

LD-TMR
Large Digit Display

Timer/Elapsed Timer/Stopwatch

Operation & Instruction Manual

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1 Introduction

This manual contains information for the installation and operation of the LD-TMR Monitor. The instrument may be set to operate as a period or scaled period timer. The **SEt OPEr** function allows selection of one of these two modes. A brief description of each mode is given below. The two modes of operation covered in this manual are:

S.Pr d - scaled period display mode. This mode allows the measurement and scaling of the duration of an input pulse. Since time is being measured the display would typically be programmed and scaled to read in time (seconds, milli seconds etc.) or rate (metres/second, litres/hour etc.). It is equally valid to scale the display to read in any units which may be a function of time e.g. distance travelled in mm.

PEr d - period of the input pulse display. The period of the input pulse is measured and may be displayed in any one of 8 different time display modes (e.g. hours.minutes.seconds). Count up from zero or count down from a preset value modes of operation are provided. Typical applications for this mode include stopwatch and elapsed time displays.

Selection of operating mode, calibration and scaling are all accomplished by push button operation. "On display" prompts are given for each function to assist in setting up the instrument. Some changes may require dismantling the instrument to alter PCB links.

Two inbuilt relays provide alarm/control functions, optically isolated serial communications (RS232 or RS485) may also be optionally provided.

Unless otherwise specified at the time of order, your LD has been factory set to a standard configuration, see the function tables for the mode selected mode for default settings.

Full electrical isolation between power supply, input voltage and serial communications output is provided by the LD, thereby eliminating grounding and common voltage problems. This isolation feature makes the LD ideal for interfacing to computers, PLCs and other data acquisition devices.

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

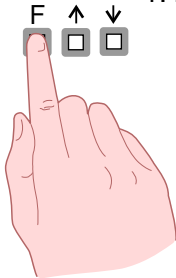
1.1 Meter setup

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

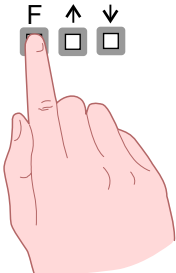
FUNC mode (simple push button sequence) allows access to commonly set up functions such as alarm setpoints. **CAL** mode (power up sequence plus push button sequence) allows access to all functions including calibration parameters. One of the setup functions named **ACCESS** can be used to control access to functions e.g. if the **ACCESS** function is set to **ALL** then all functions will be accessible via **FUNC** mode.

In all displays other than the 38mm 6 digit LED type the three push buttons are located on the main circuit board, the front cover will need to be removed to gain access to the pushbuttons. The 38mm 6 digit LED display has pushbuttons on the front face plate. 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. Changes to function settings will not be accepted and stored in memory until the **F** button is pressed to accept the change. See also the flow chart example on the following page.

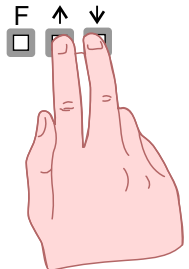
Entering **CAL** Mode



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.



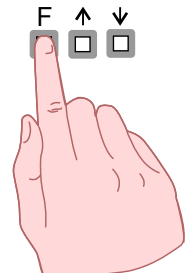
3. Within 2 seconds of releasing the **F** button press, then release the **▲** and **▼** buttons together. The display will now indicate **FUNC** followed by the first function.

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.

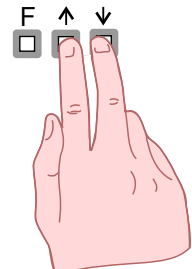
The instrument should show all 8's on power up e.g. **8888** if the instrument does not reset then these numbers will not be seen. Switch off the instrument and allow a longer time delay before powering up again.

Entering **FUNC** Mode

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

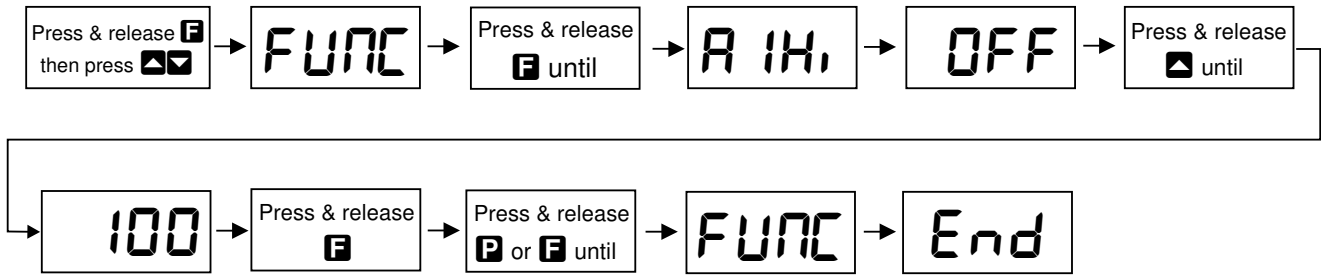


1. When the "wake up" messages have finished and the display has settled down to its normal reading press, then release the **F** button. Move to step 2 below.

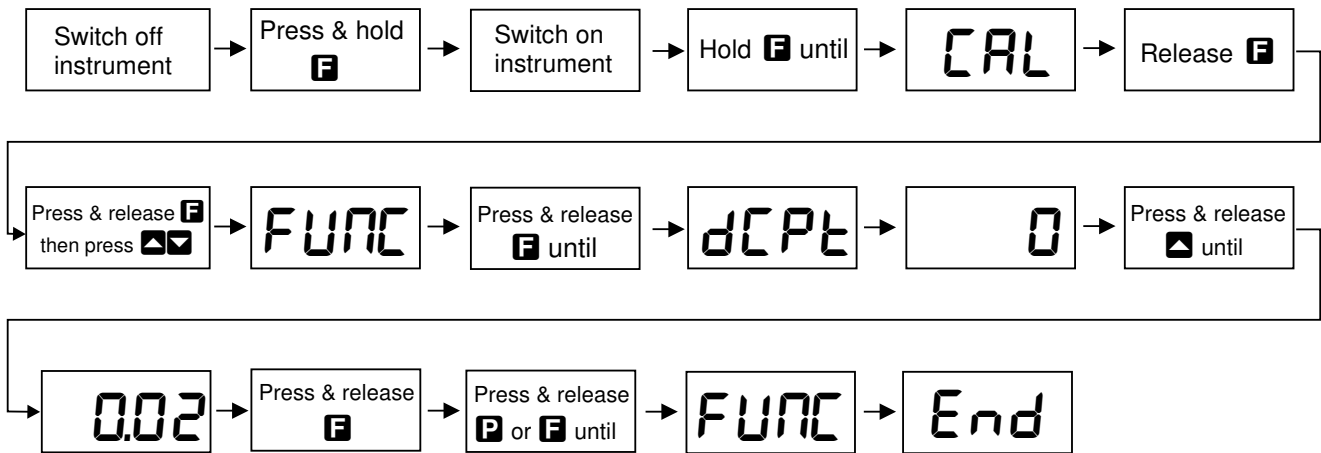


2. Within 2 seconds of releasing the **F** button press, then release the **▲** and **▼** buttons together. The display will now indicate **FUNC** followed by the first function.

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

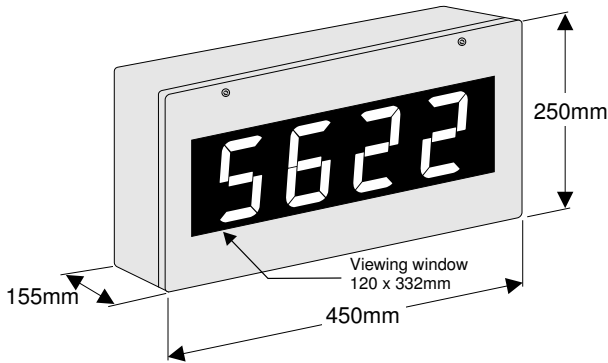


Example: Entering **CAL** mode to change decimal point **dCPl** function from **0** to **0.02**

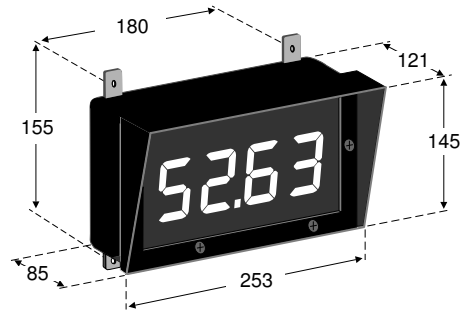


2 Mechanical Installation

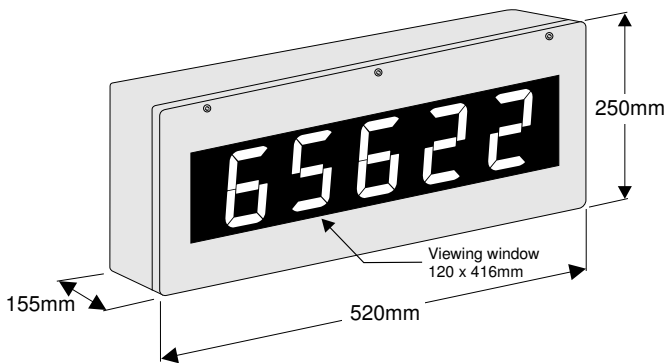
100mm 4 digit LED or Electromagnetic



38mm 6 digit LED, 45mm 5 digit & 57mm 4 digit LED

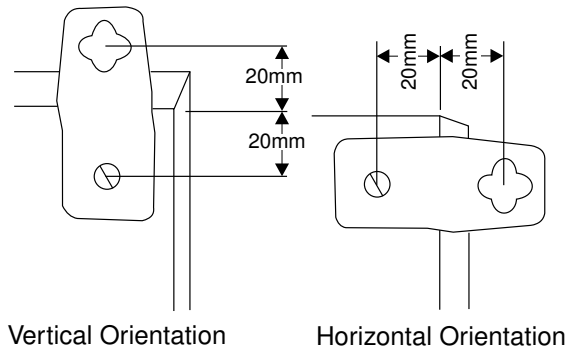
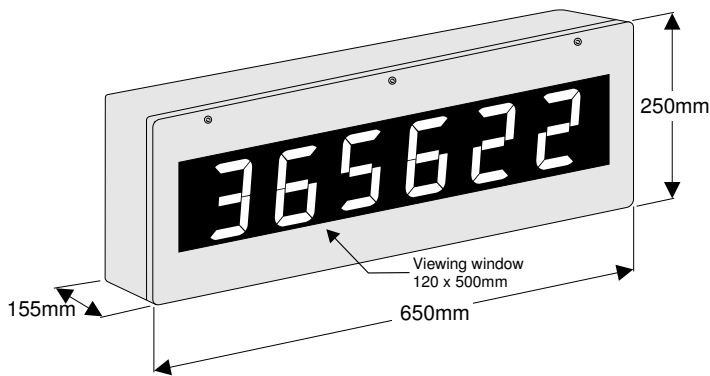


100mm 5 digit Electromagnetic only

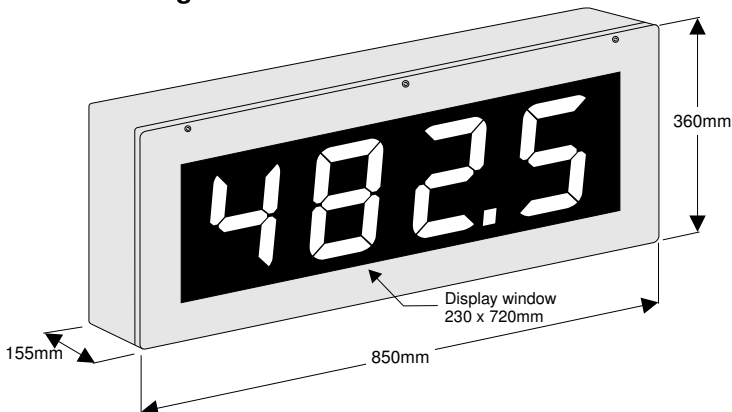


Four mounting kit brackets are supplied for use with all 100 & 200mm display models. Diagrams below illustrate vertical and horizontal installation. If mounting without the brackets is preferred then the 9mm dia. case holes provided for the brackets can be used as alternative mounting holes. If the brackets are not used in mounting these holes should be sealed against dust and water.

