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Users' Manual

CN2516, CN2508 and CN2504

This manual supplements the Concise Product manual supplied with each instrument at the time of shipment. Information in this installation, wiring and operation manual is subject to change without notice.

Note:

It is strongly recommended that applications incorporate a high or low limit protective device, which will shut down the equipment at a preset process condition in order to prevent possible damage to property or products.

WARNING:

THE INTERNATIONAL HAZARD SYMBOL IS INSCRIBED ADJACENT TO THE REAR CONNECTION TERMINALS. IT IS IMPORTANT TO READ THIS MANUAL BEFORE INSTALLING OR COMMISSIONING THE UNIT.

Products covered by this manual are suitable for Indoor use, Installation Category II, Pollution category 2 environments

Products covered in this issue of the manual:
CN2516, CN2508 and CN2504 series limit devices.

Contents

Page Number:

How to use this manual

This manual is structured to give easy access to the information required for all aspects of the installation and use and of the products:

Section 1: **Introduction** - A brief description of the product range.

Section 2: **Installation** - Unpacking, installing and panel mounting instructions.

Section 3: **Plug-in Options** - Installation of the plug-in option modules.

Section 4: **Wiring Guidelines** - Guidance on good wiring practice, noise avoidance, wiring diagrams and input/output connections.

Section 5: **Powering Up** - Powering up procedure and descriptions of displays & switches.

Section 6: **Messages & Error Indications** - Display Messages and fault indications.

Section 7: **Operation Modes** - Describes operating modes common across the range. These include Select Mode for gaining access to the Setup and Configuration menus and the Product information menus.

Section 8: **CN2516, CN2508 & CN2504 Model Group** - Describes unique operating features of these limit controllers. It covers the Configuration, Setup & Operator menus, and Communications parameters, adjusting the Limit Setpoint and resetting the Limit Output.

Section 09: **Modbus Serial Communications** - Details the physical layer and message formats used for the Modbus communications protocol common to all products in the range.

Section 10: **ASCII Serial Communications** - Details the physical layer and message formats used for the ASCII serial communications protocol available on some products.

Section 11: **Calibration Mode** - Step-by-step instructions to calibrate the instrument. This section is intended for use by suitably qualified personnel.

Appendix 1: **Glossary** - Explanations of the terms used and product features.

Appendix 2: **Specification** - Technical specifications for all products in the range.

1 Introduction

These instruments are microprocessor based limit devices. They can measure process variables such as temperature, pressure, flow and level from a variety of inputs. Models are available in three sizes. $^{1}/_{16}$ DIN (48 x 48mm front), $^{1}/_{8}$ DIN (48 x 96mm front) and $^{1}/_{4}$ DIN (96 x 96mm front).

The operating voltage is either 100-240V at 50/60 Hz or 24V-48V AC/DC depending on the model purchased. EEPROM technology protects against data or configuration loss during power outages.

Inputs are user configurable for connection to thermocouple and RTD probes, as well as linear process signal types such as mVDC, VDC or mADC. Output options include relays, SSR drivers, triacs or linear mV/voltage modules. These can be used for alarms or retransmission of the process variable to external devices such as data recorders or PLC's. A Transmitter Power Supply option module can provide an unregulated 24V DC (22mA) auxiliary output voltage for external signal transmitters.

Alarm indication is standard on all instruments. Alarms may be set as process high or low, deviation (active above or below Limit setpoint) or band (active both above and below setpoint). These alarms can be linked to any suitable output. Alarm status is indicated by LED's or the alarm status screen.

Limit Controllers shut down a process in order to prevent possible damage to equipment or products. They have a latching relay, which cannot be reset until the process is in a safe condition. Limit controllers work independently of the normal process controller and have approvals for critical applications.

2 Installation

Unpacking

1. Remove the product from its packing. Retain the packing for future use, in case it is necessary to transport the instrument to a different site or to return it to the supplier for repair/testing.

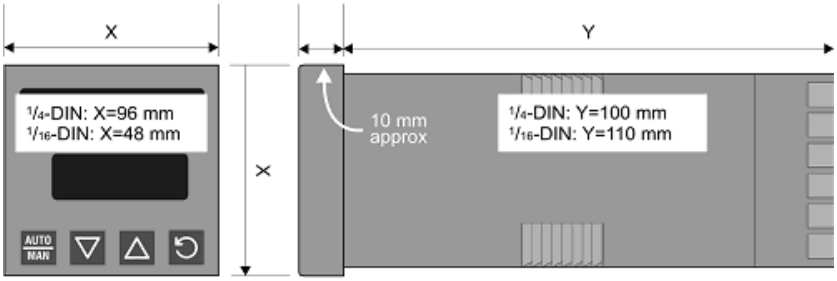
2. The instrument is supplied with a panel gasket and push fit fixing strap. A single sheet concise manual is also supplied in one or more languages. Examine the delivered items for damage or defects. If any are found, contact your supplier immediately.

Installation

CAUTION:

Installation and configuration should be performed only by personnel who are technically competent and authorised to do so. Local regulations regarding electrical installation and safety must be observed.

$^1/_4$ - DIN & $^1/_{16}$ - DIN Instruments



$^1/_8$ - DIN Instruments

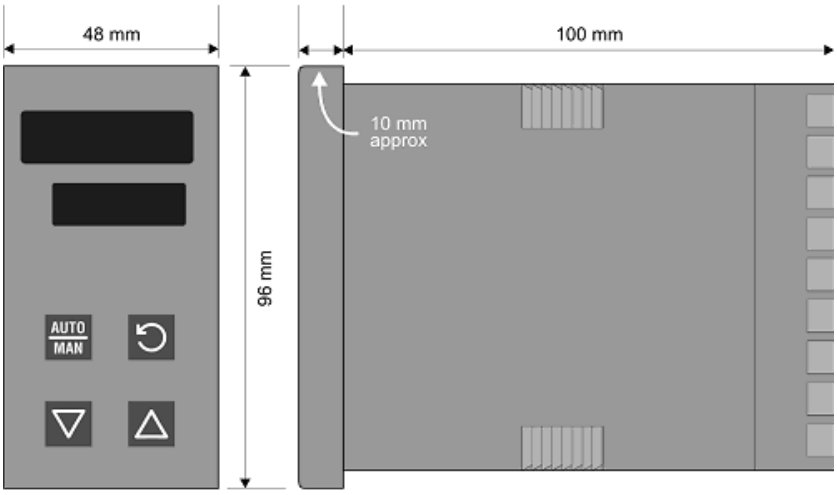


Figure 1. Main dimensions

Panel Cut-outs

The mounting panel must be rigid and may be up to 6.0mm (0.25 inches) thick. The cut-outs required for the instruments are shown below.

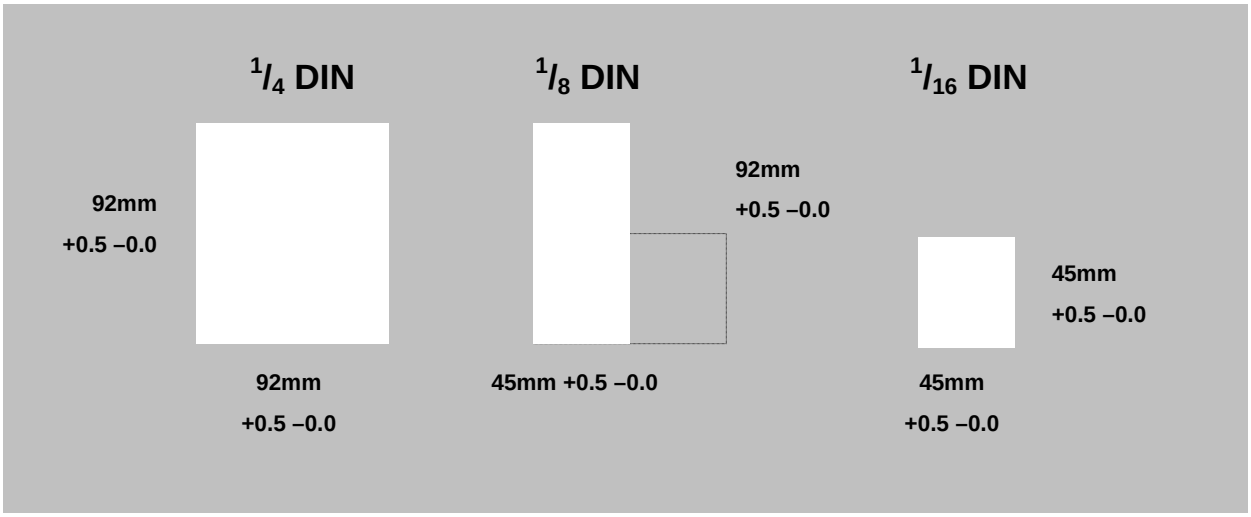


Figure 2. Panel cut-out sizes

Panel-Mounting

CAUTION:

Insure the inside of the panel is with the instruments operating temperature and that there is adequate air flow to prevent overheating.

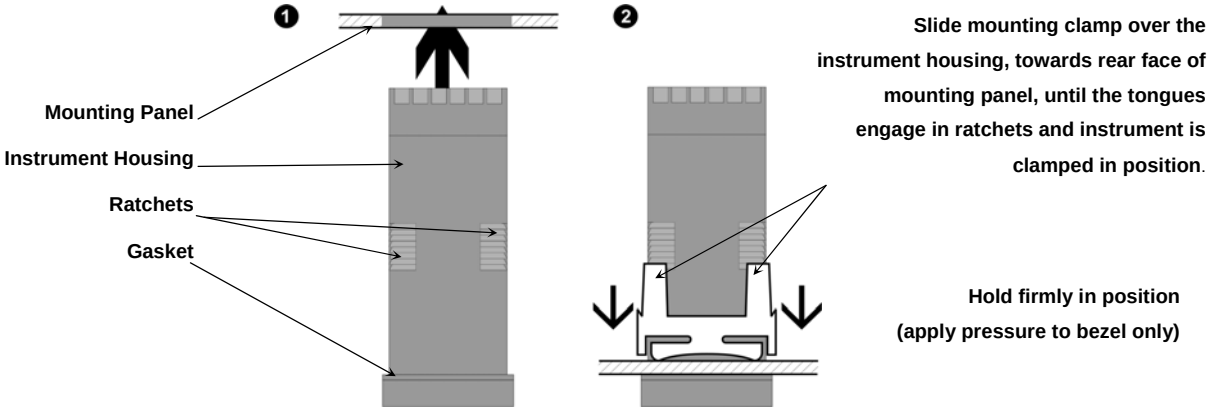


Figure 3. Panel-Mounting the device

CAUTION:

For an effective IP66 seal against dust and moisture, ensure gasket is well compressed against the panel, with the 4 tongues located in the same ratchet slot..

Once the instrument is installed in its mounting panel, it may be subsequently removed from its housing, if necessary, as described in the Fitting and Removing Option Modules section.

Instruments may be mounted side-by-side in a multiple installation, but instrument to panel moisture and dust sealing will be compromised. The cut-out width (for n instruments) is shown below.

$^{1}/_{8}$ - & $^{1}/_{16}$ - DIN Instruments: (48n - 4) mm or (1.89n - 0.16) inches

$^{1}/_{4}$ - DIN Instruments: (96n - 4) mm or (3.78n - 0.16) inches

If panel sealing must be maintained, mount each instrument into an individual cut-out with 6mm or more clearance between the edges of the holes.

Note:

The mounting clamp tongues may engage the ratchets either on the sides or the top/bottom faces of the Instrument housing. When installing several Instruments side-by-side in one cut-out, use the ratchets on the top/bottom faces.

3 Plug-in Options

Options Modules and Functions

A range of plug-in option modules is available to add additional input, output and communication functions to the instruments in the range. These modules can be either pre-installed at the time of manufacture, or retrofitted in the field.

The modules are installed between the instruments main circuit boards into the four option slots. These are designated as Slots 1, 2, 3, and A. Installation is detailed below.

Note:

Slot 1 modules are fitted with a fixed limit relay. Slot 2 & 3 modules cannot be fitted into Slot 1. Some Slot 2 &3 modules should only be fitted into one of the two slots. This is detailed in the - Option Module vs. Model Matrix below.

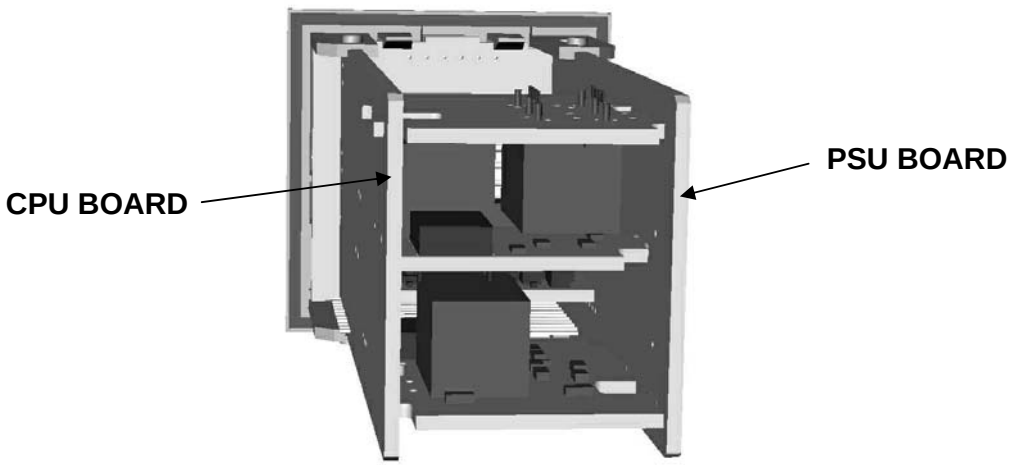


Figure 4. Typical rear view (uncased) & main board positions

Auto Detection of Option Modules

The instrument automatically detects which option modules have been fitted into each slot. In Configuration Mode, the menus will change to reflect the options compatible with the hardware fitted. The modules fitted can be viewed in the products information menu, as detailed in the Product Information Mode section of this manual.

Table 1. Option Module vs. Model Matrix

MODULE PART NUMBER & Function	CN2516	CN2508	CN2504
OPTION SLOT 1	*Fitted with fixed Limit Relay*		
OPTION SLOT 2			
CN2500X-R Relay			
CN2500X-DC SSR Driver			
CN2500X-T Triac			
CN2300X-F Linear mA/V DC			
OPTION SLOT 3			
CN2500X-R Relay			
CN2500X-DC SSR Driver			
CN2300X-F Linear mA/V DC			
CN2300X-TPS Transmitter Power Supply			
OPTION SLOT A			
CN2300X-485 RS485 Comms			
CN2300X-DI Digital Input			
SOFTWARE & ACCESSORIES			
CN2500-SOFT Config Software			

Preparing to Install or Remove Options Modules

CAUTION:

Before removing the instrument from its housing, insure that all power has been removed from the rear terminals.

1. Remove the instrument from its housing by gripping the side edges of the front panel (there is a finger grip on each edge) and pull the instrument forwards. This will release the instrument from the rear connectors in the housing and will give access to the PCBs.

2. Take note of the orientation of the instrument for subsequent replacement into the housing. The positions of the main and option PCBs in the instrument are shown below.

Removing/Replacing Option Modules

With the instrument removed from its housing:

1. To remove or replace modules into Option Slot A, it is necessary to gently separate the **CPU** and **PSU** PCBs. This is achieved by detaching the main boards (**PSU** and **CPU**) from the front molding by lifting first the upper and then lower mounting struts as shown. This frees the boards from the front. If only Option slots 2 or 3 are to be changed, this stage is not required as these slots are accessible without separating the main boards from the front.

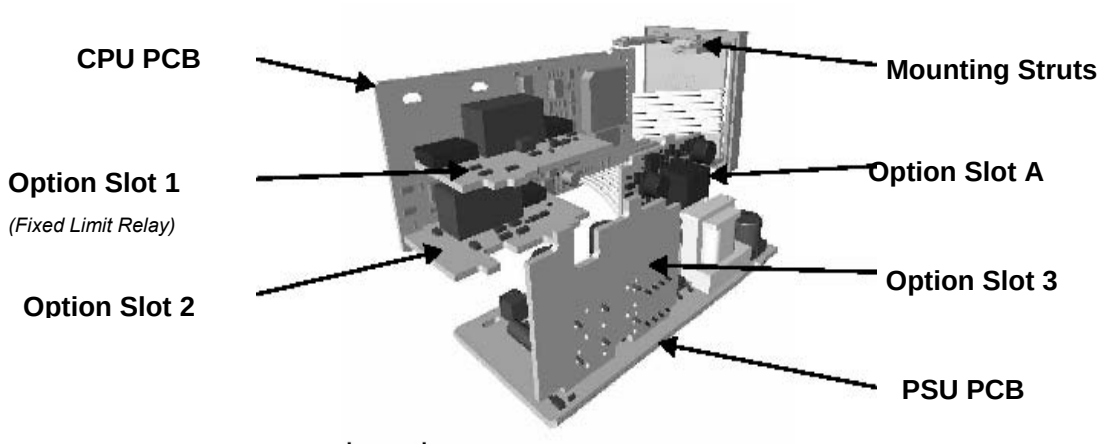


Figure 5. Location of Option Slots - $^{1}/_{16}$ DIN Instruments

CAUTION:

Take care not to put undue stress on the ribbon cable attaching the display and CPU boards.

