# PM4 Panel Meter
# Optional Output Addendum

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# Table of Contents

# 1 Introduction

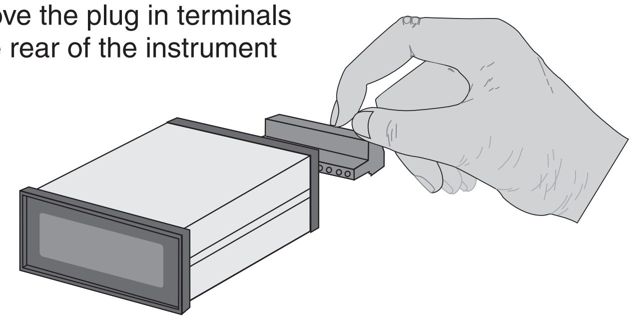
This manual addendum contains information on the PM4 optional outputs. This manual is supplied whenever a PM4 panel meter is supplied with an optional output fitted. Refer to the standard manual for the PM4 model purchased for information not covered in this addendum.

Note: Not all options are available on all instruments. Check the instruction manual or brochure for the instrument to be used to see which options are available or contact supplier.

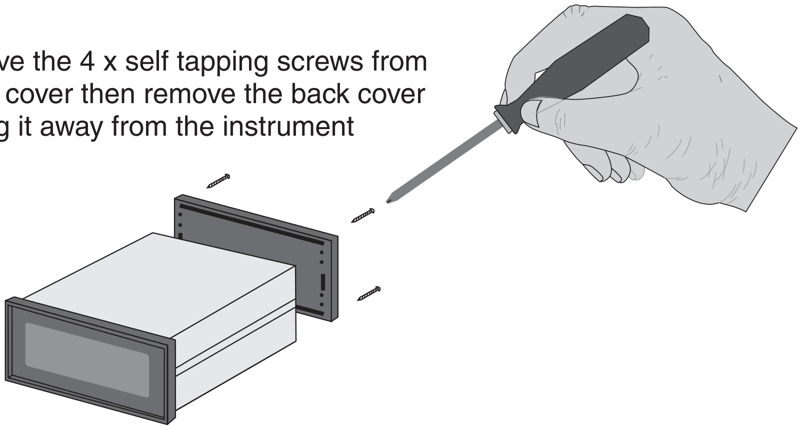
## 1.1 Input Output Configuration

If you need to alter the input or output configuration link settings proceed as follows:

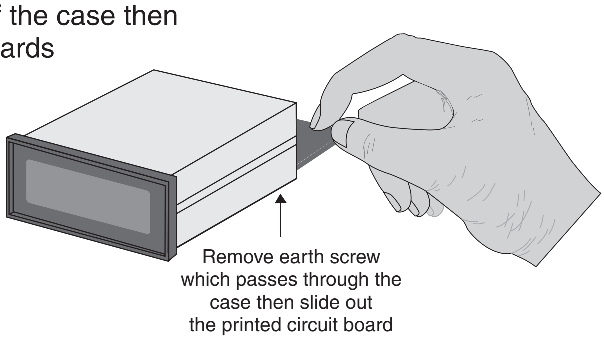
1. Remove the plug in terminals from the rear of the instrument



2. Remove the 4 x self tapping screws from the back cover then remove the back cover by pulling it away from the instrument



3. Remove the earth screw which passes through the underside of the case then slide out the board or boards




4. Configure the PCB links as requred, see appropriate chapter

5. Slide PCB back into case

6. Replace the earth screw which passes through the case

7. Refit the back cover and fix with the self tapping screws

8. Plug the terminal strips back into the rear of the instrument

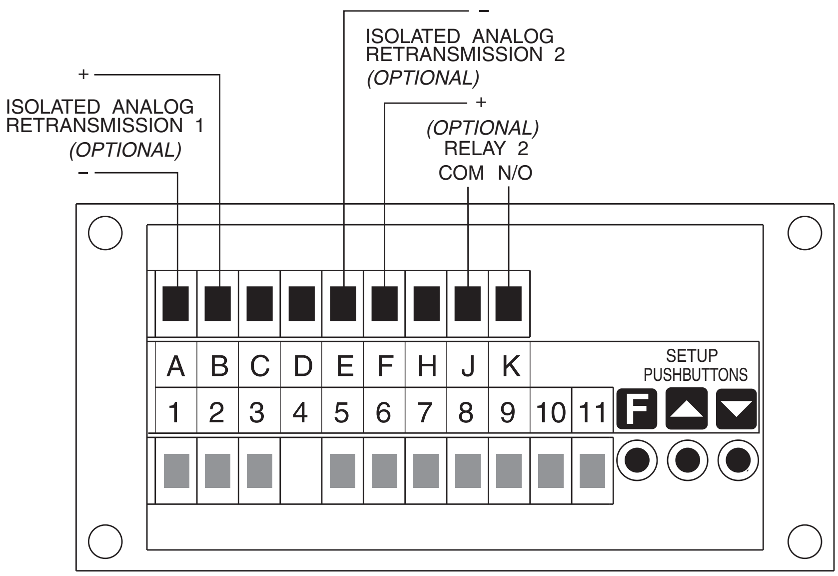
# 2 Analog, dual analog outputs plus relay option (-A, -AA, -AR, -AAR and -R options)

This chapter deals with the the 12 bit single and dual isolated analog output boards. These boards may also be optionally fitted with a relay. The relay will revert to the normally open (N/O) contact being open when power is removed. 4-20mA outputs can be factory configured as current sinking if required. A bipolar +/- 10V output option is also available.

| Option code | Options fitted to the board |
|---|---|
| -A | Single isolated analog output |
| -AA | Dual isolated analog output |
| -AR | Single isolated analog output plus relay (form A, rated at 240VAC, 5A into resistive load) |
| -AAR | Dual isolated analog output plus relay (form A, rated at 240VAC, 5A into resistive load) |
| -R | Single extra relay |

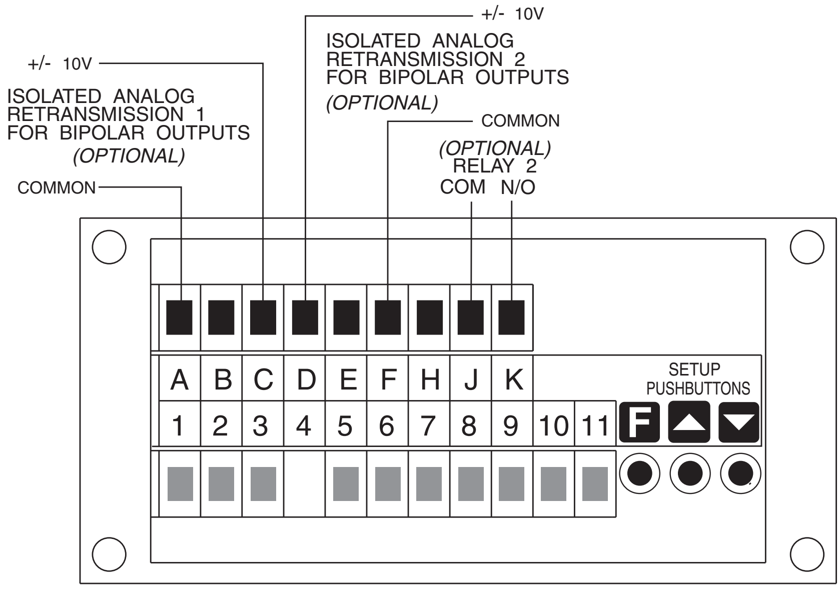
## 2.1 Electrical Connections

All electrical connections are at the rear of the instrument. The plug in screw connectors used allow wire of up to 2.5mm$^2$. Refer to "Electrical Installation" chapter in the main PM4 manual for general information on electrical connections.