100mm 6 digit LED or Electromagnetic



180mm 4 digit LED

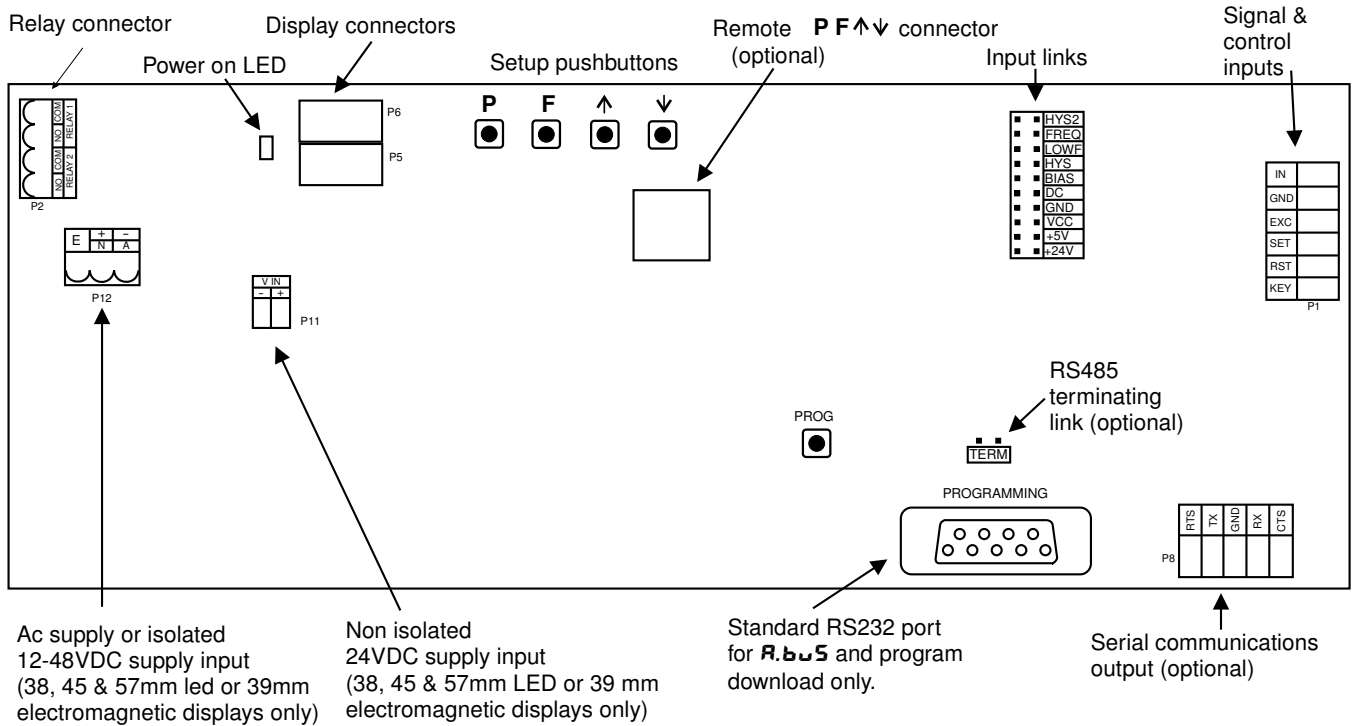


3 Electrical Installation

The LD-TMR 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 are plug in screw type for ease of installation and allow for wires of up to 1.5mm² (2.5mm² for relay, AC or isolated DC supply 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.

3.1 Main circuit board layout

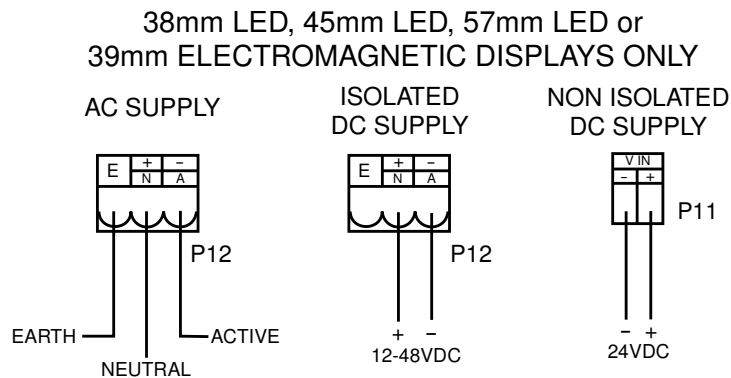


3.2 Power supply connections

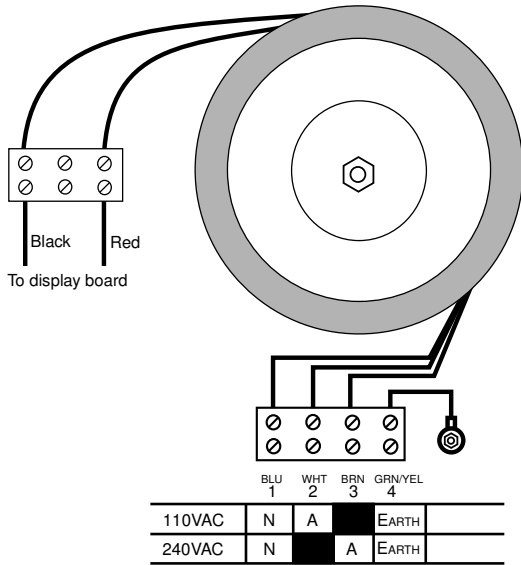
38mm LED, 45mm LED or 39mm electromagnetic display power supplies

AC power connections use a plug in connector with screw terminals at P12 (2.5mm² max. wire diameter). Isolated DC supplies (12-48VDC) use the same terminals.

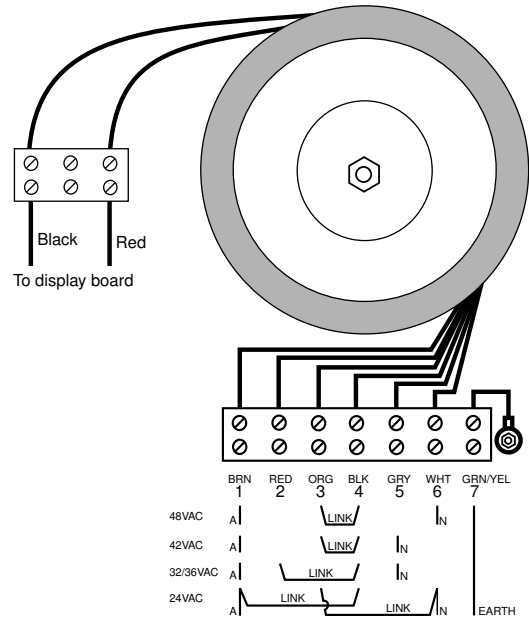
Non isolated DC supplies (24VDC only) may be connected directly to the main circuit board power supply connector via the plug in connector terminals at P11 (1.5mm² max wire diameter).



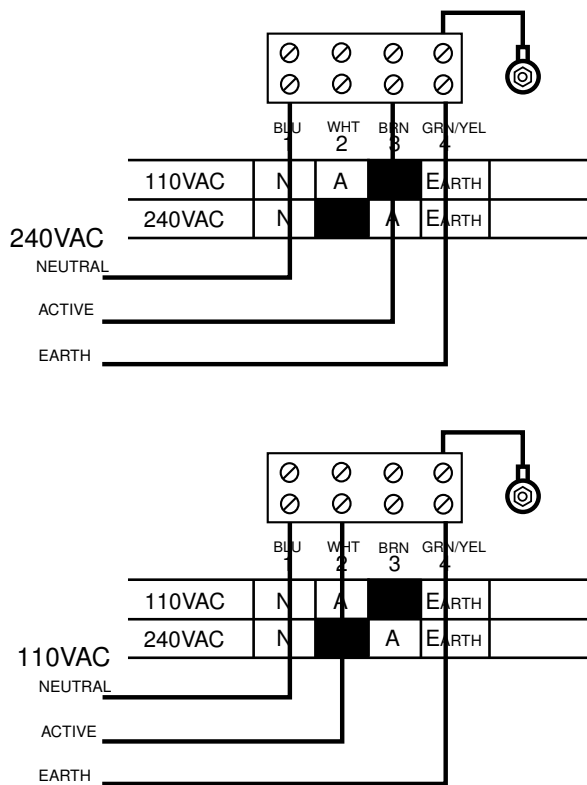
240 & 110VAC supplies.
For 100mm/200mm LED or 100mm
electromagnetic display types only.



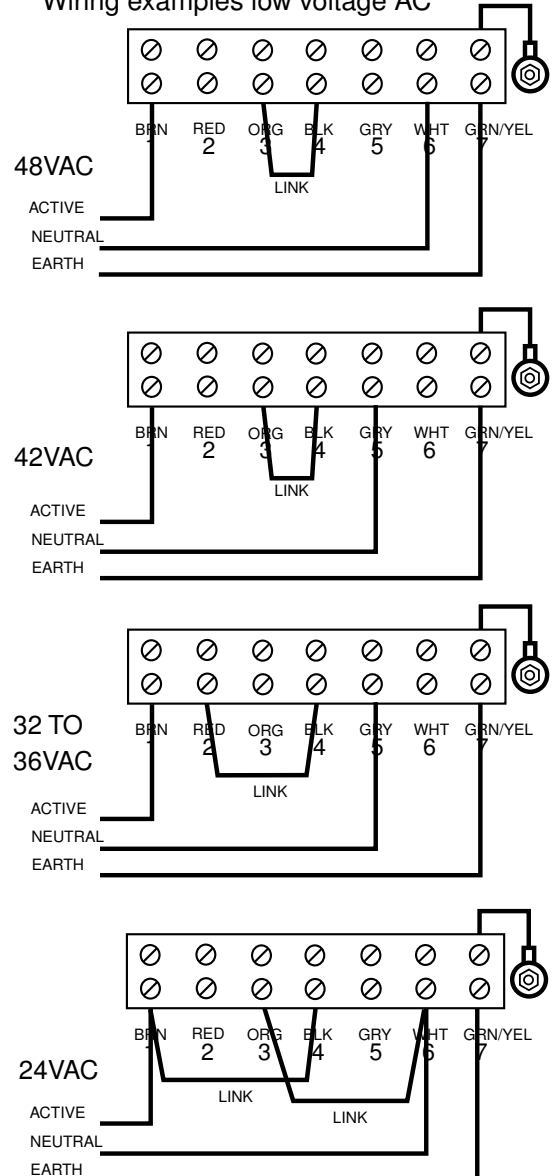
Low voltage AC supplies.
For 100mm/200mm LED or 100mm
electromagnetic display types only.



Wiring examples 240VAC & 110VAC



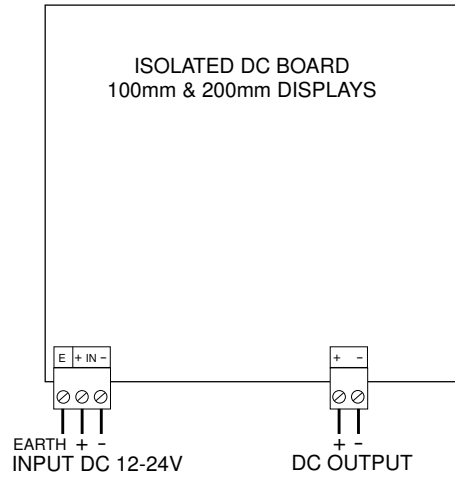
Wiring examples low voltage AC



Important note: the 240V & 110V supplies use the same transformer, low voltage instruments use a different transformer. Do not use a low voltage transformer for 240V or 110V or vice versa.

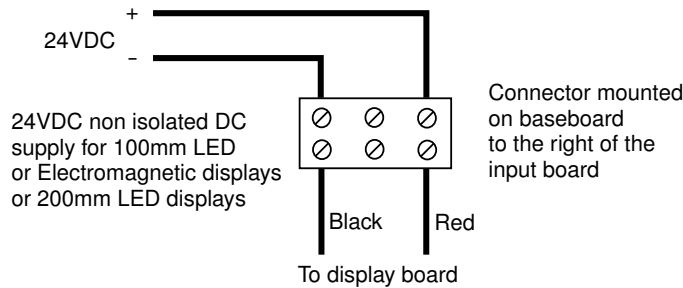
LED & 100mm electromagnetic display isolated DC power supplies

Isolated DC supplies (12 to 24VDC) connect to the isolated supply pcb on the base board. AC supplies connect to the transformer primary on the base board. The base board is located under the input circuit board.



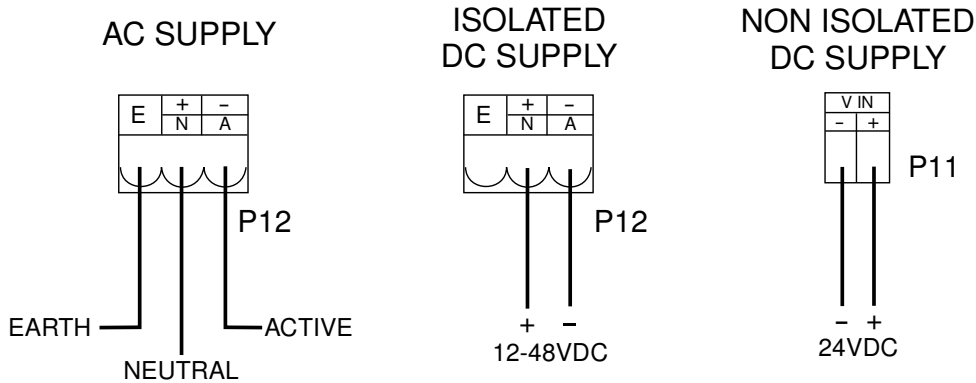
100mm, 200mm LED & 100mm electromagnetic display non isolated DC power supplies

Non isolated DC supplies (24VDC) are wired to a connector on the baseboard as shown below.



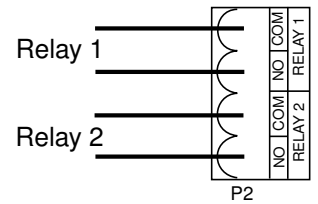
38mm, 45mm & 57mm LED power supplies

38mm, 45mm, & 57mm LED DISPLAY POWER CONNECTIONS



3.6 Relay connections

The LD is supplied with two alarm relays as standard with connections on terminals P2. 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. Each relay will open when power is removed.