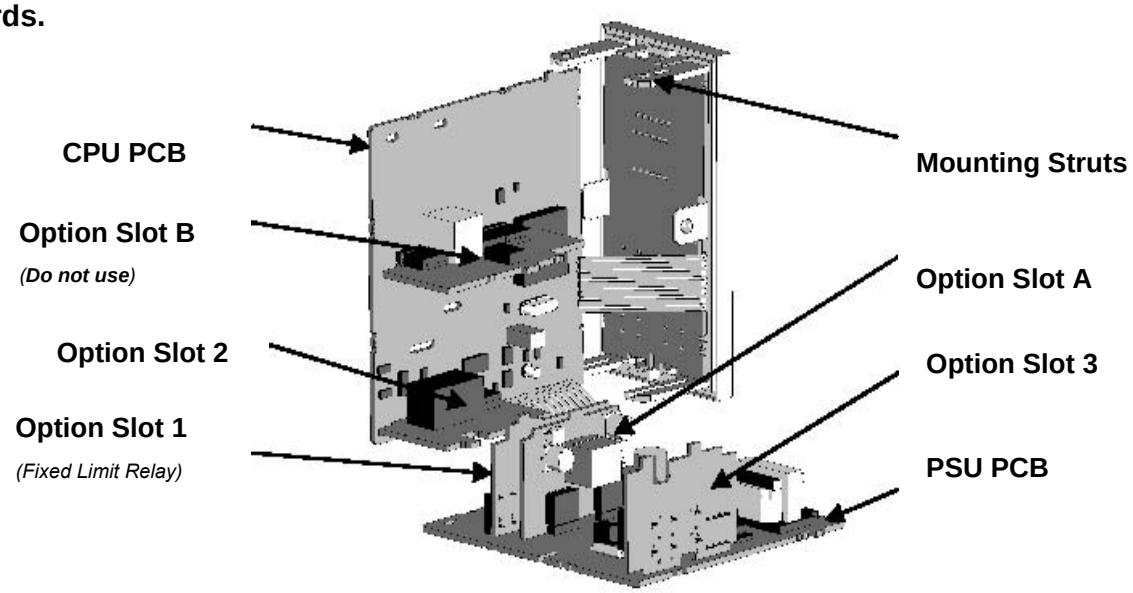


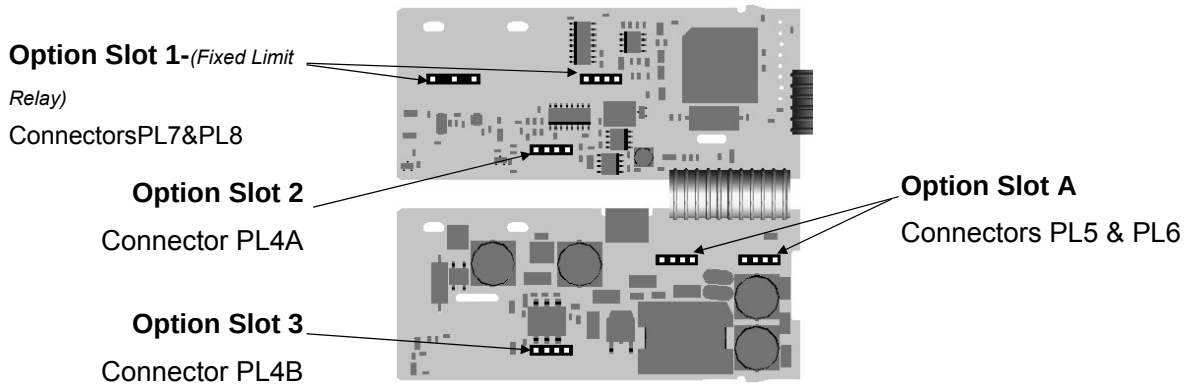
Figure 6. Location of Option Slots - $^{1}/_{8}$ & $^{1}/_{4}$ DIN Instruments

CAUTION:

Take care not to put undue stress on the ribbon cable attaching the display and CPU boards.

2. Remove or fit the modules into the Option slots as required. The location of the connectors is shown below. Tongues on each option module locate into slots cut into the main boards, opposite each of the connectors.

Figure 7. Option Module Connectors - $^{1}/_{16}$ DIN Instruments



CAUTION:

Check for correct orientation of the modules and that all pins locate correctly into the socket.

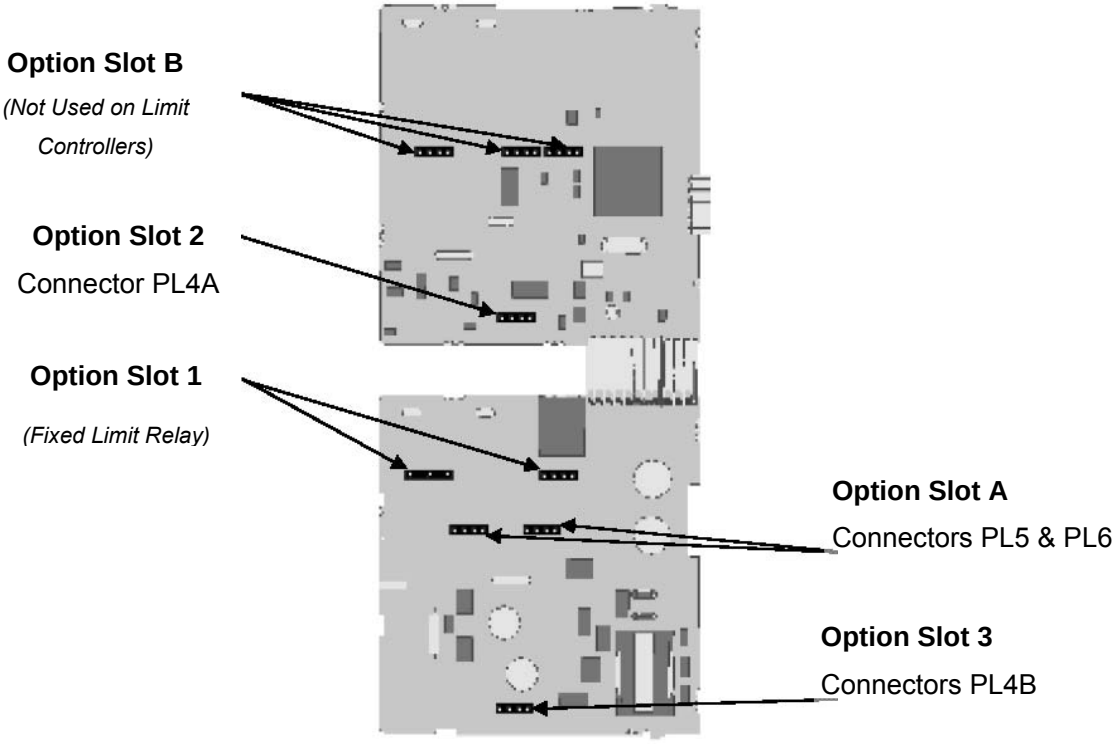


Figure 8. Option Module Connectors - $^{1}/_{8}$ & $^{1}/_{4}$ DIN Instruments

CAUTION:

Check for correct orientation of the modules and that all pins locate correctly into the socket

Replacing the Instrument in its Housing

With the required option modules correctly located into their respective positions the instrument can be replaced into its housing as follows:

1. If required, move the **CPU** and **PSU** boards back together, taking care to locate the option module tongues into the slots in the board opposite. Hold the main boards together while relocating them back into the mounting struts on the front panel.

2. Align the **CPU** and **PSU** PCBs with their guides and connectors in the housing.

3. Slowly and firmly, push the instrument in position.

CAUTION:

Insure that the instrument is correctly orientated. A mechanical stop will operate if an attempt is made to insert the instrument in the wrong orientation, this stop MUST NOT be over-ridden.

4 Wiring Instructions

Electrical noise is a phenomenon typical of industrial environments. As with any instrumentation, these guidelines should be followed to minimize the effect of noise.

Installation Considerations

Ignition transformers, arc welders, mechanical contact relays and solenoids are all common sources of electrical noise in an industrial environment and therefore the following guidelines MUST be followed.

1. If the instrument is being installed in existing equipment, the wiring in the area should be checked to insure that good wiring practices have been followed.
2. Noise-generating devices such as those listed should be mounted in a separate enclosure. If this is not possible, separate them from the instrument, by the largest distance possible.
3. If possible, eliminate mechanical contact relays and replace with solid-state relays. If a mechanical relay being powered by an output of this instrument cannot be replaced, a solid-state relay can be used to isolate the instrument.
4. A separate isolation transformer to feed only the instrumentation should be considered. The transformer can isolate the instrument from noise found on the AC power input.

AC Power Wiring - Neutral (for 100 to 240V AC versions)

It is good practice to ensure that the AC neutral is at or near ground (earth) potential. A proper neutral will help insure maximum performance from the instrument.

Wire Isolation

Four voltage levels of input and output wiring may be used with the unit:

1. Analogue input or output (for example thermocouple, RTD, VDC, mVDC or mADC)
2. Relays & Triac outputs
3. SSR Driver outputs
4. AC power

CAUTION:

The only wires that should run together are those of the same category.

If any wires need to run parallel with any other lines, maintain a minimum space of 150mm between them.

If wires MUST cross each other, insure they do so at 90 degrees to minimize interference.

Use of Shielded Cable

All analogue signals must use shielded cable. This will help eliminate electrical noise induction on the wires. Connection lead length must be kept as short as possible keeping the wires protected by the shielding. The shield should be grounded at one end only. The preferred grounding location is at the sensor, transmitter or transducer.

Noise Suppression at Source

Usually when good wiring practices are followed, no further noise protection is necessary. Sometimes in severe electrical environments, the amount of noise is so great that it has to be suppressed at source. Many manufacturers of relays, contactors, etc supply 'surge suppressors' which mount on the noise source. For those devices that do not have surge suppressors supplied, Resistance-Capacitance (RC) networks and/or Metal Oxide Varistors (MOV) may be added.

Inductive coils: - MOVs are recommended for transient suppression in inductive coils, connected in parallel and as close as possible to the coil. Additional protection may be provided by adding an RC network across the MOV.

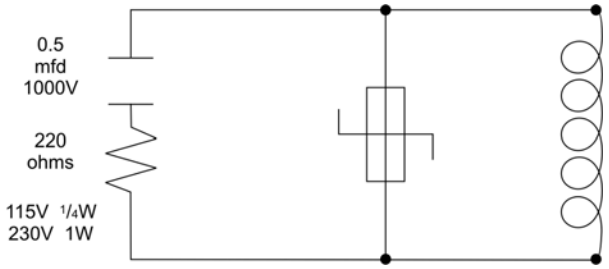


Figure 9. Transient suppression with inductive coils

Contacts: - Arcing may occur across contacts when they open and close. This results in electrical noise as well as damage to the contacts. Connecting a properly sized RC network can eliminate this arc.

For circuits up to 3 amps, a combination of a 47 ohm resistor and 0.1 microfarad capacitor (1000 volts) is recommended. For circuits from 3 to 5 amps, connect two of these in parallel.

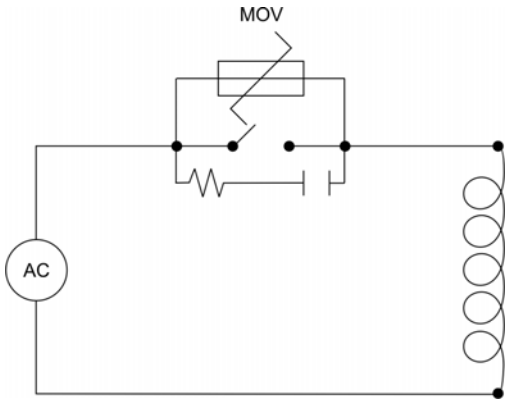


Figure 10. Contact noise suppression

Sensor Placement (Thermocouple or RTD)

If the temperature probe is to be subjected to corrosive or abrasive conditions, it must be protected by an appropriate thermowell. The probe must be positioned to reflect true process temperature:

1. 1. In a liquid media - the most agitated area
2. 2. In air - the best circulated area

CAUTION:

The placement of probes into pipe work some distance from the heating vessel leads to transport delay, which results in poor control.

For a two wire RTD a wire link should be used in place of the third wire. Two wire RTDs must only be used with lead lengths less than 3 metres. Use of three wire RTDs is strongly recommended.

Thermocouple Wire Identification Chart

The different thermocouple types are identified by their wires' color, and where possible, the outer insulation as well. There are several standards in use throughout the world.

The table below shows the wire and sheath colors used for most common thermocouple types. The format used in this table is:

Table 2. Thermocouple Extension Wire Colors

Type		International IEC584-3		USA ANSI MC 96.1		British BS1843		French NFC 42-324		German DIN 43710	
J	+*	Black	Black	White	Black	Yellow	Black	Yellow	Black	Red	Blue
	-	White		Red		Blue		Black		Blue	
T	+	Brown	Brown	Blue	Blue	White	Blue	Yellow	Blue	Red	Brown
	-	White		Red		Blue		Blue		Brown	
K	+	Green	Green	Yellow	Yellow	Brown	Red	Yellow	Yellow	Red	Green
	-*	White		Red		Blue		Purple		Green	
N	+	Pink	Pink	Orange	Orange	Orange	Orange				
	-	White		Red		Blue					
B	+	Grey	Grey	Grey	Grey					Red	Grey
	-	White		Red						Grey	
R & S	+	Orange	Orange	Black	Green	White	Green	Yellow	Green	Red	White
	-	White		Red		Blue		Green		White	
C (W5)	+			White	White						
	-			Red							

Note:

***** = *Wire is magnetic*

Connections and Wiring

The rear terminal connections for $^{1}/_{16}$ DIN and $^{1}/_{4}$ & $^{1}/_{8}$ DIN instruments are illustrated in the following diagrams.

In general, all wiring connections are made to the instrument after it is installed. Copper wires must be used for all connections (except thermocouple signal wires).

WARNING:

TO AVOID ELECTRICAL SHOCK, AC POWER WIRING MUST NOT BE CONNECTED TO THE SOURCE DISTRIBUTION PANEL UNTIL ALL WIRING PROCEDURES ARE COMPLETED.

WARNING:

CHECK THE INFORMATION LABEL ON THE CASE TO DETERMINE THE CORRECT VOLTAGE BEFORE CONNECTING TO A LIVE SUPPLY.

Note:

The wiring diagram below shows all possible combinations. The actual connections required depend upon the features available on the model and the modules and options fitted.

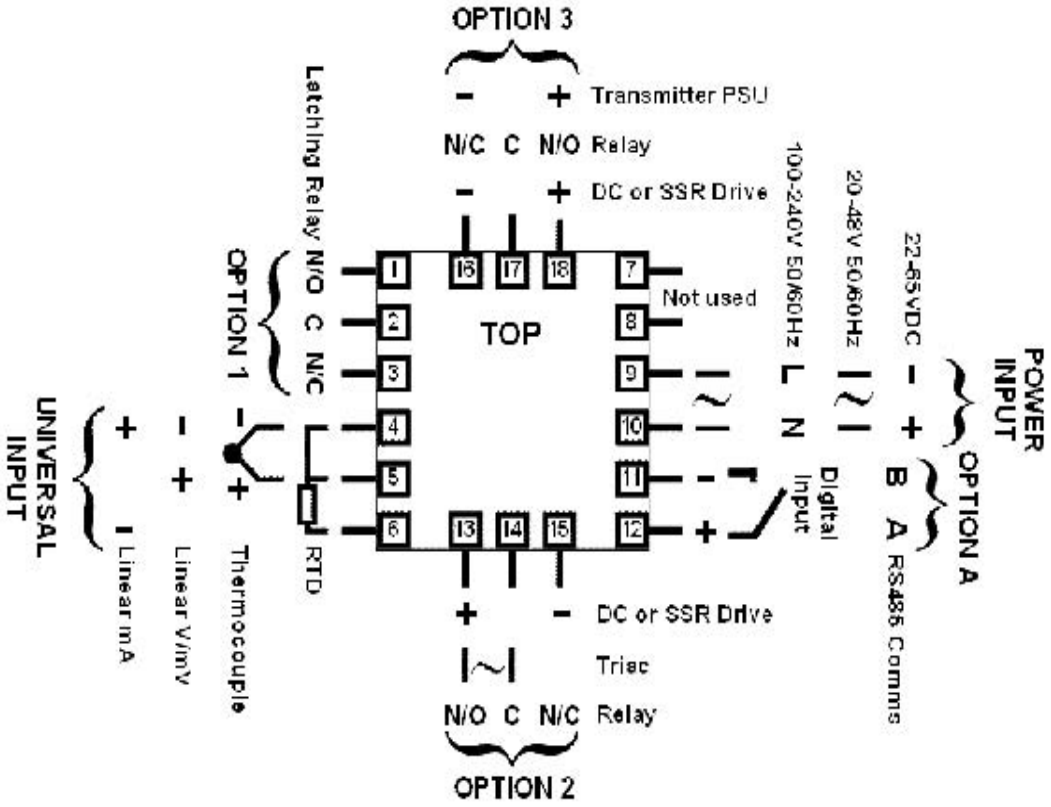


Figure 11. Rear terminals ($^{1}/_{16}$-DIN Instruments)

WARNING:

TO AVOID ELECTRICAL SHOCK, AC POWER WIRING MUST NOT BE CONNECTED TO THE SOURCE DISTRIBUTION PANEL UNTIL ALL WIRING PROCEDURES ARE COMPLETED.