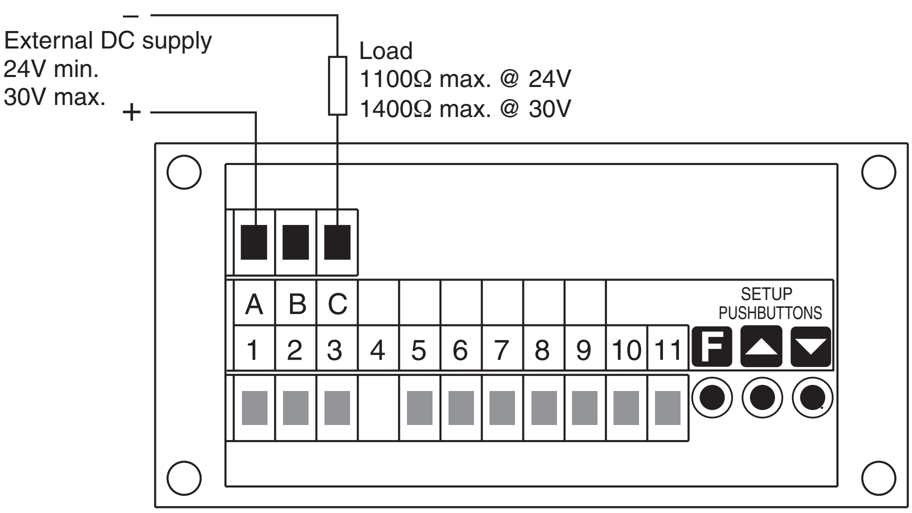
## 2.2 Bipolar output connections

The single and dual analog output options are available in bipolar 10V output form i.e. ±10V. The bipolar output is not user configurable and must be factory set since extra components are required. The circuit board links should be set to 10V for this option. Connections are as shown below.




## 2.3 Current sinking 4-20mA output

The current sinking output is not a standard retransmission output and requires factory configured modification to the circuit board. In this mode an external supply is required as shown in the diagram below. This output type is sometimes required when an analog input device has a power supply connected to the input which cannot be disconnected.

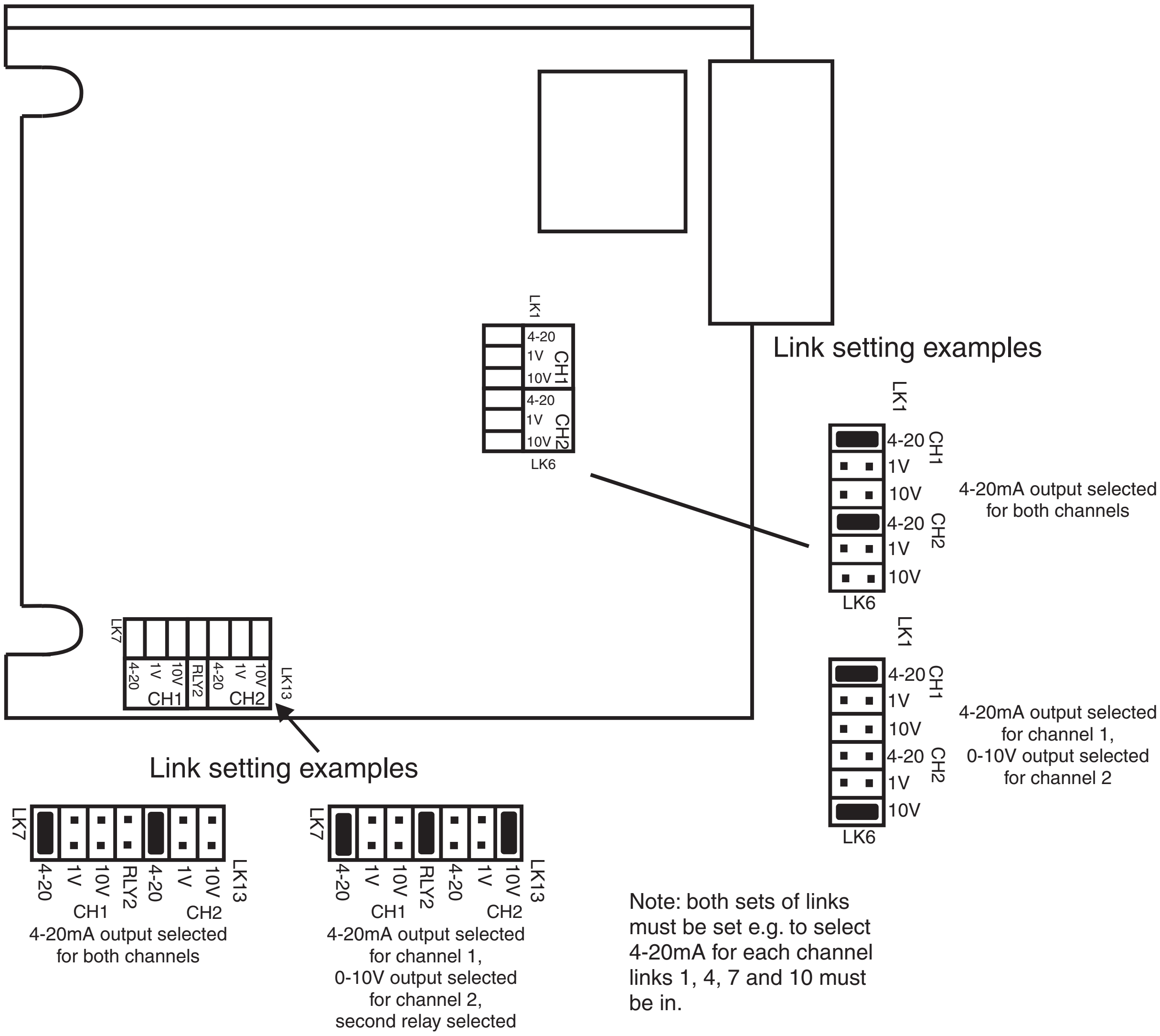



4-20mA output connected in current sinking mode
Links required LK1 (4-20mA), LK7 (4-20mA) & LK16 (solder link)
Components C14 and D4 removed

## 2.4 Configuring the output board

The output board has facilities for single or dual analog (4-20mA, 0-1V or 0-10V) output and an optional relay and is factory supplied with all the necessary component for the output options ordered. PCB links are fitted to the circuit board to provide data to the microprocessor and to connect the electronic components for the correct output types. The 4-20mA outputs will drive into 800Ω loads max. See the "Input Output Configuration" section 1.1 for details on dismantling the instrument. Note: links will only activate the option if that option was ordered and fitted e.g. fitting the "RLY2" link will only enable the second relay if this option was ordered.

Note: For single analog output boards only channel 1 links will be fitted. Bipolar 10V outputs are only available if factory fitted and require the 10V link to be in.



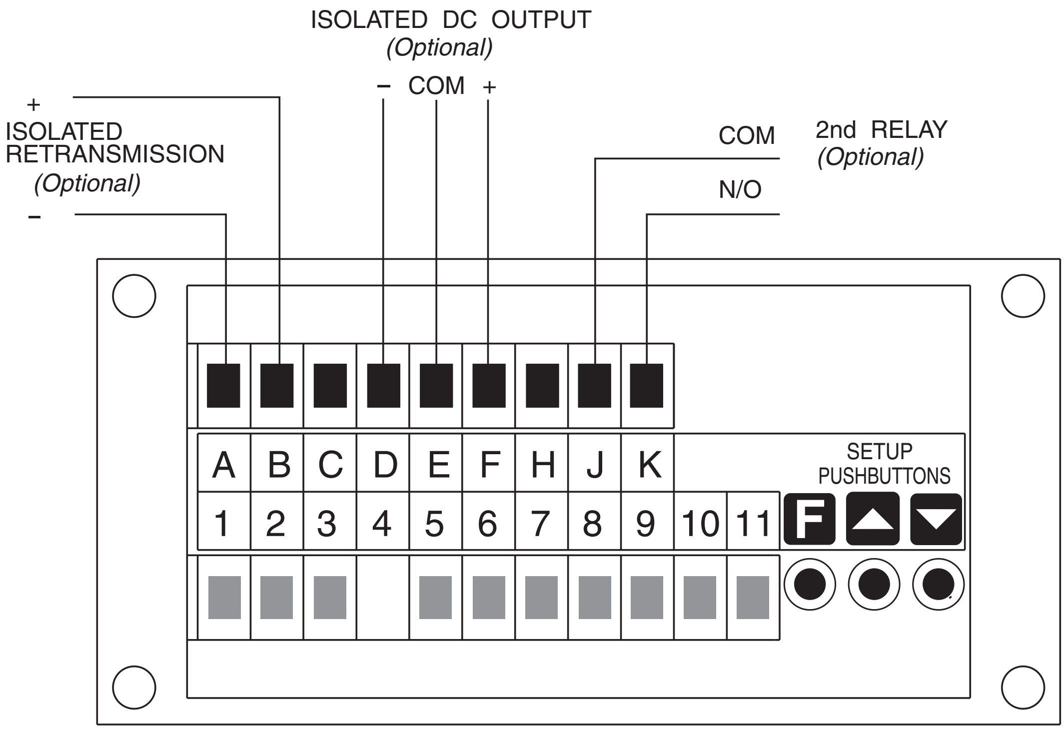
# 3 Transmitter supply option (-12, -R12, -A12 and -AR12 options)