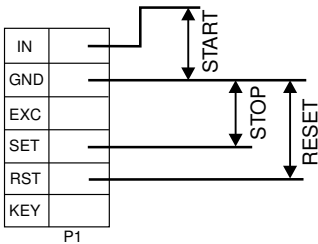
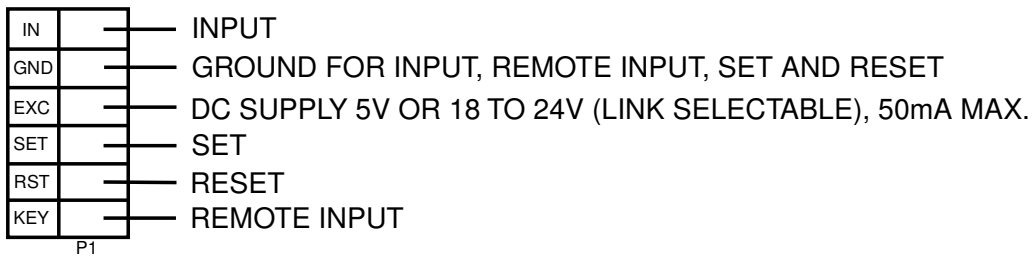
3.7 Input/output connections

The diagram below shows the input connectors for the LD-TMR.

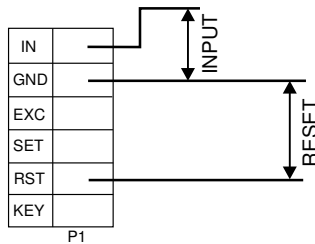
An internal power supply at the EXC terminal can be used to give a sensor supply output of either 5VDC regulated or 18 to 24VDC unregulated set via links LK 1 or 2. The 18 to 24V unregulated sensor supply is available even if the LD power supply is less than 18V (isolated DC only). When using this output as a transmitter supply ensure that only one link (LK1 or LK2) is in. Maximum current draw is 50mA for both 5V regulated and 18 to 24V unregulated sensor supply. For LD instruments powered from non isolated DC supplies the 5V regulated supply is available but the unregulated supply will be slightly less than the supply voltage.

Either a contact closure (0V) or 5V control voltage can be used as the SET and RST inputs. For a contact closure or 0V reset the **CRSE** function must be set to either **Lo** or **LoE**. For 5V control voltage reset the **CRSE** function must be set to **Hi** or **HiE**. For a contact closure or 0V SET input the **SRNP** function must be set to either **Lo**. For 5V control voltage SET input the **SRNP** function must be set to **Hi**.

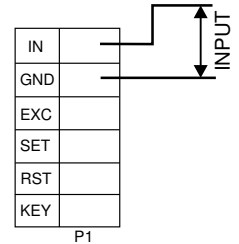
The remote input (KEY) terminal can be used to perform one of the functions chosen at the **SRNP** function. A contact closure or 0V is required to operate the required remote input function.



Input connections for **UP** and **dn** operation modes.



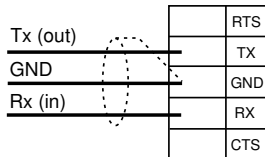
Input connections for **run**, **SngL**, **SngH**, **R.dur** and **SngF** operation modes



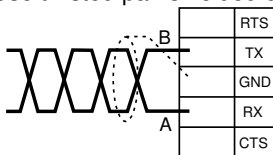
Input connections for **dur**, **PLS**, **PLS.H** and **PLS.F** operation modes

3.8 Optional serial communications connections

RS232 communications use 3 core shielded cable



RS485 communications use twisted pair shielded cable



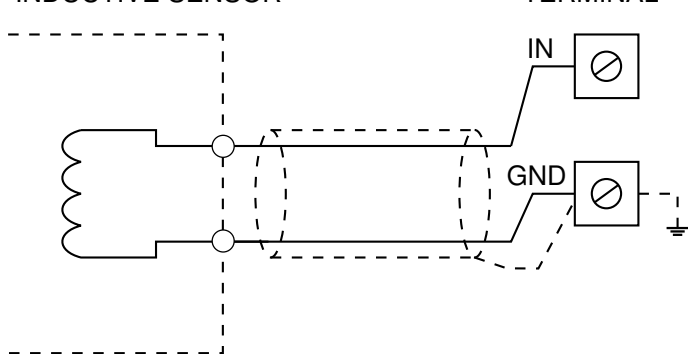
Serial communications is optional, connectors and circuitry will only be fitted if the instrument was ordered with the serial communications option. The optional serial communications will be factory configured for RS232 or RS485 communications.

Note: when connecting using RS232 the Tx line at the display connects to the Rx line at the device it is communicating with. Likewise the Rx line at the display connects to Tx. When using RS485 connections are A to A and B to B

RS485 terminating link. The link should be in for long cable runs. If multiple instruments are connected insert the link if the display is the first and last unit on the line.

3.3 Input connection details & link settings

INDUCTIVE SENSOR

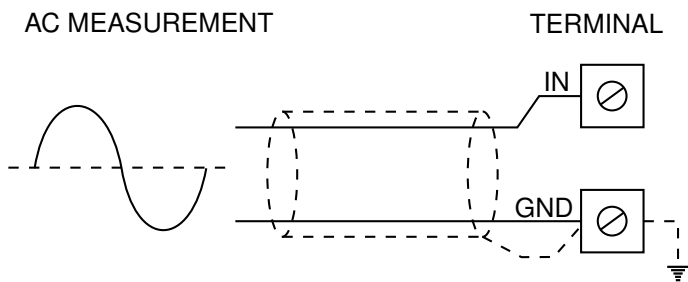


Inductive Sensor (48V RMS Max)

Typical Internal Link Settings

LK 1 & 2 - see "Input link settings, section 3.8"
 VCC Link 3 out
 GND Link 4 in or out *
 DC Link 5 in
 BIAS Link 6 out
 HYS Link 7 in or out *
 LOWF Link 8 out
 FREQ Link 9 in
 HYS2 Link 10 in or out *
 *See "Input link setting, section 3.8"

AC MEASUREMENT

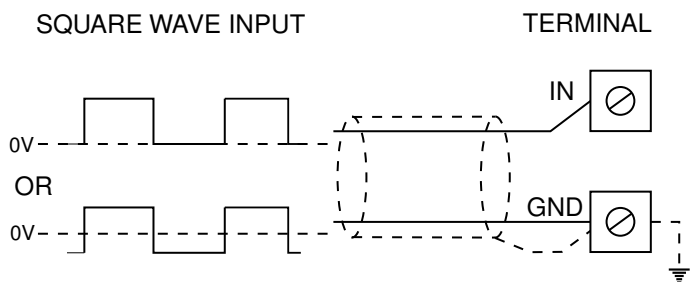


AC Measurement (48V RMS Max)

Typical Internal Link Settings

LK 1 & 2 - see "Input link settings, section 3.8"
 VCC Link 3 out
 GND Link 4 in or out *
 DC Link 5 in or out *
 BIAS Link 6 out
 HYS Link 7 in or out *
 LOWF Link 8 out
 FREQ Link 9 in
 HYS2 Link 10 in or out *
 *See "Input link settings, section 3.8"

SQUARE WAVE INPUT

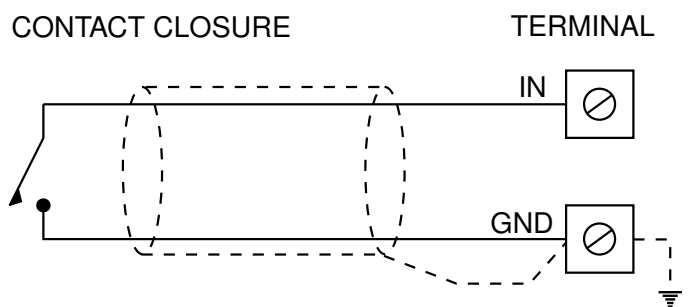


Square Wave (48V Max)

Typical Internal Link Settings

LK 1 & 2 - see "Input link settings, section 3.8"
 VCC Link 3 out
 GND Link 4 in or out *
 DC Link 5 in
 BIAS Link 6 in or out *
 HYS Link 7 in or out *
 LOWF Link 8 out
 FREQ Link 9 out
 HYS2 Link 10 in or out *
 *See "Input link settings, section 3.8"

CONTACT CLOSURE

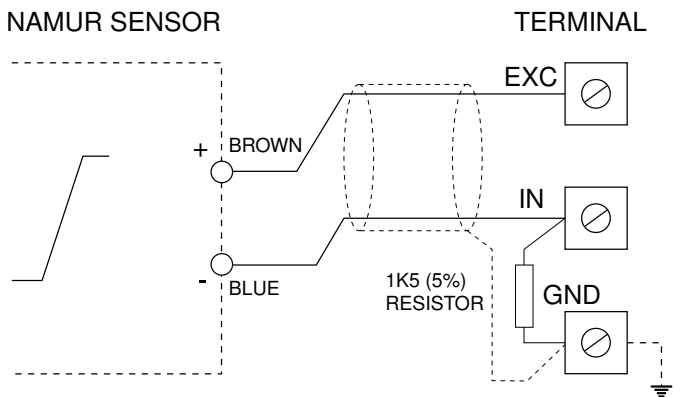


Switch Contact

Typical Internal Link Settings

LK 1 & 2 - see "Input link settings, section 3.8"
 VCC Link 3 in
 GND Link 4 out
 DC Link 5 in
 BIAS Link 6 in
 HYS Link 7 in
 LOWF Link 8 in
 FREQ Link 9 out
 HYS2 Link 10 out
 *See "Input link settings, section 3.8"

NAMUR SENSOR



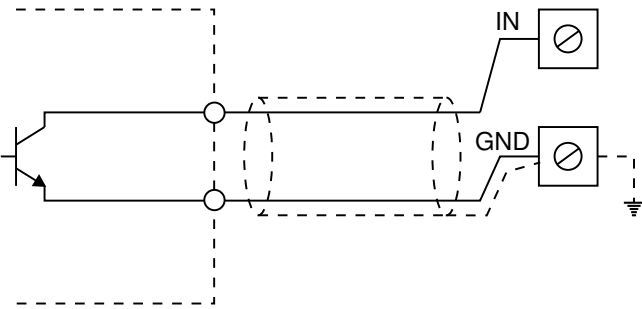
NAMUR Sensor

Typical Internal Link Settings

LK 1 & 2 - see "Input link settings, section 3.8"
 VCC Link 3 out
 GND Link 4 in
 DC Link 5 in
 BIAS Link 6 in
 HYS Link 7 in
 LOWF Link 8 out
 FREQ Link 9 out
 HYS2 Link 10 out
 *See "Input link settings, section 3.8"

Note: the transducer may require an external DC supply, check sensor specifications.

NPN TRANSISTOR



NPN Transistor

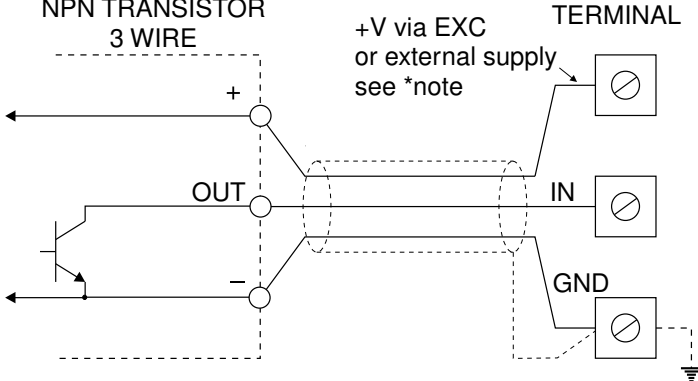
Typical Internal Link Settings

LK 1 & 2 - see "Input link settings, section 3.8"

VCC	Link 3	in
GND	Link 4	out
DC	Link 5	in
BIAS	Link 6	in
HYS	Link 7	in
LOWF	Link 8	out
FREQ	Link 9	out
HYS2	Link 10	out

*See "Input link settings"

NPN TRANSISTOR 3 WIRE



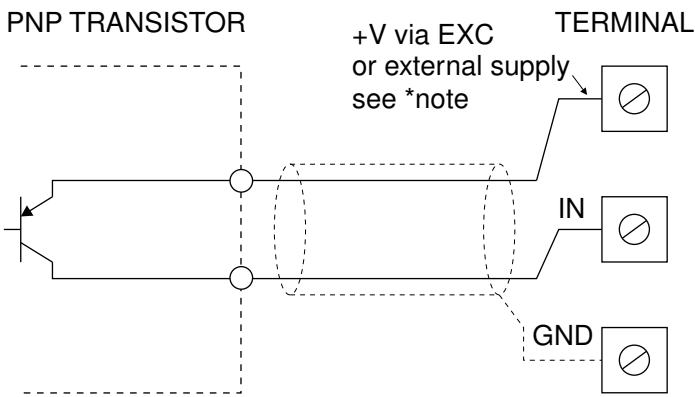
NPN Transistor 3 Wire

Typical Internal Link Settings

LK 1 & 2 - see "Input link settings, section 3.8"

VCC	Link 3	in
GND	Link 4	out
DC	Link 5	in
BIAS	Link 6	in
HYS	Link 7	in
LOWF	Link 8	out
FREQ	Link 9	out
HYS2	Link 10	out