WARNING:

CHECK THE INFORMATION LABEL ON THE CASE TO DETERMINE THE CORRECT VOLTAGE BEFORE CONNECTING TO A LIVE SUPPLY.

Note:

The wiring diagram below shows all possible combinations. The actual connections required depend upon the features available on the model and the modules and options fitted

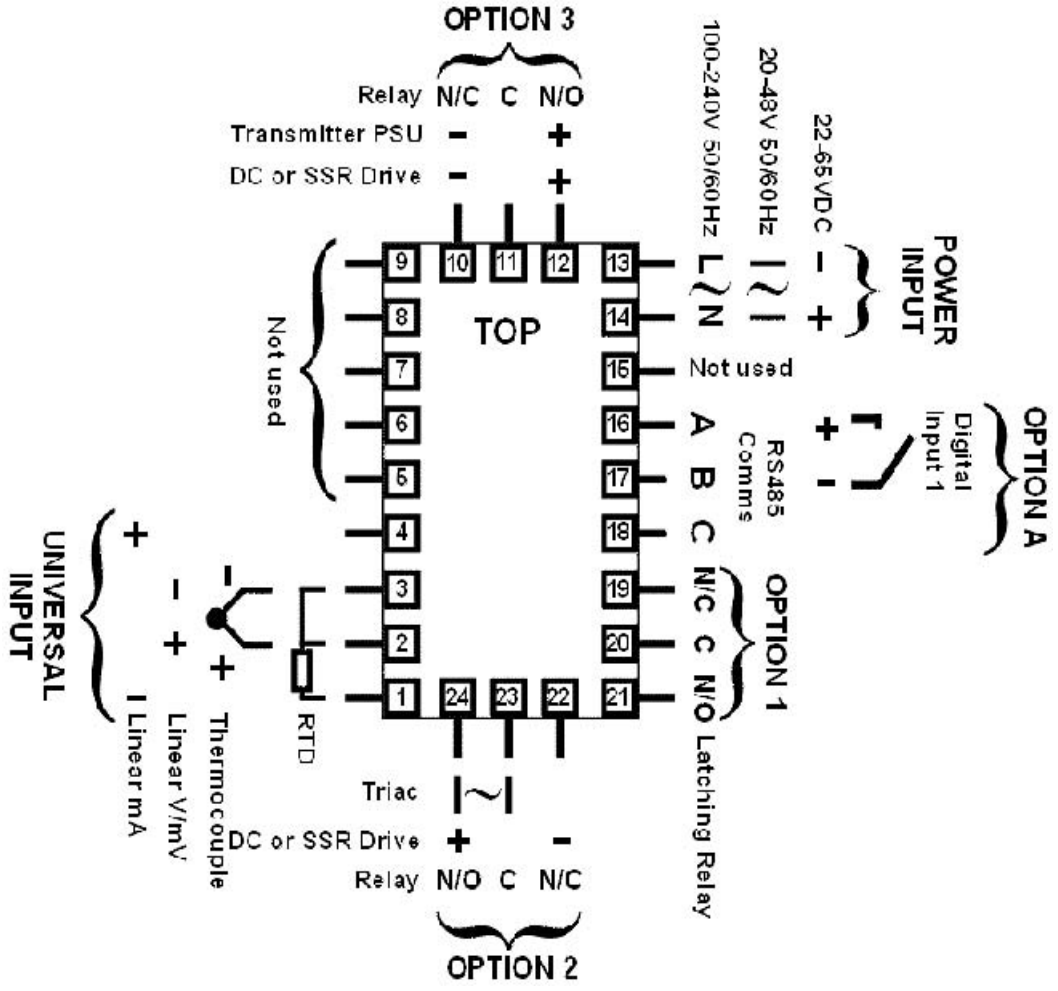


Figure 12. Rear terminals ($^1/_4$-DIN & $^1/_8$-DIN Instruments)

Power Connections - Mains Powered Instruments

Mains powered instruments operate from a 100 to 240V (±10%) 50/60Hz supply. Power consumption is 7.5VA. Connect the line voltage (live and neutral) as illustrated via a two-pole isolating switch (preferably located near the equipment) and a 1amp anti-surge fuse. If the instrument has relay outputs with contacts carrying mains voltage, it is recommended that the relay contacts supply should be switched and fused in a similar manner, but should be separate from the instruments mains supply.

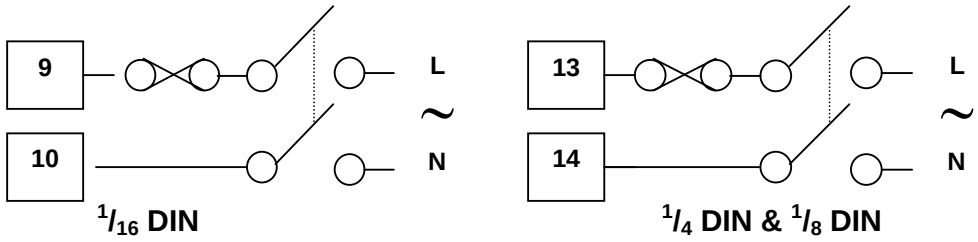


Figure 13. Mains Power Connections

WARNING:

CHECK THE INFORMATION LABEL ON THE CASE TO DETERMINE THE CORRECT VOLTAGE BEFORE CONNECTING TO A LIVE SUPPLY.

CAUTION:

This equipment is designed for installation in an enclosure that provides adequate protection against electric shock

Power Connections - 24/48V AC/DC Powered Instruments

24/48V AD/DC powered instruments will operate from a 20 to 48V AC or 22 to 55V DC supply. AC power consumption is 7.5VA max; DC power consumption is 5 watts max. Connection should be via a two-pole isolating switch (preferably located near the equipment) and a 315mA slow-blow (anti-surge type T) fuse.

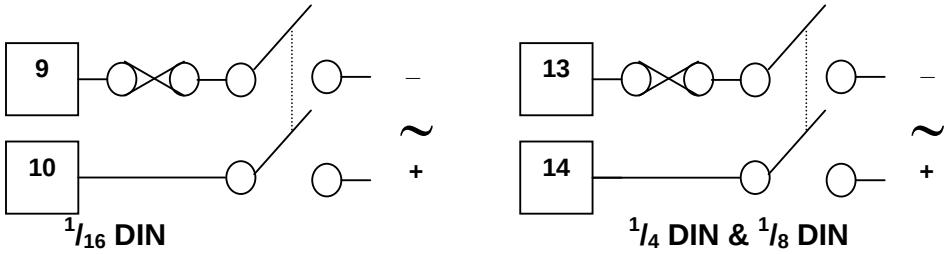


Figure 14. 24/48V AC/DC Power Connections

WARNING:

CHECK THE INFORMATION LABEL ON THE CASE TO DETERMINE THE CORRECT VOLTAGE BEFORE CONNECTING TO A LIVE SUPPLY.

Universal Input Connections - Thermocouple (T/C)

Use only the correct thermocouple wire or compensating cable from the probe to the instrument terminals avoiding joints in the cable if possible. Failure to use the correct wire type will lead to inaccurate readings. Insure correct polarity of the wires by cross-referencing the colors with a thermocouple reference table.

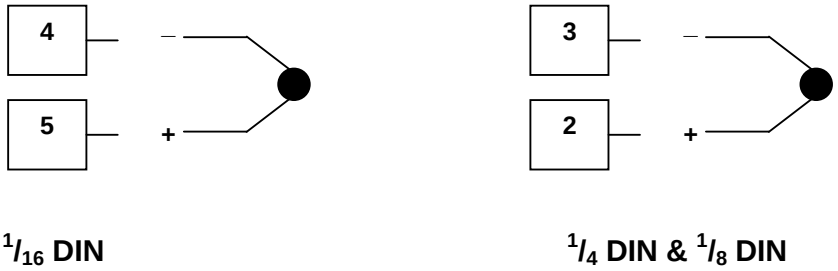


Figure 15. Thermocouple Input Connections

Universal Input Connections – PT100 (RTD) input

For three wire RTDs, connect the resistive leg and the common legs of the RTD as illustrated. For a two wire RTD a wire link should be used in place of the third wire (shown by dotted line). Two wire RTDs should only be used when the leads are less than 3 metres long. Avoid cable joints.

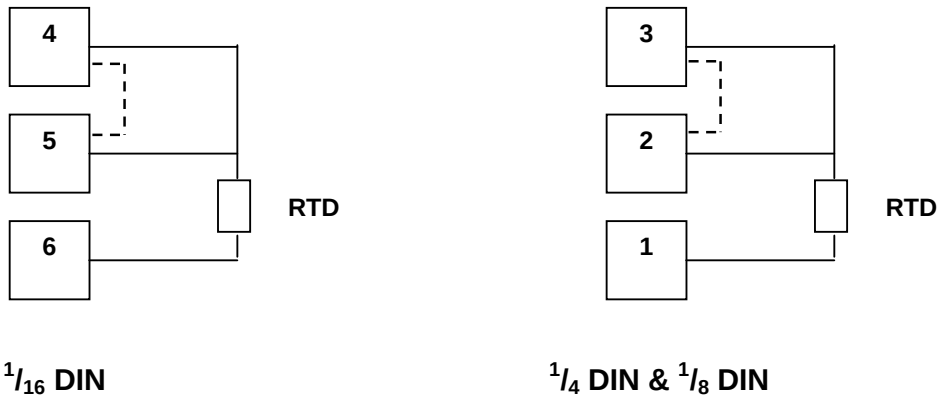
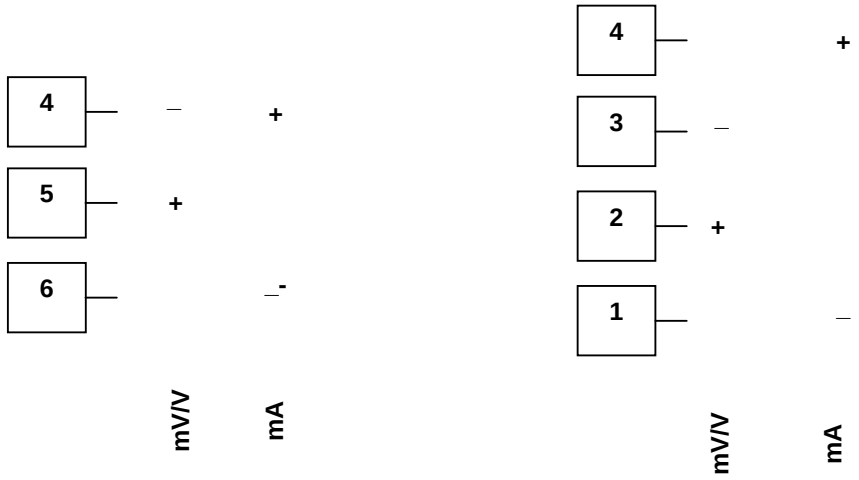


Figure 16. RTD Input Connections

Four wire RTDs can be used, provided that the fourth wire is left unconnected. This wire should be cut short or tied back so that it cannot contact any of the terminals on the rear of the instrument.

Universal Input Connections - Linear Volt, mV or mA input

Linear DC voltage, millivolt or milliamp input connections are made as illustrated. Carefully



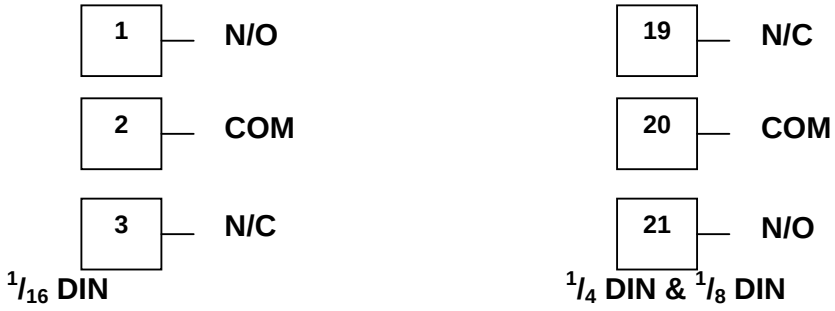
observe the polarity of the connections.

$^1/_{16}$ DIN **$^1/_4$ DIN & $^1/_8$ DIN**

Figure 17. DC Volt, mV & mA Input Connections

Option Slot 1 – Relay Output Module

If option slot 1 is fitted with a fixed relay output, make connections as illustrated. The relay contacts are rated at 5 amps resistive, 240 VAC.



$^1/_{16}$ DIN **$^1/_4$ DIN & $^1/_8$ DIN**

Figure 18. Option Slot 1 – Fixed Relay

Option Slot 2 - Relay Output Module

If option slot 2 is fitted with a relay output module, make connections as illustrated. The relay contacts are rated at 2 amps resistive, 240 VAC.

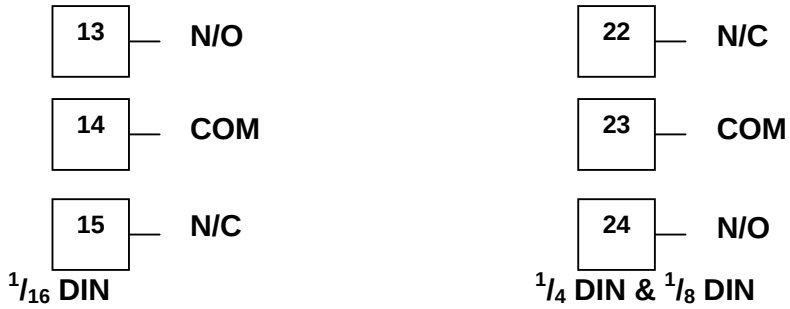


Figure 19. Option Slot 2 - Relay Module

Option Slot 2 - SSR Driver Output Module

If option slot 2 is fitted with an SSR driver output module, make connections as illustrated. The solid-state relay driver is a 0-10V DC signal, load impedance must be no less than 500 ohms. SSR driver outputs are not isolated from the signal input or other SSR driver outputs.

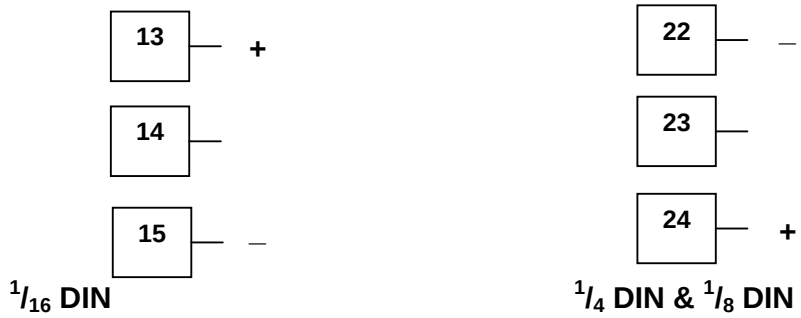


Figure 20. Option Slot 2 - SSR Driver Module

Option Slot 2 - Triac Output Module

If option slot 2 is fitted with a Triac output module, make connections as shown. This output is rated at 0.01 to 1 amp @ 280V AC 50/60Hz..

Figure 21. Option Slot 2 - Triac Module

WARNING: THIS MODULE MUST NOT BE FITTED INTO OPTION SLOT 3.

Option Slot 2 - Linear Voltage or mADC Output module

If option slot 2 is fitted with a DC linear output module, make connections as illustrated.

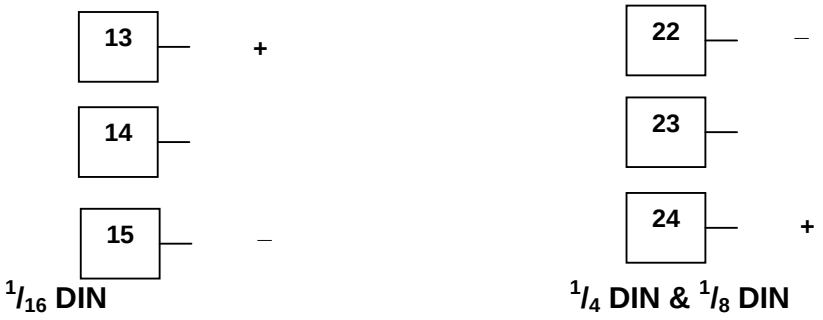


Figure 22. Option Slot 2 - Linear Voltage & mADC module

Option Slot 3 - Relay Output Module

If option slot 3 is fitted with a relay output module, make connections as illustrated. The relay contacts are rated at 2 amps resistive, 240 VAC.

Figure 23. Option Slot 3 - Relay Module

Option Slot 3 - SSR Driver Output Module

If option slot 3 is fitted with an SSR driver output module, make connections as illustrated. The solid-state relay driver is a 0-10V DC signal; load impedance must be no less than 500 ohms. SSR driver outputs are not isolated from the signal input or other SSR driver outputs.