This chapter deals with the the transmitter supply option circuit board. The transmitter supply may be fitted on its own or with combinations of relay and analog retransmission. The relay will revert to the normally open (N/O) contact being open when power is removed. Note that an internal link setting can be used to convert the transmitter supply from 24V (±12V) to 10V (±5V) if required, see link location drawing which follows.

| Option code | Options fitted to the board |
|---|---|
| -12 | 24VDC (±12V) isolated and regulated transmitter supply rated at 25mA max. |
| -R12 | 24VDC (±12V) isolated and regulated transmitter supply rated at 25mA max. plus extra relay |
| -A12 | 24VDC (±12V) isolated and regulated transmitter supply rated at 25mA max. plus analog retransmission |
| -AR12 | 24VDC (±12V) isolated and regulated transmitter supply rated at 25mA max. plus analog retransmission plus extra relay |

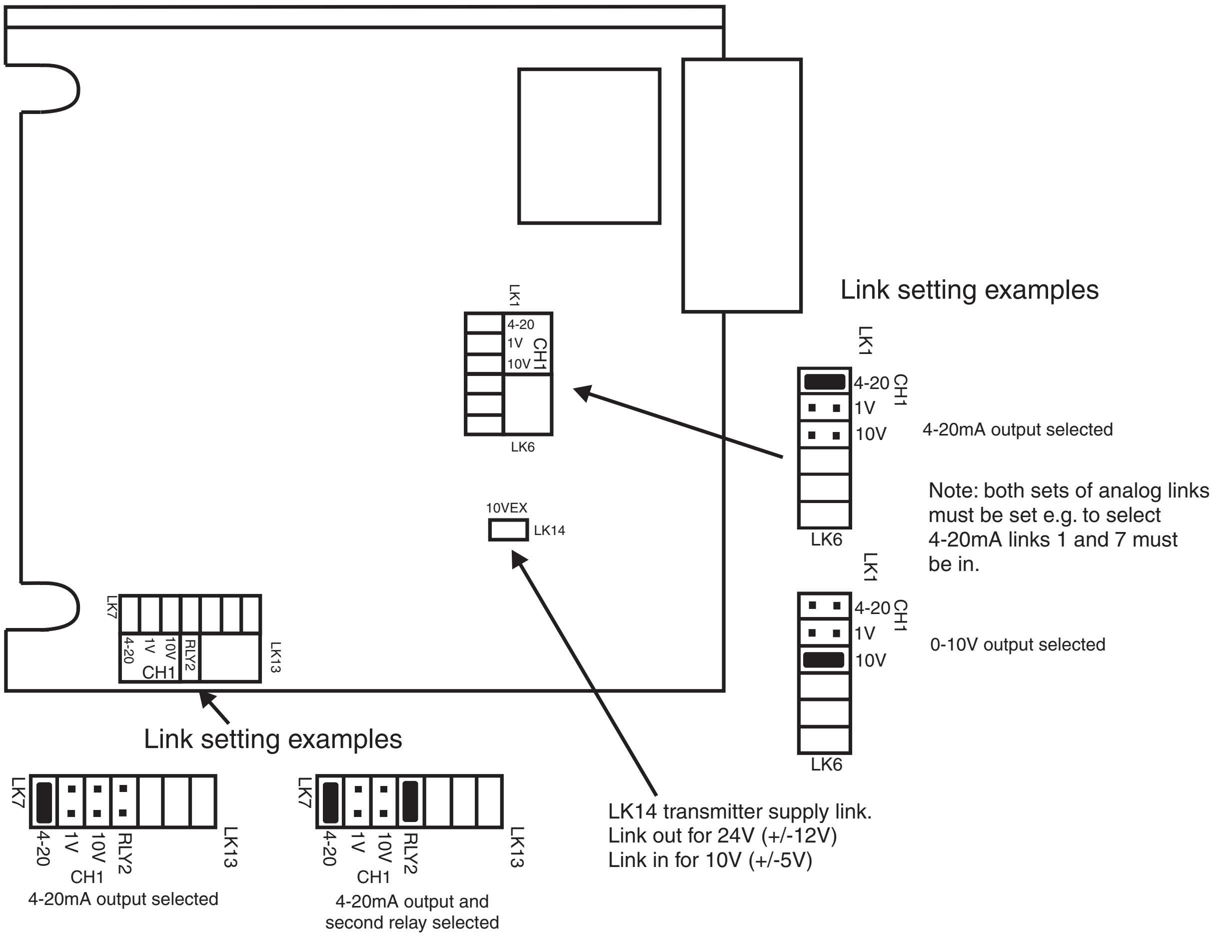
## 3.1 Electrical Connections

All electrical connections are at the rear of the instrument. The plug in screw connectors used allow for wire of up to 2.5mm$^2$. Connect across D and F for 24V or across E and F for 12V or across D and E for -12V. Refer to “Electrical Installation” chapter in the main PM4 manual for general information on electrical connections.



## 3.2 Configuring the output board

The 4-20mA output will drive into 800Ω load max. PCB links are fitted to the circuit board to provide data to the microprocessor and to connect the electronic components for the correct output types. It may be necessary to alter the PCB links to change the analog output or DC voltage output (see link settings below). See the "Input Output Configuration" section 1.1 for details on dismantling the instrument.



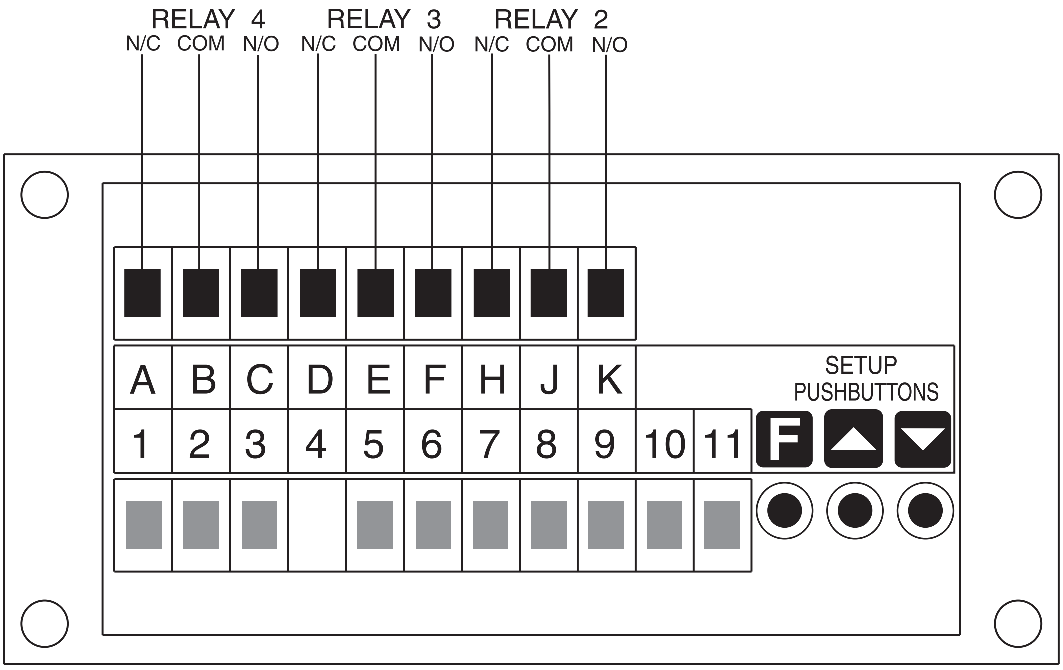
# 4 Three relay output option (-RRR option)

This chapter deals with the the three relay output option.

Components are factory fitted for the three relay operation. No links are required for the selection of the relay outputs. Relays are form C, rated at 240VAC, 5A resistive load. All relays will revert to the normally open (N/O) contacts being open circuit when power is removed.

## 4.1 Electrical Connections

All electrical connections are at the rear of the instrument. The plug in screw connectors used allow for wire of up to 2.5mm$^2$. Refer to "Electrical Installation" chapter in the main PM4 manual for general information on electrical connections.