PNP TRANSISTOR



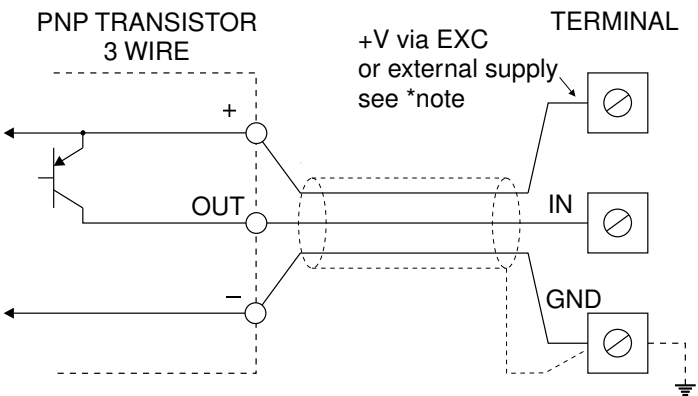
PNP Transistor

Typical Internal Link Settings

LK 1 & 2 - see "Input link settings, section 3.8"

VCC	Link 3	out
GND	Link 4	in
DC	Link 5	in
BIAS	Link 6	in
HYS	Link 7	in
LOWF	Link 8	out
FREQ	Link 9	out
HYS2	Link 10	out

PNP TRANSISTOR 3 WIRE



PNP Transistor 3 Wire

Typical Internal Link Settings

LK 1 & 2 - see "Input link settings, section 3.8"

VCC	Link 3	out
GND	Link 4	in
DC	Link 5	in
BIAS	Link 6	in
HYS	Link 7	in
LOWF	Link 8	out
FREQ	Link 9	out
HYS2	Link 10	out

3.4 Input link settings

LK1 & LK2. An internal power supply allows the **EXC** input to be used to give a sensor supply output of either 5VDC (LK2) regulated or 18 to 24VDC (LK1) regulated. When using this output as a sensor supply ensure that only one link (LK1 or LK2) is in.

For inputs above 24V both the **VCC** LK3 and **GND** LK4 link should be out.

The **DC** link LK5 should be in for maximum input frequencies less than 10Hz.

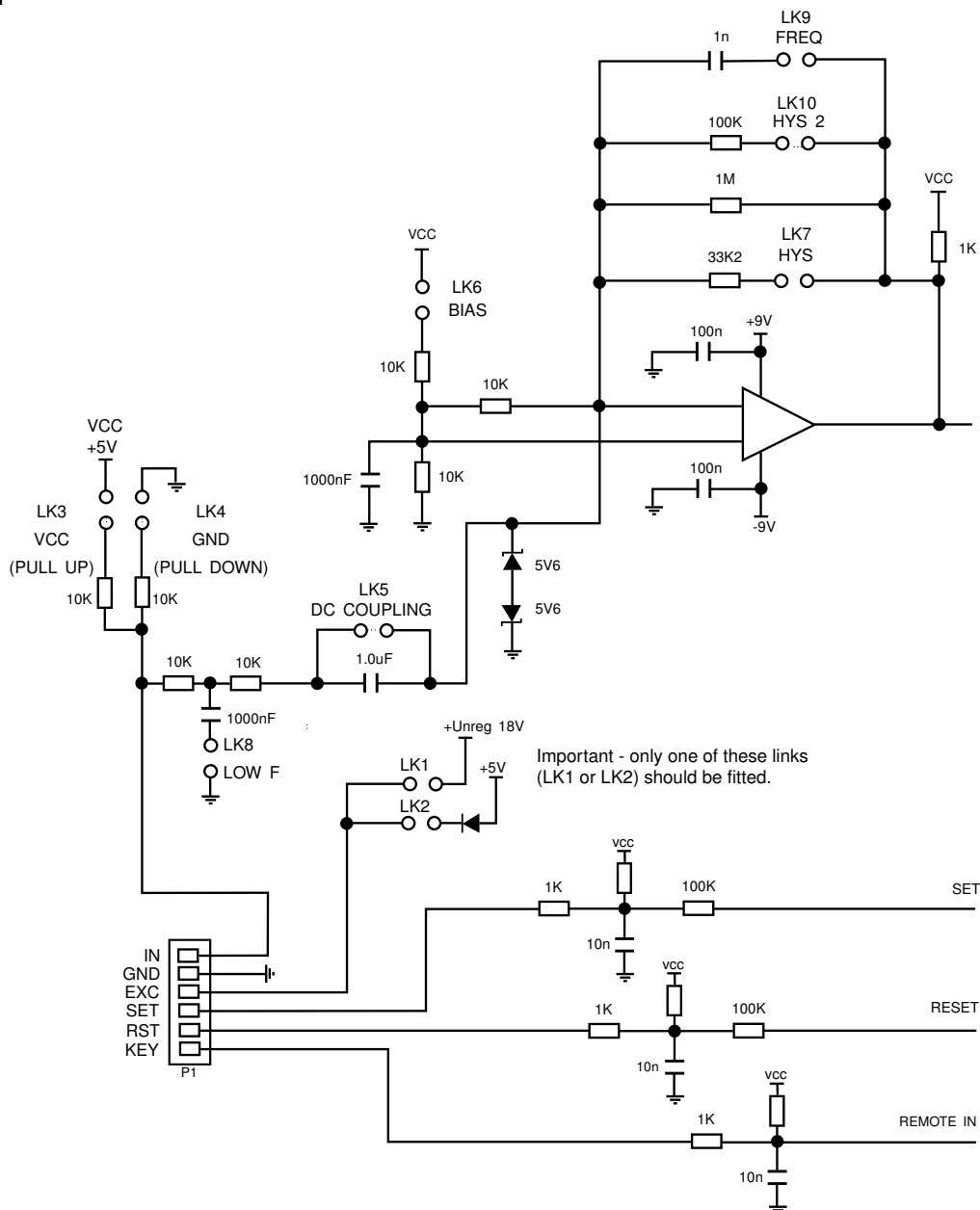
The **BIAS** link LK6 should be in when input signal does not go below 0V.

HYS link LK7 should be in for signals greater than 5V (48VDC or RMS max). **HYS2** link LK10 should be in for signals greater than 1V but less than 5V. Only one hysteresis link should be fitted i.e either LK7 or LK10. For signals lower than 1V both links should be out (100mV minimum signal). Having both links out is not normally recommended since the instrument will be prone to pick up both low signal levels and noise.

The **LOW F** link LK8 is used to provide a low pass filter. When this link is in frequencies above approx. 80Hz will be filtered out and will not appear as an input. This link should be in for contact closure inputs e.g. switches and relays when the maximum input frequency is less than 80Hz. This link can also be left in to filter out high frequency interference for any input type when the maximum input frequency is below 80Hz.

The **FREQ** link LK9 is used to create a sharply rising edge to give a more definite pulse signal and will be used mainly for input signals with slowly rising edges, typically sinewave AC inputs and inductive inputs.

3.5 Input circuit



4 Scaled Period Measurement

This chapter refers to the “scaled period measurement” (*S.Prd*) mode operation. The scaled period mode allows an event to be timed and scaled to match the display units required rather than showing the true time. This mode may be selected via the **SEt OPEr** function. The scaled period mode has four different operating modes, namely **PLSE** (pulse), **SNGL** (single pulse), **PLS.F** (pulse reciprocal) and **SNGL.F** (single pulse reciprocal). See the **OPEr** function for a description of each mode. The pulse reciprocal and single pulse reciprocal allow the display to be scaled with the result being inversely proportional to time, this allows scaling in units such as velocity e.g. cm/sec, km/hr etc.

You will need to enter via **CAL** or **FUNC** mode (see section 1.2) to gain access to functions, the function table for each mode shows which functions require entry via **CAL** mode.

The LD-TMR has an easy alarm access facility which allows access to the alarm setpoints simply by pressing the **F** button at the front or rear of the instrument. 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 in order for the easy access to work:

1. Either the **ACC5** function must be set to **EASY** or the **F: NP** function must be set to **SP.AC**.
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.

4.1 Explanation of functions

R 1Lo (alarm 1 low setpoint)

Displays and sets the alarm low setpoint value for the designated alarm relay. The low alarm setpoint may be disabled by pressing the **▲** and **▼** pushbuttons simultaneously. When the alarm is disabled the display will indicate **OFF**. The alarm relay will trip when the displayed value is less than the **RxLo** setpoint value. Relays may be configured with both a low and high setpoint, so the relay may be tripped when the reading is outside the band set between low and high. e.g. if **R 1Lo** is set to **10.0** and **R 1H** is set to **90.0** then the alarm output relay will trip when the display value is either below **10.0** or above **90.0**.

R 2Lo (alarm 2 low setpoint)

Displays and sets alarm 2 low setpoint, see **R 1Lo** for further description.

R 1H (alarm 1 high setpoint).

Displays and sets the alarm high setpoint value for the designated alarm relay. The high alarm setpoint may be disabled by pressing the **▲** and **▼** pushbuttons simultaneously. When the alarm is disabled the display will indicate **OFF**. The alarm relay will trip when the displayed value is greater than the **RxH** setpoint value. Relays may be configured with both a low and high setpoint, so the relay may be tripped when the reading is outside the band set between low and high (see **R 1Lo** for example).

R 2H (alarm 2 high setpoint)

Displays and sets alarm 2 high setpoint, see **R 1H** for further description.

R 1HY (alarm 1 hysteresis [deadband]) - this function will not be seen if both the high and low setpoints are set to **OFF**.

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 alarm relay when the measured value stays close to the setpoint. Without a hysteresis setting (**RxHY** set to zero) the alarm will trip 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 tripped the input must fall below the setpoint value minus the hysteresis value to reset the alarm.

e.g. if **A 1H** is set to **50.0** and **A 1HY** is set to **3.0** then the alarm output relay will trip 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 tripped the input must rise above the setpoint value plus the hysteresis value to reset the alarm.

e.g. if **A 1Lo** is set to **20.0** and **A 1HY** is set to **10.0** then the alarm output relay will trip 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.

A 2HY (alarm 2 hysteresis) - this function will not be seen if both the high and low setpoints are set to **OFF**.

Displays and sets alarm 2 hysteresis, see **A 1HY** for further description.

A 1t (alarm 1 trip time) - this function will not be seen if both the high and low setpoints are set to **OFF**.

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 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.

A 2t (alarm 2 trip time)

Displays and sets alarm 2 trip time, see **A 1t** for further description.

A 1r (alarm 1 reset time) - this function will not be seen if both the high and low setpoints are set to **OFF**.

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.

A 2r (alarm 2 reset time) - this function will not be seen if both the high and low setpoints are set to **OFF**.

Displays and sets alarm 2 reset time, see **A 1r** for further description.

A 1n.o or **A 1n.c (alarm 1 normally open or normally closed)** - this function will not be seen if both the high and low setpoints are set to **OFF**.

Displays and sets the 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.

A 2n.o or **A 2n.c (alarm 2 normally open or normally closed)** - this function will not be seen if both the high and low setpoints are set to **OFF**.

Displays and sets alarm 2 normally open/normally closed operation, see **A 1n.o/A 1n.c** for further description.

br 9t (display brightness) - not seen if **br 9t AUTO** is set to **on**. Not applicable to electromagnetic displays.

Displays and sets the digital display brightness. The display brightness is selectable from **1** to **53**, where **1** = lowest intensity and **53** = highest intensity. This function is useful for reducing glare in low light environments.

br 9t AUTO (auto brightness on or off) - Not applicable to electromagnetic displays.

Automatic display brightness adjustment. The automatic brightness adjustment uses the optional light sensor to gauge the required brightness level for the environment. The high and low brightness limits are set at the **br 9t Hi 9H** and **br 9t Lo** functions described below. If the optional light sensor is not fitted this function should be set to **OFF**. Note: when **br 9t AUTO** is set to **on** the manual brightness control function **br 9t** is not seen.

br 9t Hi 9H (auto brightness high level) - Not applicable to electromagnetic displays.

Automatic brightness high level - seen only when **br 9t AUTO** is set to **on**. The high brightness level

sets the maximum brightness which the automatic brightness control can achieve with **53** being the highest intensity.

br 9t Lo (auto brightness low level) - Not applicable to electromagnetic displays.

Automatic brightness low level - seen only when **br 9t Auto** is set to **on**. The low brightness level sets the minimum brightness which the automatic brightness control can achieve with **53** being the highest intensity.

dULL (remote display brightness) - Not applicable to electromagnetic displays.

Displays and sets the level for remote input brightness switching, see **r.i NP** function. When the remote input is set to **dULL** the remote input can be used to switch between the display brightness level set by the **br 9t** 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.

dr nd (display rounding)

Displays and sets the display rounding value. This value may be set from **1** - **5000** displayed units (e.g. **0.00 1** to **5.000** if decimal point set to 3 places). 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. (example: if set to **10** the instruments display will increment in multiples of 10).

dCPt (decimal point selection)

Displays and sets the decimal point for the scaled period or period display. 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), **0.003** (3 decimal places) etc. up to the number of display digits.

PERd: NPt (period input scale factor)

Displays and sets the period input scale factor to be used with the period scale function to generate the display scaling. In **S.Prd** mode the period input is measured in seconds.

