

LD4-LN

Large Digit Display

DC Current / DC Voltage

50 Point Lineariser

Operation and Instruction Manual

(Inputs 0-20mA, 4-20mA, 0-100mV,
0-1V, 0-10V or 0-100V)

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1 Introduction

This manual contains information for the installation and operation of the LD4-LN Lineariser Monitor. The LD4 is a general purpose instrument which may be configured to accept an input of 0 to 20mA, 4 to 20mA, $\pm 100\text{mV}$, $\pm 1\text{V}$, $\pm 10\text{V}$ or $\pm 100\text{VDC}$. The LD4-LN offers the choice of linear, square root or linearised display.

In lineariser operation up to 50 points may be entered. These points and any function settings and scaling values are stored in EEPROM memory. The lineariser points are stored in a "lineariser table". A written copy of the table should be maintained for reference, a table is provided in for this purpose. The lineariser table stores the display values for each point and the input values (scaled or otherwise) associated with these display values. Prior to entering values into the table the display must be scaled via a 2 point calibration. Functions **CAL 1** and **CAL 2** can be used for live input display scaling for all input types. For 4-20mA inputs only an alternative scaling method is provided via the **USER En4** and **USER En20** functions. The **▲** and **▼** buttons on the main circuit board can be used to toggle between then linearised (**LIN**) and linear input (**LINE**) values.

Two separate sets of calibration scaling values can be stored, with the display choice being made via a remote input.

Two standard inbuilt relays are provided for alarm/control functions, a transmitter supply of 18VDC (unregulated) is also provided on AC powered models. An optional isolated $\pm 12\text{V}$ (24V) transmitter supply is available. Optional isolated analog retransmission or serial communications or two extra relays may also be optionally provided.

Unless otherwise specified at the time of order, your LD4 has been factory set to a standard configuration, see the "Function Table" for a list of default settings. Like all other LD4 series instruments the configuration and calibration is easily changed by the user. Initial changes may require dismantling the instrument to alter PCB links, other changes are made via push button functions.

The LD4 series of Large Digit Display Monitors are designed for high reliability in industrial applications. The high brightness LED display provides good visibility, even in areas with high ambient light levels.

Inputs

Programming keypad (on main circuit board)
Power supply 240VAC, 110VAC, 12 to 16VAC, 15 to 24VDC or
optional isolated DC supplies (factory configured)
Signal input $\pm 20\text{mA}$, 4-20mA, $\pm 100\text{mV}$, $\pm 1\text{V}$, $\pm 10\text{V}$ or $\pm 100\text{V}$ (set via internal links)
Remote switch input to perform special functions



Standard outputs

Two alarm relays
Transmitter supply 16VDC unregulated & non isolated (AC powered models only)

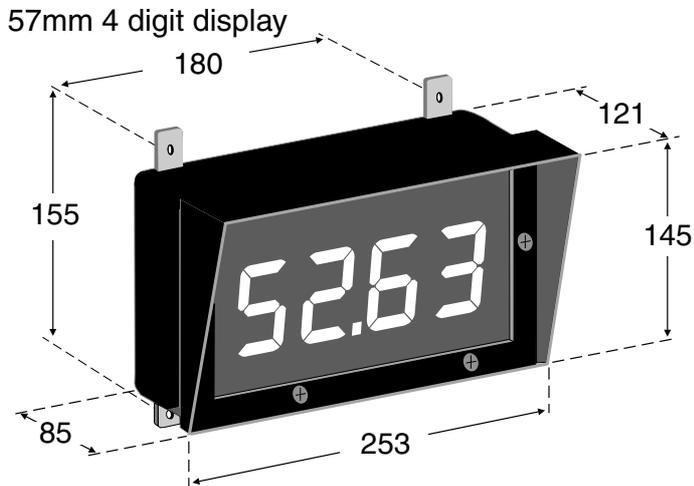
Optional outputs

Two extra alarm relays
Analog retransmission 4-20mA, 0-1V or 0-10V
Serial communications RS232 or RS485 ASCII
Isolated & regulated transmitter supply 24VDC ($\pm 12\text{V}$)

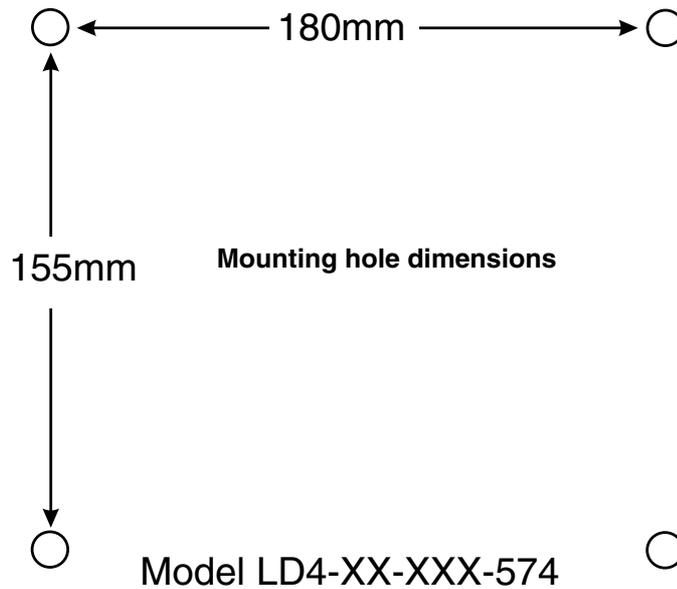
2 Mechanical Installation

The instrument is designed be wall mounted. Carefully measure and drill holes, as shown below.

All sizes are in mm. Mounting hole diameters are 6.5mm.



An optional panel mount kit is available for the 57mm type display. Panel cut out size is 240 x 130mm (-0.0mm/+0.5mm)



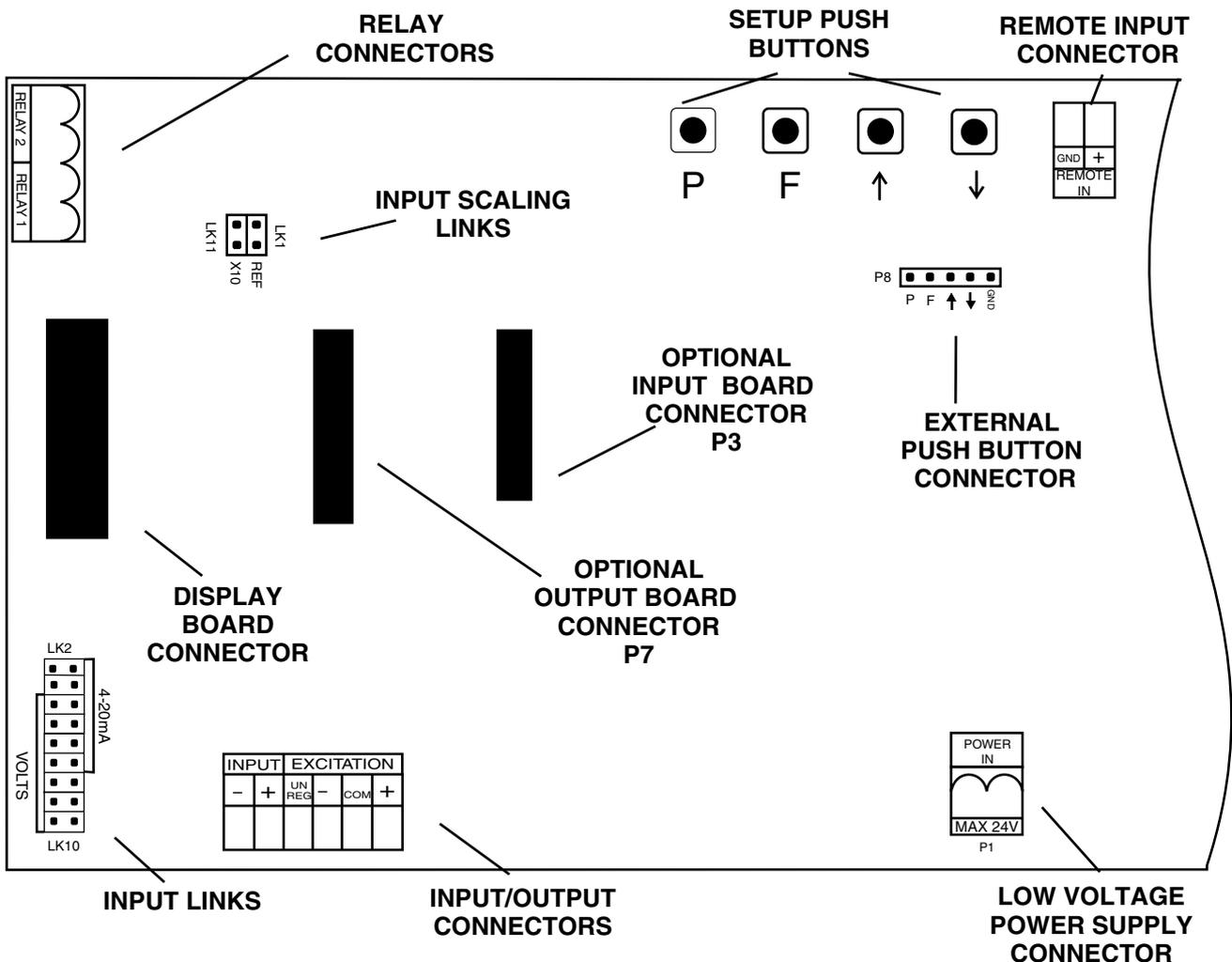
3 Electrical Installation

The LD4-LN instrument is designed for continuous operation and no power switch is fitted to the unit. It is recommended that an external switch and fuse be provided to allow the unit to be removed for servicing.

The terminal blocks, which are the plug in type for ease of installation, allow for wires of up to 1.5mm² (2.5mm² for relay and power connections) to be fitted. Connect the wires to the appropriate terminals as indicated below. Refer to other details provided in this manual to confirm proper selection of voltage, polarity and input type before applying power to the instrument. When power is applied the instrument will cycle through a display sequence, indicating the software version and other status information, this indicates that the instrument is functioning.

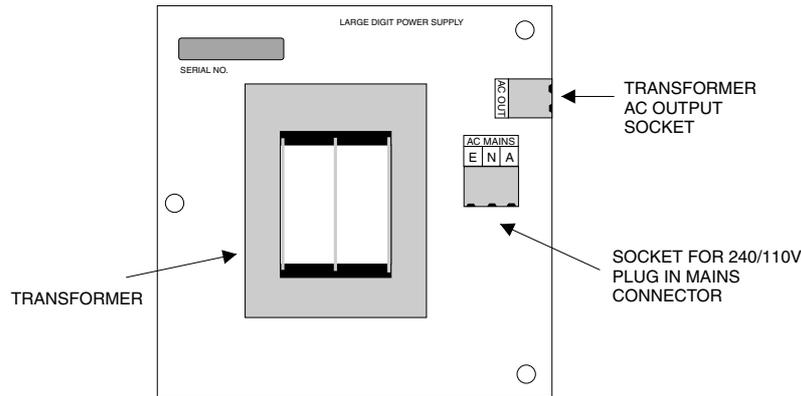
See the appropriate appendix at the rear of this manual for option board electrical connections.

MAIN CIRCUIT BOARD LAYOUT (PARTIAL VIEW)



3.1 Power supply connections

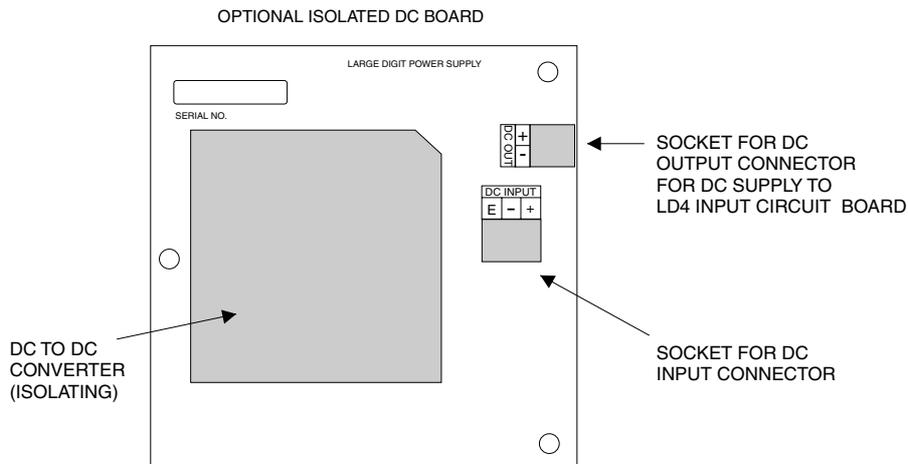
Mains power connections (240VAC or 110VAC) are made via a plug in terminal with screw connections.



The transformer low voltage AC output goes to the power supply connector P1 on the main circuit board via the lead supplied.

Non isolated DC supplies (15 to 24V) are connected at the main circuit board power supply connector P1 via the plug in connector terminals. The positive and negative supplies may be connected either way around.

Optional isolated DC supplies use plug in terminals supplied on the power supply board as shown below. The output from the isolated DC supply board connects directly to the main circuit board power supply connector via the plug in connector (P1) terminals.

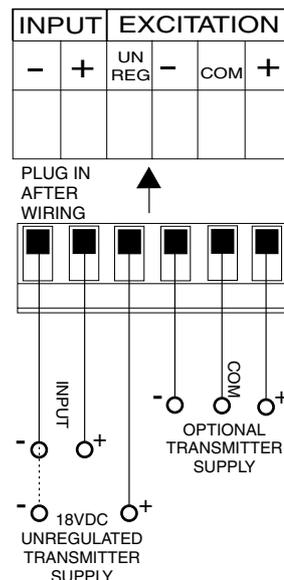


3.2 Relay connections

The LD4 is supplied with two alarm relays as standard with connections on P6. The relays are single pole, single throw types and are rated at 5A, 240VAC into a resistive load. The relay contact is voltage free and may be programmed for normally open or normally closed operation.

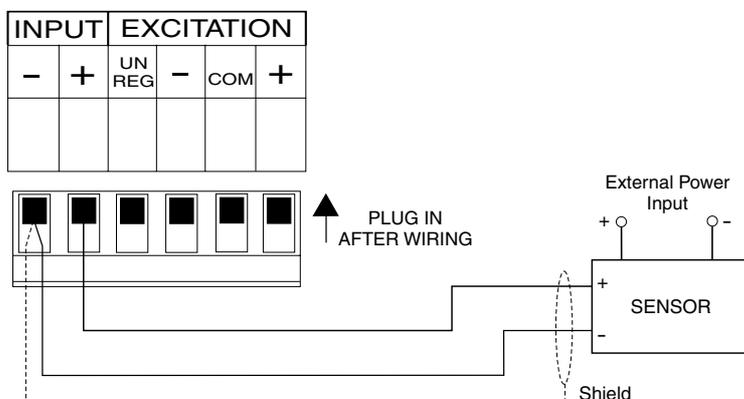
3.3 Input/output connectors

The diagram shows the input/output connectors for the LD4-LN. The input signal connection is between INPUT + and INPUT -. The standard 18VDC unregulated transmitter supply output is between INPUT - and EXCITATION UN REG. The optional 24VDC ($\pm 12V$) transmitter supply output is between COM, EXCITATION + and EXCITATION -. Wires of up to 1.5mm diameter can be accepted. The connectors are of the plug in type for ease of installation.