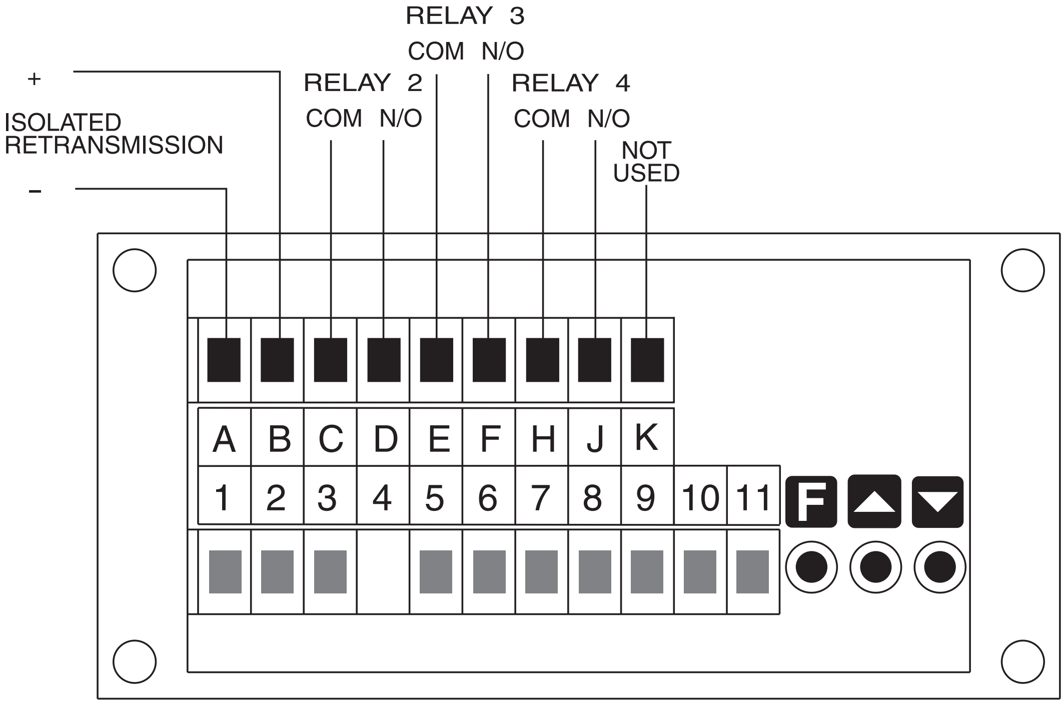


# 5 Three relay plus analog output option (-ARRR option)

This chapter deals with the the three relay plus isolated analog output option circuit board. Components are factory fitted for the option. Relays are form A, rated at 240VAC 5A resistive load. Links for selection of analog output type are as shown below. No link settings are required for the relays. All relays will revert to the normally open (N/O) contacts being open when power is removed.

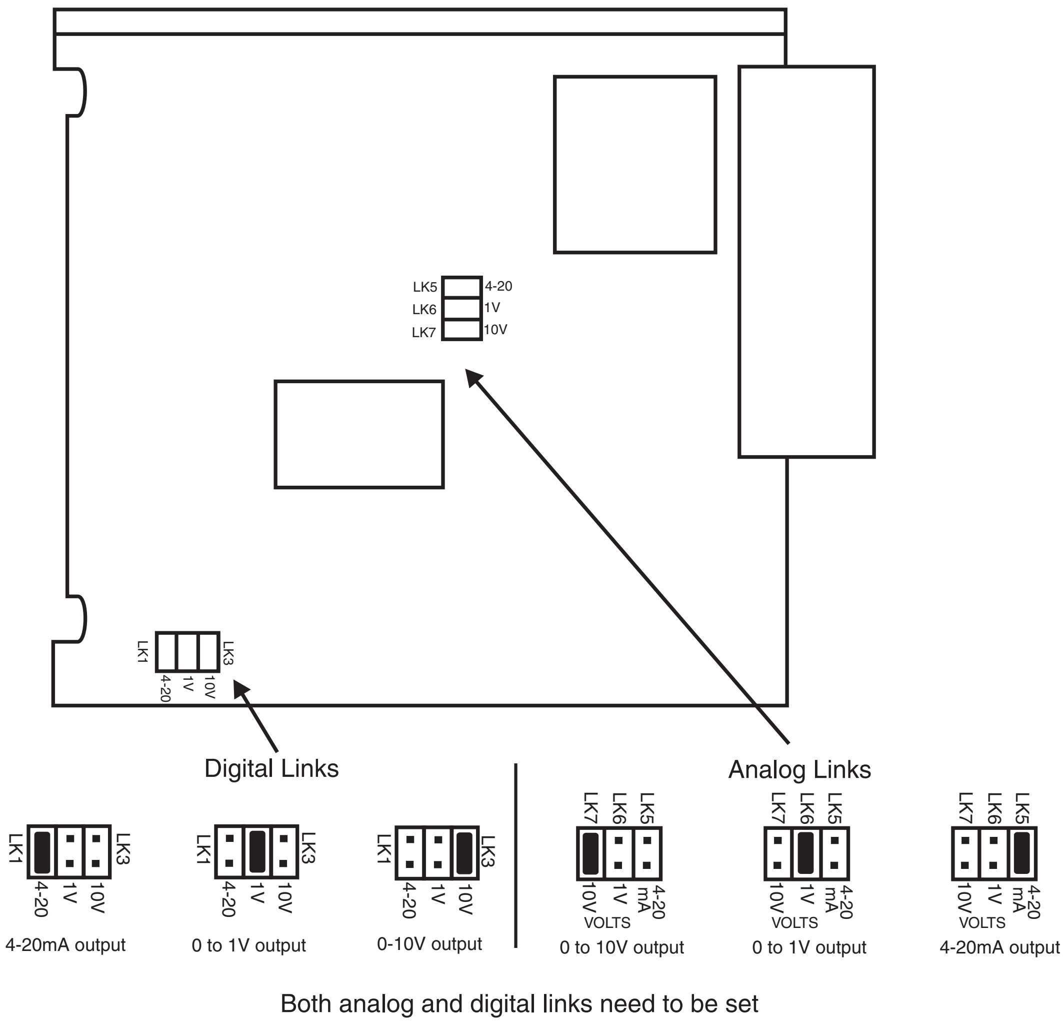
## 5.1 Electrical Connections

All electrical connections are at the rear of the instrument. The plug in screw connectors used allow for wire of up to 2.5mm$^2$. Refer to "Electrical Installation" chapter in the main PM4 manual for general information on electrical connections.



## 5.2 Configuring the output board

The output board for the -ARRR option has facilities for 4-20mA, 0-1V and 0-10V output and is factory supplied with all the necessary component for the output options required. The 4-20mA output will drive into 600Ω load max. PCB links are fitted to the circuit board to provide data to the microprocessor and to connect the electronic components for the correct output types. It may be necessary to alter the PCB links to change the output type (see link settings below). See the "Input Output Configuration" section 1.1 for details on dismantling the instrument.



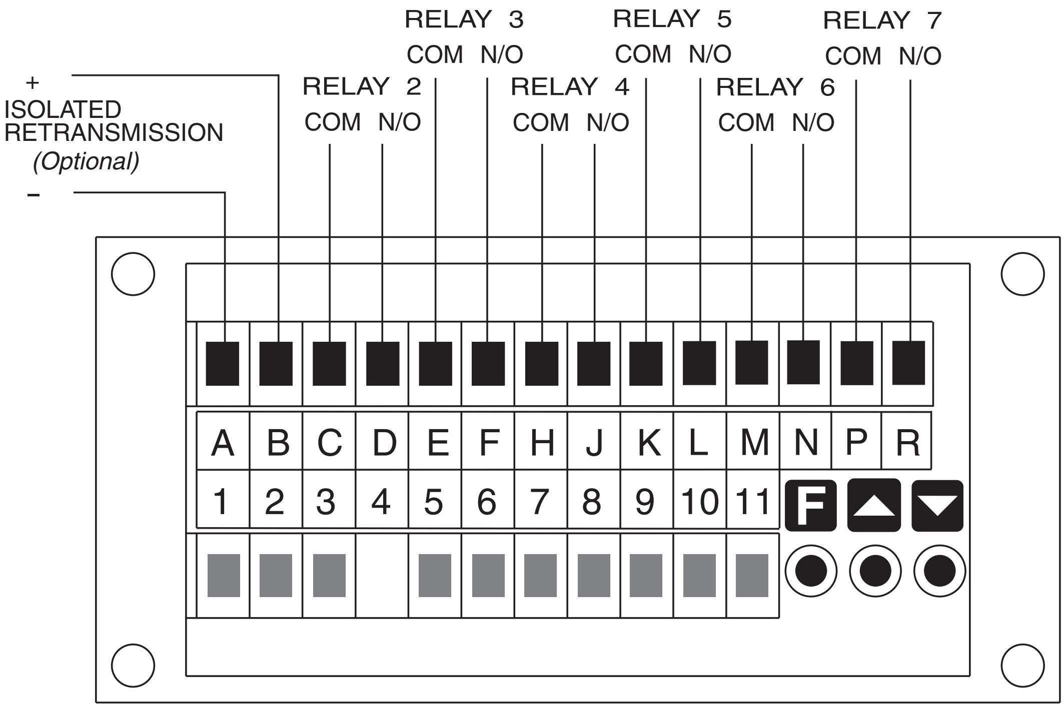
# 6 Six relay option (-R6 and -AR6 options)