PERd SCALE (period scale factor)

Displays and sets the scale factor to be used with the period input setting (see chapter 7 "Period Operation" for examples). To calculate the display value the input frequency and hence the period of this input needs to be known. Scale and input work together to produce a display as follows:

$$\text{Display Value} = \frac{\text{input period (seconds)} \times \text{PERd SCALE}}{\text{PERd: NPt}}$$

Note: the displayed value is also affected by the decimal point and display range settings.

QPEF (scaled period operating mode)

Displays and sets the operation mode to be used in measuring the pulse period. The options are as follows:

PLSE (pulse) - When this mode is selected the period of the input pulse is displayed according to the scaling factors (**PERd: NPt**, **PERd SCALE** and **dCPt**). When a new pulse is applied to the input the instrument will measure, scale and display the new period i.e. the old display will be overwritten.

Sn 9L (single pulse) - This mode will display the period (again see **PERd: NPt**, **PERd SCALE** and **dCPt**) of the first pulse and will hold this display value until reset via a contact closure across the reset lines i.e. the display will not be overwritten by any subsequent input pulses.

PL S.F (pulse reciprocal) - Functions in the same manner as the **PLSE** mode except that the display will show the inverse of the period. This is useful for displaying rate, velocity and other measuring units requiring a time reciprocal.

Sn 9.F (single pulse reciprocal) - Functions in the same manner as the **Sn 9L** mode except that the display will show the inverse of the period. This is useful for displaying rate, velocity and other measuring units requiring a time reciprocal.

r.i NP (remote input function)

Terminals GND and KEY SW are the remote input terminals. When these terminals 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 time value whilst the remote input terminals are short circuited. The message **P.Hld** will flash momentarily every 8 seconds whilst the input is activated to indicate that the peak value is being displayed.

d.Hld - display hold. The display will hold its value whilst the remote input terminals are short circuited. The message **HOLD** will flash momentarily every 8 seconds whilst the input is activated to indicate that the peak value is being displayed.

H_i - peak memory. The peak value stored in memory will be displayed if the remote input terminals 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 then the memory will be cleared. The display message **H_i** will precede the peak memory value and this message will flash momentarily every 8 seconds to indicate that the peak memory value is being viewed. The display will revert back to live reading after approx. 20 seconds.

L_o - valley memory. The minimum value stored in memory will be displayed. Otherwise operates in the same manner as the **P.H_i** function. If the short circuit is held for 1 to 2 seconds then the memory will be cleared. The display message **P.L_o** will precede the valley memory value and this message will flash momentarily every 8 seconds to indicate that the valley memory value is being viewed. The display will revert back to live reading after approx. 20 seconds.

H_i L_o - toggle between **H_i** and **L_o** 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. **P.H_i** or **P.L_o** will flash before each display to give an indication of display type. If the short circuit is held for 1 to 2 seconds then the memory will be cleared. The display will revert back to live reading after approx. 20 seconds.

ZEFO - zero the display. The time will be zeroed when the remote input is short circuited. The message **ZEFO** will be seen momentarily to indicate that the zero operation has taken place.

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.

d| SP - display toggle. Not applicable to this manual.

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.

g.rst - grand total reset. Not applicable to this manual.

P.but (P button function)

The **P** button may be set to operate some of the remote input functions, this button is located on main printed circuit board. A connector is also provided to allow external connection of remote switches to the **P**, **F**, **▲** and **▼** buttons. With some functions, to prevent accidental operation, the **P** button must be held pressed for 2-3 seconds before the function will operate. 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.1 NP** function above with the exception of the **FUNC** function.

Functions available are:

NONE, H_i, L_o, H_i L_o, ZEFO, d| SP, FUNC and **g.rst**.

The **FUNC** function allows the preset value used with the down timer (when in **PEFd** mode) to be displayed and set without the need to enter **CAL** and **FUNC** modes. Note that this is an alternative method to setting the preset value at the **P.SET** function. To alter the **FUNC** (preset) value press the **P** pushbutton, the display will indicate **FUNC** followed by the current preset value. This value may now be altered via the **▲** or **▼** pushbutton. When the preset value is set as required press, then release, the **F** pushbutton, the display will indicate **End** and will return to normal measurement.

ACCESS (alarm relay access mode)

Access mode (**OFF, EASY, NONE** or **ALL**) - If set to **OFF** the mode function has no effect or alarm relay operation. If set to **EASY** the "easy alarm access" mode will be in operation, see page 18. 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 functions. This function provides an alternative to using the **F:NP** function for easy access or no access mode thereby allowing the remote input to be programmed for an alternative use. If set to **ALL** then access to all functions can be made via **FUNC** mode i.e. there is no need to enter via **CAL** mode.

SPAC (setpoint access) - only seen if more than 1 relay fitted.

Sets the access to the alarm relay set points. The following choices are available: **A 1** - Allows setpoint access to alarm 1 only. **A 1-2** - Allows access to alarms 1 and 2. For this function to operate the remote input function (**F:NP**) must be set to **SP.AC**.

Lo d: SP, Hi, SH d: SP and **d: SP** functions - not applicable to this model.

I:NPt (input type)

Displays and sets the input type to be used for period measurement. If set to **Lo** then the instrument will measure the period of an input with a low going edge. If set to **Hi, SH** then the instrument will measure the period of an input with a high going edge.

c.r St (reset value) - applicable to **PEFd** mode only.

The reset terminal can be programmed to cause the display to reset to either zero or the selected preset value. Choose either **ZEF0** or **P.Stt** to select the required operation.

c.r St (reset mode)

Allows selection of reset level or edge to force a reset. If set to **Lo** a low input level or closed switch on the reset line will force a reset. If set to **Hi** a high input level or open switch on the reset line will force a reset. If set to **LoE** then a falling edge or switch closure on the reset line will force a reset. If set to **Hi E** then a rising edge or switch opening on the reset line will force a reset.

dbnc (debounce)

Displays and sets the debounce time. The debounce time can be set from 0 to 1000 displayed units. If the input pulse width is less than the debounce time setting then the input will be ignored and will not be displayed.

SEt OPEr (set operating mode)

Displays and sets the selected operating mode, e.g. select **S.Prd** for scaled period measurement. See the dedicated chapter in this manual for description of the required operating mode. Options are:

S.Prd - Scaled period measurement.

rte - Not applicable to this manual

PEFd - Period measurement

both - Not applicable to this manual

toL - Not applicable to this manual

FtE9 - Not applicable to this manual

Serial Output Functions

The following functions appear after the **SEt OPEr** function. Refer to the "RS232/RS485" output appendix for further details.

bAUDrRtE

Prty

O.PUt

Rddr

SEt. I tYPE - used to select the optional serial output, applicable only when this option is fitted. Select from **NONE**, **r232** (RS232), **r485** (RS485) or **i 20** (serial current loop).

Returning to the normal measure mode

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

4.2 Scaled period measurement examples

Examples of using *PERD:NPt* and *PERD:SCALE*.

The actual period of the input pulse (seconds) is used with the *PERD:NPt* and *PERD:SCALE* functions to scale the display value. Normal and reciprocal modes are available. The formulae for each type are as below.

For normal mode (*PLSE* or *SNGL*)

$$\text{Display Value} = \frac{\text{input period (seconds)} \times \text{PERD:SCALE}}{\text{PERD:NPt}}$$

i.e. the display value is proportional to the input period of the pulse and the display is scaled by the *PERD:NPt* and *PERD:SCALE* functions.

For reciprocal mode (*PLSF* or *SNGLF*)

$$\text{Display Value} = \frac{\text{PERD:SCALE}}{\text{input period (seconds)} \times \text{PERD:NPt}}$$

i.e. the display value is inversely proportional to the input period of the pulse and the display is scaled by the *PERD:NPt* and *PERD:SCALE* functions.

Example 1 - Using normal mode

The input pulse is the time an object takes to move over a distance of 100mm. Display is to show time taken in milli seconds with a resolution of 0.1 milliseconds.

Set the decimal point (*DCPt*) to **0.1**. Set period scale to **1000.0** (one thousand milli seconds = 1 second) and period input to **1**. The actual period in seconds will be multiplied by 1000.0 and divided by 1 to give a scaled result in milli seconds.

Example 2 - Using reciprocal mode

For the same inputs given in Example 1 it is required to display velocity in metres per second with a resolution of 0.01 metres per second.

Set the decimal point (*DCPt*) to **0.02**. Set period scale to **1.00** and period input to **10** (100mm in 0.1 seconds = 1m/s). The period scale of 1.0 will be divided by the product of the input period in seconds and the period input to give a display scaled in metres/sec. So for 100mm travelled in 0.1 second the display value = $1.00 / (0.1 \times 10) = 1\text{m/s}$.


Example 3 - Using reciprocal mode

For the same inputs as Example 2 it is now required to scale the instrument to read in kilometres per hour.

Set period input to **10000.00** (ten thousand times 100mm = one kilometre) and period scale to **3600** (three thousand, six hundred seconds in one hour). The period scale of 1000.00 will be divided by the product of the input period in seconds and the period input to give a display scaled in metres/sec.

Note: For all the examples above the period input and period scale factors may be reduced for simplicity if required e.g. in Example 3 a period scale setting of **100.00** combined with a period input of **36** would give the same result.

4.3 Function table - scaled period mode

Initial display	Meaning of display	Next display	Default Settings	Record Your Settings
<i>A 1Lo</i>	Alarm 1 low setpoint value	Setpoint value or <i>OFF</i>	<i>OFF</i>	
<i>A 1Hi</i>	Alarm 1 high setpoint value	Setpoint value or <i>OFF</i>	<i>OFF</i>	
<i>A 2Lo</i>	Alarm 2 low setpoint value	Setpoint value or <i>OFF</i>	<i>OFF</i>	
<i>A 2Hi</i>	Alarm 2 high setpoint value	Setpoint value or <i>OFF</i>	<i>OFF</i>	
<i>A 1HY</i>	Alarm 1 hysteresis	Hysteresis value in measured units	<i>10</i>	
<i>A 2HY</i>	Alarm 2 hysteresis	Hysteresis value in measured units	<i>10</i>	
<i>A 1tt</i>	Alarm 2 trip time	No of seconds before relay trips	<i>0</i>	
<i>A 2tt</i>	Alarm 2 trip time	No of seconds before relay trips	<i>0</i>	
<i>A 1rt</i>	Alarm 1 reset time	No of seconds before relay resets	<i>0</i>	
<i>A 2rt</i>	Alarm 2 reset time	No of seconds before relay resets	<i>0</i>	
<i>A 1n.o</i> or <i>A 1n.c</i>	Alarm 1 action N/O or N/C	<i>A 1n.o</i> or <i>A 1n.c</i>	<i>A 1n.o</i>	
<i>A 2n.o</i> or <i>A 2n.c</i>	Alarm 2 action N/O or N/C	<i>A 2n.o</i> or <i>A 1n.c</i>	<i>A 2n.o</i>	
<i>brgt</i>	Digital display brightness	<i>1</i> to <i>63</i> (<i>63</i> = highest brightness)	<i>63</i>	
<i>dULL</i>	Remote input brightness control	<i>0</i> to <i>63</i> (<i>63</i> = highest brightness)	<i>0</i>	
The functions below are accessible only via CAL mode - see section 1.2 or if the ACCESS function is set to ALL				
<i>brgt AUTO</i>	Automatic brightness control	<i>on</i> or <i>OFF</i>	<i>on</i>	
<i>brgt HI 9H</i>	Automatic high brightness level	<i>1</i> to <i>63</i>	<i>63</i>	
<i>brgt Lo</i>	Automatic low brightness level	<i>1</i> to <i>63</i>	<i>10</i>	
<i>drnd</i>	Display rounding, selects resolution	Value in memory	<i>1</i>	
<i>r.i NP</i>	Remote input	<i>NONE</i> , <i>PHLd</i> , <i>d.HLd</i> , <i>H</i> , <i>Lo</i> , <i>H</i> , <i>Lo</i> , <i>2EFD</i> , <i>SP.Ac</i> , <i>No.Ac</i> , <i>d</i> ! <i>SP</i> , <i>dULL</i> or <i>9.rSt</i>	<i>NONE</i>	
<i>P.but</i>	 Button operation	<i>NONE</i> , <i>H</i> , <i>Lo</i> , <i>H</i> , <i>Lo</i> , <i>2EFD</i> , <i>d</i> ! <i>SP</i> , <i>FUNC</i> or <i>9.rSt</i>	<i>NONE</i>	
ACCESS	Relay access mode	<i>OFF</i> , <i>NONE</i> , <i>ERS4</i> or <i>ALL</i>	<i>OFF</i>	
SPAC	Setpoint access	<i>A 1</i> or <i>A 1-2</i>	<i>A 1</i>	
<i>Lo di SP</i>	Not applicable to this model		<i>OFF</i>	
<i>Hi 9H di SP</i>			<i>OFF</i>	
<i>d</i> ! <i>SP</i>			<i>FLSH</i>	
<i>P.SET</i>	Preset value	Value in memory	<i>0</i>	
<i>dCPE</i>	Decimal point setting	Value in memory	<i>0</i>	
<i>OPER</i>	Set operating mode	<i>PLSE</i> , <i>5n9L</i> , <i>PLS.F</i> or <i>5n9.F</i>	<i>PLSE</i>	
<i>PER di NPt</i>	Period input scale factor	Value in memory	<i>1</i>	
<i>PER dSCLF</i>	Period scale factor	Value in memory	<i>1</i>	
<i>i NPt</i>	Input edge type	<i>Lo</i> or <i>hi</i> , <i>9h</i>	<i>hi</i> , <i>9h</i>	
<i>c.rSt</i>	Counter reset value	<i>2EFD</i> or <i>P.SET</i>	<i>2EFD</i>	
<i>c.rSt</i>	Counter reset mode	<i>Lo</i> , <i>H</i> , <i>LoE</i> or <i>H</i> , <i>E</i>	<i>Lo</i>	
<i>dbnc</i>	Debounce time (mS)	<i>0</i> to <i>9999</i>	<i>0</i>	
<i>SEt OPER</i>	Set operating mode	<i>S.Pr d</i> , <i>rt c</i> , <i>PEFd</i> , <i>both</i> , <i>both</i> ! or <i>FFEQ</i>	<i>PEFd</i>	
<i>SEF.1 tYPE</i>	Serial communications type	<i>NONE</i> , <i>F232</i> , <i>F485</i> or <i>1 20</i>	<i>NONE</i>	
<i>SEF.2 tYPE</i>	Not applicable to this instrument			

5 Period Operation

The period mode operation is used when a display of the actual time period of the input pulse is required (with no scaling). Eight different period display options are given, from a display in seconds to a display in days. These display options may be selected at the **di SP FASE** function. You will also need to choose the required operation mode from the **OPER** function. There are nine different operation modes to choose from, allowing a wide choice of timing method.