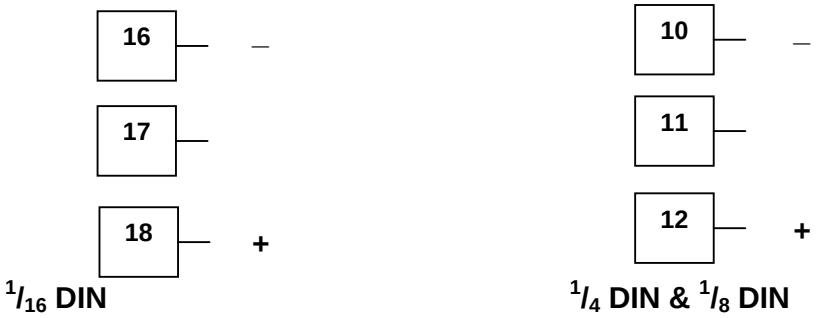


Figure 24. Option Slot 3 - SSR Driver Module

Option Slot 3 - Linear Voltage or mADC Output module

If option slot 3 is fitted with a DC linear output module, make connections as illustrated.

Figure 25. Option Slot 3 - Linear Voltage & mADC module

Option Slot 3 - Transmitter Power Supply Module

If option slot 3 is fitted with a transmitter power supply module, make connections as illustrated. The output is an unregulated 24V DC, 22mA supply.

Figure 26. Option Slot 3 - Transmitter Power Supply Module

WARNING:

THIS MODULE MUST NOT BE FITTED INTO OPTION SLOT 2.

Option Slot A Connections - RS485 Serial Communications Module

If option slot A is fitted with the RS485 serial communication module, connections are as illustrated. Carefully observe the polarity of the A (Rx/Tx +ve) and B (Rx/Tx -ve) connections.

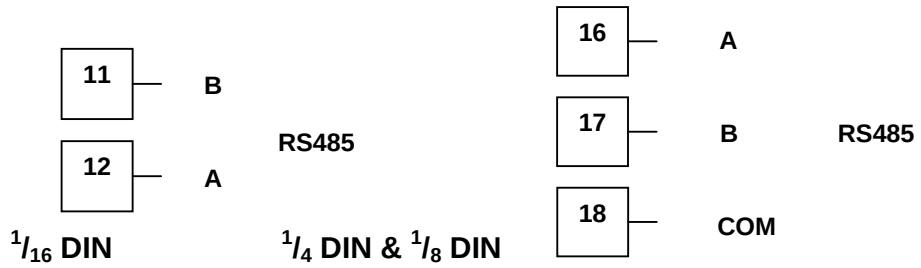


Figure 27. Option Slot A – RS485 Serial Communications Module

Option Slot A Connections - Digital Input Module

If a digital input module is fitted in option slot A, this may be connected to either voltage free contacts (e.g. switch or relay), or a TTL compatible voltage. Connections are shown below.

Figure 28. Option Slot A – Digital Input Module

5 Powering Up

WARNING:

INSURE SAFE WIRING PRACTICES ARE FOLLOWED

The instrument must be powered from a supply according to the wiring label on the side of the unit. The supply will be either 100 to 240V AC, or 24/48V AC/DC powered. Check the supply voltage and connections **carefully** before applying power.

CAUTION:

When powering up for the first time, disconnect the output connections.

Powering Up Procedure

At power up, a self-test procedure is automatically started, during which all LED segments and indicators are lit. At the first power up from new, or if the option modules are changed, **Goto ConF** will be displayed, indicating configuration is required *(refer to section 6)*. At all other times, the instrument returns to operator mode once the self-test procedure is complete.

Overview of Front Panel

The illustration below shows a typical instrument front panel. Refer to the following table – Typical LED functions for a description of the front panel indicators. Each model in the range will vary slightly from the example shown.

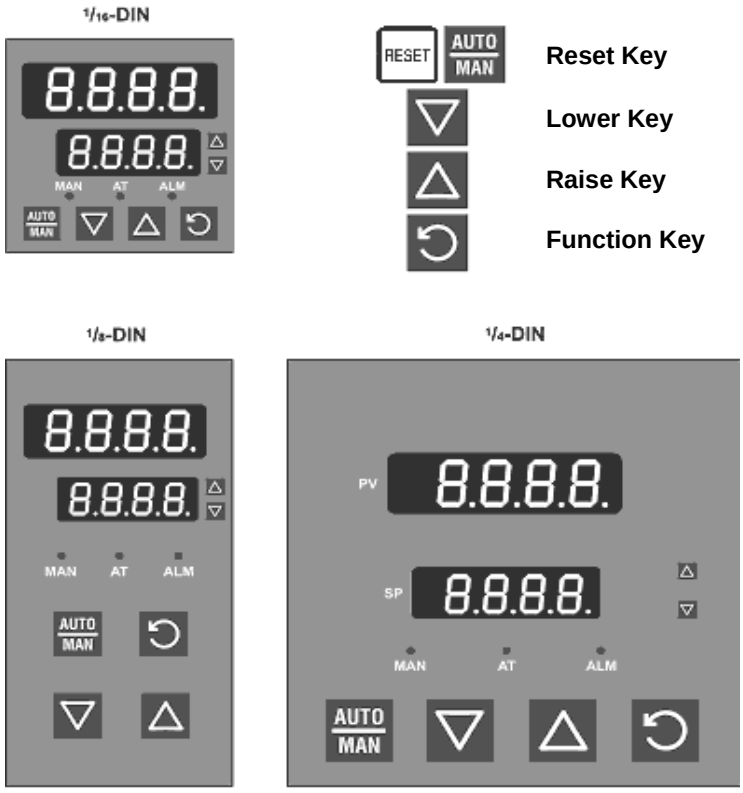


Figure 29. Typical front panel and keys

Displays

Controllers are provided with a dual line display and LED indicators for mode, automatic tune, alarm, and output status. The upper display shows the process variable value during normal operation, while the lower display shows the Setpoint value. See the preceding diagram - Typical front panel and keys.

Keypad

Each instrument has either three or four switches, which are used to navigate through the user menus and make adjustment to the parameter values. See - Overview of Front Panel above

LED Functions

Table 3. Typical LED functions

LED	Function
	**ON** indicates the Setup Mode has been entered (*This LED is labelled* S)
	**FLASHING** indicates that an alarm condition is present
	**ON** in unison with Primary output

6 Messages and Error Indications

The following displays are shown when an error occurs or a hardware change is detected.

Table 4. Error/Faults conditions

Error/Faults Conditions	Upper display	Lower Display (where fitted)
Configuration & Setup is required. Seen at first turn on or if hardware configuration changed. Press to enter Configuration Mode, next press or to enter the unlock code number, then press to proceed. Configuration must be completed before return to operator mode is allowed [1]	Goto (Goto for 1 second)	Conf
Input more than 5% over-range[2]	[HH] *	Normal Display
Input more than 5% under-range[3]	[LL] *	Normal Display
Sensor Break. Break detected in the input sensor or wiring	OPEN *	Normal Display
Auxiliary input over-range	Normal Display	[HH] *
Auxiliary input under-range	Normal Display	[LL] *
Auxiliary Break. Break detected in the auxiliary input	Normal Display	OPEN *
Option 1 module fault.	Err**	OPn 1
Option 2 module fault.	Err**	OPn2
Option 3 module fault.	Err**	OPn3
Option A module fault.	Err**	OPnA
Option B module fault.	Err	OPnb

*** Note**

Input sensor and Auxiliary over/under-range or break indications will be seen wherever these values would normally be displayed.

[1] *This feature does not guarantee correct configuration. It only helps to insure that the unit will be configured before use. Use of set-up mode is not enforced but may be essential for the user's application.*

[2] *If the PV display exceeds 9999 before 5% over-range is reached, an over-range indication is given.*

[3] *Indicators will allow up to 10% under-range on non-zero based Linear ranges. If the PV display is less than -1999 before the % under-range is reached, an under-range indication is given.*

7 Instrument Operation Modes

All instruments in the range share a similar user interface. For more details, refer to the mode tables below.

Select Mode

This mode is used to gain entry to each of the modes available in the instrument.

Entry into the Select Mode

Hold down ↺ and press △ in any mode to force the unit to enter Select Mode.

Navigating in Select Mode

Once in Select Mode, press △ or ▽ to select the required mode, then press ↺ to enter the chosen mode.

To prevent unauthorized entry to Configuration, Setup and Automatic Tuning modes, an unlock code is required. These are shown in the - Lock code values table.

Table 5. Select Mode Menus

Mode	Description	Upper/Main Display	Lower Display
Operator Mode	The Default Mode on power up used for normal operation.	OPtr	SLCt
Set Up Mode	Used to tailor the instrument to the application, adjustment of tuning terms etc.	SEtP	SLCt
Configuration Mode	Used to configure the instrument for first time use or on re-installation.	ConF	SLCt
Product Information Mode	Used to check the hardware, firmware and manufacturing information of the instrument.	inFo	SLCt

Unlock Codes

The ULoc screen is seen before entry is allowed to Configuration, Setup and Automatic Tuning modes.

An unlock code must be correctly selected using the ▽ or △ keys to enter the required mode. An incorrect entry results in a return to Select Mode. The value of the lock codes only can be changed from within the modes to which they apply.

Table 6. Lock Code – Entry and Default Values

Description	Upper/Main Display	Lower Display
Default values are: Set-up mode = 10 Configuration Mode = 20.	0	ULoc

Product Information Mode

This is a read only mode describing the instrument and the options fitted to it.

Navigating in the Product Information Mode

Press ↺ to view each parameter in turn.

Hold Down ↺ and press △ to return to Select Mode.

Note: *If there is no key activity for 2 minutes the device automatically returns to operator mode*

Table 7. Product Information Mode Parameters

Parameter	Possible Values	Upper/Main Display	Lower Display
Input type	Universal input	Un i	In_1
Option 1 module type	Relay	rLY	OPn1
Option 2 module type	No option fitted.	nonE	OPn2
	Relay	rLY	
	SSR drive	SSr	
	Triac	tri	
	Linear voltage / current output	L in	
Option 3 module type	No option fitted.	nonE	OPn3
	Relay	drLY	
	SSR drive	SSr	
	Linear voltage / current output	L in	
	24V Transmitter power supply	dc24	
Auxiliary option A module type	No option fitted	nonE	OPnA
	RS485 comms	r485	
	Digital input	d iG i	
Firmware	Value displayed is firmware type number		FWJ
Issue No.	Value displayed is firmware issue number		ISS
Product Rev Level	Value displayed is Product Revision Level.		PrL
Date of manufacture	Manufacturing date code (mmyy)		dOM
Serial No.1	First four digits of serial number		Sn1
Serial No.2	Second four digits of serial number		Sn2
Serial No. 3	Last four digits of serial number		Sn3

Lock Code View

In the event that a lock code is forgotten, the instrument lock code values can be seen in the lock code view. In this view the codes are read only, the codes can be changed from the mode to which they apply.

Entry and Navigating in Lock Code View Mode

Press △ and ↺ together while the instrument is powering up until the CLoc display is shown.

Once in this mode

Press ↺ to step between lock codes.

Note:

If there is no key activity for 2 minutes the instrument returns to Operator Mode. To forcibly exit this view, switch off the instrument.

Table 8. Lock Code View Menu

Lock Code Name	Description	Upper/Main Display	Lower Display
Configuration Lock Code	Read only view of Configuration Lock Code.	Current Value	CLoc
Setup Lock Code	Read only view of Setup Mode Lock Code.	Current Value	SLoc

8 CN2516, CN2508 & CN2504 – Model Group

Limit Controllers protect processes that could be damaged or become hazardous under fault conditions. They shut down the process at a preset level. Three model sizes are available: CN2516 $^{1}/_{16}$ DIN Limit Device (48 x 48mm), CN2508 $^{1}/_{8}$ DIN Limit Device (96 x 48mm) and CN2504 $^{1}/_{4}$ DIN Limit Device (96 x 96mm).

High or low trip	5 amp latching limit relay
Exceed & relay trip indicators	2 Annunciators or process alarms
RS485 Modbus and ASCII comms option	Remote reset option
PV retransmit option	PC configuration option

CN2516, CN2508 & CN2504 Limit Devices - Configuration Mode

This mode is normally used only when the instrument is configured for the first time or when a major change is made to the controller characteristics. The Configuration Mode parameters must be set as required before adjusting parameters in Setup Mode, or attempting to use the instrument in an application.

Entry into the Configuration Mode

CAUTION:

Adjustments to these parameters should only be performed by personnel competent and authorized to do so.

Configuration is entered from Select Mode

Hold down ↺ and press △ to force the controller into the Select Mode.

then

Press △ or ▽ to navigate to the Configuration Mode option, then press ↺.

Note:
Entry into this mode is security-protected by the Configuration Mode Lock Code. Refer to the Unlock Code section for more details.

Scrolling through Parameters and Values

Press ↺ to scroll through the parameters (parameters are described below).

Note:
Only parameters that are applicable to the hardware options chosen will be displayed.

Changing Parameter Values

Press ↺ to navigate to the required parameter, then press △ or ▽ to set the value as required.

When a value is changed, the display will flash to indicate that confirmation of the change is required. The value will revert back if not confirmed within 10 seconds.

Press RESET to accept the change.

Or

Press ↺ to reject the change and to move onto the next parameter.

Hold down ↺ and press △ to return to Select Mode.

Note:
If there is no key activity for 2 minutes, the instrument returns to the operator mode.

Table 9. CN2516, CN2508 & CN2504 Configuration Mode Parameters

Parameter	Lower Display	Upper Display	Description	Default Value	When Visible
Input type and Range	InPt	bC	B type: 100 to 1824 ºC	JC for Europe JF for USA	Always
		bF	B type: 211 to 3315 ºF		
		CC	C type: 0 to 2320 ºC		
		CF	C type: 32 to 4208 ºF		
		JC	J type: -200 to 1200 ºC		
		JF	J type: -328 to 2192 ºF		
		J.C	J type: -128.8 to 537.7 ºC with decimal point		
		J.F	J type: -199.9 to 999.9 ºF with decimal point		
		KC	K type: -240 to 1373 ºC		
		KF	K type: -400 to 2503 ºF		
		K.C	K type: -128.8 to 537.7 ºC with decimal point		
		K.F	K type: -199.9 to 999.9 ºF with decimal point		
		LC	L type: 0 to 762 ºC		
		LF	L type: 32 to 1403 ºF		
		L.C	L type: 0.0 to 537.7 ºC with decimal point		
		L.F	L type: 32.0 to 999.9 ºF with decimal point		
		nC	N type: 0 to 1399 ºC	JC for Europe JF	Always
		nF	N type: 32 to 2551 ºF		
		rC	R type: 0 to 1759 ºC		

Parameter	Lower Display	Upper Display	Description	Default Value	When Visible
Input type and Range (*Continued*)		rF	R type: 32 to 3198 ºF	for USA	
		SC	S type: 0 to 1762 ºC		
		SF	S type: 32 to 3204 ºF		
		tC	T type: -240 to 400 ºC		
		tF	T type: -400 to 752 ºF		
		t.C	T type: -128.8 to 400.0 ºC with decimal point		
		t.F	T type: -199.9 to 752.0 ºF with decimal point		
		P24C	PtRh20% vs PtRh40%: 0 to 1850 ºC		
		P24F	PtRh20% vs PtRh40%: 32 to 3362 ºF		
		PtC	Pt100: -199 to 800 ºC		
		PtF	Pt100: -328 to 1472 ºF		
		Pt.C	Pt100: -128.8 to 537.7 ºC with decimal point		
		Pt.F	Pt100: -199.9 to 999.9 ºF with decimal point		
		0_20	0 to 20mA DC		
		4_20	4 to 20mA DC		
		0_50	0 to 50mV DC		
		10.50	10 to 50mV DC		
		0_5	0 to 5V DC		
		1_5	1 to 5V DC		
		0_10	0 to 10V DC		
		2_10	2 to 10V DC		
Scale Range Upper Limit	rUL	Scale Range Lower Limit +100 to Range Max		Linear inputs = 1000 (°C/°F = max range)	Always
Scale Range Lower Limit	rLL	Range Min. to Scale range Upper Limit -100		Linear = 0 (°C/°F = min range)	Always

Parameter	Lower Display	Upper Display	Description	Default Value	When Visible
Decimal point position	dPoS	0	Decimal point position in non-temperature ranges. 0 = **XXXX** 1 = **XXX.X** 2 = **XX.XX** 3 = **X.XXX**	1	InPt = mV, V or mA
		1			
		2			
		3			
Process Variable Offset	OFFS	±Span of controller (*see **CAUTION** note at end of section*)		0	Always
Limit Action	CtrL	H i	High Limit. *Limit relay is energized when process "safe" (PV < Limit Setpoint)*	H i	Always
		Lo	Low Limit. *Limit relay is energized when process "safe" (PV > Limit Setpoint)*		
Setpoint Upper Limit	SPuL	Current Setpoint value to Scale Range Maximum		Range Max.	Always
Setpoint Lower Limit	SPLL	Scale Range Minimum to current Setpoint value		Range Min	Always
Alarm 1Type	ALA 1	P_H i	Process High Alarm	P_H i	Always
		P_Lo	Process Low Alarm		
		dE	Deviation Alarm		
		bAnd	Band Alarm		
		nonE	No alarm		
Process High Alarm 1 value*	PhA 1	Range Min. to Range Max.		Range Max.	ALA 1 = P_H i
Process Low Alarm 1 value*	PLA 1	Range Min. to Range Max		Range Min.	ALA 1 = P_Lo
Deviation Alarm 1 Value*	dAL 1	±span from setpoint		5	ALA 1 = dE
Band Alarm 1 value*	bAL 1	1 LSD to full span from setpoint.		5	ALA 1 = bAnd
Alarm 1 Hysteresis*	AHY 1	1 LSD to 100% of span (in display units) on "safe" side of alarm point.		1	Always
Alarm 2 Type	ALA2	As for alarm 1 type		P_Lo	Always
Process High Alarm 2 value*	PhA2	Range Min. to Range Max.		Range Max.	ALA2 = P_H i
Process Low Alarm 2 value*	PLA2	Range Min. to Range Max.		Range Min.	ALA2 = P_Lo
Deviation Alarm 2 Value*	dAL2	±span from setpoint.		5	ALA2 = dE
Band Alarm 2 value*	bAL2	1 LSD to full span from setpoint.		5	ALA2 = bAnd