The optional output board is factory supplied with the necessary components for the output options required. The last digits in the model number, which can be found at the bottom of the label on the instrument case, indicate the options fitted, option combinations available with this board are show in the table below. Relays are form A, rated 240VAC, 5A resistive load. All relays will revert to the normally open (N/O) contacts being open when power is removed.

| Option code | Options fitted to the board |
|---|---|
| -R6 | Six extra relays |
| -AR6 | Six extra relays plus isolated analog retransmission, link selectable 4-20mA, 0-1VDC or 0-10VDC |

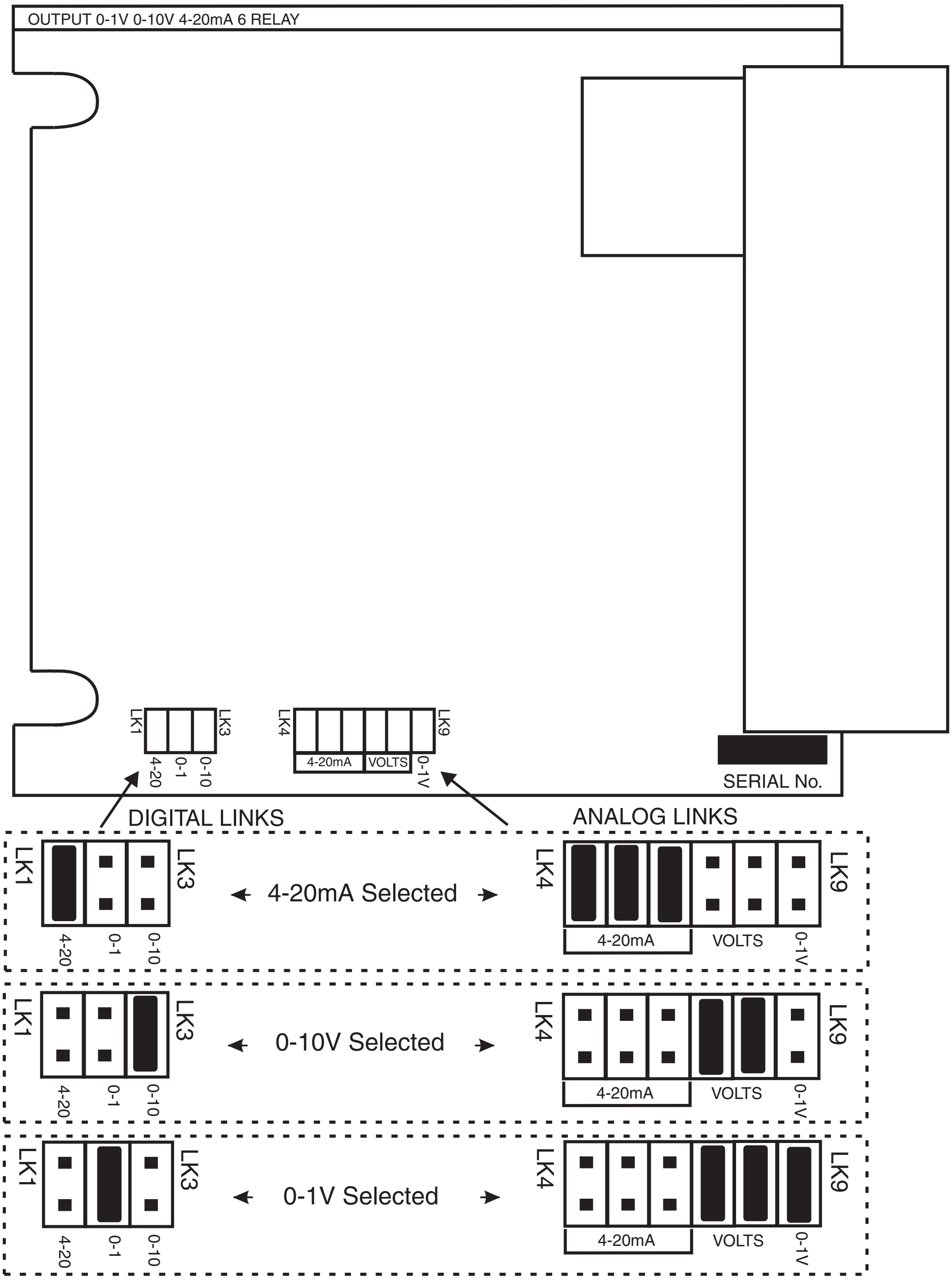
## 6.1 Electrical Connections

All electrical connections are at the rear of the instrument. The plug in screw connectors used allow for wire of up to 2.5mm$^2$. Refer to "Electrical Installation" chapter in the main PM4 manual for general information on electrical connections.



## 6.2 Configuring the output board

The 4-20mA output will drive into 600Ω load max. PCB links are fitted to the circuit board to provide data to the microprocessor and to connect the electronic components for the correct output types. It may be necessary to alter the PCB links to change the analog output or DC voltage output (see link settings below). See the "Input Output Configuration" section 1.1 for details on dismantling the instrument.



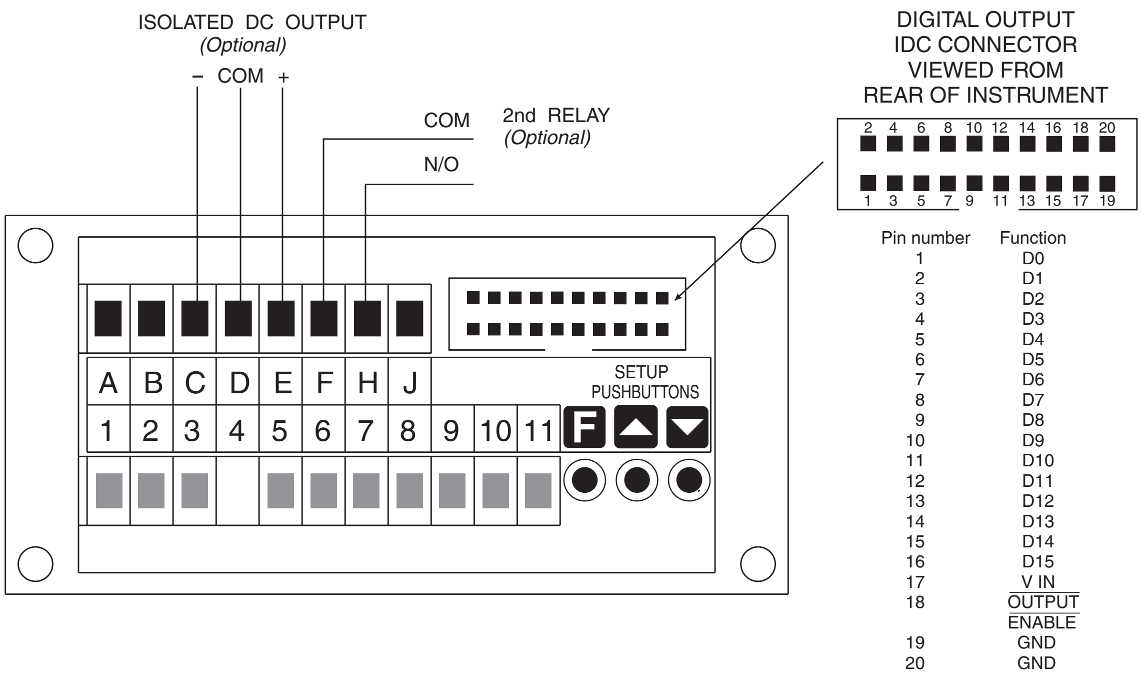
# 7 Binary/BCD output option (-DN, -DNR, -DN12, -DP, -DPR, -DP12 and -DPR12 options)

