

## **INDICATING TRIP AMPLIFIER**

Three Point Programmable  
Type B12-TT

### **User Guide**

Continuous development may necessitate  
changes in these details without notice



PROCESS MEASUREMENT, CONTROL & DISPLAY INSTRUMENTATION

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## **WARNING!**

**It is important that this guide is read and fully understood before attempting installation or commissioning of the instrument. Instructions appearing in this document, and current safety legislation, must be observed to ensure personal safety and to prevent damage to the instrument or equipment connected to it.**

**The instrument should be installed, commissioned and operated *only* by suitably qualified and authorised personnel.**

## **Safety and EMC information**

Safety: EN61010 -1

Immunity: EN50082-1

Emissions: EN50081-1

CE certified



The specifications for the instrument must not be exceeded. If the instrument is used in a manner not specified, the protection provided by the instrument may be compromised.



The instrument must be installed in an enclosure that provides adequate protection against electric shock.



Ensure that power to the instrument is switched off and signal wiring isolated from hazardous voltages before carrying out installation or maintenance.



The instrument is designed for installation in a clean, dry environment (Pollution degree 1).



Stroud Instruments Ltd strongly recommends that repairs and re-calibration work are done on a return to factory basis in order that our quality standards, product specifications and safety precautions are not compromised.



The instrument is double insulated

Note: Clean with a moist cloth - USE NO SOLVENTS.

## Installation



**WARNING:** Installation should be conducted by appropriately skilled and authorised personnel only.



**WARNING:** Ensure that power to the instrument is switched off and signal wiring isolated from hazardous voltages before carrying out installation.



**WARNING:** The instrument must be installed in an enclosure that provides adequate protection against electric shock.

### Location

- The instrument is designed for installation in a clean, dry environment
- Do not install near to switch gear, motor controllers or other sources of strong magnetic fields.
- Avoid exposure to direct sunlight and ensure the ambient temperature inside the enclosure that the unit is mounted in will not exceed our specification.

### Fixing

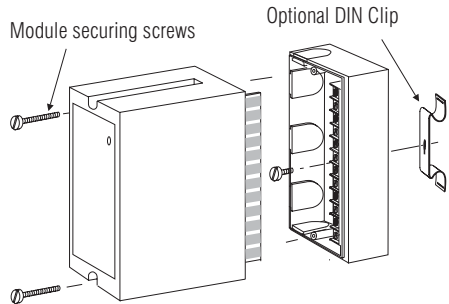
B12 Series Modules are designed to be fitted to a flat dry surface using two 4mm screws. Alternatively, by fitting an optional DIN clip, they may be clipped to a rail conforming to BS5584:1978, EN50 022, DIN46277-3.

Grommets are provided on three sides of the base section and there are two rear entry knock outs in the bottom.

To gain access to fixing points:

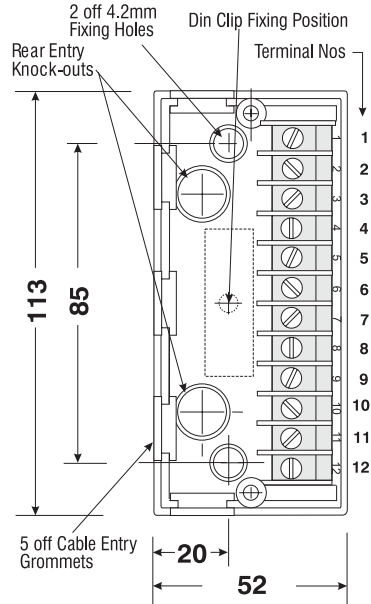
1. Remove the plug-in module securing screws.
2. Gently pull away the plug-in module from the base section.

3. To refit the module, align the module edge connectors with the socket in the base and carefully press home. NB do not overtighten the module securing screws.



### Dimensions and fixing positions

Height of unit 106mm



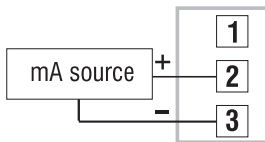
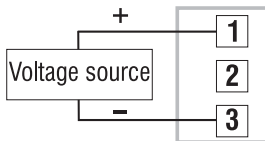
## Wiring and connections

- Segregate power supply and signal wiring.
- Use screened cable for all signal wiring with the screen earthed at instrument end only.
- All connections should be made using ferrules.