Parameter	Lower Display	Upper Display	Description	Default Value	When Visible
Alarm 2 Hysteresis*	AHY2	1 LSD to 100% of span (in display units) on "safe" side of alarm point.		1	Always
Output 2 Usage	USE2	LMT	Limit Output Relay	A2_d when OPn2 is not linear output type, rEtP if OPn2 is linear output type	OPn2 = rLY
		A1_d	Alarm 1, Direct Acting		*Not linear*
		A1_r	Alarm 1, Reverse Acting		*Not linear*
		A2_d	Alarm 2, Direct Acting		*Not linear*
		A2_r	Alarm 2, Reverse Acting		*Not linear*
		Or_d	Logical Alarm 1 OR Alarm 2 Direct Acting		*Not linear*
		Or_r	Logical Alarm 1 OR Alarm 2 Reverse Acting		*Not linear*
		Ar_d	Logical Alarm 1 AND Alarm 2, Direct Acting		*Not linear*
		Ar_r	Logical Alarm 1 AND Alarm 2, Reverse Acting		*Not linear*
		An_d	Limit Annunciator, Direct Acting		*Not linear*
		An_r	Limit Annunciator, Reverse Acting		*Not linear*
		rETS	Retransmit SP Output		*Linear only*
		rETP	Retransmit PV Output		*Linear only*
Linear Output 2 Range	tYP2	0_5	0 to 5 V DC output 1	0_10	OPn2 = Lin
		0_10	0 to 10 V DC output		
		2_10	2 to 10 V DC output		
		0_20	0 to 20 mA DC output		
		4_20	4 to 20 mA DC output		
Retransmit Output 2 Scale maximum	ro2H	-1999 to 9999 Display value where output is maximum		Range max	USE2 = rETS or rETP
Retransmit Output 2 Scale minimum	ro2L	-1999 to 9999 Display value where output is minimum		Range min	USE2 = rETS or rETP
Output 3 Usage	USE3	As for output 2		A1_d	OPn3 is not nonE
Linear Output 3 Range	tYP3	As for output 2		0_10	OPn3 = Lin

Parameter	Lower Display	Upper Display	Description	Default Value	When Visible
Retransmit Output 3 Scale maximum	ro3H	-1999 to 9999	Display value where output is maximum	Range max	USE3 = rEtS or rEtP
Retransmit Output 3 Scale minimum	ro3L	-1999 to 9999	Display value where output is minimum	Range min	USE3 = rEtS or rEtP
Display Strategy	d iSP	EnAb	PV is visible in Operator mode	EnAb	Always
		d iSA	PV not visible in Operator mode		
		SAFE	Displays SAFE in Operator mode when Limit Output is not active		
Comms Protocol	Prot	ASC I	ASCII	rtbn	OPnA = r485
		rtbn	Modbus with no parity		
		rtbE	Modbus with Even Parity		
		rtbo	Modbus with Odd Parity		
Bit rate	bAud	1.2	1.2 kbps	4.8	OPnA = r485
		2.4	2.4 kbps		
		4.8	4.8 kbps		
		9.6	9.6 kbps		
		19.2	19.2 kbps		
Communica-tions Address	Addr	1	A unique address for each instrument between 1 to 255 (Modbus), or 1 to 99 (Ascii)	1	OPnA = r485
Communica-tions Write Enable	CoEn	r_o	Read only. Comms writes ignored	r_Wr	Always
		r_Wr	Read / Write. Writing via Comms is possible		
Configuration Mode Lock Code	CLoc	0 to 9999		20	Always

Notes:

Option Slot 1 is a fixed Limit Relay output. A Digital Input module, if fitted to Option Slot A will duplicate the function of the front Reset key [RESET]. As these functions cannot be changed, configuration menus are not required.

*Alarm parameters marked * are repeated in Setup Mode.*

CAUTION:

Process Variable Offset modifies the measured value to compensate for probe errors. Positive values increase the reading, negative values are subtracted. This parameter is, effectively, a calibration adjustment and MUST be used with care.

CN2516, CN2508 & CN2504 Limit Devices – Setup Mode

This mode is normally selected only after Configuration Mode has been completed, and is used when a change to the process set up is required.

Note:
Entry into Setup Mode is security-protected by the Setup Mode lock code.

Entry into the Setup Mode

Hold down ↺ and press △ to enter the Select Mode

Press △ or ▽ to navigate to the Setup Mode option, then press ↺ to enter Setup Mode.
The Setup LED **S** will light while in Setup mode

Scrolling through Parameters & Values

Press ↺ to scroll through the parameters (refer to the table below) and their values.

Changing Parameter Values

Press ↺ to select the required parameter, then press △ or ▽ to set the value as required.

Once the displayed value is changed, the effect is immediate. No confirmation of the change is required.

Note:
If there is no key activity for two minutes, the instrument returns to the operator mode.

Table 10. CN2516, CN2508 & CN2504 Set Up Mode Parameters

Parameter	Lower Display	Upper Display Adjustment Range	Default Value	When Visible
Limit Setpoint value	SP	Scaled Range Minimum to Scaled Range Maximum	Range max when CtrL=H ı Range min when CtrL=Lo	Always
Limit Hysteresis	HYSt	1 LSD to full span in display units, on the safe side of the limit SP	1	Always
Input Filter Time constant	F ıLt	OFF, 0.5 to 100.0 secs in 0.5 sec increments (*see **CAUTION** note at end of section*)	2.0	Always

Parameter	Lower Display	Upper Display Adjustment Range	Default Value	When Visible
Process High Alarm 1 value*	PhA 1	Range Min. to Range Max.	Range Max.	ALA 1 = P_H i
Process Low Alarm 1 value*	PLA 1	Range Min. to Range Max.	Range Min.	ALA 1 = P_Lo
Deviation Alarm 1 Value*	dAL 1	±span from setpoint	5	ALA 1 = dE
Band Alarm 1 value*	bAL 1	1 LSD to full span from setpoint.	5	ALA 1 = bAnd
Alarm 1 Hysteresis*	AHY 1	Up to 100% of span	1	Always
Process High Alarm 2 value*	PhA2	Range Min. to Range Max.	Range Max.	ALA2 = P_H i
Process Low Alarm 2 value*	PLA2	Range Min. to Range Max.	Range Min.	ALA2 = P_Lo
Deviation Alarm 2 Value	dAL2	±span from setpoint	5	ALA2 = dE
Band Alarm 2 value*	bAL2	1 LSD to full span from setpoint.	5	ALA2 = bAnd
Alarm 2 Hysteresis*	AHY2	Up to 100% of span	1	Always
Set-up Lock Code	SLoc	0 to 9999	10	Always
**First Operator mode displays follows.				

Note:

*Alarm parameters marked * are repeated in Configuration Mode.*

Note:

***Once the complete list of Set Up Mode parameters has been displayed, the first Operator Mode display is shown without exiting from Set Up Mode.*

CAUTION:

An excessively large filter time could significantly delay detection of a limit condition. Set this value to the minimum required to remove noise from the process variable.

CN2516, CN2508 & CN2504 Limit Devices - Operator Mode

This is the mode used during normal operation of the instrument. It can be accessed from Select Mode, and is the usual mode entered at power-up.

WARNING:

IN NORMAL OPERATION, THE OPERATOR MUST NOT REMOVE THE INSTRUMENT FROM ITS HOUSING OR HAVE UNRESTRICTED ACCESS TO THE REAR TERMINALS, AS THIS WOULD PROVIDE POTENTIAL CONTACT WITH HAZARDOUS LIVE PARTS.

CAUTION:

Set all Configuration Mode parameters and Setup Mode parameters as required before starting normal operations.

Navigating in Operator Mode

Press  to move between displays.

Table 11. CN2516, CN2508 & CN2504 Operator Mode Displays

Upper Display	Lower Display	When Visible	Description	
PV Value	Limit SP Value	Display strategy is set to EnAb. *(Initial Screen)*	Process Variable and Limit Setpoint values. *Read only*	
Limit SP Value	*Blank*	Display strategy is set to d iSA. *(Initial Screen)*	Limit Setpoint value only. *Read only*	
SAFE or rSEt	*Blank* or PV Value	Display strategy is set to SAFE. *(Initial Screen)*	Displays SAFE and *blank* if Limit Output is not active. Displays rSEt and Process Variable value if Limit Output is active. *Read only*	
High Limit Hold	H iHd	CtrL = H i in Configuration Mode	Highest PV value since this parameter was last reset.	
Low Limit Hold	LoHd	CtrL = Lo in Configuration Mode	Lowest PV value since this parameter was last reset.	
Exceed Time Value	t i	Always available	Accumulated time of Limit SP exceed conditions since this parameter was last reset. Time Format: *mm.ss to 99.59, then mmm.s (10 sec increments)* *Shows* CHHJ when ≥*999.9*	
Active Alarm Status	ALSt	When any alarm is active. ALM **ALM** indicator will also flash	Upper display shows which alarm(s) are active. Inactive alarms are blank	
			1	Alarm 1 Active
			2	Alarm 2 Active
			An	Annunciator Active

Limit Setpoint Adjustment

Adjustment of the Limit Setpoint can be only made from Setup Mode.

Exceed Condition

An Exceed Condition occurs when the Process Variable exceeds the Limit Setpoint value (i.e. PV is greater than the Limit Setpoint when set for high limit action, PV is less than the Limit Setpoint for low limit action). The EXCEED LED is on during this condition, and is extinguished once it has passed.

Limit Output Function

The Limit Output relay(s) de-energize whenever an Exceed condition occurs, causing the process to shut down. The OUT LED is on when the relay is de-energized.The relay remains latched off even if the Exceed condition is no longer present. A reset instruction must be given **after the exceed condition has passed** to re-energize the relay, allowing the process to continue. The OUT LED then turns off.

Limit Annunciator Outputs

An Annunciator output will activate when an Exceed condition occurs, and will remain active until a reset instruction is received, or the Exceed condition has passed. Unlike the Limit Output, an Annunciator can be reset even if the Exceed condition is present. When an Annunciator is active, the ALM LED will flash and the Alarm Status screen is available.

Resetting Limit Outputs & Annunciators

A reset instruction can be given by any of the following methods. The front panel Reset key, the Digital Input (if fitted) or via Serial Communications command if an RS485 Communications module is fitted.

Using the Reset Key to Reset Limit Outputs & Annunciators

Press the RESET key to reset an active Annunciator or latched Limit Relay.

Note: *Annunciators will deactivate immediately, Limit Outputs will only re-energize if the Exceed condition has passed.*

CAUTION:

Insure that the cause of the Exceed condition has been rectified before resetting the Limit Output.

Resetting Limit Hold and Exceed Time

The highest PV value reached (for High Limit action) or lowest PV value reached (for Low Limit action) and the accumulated time of Limit SP exceed conditions can be viewed.

To reset the stored Limit Hold and Exceed Time values

Display the value to be reset, the press the ▽ key for 5 seconds. The upper display briefly shows `----` when the value is reset.

CN2516, CN2508 & CN2504 Devices – Serial Communications Parameters

The Modbus parameter addresses, and the possible ASCII message types and parameters indents for the CN2516, CN2508 & CN2504 are detailed below. RO indicates a parameter is read only, R/W indicates it can also be written to. Communications writes will not implement if the Communications Write Parameter is disabled. Refer to the Modbus and ASCII Communications sections of this manual for details of the protocols used.

Bit Parameters

Bit parameters are not applicable to the ASCII protocol.

Table 12. CN2516, CN2508 & CN2504 Communications - Bit Parameters

Parameter	Modbus Parameter No.		Notes
Communication Write Status	**1**	RO	1 = Write Enabled, 0 = Write Disabled. A negative acknowledgement (exception code 3) is sent to write commands if communications writes are disabled
Limit Action	**2**	RO	1 = Low Limit, 0 = High Limit
Reset Limit Relay	**3**	R/W	1 = Reset Latched Relays. A read returns the values 0
Limit Status	**4**	RO	1 =In Exceed Condition, 0 = Not in Exceed Condition
Alarm 1 Status	**5**	RO	1 = Active, 0 = Inactive
Alarm 2 Status	**6**	RO	1 = Active, 0 = Inactive
Limit Output Status	**7**	RO	1 = Relay latched, 0 = Relay not latched
Annunciator Output Status	**8**	RO	1 = Active, 0 = Inactive

To set the bit value to 1 write FF, to set the bit value to 0 write 00. Refer to Function Code 05 in the Modbus Communications section.

Word Parameters

Table 13. CN2516, CN2508 & CN2504 Communications - Word Parameters

Parameter	Modbus Parameter No.		ASCII Ident & Message Types		Notes
Process Variable	**1**	RO	**M** *Type 2*	RO	Current value of PV.
					If under-range = 62976 (<??>5 ASCII)
					If over-range = 63232 (<??>0 ASCII)
					If Sensor break = 63488 (ASCII = n/a)
Limit Setpoint	**2**	R/W	**S** *Type 2, 3/4*	R/W	Value of the Limit Setpoint.

Parameter	Modbus Parameter No.		ASCII Ident & Message Types		Notes
Hold Value	**3**	R/W	**A** *Type 2*	RO	Highest PV value (High Limit Action) or Lowest PV value (Low Limit Action) since this parameter was last reset. Modbus: Write any value to reset ASCII: See Controller Command 00160 for reset.
Deviation	**4**	RO	**V** *Type 2*	RO	Difference between Process Variable and Limit Setpoint (value = PV-Limit SP)
Time Exceeded Value	**5**	R/W	**T** *Type 2*	RO	Accumulated time of Limit SP exceed conditions since this parameter was last reset. Modbus: Write any value to reset ASCII: See Controller Command 00170 for reset
Limit Hysteresis	**6**	R/W	**F** *Type 2, 3/4*	R/W	A band on the "safe" side of the Limit SP. Adjustable 0 to 100% of span. A latched limit relay cannot be reset until the process passes through this band
Alarm 1 Value	**7**	R/W	**C** *Type 2, 3/4*	R/W	Alarm 1 active at this level
Alarm 2 Value	**8**	R/W	**E** *Type 2, 3/4*	R/W	Alarm 2 active at this level
Scale Range Lower Limit	**9**	R/W	**H** *Type 2* *Type 3/4*	RO R/W	Lower limit of scaled input range
Scale Range Upper Limit	**10**	R/W	**G** *Type 2* *Type 3/4*	RO R/W	Upper limit of scaled input range
Decimal Point Position	**11**	R/W	**Q** *Type 2* *Type 3/4*	RO R/W	Read only if not Linear Input. 0 = xxxx 1 = xxx.x 2 = xx.xx 3 = x.xxx
Input Filter Time Constant	**12**	R/W	**m** *Type 2, 3/4*	R/W	0 to 100 seconds
Re-transmit output Maximum	**13**	R/W	**[** *Type 2, 3/4*	R/W	Maximum scale value for retransmit output, 1999 to 9999. This parameter applies to the first re-transmit output fitted (see also Modbus parameters 2224, 2225, 2234 & 2235).
Re-transmit Output Minimum	**14**	R/W	**** *Type 2, 3/4*	R/W	Minimum scale value for retransmit output, 1999 to 9999. This parameter applies to the first re-transmit output fitted (see also Modbus parameters 2224, 2225, 2234 & 2235).

