eg. **9.99**. PLEASE

QUOTE THE SOFTWARE VERSION AND INSTRUMENT TYPE WHEN CONTACTING YOUR SUPPLIER WITH A QUERY. The instrument's serial number is useful too. The serial number may be seen to the right of the rightmost display digit through the tinted display filter.

Analogue Comms Location 9	Read-Only
Version eg. +0.5900	

Product Specification

Power Requirements

90V AC to 265V AC 50/60Hz,
20VA maximum.

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 (optionally green).
Range	-19999 to +99999.

Input

ADC	High precision Sigma Delta.
Input range	0.05V rms to 5V rms.
Resolution	18bit.
Non-linearity	<0.02%.
Temperature drift	< 50ppm/°C.
Stability	< 0.01% FSO after 15 minutes.
Input impedance	100kΩ.
Common mode rejection	>150dB.
Series mode rejection	>70dB @ 50/60Hz.

Excitation

Voltage	3V AC rms or 5V AC rms selectable.
Frequency	2.5kHz or 5kHz selectable.
Temperature drift	(amplitude) < 100ppm/°C. (frequency) < 100ppm/°C.

High Speed Analogue Output

Output	±10V maximum.
Response	Output filter -3dB @ 125Hz.

Analogue Output

Ranges	0 to 10V, 0 to 20mA or 4 to 20mA selectable.
Accuracy	0.2% of span.
Temperature drift	<100ppm/°C.
Output ripple	<10mV or 50µA @ 30Hz.
Response	63% within 32mS. 99% within 100mS.
Resolution	0.05% of span, 5mV or 0.01mA.
Maximum output	18V @ 25mA.
Isolation	500V.

Alarm Relays (when fitted)

Type	2 off changeover.
Rating	1A @ 250V.

Logic Outputs (when fitted)

Type	4 off optically isolated (common ground) open collector transistor outputs.
Rating	50mA.

Communications Interface

Type	EIA RS485 (RS422 compatible).

Appendix A - Display Messages

Error Messages

Err1 Err2 Err3 Indicates that an error has been detected in one of the instrument's internal memory areas as part of the power up self test sequence.

AdEr Indicates that the instrument has detected a fault in its measurement circuitry.

NOTE: For any of the above error messages, return the instrument to the supplier.

Out of Range Messages

undr Indicates either:

- Displayed value is below displayable range (see **Decimal Point Position** page 22).
- The measured value is below the measurable range for the sensitivity of the input.

oUEr Indicates either:

- Displayed value is above displayable range (see **Decimal Point Position** page 22).
- The measured value is above the measurable range for the sensitivity of the setting.

Calibration Messages

Calibration is discussed on pages 30 to 32, but since it can be controlled without front panel intervention via comms, the messages are listed here:

L-P 9.-H Prompt the user to apply low and high displacements.

LoU H.9H H=L oUEr undr Are possible calibration errors.

The action that started the calibration process should be repeated until none of these messages are displayed. This action might be, pressing the **Enter** Key, activating the status input, pressing the function key, or setting Logic Location 25 to On via comms again.

A power up reset aborts calibration.

Alarm Messages

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

High alarm.

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

Low alarm.

High deviation alarm.

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.

(See also **Message Display** page 40).

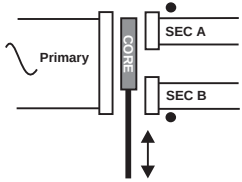
Appendix B - Measurement Modes

Introduction

Your instrument is designed to operate with a wide range of LVDTs. It can be configured to work in one of 3 Measurement Modes:

1. Secondary Only.
2. Secondary to Primary Ratiometric.
3. Secondary to Secondary Ratiometric.

The Measurement Mode may be selected from the **inPt**, **tYPE** (input, type) menu.



Secondary Only Measurement Mode (SEC)

Using Secondary Only Measurement Mode, the instrument determines its measurements by measuring the differential amplitude of the 2 secondary coils of the LVDT. This mode takes no account of variations in the excitation voltage caused by temperature changes or changes in the characteristics of the LVDT.