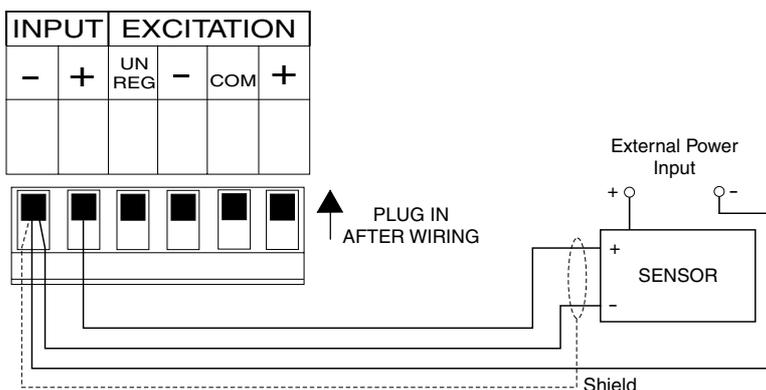


Connection examples

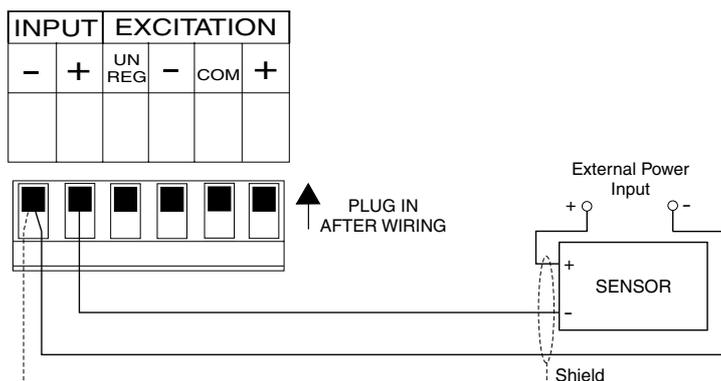
1. 4 wire $\pm 20mA$ or 4-20mA input - externally powered sensor



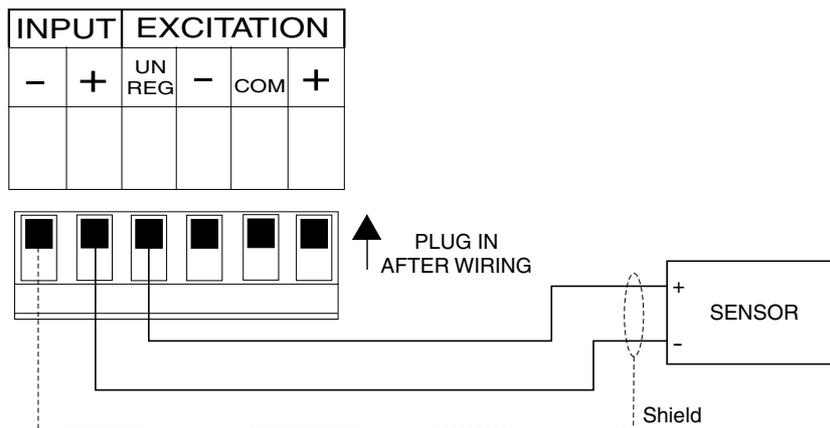
2. 3 wire $\pm 20mA$ or 4-20mA input - externally powered sensor, common negative



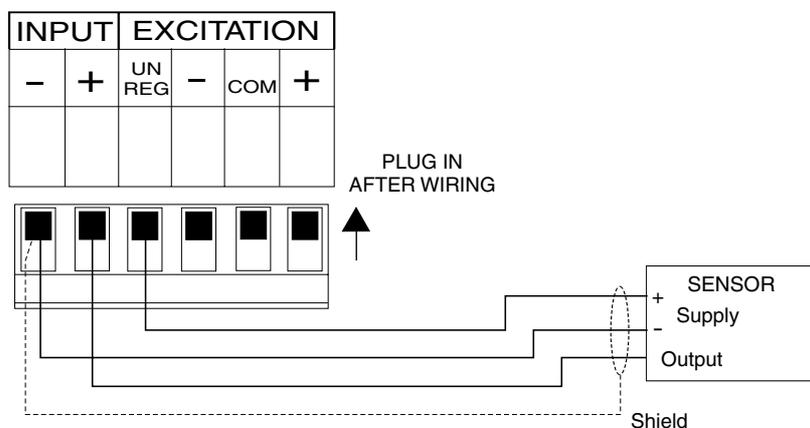
3. 2 wire $\pm 20mA$ or 4-20mA input - externally powered sensor



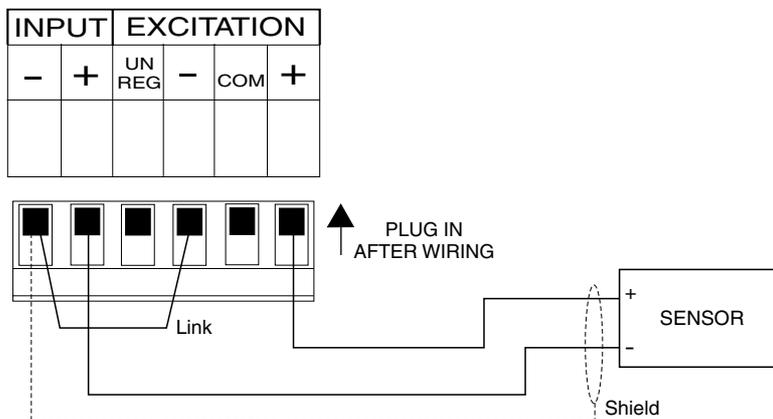
4. 2 wire 4-20mA input - powered from standard 18VDC supply (AC powered models only)



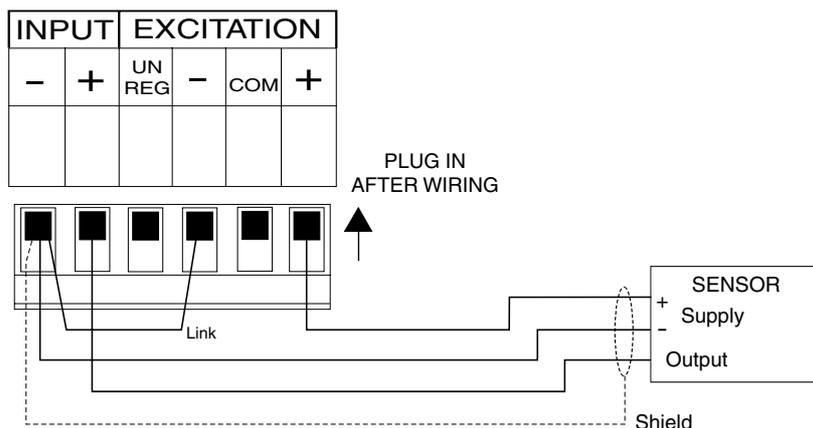
5. 3 wire $\pm 20\text{mA}$ or 4-20mA input - powered from standard 18VDC supply (AC powered models only)



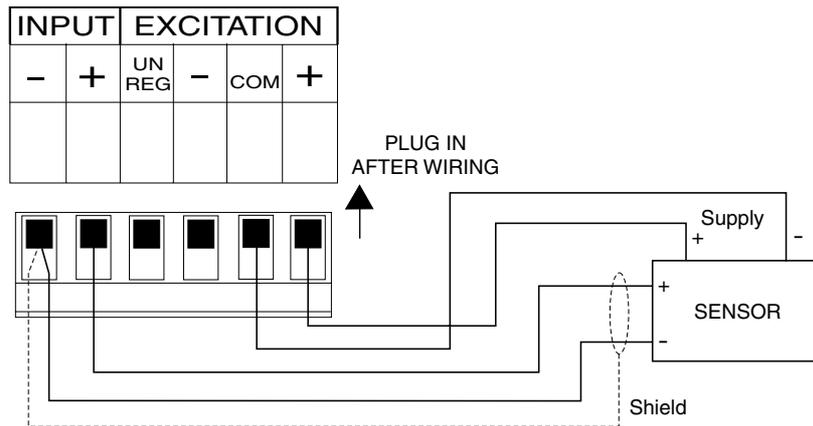
6. 2 wire $\pm 20\text{mA}$ or 4-20mA input - powered from optional 24V ($\pm 12\text{V}$) supply



7. 3 wire $\pm 20\text{mA}$ or 4-20mA input - powered from optional 24V ($\pm 12\text{V}$) supply

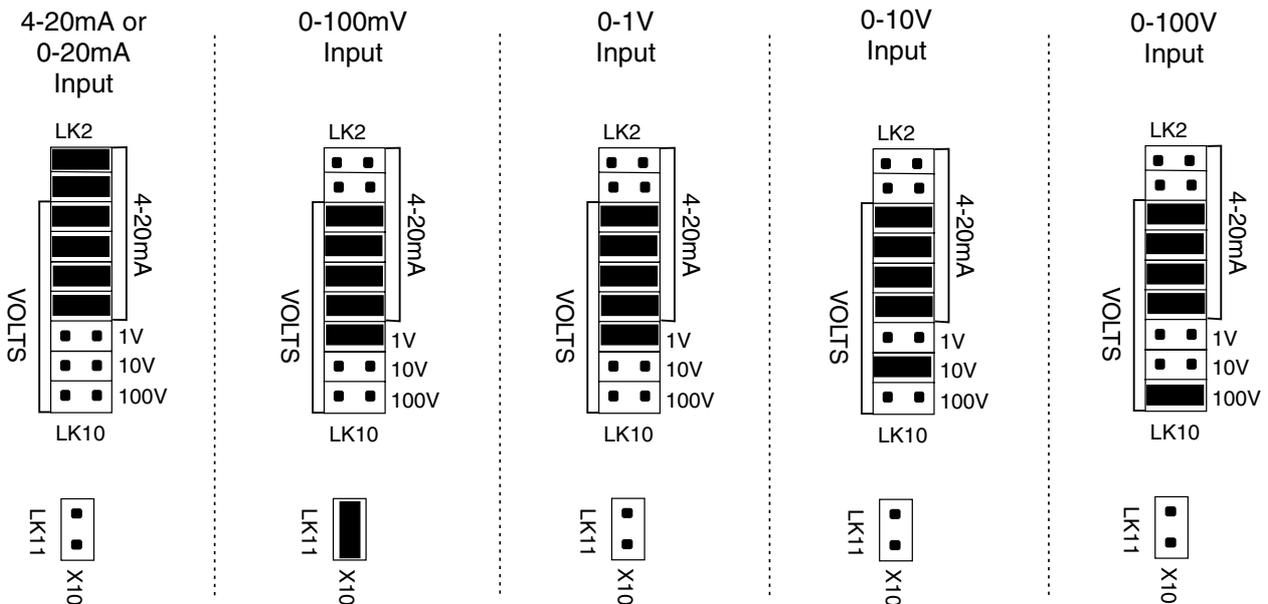


8. DC voltage input - powered from optional supply using +12V



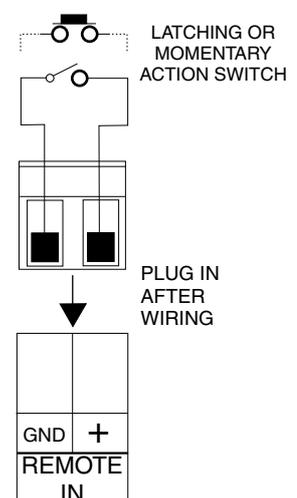
3.4 Input type selector links

The input type selector links must be set to suit the input type required. Input links allow selection of 4-20mA, 0-1VDC, 0-10VDC or 0-100VDC input. Note that the x10 link (LK11) is used for the 0-100mVDC input range. The 4-20mA input will allow both 4-20mA and 0-20mA input ranges. Note: Input link LK1 must always be in unless an optional input board is fitted.



3.5 Remote input connector

The LD4-LN has a software function named **REMOTE** or remote input. Closure of the remote input connector via a switch or relay contact will cause the selected remote input function to operate. Choose the switch type to suit the remote input required e.g. for a **ZERO** function a momentary action switch is most commonly used, for a display hold **PHLD** a latching switch may be required.



4 Explanation of Functions

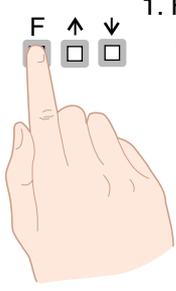
The LD4 setup and calibration functions are configured through a push button sequence. Two levels of access are provided for setting up and calibrating:-

FUNC mode (simple push button sequence) allows access to commonly set up functions such as alarm setpoints.

CAL mode (power up sequence plus push button sequence) allows access to all functions including calibration parameters.

The three push buttons located on the main circuit board are used to alter settings. Once **CAL** or **FUNC** mode has been entered you can step through the functions, by pressing and releasing the **F** push button, until the required function is reached. Changes to functions are made by pressing the **▲** or **▼** push button (in some cases both simultaneously) when the required function is reached. See the flow chart example which follows

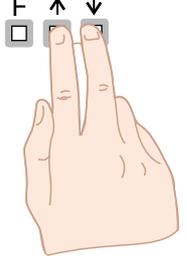
Entering **CAL** Mode



1. Remove power from the instrument and wait 5 seconds . Hold in the **F** button and reapply power. The display will indicate **CAL** as part of the "wake up messages" when the **CAL** message is seen you can release the button. Move to step 2 below.



2. When the "wake up" messages have finished and the display has settled down to its normal reading press, then release the **F** button. Move to step 3 below.



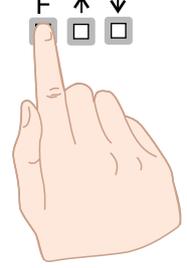
3. Within 2 seconds of releasing the **F** button press, then release the **▲** and **▼** buttons together. The display will now indicate **FUNC** followed by the first function.

Notes: If step 1 above has been completed then the instrument will remain in this **CAL** mode state until power is removed. i.e. there is no need to repeat step 1 when accessing function unless power has been removed.

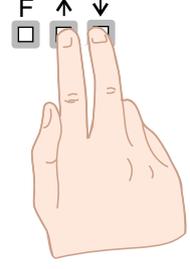
The instrument should show all 8's on power up e.g. **8.8.8.8**. if the instrument does not reset then these numbers will not be seen. Switch off the instrument and allow a longer time delay before powering up again.

Entering **FUNC** Mode

No special power up procedure is required to enter **FUNC** mode.

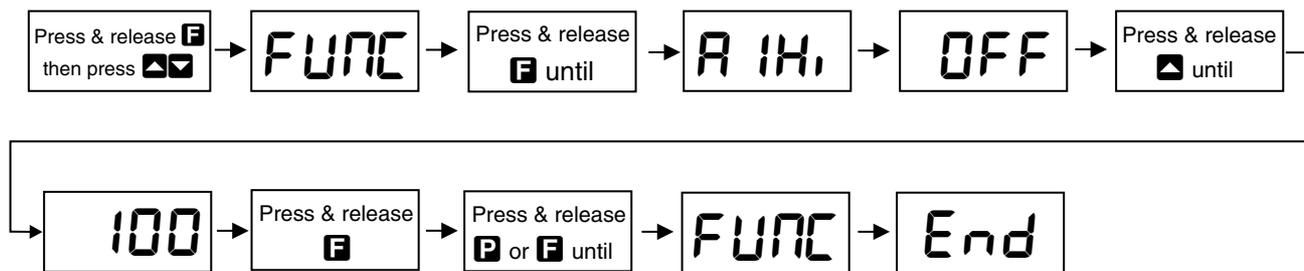


1. When the "wake up" messages have finished and the display has settled down to its normal reading press, then release the **F** button. Move to step 2 below.

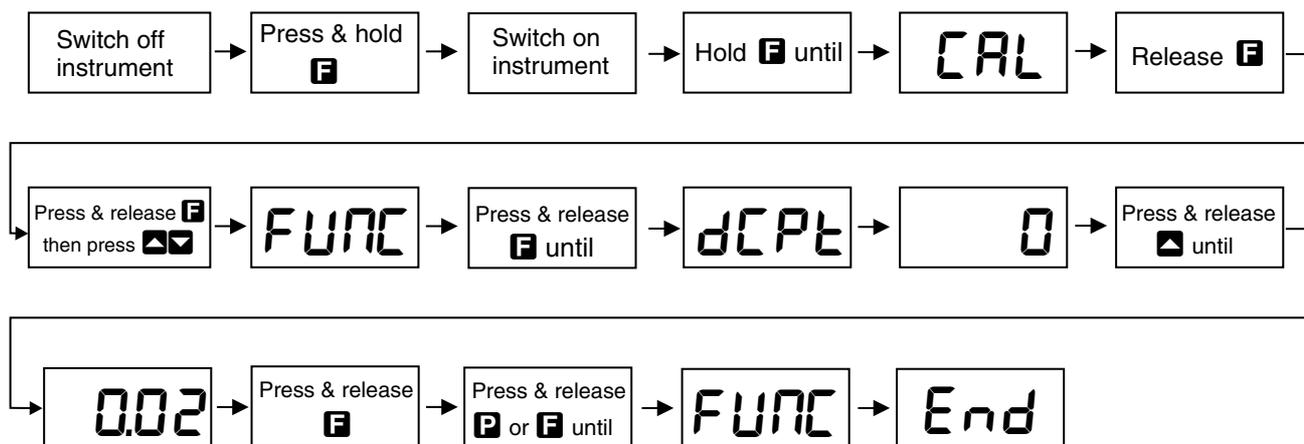


2. Within 2 seconds of releasing the **F** button press, then release the **▲** and **▼** buttons together. The display will now indicate **FUNC** followed by the first function.

Example: Entering **FUNC** mode to change alarm 1 high function **RIH**, from **OFF** to **100**



Example: Entering **CAL** mode to change decimal point **dCPL** function from **0** to **0.02**



The alarm and brightness functions below are accessible via **FUNC** mode.

The LD4-LN has an easy alarm access facility which allows access to the alarm setpoints simply by pressing the **F** button. The first setpoint will then appear and changes to this setpoint may be made to this setpoint via the **▲** or **▼** buttons. Press the **F** button to accept any changes or to move on to the next setpoint.

The instrument must be set in the manner described below to allow the easy access facility to work:

1. The **F.I. RP** function must be set to **SP.AC** or the **ACCESS** function must be set to **EASY**.
2. At least one alarm must have a setpoint, nothing will happen if all the alarm setpoints are set to **OFF**.
3. The **SP.AC** function must be set to allow access to the relays required e.g. if set to **R 1-2** then the easy access will work only with alarm relays 1 and 2 even if more relays are fitted.
4. The instrument must be in normal measure mode i.e. if the instrument is powered up so that it is in **CAL** mode then the easy access will not function. If in doubt then remove power from the instrument, wait for a few seconds then apply power again.
5. If the easy access facility is used then the only way to view or alter any other function settings is to power up via **CAL** mode i.e. there is not entry to **FUNC** mode unless the instrument is powered up in **CAL** mode.

See the "Analog PI Control Output" chapter for an explanation of the analog PI control functions available when the optional analog output is fitted.

R 1L (alarm low setpoint)

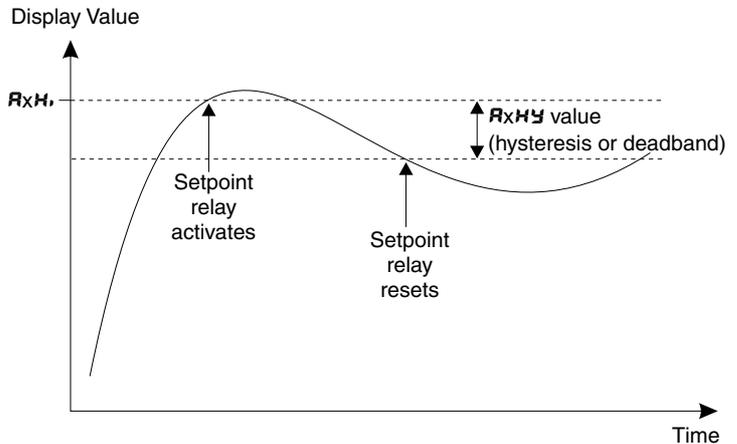
Displays and sets the low setpoint value for alarm 1 relay. The low alarm setpoint may be disabled by pressing the **▲** and **▼** pushbuttons simultaneously. When the alarm is disabled the display will indicate **OFF**. Use **▲** or **▼** to adjust the setpoint value if required. The alarm will activate when the displayed value is lower than the **R 1L** setpoint value. Each relay may be configured with both a low and high setpoint if required, if so the relay will be activated when the display reading moves outside the band set between low and high setpoints.