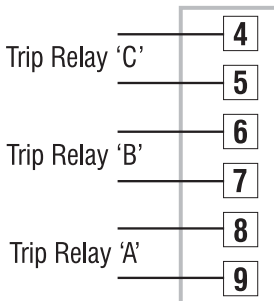
Screw terminal connectors are provided. Maximum wire capacity is 2 x 1.5 sq. mm (approx. 16 AWG).

## Input and output connections

### Input signal



### Trip relay outputs



## Power supply connections

This instrument is supplied in *one* of two power supply versions.

1. AC mains supply in the range 85 - 260 V, 50/60Hz, 3VA.
2. Low voltage option 11-32 VDC, 4W or 12-24VAC



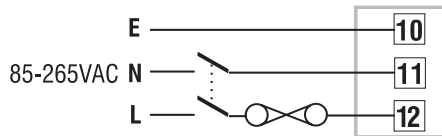
**WARNING:** Check that the supply voltage on the data label (on top of instrument) is suitable for the application.



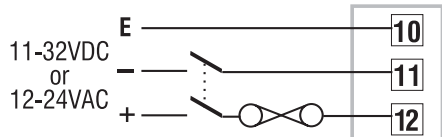
**WARNING:** Ferrules must be used for AC mains power wiring

Power supply wiring to the instrument should be protected by a suitable fuse and double pole switch - see below. The switch should be clearly marked as the isolating switch for the instrument.

### AC Mains



### Low voltage



## Please note:

The unit cannot be changed by the user from one type of power supply version to another. This conversion can only be done on a return to factory basis.

# Operation

The B12 Indicating three-point trip amplifier provides voltage free contacts that change state when the input signal passes adjustable reference set-points. All adjustable functions are programmed from the front panel of the unit.

The four-digit display will show the monitored signal level in volts, milliamps or engineering units as programmed.

Any readings detected above the chosen range will be displayed as 'OErr'. A reading less than 4mA when on the 4-20mA scale will be displayed as 'UErr'. For control function purposes, overrange or underrange readings will be considered to be at the maximum or minimum of the range as programmed.

## Default settings

The unit is supplied ready to go with preset defaults. The default settings are given in Appendix 1.

## Input source and scaling

The input may be programmed to accept most standard voltage and milliamp process signals. Display scaling to user specified engineering units is also catered for.

## Delay

The delay function inhibits a trip operation until the period programmed has expired.

## Hysteresis

The hysteresis may be programmed with values of up to 100% of the input signal fullscale from the set trip point (see "Alarm Type"). Hysteresis values may be set in percentages or display units.

## Interlocked action

Each channel can be independently set to operate at the trip point but reset at a different point using the hysteresis setting. This feature can be used in duty-standby pump control and can also include the delay function.

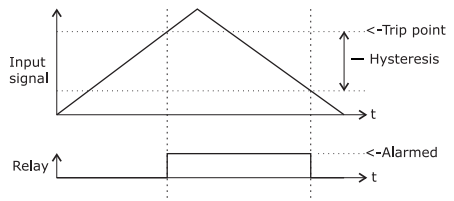
## Alarm type

Each trip channel may be set as 'Active High' or 'Active Low'.

## Active High Channels

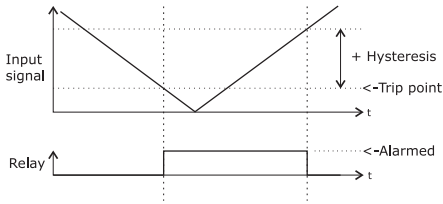
Active High channels are:

- Not alarmed on power up



- Stay not alarmed with input signal below set point
- Become alarmed if the signal is above the set-point continuously for the delay time
- Stay alarmed if the signal remains above the set-point minus the hysteresis value
- Become not alarmed if the signal falls below the set-point minus the hysteresis continuously for the delay time.

## Active Low Channels



Active Low channels are:

- Not alarmed on power up
- Stay not alarmed if the signal remains above the set-point
- Become alarmed if the signal is below the set-point continuously for the delay time
- Stay alarmed if the signal remains below the set-point plus the hysteresis value
- Become not alarmed if the signal rises above the set-point plus the hysteresis continuously for the delay time.

### Relay action

The relay output follows the alarm state for its channel and the programmed action type setting. This may be set to de-energise (off) on alarm or energise (on) on alarm.

### Channel status indication

Tri-colour LEDs provide continuous indication of the status of each channel.