Parameter	Modbus Parameter No.		ASCII Ident & Message Types		Notes	
Process Value Offset	**26**	R/W	**v** *Type 2* *Type 3/4*	RO R/W	Modified PV = Actual PV + PV Offset. Limited by Scale Range Max. and Scale Range Min.	
Alarm 1 Hysteresis	**32**	R/W			0 to 100% of span	
Alarm 2 Hysteresis	**33**	R/W			0 to 100% of span	
Controller Commands			**Z** *Type 3/4*	R/W	The Type 3 {DATA} field must be one of three five-digit numbers: 00150 = Reset Limit Outputs 00160 = Reset Hold Value 00170 = Reset Exceed Time value The response contains the same {DATA}. A negative acknowledgement will be returned if Reset in not possible or already implemented.	
Controller Status			**L** *Type 2*	RO	***Bits***	***Meaning***
					0	Alarm 1 status: 0 = Activated, 1 = Safe
					1	Alarm 2 status: 0 = Activated, 1 = Safe
					2	Not used
					3	Change Indicator: 0 = No changes, since Controller Status was last read. 1 = A parameter other than Controller Status or PV has changed
					4	Comms write status: 0 = Disabled 1 = Enabled
					5	Not used
					6	Not used
					7	Not used
					8	Not used
					9	Limit status: 0 = Not Exceeded, 1 = Exceeded
					10	Limit Relay Status: 0 = safe, 1 = Latched Off
					11	Limit Action: 0 = Low Limit, 1 = High Limit
					12	Annunciator status: 0 = inactive, 1 = Active

Parameter	Modbus Parameter No.		ASCII Ident & Message Types		Notes	
Scan Table			] *Type 2*	RO	Reads back main process values. Response is: L{N}25aaaaabbbbb ccccdddddeeeeeA* where: aaaaa = Limit Setpoint value bbbbb = Process Variable value ccccc = Hold value ddddd = Exceeded Time value eeeee = Controller Status (see above)	
Equipment ID	**122**	RO			The four digit model number 6700	
Serial Number Low	**123**	RO			Digits aaaa	Unit serial number. Format aaaa bbbb cccc, (12 BCD digits).
Serial Number Mid	**124**	RO			Digits bbbb	
Serial Number High	**125**	RO			Digits cccc	
Date of manufacture	**126**	RO			Manufacturing date code as an encoded binary number. E.g. 0403 for April 2003 is returned as 193hex	
Product Revision Level	**129**	RO			Low Byte High Byte	Alpha part of PRL. E.g. A = 01hex Numeric part of PRL. E.g. 13 = 0Dhex
Firmware Version	**130**	RO			***Bits*** 0 - 4 5 - 9 10 - 15	***Meaning*** Revision number (1,2...) Alpha version (A=0, B=1...) Numeric version (starting from 121 = 0)
Input status	**133**	RO			Input status. Read Only. Bit 0: Sensor break flag Bit 1: Under-range flag Bit 2: Over-range flag	
Option Slot 2 Re-transmit output Maximum	**2224**	R/W			Maximum scale value for retransmit output in slot 2, 1999 to 9999.	
Option Slot 2 Re-transmit output Minimum	**2225**	R/W			Minimum scale value for retransmit output in slot 2, 1999 to 9999.	
Option Slot 3 Re-transmit output Maximum	**2234**	R/W			Maximum scale value for retransmit output in slot 3, 1999 to 9999.	
Option Slot 3 Re-transmit output Minimum	**2235**	R/W			Minimum scale value for retransmit output in slot 3, 1999 to 9999.	

Note:

Some of the parameters that do not apply to a particular configuration will accept reads and writes (e.g. attempting to scale a Linear output which has not been fitted). Read only parameters will return an exception if an attempt is made to write values to them.

9 Modbus Serial Communications

All models support the Modbus RTU communication protocol. Some models also support an ASCII communication protocol. Where both Modbus and ASCII are supported, the protocol to be used is selected from Configuration Mode. The RS485 Communications Module must be fitted into Option Slot A in order to use serial communications.

Refer to the relevant Model Group Section for the ASCII and Modbus Application Layer (parameter address/ident information).

For a complete description of the Modbus protocol refer to the description provided at http://www.modicon.com/ or http://www.modbus.org/

Physical Layer

The Base address, bit rate and character format are configured via the front panel in Configuration Mode or by using the PC Configurator software.

Physical layer configuration settings possible are:

Data rate:	1200, 2400, 4800 (default), 9600 and 19,200 bps
Parity:	None (default), Even, Odd
Character format:	Always 8 bits per character.

The transmitter must not start transmission until 3 character times have elapsed since reception of the last character in a message, and must release the transmission line within 3 character times of the last character in a message.

Note:
Three character times = 1.5ms at 19200, 3ms at 9600, 6ms at 4800, 12ms at 2400 and 24ms at 1200 bps.

Link Layer

A Query (or command) is transmitted from the Modbus Master to the Modbus Slave. The slave instrument assembles the reply to the master. All of the instruments covered by this manual are slave devices, and cannot act as a Modbus Master.

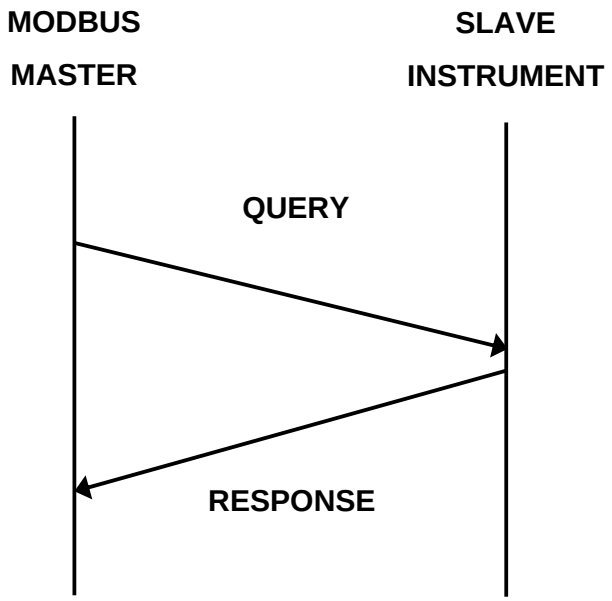


Figure 30. Modbus Link Layer

A message for either a QUERY or RESPONSE is made up of an inter-message gap followed by a sequence of data characters. The inter-message gap is at least 3.5 data character times.

Data is encoded for each character as binary data, transmitted LSB first.

For a QUERY the address field contains the address of the slave destination. The slave address is given together with the Function and Data fields by the Application layer. The CRC is generated from the given address, function and data characters.

For a RESPONSE the address field contains the address of the responding slave. The Function and Data fields are generated by the slave application. The CRC is generated from the address, function and data characters.

The standard MODBUS RTU CRC-16 calculation employing the polynomial $2^{16}+2^{15}+2^{2}+1$ is used.

Inter-message gap	Address 1 character	Function 1 character	Data *n* characters	CRC Check 2 characters

Device Addressing

The instrument is assigned a unique device address by the user in the range 1 (default) to 255 using the Addr parameter in Configuration Mode. This address is used to recognise Modbus Queries intended for this instrument. The instrument does not respond to Modbus Queries that do not match the address that has been assigned to it.

The instrument will also accept global Queries using device address 0 no matter what device address is assigned. No responses are returned for globally addressed Queries.

Supported Modbus Functions

Modbus defines several function types; these instruments support the following types:

Table 14. Supported Modbus Functions

Function Code (decimal)	Modbus Meaning	Description
01 / 02	Read Coil/Input Status	Read output/input status bits at given address.
03 / 04	Read Holding/Input registers	Read current binary value of specified number of parameters at given address. Up to 64 parameters can be accessed with one Query.
05	Force single Coil	Writes a single binary bit to the Specified Slave Bit address.
06	Pre-set Single Register	Writes two bytes to a specified word address.
08	Diagnostics	Used for loopback test.
16	Pre-set Multiple Registers	Writes up to 1 word parameter values to the specified address range.

Function Descriptions

The following is interpreted from the Modbus Protocol Description obtainable from http://www.modicon.com/ or http://www.modbus.org/. Refer to that document if clarification is required.

In the function descriptions below, the preceding device address value is assumed, as is the correctly formed two-byte CRC value at the end of the QUERY and RESPONSE frames.

Read Coil/Input Status (Function 01 / 02)

Reads the content of instruments output/input status bits at the specified bit address.

Table 15. Read Coil/Input Status (Modbus Function 01/02)

QUERY

Function	Address of 1st Bit		Number of Bits	
01 / 02	HI	LO	HI	LO

RESPONSE

Function	Number of Bytes	First 8 bits	2nd 8 Bits
01 / 02			

In the response the “Number of Bytes” indicates the number of data bytes read from the instrument. E.g. if 16 bits of data are returned then the count will be 2. The maximum number of bits that can be read is 16 in one transaction. The first bit read is returned in the least significant bit of the first 8 bits returned.

Read Holding/Input Registers (Function 03 / 04)

Reads current binary value of data at the specified word addresses.

Table 16. Read Holding/Input Registers (Modbus Function 03/04)

QUERY

Function	Address of 1st Word		Number of Words	
03 / 04	HI	LO	HI	LO

RESPONSE

Function	Number of Bytes	First Word		Last Word	
03 / 04		HI	LO	HI	LO

In the response the “Number of Bytes” indicates the number of data bytes read from the instrument. E.g. if 5 words are read, the count will be 10 (A hex). The maximum number of words that can be read is 64. If a parameter does not exist at one of the addresses read, then a value of 0000h is returned for that word.

Force Single Coil (Function 05)

Writes a single binary value to the Specified Instrument Bit address.

Table 17. Force Single Coil (Modbus Function 05)

QUERY

Function	Address of Bit		State to write	
05	HI	LO	FF/00	00

RESPONSE

Function	Address of Bit		State written	
05	HI	LO	FF/00	00

The address specifies the address of the bit to be written to. The State to write is FF when the bit is to be SET and 00 if the bit is to be RESET.

Note:
The Response normally returns the same data as the Query.

Pre-Set Single Register (Function 06)

Writes two bytes to a specified word address.

Table 18. Pre-Set Single Register (Modbus Function 06)

QUERY

Function	Address of Word		Value to write	
06	HI	LO	HI	LO

RESPONSE

Function	Address of Word		Value written	
06	HI	LO	HI	LO

Note:
The Response normally returns the same data as the Query.

Loopback Diagnostic Test (Function 08)

Table 19. Loopback Diagnostic Test (Modbus Function 08)

QUERY

Function	Diagnostic Code		Value	
08	HI =00	LO=00	HI	LO

RESPONSE

Function	Sub-function		Value	
08	HI=00	LO=00	HI	LO

Note:
The Response normally returns the same data as the Query.

Pre-Set Multiple Registers (Function 10 Hex)

Writes a consecutive word (two-byte) value to the specified address range.

Table 20. Pre-Set Multiple Registers (Modbus Function 10 Hex)

QUERY

Function	1st Word Address		Number of Words		Number of Query Bytes	First value to write	
10	HI	LO	HI	LO		HI	LO

RESPONSE

Function	1st Word Address		Number of Words	
10	HI	LO	HI	LO

Note:
The number of consecutive words that can be written is limited to 1.

Exception Responses

When a QUERY is sent that the instrument cannot interpret then an Exception RESPONSE is returned. Possible exception responses are:

Table 21. Modbus Exception Responses

Exception Code	Error Condition	Interpretation
00	Unused	None.
01	Illegal function	Function number out of range.
02	Illegal Data Address	Write functions: Parameter number out of range or not supported. (for write functions only). Read Functions: Start parameter does not exist or end parameter greater than 65536.
03	Illegal Data Value	Attempt to write invalid data / required action not executed.

The format of an exception response is:

RESPONSE

Function	Exception Code
Original Function code with its Most Significant Bit (MSB) set.	*as detailed above*

Note:
In the case of multiple exception codes for a single QUERY the Exception code returned is the one corresponding to the first parameter in error.

10 ASCII Communications

This is simple ASCII protocol provides backwards compatibility with some older products. ASCII is not available in all models in the range. The Modbus protocol is recommended for future use. Refer to the relevant Model Group Section for the ASCII and Modbus Application Layer (parameter address/ident information).

Physical Layer

The Base address, bit rate and character format are configured via the front panel in Configuration Mode or by using the PC Configurator software.

Physical layer configuration settings possible are:

Data rate:	1200, 2400, 4800 (default), 9600 and 19,200 bps
Parity:	Even
Character format:	7 bits per character. + 1 stop bit.

The transmitter must not start transmission until 3 character times have elapsed since reception of the last character in a message, and must release the transmission line within 3 character times of the last character in a message.

Note:
Three character times = 1.5ms at 19200, 3ms at 9600, 6ms at 4800, 12ms at 2400 and 24ms at 1200 bps.

Device Addressing

The instrument is assigned a device address by the user using the Addr parameter in Configuration Mode. The address may be set to any unique value from 1 (default) to 99. This address is used to recognise ASCII messages intended for this instrument. The instrument does not respond to messages that do not match the address that has been assigned to it.

Session Layer

The ASCII protocol assumes half duplex communications. The master device initiates all communication. The master sends a command or query to the addressed slave instrument and the slave replies with an acknowledgement of the command or the reply to the query.

Messages from the master device may be one of five types:

Type 1: {S}{N}??*
Type 2: {S}{N}{P}{C}* or R{N}{P}{C}*
Type 3: {S}{N}{P}#{DATA}* or R{N}{P}#{DATA}*
Type 4: {S}{N}{P}I* or R{N}{P}I*
Type 5: {S} {N} \ P S S ? *

All characters are in ASCII code. See the following Parameter Key table for details of the parameters in brackets **{ }**.

Table 22. ASCII Parameter Key

{S}	is the Start of Message character L (Hex 4C) or R (Hex 52). L is used for Controllers; R is used for Profilers.
{N}	is the slave device address (in the range 1 - 99); addresses 1 - 9 may be represented by a single digit (e.g. 7) or in two-digit form, the first digit being zero (e.g. 07).
{P}	is a character which identifies the parameter to be interrogated/modified.
{C}	is the command (Refer to the Serial Communications Application Layer information for each Model Group)
#	indicates that {DATA} is to follow (Hex 23)
{DATA}	is a string of numerical data in ASCII code (refer to the Data Element table below)
P	is the Program Number
S S	is the Segment Number (01 to 16)
*****	is the End of Message Character (Hex 2A)

No space characters are permitted in messages. Any syntax errors in a received message will cause the slave instrument to issue no reply and await the Start of Message character.

Table 23. ASCII Data Element – Sign/Decimal Point Position

{DATA} Content	Data Format	Description
abcd0	+abcd	Positive value, no decimal place
abcd1	+abc.d	Positive value, one decimal place
abcd2	+ab.cd	Positive value, two decimal places
abcd3	+a.bcd	Positive value, three decimal places
Abcd5	- abcd	Negative value, no decimal place
Abcd6	- abc.d	Negative value, one decimal place
Abcd7	- ab.cd	Negative value, two decimal places
Abcd8	- a.bcd	Negative value, three decimal places

(In the Data Content, abcd represents the data value, the last digit indicates data format)

Type 1 Message

L {N} ? ? *

This message is used by the master device to determine whether the addressed slave device is active.

The reply from an active slave is

L {N} ? A *

An inactive device will give no reply.

Type 2 Message

L {N} {P} {C} * or R {N} {P} {C} *

This type of message is used by the master device, to interrogate or modify a parameter in the addressed slave device. **{P}** identifies the parameter and **{C}** represents the command to be executed, which may be one of the following:

+ (Hex 2B) = Increment the value of the parameter defined by **{P}**
– (Hex 2D) = Decrement the value of the parameter defined by **{P}**
? (Hex 3F) = Determine the current value of the parameter defined by **{P}**

The reply from the addressed slave device is of the form:

L {N} {P} {DATA} A * or R {N} {P} {DATA} A *

where **{DATA}** comprises five ASCII-coded digits whose format is shown in the Data Element table above. The data is the value requested in a query message or the new value of the parameter after modification. If the action requested by the message from the master device would result in an invalid value for that parameter (either because the requested new value would be outside the permitted range for that parameter or because the parameter is not modifiable), the slave device replies with a negative acknowledgement:

L {N} {P} {DATA} N * or R {N} {P} {DATA} N *

The **{DATA}** string in the negative acknowledgement reply will be indeterminate. If the process variable or the deviation is interrogated whille the process variable is outside the range of the slave device, the reply is:

L {N} {P} < ? ? > 0 A *

if the process variable is over-range, or

L {N} {P} < ? ? > 5 A *

if the process variable is under-range.

Type 3 Message

L {N} {P} # {DATA} * or R {N} {P} # {DATA} *

This message type is used by the master device to set a parameter to the value specified in **{DATA}**. The command is not implemented immediately by the slave device; the slave will receive this command and will then wait for a Type 4 message (see below). Upon receipt of a Type 3 message, if the **{DATA}** content and the specified parameter are valid, the slave device reply is of the form:

L {N} {P} {DATA} I * or R {N} {P} {DATA} I *

(where I = Hex 49) indicating that the slave device is ready to implement the command. If the parameter specified is invalid or is not modifiable or if the desired value is outside the permitted range for that parameter, the slave device replies with a negative acknowledgement in the form:

L {N} {P} {DATA} N * or R {N} {P} {DATA} N *

Type 4 Message

L {N} {P} I * or R {N} {P} I *

This type of message is sent by the master device to the addressed slave device, following a successful Type 3 transaction with the same slave device. Provided that the **{DATA}** content and the parameter specified in the preceding Type 3 message are still valid, the slave device will then set the parameter to the desired value and will reply in the form:

L {N} {P} {DATA} A *

where **{DATA}** is the new value of the parameter. If the new value or parameter specified is invalid, the slave device will reply with a negative acknowledgement in the form:

L {N} {P} {DATA} N *

where **{DATA}** is indeterminate. If the immediately preceding message received by the slave device was not a Type 3 message, the Type 4 message is ignored.

Error Response

The circumstances under which a message received from the master device is ignored are:

Parity error detected
Syntax error detected
Timeout elapsed
Receipt of a Type 4 message without a preceding Type 3 command message.

Negative acknowledgements will be returned if, in spite of the received message being notionally correct, the slave device cannot supply the requested information or perform the requested operation. The **{DATA}** element of a negative acknowledgement will be indeterminate.

11 Calibration Mode

WARNING:

CALIBRATION IS ONLY REQUIRED FOR INSTRUMENTS IN WHICH CALIBRATION ERRORS HAVE BEEN ENCOUNTERED. REFER TO CALIBRATION CHECK BELOW.

CAUTION:

Calibration must be performed by personnel who are technically competent and authorized to do so.

Calibration is carried out during manufacture and is not normally required again during the lifetime of an instrument.