The optional output board is factory supplied with the necessary components for the output options required. The option board will be factory configured as either NPN or PNP output versions. The last digits in the model number which can be found at the bottom of the label on the instrument case indicate the options fitted, option combinations available with this board are show in the table below. Relays are form A, rated 240VAC 5A resistive. The relay will revert to the normally open (N/O) contact being open when power is removed.

| Option code | Options fitted to the board |
|---|---|
| -DN | Digital retransmission NPN, 16 bit user selectable as binary or BCD |
| -DNR | Digital retransmission NPN plus second relay |
| -DN12 | Digital retransmission NPN plus isolated DC supply 24VDC (12V) rated at 25mA max. |
| -DNR12 | Digital retransmission NPN plus second relay plus isolated DC supply. |
| -DP | Digital retransmission PNP, 16 bit user selectable as binary or BCD |
| -DPR | Digital retransmission PNP plus second relay |
| -DP12 | Digital retransmission PNP plus isolated DC supply 24VDC (12V) rated at 25mA max. |
| -DPR12 | Digital retransmission PNP plus second relay plus isolated DC supply. |

## 7.1 Electrical Connections

All electrical connections are at the rear of the instrument. The plug in screw connectors used allow for wire of up to 2.5mm$^2$ for relay and transmitter supply option wiring. An IDC connector is used for the NPN or PNP digital output. Refer to “Electrical Installation” chapter in the main PM4 manual for general information on electrical connections.



## 7.2 NPN digital isolated output

The NPN output board is provided with internal PCB links for selecting internal 5V or external V+ (5 to 50VDC) signal voltages and output continuously enabled or externally controlled. If the optional pull up resistors are not fitted the output requires an externally supplied 5VDC signal voltage on each of the output terminals used (D0 to D15). The signal voltages will be switched between 5V (or V+ via Link 5) and 0V by the output transistors Q0 to Q15. Unless otherwise ordered the links are factory set as follows:

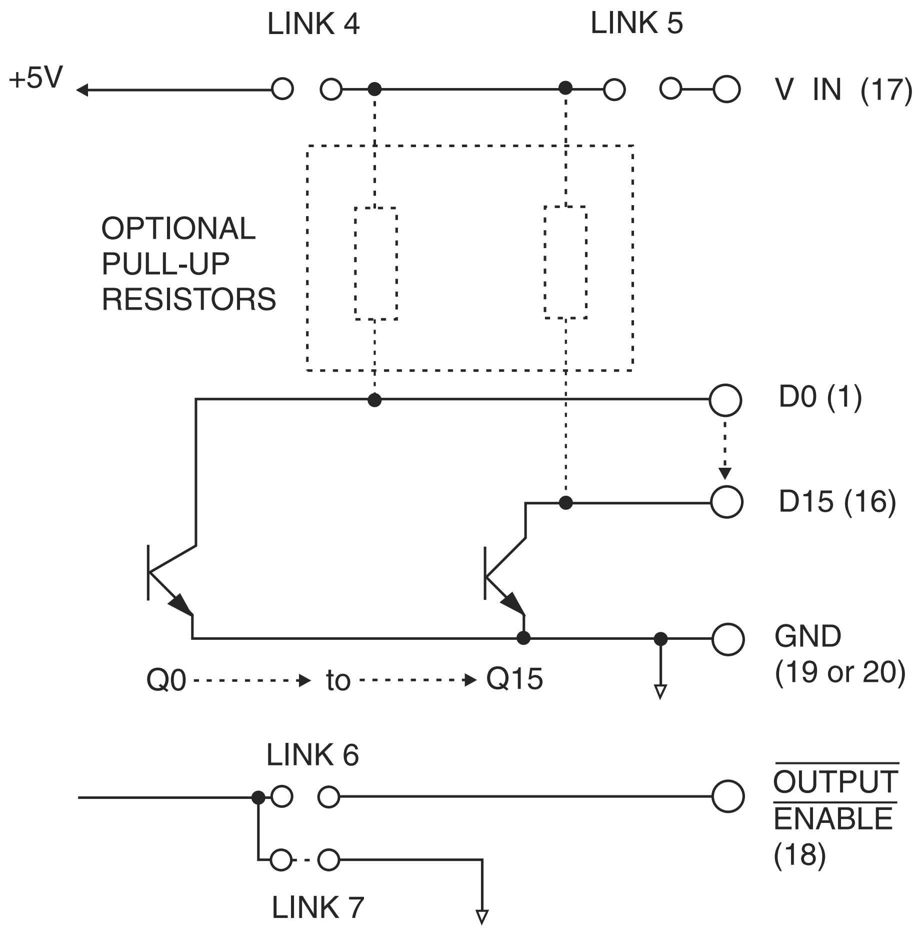
Link 4 OUT (when in Link 4 provides +5V output level via optional pull up resistors).

Link 5 OUT (when in Link 5 connects external V+ to the output via the optional pull up resistors).

Link 6 OUT (when in link 6 connects circuit for external control). Note: this input OUTPUT ENABLE is initiated by a TTL level, active low input. The chip has internal pull-up resistor fitted.

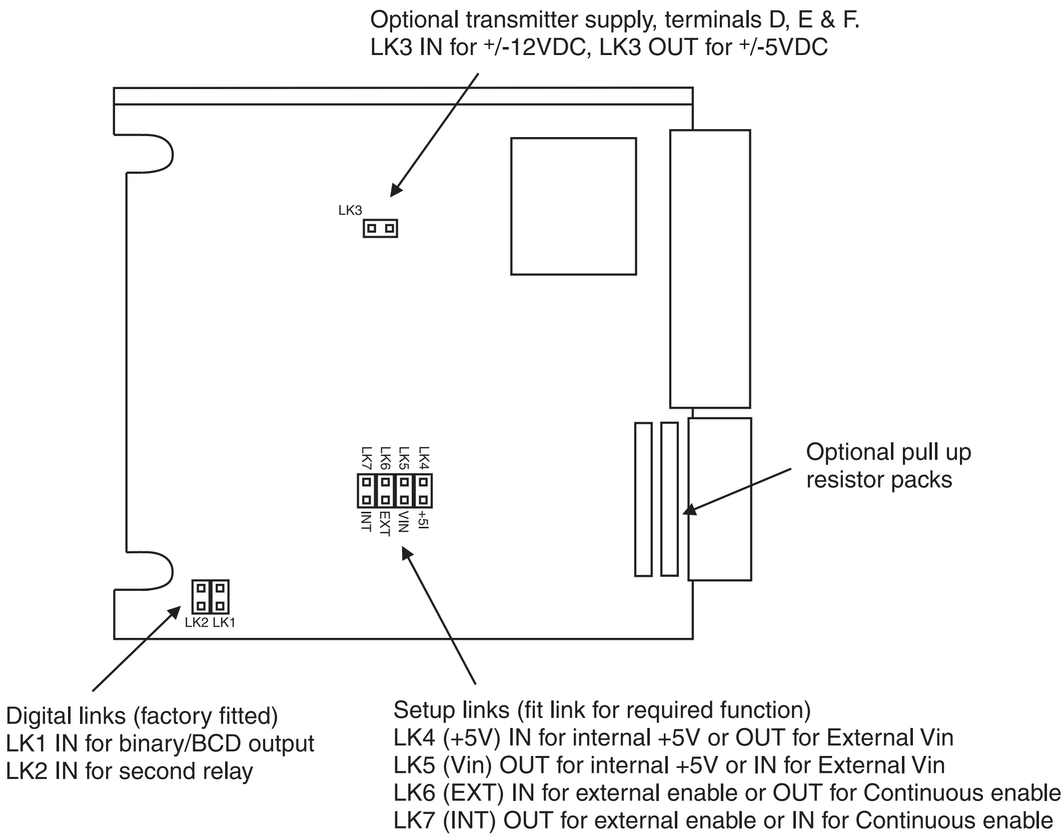
Link 7 IN (when in Link 7 sets circuit to continuous enable).

Notes: the maximum allowable V+ voltage is 50 volts, note this is dependant on the input resistance of the connected device. Link 4 or 5 is only required when the optional pull up resistors are fitted. Only one of these links should be fitted. The value of the pull up resistors depends on the voltage being switched and the input resistance of the connected device. Link 6 or Link 7 must be fitted, do not fit links to both Link 6 and Link 7.