The instrument will measure the period of the pulse width from either the low or high going edge of the pulse, selection of which edge to start measurement from is via the **i NPE** function.

For inputs such as relays with contact bounce problems which may lead to unstable readings, it may be useful to use the debounce (**dbnc**) function to filter out the contact bounce.

You will need to enter via **CAL** or **FUNC** mode (see section 1.2) to gain access to functions, the function table for each mode shows which functions require entry via **CAL** mode.

The LD-TMR has an easy alarm access facility which allows access to the alarm setpoints simply by pressing the **F** button at the front or rear of the instrument. 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 in order for the easy access to work:

1. Either the **ACCESS** function must be set to **EASY** or the **F: NP** function must be set to **SP.AC**.
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.

5.1 Explanation of functions

R 1Lo (alarm 1 low setpoint)

Displays and sets the alarm low setpoint value for the designated alarm relay. The low alarm setpoint may be disabled by pressing the **▲** and **▼** pushbuttons simultaneously. When the alarm is disabled the display will indicate **OFF**. The alarm relay will trip when the displayed value is less than the **RxLo** setpoint value. Relays may be configured with both a low and high setpoint, so the relay may be tripped when the reading is outside the band set between low and high. e.g. if **R 1Lo** is set to **10.0** and **R 1H** is set to **90.0** then the alarm output relay will trip when the display value is either below **10.0** or above **90.0**.

R 2Lo (alarm 2 low setpoint)

Displays and sets alarm 2 low setpoint, see **R 1Lo** for further description.

R 1H (alarm 1 high setpoint)

Displays and sets the alarm high setpoint value for the designated alarm relay. The high alarm setpoint may be disabled by pressing the **▲** and **▼** pushbuttons simultaneously. When the alarm is disabled the display will indicate **OFF**. The alarm relay will trip when the displayed value is greater than the **RxH** setpoint value. Relays may be configured with both a low and high setpoint, so the relay may be tripped when the reading is outside the band set between low and high (see **R 1Lo** for example).

R 2H (alarm 2 high setpoint)

Displays and sets alarm 2 high setpoint, see **R 1H** for further description.

R 1HY (alarm 1 hysteresis [deadband]) - this function will not be seen if both the high and low setpoints are set to **OFF**.

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 alarm relay when the measured value

stays close to the setpoint. Without a hysteresis setting (**AxHY** set to zero) the alarm will trip 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 tripped the input must fall below the setpoint value minus the hysteresis value to reset the alarm.

e.g. if **A 1H** is set to **50.0** and **A 1HY** is set to **3.0** then the alarm output relay will trip 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 tripped the input must rise above the setpoint value plus the hysteresis value to reset the alarm.

e.g. if **A 1L** is set to **20.0** and **A 1HY** is set to **10.0** then the alarm output relay will trip 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.

A2HY (alarm 2 hysteresis) - this function will not be seen if both the high and low setpoints are set to **OFF**.

Displays and sets alarm 2 hysteresis, see **A 1HY** for further description.

A 1t (alarm 1 trip time) - this function will not be seen if both the high and low setpoints are set to **OFF**

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 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.

A2t (alarm 2 trip time)

Displays and sets alarm 2 trip time, see **A 1t** for further description.

A 1r (alarm 1 reset time) - this function will not be seen if both the high and low setpoints are set to **OFF**.

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.

A2r (alarm 2 reset time) - this function will not be seen if both the high and low setpoints are set to **OFF**.

Displays and sets alarm 2 reset time, see **A 1r** for further description.

A 1n.o or **A 1n.c (alarm 1 normally open or normally closed)**- this function will not be seen if both the high and low setpoints are set to **OFF**.

Displays and sets the 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.

A2n.o or **A2n.c (alarm 2 normally open or normally closed)** - this function will not be seen if both the high and low setpoints are set to **OFF**.

Displays and sets alarm 2 normally open/normally closed operation, see **A 1n.o/A 1n.c** for further description.

br 9t (display brightness) - not seen if **br 9t AUt** is set to **on**. Not applicable to electromagnetic displays.

Displays and sets the digital display brightness. The display brightness is selectable from **1** to **53**, where **1** = lowest intensity and **53** = highest intensity. This function is useful for reducing glare in low light environments.

br 9t AUt (auto brightness on or off) - Not applicable to electromagnetic displays.

Automatic display brightness adjustment. The automatic brightness adjustment uses the optional light sensor to gauge the required brightness level for the environment. The high and low brightness limits are set at the **br 9t H: 9H** and **br 9t L: 0** functions described below. If the optional light sensor is not fitted this function should be set to **OFF**. Note: when **br 9t AUt** is set to **on** the manual brightness control function **br 9t** is not seen.

br 9t Hi 9H (auto brightness high level) - Not applicable to electromagnetic displays.

Automatic brightness high level - seen only when **br 9t AUTO** is set to **on**. The high brightness level sets the maximum brightness which the automatic brightness control can achieve with **53** being the highest intensity.

br 9t Lo (auto brightness low level) - Not applicable to electromagnetic displays.

Automatic brightness low level - seen only when **br 9t AUTO** is set to **on**. The low brightness level sets the minimum brightness which the automatic brightness control can achieve with **53** being the highest intensity.

dULL (remote display brightness) - Not applicable to electromagnetic displays.

Displays and sets the level for remote input brightness switching, see **F.I NP** function. When the remote input is set to **dULL** the remote input can be used to switch between the display brightness level set by the **br 9t** 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.

drnd (display rounding)

Displays and sets the display rounding value. This value may be set from **1 - 5000** displayed units (e.g. **0.00 1** to **5.000** if decimal point set to 3 places). 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. (example: if set to **10** the instruments display will increment in multiples of 10).

dCPE (decimal point selection)

Displays and sets the decimal point for the period display. By pressing the **▲** or **▼** pushbuttons the decimal point position may be set. The decimal point function display shown will depend on the number of digits in the display and the **d: SPFNSE** setting. The table below shows all the possible settings for a 4 digit display.

d: SPFNSE	dCPE	Measured values
SECS	0	Seconds
	0. 1	Seconds & tenths of seconds
	0.02	Seconds & hundredths of seconds
m̄m̄.ss	0.00	Minutes & seconds
	0.00. 1	Minutes, seconds & tenths of seconds
	0.02	Seconds & hundredths of seconds
h̄m̄.s	0.00	Minutes & seconds
	0.00. 1	Minutes, seconds & tenths of seconds
	0.02	Seconds & hundredths of seconds
m̄m̄m̄	0	Minutes
	0. 1	Minutes & tenths of minutes
	0.02	Minutes & hundredths of minutes
hh.m̄m̄	0.00	Hours & minutes
	0.00. 1	Hours, minutes and tenths of minutes
	0.02	minutes & hundredths of minutes
hrS	0	Hours
	0. 1	Hours & tenths of hours
	0.02	Hours & hundredths of hours
dd.hh	0.00	Days & hours
	0.00. 1	Days, hours & tenths of hours
	0.02	Hours & hundredths of hours
dAYS	0	Days
	0. 1	Days & tenths of days
	0.02	Days and hundredths of days

OPEF (period operating mode)

Displays and sets the operation mode to be used in measuring the pulse period. All of the modes are up timers with the exception of the **dn** mode.

The descriptions below use the terms "active inputs", "inactive inputs" and "reset". The reset operation is via a contact closure or control voltage input between the GND and KEY RESET terminals a reset can cause the display to go to zero or a preset value, see the two **crSt** functions for reset operating modes. An input can be a contact closure or control voltage type input depending on the circuit board link settings, the input mode is set via the **iNPE** function. For example with **iNPE** set to **Lo** a short circuit or 0V between the GND and IN terminals will be taken as an active input and an open circuit or control voltage between the GND and IN terminals will be taken as an inactive input. The available modes operate as follows:

Mode	Operation
run (run)	The run option allows accumulated time display. The mode operates in the following manner: Input inactive: The timer stops but holds the time display. Input active: The timer continues timing from the previous time i.e. the time accumulates.
dur (duration)	The duration option allows display of an input time with a reset at the end of the input. The mode operates in the following manner: Input inactive: The timer is automatically reset and the display shows zero or the preset value. Input active: The timer starts timing from zero or the preset value.
PLSE (pulse)	The pulse option allows timing of the duration of an input pulse. The mode operates in the following manner: Input inactive: The display will hold the time of the last pulse. Input active: The display resets to zero (preset does not apply to this mode) then starts timing the new pulse.
Sn9L (single pulse)	The single pulse option allows timing of the duration of a pulse. The mode operates in the following manner: Input inactive: The display will hold the time of the last pulse. The display must be reset before a new pulse can be timed. Input active: If the previous time display has been reset then the timing process will start from zero or the preset value. If the previous display has not been reset the value displayed will not change when the input becomes active.
PLS.H (pulse held)	The pulse held option operates in the same manner as the PLSE option with the exception that the display indication only changes at the end of the active input i.e. the previous display is held until the new active input ends. Preset does not apply to this mode.
Sn9.H (single pulse held)	The pulse held option operates in the same manner as the Sn9L option with the exception that the display indication only changes at the end of the input pulse. As with the Sn9L option the display must be reset before a new pulse can be timed.
UP (up timer)	The up timer option allows the instrument to be used as a timer with a start, stop and reset input (see iNPE and SiNP functions for edge settings for these inputs). Note the crSt function must be set to ZER0 if this mode is used. The mode operates in the following manner: Upon receiving an active input the display will show accumulated time. This timing will continue until a STOP input is received even if the input becomes inactive. This STOP input is operated via an edge between the GND and SET terminals. A reset input will reset the timer to zero. If the timer is stopped and then restarted without a reset the timing will continue from the previous time.
dn (down timer)	The down timer works in the same manner as the UP timer with the exception that the down timing will automatically start from the number set at the P.SET function. The crSt function must be set to PSET if this mode is used.
R.dur (accumulating duration)	The accumulating duration mode allows displays of current timing period and accumulated total. The mode operates in the following manner: Input active: Display starts timing from zero (preset does not apply to this mode). Input inactive: Display shows accumulated time from previous timing periods. A reset operation must be carried out when the accumulated total needs to be reset.

dI SP RANGE (display range).

The display range function allows selection of various display modes. Eight different modes are available these are:

- SECS** for a display in seconds
- mm.SS** for a display in minutes and seconds.
- h.m.S** for a display in hours, minutes and seconds.
- mmmm** for a display in minutes.
- hh.mm** for a display in hours and minutes
- hrS** for a display in hours
- dd.hh** for a display in days and hours
- DRYS** for a display in days

Note that the display is also affected by the decimal point setting.

Examples below show how a 100 second input is affected by the **dI SP RANGE** and **dCPE** functions. Examples are shown for a 4 digit display type instrument.

dCPE	dI SP RANGE	DISPLAY
0	SECS	100 i.e. 100 seconds with a no decimal points display
0.1	SECS	100.0 i.e. 100.0 seconds
0.02	mmmm	1.70 i.e. 1 minute and 70 hundredths of seconds

F.I RP (remote input function)

Terminals GND and KEY SW are the remote input terminals. When these terminals are short circuited, via a pushbutton or keyswitch the instrument will perform the selected remote input function. Alternatively a control voltage of 0V & 5VDC could be used to activate and deactivate the remote input. 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 time value whilst the remote input terminals are short circuited. The message **P.HLd** will flash momentarily every 8 seconds whilst the input is activated to indicate that the peak value is being displayed.

d.HLd - display hold. The display will hold its value whilst the remote input terminals are short circuited. The message **HOLd** will flash momentarily every 8 seconds whilst the input is activated to indicate that the peak value is being displayed.