Secondary to Primary Ratiometric Mode (S/P)

Using this mode, the instrument determines the measurement by taking into account both the primary and secondary voltages. The instrument measures the differential output of the LVDT (SECA - SECB) as before and in addition, the excitation voltage across the primary coil is also measured. When using this mode, the measurements will automatically compensate for changes in the excitation voltage. This mode will not compensate for changes in the characteristics of the LVDT due to temperature or other effects.

Secondary to Secondary Ratiometric Mode (S/S)

This mode measures the output from both secondary coils of the LVDT separately and calculates a ratio between the 2 secondaries using the following formula:

$$\frac{SECA - SECB}{SECA + SECB}$$

This method of measurement compensates for variations both in excitation and for a number of different changes in the characteristics of the LVDT. This mode can only be used with LVDTs which have the centre tap connection available.

Appendix C - Calibration

Introduction

This appendix describes the steps necessary to calibrate your LVDT to your instrument in more detail.

Initial Setup

The LVDT should be connected to your instrument as described earlier in this manual and the appropriate Input Measurement Mode selected from the **inPt**, **tYPE** (input, type) menu. You should also set up the correct **Vout** (excitation voltage) and **HZ** (frequency) for your LVDT, as described in the documentation supplied with your LVDT. The instrument uses different amplification gains depending on the output of your LVDT. In order for the instrument to set the correct gain for your LVDT, you need to set the LVDT **SEn** (sensitivity) and **Stro** (stroke) values in the **inPt** menu. If you are unsure of the characteristics of your LVDT, you should select the **AUto** (automatic gain selection) option from the **inPt** menu and set this to **on**.

Null Position Locator

It is important that the LVDT operates around the midpoint of its stroke as this gives the best results by minimising any errors due to non-linearity. A feature of this instrument is the ability to locate the midpoint of the LVDT's measurement range (null point). To do this, select **nuLL** from the **ConF** (configuration) menu and a value will be displayed (flashing). The nearer the value to zero, the nearer the LVDT is to its null position. The LVDT should be mounted so that the required measurement range transverses the null point approximately equally.

Initial Calibration

To perform an initial calibration of the LVDT to the instrument, select the **CAL** option from the **ConF** menu. The display will show the message **L-iP** (low input). Set the position of the LVDT to its minimum displacement position (minimum stroke) and note the displacement, ie. 0mm. When the LVDT is set at its low calibration point, press the **Enter** Key. The display will show **WAit** for a few seconds whilst the instrument measures the output from the LVDT.

When finished, the display will show **H-iP** (high input), indicating that the instrument is ready to calibrate the high point. Set the LVDT to its high calibration point maximum displacement position, ie. 200mm. Press the **Enter** Key when ready to continue. The unit will display the message **WAit** whilst it measures the output from the LVDT. At the end of the calibration sequence, the instrument will use the 2 measured output values from the LVDT to calculate its own calibration constants. The LVDT will utilise these constants in all future measurements. Note, these constants are all retained when power is removed from the instrument. When a calibration is performed with **AUto** enabled, the instrument will determine the optimum internal gain setting for all future measurements from the output levels from the LVDT detected during calibration.

Scaling the Display

In order to display the displacement or other parameter in the correct units of measurement, it is necessary to first scale the instrument. To do this, select **SCLE** (scale) from the **ConF** menu and enter the desired **LdSP** (low display) and **HdSP** (high display) values. The **LdSP** value corresponds to the displacement at the **L-iP** calibration point, ie. 0mm. The **HdSP** value corresponds to the displacement at the **H-iP** calibration point, ie. 200mm.

Calibration

Subsequent routine calibrations of the LVDT to the instrument can be performed either from within the menus or by assignment of either a status input or function key. As the **LdSP** and **HdSP** scaling values will be retained throughout subsequent calibrations, all subsequent calibrations must be performed using the same points. If not, the **LdSP** and **HdSP** values will need to be changed.

The calibration points used may be set anywhere in the display range of the instrument. Although the unit can read above and below the nominal calibration points, it is advisable to calibrate at the extremes of the required measurement range for best performance.

Appendix D - Connecting the Serial Interface

Four instrument Terminals: 10, 11, 12 and 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 and 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 and 12 of each instrument, and the other wire must be connected to Terminals 11 and 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.