- Green indicates a non-alarmed state
- Red indicates that the channel is in an alarm state

- Flashing green indicates that the input signal is within the hysteresis or delay band and is approaching the set-point.
- Flashing red indicates that the input signal has passed the set-point and is within the hysteresis or delay band.
- Yellow indicates a programming mode and may be steady or flashing depending on the programming mode (see Setting up).

# Setting up

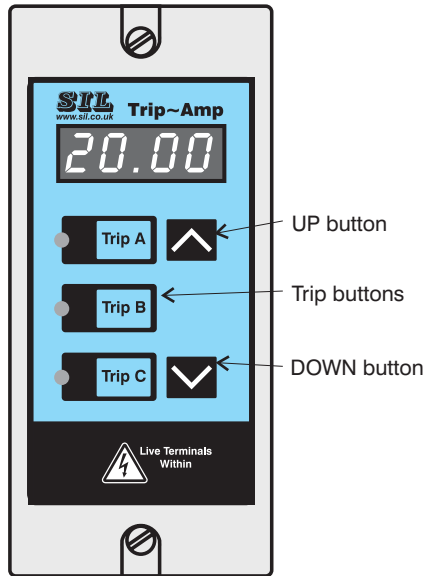
## Introduction

All parameters are viewed as a label alternating with the value currently set. Parameters are adjusted with the Up - Down arrow buttons. Control of the output relays is maintained whilst programming is in progress, however, in this mode the front panel LEDs do not indicate the control state but are used to indicate programming mode in progress.

The display can be programmed to show the signal level in Volts, Milliamps or Custom Units. The default setting is Custom Units with the display reading 0 - 100.0, representing the input signal as a percentage.

## Initialisation

On power up the display briefly indicates 'SIL' and then 'SO-X' where X is the software version number. During this period the LEDs are flashed alternately green/red to indicate that they are all functioning. The settings are read from the internal EEPROM at this point. If the checksum does not match the stored data then 'EErr' will be displayed and the LEDs will continue to flash red/green indefinitely. The relays will remain off and will not follow the control algorithm. Pressing any trip button will set the unit to defaults and attempt to re-save the settings. The unit should be re-powered to check that the error does not occur again. *NB the calibration settings may have been lost if this error occurs.*





## Programming

There are three programming modes:

### • Global parameters -

For setting:

- Input source (*mA or volts*),
- Scaling
- Custom units
- Custom unit decimal point position
- Custom unit zero value
- Custom unit full scale value
- Linearisation
- Reset to factory default settings
- Programme Lock
- Selection of expansion option
- Unit address (expansion option only)

### • Channel specific parameters -

For setting:

- Hysteresis type
- Hysteresis value
- Alarm type
- Relay action
- Delay

### • Alarm level parameters -

For setting trip points

Entry into each of these modes and the parameters to be set are covered in the following sections.

Notes:

- (i) Control continues whilst any programming is being performed but the LEDs show yellow to indicate programming mode in progress.
- (ii) All parameters are displayed as a parameter label alternating with the value currently set e.g. '*trIP*' followed by '*75.0*'. Whilst the parameter is being modified (using the 'Up' or 'Down') buttons the display remains on the value.
- (iii) Each press of the 'Up' or 'Down' buttons advance the setting by one count. If either 'Up' or 'Down' is held pressed or approximately two seconds the units digit remains as set and the tens digit advances. After a further 10 seconds the 100s digit advances and so on. All parameters 'wrap around' when their minimum or maximum values are reached.
- (iv) Parameters that become invalid as a result of changes to other parameters will be automatically clipped to the new valid range.
- (v) Changes to parameters that effect the control are implemented in real time. The status of the relays will immediately reflect the new settings.
- (vi) Not pressing any buttons for two minutes will revert back to normal measuring operation and save any settings already modified.

## Setting *Global* parameters

In this mode the programming menu follows a set sequence, stepping onto the next item with each press of the Trip B button.

1. Enter Global parameters mode by pressing and holding trip buttons, **Trip A** and **Trip C**, for a minimum of two seconds. All three Trip LEDs will flash yellow to indicate entry into the global parameter programming mode.
2. Each press of the **Trip B** button will advance the menu through to the next parameter. Changing the parameter value is effected by pressing the 'Up' or 'Down' buttons until the value required is shown on the display.

Table 1 shows the parameters in menu sequence order, the values which can be applied and the display viewed in each case.

3. Pressing **Trip A** button will revert to the previous parameter in the menu.
4. Stepping past the last menu item will revert the unit back to normal operating mode and save any settings already modified.