Equipment Required For Checking or Calibrating the Universal Input

A suitable calibration signal source is required for each input type. To verify the accuracy of the instrument or carry out recalibration, the listed input sources are required, with better than ±0.05% of the reading accuracy:

1. DC linear inputs: 0 to 50mV, 0 to 10VDC and 0 to 20mADC.

2. Thermocouple inputs - complete with 0ºC reference facility, appropriate thermocouple functions and compensating leads (or equivalent).

3. RTD inputs: decade resistance box with connections for three-wire input (or equivalent).

Calibration Check

1. Set the instrument to the required input type.

2. Power up the instrument and connect the correct input leads.
   Leave powered up for at least five minutes for RTD and DC linear inputs, or at least 30 minutes for thermocouple inputs.

3. After the appropriate delay for stabilisation has elapsed, check the calibration by connecting the appropriate input source and checking a number of cardinal points.

4. Repeat the test for all required input types.

Recalibration Procedure

Recalibration is carried out in five phases as shown in the table below, each phase corresponds to an input range of the instrument.

CAUTION:

The 50mV phase MUST be calibrated before the thermocouple range.

Table 24. Input Calibration phases

iP_1	50 mV
iP_2	10 V
iP_3	20 mA
iP_4	RTD input (200 ohm)
iP_5	Thermocouple (K type source at 0ºC required)

To start calibration, apply the required calibration input from the source type list above, using the correct connections,

1. While the instrument is powering up, press and together until iP_1 is displayed.

Note:
If a phase has not been previously calibrated the display will flash.

2. Press RESET to initiate calibration
3. During calibration the display changes to ---- for a few seconds.
4. If the input is misconnected or an incorrect signal is applied the calibration will be aborted and the display will shown FAiL. The previous calibration value will be retained.
5. If the calibration has succeeded, the pass display is shown iP_1 (non-flashing).
6. Press to step onto the next phase.
7. Repeat this process for each input type until all the phases are calibrated.

Note:
Switch off the instrument to exit the Calibration Mode.
Calibration Mode automatically exits if there is no button activity for five minutes.

12 Appendix 1 – Glossary

This Glossary explains the technical terms and parameters used in this manual. The entry type is also shown:

Limit Device Definition:

Limit Device Parameter:

Alarm Hysteresis Type: *Limit Device Parameter*

An adjustable band on the “safe” side of an alarm point, through which the process variable must pass before the alarm will change state, as shown in the diagram below. E.g. a high alarm’s hysteresis band is below the high alarm value, and a low alarm’s hysteresis is above the low alarm value.
Also refer to *Alarm Operation*.

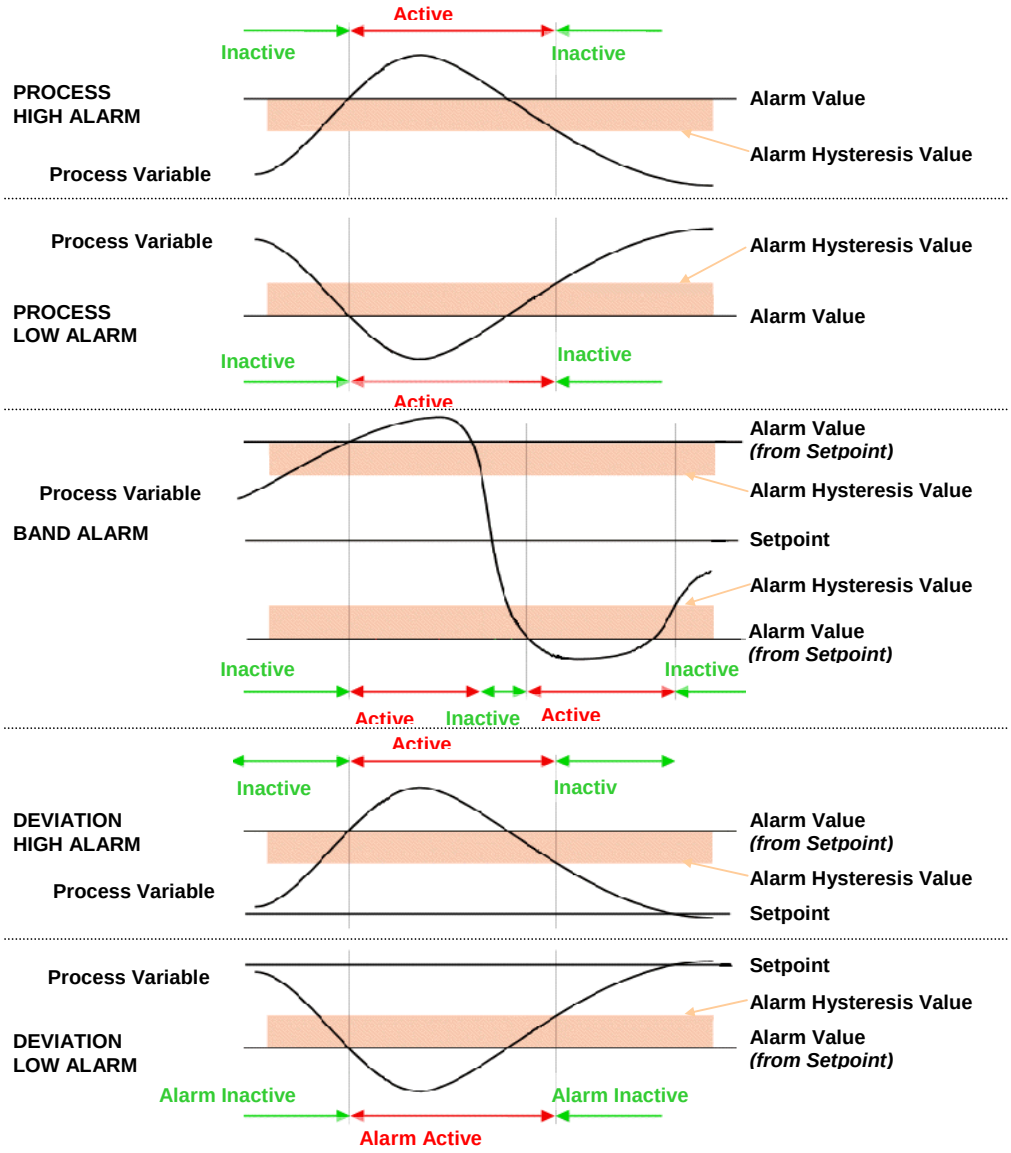


Figure 31. Alarm Hysteresis Operation

Alarm Operation Type: *Limit Device Definition*

The different alarm types are shown below, together with the action of any outputs.
Also refer to *Alarm Hysteresis*, *Alarm Inhibit*, *Band Alarm*, *Deviation Alarm*, *Latching Relay*, *Logical Alarm Combinations*, *Loop Alarm*, *Process High Alarm* and *Process Low Alarm*.

Figure 32. Alarm Operation

Annunciator Type: *Limit Device Definition*

A special type of alarm output that is linked to a Limit Controllers main Limit Output. An Annunciator output will activate when an Exceed condition occurs, and will remain active until a reset instruction is received, or the Exceed condition has passed. Unlike the Limit Output, an Annunciator can be reset even if the Exceed condition is present

Also refer to Exceed Condition, Latching Relay, Limit Controller, Limit Hysteresis and Limit Setpoint

Band Alarm 1 Value Type: *Limit Device Parameter*

This parameter is applicable only if Alarm 1 is selected to be a Band Alarm. It defines a band of process variable values, centered on the current actual setpoint value. If the process variable value is outside this band, the alarm will be active. This parameter may be adjusted from 1 to full span from the setpoint.

Display code = bAL 1, default value = 5.

Also refer to Alarm Operation, Band Alarm 2 Value and Input Span.

Band Alarm 2 Value Type: *Limit Device Parameter*

This parameter is similar to the Band Alarm 1 Value. It is applicable only if Alarm 2 is selected to be a Band Alarm.

Display code = bAL2, default value = 5.

Also refer to Alarm Operation, Band Alarm 1 Value and Input Span.

Communications Write Enable Type: *Limit Device Definition*

This enables/disables the changing of parameter values via the RS485 communications link, if the communications option is installed. Possible settings are read only or read/write.

Display code = CoEn, default setting = r_ Wr (read/write).

CPU Type: *Limit Device Definition*

This stands for Central Processing Unit and refers to the onboard microprocessor that controls all of the measuring, alarm and control functions of the instrument.

Deviation Alarm 1 Value Type Type: *Limit Device Parameter*

This is applicable only if Alarm 1 is selected to be Deviation Alarm. A positive value (Deviation High) sets the alarm point above the current actual setpoint; a negative value (Deviation Low) sets it below. If the process variable deviates from the setpoint by a margin greater than this value, alarm 1 becomes active.

Display code = dAL 1, Default value = 5.

Also refer to Alarm Operation and Deviation Alarm 2 Value.

Deviation Alarm 2 Value Type: *Limit Device Parameter*

Applicable only if Alarm 2 is selected as a Deviation Alarm. It is similar to Deviation Alarm 1 Value.

Display code = dAL2. Default value = 5.

Also refer to Alarm Operation and Deviation Alarm 1 Value.

Display Strategy Type: *Limit Device Parameter*

Alters the parameters displayed in normal operator mode. For example a controller could display PV + SP, PV + adjustable SP, PV + Ramping SP, PV only or SP only. Display strategy 6 will allow read only access to the setpoint values in Operator Mode, Setup Mode must then be entered to change the setpoint.

Display code = d iSP

Also refer to Process Variable, Setpoint and Setpoint Ramping.

Exceed Condition Type: *Limit Device Definition*

This is a state that occurs when the Process Variable exceeds the Limit Setpoint value. E.g. if the PV is above the Limit SP when set for high limit action, or below the Limit SP for low limit action. The Limit Controller will shut down the process when this condition occurs, and cannot be reset until the Exceed Condition has passed.

Also refer to Annunciator, Exceed Time, Latching Relay, Limit Controller, Limit Hysteresis and Limit Setpoint.

Exceed Time Type: *Limit Device Definition*

The total accumulated time that a Limit Controller has been in the Exceed Condition since this parameter was last reset.

Also refer to *Elapsed Time*, *Exceed Condition* and *Limit Controller*.

Input Filter Time Constant Type: *Limit Device Parameter*

This parameter is used to filter out extraneous impulses on the process variable. The filtered PV is used for all PV-dependent functions (display control, alarm etc). The time constant is adjustable from 0.0 seconds (off) to 100.0 seconds in 0.5 second increments.

Display code = F iLt, Default value = 2.0 seconds.

Also refer to Process Variable.

Input Range Type: *Limit Device Definition*

This is the overall process variable input range and type as selected by the InPt parameter in Configuration Mode.

Also refer to Input Span.

Input Span Type: *Limit Device Definition*

The measuring limits, as defined by the Scale Range Lower and Scale Range Upper Limits. The trimmed span value is also used as the basis for calculations that relate to the span of the instrument.

Also refer to Input Range, Scale Range Lower Limit and Scale Range Upper Limit.

Latching Relay Type: *Limit Device Definition*

A type of relay that, once it becomes active, requires a reset signal before it will deactivate. This output is available on Limit controllers and indicator alarms. To successfully deactivate a latched relay, the alarm or limit condition that caused the relay to become active must first be removed, and then a reset signal can be applied. This signal may be applied from the instrument keypad, Digital Input or command via Serial Communication.

Also refer to Alarm Operation, Limit Controller, Limit Hysteresis, Serial Communications.

LED Type: *Limit Device Definition*

Light Emitting Diode. LED's are used as indicator lights (e.g. for the alarm indication). The upper and lower 7-segment displays are also LED's.

Limit Device Type: *Limit Device Definition*

This is a protective device that will shut down a process at a preset Exceed Condition, in order to prevent possible damage to equipment or products. A fail-safe latching relay is used, which cannot be reset by the operator until the process is back in a safe condition. This signal may be applied from the instrument keypad, Digital Input or command via Serial Communication. Limit controllers work independently of the normal process controller. Limit Controllers have specific approvals for critical applications. They are recommended for any process that could potentially become hazardous under fault conditions.

Also refer to Annunciator, Controller, Exceed Condition, Exceed Time, Latching Relay, Limit Hysteresis, Limit Setpoint and Serial Communications.

Limit Hysteresis Type: *Limit Device Definition*

This is an adjustable band on the "safe" side of the Limit Setpoint. For a high limit, the hysteresis band is below the limit setpoint value, for a low limit, the hysteresis is above the limit setpoint value. The latching limit relay cannot be reset by the operator until the process has passed through this band

Also refer to Exceed Condition, Latching Relay, Limit Controller and Limit Setpoint.

Limit Setpoint Type: *Limit Device Definition*

This is the preset value at which an Exceed Condition will occur. When a Limit Controller has been set for High Limit control action, the Exceed Condition is above the Limit Setpoint. When a Limit Controller has been set for Low Limit control action, the Exceed Condition is below the Limit Setpoint.

Also refer to Annunciator, Exceed Condition, Limit Hysteresis, Limit Controller and Setpoint.

Lock Codes Type: *Limit Device Parameter*

This defines the four-digit codes required to enter Configuration (20) and Set-Up (10).

Display codes = **cLoc** and **SLoc** -default values shown above in brackets.

Logical Combination of Alarms Type: *Limit Device Definition*

Two alarms may be combined logically to create an AND/OR situation. Any suitable output may be assigned as a Logical Alarm Output, configured for Reverse-acting or Direct action.

Also refer to Alarm Operation

Table 25. Logical Alarm Outputs

Logical OR: Alarm 1 OR Alarm 2											
Direct Acting						**Reverse-Acting**					
ALARM 1	OFF	**ALARM 2**	OFF	**OUTPUT**	OFF	**ALARM 1**	OFF	**ALARM 2**	OFF	**OUTPUT**	ON
	ON		OFF		ON		ON		OFF		OFF
	OFF		ON		ON		OFF		ON		OFF
	ON		ON		ON		ON		ON		OFF

Logical AND: Alarm 1 AND Alarm 2											
Direct Acting						**Reverse-Acting**					
ALARM 1	OFF	**ALARM 2**	OFF	**OUTPUT**	OFF	**ALARM 1**	OFF	**ALARM 2**	OFF	**OUTPUT**	ON
	ON		OFF		OFF		ON		OFF		ON
	OFF		ON		OFF		OFF		ON		ON
	ON		ON		ON		ON		ON		OFF

mADC Type: *Limit Device Definition*

This stands for milliamp DC. It is used in reference to the DC milliamp input ranges and the linear DC milliamp outputs. Typically, these will be 0 to 20mA or 4 to 20mA.

PLC Type: *Limit Device Definition*

This stands for Programmable Logic Controller. A microprocessor based device used in machine control. It is particularly suited to sequential control applications, and uses “Ladder Logic” programming techniques. Some PLC’s are capable of basic PID control, but tend to be expensive and often give inferior levels of control.

Process High Alarm 1 Value Type: *Limit Device Parameter*

This parameter, applicable only when Alarm 1 is selected to be a Process High alarm, defines the process variable value above which Alarm 1 will be active. Its value may be adjusted between Scale Range Upper Limit and Scale Range Lower Limit.

Display code = PHA 1, Default value = Scale Range Upper Limit.

Also refer to Alarm Operation, Process High Alarm 2 Value, Process Variable, Scale Range Lower Limit and Scale Range Upper Limit.

Process High Alarm 2 Value Type: *Limit Device Parameter*

This parameter is applicable only when Alarm 2 is selected to be a Process High alarm. It is similar to the Process High Alarm 1 Value.

Display code = PHA2, Default value = Scale Range Upper Limit.

Also refer to Alarm Operation, Process High Alarm 1 Value, Process Variable, Scale Range Lower Limit and Scale Range Upper Limit.

Process Low Alarm 1 Value Type: *Limit Device Parameter*

This parameter, applicable only when Alarm 1 is selected to be a Process low alarm, defines the process variable value below which Alarm 1 will be active. Its value may be adjusted between Scale Range Upper Limit and Scale Range Lower Limit.

Display code = PLA 1, Default value = Scale Range Lower Limit.

Also refer to Alarm Operation, Process Low Alarm 2 Value, Process Variable, Scale Range Lower Limit and Scale Range Upper Limit.

Process Low Alarm 2 Value Type: *Limit Device Parameter*

This parameter is applicable only when Alarm 2 is selected to be a Process low alarm. It is similar to the Process Low Alarm 1 Value.

Display code = PLA2, default value = Scale Range Lower Limit.

Also refer to Alarm Operation, Process Low Alarm 1 Value, Process Variable, Scale Range Lower Limit and Scale Range Upper Limit.

Process Variable (PV) Type: *Limit Device Definition*

Process Variable is the variable to be measured by the primary input of the instrument. The PV can be any parameter that can be converted into a electronic signal suitable for the input. Common types are Thermocouple or PT100 temperature probes, or pressure, level, flow etc from transducers which convert these parameters into linear DC signals (e.g. 4 to 20mA). Linear signals can be scaled into engineering units using the Scale Range Lower Limit and Scale Range Upper Limit parameters.

Also refer to Input Span, Offset, Scale Range Lower Limit and Scale Range Upper Limit.

Process Variable Offset Type: *Limit Device Parameter*

- Refer to *Offset*.

Retransmit Output Type: *Limit Device Definition*

A linear DC voltage or mA output signal, proportional to the Process Variable or Setpoint, for use by slave controllers or external devices, such as a Data Recorder or PLC. The output can be scaled to transmit any portion of the input or setpoint span.
Also refer to Input Span, Master & Slave, Process Variable and Setpoint.