H, - peak memory. The peak value stored in memory will be displayed if the remote input terminals 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 then the memory will be cleared. The display message **H,** will precede the peak memory value and this message will flash momentarily every 8 seconds to indicate that the peak memory value is being viewed. The display will revert back to live reading after approx. 20 seconds.

Lo - valley memory. The minimum value stored in memory will be displayed. Otherwise operates in the same manner as the **PH,** function. If the short circuit is held for 1 to 2 seconds then the memory will be cleared. The display message **PLo** will precede the valley memory value and this message will flash momentarily every 8 seconds to indicate that the valley memory value is being viewed. The display will revert back to live reading after approx. 20 seconds.

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. If the short circuit is held for 1 to 2 seconds then the memory will be cleared. The display will revert back to live reading after approx. 20 seconds.

ZEFO - zero the display. The time will be zeroed when the remote input is short circuited. The message **ZEFO** will be seen momentarily to indicate that the zero operation has taken place.

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.

di SP - display toggle. Not applicable to this manual.

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 **br 9t** function and the brightness level set at the **dULL** function.

9.r 5t - grand total reset. Not applicable to this manual.

P.but (P button function)

The **P** button may be set to operate some of the remote input functions, this button is located on main printed circuit board a connector is also provided to allow external connection of remote switches to the **P**, **F**, **▲** and **▼** buttons. With some functions, to prevent accidental operation, the **P** button must be held pressed for 2-3 seconds before the function will operate. 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 NP** function above with the exception of the **FUNC** function.

Functions available are:

NONE, Hi, Lo, Hi Lo, ZEFQ, di SP, FUNC and **9.r 5t**

The **FUNC** function allows the preset value used with the down timer (when in **PEFd** mode) to be displayed and set without the need to enter **CAL** and **FUNC** modes. Note that this is an alternative method to setting the preset value at the **P.5Et** function. To alter the **FUNC** (preset) value press the **P** pushbutton, the display will indicate **FUNC** followed by the current preset value. This value may now be altered via the **▲** or **▼** pushbutton. When the preset value is set as required press, then release, the **F** pushbutton, the display will indicate **End** and will return to normal measurement.

ACCESS (alarm relay access mode)

Access mode (**OFF, EASY, NONE** or **ALL**) - If set to **OFF** the mode function has no effect or alarm relay operation. If set to **EASY** the "easy alarm access" mode will be in operation, see page 18. 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 functions. This function provides an alternative to using the **F.I NP** function for easy access or no access mode thereby allowing the remote input to be programmed for an alternative use. If set to **ALL** then access to all functions can be made via **FUNC** mode i.e. there is no need to enter via **CAL** mode.

SPAC (setpoint access)

Sets the access to the alarm relay set points. The following choices are available: **A 1** - Allows setpoint access to alarm 1 only. **A 1-2** - Allows access to alarms 1 and 2. For this function to operate the remote input function must be set to **SP.AC**.

Lo di SP, Hi 9H di SP and **di SP** functions - not applicable to this model.

P.5Et (preset value)

This function displays and sets the preset value to be used when the **OPER** function is set to down count timer (**dn**). Note that the **P** button may be programmed to allow access to the preset value also. The preset value is the value which will automatically be set when a timing process starts in down count mode. The preset can also be used in some other up counting modes if required, see **OPER** function.

I NPt (input type)

Displays and sets the input type to be used for period measurement. If set to **Lo** then the instrument will measure the period of an input with a low going edge. If set to **Hi 9h** then the instrument will measure the period of an input with a high going edge.

S.I NP (SET terminal input)

Displays and sets the input type to be used to halt the timing process when using the up or down count timer. The SET input is used as the stop input when using the up or down timer. If set to **Lo** then the timing will be held when a low going edge is received, if set to **Hi 9h** then the timing will be held when a high going edge is received.

c.rSt (reset value)

The reset terminal can be programmed to cause the display to reset to either zero or the preset value set via the **PSEt** function. Choose either **ZEF0** or **P.SEt** to select the required operation.

c.rSt (reset mode)

Allows selection of reset level or edge to force a reset. If set to **L0** a low input level or closed switch on the reset line will force a reset. If set to **H1** a high input level or open switch on the reset line will force a reset. If set to **L0E** then a falling edge or switch closure on the reset line will force a reset. If set to **H1E** then a rising edge or switch opening on the reset line will force a reset.

dbnc (debounce)

Displays and sets the debounce time. The debounce time can be set from 0 to 1000 displayed units. If the input pulse width is less than the debounce time setting then the input will be ignored and will not be displayed.

SEt OPEr (set operating mode)

Displays and sets the selected operating mode, e.g. select **S.Prd** for scaled period measurement. See the dedicated chapter in this manual for description of the required operating mode. Options are:

- S.Prd** - Scaled period measurement.
- rbc** - Not applicable to this manual
- PEFd** - Period measurement
- both** - Not applicable to this manual
- totL** - Not applicable to this manual
- FTE9** - Not applicable to this manual

Serial Output Functions

The following functions appear after the **SEt OPEr** function. Refer to the "RS232/RS485" output appendix for further details.

bAUd rRtE

Prty

0.PUt - the update mode is used with the real time clock mode only.

Rddr

SEt. tYPE - used to select the optional serial output, applicable only when this option is fitted. Select from **none**, **r232** (RS232), **r485** (RS485) or **i20** (serial current loop).

Returning to the normal measure mode

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

5.2 Period measurement examples

Examples below show three typical applications, see the **OPEr** function for a full description of these and other modes.

Example 1 - Stopwatch operation.

To operate as a up counting stopwatch (start/stop and reset inputs) and display in hours, minutes and seconds choose **hns** mode at the **di SPFRGE** function. Choose **UP** at the **OPEr** function. The **c.rSt** function must be set to **ZEF0**.

To operate as a down counting stopwatch (start/stop and reset inputs) and display in hours, minutes and seconds choose **hns** mode at the **di SPFRGE** function. Choose **dn** at the **OPEr** function. The **c.rSt** function must be set to **PSEt** and a preset value to count down form entered at the **PSEt** function.

Note: if the STOP input is not required the **UP** and **dn** modes can be used with the START and RESET inputs only.

Example 2 - Elapsed time operation.

To operate as a simple elapsed time display with a start and reset input and a display in seconds choose **SECS** mode at the **di SPTRNGE** function. Choose **SINGL** at the **OPER** function. The **CRSE** function must be set to **ZERO**. Whist the input is active the display will increment in seconds. When the input becomes inactive the time display will be held. To start from zero a reset input must be given.

Example 3 - Pulse timer operation.

To operate as a simple pulse timer display with a display in minutes & seconds choose **MM.SS** mode at the **di SPTRNGE** function. Choose **PULSE** at the **OPER** function. When the input becomes active the display will automatically reset to zero and start timing from zero. When the input becomes inactive the display will hold the time of the last pulse input.

5.3 Function table - period mode

Initial display	Meaning of display	Next display	Default Setting	Record Your Settings
<i>A 1Lo</i>	Alarm 1 low setpoint value	Setpoint value or <i>OFF</i>	<i>OFF</i>	
<i>A 1H</i>	Alarm 1 high setpoint value	Setpoint value or <i>OFF</i>	<i>OFF</i>	
<i>A 2Lo</i>	Alarm 2 low setpoint value	Setpoint value or <i>OFF</i>	<i>OFF</i>	
<i>A 2H</i>	Alarm 2 high setpoint value	Setpoint value or <i>OFF</i>	<i>OFF</i>	
<i>A 1HY</i>	Alarm 1 hysteresis	Hysteresis value in measured units	<i>10</i>	
<i>A 2HY</i>	Alarm 2 hysteresis	Hysteresis value in measured units	<i>10</i>	
<i>A 1tt</i>	Alarm 1 trip time	No of seconds before relay trips	<i>0</i>	
<i>A 2tt</i>	Alarm 2 trip time	No of seconds before relay trips	<i>0</i>	
<i>A 1rt</i>	Alarm 1 reset time	No of seconds before relay resets	<i>0</i>	
<i>A 2rt</i>	Alarm 2 reset time	No of seconds before relay resets	<i>0</i>	
<i>A 1n.o</i> or <i>A 1n.c</i>	Alarm 1 action N/O or N/C.	<i>A 1n.o</i> or <i>A 1n.c</i>	<i>A 1n.o</i>	
<i>A 2n.o</i> or <i>A 2n.c</i>	Alarm 2 action N/O or N/C.	<i>A 2n.o</i> or <i>A 1n.c</i>	<i>A 2n.o</i>	
<i>brgt</i>	Digital display brightness	<i>1</i> to <i>63</i> (<i>63</i> = highest brightness)	<i>63</i>	
<i>dULL</i>	Remote input brightness control	<i>0</i> to <i>63</i> (<i>63</i> = highest brightness)	<i>0</i>	
The functions below are accessible only via CAL mode - see section 1.2 or if the ACCESS function is set to ALL				
<i>brgt AUTO</i>	Automatic brightness control	on or <i>OFF</i>	on	
<i>brgt HI 9H</i>	Automatic high brightness level	<i>1</i> to <i>63</i>	<i>63</i>	
<i>brgt Lo</i>	Automatic low brightness level	<i>1</i> to <i>63</i>	<i>10</i>	
<i>drnd</i>	Display rounding, selects resolution	Value in memory	<i>1</i>	
<i>RI NP</i>	Remote Input	<i>NONE</i> , <i>PHLd</i> , <i>d.HLd</i> , <i>H</i> , <i>Lo</i> , <i>H</i> , <i>Lo</i> , <i>2EFD</i> , <i>SP.Ac</i> , <i>No.Ac</i> , <i>di SP</i> , <i>dULL</i> or <i>9.rSt</i>	<i>NONE</i>	
<i>P.but</i>	P Button operation	<i>NONE</i> , <i>H</i> , <i>Lo</i> , <i>H</i> , <i>Lo</i> , <i>2EFD</i> , <i>di SP</i> , <i>FUNC</i> or <i>9.rSt</i>	<i>NONE</i>	
ACCESS	Relay access mode	<i>OFF</i> , <i>NONE</i> , <i>EASY</i> or ALL	<i>OFF</i>	
SPAC	Setpoint access	<i>A 1</i> or <i>A 1-2</i>	<i>A 1</i>	
<i>Lo di SP</i>	Not applicable to this model		<i>OFF</i>	
<i>HI 9H di SP</i>			<i>OFF</i>	
<i>di SP</i>			<i>FLSH</i>	
<i>P.SET</i>	Preset value	Value in memory	<i>0</i>	
<i>dCPE</i>	Decimal point setting	Value in memory	<i>0</i>	
<i>OPER</i>	Operation mode	<i>run</i> , <i>dur</i> , <i>PLSE</i> , <i>Sn9L</i> , <i>PLS.H</i> , <i>Sn9.H</i> , <i>UP</i> , <i>dn</i> or <i>R.dur</i>	<i>dur</i>	
<i>di SP RANGE</i>	Display range	<i>dAYS</i> , <i>dd</i> , <i>hh</i> , <i>hr</i> , <i>S</i> , <i>hh</i> , <i>nn</i> , <i>nnn</i> , <i>h.n</i> , <i>S</i> , <i>nn</i> , <i>SS</i> or <i>SECS</i>	<i>SECS</i>	
<i>I NPE</i>	Input edge type	<i>Lo</i> or <i>hi</i> , <i>9h</i>	<i>hi</i> , <i>9h</i>	
<i>S.I NP</i>	Stop input edge type	<i>Lo</i> or <i>hi</i> , <i>9h</i>	<i>Lo</i>	
<i>c.rSt</i>	Counter reset value	<i>2EFD</i> or <i>P.SET</i>	<i>2EFD</i>	
<i>c.rSt</i>	Counter reset mode	<i>Lo</i> , <i>H</i> , <i>LoE</i> or <i>H</i> , <i>E</i>	<i>Lo</i>	
<i>dbnc</i>	Debounce time (mS)	<i>0</i> to <i>9999</i>	<i>0</i>	
<i>SEt OPER</i>	Set operating mode	<i>S.Pr</i> , <i>d.rtc</i> , <i>PEFd</i> , <i>both</i> , <i>totL</i> or <i>FFEQ</i>	<i>PEFd</i>	
<i>SEF.1 TYPE</i>	Optional serial communications type	<i>NONE</i> , <i>F232</i> , <i>F485</i> or <i>120</i>	<i>NONE</i>	
<i>SEF.2 TYPE</i>	Not applicable to this instrument			

6 RS232/RS485 Commands

RS232/485 Operation and Commands (seen only when the serial communications option is fitted)

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

none - no serial communications

r.bus - modbus RTU communications - see section 8.1

R.bus - special binary communications mode.

This mode is for use with optional special Windows communications software for use with a personal computer. Refer to the user manual supplied with the software.

d. SP - Image Display Mode:

In image display mode the display value is sent via RS232/485 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.

The most common usage would be to provide output for 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, Bit 7 is decimal point etc.

Cont - Continuous Transmit Mode (ASCII):

In this mode the display value is continually sent via the RS232/485 interface every display update (approx. 4 times per second depending on the baud rate). 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 or X '-' (45 Dec, 2D Hex) for a negative value.

YYYY is the display value in ASCII (length depends on number of display digits).

<CR> is a Carriage Return (13 Dec, 0D Hex)

e.g.: If the display is showing 123456 then the instrument will send '02 20 31 32 33 34 35 36 0D' (HEX) to the host.