Notes:

- (i) *Hint* - If a 4-20mA input signal is being monitored and a trip level at, near or even below 4mA is required, set the Input Source to 0 - 20mA. This will avoid problems with the instrument displaying under-range error (*U Err*) as the input falls to 4mA.
- (ii) User Linearisation and Programme Lock functions are only available on instruments with software version 7 and above, See Appendix 4.

Table 1 - Programmable *Global* parameters

<b>Parameter</b>	<b>Display</b>	<b>Value</b>	<b>Display</b>
<b>Input Source</b>	<i>SrCE</i>	Current Voltage	<i>CUrr</i> <i>UOLt</i>
<b>Scale</b>	<i>SCAL</i>	4-20mA 0-10mA 0-20mA 0-10V 0-5V	4-20 * 0-10 * 0-20 * 0-10 ‡ 0-5 ‡
		* values available when Source = current	‡ values available when Source = voltage
<b>Serial Expansion</b> <i>for a future option</i> <i>- not adjustable</i>	<i>AdOn</i>	Fitted Not fitted	<i>YES</i> <i>n0</i>
<b>Unit Address</b>	<i>Addr</i>	Any value from 1 to 127, only used when the serial expansion card is fitted	
<b>Custom Units</b>	<i>CUSt</i>	Not required Required	<i>n0</i> <i>YES</i>
- - - - -NB if Custom Units are <i>not</i> selected, menu jumps to 'Reset to Default' parameter.- - - - -			
<b>Custom Unit Decimal point position **</b>	<i>CUdP</i>	None Position 1 Position 2 Position 3	<i>n0nE</i> <i>0.0</i> <i>0.00</i> <i>0.000</i>
<b>Custom Unit - Zero **</b>	<i>CUZE</i>	Adjustable -999 to 9999	
<b>Custom Unit - Full scale **</b>	<i>CUFS</i>	Adjustable -999 to 9999	
- - - - - ** These parameters are not available when Custom Units "CUST" = "n0" - - - - -			

Table 1 continues on next page >

Table 1 - continued

Parameter	Display	Value	Display
User Linearisation	<i>LInF</i>	2 break points	2
		3 break points	3
		4 “	4
		5 “	5
		6 “	6
		7 “	7
		8 “	8
		9 “	9
		10 ”	10
NB with any setting other than <i>OFF</i> , subsequent presses of Button B will step through the X and Y settings for each of the number of breakpoints selected. If <i>OFF</i> is selected in the above steps, the next press of Button B will step to the 'Reset to Default' setting.			
Breakpoint (1) X value	<i>HP0I</i>	Adjustable 0 to 9999	
Breakpoint (1) Y value	<i>YP0I</i>	Adjustable 0 to 9999	
NB display will read <i>HP0'n</i> and <i>YP0'n</i> for breakpoint (n) where 'n' is displayed as a number 1 to 10			
Reset to Default	<i>dEFt</i>	displays “n0” to start	
Press and hold 'up' and 'down' buttons until display shows “YES” to indicate that defaults have been now set. See 'Default settings' for parameter values set with this action.			
Programme Lock	<i>LOC</i>	Protect settings	<i>On</i>
		Enable programming	<i>OFF</i>
NB Simultaneously press 'Up' and 'Down' buttons to toggle setting			

## Setting *Channel Specific* parameters

In this mode the programming menu follows a set sequence, stepping onto the next item with each press of the Trip 'X' button (where 'X' is A, B or C).

1. To set Channel specific parameters, hold pressed - for a minimum of two seconds - the appropriate 'Trip' button for the channel to be set. The selected trip channel LED will show flashing yellow and the display will show the parameter label '*hYSt*' (hysteresis type) alternating with the parameter value . This indicates that the unit is at the first menu item in Global parameters mode which is the Hysteresis 'Type' setting.

2. Each press of the Trip button will step through the menu sequence to the next parameter. Changing the parameter value is effected by pressing the Up' or 'Down' buttons until the value required is shown on the display. The following shows the parameters in menu sequence order, the values which can be applied and the display in each case.
3. Stepping past the last menu item will revert the unit back to normal operating mode and save any settings already modified.