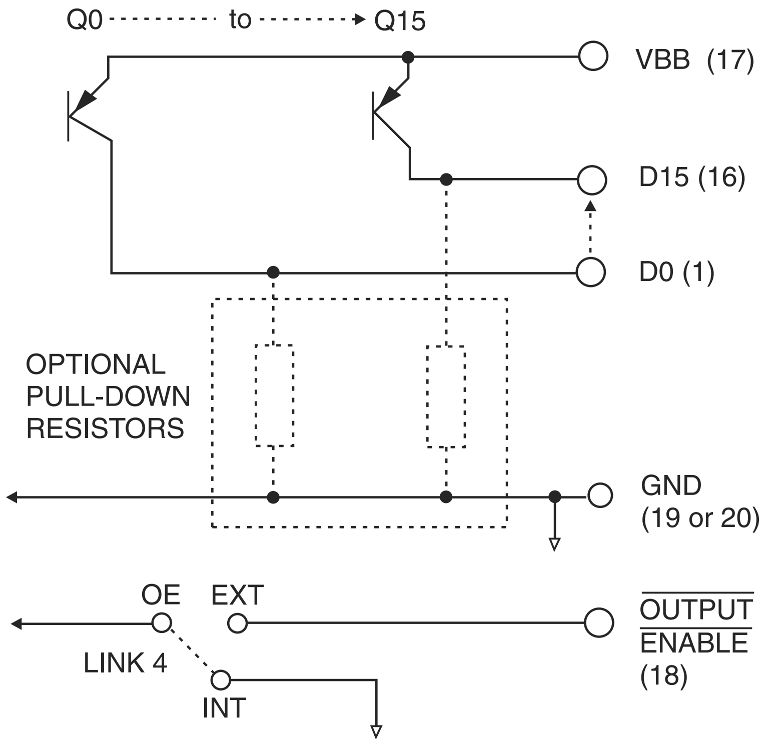
## 7.3 Configuring the NPN output board

The digital output board is factory supplied with the necessary components for the output options required. PCB links are fitted to the circuit board to provide data to the microprocessor and to connect the electronic components for the correct output types. It may be necessary to alter the PCB links to configure to you requirements (see drawing below). See the "Input Output Configuration" section 1.1 for details on dismantling the instrument. Optional plug-in pull-up resistors are available - these are factory fitted only if specified when ordered.



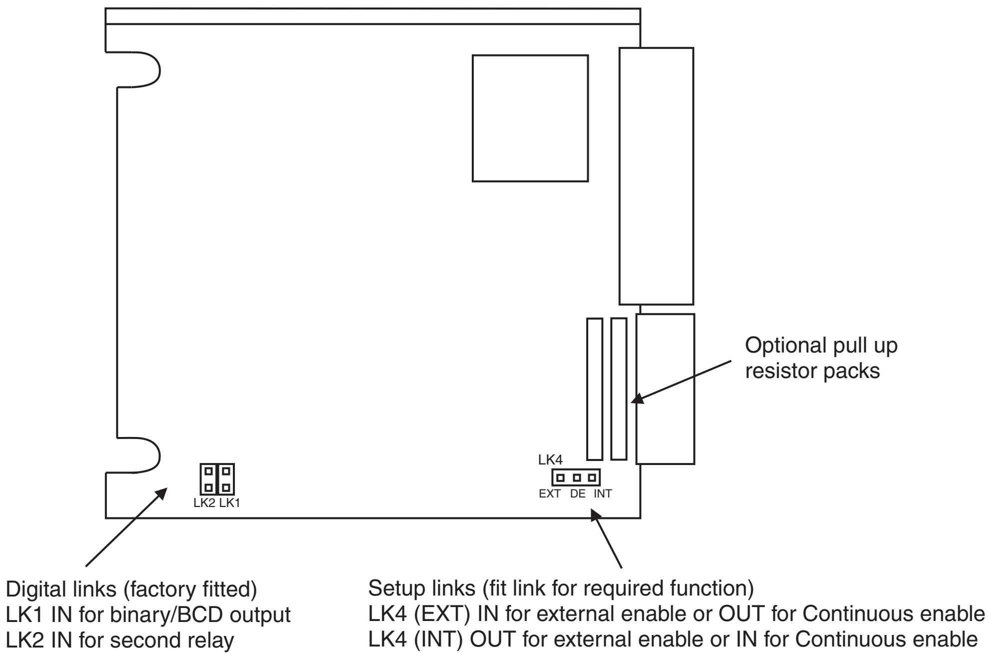

## 7.4 PNP digital isolated output

The PNP output board is provided with an internal PCB link selecting the output as continually enabled or externally controlled. Optional plug-in pull-down resistors are available - these are factory fitted only if specified when ordered. Unless otherwise ordered the links are factory set with Link 4 set between "OE" and "INT" (ground) i.e. set to continuous enable. To select for external control move the link to between "OE" and "EXT". Note: This input OUTPUT ENABLE is initiated by a TTL level - active low input. Note: External supply VBB required, 5VDC minimum to 50VDC maximum, note this is dependant on the input resistance of the connected device.




## 7.5 Configuring the PNP output board

The digital output board is factory supplied with the necessary components for the output options required. PCB links are fitted to the circuit board to provide data to the microprocessor and to connect the electronic components for the correct output types. It may be necessary to alter the PCB links to configure to you requirements (see drawing below). See the "Input Output Configuration" section 1.1 for details on dismantling the instrument. Optional plug-in pull-down resistors are available - these are factory fitted only if specified when ordered.



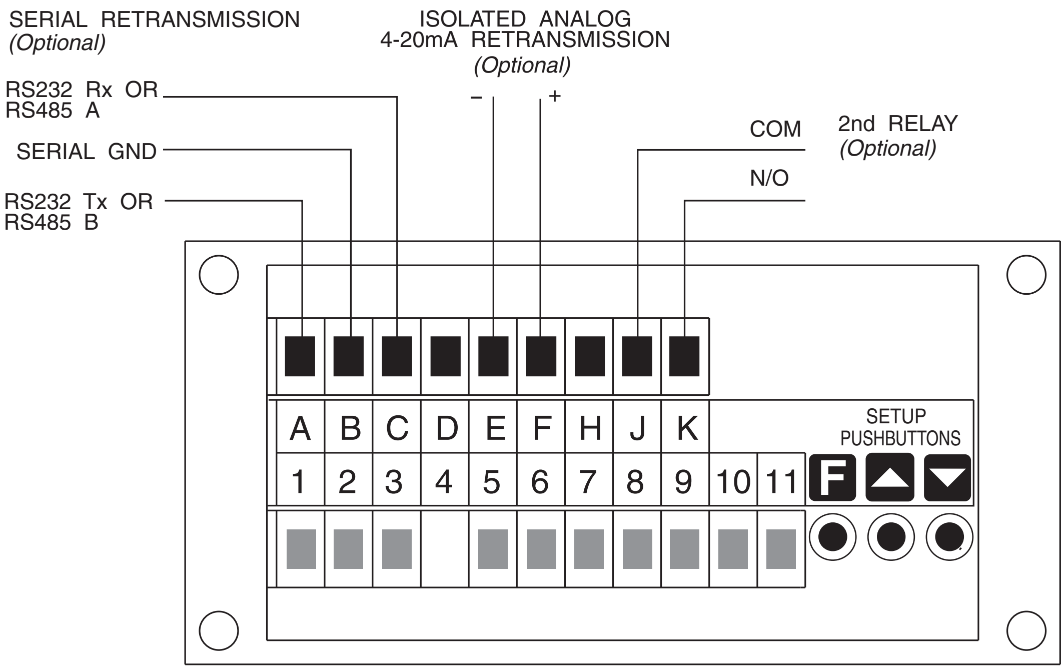
# 8 Serial and 4-20mA output option (-A2, -A2R, -A4 and -A4R options)

This addendum covers instruments with the isolated serial/isolated analog output board. This board allows output of either RS232 or RS485 plus 4 - 20mA plus a second relay. See “Configuring the output board” section which follows for link selection details. The last digits in the model number, which can be found at the bottom of the label on the instrument case, indicate the options fitted, option combinations available with this board are show in the table below. Note: Voltage output is not available with this board. Relays are form A, rated 240VAC, 5A resistive load. The relay will revert to the normally open (N/O) contact being open when power is removed.

| **Option code** | **Options fitted to the board** |
|---|---|
| -A2 | Isolated 4-20mA output plus isolated RS232 serial communication |
| -A2R | Isolated 4-20mA output plus isolated RS232 serial communication plus second relay |
| -A4 | Isolated 4-20mA output plus isolated RS485 serial communication |
| -A4R | Isolated 4-20mA output plus isolated RS485 serial communication plus second relay |