R 1H (alarm high setpoint)

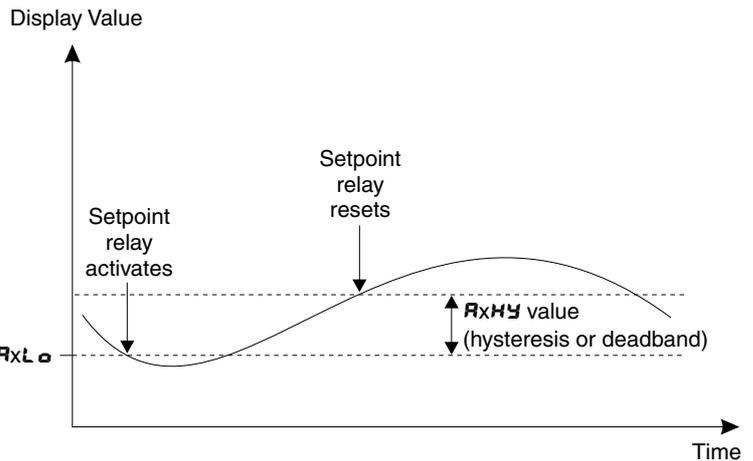
Displays and sets the high setpoint value for alarm 1 relay. The high alarm setpoint may be disabled by pressing the  and  pushbuttons simultaneously. When the alarm is disabled the display will indicate OFF. Use  or  to adjust the setpoint value if required. The alarm will activate when the displayed value is higher than the R 1H setpoint value. Each relay may be configured with both a low and high setpoint if required, if so the relay will be activated when the display reading moves outside the band set between low and high setpoints.

R 1HY (alarm hysteresis [deadband])

Displays and sets the alarm hysteresis limit and is common for both high and low setpoint values. The hysteresis value may be used to prevent too frequent operation of the setpoint relay when the measured value stays close to the setpoint. Without a hysteresis setting (R 1HY set to zero) the alarm will activate when the display value goes above the alarm setpoint (for high alarm) and will reset when the display value falls below the setpoint, this can result in repeated on/off switching of the relay at around the setpoint value. The hysteresis setting operates as follows:



In the high alarm mode, once the alarm is activated the input must fall below the setpoint value minus the hysteresis value to reset the alarm. e.g. if R 1H is set to 50.0 and R 1HY is set to 3.0 then the setpoint output relay will activate once the display value goes above 50.0 and will reset when the display value goes below 47.0 (50.0 minus 3.0).



In the low alarm mode, once the alarm is activated the input must rise above the setpoint value plus the hysteresis value to reset the alarm.

e.g. if R 1L is set to 20.0 and R 1HY is set to 10.0 then the alarm output relay will activate when the display value falls below 20.0 and will reset when the display value goes above 30.0 (20.0 plus 10.0).

The hysteresis units are expressed in displayed engineering units.

R 1TT (alarm trip time)

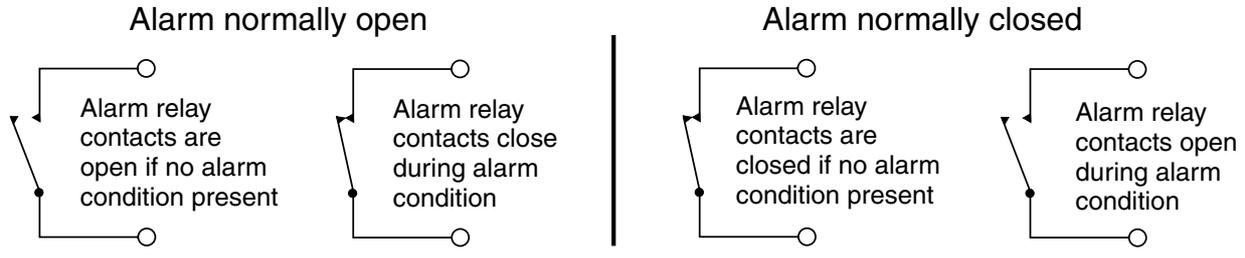
Displays and sets the alarm trip time and is common for both alarm high and low setpoint values. The trip time is the delay time before the alarm relay will activate, or trip, when an alarm condition is present. The alarm condition must be present continuously for the trip time period before the alarm will trip. This function is useful for preventing an alarm trip due to short non critical deviations from setpoint. The trip time is selectable over 0 to 9999 seconds.

R 1RT (alarm reset time)

Displays and sets the alarm relay reset time. With the alarm condition is removed the alarm relay will stay in its alarm condition for the time selected as the reset time. The reset time is selectable over 0 to 9999 seconds.

***R In.o* or *R In.c* (alarm x normally open or normally closed)**

Displays and sets the setpoint alarm relay action to normally open (de-energised) or normally closed (energised), when no alarm condition is present. A normally closed alarm is often used to provide a power failure alarm indication.



***R2Lo* . *R3Lo* & *R4Lo* (alarm low setpoint)**

Displays and sets alarm 2, 3 & 4 low setpoints, see *R ILo* for further description. Note: alarm relays 3 & 4 are only fitted as options.

***R2H* . *R3H* & *R4H* (alarm high setpoint)**

Displays and sets alarm 2, 3 & 4 high setpoints, see *R IH* for further description. Note: alarm relays 3 & 4 are only fitted as options.

***R2HY* . *R3HY* & *R4HY* (alarm hysteresis [deadband])**

Displays and sets the alarm hysteresis limit for alarm 2, 3 & 4, see *R IHY* for further description. Note: alarm relays 3 & 4 are only fitted as options.

***R2t* . *R3t* & *R4t* (alarm trip time)**

Displays and sets the alarm trip time for alarm 2, 3 & 4, see *R It* for further description. Note: alarm relays 3 & 4 are only fitted as options.

***R2r* . *R3r* & *R4r* (alarm reset time)**

Displays and sets the alarm relay reset time for alarm 2, see *R Ir* for further description. Note: alarm relays 3 & 4 are only fitted as options.

***R2n.o* / *R2n.c* . *R3n.o* / *R3n.c* , *R4n.o* / *R4n.c* (alarm normally open or normally closed)**

Displays and sets the setpoint alarm relay action for alarm 2, 3 & 4, see *R In.o* / *R In.c* for further description. Note: alarm relays 3 & 4 are only fitted as options.

***Rx.SP* , *Rx.t 1* , *Rx.t 2* etc. (relay operation independent setpoint or trailing)** - this function will not be seen if both the high and low setpoints are set to **OFF**.

Each alarm may be programmed to operate with an independent setpoint setting or may be linked (or trailing) to operate at a fixed difference to another relay setpoint. The operation is as follows: Alarm 1 (**R1**) is always independent. Alarm 2 (**R2**) may be independent or may be linked to Alarm 1. Alarm 3 (**R3**) may be independent or may be linked to Alarm 1 or Alarm 2. Alarm 4 (**R4**) may be independent or may be linked to Alarm 1, Alarm 2 or Alarm 3. The operation of each alarm is selectable within the Function Setup Mode by selecting, for example, (Alarm 4) **R4.SP** = Alarm 4 normal setpoint or **R4.t 1** = Alarm 4 trailing Alarm 1 or **R4.t 2** = Alarm 4 trailing Alarm 2 or **R4.t 3** = Alarm 4 trailing Alarm 3. For trailing set points the setpoint value is entered as the difference from the setpoint being trailed.

If the trailing setpoint is to operate ahead of the prime setpoint then the value is entered as a positive number and if operating behind the prime setpoint then the value is entered as a negative number. For example, with Alarm 2 set to trail alarm 1, if **R IH** is set to 1000 and **R2H** is set to 50 then Alarm 1 will trip at 1000 and alarm 2 will trip at 1050 (i.e. 1000 + 50). If Alarm 2 had been set at -50 then alarm 2 would trip at 950 (i.e. 1000 - 50). See the trailing alarm table which follows.

Trailing Alarm Table Showing Possible Alarm Assignments			
	A2	A3	A4
A1	A2.t1	A3.t1	A4.t1
A2		A3.t2	A4.t2
A3			A4.t3

br9t (display brightness)

Displays and sets the digital display brightness. The display brightness is selectable from **1** to **15**, where **1** = lowest intensity and **15** = highest intensity. This function is useful for improving the display readability in dark areas or to reduce the power consumption of the instrument.

duLL (remote input controlled display brightness)

This function will not be seen unless the **F.I. NP** function is set to **duLL**. Displays and sets the level for remote input brightness switching, see **F.I. NP** function. When the remote input function is set to **duLL** the remote input can be used to switch between the display brightness level set by the **br9t** function and the display brightness set by the **duLL** function. The display brightness is selectable from **0** to **15**, where **0** = lowest intensity and **15** = highest intensity. This function is useful in reducing glare when the display needs to be viewed in both light and dark ambient light levels.

The functions which follow are accessible via **CRAL** mode only.

rEE- (recorder/analog retransmission output low value)

Seen only when analog retransmission option fitted. Displays and sets the analog retransmission (4-20mA, 0-1V or 0-10V, link selectable) output low value (4mA or 0V) in displayed engineering units. e.g. if it is required to retransmit 4mA when the display indicates **0** then select **0** in this function via the **▲** or **▼** button. This function will not be seen if the **FEE ctrl** function is set to **on**.

rEE+ (recorder/analog retransmission output high value)

Seen only when analog retransmission option fitted. Displays and sets the analog retransmission (4-20mA, 0-1V or 0-10V, link selectable) output high value (20mA, 1V or 10V) in displayed engineering units. e.g. if it is required to retransmit 20mA when the display indicates **500** then select **500** in this function via the **▲** or **▼** button. This function will not be seen if the **FEE ctrl** function is set to **on**.

drnd (display rounding)

Displays and sets the display rounding value. This value may be set to 0 - 5000 displayed units. Display rounding is useful for reducing the instrument resolution without loss of accuracy, in applications where it is undesirable to display to a fine tolerance. For example if **drnd** is set to **10** the display indication will change in multiples of 10 only i.e. it will be able to display **0 . 10 . 20 . 30** etc. but not **2 . 4 . 15** etc.

dCPt (decimal point selection)

Displays and sets the decimal point. By pressing the **▲** or **▼** pushbuttons the decimal point position may be set. The display will indicate as follows: **0** (no decimal point), **0 . 1** (1 decimal place), **0 . 02** (2 decimal places) or **0 . 003** (3 decimal places).

FtEr (digital filter)

Displays and sets the digital filter value. Digital filtering is used for reducing susceptibility to short term interference. The digital filter range is selectable from **0** to **8**, where **0** = none and **8** = most filtering. A typical value for the digital filter would be 3. Use **▲** or **▼** to alter if required. Note that at higher filter values the display update time will be increased.

FEE ctrl (Analog output mode)

Seen only when analog output option is fitted. Refer to the "Analog PI Control Output" chapter for an explanation of the analog PI control functions available when the optional analog output is fitted.

This function allows selection of **on** or **OFF** for PI control analog output. If set to **OFF** the analog output operates as a retransmission output and uses the functions described in this chapter. If set to **on** the analog output operates as a PI control output.

4.1 Calibration functions.

The **CAL 1** and **CAL 2** functions described below allow the display to be scaled to read in engineering units using “live” inputs. For 4-20mA inputs and alternative method which does not require “live” inputs may be used, see the **USEF EN4** and **USEF EN20** functions which follow.

CAL 1 (first scaling point for 2 point scaling method)

CAL 1 and **CAL 2** are used together to scale the instruments display, values for both must be set when using this scaling method.

The **CAL 1** function sets the first calibration point for live input calibration . When using this method a “live” signal input must be present at the input terminals. Note: **CAL 1** and **CAL 2** can be set independently i.e. it is not necessary to perform a **CAL 2** operation directly after a **CAL 1**.

The procedure for entering the first scaling point is:

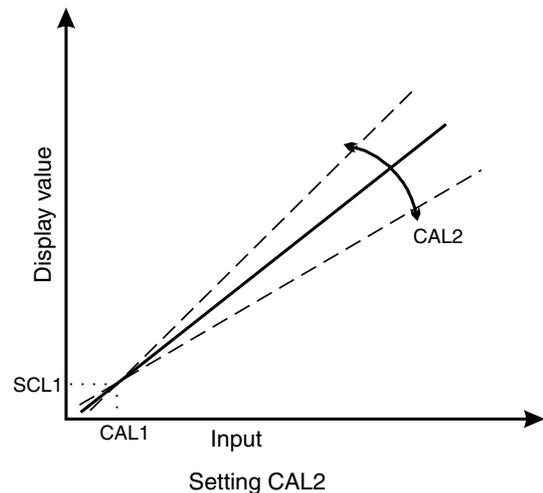
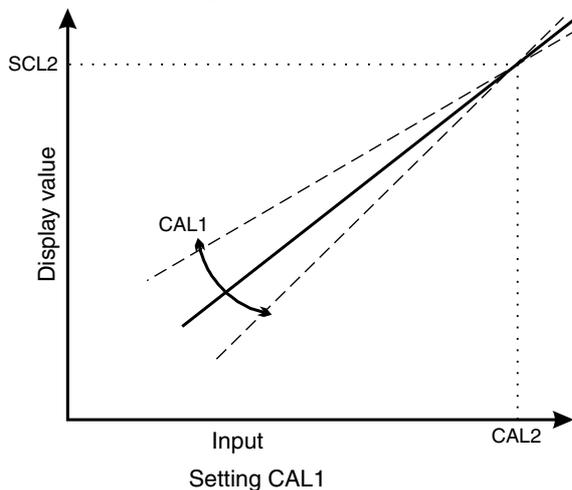
- Ensure that an input signal is present at the input terminals, this will normally be at the low end of the signal range e.g. 4mA for a 4-20mA input type.
- At the **CAL 1** function press **▲** and **▼** simultaneously, then release them. The display will indicate the live input value. Do not be concerned at this stage if the live input display value is not what is required. It is important that the live input value seen is a steady value, if not then the input stability needs to be investigated before proceeding with the scaling.
- Press, then release the **F** button. The display will indicate **SCL 1** followed by a value. Use the **▲** or **▼** button to change this value to the required display scale value at this input. e.g. if 4mA was input and the required display at 4mA was **0** then ensure **0** is selected at **SCL 1**. Press the **F** button to accept changes, the display will show **CAL End** and will then move on to the next function.

CAL 2 (second scaling point for 2 point scaling method)

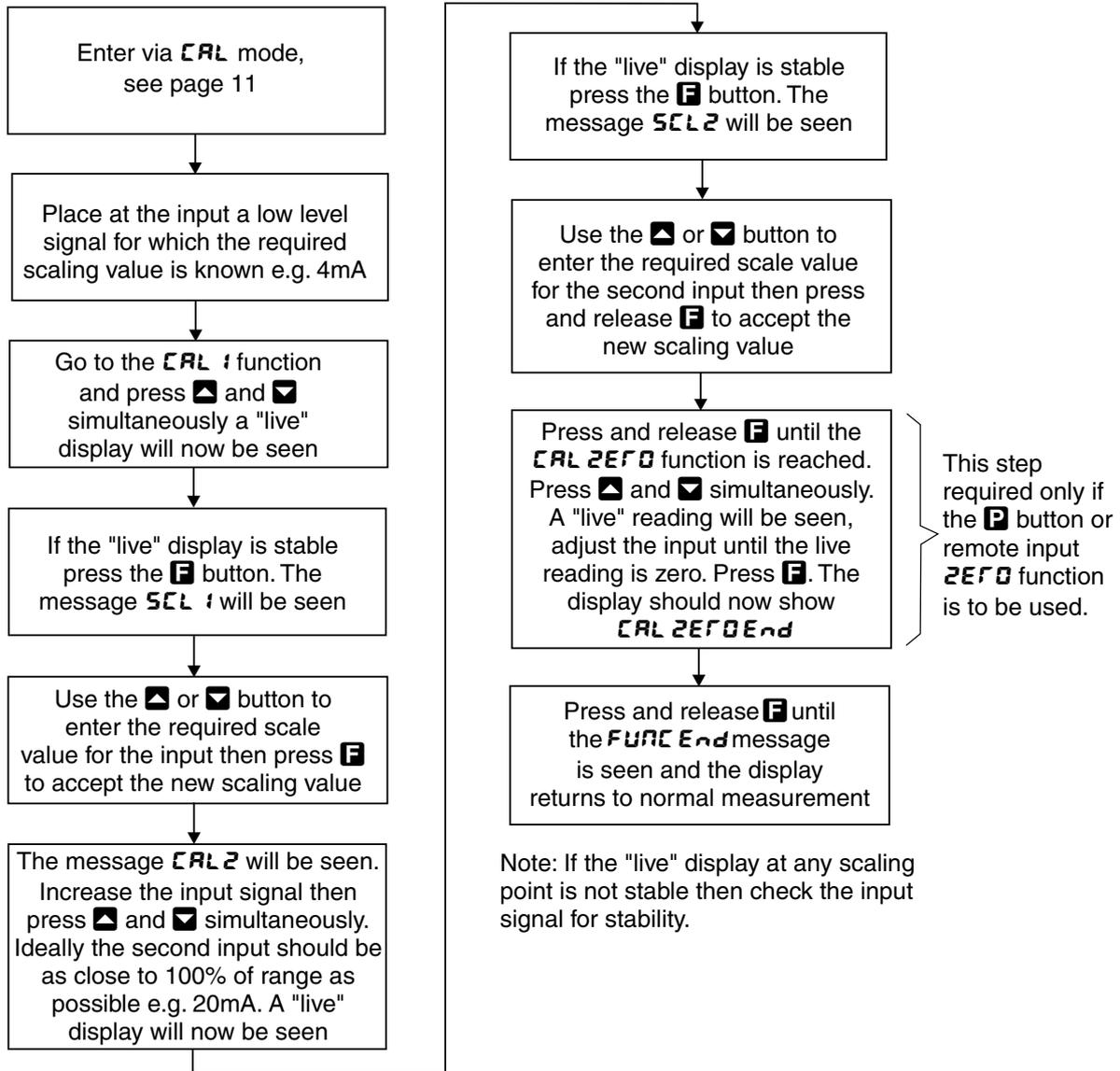
The second point scaling is performed in exactly the same manner as **CAL 1** except that **SCL 2** will be seen instead of **SCL 1**. It is essential that the live input is different in value to the **CAL 1** input e.g. for a 4-20mA input use 20mA as the **CAL 2** live input. Note; it is not essential that exactly 4 and 20mA are used as the live inputs for a 4-20mA scaling but the input values must be significantly different.