When the instrument is in ***both*** mode the rate followed by the total followed by the grand total (if selected) will be sent with a comma separating each e.g.

<STX>XYYYY,XYYYY,XYYYY<CR>

The exact number of characters sent will depend on the number of display digits, leading zeroes will be sent as space characters.

POLL - Host Controlled Transmit Mode (ASCII):

This mode requires a host computer or PLC to poll the instrument to obtain display or other information or reset various setpoint parameters. The format for the host command is as follows:-

<STX>CA<CR> (Standard read etc.)

<STX>CA<CR>N<CR>YYYY (Set Value Command)

Where: <STX> is Start of Text Character (2 Dec, 02 Hex)

C is the command character (see list below)

A is the unit address (Range: 32 to 63 Dec, 20 to 3F Hex - address is offset by 32 Dec, 20 Hex)

<CR> is Carriage Return (13 Dec, 0D Hex)

N is the setpoint number in ASCII

e.g.: 31 Hex would be 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:

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

Instructs unit to return the primary display value. The primary value is the main reading. In **FFEQ** and **both** modes the rate value is the primary display value. In **total** mode the total is the primary display value. 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).

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

Instructs unit to return the secondary display value. For example the secondary value would be total value when **SEt OPER** is set to **both**. If no secondary value exists then the primary display value is returned. Format of returned data is:-

<ACK>SAXYYYY<CR>

Where:<ACK> is Acknowledge (6 Dec, 06 Hex)

S echo command received 'S' (83 Dec, 53 Hex)

A is the responding unit's address

X is 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).

If the instrument does not have a secondary display then the command will be echoed back with no display value (i.e.:<ACK>SA<CR>).

Transmit Special Function Value: <STX>KA<CR>

Instructs unit to return the special function value (if enabled). Will return the Display Hold, Peak Hold, Valley High, Valley Low value depending upon which is selected at the **FLIP** function. Format of returned data is:-

<ACK>KAXYYYY<CR>

Where: <ACK> is Acknowledge (6 Dec, 06 Hex)

K echo command received 'K' (75 Dec, 4B Hex)

A is the responding unit's address

X is 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).

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

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

Instructs the unit to reset the special function value (if applicable). Will reset the stored value for Peak Hold, Valley High and Valley Low depending upon which is selected at the **FLIP** function. 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).

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

Instructs unit to return value of low alarm setpoint. Format of returned data is:

<ACK>LANXYYYY<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).

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

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

<ACK>HANXYYYY<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).

Set Low Alarm Setpoint: <STX>IA<CR>N<CR>XYYYY<CR>

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

<ACK>IANXYYYY<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>IA0YYYY).

Set High Alarm Setpoint: <STX>hA<CR>N<CR>XYYYY<CR>

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

<ACK>hANXYYYY<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>hA0YYYY).

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

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 a 2 character model identifier (e.g.: 1F)
X.X is the version number (e.g.: '0.1')
<CR> is a Carriage Return (13 Dec, 0D Hex)

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.

SEF 1 - Output mode for serial port 1

Displays and sets the output mode for serial port 1. Options are:

NONE - no serial input/output
F232 - RS232 serial input/output
F485 - RS485 serial input/output
I 20 - 20mA serial current loop

Where a serial input/output is being used the option must be set to correspond to the input/output hardware fitted. e.g. if the instrument was ordered with an RS232 output then **SEF 1 TYPE** must be set to **F232**.

SEF 2 - Output mode for serial port 2

Displays and sets the output mode for serial port 2. Options are as per **SEF 1**. This function is only used in special software versions and should normally be set to **NONE**.

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 Char.	Dec	Hex	ASCII Char.	Dec	Hex
NUL (^@)	000	00	@	64	40
SOH (^A)	001	01	A	65	41
STX (^B)	002	02	B	66	42
ETX (^C)	003	03	C	67	43
EOT (^D)	004	04	D	68	44
ENQ (^E)	005	05	E	69	45
ACK (^F)	006	06	F	70	46
BEL (^G)	007	07	G	71	47
BS (^H)	008	08	H	72	48
HT (^I)	009	09	I	73	49
LF (^J)	010	0A	J	74	4A
VT (^K)	011	0B	K	75	4B
FF (^L)	012	0C	L	76	4C
CR (^M)	013	0D	M	77	4D
SO (^N)	014	0E	N	78	4E
SI (^O)	015	0F	O	79	4F
DLE (^P)	016	10	P	80	50
DC1 (^Q)	017	11	Q	81	51
DC2 (^R)	018	12	R	82	52
DC3 (^S)	019	13	S	83	53
DC4 (^T)	020	14	T	84	54
NAK (^U)	021	15	U	85	55
SYN (^V)	022	16	V	86	56
ETB (^W)	023	17	W	87	57
CAN (^X)	024	18	X	88	58
EM (^Y)	025	19	Y	89	59
SUB (^Z)	026	1A	Z	90	5A
ESC (^[)	027	1B	[91	5B
FS (^\[)	028	1C	\	92	5C
GS (^\[)	029	1D]	93	5D
RS (^_)	030	1E	^	94	5E
US (^_)	031	1F	_	95	5F
SP (^)	032	20	`	96	60
!	033	21	a	97	61
"	034	22	b	98	62
#	035	23	c	99	63
\$	036	24	d	100	64
%	037	25	e	101	65
&	038	26	f	102	66
'	039	27	g	103	67
(040	28	h	104	68
)	041	29		105	69
*	042	2A	j	106	6A
+	043	2B	k	107	6B
,	044	2C	l	108	6C
-	045	2D	m	109	6D
.	046	2E	n	110	6E
/	047	2F	o	111	6F
0	048	30	p	112	70
1	049	31	q	113	71
2	050	32	r	114	72
3	051	33	s	115	73
4	052	34	t	116	74
5	053	35	u	117	75
6	054	36	v	118	76
7	055	37	w	119	77
8	056	38	x	120	78
9	057	39	y	121	79
:	058	3A	z	122	7A
;	059	3B	{	123	7B
<	060	3C		124	7C
=	061	3D	}	125	7D
>	062	3E	~	126	7E
?	063	3F	DEL	127	7F

6.1 Modbus Communications

This section covers the use of Modbus RTU communications when using the LD-TMR monitor.

When using Modbus communications the instrument must be set up electrically for RS232 or RS485 communications and the LD-TMR **0.PuE** function must be set to **5.bu5**.

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 LD-TMR, the LD-TMR then responds to the query.

An example of a query to read coils 1 to 4 from the LD-TMR 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) Hi	-- (automatically generated number)
Error check (LRC or CRC) Lo	-- (automatically generated number)

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) Hi	-- (automatically generated number)
Error check (LRC or CRC) Lo	-- (automatically generated number)

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 LD-TMR being addressed. Each value is stored in the LD-TMR as a 32 bit value stored in two 16 bit registers per set of values i.e. 4 bytes per set of values. Note: an overrange indication value depends on the number of display digits e.g. for a 5 digit display 100,000 decimal or 186a0 hex indicates a positive overrange and -20,000 decimal or fffb1e0 hex will represent a negative overrange since these numbers are just outside the display range of a 5 digit display (99999 to -19999).

The register allocation depends on model type, see the register table overleaf.

An example of a query to read holding registers 1 to 8 from the LD-TMR at address 1 is given below.

Field Name	Example (Hex)
Unit address	01
Function	03
Starting address Hi	00
Starting address Lo	00
Number of points Hi	00
Number of points Lo	08
Error check (LRC or CRC) Hi	44
Error check (LRC or CRC) Lo	0c

This would be transmitted as 01 03 00 00 00 08 44 0c where:

01 is the unit address (set at the PM4 ~~Addr~~ function)

03 is the function number (function 3)

00 00 is the starting address of zero. Note addresses 0 to 7 correspond to registers 1 to 8.

00 08 is the number of points required (08 hex.)

44 0c is the error check (generated by the modbus program)

An example of a response is given below:

Field Name	Example (Hex)
Unit address	01
Function	03
Byte count	10
Data Hi (register 1)	00
Data Lo (register 1)	00
Data Hi (register 2)	00
Data Lo (register 2)	3e
Data Hi (register 3)	00
Data Lo (register 3)	00
Data Hi (register 4)	00
Data Lo (register 4)	3e
Data Hi (register 5)	00
Data Lo (register 5)	00
Data Hi (register 6)	01
Data Lo (register 6)	3d
Data Hi (register 7)	00
Data Lo (register 7)	00
Data Hi (register 8)	05
Data Lo (register 8)	8b
Error check (LRC or CRC) Hi	84
Error check (LRC or CRC) Lo	65

An example of the entire message transmitted and received in this example is:

tx: 01 03 00 00 00 08 44 0c

rx: 01 03 10 00 00 00 3e 00 00 00 3e 00 00 01 3d 00 00 05 8b 84 65

The data received (rx:) is interpreted as follows:

01 is the address of the LD-TMR

03 denotes function 3

10 is the byte count (10 hex., 16 decimal) i.e. 16 bytes at 4 bytes per set of data

00 00 00 3e is the rate value 3e hex., 62 decimal (requires 4 bytes i.e. 2 registers)

00 00 00 3e is the same rate value again

00 00 01 3d is the total value (13d hex., 317 decimal)

00 00 05 8b is the grand total value (58b hex., 1419 decimal)

84 65 is the error check value generated

Register table

Address	Register	
0x00	1	Rate display value high word
0x01	2	Rate display value low word
0x02	3	Rate display value high word (repeated)
0x03	4	Rate display value low word (repeated)
0x04	5	Total display value high word
0x05	6	Total display value low word
0x06	7	Grand total display value high word
0x07	8	Grand total display value low word

7 Specifications

7.1 Technical Specifications

Display:	4, 5 or 6 digit 100mm yellow electromagnetic type or 6 digit 38mm red LED type or 5 digit 45mm red LED type or 4 digit 57mm red LED type or 4 or 6 digit 100mm red LED type or 4 digit 178mm red LED type
Input:	Link selectable to suit most sensor types. For inductive, AC and square wave inputs the maximum input voltage is 48VDC or RMS with appropriate link settings
Impedance:	10k Ω
Memory Retention:	Battery backed memory
Display Reset:	Remote reset via "RST" input (contact closure or 5VDC maximum)
Microprocessor:	MC68HC11 CMOS
Ambient Temperature:	-10 to 60°C
Humidity:	5 to 95% non condensing
Power Supply:	100mm & 200mm LED & 100mm electromagnetic displays: AC 240/110V selectable 50/60Hz or AC 48/42/32/24V selectable 50/60Hz or DC 12 to 24V isolated or DC 30 to 48V isolated or 24VDC non isolated. 38mm or 45mm LED or 39mm electro magnetic displays: AC 240V or 110V 50/60Hz or DC 12 to 48V isolated or DC 24V ($\pm 10\%$) non isolated Note: 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 typically less than 10VA, 3A peak
Sensor DC supply:	Regulated 5VDC or unregulated 18 to 24VDC (link selectable) @ 50mA max. Note: for instruments powered from non isolated DC the 18 to 24V unregulated supply will be slightly less than the power supply voltage.

Physical characteristics

Models LD-TMR-X-100E4 100mm 4 digit electromagnetic	Case size (mm) = 450 x 250 x 155 Weight: = 8.5 kgs Mounting hole locations - see "Mechanical Installation" chapter
Models LD-TMR-X-100E5 100mm 5 digit electromagnetic	Case size (mm) = 520 x 250 x 155 Weight: = 9.5 kgs Mounting hole locations - see "Mechanical Installation" chapter
Models LD-TMR-X-100E6 100mm 6 digit electromagnetic	Case size (mm) = 650 x 250 x 155 Weight: = 10.5 kgs Mounting hole locations - see "Mechanical Installation" chapter
Model LD-TMR-X-38R6 38mm 6 digit LED	Case size (mm) = 255 x 145 x 125 Weight: = 1.3 kgs Mounting hole locations (mm) - see "Mechanical Installation" chapter
Model LD-TMR-X-45R5 45mm 5 digit LED	Case size (mm) = 255 x 145 x 125 Weight: = 1.3 kgs Mounting hole locations (mm) - see "Mechanical Installation" chapter
Model LD-TMR-X-57R4 57mm 4 digit LED	Case size (mm) = 255 x 145 x 125 Weight: = 1.3 kgs Mounting hole locations (mm) - see "Mechanical Installation" chapter
Model LD-TMR-X-100R4 100mm 4 digit LED	Case size (mm) = 450 x 250 x 155 Weight: = 8.5 kg Mounting hole locations (mm) - see "Mechanical Installation" chapter
Model LD-TMR-X-100R6 100mm 6 digit LED	Case size (mm) = 650 x 250 x 155 Weight: = 10.5 kg Mounting hole locations - see "Mechanical Installation" chapter
Model LD-TMR-X-180R4 180mm 4 digit LED	Case size (mm) = 850 x 360 x 130 Weight: = 12 kg Mounting hole locations - see "Mechanical Installation" chapter

7.2 Options

Serial Communications: SOFT-DL1 LD-RC10	RS232 or RS485 serial communications (factory configured) Windows download software for serial communications Remote programming pushbuttons with 10m cable
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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.

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This product is designed and manufactured in Australia.