Table 2 - Programmable *Channel specific* parameters

Parameter	Display	Value	Display
Hysteresis type	<i>hYSt</i>	Percentage Display Units	<i>PErC</i> <i>dISP</i>
Hysteresis value	<i>hYSP</i> *  <i>hYSd</i> * * label displayed depends on type setting	Adjustable 0-100% of fullscale, value as percentage or display units	
- - - - For an explanation of how hysteresis is applied see graphs in Alarm type settings on page 4 - - - -			
Alarm type	<i>AtYP</i>	Active High Active Low	<i>hI9h</i> <i>L0</i>
Relay action	<i>rELY</i>	ON on Alarm OFF on Alarm	<i>nOFF</i> <i>n_On</i>
Delay	<i>dELY</i>	Adjustable 0-999.9 sec in 0.1 sec steps	

## Setting Trip Levels

1. Enter the Trip level mode by momentarily pressing the appropriate 'Trip' button for the channel to be set.  
The selected trip channel LED will indicate steady yellow and the display will show the parameter label '*trIP*' alternating with the level set for the selected channel e.g. '*trIP*' followed by '75.0'.
2. Adjust the trip level by pressing the 'Up' 'Down' buttons.
3. Store the new setting by pressing the trip button.

### Notes:

- (i) The units used to display the level set are Milliamps, Volts or the custom units as set in Global parameters mode.
- (ii) Pressing the 'Up' or 'Down' buttons continuously for a period causes the value to automatically increment. After a further period the rate at which the increments change increases. This speeds up the setting of large values when appropriate. All parameters 'wrap around' when their minimum or maximum values are reached.
- (iii) Pressing the trip button of another channel will also store the adjusted setting and move the programming function to the new channel.

## Appendix 1- Default settings

Factory set defaults and to which the unit may be subsequently reset (see Table 1).

Trip Level	Trip A - 75.0% Trip B - 50.0% Trip C - 25.0%
Hysteresis	Type - percentage Value - 1.0%
Alarm Type	Active high
Relay Action	Normally off i.e. 'ON' (or energise) for alarm
Delay	1.0 sec
Input source	Current
Scale	4-20mA
Serial Expansion	Not fitted
Unit address	1
Custom Units	Yes
Custom Unit Dec. Point	0.0
Custom Unit Zero	0
Custom Unit Full scale	100.0
Programme Lock	Off
User Linearisation	Off

## Appendix 2 - Indicator signals

Colour	Steady	Flashing
Green	Non-alarmed state	Input signal is within the hysteresis or delay band and is approaching the set-point
Red	Channel in an alarmed state	Input signal has passed the set-point and is within the hysteresis or delay band
Yellow	Unit in Trip Level programming mode	(i) Single LED Unit in programming Channel Specific parameters mode  (ii) All LEDs Unit in programming Global parameters mode
Alternating Green and Red	N/a	(i) Momentarily (on power up) self-test to indicate all LEDs functioning  (ii) Continuously with ' <i>Err</i> ' appearing in the four-digit display indicates a power up self-diagnostic error (see 'Initialization' in the Setting up section).



## Appendix 3 - Display messages

No	Message	Meaning	Mode
1	SIL	Alternates with message No.2 on power up	Initialisation
2	SO-X	Software version number ( <i>where 'X' = revision number</i> )	Initialisation
3	EErr	Power up self-test error	Initialisation
4	OErr	reading is above the chosen range	Operating
5	UErr	reading is less than 4mA when on the 4-20mA scale	Operating
6	TRIP	PL* for trip level setting -alternates with value	Trip levels
7	hyst	PL* for hysteresis type -alternates with value	Channel params
8	PERC	Value for No.7 - indicates percentage selected	Channel params
9	DISP	Value for No.7 - indicates display units selected	Channel params
10	hysp	PL* for hysteresis expressed as % -alternates with value	Channel params
11	hysd	PL* for hysteresis in display units -alternates with value	Channel params
12	ALYP	PL* for alarm type - -alternates with value	Channel params
13	high	Value for No.12	Channel params
14	LO	Value for No.12	Channel params
15	RELY	PL* for relay action - alternates with value	Channel params
16	nOFF	Value for No.15	Channel params
17	n_On	Value for No.15	Channel params
18	dELY	PL* for delay setting - alternates with value (0-999.9 sec)	Channel params
19	srCE	PL* for Input source - alternates with value	Global params
20	Curr	Value for No. 19	Global params
21	VOLT	Value for No. 19	Global params
22	SCAL	PL* for scale - alternates with value (Nos 23,24,25 or 26)	Global params
23	4-20	Value for No. 22 (4-20mA)	Global params
24	0-10	Value for No. 22 (0-10 V or mA)	Global params
25	0-20	Value for No. 22 (0-20mA)	Global params
26	0-5	Value for No. 22 (0-5V)	Global params
* PL = Parameter Label			