The procedure for entering the second scaling point is:

- Ensure that an input signal (different to the input used at **CAL 1**) is present at the input terminals, this will normally be at the high end of the signal range e.g. 20mA for a 4-20mA input type.
- At the **CAL 2** function press **▲** and **▼** simultaneously, then release them. The display will indicate the live input value. Do not be concerned at this stage if the live input display value is not what is required. It is important that the live input value seen is a steady value, if not then the input stability needs to be investigated before proceeding with the scaling.
- Press, then release the **F** button. The display will indicate **SCL 2** followed by a value. Use the **▲** or **▼** button to change this value to the required display scale value at this input. e.g. if 20mA was input and the required display at 20mA was **500** then ensure **500** is selected at **SCL 2**. Press the **F** button to accept changes, the display will show **CAL End** and will then move on to the next function.

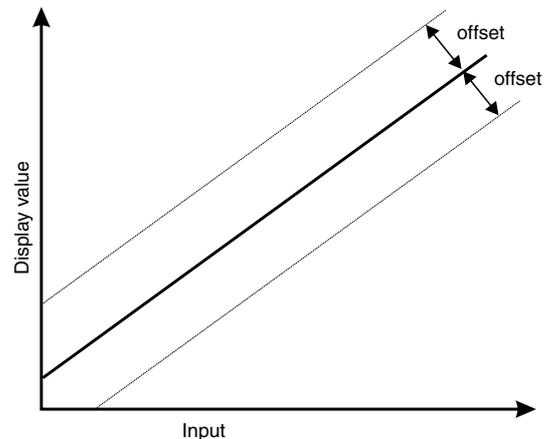


Example - Scaling using two live inputs



CAL OFFSET (calibration offset)

The calibration offset is a single point adjustment which can be used to alter the calibration scaling values across the entire measuring range without affecting the calibration slope. This method can be used instead of performing a two point calibration when a constant measurement error is found to exist across the entire range. To perform a calibration offset press the **[Up]** and **[Down]** buttons simultaneously at the **CAL OFFSET** function. A "live" reading from the input will be seen, make a note of this reading. Press the **[F]** button, the message **SCL E** will now be seen followed by the last scale value in memory. Use the **[Up]** or **[Down]** button to adjust the scale value to the required display value for that input. For example if the "live" input reading was 50 and the required display value for this input was 70 then adjust the **SCL E** value to 70.



ZERO RANGE (zero range)

The zero range function allows a limit value to be set (in engineering units) above which the display will not zero i.e. if a zero operation is attempted via the **0** button, remote input or set zero function when the display value is greater than the zero range setting the display will refuse to zero and give a **ZERO RANGE Err** message (note that the **CAL OFFSE** function is also affected by the **ZERO RANGE** setting). For example if the zero range setting is 10 the instrument will only respond to a zero operation if the display reading at the time is between -10 and 10. If the zero range function is not required it can be set to **OFF** by pressing the **▲** and **▼** buttons simultaneously at this function. When switched off the instrument can be zeroed no matter what the display value.

Note that the instrument keeps track of the value being zeroed at each operation, when the total amount zeroed from repeated operations becomes greater than the zero range value the instrument will reject the zero operation and a **ZERO RANGE Err** message will be seen. To allow a zero operation beyond this point either the **ZERO RANGE** function value will need to be raised or a new zero reference point introduced via the **CAL ZERO** function.

If repeated zero operations are required the **ZERO RANGE** function should be set to **OFF** or alternatively the **LRFE** operation could be considered.

CAL ZERO (calibration zero)

The calibration zero function is used following a calibration via **CAL 1** and **CAL 2**. A calibration zero operation at this time ensures that the display zero and the **ZERO RANGE** reference zero are at the same point after a calibration. After a calibration the calibration zero can also be used to select a zero point other than the display zero as the reference for the **ZERO RANGE** function. For example if the **CAL ZERO** operation is carried out with a display reading of 500 and a **ZERO RANGE** reading of 10 the zero range function will allow the display to zero only if the current display reading is between 490 and 510. To perform a calibration zero press the **▲** and **▼** buttons simultaneously at the **CAL ZERO** function, a live reading will be seen, press the **0** button, the message **CAL ZERO End** should now be seen indicating that the instrument has accepted the zero point. Although the display reading will not change as a result of the calibration zero the input value on the display at the time of the operation will be the new zero reference point for the **ZERO RANGE** function.

USEF En 4 (4mA input scaling without a live input)

This calibration method can be used with 4-20mA inputs only. The instrument can be scaled for a 4-20mA input without a live input i.e. this is an alternative method to the **CAL 1** and **CAL 2** method of scaling. To perform the first point (**En 4**) scaling simply press the **▲** and **▼** buttons simultaneously when the **USEF En 4** function has been reached. The display will now indicate a value. Use the **▲** or **▼** button to change this value to the scale value required for a 4mA input. Once the **USEF En 4** scaling has been completed, the **USEF En 20** function should be completed, see below.

USEF En 20 (20mA input scaling without a live input)

This calibration method can be used with 4-20mA inputs only. The same method described in **USEF En 4** above can be used to scale the instrument for a 20mA input. Again use the **▲** or **▼** button to change the value displayed to the scale value required for a 20mA input.

Example : If the 4-20mA input is to be scaled so that the display reads **0** at 4mA and **5000** at 20mA then **USEF En 4** should be set to **0** and **USEF En 20** should be set to **5000**.

UCAL (uncalibrate)

Used to set the instrument back to the factory calibration values. This function should only be used when calibration problems exist, and it is necessary to clear the calibration memory. To reset the instrument calibration press **▲** and **▼** together at the **UCAL** function. The message **CAL CLR** should be seen.

P.butt (P button function)

The **P** button may be set to operate some of the remote input functions, see **F.I RP** below for a description of these functions. If both the remote input and **P** button function are operated simultaneously the **P** button will override the remote input. The functions below are as described in the **F.I RP** function above with the exception of the **P.SET** function.

Functions available are:

NONE, H, Lo, H Lo, TARE or ZERO

Note: To prevent accidental operation of the **P** button in the **TARE** or **ZERO** functions it is necessary to hold the button in for 2 seconds to perform the selected operation.

F.I RP (remote input function)

See the “Electrical Installation” chapter for the location of the remote input electrical connector. When these pins are short circuited, via a pushbutton or keyswitch the instrument will perform the selected remote input function. A message will flash to indicate which function has been selected when the remote input pins are short circuited. The remote input functions are as follows:

NONE - no remote function required.

P.Hld - peak hold. The display will show the peak value only whilst the remote input pins are short circuited.

d.Hld - display hold. The display value will be held whilst the remote input pins are short circuited.

H - peak memory. The peak value stored in memory will be displayed if the remote input pins are short circuited, if the short circuit is momentary then the display will return to normal measurement after 20 seconds. If the short circuit is held for 1 to 2 seconds or the power is removed from the instrument then the memory will be reset.

Lo - valley memory. The minimum value stored in memory will be displayed. Otherwise operates in the same manner as the **H** function.

H Lo - toggle between **H** and **Lo** displays. This function allows the remote input to be used to toggle between peak and valley memory displays. The first operation of the remote input will cause the peak memory value to be displayed, the next operation will give a valley memory display. **PH** or **PLo** will flash before each display to give an indication of display type.

TARE - display tare. Short circuiting the remote input pins momentarily will allow toggling between nett and gross values (shown as **NETT** and **GROSS**). If the remote input is short circuited for approx. 2 seconds the display will be tared and will show zero. The tare will be lost if power is removed.

ZERO - display zero. Zeroes the display in same manner as the tare function except that the zero is not lost when power is removed and the display will zero as soon as the remote input is short circuited.

SP.AC - setpoint access only. This blocks access to any functions except the alarm setpoint functions unless the remote input pins are short circuited or entry is made via **CAL** mode.

No.AC - no access. This blocks access to all functions unless the remote input pins are short circuited or entry is made via **CAL** mode.

CAL.S - calibration select. The remote input can be used to select between calibration scaling values. Two different sets of calibration values, decimal points and display units can be entered in the LD4, one set with the remote input open circuit and another set with the remote input short circuit to ground. The remote input can then be used to switch between one set and the other. This feature can be used on all input ranges. For example: With the remote input open circuit a 4-20mA input can be scaled (using **CAL 1 & CAL 2** or **USER En4** and **USER En20**) to read **0** to **100** over the 4-20mA range. With the remote input short circuit to ground the scaling can be repeated using figures of **0** to **5000** for the 4-20mA range. The remote input can be used to switch between ranges. In this example the first scaling could represent a % figure and the second scaling could represent the actual process units (litres, kg, volts etc).

dULL - display brightness control. The remote input can be used to change the display brightness. When this mode is selected the display brightness can be switched, via the remote input, between the brightness level set at the **brgt** function and the brightness level set at the **dULL** function.

NETT FLASH (nett value display mode)

The nett value is only seen when the remote input or **P** button is set to **LRFE**. The **NETT FLASH** function can be set to **ON** or **OFF**. If set to **ON** then the message **NETT** will flash briefly approximately every 6 seconds when the operator toggles to a nett display to remind the operator that a nett value is being viewed. If set to **OFF** then the message **NETT** will flash briefly once only when the operator toggles to the nett value.

ACCESS (access mode)

The access mode function **ACCESS** has four possible settings namely **OFF**, **EASY**, **NONE** and **ALL**. If set to **OFF** the mode function has no effect on alarm relay operation. If set to **EASY** the easy alarm access mode will be activated, see details at the beginning of this chapter preceding the **ALLO** function. If set to **NONE** there will be no access to any functions via **FUNC** mode, entry via **CAL** mode must be made to gain access to alarm and calibration functions. If set to **ALL** then access to all functions, including calibration functions, can be gained via **FUNC** mode.

SPAC (setpoint access)

Sets the access to the alarm relay set points. The following choices are available:

- R1** - Allows setpoint access to alarm 1 only.
- R1-2** - Allows access to alarms 1 and 2 only.
- R1-3** - Allows access to alarms 1, 2 and 3 only (requires optional relays to be fitted).
- R1-4** - Allows access to alarms 1, 2, 3 and 4 (requires optional relays to be fitted).

The remote input function (**RI NP**) must be set to **SPAC** for this function to operate. **Note:** Only the setpoints which have been given a value will be accessible e.g. if **R1H** is set to **OFF** then there will be no access to the **R1H** function when **SPAC** is used.

SQR (square root)

Selects the square root scaling to **ON** or **OFF**. When set to on a square root function is applied to the input. When set to **OFF** the calibration is a linear function. Note: It is essential that the display is rescaled, using **CAL1** and **CAL2** or **USEREN4** and **USEREN20**, whenever the square root function is turned on or off.

When the square root facility is used the scaled displayed value follows the square root of the percentage of the full scale input value. The upper and lower input limits are set as normal as are the values to be displayed at these limits. For example if, for a 4 - 20mA input, you wish to display **0** at 4mA and **1000** at 20mA the square root function will calculate as follows:

- At 20mA (100%) the display will be **1000** i.e. $\sqrt{1} \times 1000$.
- At 16mA (75%) the display will be **866** i.e. $\sqrt{0.75} \times 1000$.
- At 12mA (50%) the display will be **707** i.e. $\sqrt{0.50} \times 1000$ and so on.

4.2 Lineariser functions

The following five functions are used to set up the lineariser table. The lineariser is of the X,Y type with space for up to 50 points to be programmed and stored. All points are stored in battery backed memory and will be retained when power is removed. Chapter 6 contains a table in which you can make a permanent written record of the points entered.

The X values for each point will actually be indicated as **P** (e.g. **P1**, **P2** etc.) since the seven segment display cannot show an X. The **P** values are normally entered either as a percentage of full scale input or as a direct representation of the input signal e.g. for a 4-20mA input you could either enter 4mA = **0.0** and 20mA = **100.0** or 4mA = **4.0** and 20mA = **20.0**. The value entered into the table must correspond with the initial calibration values (**CAL1** & **CAL2** or **USEREN4** & **USEREN20**). For example if a 4-20mA input is initially scaled to read from **0.0** to **100.0** then you cannot enter these values as **4.0** to **20.0** in the table (without causing errors in the reading). The number of decimal points available for entering **P** values is 1 decimal place.

The Y values are indicated as **Y** (e.g. **Y1**, **Y2** etc.) . These **Y** values represent the display required for the given **P** value entered. For example if **P3** = **25.0** and **Y3** = **1500** then **1500** will be displayed whenever that input is present.

Y values to be entered into the lineariser table must be either calculated or measured via a live input. Refer to the "Example" later in this chapter for an example of creating a lineariser table using live inputs.

TABLE (lineariser on or off)

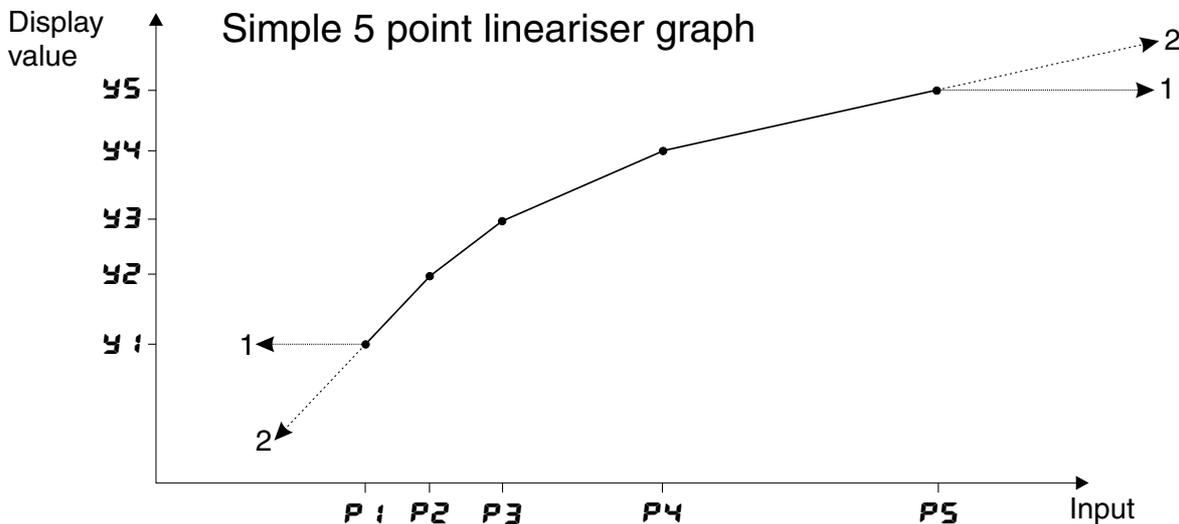
Allows the lineariser to be switched on (ON) or off (OFF). If it is switched off then none of the other lineariser functions will be seen on the display and the instrument will either operate as a linear display using the CAL 1 & CAL 2 or USER EN 4 & USER EN 20 scaling values or as a square root law display if the SQRT function is set to ON.

TABLE STOP (mode of operation at points outside the table range)

This function sets the mode in which the instrument will behave when a value is input which is higher than the largest value entered in the table or lower than the smallest value entered in the table. Refer to the graph above.

If set to ON then the display value will remain equal to the nearest table entry value. For example if the lowest table entry is made at 8mA and the display indicates 500 at this value then any input lower than 8mA will also cause the display to indicate 500.

If set to OFF then the display value will continue to change when an input outside the table limits in encountered. The instrument will extrapolate the reading using the slope of the previous pair of points.



Arrows labelled "1" show the effect of TABLE STOP function = ON
 Arrows labelled "2" show the effect of TABLE STOP function = OFF

SCALE STEP (table rounding value)

This function allows a rounding value to be set for Y entries. Options provided are 1, 2, 5, 10, 20, 25, 50, 100, 250, 500 or 1000. For example if the rounding value is set to 25 then the Y entries will jump in steps of 25 i.e. 0, 25, 50, 75 etc. (or 0.00, 0.25 etc. depending on decimal place setting). This rounding factor is useful in that it allows the speeding up of entries into the table, it does not cause the final display value to jump in steps. Use the DRND function if you wish to cause the final display value to also jump in these steps.

TABLE POINTS (number of table points)

Displays and sets the number of points in the lineariser table. Select the number you require and enter that number of points. If you wish to increase or decrease the number of points then the TABLE POINTS value can be changed at a later stage.