Retransmit Output 2 Scale Maximum Type: *Limit Device Parameter*

Scales a linear output module in slot 2 that has been set up to retransmit PV or SP. Retransmit Scale Maximum defines the value of the process variable, or setpoint, at which the output will be at its maximum value. E.g. for a 0 to 5V output, the value corresponds to 5V. It may be adjusted within the range -1999 to 9999; the decimal position is always the same as that for the process variable input. If this parameter is set to a value less than that for Retransmit Output 2 Scale Minimum, the relationship between the process variable/setpoint value and the retransmission output is reversed.

Display code = ro 1H, default value = Scale Range Upper Limit.
Also refer to Process Variable, Retransmit Output, Retransmit Output 2 Scale Minimum, Scale Range Upper Limit and Setpoint.

Retransmit Output 2 Scale Minimum Type: *Limit Device Parameter*

Scales a linear output module in slot 2 that has been set up to retransmit PV or SP. Retransmit Scale Minimum defines the value of the process variable, or setpoint, at which the output will be at its minimum value. E.g. for a 0 to 5V output, the value corresponds to 0V. It may be adjusted within the range -1999 to 9999; the decimal position is always the same as that for the process variable input. If this parameter is set to a value greater than that for Retransmit Output Scale Maximum, the relationship between the process variable/setpoint value and the retransmission output is reversed.

Display code = ro 1L, default value = Scale Range Lower Limit.
Also refer to Process Variable, Retransmit Output, Retransmit Output 2 Scale Maximum, Scale Range Lower Limit and Setpoint.

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Retransmit Output 3 Scale Maximum Type: *Limit Device Parameter*

Defines the value of the process variable, or setpoint, at which Retransmit Output 3 will be at its maximum value. It is similar to Retransmit Output 1 Scale Maximum.

Display code = ro3H, default value = Scale Range Upper Limit.
Also refer to Process Variable, Retransmit Output, Retransmit Output 3 Scale Minimum, Scale Range Upper Limit and Setpoint.

Retransmit Output 3 Scale Minimum Type: *Limit Device Parameter*

Defines the value of the process variable, or setpoint, at which Retransmit Output 3 will be at its minimum value. It is similar to Retransmit Output 1 Scale Minimum.

Display code = ro3L, default value = Scale Range Lower Limit.
Also refer to Process Variable, Retransmit Output, Retransmit Output 3 Scale Maximum, Scale Range Lower Limit and Setpoint.

Scale Range Upper Limit Type: *Limit Device Parameter*

For linear inputs, this parameter is used to scale the process variable into engineering units. It defines the displayed value when the process variable input is at its maximum value. It is

adjustable from -1999 to 9999 and can be set to a value less than (but not within 100 units of) the Scale Range Lower Limit, in which case the sense of the input is reversed.
For thermocouple and RTD inputs, this parameter is used to reduce the effective range of the input. All span related functions work from the trimmed input span. The parameter can be adjusted within the limits of the range selected by Configuration Mode parameter inPt. It is adjustable to within 100 degrees of the Scale Range Lower Limit.
Display code = rUL, default value = 1000 for linear inputs or range maximum for temperature inputs.
Also refer to Input Span, Process Variable and Scale Range Lower Limit.

Scale Range Lower Limit Type: *Limit Device Parameter*

For linear inputs, this parameter can be used to display the process variable in engineering units. It defines the displayed value when the process variable input is at its minimum value. It is adjustable from -1999 to 9999 and can be set to a value more than (but not within 100 units of) the Scale Range Upper Limit, in which case the sense of the input is reversed.
For thermocouple and RTD inputs, this parameter is used to reduce the effective range of the input. All span related functions, work from the trimmed span. The parameter can be adjusted within the limits of the range selected by Configuration Mode parameter inPt. It is adjustable to within 100 degrees of the Scale Range Upper Limit.
Display code = rUL, default value = 0 for linear inputs, or range minimum for temperature inputs.
Also refer to Input Span, Process Variable and Scale Range Upper Limit.

Serial Communications Option Type: *Limit Device Definition*

This feature allows other devices such as PC's, PLC's or a master controller to read or change an instrument's parameters via an RS485 Serial link. Full details can be found in the Serial Communications sections of this manual.
Also refer to Master & Slave, Limit Controller and PLC

Solid State Relay (SSR) Type: *Limit Device Definition*

An external device manufactured using two Silicone Controlled Rectifiers, which can be used to replace mechanical relays in most AC power applications. As a solid state device, an SSR does not suffer from contact degradation when switching electrical current. Much faster switching cycle times are also possible, leading to superior control. The instrument's SSR Driver output is a time proportioned 10VDC pulse, which causes conduction of current to the load when the pulse is on.
Also refer to Triac.

Triac Type: *Limit Device Definition*

This is a small internal solid state device, which can be used in place of a mechanical relay in applications switching low power AC, up to 1 amp. Like a relay, the output is time proportioned, but much faster switching cycle times are also possible, leading to superior control. As a solid-state device, a Triac does not suffer from contact degradation when switching electrical currents. A triac cannot be used to switch DC power.
Also refer to SSR .

13 Appendix 2 - Specifications

Universal Input

General Input Specifications

Input Sample Rate:	Four samples/second.	
Digital Input Filter time constant	0.0 (OFF), 0.5 to 100.0 seconds in 0.5 second increments.	
Input Resolution:	14 bits approximately. Always four times better than display resolution.	
Input Impedance:	10V DC:	47KΩ
	20mA DC:	5Ω
	Other ranges:	Greater than 10MΩ resistive
Isolation:	Isolated from all outputs (except SSR driver). If single relay outputs are connected to a hazardous voltage source, and the universal input is connected to operator accessible circuits, supplementary insulation or input grounding is required.	
PV Offset:	Adjustable ±input span.	
PV Display:	Displays process variable up to 5% over and 5% under span.	

Thermocouple

Thermocouple Ranges Available

Sensor Type	Range Min in °C	Range Max in °C	Range Min in °F	Range Max in °F	Resolution
J (default)	-200	1200	-328	2192	1°
J	-128.8	537.7	-199.9	999.9	0.1°
T	-240	400	-400	752	1°
T	-128.8	400.0	-199.9	752.0	0.1°
K	-240	1373	-400	2503	1°
K	-128.8	537.7	-199.9	999.9	0.1°
L	0	762	32	1403	1°
L	0.0	537.7	32.0	999.9	0.1°
N	0	1399	32	2551	1°
B	100	1824	211	3315	1°
R	0	1759	32	3198	1°
S	0	1762	32	3204	1°
C	0	2320	32	4208	1°
PtRh20%: PtRh40%	0	1850	32	3362	1°

Note:

Defaults to °F for USA units. Defaults to °C for non-USA units.

The Configuration Mode parameters, Scale Range Upper Limit and Scale Range Lower Limit, can be used to restrict range.

Thermocouple Performance

Calibration:	Complies with BS4937, NBS125 and IEC584.
Measurement Accuracy:	±0.1% of full range span ±1LSD. NOTE: Reduced performance for B Thermocouple from 100 to 600°C. NOTE: PtRh 20% vs PtRh 40% Thermocouple accuracy is 0.25% and has reduced performance below 800°C.
Linearisation Accuracy:	Better than ±0.2°C any point, for 0.1° resolution ranges (±0.05°C typical). Better than ±0.5°C any point, for 1° resolution ranges.
Cold Junction Compensation:	Better than ±0.7°C under reference conditions. Better than ±1°C under operating conditions.
Temperature Stability:	0.01% of span/°C change in ambient temperature.
Supply Voltage Influence:	Negligible.
Relative Humidity Influence:	Negligible.
Sensor Resistance Influence:	Thermocouple 100Ω: <0.1% of span error. Thermocouple 1000Ω: <0.5% of span error.
Sensor Break Protection:	Break detected within two seconds. Limit outputs turn off (goes into Exceed condition); Alarms operate as if the process variable is over-range.

Resistance Temperature Detector (RTD)

RTD Ranges Available

Range Min in °C	Range Max in °C	Range Min in °F	Range Max in °F	Resolution
-128.8	537.7	-199.9	999.9	0.1°
-199	800	-328	1472	1° (default)

Note:

Scale Range Upper Limit and Scale Range Lower Limit Configuration Mode parameters can be used to restrict range.

RTD Performance

Type:	Three-wire Pt100.
Calibration:	Complies with BS1904 and DIN43760 *(0.00385Ω/Ω/°C).*
Measurement Accuracy:	±0.1% of span ±1LSD.
Linearisation Accuracy:	Better than ±0.2°C any point, any 0.1°C range (±0.05°C typical). Better than ±0.5°C any point, any 1°C range.
Temperature Stability:	0.01% of span/°C change in ambient temperature.
Supply Voltage Influence:	Negligible.
Relative Humidity Influence:	Negligible.
Sensor Resistance Influence:	Pt100 50Ω/lead: <0.5% of span error.
Lead Compensation:	Automatic scheme.
RTD Sensor Current:	150μA (approximately).
Sensor Break Protection:	Break detected within two seconds. Limit outputs turn off (goes into Exceed condition); Alarms operate as if the process variable has gone over-range.

DC Linear

DC Linear Ranges Available

0 to 20mA	0 to 50mV	0 to 5V
4 to 20mA (default)	10 to 50mV	1 to 5V
		0 to 10V
		2 to 10V

DC Linear Performance

Scale Range Upper Limit:	–1999 to 9999. Decimal point as required.
Scale Range Lower Limit:	–1999 to 9999. Decimal point as for Scale Range Upper Limit.
Minimum Span:	1 display LSD.
Measurement Accuracy:	±0.1% of span ±1LSD.
Temperature stability:	0.01% of span/°C change in ambient temperature.
Supply Voltage Influence:	Negligible.
Relative Humidity Influence:	Negligible.
Input Protection:	Up to 10 times maximum span of selected input connection.
Sensor Break Protection:	**Applicable for 4 to 20mA, 1 to 5V and 2 to 10V ranges only.** Limit outputs turn off (goes into Exceed condition); Alarms operate as if process variable is under-range.

Digital Inputs

Type:	Voltage-free or TTL-compatible
Voltage-Free Operation:	Connection to contacts of external switch or relay: **Open** = *Minimum contact resistance = 5KΩ,* **Closed** = Latching Relay, reset (edge triggered). *Maximum contact resistance = 50Ω.*
TTL levels:	**2.0 to 24VDC** **–0.6 to 0.8VDC** = Latching Relay, reset (edge triggered)
Maximum Input Delay (OFF-ON):	0.25 second.
Maximum Input Delay (ON-OFF):	0.25 second.
Isolation:	Reinforced safety isolation from any source of hazardous voltages.

Output Specifications

Output Module Types

Option Slot 1 Module Options:	*Limit Controllers have a fixed Latching Relay only.*
Option Slot 2 Module Options:	Relay, SSR drive, Triac or DC linear.
Option Slot 3 Module Options:	Relay, SSR drive, DC Linear or Transmitter PSU.

Specifications of Output Types

Single Relay:	Contact Type:	Single pole double throw (SPDT).
	OP1 Relay Contact Rating:	5A latching relay
	OP2 / 3 Relay Contact Rating:	2A resistive at 240V AC
	Alarm Lifetime:	>500,000 operations at rated voltage/current.
	Limit Output Lifetime:	>100,000 operations at rated voltage/current.
	Isolation:	Basic Isolation from universal input and SSR outputs.
SSR Driver:	Drive Capability:	10V minimum at up to 20mA load.
	Isolation:	Not isolated from universal input or other SSR driver outputs.

Triac:	Operating Voltage Range:	20 to 280Vrms @47 to 63Hz. (140V max when directly driving motorised valves).
	Current Rating:	0.01 to 1A (full cycle rms on-state @ 25°C); derates linearly above 40°C to 0.5A @ 80°C.
	Max. Non-repetitive Surge Current (16.6ms):	25A peak.
	Min. OFF-State dv/dt @ Rated Voltage:	500V/μs.
	Max. OFF-State leakage @ Rated Voltage:	1mA rms.
	Max. ON-State Voltage Drop @ Rated Current:	1.5V peak.
	Repetitive Peak OFF-state Voltage, Vdrm:	600V minimum.
	Isolation:	Reinforced safety isolation from inputs and other outputs.
Linear DC:	Resolution:	Eight bits in 250mS (10 bits in 1 second typical, >10 bits in >1 second typical).
	Update Rate:	Every control algorithm execution.
	Ranges:	0 to 10V 0 to 20mA 0 to 5V 4 to 20mA 2 to 10V (default)
	Load Impedance:	0 to 20mA & 4 to 20mA: 500Ω maximum. 0 to 5V, 0 to 10V & 2 to 10V: 500Ω minimum. Short circuit protected.
	Accuracy:	±0.25% (mA @ 250Ω, V @ 2kΩ). Degrades linearly to ±0.5% for increasing burden (to specification limits).
	Isolation:	Reinforced safety isolation from inputs and other outputs.
Transmitter Power Supply:	Power Rating	19 to 28VDC (24V nominal) into 910Ω minimum resistance.
	Isolation:	Reinforced safety isolation from inputs and other outputs.

Control Specifications

Setpoint Range:	Limited by Setpoint Upper Limit and Setpoint Lower Limit.
Setpoint Maximum:	Limited by Setpoint and Scale Range Upper Limit.
Setpoint Minimum:	Limited by Scale Range Lower Limit and Setpoint.

Process Alarms

Maximum Number of Alarms	Two “soft” process alarms (high, low, deviation or band)
Combinatorial Alarms:	Logical OR or AND of alarms to any suitable output.

Digital Communications

Type:	Asynchronous Serial.
Protocols Supported:	Modbus RTU (all models) and ASCII (some models).
Physical Layer:	RS485.
Zone address range:	1 to 99 (ASCII), 1 to 255 (Modbus).
Bit rate:	1200, 2400, 4800, 9600 and 19200 bps.
Bits per character:	ASCII: 10 Modbus: 10 or 11 (depending on parity setting)
Stop bits:	1
Parity:	ASCII: Even (fixed). Modbus: None, even or odd (selectable).
Isolation:	Reinforced safety isolation from inputs and outputs.

Reference Conditions

Ambient Temperature:	20°C ±2°C.
Relative Humidity:	60 to 70%.
Supply Voltage:	100 to 240V AC 50Hz ±1%.
Source Resistance:	<10Ω for thermocouple input.
Lead Resistance:	<0.1Ω/lead balanced (Pt100).

Operating Conditions

Ambient Temperature (operating):	0°C to 55°C.
Ambient Temperature (storage):	-20°C to 80°C.
Relative Humidity:	20% to 95% non-condensing.
Altitude:	Up to 2000m above sea level.
Supply Voltage:	Either 100 to 240V ±10% AC 50/60Hz or 20 to 48V AC 50/60Hz & 22 to 55V DC
Power Consumption:	5W / 7.5 VA maximum.
Source Resistance:	1000Ω maximum (thermocouple).
PT100 Input Lead Resistance:	50Ω per lead maximum, balanced

Standards

Conformance Norms:	CE, UL, ULC.
EMC standards:	EN61326*
Safety Standards:	EN61010-1, UL61010-1 Pollution Degree 2, Installation Category II. FM 3545, 1998.
Front Panel Sealing:	IP66 when correctly mounted – refer to installation section

Note:

**For disturbances induced by RF fields of 10V/m 80% AM at 1kHz the input accuracy specification is changed to 0.25% in the frequency bands 465 to 575 MHz and 630 to 660 MHz.*

Physical Specifications

Dimensions:	**Depth behind panel:**	110mm ($^1/_{16}$ DIN instruments). 100mm ($^1/_8$ & $^1/_4$ DIN instruments).
	Front bezel size (*w x h*):	48 x 48mm ($^1/_{16}$ DIN instruments). 48 x 96mm ($^1/_8$ DIN controllers). 96 x 48mm ($^1/_8$ DIN indicators). 96 x 96mm ($^1/_4$ DIN instruments).
Mounting:		Plug-in with panel mounting fixing strap.
Panel cut-out size (*w x h*)::		45mm x 45mm ($^1/_{16}$ DIN instruments). 45 x 92mm ($^1/_8$ DIN controllers). 92mm x 92mm ($^1/_4$ DIN instruments).
Terminals:		Screw type (combination head).
Weight:		0.21kg maximum.

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

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CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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FLOW/LEVEL

- Rotameters, Gas Mass Flowmeters & Flow Computers
- Air Velocity Indicators
- Turbine/Paddlewheel Systems
- Totalizers & Batch Controllers

pH/CONDUCTIVITY

- pH Electrodes, Testers & Accessories
- Benchtop/Laboratory Meters
- Controllers, Calibrators, Simulators & Pumps
- Industrial pH & Conductivity Equipment

DATA ACQUISITION

- Data Acquisition & Engineering Software
- Communications-Based Acquisition Systems
- Plug-in Cards for Apple, IBM & Compatibles
- Data Logging Systems
- Recorders, Printers & Plotters

HEATERS

- Heating Cable
- Cartridge & Strip Heaters
- Immersion & Band Heaters
- Flexible Heaters
- Laboratory Heaters

ENVIRONMENTAL MONITORING AND CONTROL

- Metering & Control Instrumentation
- Refractometers
- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
- pH, Conductivity & Dissolved Oxygen Instruments

M5284/0114