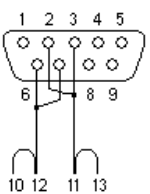
One pair of wires is used for transmitting and the other pair listens. This avoids the problems of how and when to switch from transmit to receive as described above.

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

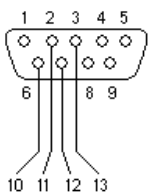
The instruments have an RS485/RS422 compatible interface with the additional ability to release the instrument-to-master communication channel when not transmitting. This allows other instruments wanting to transmit to do so.

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 K485-FD or any other K485 converter wired for 2-wire comms



KK Systems K485-FD-4w K422 or K485-4w converter wired for 4-wire comms

Instrument Terminals

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

Appendix E - 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 49). 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 indicates a value is under range (see **Troubleshooting Comms** page 83).

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 49).

#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 a non-zero value to an unused location.

Appendix F - Realtime Comms Locations

Analogue Locations

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

0	RO	Instrument type ie: +263.00 or +264.00 or +265.00.
1 & 38	RO	Measured value unfiltered (no **LSd0**, no **nEg**).
2 & 39	RO	Displayed value filtered.
3 & 16	RO	Source of displayed value when display sourced from comms (ie. when Analogue Location 53 is 4 - see **Display Value Source** page 23).
5	RO	Number of logic outputs fitted: 0, 2 (relays) or 4 (TTL's).
7	RO	First 4 digits of serial number (eg. +9908.0 indicates 9908).
8	RO	Last 4 digits of serial number (eg. +7.0000 indicates 0007).
9	RO	Instrument software version (eg. +0.5800 indicates version 0.58).
29	RO	Zero offset in display units (+0.0000 if display is not zeroed).
30	RO	Tare offset in display units (+0.0000 if display is not tared).
32	RO	Test value incremented every 20mS by instrument. Resets at 32767.
33	RO	Millivolts applied to Status 1 Input (0 to 5000mV 1% resolution).
34	RO	Millivolts applied to Status 2 Input (0 to 5000mV 1% resolution).
35	RO	Low display value (minimum peak since reset - see **Reset** page 56).
36	RO	High display value (maximum peak since reset - see **Reset** page 56).
37	RO	Average display value (over **AVti** - see **Averaging time** page 64).

Logic Locations

Status

6	RO	State of Function Key 1	On = pressed (leftmost key).
7	RO	State of Function Key 2	On = pressed (rightmost key).
8	RO	State of Status Input 1	On = contacts closed.
9	RO	State of Status Input 2	On = contacts closed.
10	RO	Alarm 1 state	On = activated.
11	RO	Alarm 2 state	On = activated.
12	RO	Alarm 3 state	On = activated.
13	RO	Alarm 4 state	On = activated.
14	RO	On = Abnormal state of Op-1 (T264 or T265 only).	
15	RO	On = Abnormal state of Op-2 (T264 or T265 only).	
16	RO	On = Abnormal state of Op-3 (T265 only).	
17	RO	On = Abnormal state of Op-4 (T265 only).	
24	RO	Off Indicates whole calibration process complete (see Logic Location 25 below).	

Commands

25	RW	On Performs a calibration step. After turning On, read location repeatedly until Off (step done), then turn On again (next step) if Logic Location 24 is On too (more steps to perform). Low & high calibration displacements should be applied to the LVDT for the same steps that they are when **CAL** is performed from the panel (see **Calibration Sequence** pages 30 to 32).
26	RW	On Acknowledges any/all active latched alarms.
27	RW	On Performs the reset function (see **Reset** pages 56).
28	RW	On Resets the high value (maximum peak) to the current display value.
29	RW	On Resets the low value (minimum peak) to the current display value.
30	RW	On Resets the average value to the current display value.

31	RW	On Zeros display.
32	RW	On Unzeros display (not recommended: use Tare/Untare instead).
33	RW	On Tares display.
34	RW	On Untares display.

Appendix G - 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 and 11 the wrong way round, as well as Terminals 12 and 13. 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 and 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

L

M

R

S

T