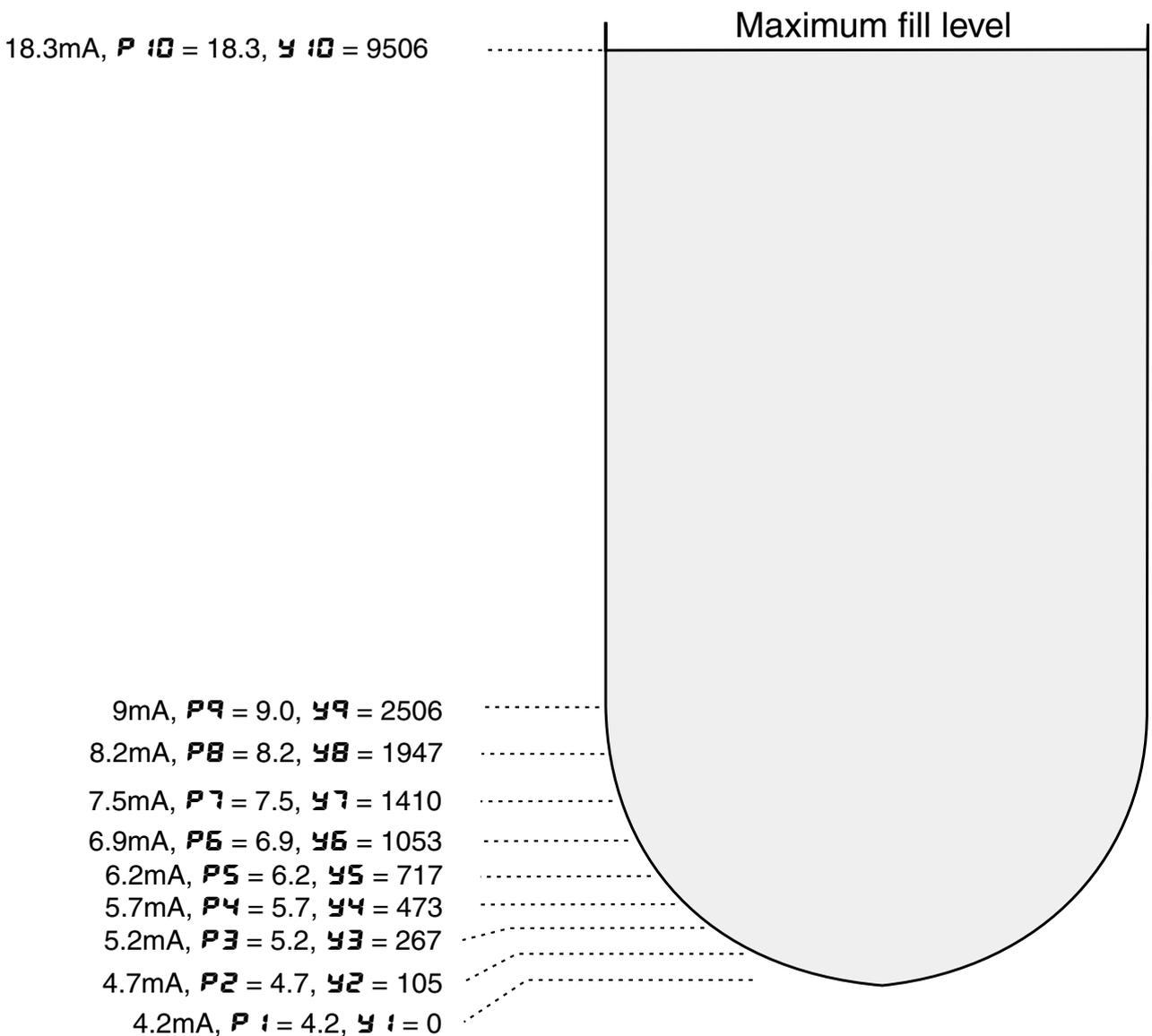
SEt tAbL (enter values into the table)

This function allows values to be entered into the lineariser table. Entries to the table do not need to be in any ascending or descending order since the instrument will automatically arrange the points in order at the end of the entry sequence. The procedure for entering points is:

1. Ensure that the correct number of points required has been set in the **tAbL PntS** function.
2. Complete the lineariser table given in Chapter 6 by calculation or measurement of values.
3. At the **SEt tAbL** function press the **▲** and **▼** buttons simultaneously.
4. The display will show **P 1** indicating the first linearising point followed by the first **P** value in memory, use the **▲** or **▼** button to adjust this to the required first input point value.
5. Press the **F** button, the display will indicate **Y 1** followed by the first **Y** value in memory, again use the **▲** or **▼** to make any changes to the value required.
6. Press the **F** button, the display will indicate **P 2** followed by the second **P** value in memory. Repeat the process described in steps 4 and 5 until all points have been entered.

Example

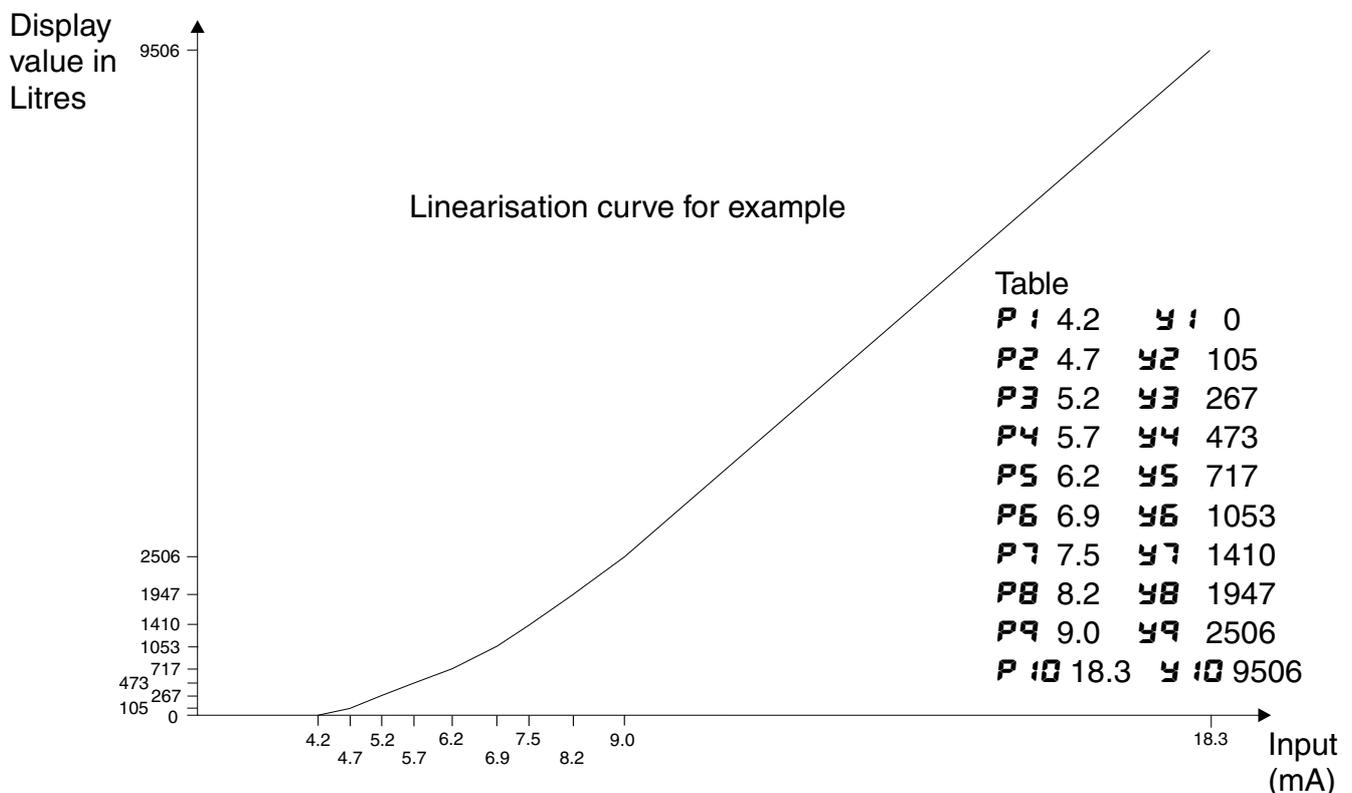
A pressure transmitter with a 4-20mA output is installed near the base of an irregularly shaped tank, see diagram below, which contains a liquid. The transmitter is connected to a LD4-LN and 10 linearising points are required to measure the number of litres in the tank. The output from the transmitter will be linear between P9 and P10 since the sides of the tank are straight. Most of the lineariser points are concentrated on the non linear (curved) parts of the tank i.e. the parts of the tank in which the output from the transducer will not be linear.



The procedure used is as follows, steps a. to n.:

- a. All general functions are set as required i.e. display rounding etc.
- c. Set the **LRBL** function to **on**. The **SRt** function should be set to **OFF**.
- c. Use **CAL 1 & CAL 2** or **USER En4 & USER En20** to scale the PM4 to show 4mA= **4.0**, 20mA= **20.0**.
- d. The tank is emptied and the transmitter is connected to the display, the tank will need to be gradually filled whilst the lineariser table (Chapter 6) record is completed. Note that the reverse process is equally valid i.e. starting with a full tank and gradually emptying it.
- e. The first reading is taken from the display (4.2 in this case) with the tank virtually empty this represents a reading of zero litres. The lineariser table is filled in for the first point, **P 1 = 4.2, Y 1 = 0**.
- f. The tank is now gradually filled and a flowmeter is used to measure the number of litres entering the tank. The panel meter reading will change as the tank is filled.
- g. The second reading is taken from the display (4.7 in this case), at this point 105 litres had been added to the tank. The lineariser table is filled in for the second point, **P 2 = 4.7, Y 2 = 105**.
- h. Repeat the filling procedure until all 10 points are recorded, the results in this example are shown in the example diagram and table.
- j. The figures from the written table record now need to be transferred to the instruments lineariser table memory. Set the **LRBL** function to **on** and the **LRBL Pnt 5** function to **10**.
- k. At the **SET LRBL** function press the **▲** and **▼** button simultaneously. The display will show **P 1** followed by a number, use the **▲** or **▼** button to change this number to **4.2**.
- l. Press, then release, the **F** button. The display will indicate **Y 1** followed by a number. Use the **▲** or **▼** button to change this to **0**.
- m. Press, then release, the **F** button. The display will indicate **P 2** followed by a number. Use the **▲** or **▼** button to change this to **4.7**.
- n. Repeat the process until all the **P** and **Y** values have been entered.

Continue pressing, then releasing, the **F** button until the **End** message is seen and the display returns to measurement mode.



Lo d: SP (low overrange limit value)

The display can be set to show an overrange message if the display value falls below the **Lo d: SP** setting. For example if **Lo d: SP** is set to **50** then once the display reading falls below **50** the message **-or-** or the display value (see **d: SP** function) will flash instead of the normal display units. This message can be used to alert operators to the presence of an input which is below the low limit. If this function is not required it should be set to **OFF** by pressing the  and  buttons simultaneously at this function.

Hi GH d: SP (high overrange limit value)

The display can be set to show an overrange message if the display value rises above the **Hi GH d: SP** setting. For example if **Hi GH d: SP** is set to **1000** then once the display reading rises above **1000** the message **-or-** or the display value (see **d: SP** function) will flash instead of the normal display units. This message can be used to alert operators to the presence of an input which is above the high limit. If this function is not required it should be set to **OFF**.

d: SP (display overrange warning flashing mode)

This function is used in conjunction with the **Lo** and **Hi GH d: SP** functions. The **d: SP** function can be set to **FLASH** or **-or-**. If the value set at the **Lo** or **Hi GH d: SP** function is exceeded and the **d: SP** function is set to **FLASH** then the display value will flash on for approximately one second and off for approximately one second as a warning. If the value set at the **Lo** or **Hi GH d: SP** function is exceeded and the **d: SP** function is set to **-or-** then the **-or-** message will flash on for approximately one second and off for approximately one second as a warning. The warning flashes will cease and the normal display value will be seen when the value displayed is higher than the low limit and lower than the high limit.

R 1 (alarm 1 operation mode)

The alarm mode function allows the selected alarm relay to follow either the live input value (**L, UE**), the tare function (**TAPE**), the peak hold function (**P.HLD**), the display hold (**d.HLD**), the peak memory (**H**) or valley memory (**Lo**) or the display value (**d: SP**). For settings other than **d: SP** operation a remote input or  button must also be set to the function required.

Example 1 - R 1 is set to L, UE

With the alarm function set to **L, UE** the alarm relay operation will follow the live input based on the electrical inputs and scaling values used when the instrument is calibrated. If the value on the display has been altered from the calibration scaling values e.g. via a tare operation then the alarm operation will ignore the display changes caused by the tare operation. For example if **R 1H** is set to **100** then alarm relay 1 will activate if the display reading goes to **100** or above. If a tare operation is now carried out when the display value is **20** then the tare will cause the display value for that input to fall to zero. The alarm relay will now activate at display value of **80** or above since the live electrical input for a tared display of **80** is the same as it was for a value of **100** prior to the tare operation.

Example 2 - R 1 is set to TAPE and F: NP (remote input special function) is set to TAPE.

Assume that **R 1H** is set to **100** and that the instrument is given a remote tare when the display reads **40**. Once the instrument is tared the display will read **0**. Alarm relay 1 is set to follow the tare value and will therefore operate when the (nett) display becomes greater than **100**.

Example 3 - R 1 is set to P.HLD and F: NP is set to P.HLD

If **R 1H** is set to **100** then it will operate whenever the display shows a value over **100**. If the peak value exceeds **100** when the remote input is closed then alarm 1 will activate and will not reset until the remote input opens **and** the display value falls below **100**.

Example 4 - R 1 is set to d.HLD and F: NP is set to d.HLD

If **R 1Lo** is set to **5** then it will operate whenever the display shows a value below **5**. If the display hold remote input is operated at a value above **5** then the alarm will not activate whilst the remote input remains closed, no matter what the electrical input. Likewise if the remote input is operated at a value below **5** then alarm will not de activate until the remote input is opened and the display value goes above 5.

Example 5 - R 1 is set to H, and F: NP is set to H,

If **R 1H** is set to **50** and the peak memory value becomes greater than **50** then alarm relay 1 will be constantly activated at this point and will only become de activated when the memory is reset at a value below **50**. The memory can be reset by holding the remote input closed for 2-3 seconds. Note that in

this case the alarm can be activated even if the display value is less than the alarm setting, this is because the alarm is activated by the value in peak memory rather than the display value.

Example 6 - $R1$ is set to $L0$ and $F1 NP$ is set to $L0$

If $R1 L0$ is set to **280** and the valley memory value becomes less than **280** then alarm 1 will be constantly activated at this point and will only become de activated when the memory is reset at a value above **280**. The memory can be reset by holding the remote input closed for 2-3 seconds. Note that in this case the alarm can be activated even if the display value is greater than the alarm setting, this is because the alarm is activated by the value in valley memory rather than the display value.

Example 7- $R1$ is set to $d1 SP$

With the alarm function set to follow the display value the alarm relay will activate whenever the display shows an alarm condition, irrespective of any alteration to the original scaling values due to a tare, zero, peak memory etc. operation. Thus if $R1 L0$ is set to **50** and $R1 H1$ is set to **100** then alarm relay 1 will activate whenever the value shown on the display falls below **50** or goes above **100**. If the $F1 NP$ function is now set to $H1$ (peak memory) and the peak memory value is **100** or greater then the alarm relay will be activated whenever the remote input is used to display the $H1$ value, irrespective of the live input at the time.

$R2, R3$ & $R4$ (alarm 2, 3 & 4 operation mode)

Operates as per $R1$ above but affects alarm relays 2, 3 & 4.

FEE (analog retransmission output mode) - seen only when analog retransmission option is fitted

The analog retransmission mode function allows the selected retransmission output to follow either the live input value ($L1 UE$), the tare function ($TRFE$), the peak hold function ($P.HLD$), the display hold ($d.HLD$), the peak memory ($H1$) or valley memory ($L0$) or the display value ($d1 SP$). For settings other than $d1 SP$ operation a remote input or P button must also be set to the function required. These settings affect the retransmission output in the same manner as the equivalent settings affect the alarm relay operation - see $R1$ function for details.

$BAUD$ (Set baud rate) - seen only with serial output option.

Select from **300, 600, 1200, 2400, 4800, 9600, 19.2** or **38.4** baud.

$PRTY$ (Set parity) - seen only with serial output option.

Select parity check to either **NONE, EVEN** or **odd**.

$Q.PUL$ (Set serial interface mode) - seen only with serial output option. Refer to "Optional Outputs" appendix in this manual for a full description of the $d1 SP$, $Cont$, $POLL$ and $n.buS$ modes.

Allows user to select the serial interface operation as follows:-

$d1 SP$ Sends image data from the display without conversion to ASCII.

$Cont$ Sends ASCII form of display data every time display is updated.

$POLL$ Controlled by computer or PLC as host. Host sends command via RS232/485 and instrument responds as requested.

$Addr$ (Set unit address for polled (POLL) mode (0 to 31)) - seen only with serial output option.

Allows several units to operate on the same RS485 interface reporting on different areas etc. The host computer or PLC may poll each unit in turn supplying the appropriate address.

The unit address ranges from 0 to 31 (DEC) but is offset by 32 (DEC) to avoid clashing with ASCII special function characters (such as <STX> and <CR>). Therefore 32 (DEC) or 20 (HEX) is address 0, 42 (DEC) or 2A (HEX) addresses unit 10.

$SEFL$ (Serial retransmission mode) - seen only with serial output option - applies only when $Q.PUL$ function set to $Cont$.

Refer to FEE function on for function description. The $H1, L0$ selection in this functions allows both the peak and valley memories to be transmitted. The peak value will be transmitted followed by a space then the valley value.

4.3 Error Messages

CRAL Errr - This indicates that one of the calibration points has caused an overrange error in the analog to digital converter. Check the input link settings against the live input then try calibration again.

SPAN Errr - This indicates that the calibration points entered were too close together. Try calibrate again with the points further apart. The calibration points should be at least 10% of full scale apart, ideally as close to 100% of full scale as possible.