No	Message	Meaning	Mode
27	<i>AdDn</i>	PL* for "serial expansion" <i>not adjustable</i> - for future use	Global params
28	<i>YES</i>	Value for No.s 27, 31, 39	Global params
29	<i>nD</i>	Value for No.s 27, 31, 39	Global params
30	<i>Addr</i>	PL* for Unit address - <i>only used with serial expansion</i>	Global params
31	<i>CUST</i>	PL* for custom units - alternates with value (No.28 or 29)	Global params
32	<i>CUdP</i>	PL* for decimal point position - alternates with value	Global params
33	<i>nDnE</i>	Value for No. 32	Global params
34	<i>0.0</i>	Value for No. 32 (one decimal position)	Global params
35	<i>0.00</i>	Value for No. 32 (two decimal positions)	Global params
36	<i>0.000</i>	Value for No. 32 (three decimal positions)	Global params
37	<i>CUZE</i>	PL* for custom unit zero - alt's with value (-999 to 9999)	Global params
38	<i>CUFS</i>	PL* for custom unit full scale = alt's with value (as No.37)	Global params
39	<i>LInF</i>	PL* for Linearisation function Values for <i>LInF</i> are 2, 3, 4, 5, 6, 7, 8, 9, 10 and OFF	Global params
40	<i>HPD 1</i>	PL* for Breakpoint (1) X value, similarly <i>HPD2</i> for BPt (2), etc. Appears if No 43 value is not equal to <i>OFF</i>	Global params
41	<i>YPD 1</i>	PL* for Breakpoint (1) Y value, similarly <i>YPD2</i> for BPt (2), etc. Appears if No 43 value is not equal to <i>OFF</i>	Global params
42	<i>dEFT</i>	PL* for reset to default - alt's with value (initially No. 28)	Global params
43	<i>LOC</i>	PL* for Programming Lock (values for <i>LOC</i> are OFF or ON)	
* PL = Parameter Label			

## Appendix 4 - Changes from earlier versions

Software versions 7 and above have made available new functions. To determine which software version you have: the display on power-up briefly indicates "SIL" followed by "SO-X" where 'X' is the software version.

### New functions

User linearisation - see page 10

Programme lock - see page 10

# Specification

## INPUTS

Input source selectable: mA or Volts  
Input scaling selectable: 4-20mA, 0-10mA, 0-20mA, 0-10V, 0-5V  
Input Impedance: Current inputs 50 ohms; voltage inputs >290k ohms  
Custom engineering units:

Zero Min. -999, Max. 9999

Span Min. -999, Max. 9999

Decimal point selection: none, 0.0, 0.00, 0.000

## OUTPUTS

Relay with volt-free single pole contact per channel

Contact rating: 6A @ 230V AC resistive  
2.5A @ 24V DC resistive

## HYSTERESIS

Adjustable 0-100% of span; value as percentage or display units.

## DELAY

Adjustable 0 - 999.9 sec in 0.1 sec steps

## ALARM ACTION

Adjustable active high or active low

## RELAY TYPE

Adjustable de-energise on alarm or energise on alarm

## LINEARISATION

Up to 10 breakpoints - user programmable

## DISPLAY

Type: Four digit red LED 7.6mm high  
Resolution: 0.01mA or 0.01V  
Accuracy: +/- 0.05% of FSD

## ISOLATION

The output relay contacts are isolated from the supply and input.

## REPEATABILITY

The switching point will repeat within  $\pm 0.1\%$  of span.

## INPUT OVERRANGE PROTECTION

Voltage Inputs: 250 volts RMS or DC

Current Inputs: 100mA dc (fused)

## TEMPERATURE COEFFICIENTS

Zero:  $\pm 0.02\%$  span/ $^{\circ}\text{C}$

Span:  $\pm 0.02\%$  span/ $^{\circ}\text{C}$

## TEMPERATURE RANGE

Operating:  $-10^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$

Storage:  $-20^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$

## SUPPLY VOLTAGE REJECTION

Span change:  $< 0.1\%$  span / % supply change.

## POWER SUPPLY

Standard: accepts 85 Vac to 265 Vac, 50/60Hz 3VA

Protected by a 250mA internal fusible resistor.

Low voltage: 11-32VDC 4 W / 12 to 24VAC

Protected by a 500mA internal self-resetting fuse.

## WEIGHT

Approx. 0.4kg

## SAFETY & EMC

Safety: EN61010 -1

Immunity: EN50082-1

Emissions: EN50081-1

CE certified