ZERO RANGE Errr - This indicates that an attempt to zero or preset a value on the display has failed due to the **ZERO RANGE** function value being exceeded. Check the **ZERO RANGE** function setting, if this is set at the required figure and the display value seems to be within the zero range limits then it could be that previous zero operations have caused the limit to be exceeded.

" - - - -" - This display indicates that the actual input is higher than the input link settings e.g. a 10V input being used when the link settings are for a 0 to 1V input. Check the link settings and the live input value.

" - o r -" - This display indicates an overrange reading. This could be due to the instrument not being able to display the number because it is too large e.g. above 9999 on a 4 digit display. Alternatively it could mean that the **Lo** or **Hi SH d: SP** limit value has been exceeded and the instrument is showing a warning message.

Value on display flashing - this means that the **Lo** or **Hi SH d: SP** limit value has been exceeded and the instrument is showing a warning message.

Returning to normal measure mode

When the calibration has been completed it is advisable to return the instrument to the normal mode (where calibration functions cannot be tampered with). To return to normal mode, turn off power to the instrument, wait a few seconds and then restore power.

5 Function Table

Initial display	Meaning of display	Next display	Default Setting	Record Your Settings
RxLo	Relay low setpoint value	Setpoint value or OFF	OFF	See following table
RxHi	Relay high setpoint value	Setpoint value or OFF	OFF	See following table
RxHY	Alarm relay hysteresis	Hysteresis value in measured units	1	See following table
Rxtt	Alarm relay trip time	No of seconds before relay trips	0	See following table
Rxrt	Alarm relay reset time	Reset time in seconds	0	See following table
Rxn.o or Rxn.c	Alarm relay action N/O or N/C	A in.o or A in.c	A in.o	See following table
Rx.SP or Rx.t!	Setpoint or trailing alarm relay	Rx.SP or Rx.t!	Rx.SP	See following table
brgt	Display brightness	1 to 15	15	
dULL	Remote display brightness switching	0 to 15	1	
The functions below are only accessible via CAL mode or if ACCS function is set to ALL				
rEC-	Recorder output low limit	Value in memory	0	
rEC+	Recorder output high limit	Value in memory	1000	
drnd	Display rounding selects resolution	Value in memory	1	
dCPt	Display decimal point	Decimal point position (e.g. 0.0 , 10.02 or 0.003)	0	
FLtr	Digital filter range 0 to 8	0 to 8 (8 =most filtering)	3	
FECctr!	See "Analog PI Control Output" for optional analog PI control functions			
CAL 1	First scaling point	Live reading	n/a	
CAL 2	Second scaling point	Live reading	n/a	
CAL OFSt	Offset to calibration	Live Reading	n/a	
ZER0 RNgE	Zero range limit	Limit value or OFF	1000	
CAL ZER0	Zero point calibration	0	n/a	
USEFEn4	4mA input scaling	Value in memory	n/a	
USEFEn20	20mA input scaling	Value in memory	n/a	
UCAL	Uncalibrate	CAL CLR	n/a	
P.but	 button function	NONE , H , Lo , H , Lo , tARF or ZER0	NONE	
F.I NP	Remote input function	NONE , PHLd , dHLd , H , Lo , H , Lo , tARF , ZER0 , SP.AC , No.AC , CAL.S or dULL	NONE	
NEtt FLSH	Nett viewing mode	on or OFF	OFF	
ACCS	Access mode	OFF , ERSY , NONE or ALL	OFF	

Initial display	Meaning of display	Next display	Default Setting	Record Your Settings
SPAC	Setpoint access	R 1, R 1-2 etc.	R 1	
SQRt	Square root operation	OFF or on	OFF	
tAbL	Lineariser on/off	on or OFF	OFF	
tAbL StOP	Operation mode at table limits	on or OFF	OFF	
SCALE tbi E	Scaling (rounding) factor for lineariser Y values	1.2.5. 10.20.25.50. 100.250.500 or 1000	1	
tAbL PntS	Number of points for lineariser	2 to 50	2	
SEt tAbL	Enter points into lineariser table	P 1	n/a	
Lo dI SP	Display low overrange	Limit value or OFF	OFF	
Hi GH dI SP	Display high overrange	Limit value or OFF	OFF	
dI SP	Overrange display warning flashing mode	FLSH or -or-	FLSH	
R 1, R2 etc.	Alarm relay operation mode	L, uE, tARFE, P.HLd, d.HLd, H, Lo or dI SP	L, uE	See following table
FEC	Analog retransmission output mode.	L, uE, tARFE, P.HLd, d.HLd, H, Lo, d, SP or H, Lo	L, uE	
bAUD	Baud rate	300.600. 1200. 2400.4800.9600. 192 or 38.4	9600	
Prty	Parity	NONE, EVEN or odd	NONE	
D.PuE	Communication mode	d, SP, Cont or POLL	Cont	
Addr	Unit address	0 to 31	0	
SEFL	Serial communication output mode.	L, uE, tARFE, P.HLd, d.HLd, H, Lo, d, SP or H, Lo	L, uE	

Note: Functions shown shaded on this table will be displayed, only when those particular options are fitted.

Settings for relays - record settings here				
	A1	A2	A3 (optionally fitted)	A4 (optionally fitted)
RxLo				
RxH,				
RxHy				
RxtE				
Rxrt				
Rxn.o or Rxn.c				
Rx.SP or Rx.t 1				
Rx				

6 Lineariser table

Lineariser Table Complete and retain for reference							
P Value		Y Value (Value to be displayed)		P Value		Y Value (Value to be displayed)	
P1		Y1		P26		Y26	
P2		Y2		P27		Y27	
P3		Y3		P28		Y28	
P4		Y4		P29		Y29	
P5		Y5		P30		Y30	
P6		Y6		P31		Y31	
P7		Y7		P32		Y32	
P8		Y8		P33		Y33	
P9		Y9		P34		Y34	
P10		Y10		P35		Y35	
P11		Y11		P36		Y36	
P12		Y12		P37		Y37	
P13		Y13		P38		Y38	
P14		Y14		P39		Y39	
P15		Y15		P40		Y40	
P16		Y16		P41		Y41	
P17		Y17		P42		Y42	
P18		Y18		P43		Y43	
P19		Y19		P44		Y44	
P20		Y20		P45		Y45	
P21		Y21		P46		Y46	
P22		Y22		P47		Y47	
P23		Y23		P48		Y48	
P24		Y24		P49		Y49	
P25		Y25		P50		Y50	

7 Analog PI Control Output

PI control functions will only be seen if the optional analog output is fitted.

The PI (proportional + integral) control output may be configured for proportional only (i.e. integral gain set to **0.000**) or proportional + integral control. The control output may be link selected as either a 4-20mA, 0-1VDC or 0-10VDC signal. The instrument will, using the control function settings described below, vary the control output signal in such a way that the process being monitored is kept as close as possible to the control setpoint.

The control may be turned on or off via the **FEECtrl** function. When the **FEECtrl** function is set to **OFF** the output will act as a retransmission output rather than a control output and the PI control functions will not be seen. When set to **on** the PI control functions will be seen but the standard retransmission functions (e.g. **FEE-** and **FEE+**) will not.

The best PI control results are usually achieved by initially configuring as a Proportional only controller and introducing the Integral control once stable results have been obtained from proportional only control.

7.1 Proportional control output

For proportional only control the output is found from:

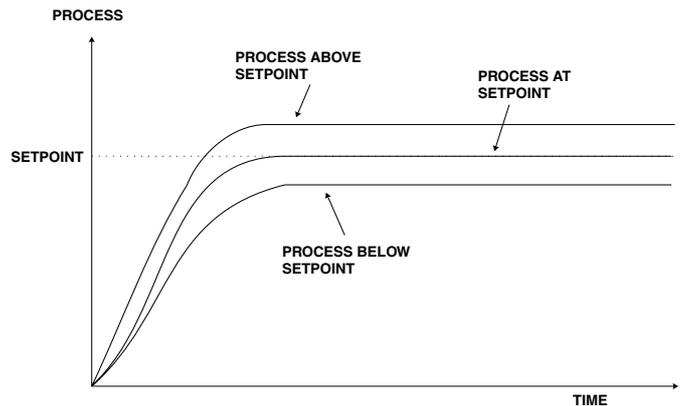
$$\text{Proportional control output} = \text{Error} \times \text{Proportional gain} + \text{Offset}$$

Where the Error is defined by the **C.SPAN** function, the Proportional gain is set by the **C.PG** function and the Offset is set by the **C.PO** function.

C.SET (control setpoint)

The control setpoint is set to the value in displayed engineering units required for control of the process. The controller will attempt to vary the control output to keep the process variable at the setpoint.

Note that the control setpoint can be made available in **FUNC** mode and in some cases in “easy access” mode via the **FEE SPAC** function described in this chapter.



FEECtrl (control enable)

This function determines whether the analog output will be used as a PI control output or as a retransmission output. When **on** is selected the analog output will be used as a control output, all of the control functions will be seen but no analog retransmission functions will be seen. When set to **OFF** the analog output will be used as a retransmission output, the retransmission functions, such as **FEE+**, **FEE-** and **FEE**, will be seen and the control functions will not appear on the display.

C.SPAN (proportional control span)

The function of the control span is to define the limit to which the proportional control values will relate. The span value defines the range over which the input must change to cause a 100% change in the control output when the proportional gain is set to 1.000. This function affects the overall gain of the controller and is normally set to the process value limits that the controller requires for normal operation. For example if the control setpoint (**C.SET**) is 50.0 and the **C.SPAN** is 15 then an error of 15 from the setpoint will cause a 100% change in proportional control output. For example, assuming that the control output is a 4-20mA signal, with **C.SET** at **50.0**, **C.SPAN** at **15.0**, **C.PG** at **1.000** and **C.PO** at **0.000** a display reading of 35.0 or lower (**C.SET - C.SPAN**) the control output will be at 100% i.e. 20mA. The control output will then gradually fall as the display value reaches the setpoint.

C₋PG (proportional gain)

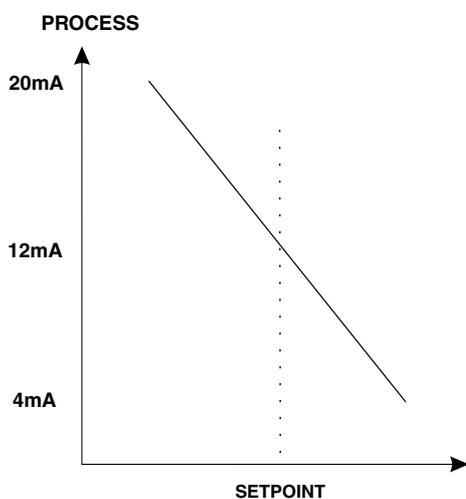
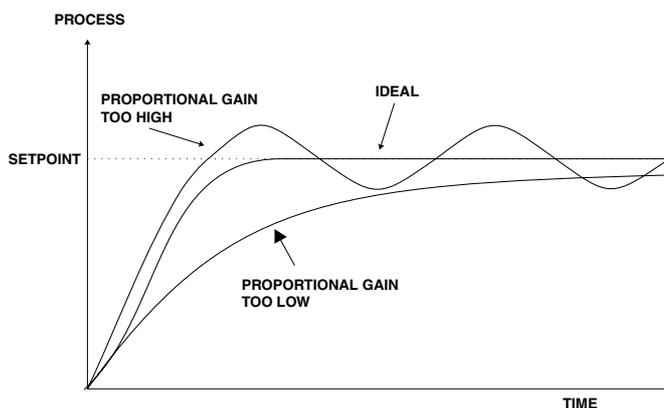
The proportional gain is the ratio between the change in measured input and change in control output. Too much proportional gain will result in instability.

Example 1, if the proportional gain is set to **1.000** and the measured input changes by 100% of the span set in **C₋SPN** then the output will change by 100%.

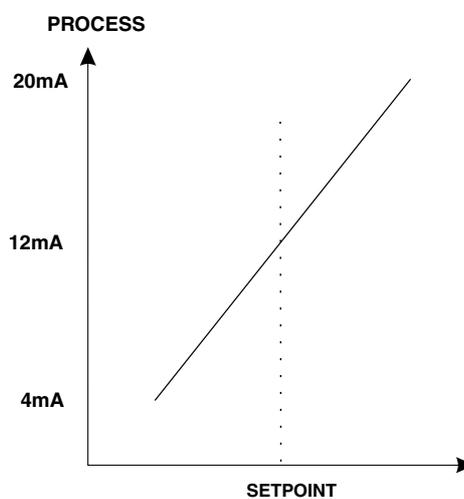
Example 2, if the proportional gain is set to **2.000** and the measured input changes by 50% of the range set in **C₋SPN** then the output will change by 100%.

Example 3, if the proportional gain is set to **2.000** and the measured input changes by 25% of the range set in **C₋SPN** then the output will change by 50%.

Setting a negative proportional gain will reverse the control output.



Positive **C₋PG** value e.g. **1.000**



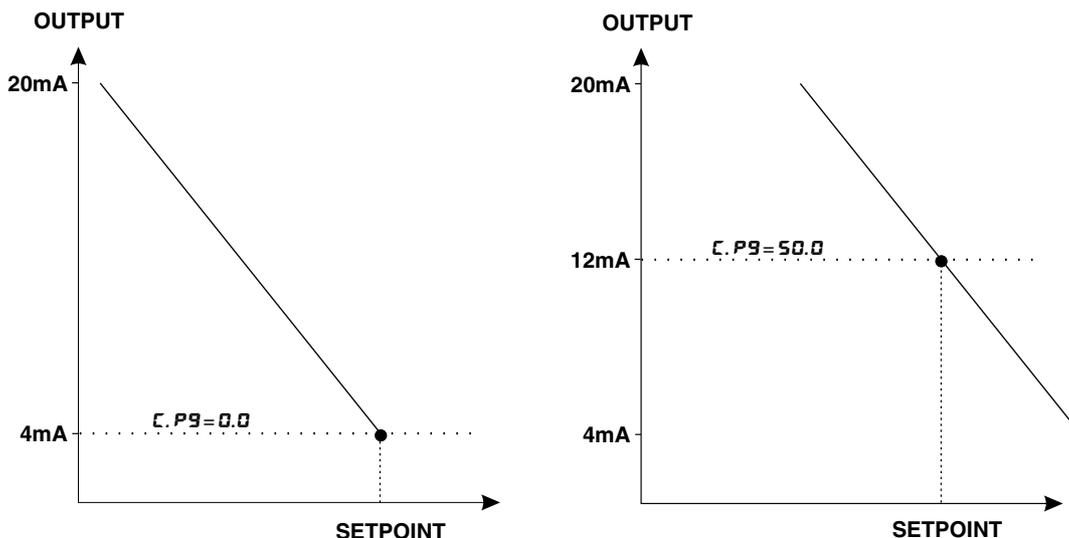
Negative **C₋PG** value e.g. **-1.000**

Effect of changing proportional gain and offset - C₋SPN = 2.00, R_{1:1} S = 0.000			
C₋SET	C₋PG	C₋PO	Effect on analog output (4-20mA used in this example)
7.00	1.000	0.0	Reading of 5.00 or below - 20mA output. Reading of 5.00 to 7.00 - mA output decreasing as reading approaches 7.00. Reading 7.00 and higher - 4mA output.
7.00	1.000	100.0	Reading of 7.00 or below - 20mA output. Reading of 7.00 to 9.00 - mA output decreasing as reading approaches 9.00. Reading 9.00 and higher - 4mA output.
7.00	1.000	50.0	Reading of 6.00 or below - 20mA output. Reading 6.00 to 8.00 - mA output decreasing as reading approaches 8.00 with 12mA output at 7.00. Reading 8.00 or above - 4mA output.
7.00	0.500	50.0	Reading of 5.00 or below - 20mA output. Reading 5.00 to 9.00 - mA output decreasing as reading approaches 9.00 with 12mA output at 7.00. Reading 9.00 or above - 4mA output.
7.00	-1.000	50.0	Reading of 6.00 or below - 4mA output. Reading 6.00 to 8.00 - mA output increases as reading approaches 8.00 with 12mA output at 7.00. Reading 8.00 or above - 20mA output.

£.P0 (proportional offset %)

The proportional offset is initially used to set the output value when operating the instrument as a proportional only controller. The proportional offset determines what % of the proportional control output will be given when the process value reaches the setpoint value. If set to **0.0** then there will be zero output (e.g. 4mA for a 4-20mA output) when the process value reaches the setpoint value. If set to **50.0** then there will be a 50% output (e.g. 12mA for a 4-20mA output) when the process reaches the setpoint value. If set to **100.0** then there will be a 100% output (e.g. 20mA for a 4-20mA output) when the process reaches the setpoint value.

If using proportional only control then when stable control is established there may be a difference between the process and the setpoint values. By altering the proportional offset value the difference may be minimised.



Proportional only control examples.

For a 4-20mA control output (0% = 4mA & 100% = 20mA) the setpoint is 7.0, the span is 2.0, the proportional gain is 1.000 and the offset is 0.0. If the reading on the display is 6.8 then the error is 10% (i.e. 10% of the span figure).

$$\text{Proportional control output} = \text{Error} \times \text{Proportional gain} + \text{Offset}$$

$$\text{Proportional control output} = 10\% \times 1 + 0\% = 10\% \text{ or } 5.6\text{mA}$$

If the proportional gain were to be changed to 2.000 then:

$$\text{Proportional control output} = 10\% \times 2 + 0\% = 20\% \text{ or } 7.2\text{mA}$$

If the proportional gain were to be changed to 0.500 then:

$$\text{Proportional control output} = 10\% \times 0.5 + 0\% = 5\% \text{ or } 4.8\text{mA}$$

If the offset were now to be changed to 50.0 (50%) then:

$$\text{Proportional control output} = 10\% \times 0.5 + 50\% = 55\% \text{ or } 12.8\text{mA}$$

7.2 Integral control output

The integral control output can be found from:

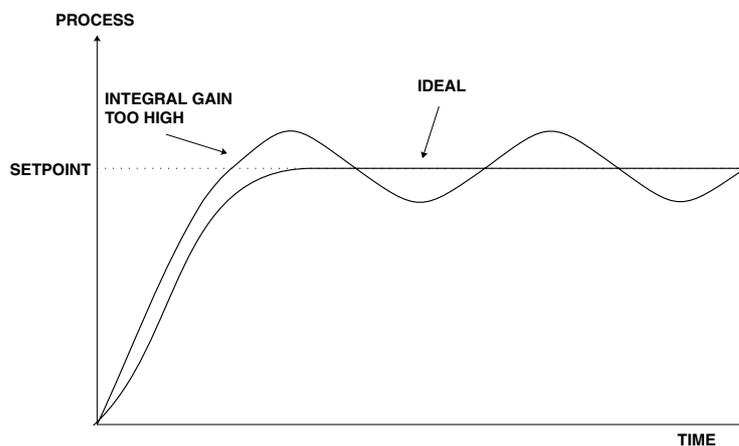
$$\text{Integral control output} = \frac{\text{error} \times \text{Ig} \times \text{time (secs.)}}{60} + \text{previous integral control output}$$

Where Ig is the integral gain set via the **£.I9** function.

£.I9 (integral gain)

The integral control action will attempt to correct any offset which the proportional control action is unable to correct (e.g. errors due to a changing load). When the integral gain is correctly adjusted the control output is ramped up or down to maintain control by keeping the process variable at the same value as the control setpoint. An integral gain which is too large will cause a rapid response to any error but can also lead

to overshooting and oscillation. An integral gain which is too small will slow the time taken to reach the setpoint. The optimum value chosen will depend on the lag time of the process and other control settings. Start with a low figure and increase until a satisfactory response time is reached. The integral gain figure has units of gain/minute and may be set in the range from approx. -19.999 to 32.767.



Setting a negative integral gain will reverse the integral control action. If introduction of an integral gain figure causes the error to increase i.e. the process value is moving further away from the setpoint then check the sign of the

integral gain e.g. if it is negative change it to a positive value. Note that the sign of the integral gain value should be the same as the proportional gain value i.e. they should either both be positive or both be negative.

I L H (high limit of integral term)

The high limit sets the maximum control output for the integral term i.e. puts a high level limit to the integral control current or voltage output. The limit is used to reduce available output swing and hence limit the effect of integral control output build up which can cause overshoot and instability in the system. If the process value is not close to the setpoint value then the integral control will see a large error. Since integral control output increases with time, the longer an error is seen the more the integral control output will build up. Unless the output is limited then once the process reaches the setpoint the integral control output can be very large (e.g. 100%) causing the process value to overshoot the control setpoint. A setting which is too high will result in allowing the integral control output to cause overshooting. A setting which is too low will result in the integral control output being limited to an extent which means that the setpoint cannot be reached. Start with a low figure e.g. 10.0 and increase the value until a satisfactory response is reached.

Maximum setting is 100.0 (100%). Having separate high and low limits is particularly useful if the process response is very one directional. For example in temperature control a heater may be used to give a fast response in heating a tank of liquid when the temperature falls below the setpoint. The heat of the liquid rises quickly but any overshoot will mean that the temperature is too high. The heater will be switched off but the tank of liquid will take a long time to cool to the setpoint level.

I L L (low limit of integral term)

This function sets the minimum control output for the integral term value and works in the same manner as **I L H** described above except that the setting controls the low swing. Maximum setting is 100.0 (100%).

F E C S P A C (control setpoint access)

This function determines whether the control setpoint function **C S E T** can be accessed via **F U N C** mode or whether entry via **C A L** mode is needed to access **C S E T**. If the operator is to have access to the **C S E T** function (via **F U N C** mode) then set the **F E C S P A C** function to on. To make the access to the **C S E T** function more difficult (**C A L** mode) then set the **F E C S P A C** function to **O F F**.

Note that in some models e.g. PM4-IV, the control setpoint value can be reached and adjusted via the “easy access” mode (see “Explanation of functions” chapter in the main manual). The **A C C S** function must be set to **E A S Y** and the **F E C S P A C** function set to **o n** to allow “easy access”. This feature could be useful if the setpoint is to be frequently changed.

If no **F E C S P A C** is set to **o n** and **A C C S** is set to **E A S Y** but the easy access is not functioning then the “easy access” facility may not be available on that instrument.

Setting up the controller

1. Set the **F E C c t r i** function to **o n**.
2. Set the control setpoint **C S E T** to the required setting.
3. Set the proportional control span **C S P A N** as required.

4. Set the proportional gain **C. P9** to an arbitrary value e.g. **1.000**.
5. Set the proportional offset **C. P0** to **0.0** (0%).
6. Set the integral gain **C. I 9** to **0.000** (i.e. off).
7. Set the integral high and low limits to an arbitrary value e.g. **20.00**.

Initialise the control system and monitor the control results. If the original settings causes process oscillations then gradually decrease the proportional gain until the oscillations decrease to an acceptable steady cycle. If the original settings do not cause process oscillations then gradually increase the proportional gain until a steady process cycling is observed.

Once the steady state is achieved note the difference between the display value and the control setpoint value. Gradually increase or decrease the proportional offset value until the displayed value matches the control setpoint value.

If process load changes occur then the proportional offset value may no longer be valid for offset free control. By introducing the integral action, setpoint offset caused by the process load changes will be minimised.

Gradually increase the integral gain until the process begins to oscillate. Then reduce the integral gain slightly to regain the control with minimum oscillation.

Alter the high and low integral limits to give the best regulation with minimum oscillation.

Create a step change to the process conditions and observe the control results. It may be necessary to fine tune the settings to obtain optimum results.

The table below summarises the effect of the main function settings.

Setup Functions	Symptom	Solution
Proportional gain	Slow response	Increase proportional gain
	High overshoot or oscillations	Decrease proportional gain
Proportional offset	Process continually either above or below setpoint	Increase or decrease offset to compensate
Integral gain	Slow response	Increase integral gain
	Instability or oscillations	Decrease integral gain

8 Specifications

8.1 Technical Specifications

Input types:	Link selectable $\pm 20\text{mA}$, 4-20mA, $\pm 100\text{mV}$, $\pm 1\text{V}$, $\pm 10\text{V}$ or $\pm 100\text{V}$
Impedance:	80 Ω (4-20mA or 0-20mA) or 1M Ω (DC Volts)
ADC Resolution:	1 in 20,000
Accuracy:	0.1% of full scale when calibrated
Sample rate:	4 per second
Lineariser table:	Selectable from 2 to 50 points (X,Y type)
Conversion method:	Dual slope ADC
Microprocessor:	MC68HC11 CMOS
Ambient Temperature:	-10 to 60°C,
Humidity:	5 to 95% non condensing
Power Supply:	AC 240V, 110V 50/60Hz or DC 15 to 24V non isolated or DC 12V, 24V or 48V isolated Supply type is factory configured
Outputs:	2 x Setpoint relays, form A, rated 5A at 240VAC
Power Consumption:	AC supply 15 VA max, DC supply, consult supplier (depends on display type & options)
Transmitter Supply:	+18V (nominal), 20mA max unregulated (AC powered models only)

8.2 Options

Relays 3 & 4	Same specifications as standard relays 1 & 2
Analog retransmission:	4-20mA, 0-1V or 0-10V
Serial communication:	RS232 or RS485 (ASCII)
Transducer Excitation:	24V ($\pm 12\text{V}$) regulated & isolated, 20mA max.

8.3 Physical characteristics

Model LD4-X-X-574	Case size (mm) = 255 x 145 x 125 Weight: = 1.3 kg
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9 Guarantee and Service

The product supplied with this manual is guaranteed against faulty workmanship for a period of 2 years from the date of dispatch.

Our obligation assumed under this guarantee is limited to the replacement of parts which, by our examination, are proved to be defective and have not been misused, carelessly handled, defaced or damaged due to incorrect installation. This guarantee is VOID where the unit has been opened, tampered with or if repairs have been made or attempted by anyone except an authorised representative of the manufacturing company.

Products for attention under guarantee (unless otherwise agreed) **must be returned to the manufacturer freight paid** and, if accepted for free repair, will be returned to the customers address in Australia free of charge.

When returning the product for service or repair a full description of the fault and the mode of operation used when the product failed must be given.

In any event the manufacturer has no other obligation or liability beyond replacement or repair of this product.

Modifications may be made to any existing or future models of the unit as it may deem necessary without incurring any obligation to incorporate such modifications in units previously sold or to which this guarantee may relate.

**This document is the property of
the instrument manufacturer
and may not be reproduced in whole or part without the
written consent of the manufacturer.**

This product is designed and manufactured in Australia.

Appendix - Optional outputs

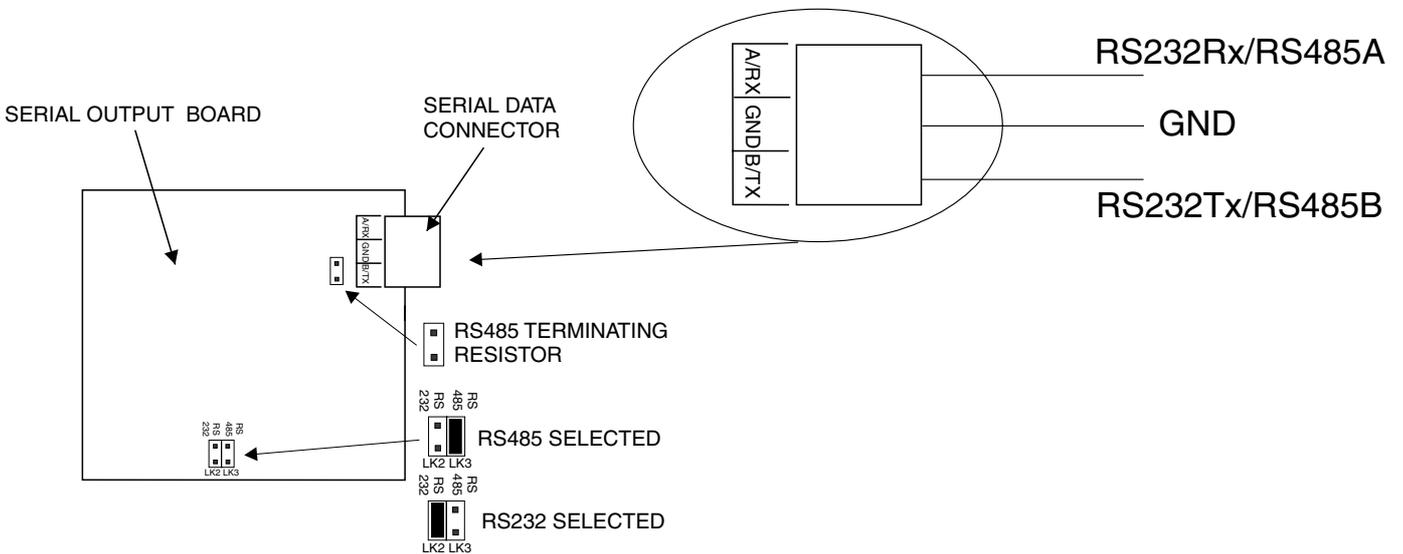
This appendix provides information required when an optional output is fitted to the LD4. For details of the optional isolated & regulated transmitter supply refer to the “Electrical Installation” chapter. The three remaining optional outputs are serial communications, analog retransmission or two extra setpoint relays. Note that only one of these three options can be fitted at any time.

Serial communications option

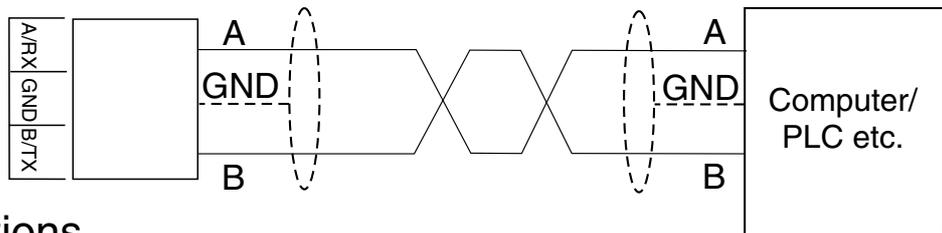
Electrical connections and output board links

See diagram below. Refer to “Electrical Installation” chapter for general information on electrical connections. External connections to the board are via plug in connectors with screw terminals these terminals allow for wires up to 1.5mm² to be fitted. Use twisted pair overall screened cable for RS485 and 3 core overall screened cable for RS232.

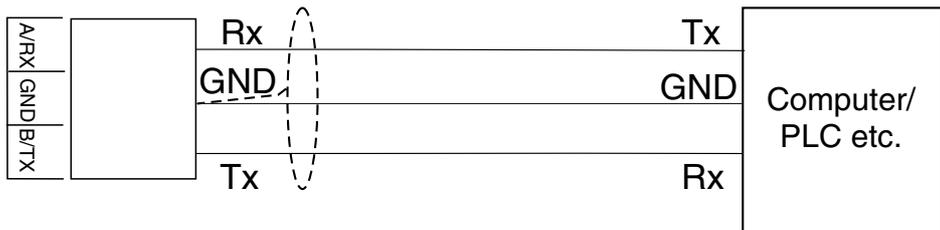
Ensure that the appropriate link is selected for RS232 or RS485. If RS232 is selected chip U1 should be in and chip U2 should be out. If RS485 is selected chip U1 should be out and chip U2 should be in. The RS485 terminating resistor link should be in if the LD4 is the first or last unit in a RS485 chain.



RS485 connections



RS232 connections



RS232/485 Operation and Commands

The RS232/485 interface is user selectable. The modes of operation available are as follows:-

d. SP - Image Display Mode:

In image display mode the display value is sent via RS232/RS485 as raw data in the following format:

<ESC> IXYYYY

Where: <ESC> is the ESCAPE character (27 Dec, 1B Hex)
I is the character 'I' (73 Dec, 49 Hex)
X is the number of image bytes in ASCII (31 to 38 Hex)
YYYY is the raw, 8 bit display data.

This information is output every display update (approx. 4 times per second - depending upon baud rate). The number of image bytes sent depends on the number of display digits present. This mode is suitable only when the receiving unit is produced by the same manufacturer as the PM4.

The most common usage would be to provide a large digit display for wide area viewing which just mimics the smaller display on the measuring instrument. The large digit displays automatically detect the image mode data and display the correct value accordingly. The data is in seven segment display image i.e. Bit 0 is segment A, Bit 1 is segment B etc.

Cont - Continuous Transmit Mode:

In this mode the display value is continually sent via the RS232/485 interface in ASCII format with 8 data bits + 1 stop bit. Data will be updated at approximately the same rate as the sample rate (approx. 4 times per second - depending upon baud rate). Refer to the **SEFL** function for choices of operation mode in continuous transmit mode. The format for this is as follows:-

<STX> XYYYY<CR>

Where: <STX> is start of text character (2 Dec, 02 Hex)
X SPACE (32 Dec, 20 Hex) for a positive value.
X '-' (45 Dec, 2D Hex) for a negative value.
YYYY is the display value in ASCII.
<CR> is a Carriage Return (13 Dec, 0D Hex)

e.g.: If the display is showing 123456 then the instrument will send
'02 31 32 33 34 35 36 0D' (HEX) to the host.

POLL - Host Controlled Transmit Mode:

This mode requires a host computer or PLC to poll the instrument to obtain display or other information or reset various setpoint parameters. Special communications software such as "Telix" is required when using POLL mode. Data is in ASCII format with 8 data bits + 1 stop bit. When polling the PM4 it is essential that the command characters are sent with less than a 10mS delay between them. This normally means that each command line must be sent as a whole string e.g. <STX>PA<CR> is sent as one string rather than <STX> on one line followed by P etc. If testing using "Telix" or other software this is normally achieved by allocating a command string to a function key. Whenever the function key is operated the whole string is sent. The format used is ASCII (8 data bits + 1 stop bit) so, for instance, if address 1 is used then the string <STX>PA<CR> must be put into "Telix", or similar program as:

^BP!^M

Where: ^B is the ASCII character for STX
P is the command line to transmit the primary display value
! is the ASCII character for address 1 (33 Dec of 21 Hex)
^M is the ASCII character for CR

A typical format for the host command is as follows:-

<STX>CA<CR> (Standard read etc.)
<STX>CA<CR>N<CR>YYYYY (Set Value Command)

Where: <STX> is Start of Text Character (2 Dec, 02 Hex, ^B ASCII)
 C is the command character (see following commands)
 A is the unit address (Range: 32 to 63 Dec, 20 to 3F Hex, "SPACE" to ? ASCII, the address is offset by 32 Dec, 20 Hex)
 <CR> is Carriage Return (13 Dec, 0D Hex, ^M ASCII)
 N is the setpoint number in ASCII e.g.: 1 for alarm 1 etc.
 X SPACE for positive and '-' for negative
 YYYY is the setpoint value in ASCII

The **POLL** commands available and instrument responses are as follows:

1. Transmit Primary Display Value: <STX>PA<CR>

e.g. ^BP!^M using Telix or similar (address 1).

Instructs unit to return the primary display value. The primary value is the live input reading. Format of returned data is:-

<ACK>PAXYYYY<CR>

Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
 P echo command received 'P' (80 Dec, 50 Hex)
 A is the responding unit's address
 X SPACE for positive and '-' for negative
 YYYY is the display value in ASCII
 <CR> is a Carriage Return (13 Dec, 0D Hex)

The number of display characters returned depends on the number of display digits present. If the decimal point is non zero then it will be sent in the appropriate place as '.' (46 Dec, 2E Hex).

2. Transmit Secondary Display Value: <STX>SA<CR>

e.g. ^BS!^M using Telix or similar (address 1).

Instructs the unit to send the secondary display value. The value will equal the primary display value if the **F.I. NP** function is set to **NONE**. If the **F.I. NP** function is set to **H, Lo, H, Lo, P.HLd** or **d.HLd** the value for the selected operation will be returned (note: For **H, Lo** the Hi value followed by the Lo value will be sent separated by a comma). Format of returned data is:

<ACK>SAYYYYY<CR> or
 <ACK>SAYYYYY,YYYY<CR> in the case of **H, Lo**

Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
 S echo command received 'S' (83 Dec, 53 Hex)
 A is the responding unit's address
 YYYY is the secondary display value in ASCII
 <CR> is a Carriage Return (13 Dec, 0D Hex)

3. Reset Special Function Value: <STX>RA<CR>

e.g. ^BR#^M using Telix or similar (address 3).

Instructs the unit to reset the special function value (if applicable). Will reset the stored value for Peak Hold, Valley High and Valley Low or will operate the tare or zero function if selected. Format of returned data is:-

<ACK>RA<CR>

Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
 R echo command received 'R' (82 Dec, 52 Hex)
 A is the responding unit's address
 <CR> is a Carriage Return (13 Dec, 0D Hex)

If special functions are not active then the invalid command message will be returned (refer Invalid Command later).

4. Read Low Alarm Setpoint: <STX>LA<CR>N<CR>

e.g. ^BL%^M2^M to read alarm 2 low setpoint value using Telix or similar (address 5).

Instructs unit to return value of low alarm setpoint.

Format of returned data is:

<ACK>LANXXXXX<CR>

- Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
- L echo command received 'L' (76 Dec, 4C Hex)
- A is the responding unit's address
- N is the setpoint number in ASCII e.g.: 31 Hex would be alarm 1 etc.
- X is SPACE for positive and '-' for negative
- YYYY is the setpoint value in ASCII
- <CR> is a Carriage Return (13 Dec, 0D Hex)

If setpoint number specified is not present the return string will have the setpoint number set to zero (i.e.: <ACK>LA0).

5. Read High Alarm Setpoint: <STX>HA<CR>N<CR>

e.g. ^BH*^M1^M to read alarm 1 high setpoint value using Telix or similar (address 10).

Instructs unit to return value of high alarm setpoint.

Format of returned data is:

<ACK>HANXXXXX<CR>

- Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
- H echo command received 'H' (72 Dec, 48 Hex)
- A is the responding unit's address
- N is the setpoint number in ASCII e.g.: 31 Hex would be alarm 1 etc.
- X is SPACE for positive and '-' for negative
- YYYY is the setpoint value in ASCII
- <CR> is a Carriage Return (13 Dec, 0D Hex)

If setpoint number specified is not present the return string will have the setpoint number set to zero (i.e.: <ACK>HA0).

6. Set Low Alarm Setpoint: <STX>IA<CR>N<CR>YYYY<CR>

e.g. ^BI!^M1^M500^M to set alarm 1 low setpoint to 500 using Telix or similar (address 1)

Instructs unit to change value of low alarm setpoint.

Format of returned data is:-

<ACK>IANXXXXX<CR>

- Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
- I echo command received 'I' (108 Dec, 6C Hex)
- A is the responding unit's address
- N is the setpoint number in ASCII e.g.: 31 Hex would be alarm 1 etc.
- X is SPACE for positive and '-' for negative
- YYYY is the setpoint value in ASCII
- <CR> is a Carriage Return (13 Dec, 0D Hex)

If setpoint number specified is not present the return string will have the setpoint number set to zero (i.e.: <ACK>IA0XXXXX).

7. Set High Alarm Setpoint: <STX>hA<CR>N<CR>YYYY<CR>

e.g. ^Bh!^M1^M1000^M to set alarm 1 high setpoint to 1000 using Telix or similar (address 1)

Instructs unit to change value of high alarm setpoint. Format of returned data is:-

<ACK>hANXXXX<CR>

Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
h echo command received 'h' (104 Dec, 68 Hex)
A is the responding unit's address
N is the setpoint number in ASCII e.g.: 31 Hex would be alarm 1 etc.
X is SPACE for positive and '-' for negative
YYYY is the setpoint value in ASCII
<CR> is a Carriage Return (13 Dec, 0D Hex)

If setpoint number specified is not present the return string will have the setpoint number set to zero (i.e.: <ACK>hA0XXXX).

8. Tare Using Current Display Value: <STX>TA<CR>

e.g. ^BT\$^M using Telix or similar (address 4).

Instructs the unit to tare the instrument using the current display value (if tare has been selected in special functions mode). Format of returned data is:-

<ACK>TA<CR>

Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
T is echo command received 'T' (84 Dec, 54 Hex)
A is the responding unit's address
<CR> is a Carriage Return (13 Dec, 0D Hex)

If tare is not valid then the invalid command message will be returned (refer Invalid Command later).

9. Transmit Instrument Model and Version: <STX>IA<CR>

e.g. ^BI!^M using Telix or similar (address 1)

Instructs unit to return the model and version number of the instrument. Format of returned data is:-

<ACK>IACCX.X<CR>

Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
I is echo command received 'I' (73 Dec, 49 Hex)
A is the responding unit's address
CC is a one or two character model identifier (e.g.: 'E')
X.X is the version number (e.g.: '0.1')
<CR> is a Carriage Return (13 Dec, 0D Hex)

10. Invalid Command

If the command received from the host is not valid then the unit will return the following:-

<ACK>?A<CR>

Where: <ACK> is Acknowledge (6 Dec, 06 Hex)
? is the character '?' (63 Dec, 3F Hex)
A is the responding unit's address
<CR> is a Carriage Return (13 Dec, 0D Hex)

If the address received from the host does not match the units address then the unit will not respond at all.

Other commands may be added to suit the particular configuration of each instrument. Value read commands will have the same format as the Transmit Primary Value command. Set Value commands will have the same format as the Set Low Alarm Setpoint command etc.

Host Timing Requirements for RS485 Operation:

RS485 operation requires the host to switch the RS485 transceiver to transmit before a command is sent. The instrument is capable of replying after 1 to 2 milliseconds. Therefore the host should switch the RS485 transceiver back to receive mode within 0.5 milliseconds after the last character of the command has been sent to ensure correct operation.

ASCII Code Conversion Listing

ASCII for control characters is shown in brackets. e.g. STX is entered as ^B if typing into a communications package for computer communication .

ASCII Char.	Dec	Hex	ASCII Char.	Dec	Hex
NUL (^@)	000	00	SP ()	032	20
SOH (^A)	001	01	!	033	21
STX (^B)	002	02	“	034	22
ETX (^C)	003	03	#	035	23
EOT (^D)	004	04	\$	036	24
ENQ (^E)	005	05	%	037	25
ACK (^F)	006	06	&	038	26
BEL (^G)	007	07	‘	039	27
BS (^H)	008	08	(040	28
HT (^I)	009	09)	041	29
LF (^J)	010	0A	*	042	2A
VT (^K)	011	0B	+	043	2B
FF (^L)	012	0C	,	044	2C
CR (^M)	013	0D	-	045	2D
SO (^N)	014	0E	.	046	2E
SI (^O)	015	0F	/	047	2F
DLE (^P)	016	10	0	048	30
DC1 (^Q)	017	11	1	049	31
DC2 (^R)	018	12	2	050	32
DC3 (^S)	019	13	3	051	33
DC4 (^T)	020	14	4	052	34
NAK (^U)	021	15	5	053	35
SYN (^V)	022	16	6	054	36
ETB (^W)	023	17	7	055	37
CAN (^X)	024	18	8	056	38
EM (^Y)	025	19	9	057	39
SUB (^Z)	026	1A	:	058	3A
ESC (^[)	027	1B	;	059	3B
FS (^)	028	1C	<	060	3C
GS (^)	029	1D	=	061	3D
RS (^)	030	1E	>	062	3E
US (^_)	031	1F	?	063	3F

@	064	40	,	096	60
A	065	41	a	097	61
B	066	42	b	098	62
C	067	43	c	099	63
D	068	44	d	100	64
E	069	45	e	101	65
F	070	46	f	102	66
G	071	47	g	103	67
H	072	48	h	104	68
I	073	49	i	105	69
J	074	4A	j	106	6A
K	075	4B	k	107	6B
L	076	4C	l	108	6C
M	077	4D	m	109	6D
N	078	4E	n	110	6E
O	079	4F	o	111	6F
P	080	50	p	112	70
Q	081	51	q	113	71
R	082	52	r	114	72
S	083	53	s	115	73
T	084	54	t	116	74
U	085	55	u	117	75
V	086	56	v	118	76
W	087	57	w	119	77
X	088	58	x	120	78
Y	089	59	y	121	79
Z	090	5A	z	122	7A
[091	5B	{	123	7B
\	092	5C		124	7C
]	093	5D	}	125	7D
^^	094	5E	~	126	7E
_	095	5F	DEL	127	7F

Modbus communications

This addendum covers the use of Modbus RTU communications when using the LD4 monitor.

When using Modbus communications the instrument must be set up electrically for RS232 or RS485 communications and the **Output** function must be set to **RS485**.

Modbus commands

Note: the maximum recommended baud rate is 9600.

The following commands are available:

Function 1 Read coil status

Reads the ON/OFF status of the relay coils. Broadcast is not supported. Relays 1 to 4 are addressed as 0 to 3. Logic 1 = ON, Logic 0 = OFF.

To read the coil status a query is sent to the LD4, the LD4 then responds to the query.

An example of a query to read coils 1 to 4 from the LD4 at address 2 is given below.

Field Name	Example (Hex)
Unit address	02
Function	01
Starting address Hi	00
Starting address Lo	00
Number of points Hi	00
Number of points Lo	04
Error check (LRC or CRC)	–

An example of a response is given below:

Field Name	Example (Hex)
Unit address	02
Function	01
Byte count	01
Data (coils 7 to 1)	04
Error check (LRC or CRC)	–

The status of the relay coils is shown in the Data 04 (hex) or binary 0100. Relay 1 is indicated by the LSB. The status of the relays is therefore:

Relay 1 - OFF, Relay 2 - ON, Relay 3 - OFF, Relay 4 - OFF

Function 3 Read holding registers

This function reads the binary contents of the holding registers in the PM4 being addressed. The value for this function is stored as a 32 bit two's complement number, 2 registers per channel are used. Note; a value of 1,000,000 represents a positive overrange and -200,000 a negative overrange. Registers 1 to 2 hold the display value, registers 3 to 4 the valley memory (lowest reading in memory), registers 5 to 6 the peak memory (highest reading in memory), registers 7 to 8 the display hold value. Registers 9 to 16 hold the alarm high values for relays 1 to 4. Note a value of 0X8000 means that the relay is set to OFF and has no high value. Registers 17 to 24 hold the alarm low values for relays 1 to 4. Note a value of 0X8000 means that the relay is set to OFF and has no low value. Register 25 represents the decimal point settings for the display.

An example of a query to read holding registers 1 to 3 from the TP488 at address 5 is given below.

Field Name	Example (Hex)
Unit address	05
Function	03
Starting address Hi	00
Starting address Lo	00
Number of points Hi	00
Number of points Lo	03
Error check (LRC or CRC)	–

An example of a response is given below:

Field Name	Example (Hex)
Unit address	05
Function	03
Byte count	06
Data Hi (register 1)	00
Data Lo (register 1)	33
Data Hi (register 2)	00
Data Lo (register 2)	25
Data Hi (register 3)	00
Data Lo (register 3)	17
Error check (LRC or CRC)	–

The contents of register 1 is 33 (hex) or 51 (decimal), register 2 is 25 (hex) or 37 (decimal) and register 3 is 17 (hex) or 23 decimal.

Register table

Address	Register	Description
0X00	1	Display value high word
0X01	2	Display value low word
0X02	3	Valley memory high word
0X03	4	Valley memory low word
0X04	5	Peak memory high word
0X05	6	Peak memory low word
0X06	7	Display hold high word
0X07	8	Display hold low word
0X08	9	Alarm 1 high setpoint high word
0X09	10	Alarm 1 high setpoint low word
0X0A	11	Alarm 2 high setpoint high word
0X0B	12	Alarm 2 high setpoint low word
0X0C	13	Alarm 3 high setpoint high word
0X0D	14	Alarm 3 high setpoint low word
0X0E	15	Alarm 4 high setpoint high word
0X0F	16	Alarm 4 high setpoint low word
0X10	17	Alarm 1 low setpoint high word
0X11	18	Alarm 1 low setpoint low word
0X12	19	Alarm 2 low setpoint high word
0X13	20	Alarm 2 low setpoint low word
0X14	21	Alarm 3 low setpoint high word
0X15	22	Alarm 3 low setpoint low word
0X16	23	Alarm 4 low setpoint high word
0X17	24	Alarm 4 low setpoint low word
0X18	25	Display decimal point

Analog retransmission option

This addendum covers instruments with the analog retransmission board. This board allows retransmission of 4 - 20mA, 0-1V or 0-10V selectable via two sets of links. Refer to the main "Explanation of Functions" chapter for details of the functions (FEEL and FEEL) associated with these outputs and to the Function table for function listing. See separate manual addendum for PI control output operation functions (FEEL set to ON).

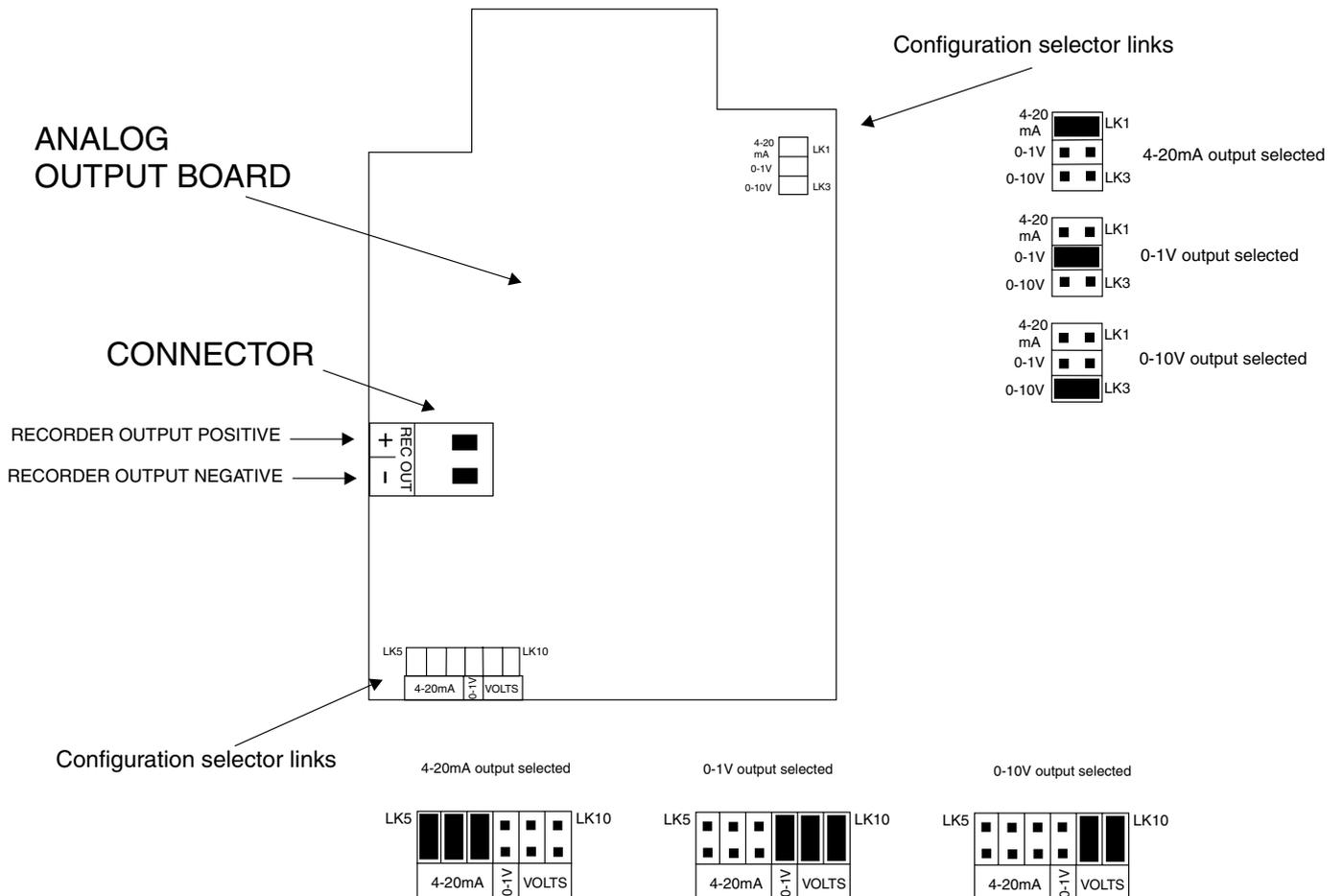
Electrical Connections

See diagram below. Refer to "Electrical Installation" chapter for general information on electrical connections. External connections to the board are via plug in connectors with screw terminals these terminals allow for wires up to 1.5mm² to be fitted.

Configuring the output board

The output board has facilities for 4-20mA, 0-1V and 0-10V retransmission and is factory supplied with all the necessary components for the output options required.

Two sets of PCB links are fitted to the circuit board to connect the electronic components for the correct output types, ensure that both sets of links have the required output selected. It may be necessary to alter the PCB links to change the output type (see link settings below).



Relay 3 and 4 option

When the relay 3 and 4 option is fitted two extra relays will be fitted as shown below. These relays have the same specification and setup functions as the standard relays 1 and 2.