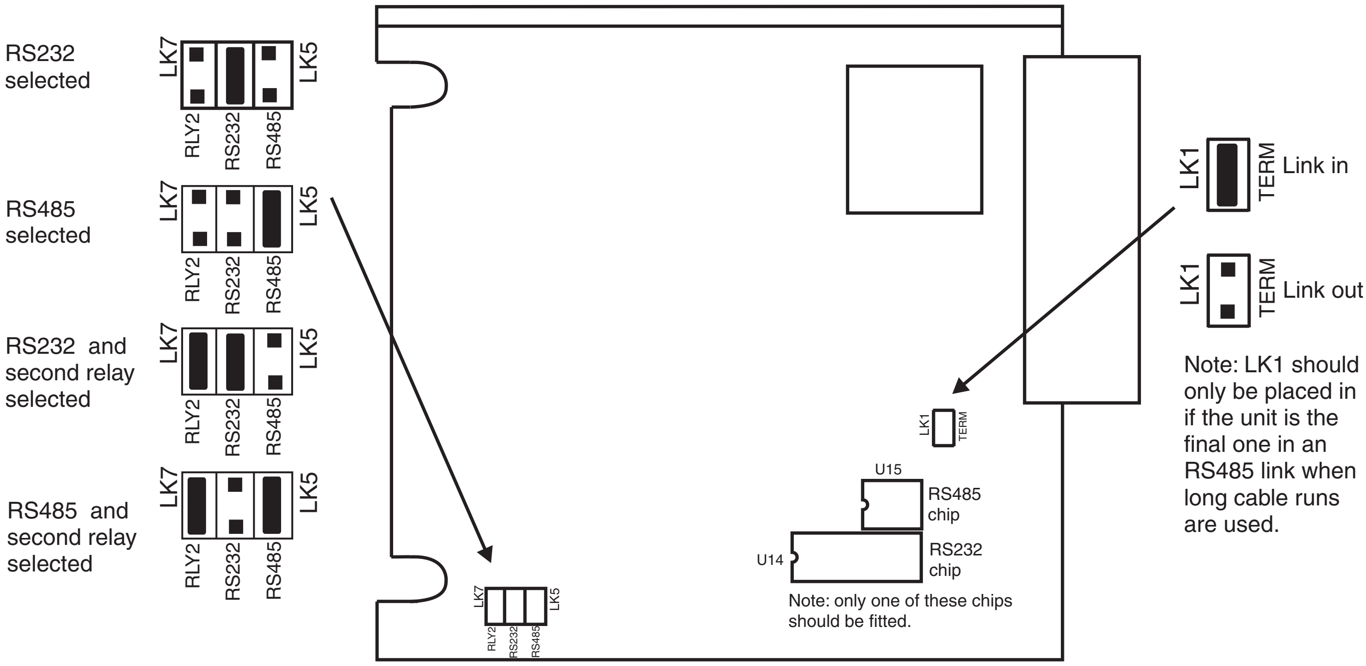
## 8.1 Electrical Connections

All electrical connections are at the rear of the instrument. The plug in screw connectors used allow for wire of up to 2.5mm$^2$. Refer to “Electrical Installation” chapter in the main PM4 manual for general information on electrical connections.



## 8.2 Configuring the output board

The PM4IS output board has facilities for RS232 or RS485 and 4-20mA output and a second relay and is factory supplied with all the necessary component for the output options ordered. PCB links are fitted to the circuit board to provide data to the microprocessor and to connect the electronic components for the correct output types. The 4-20mA output will drive into 800Ω load max. See the "Input Output Configuration" section 1.1 for details on dismantling the instrument. Note: links will only activate the option if that option was ordered and fitted e.g. fitting the "RLY2" link will only enable the second relay if this option was ordered and fitting the "RS485" link will not change the output from RS232 to RS485 unless the RS485 components are fitted and RS232 components removed.



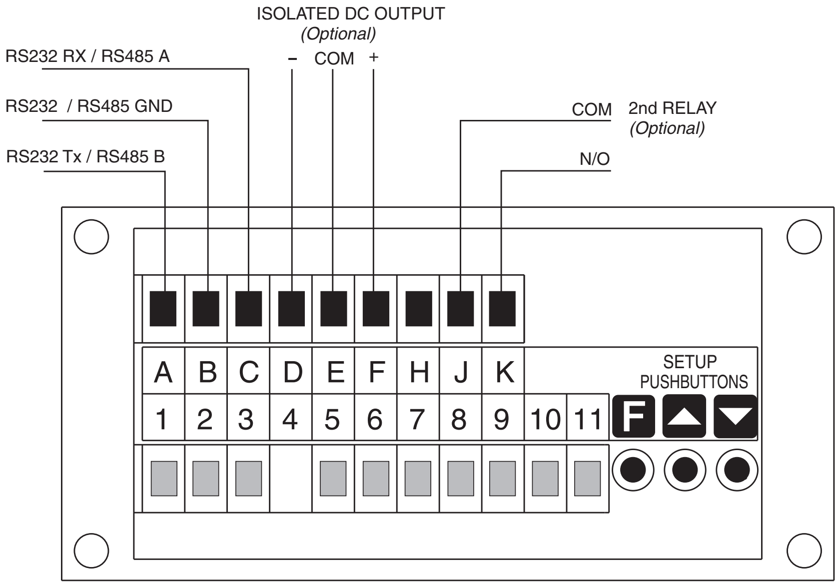
# 9 Serial, second relay & transmitter supply output option (-2, -4, -2R, -4R, -212, -412, -2R12 and -4R12 options)

The information provided in this section relates to PM4 panel meters with isolated RS232 or isolated RS485 outputs using the optional serial output/relay/transmitter supply board. Note: If the serial and 4-20mA output board has been fitted then the connection details below do not apply. Refer to the "Serial and 4-20mA output option" section 8 for connection details. Relays are form A, rated 240VAC, 5A resistive load. The relay will revert to the normally open (N/O) contact being open when power is removed.

| Option code | Options fitted to the board |
|---|---|
| -2 | Isolated RS232 serial communication |
| -4 | Isolated RS485 serial communication |
| -2R | Isolated RS232 serial communication and second relay |
| -4R | Isolated RS485 serial communication and second relay |
| -212 | Isolated RS232 serial communication and isolated transmitter supply |
| -412 | Isolated RS485 serial communication and isolated transmitter supply |
| -2R12 | Isolated RS232 serial communication and second relay and isolated transmitter supply |
| -4R12 | Isolated RS485 serial communication and second relay and isolated transmitter supply |

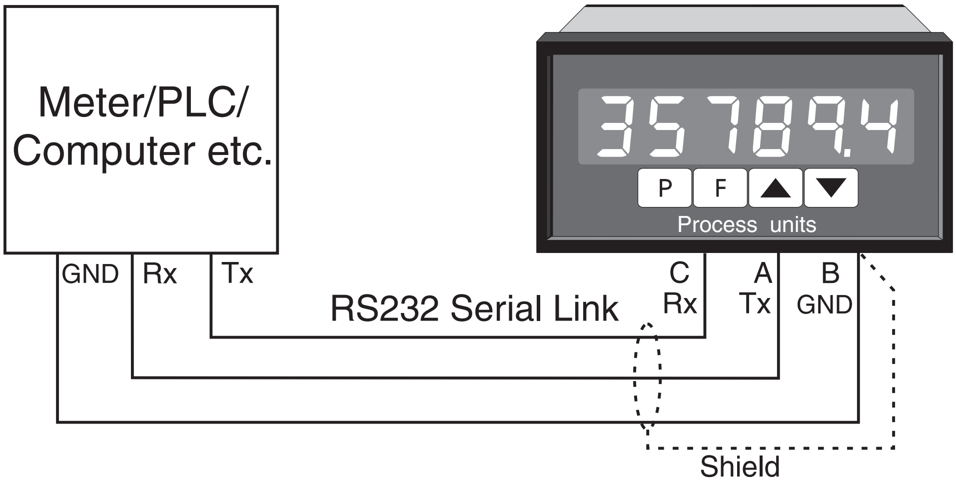
## 9.1 Electrical Connections

All electrical connections are at the rear of the instrument. The plug in screw connectors used allow for wire of up to 2.5mm$^2$. Refer to "Electrical Installation" chapter in the main PM4 manual for general information on electrical connections.



## 9.2 System interconnections - RS232 Communications

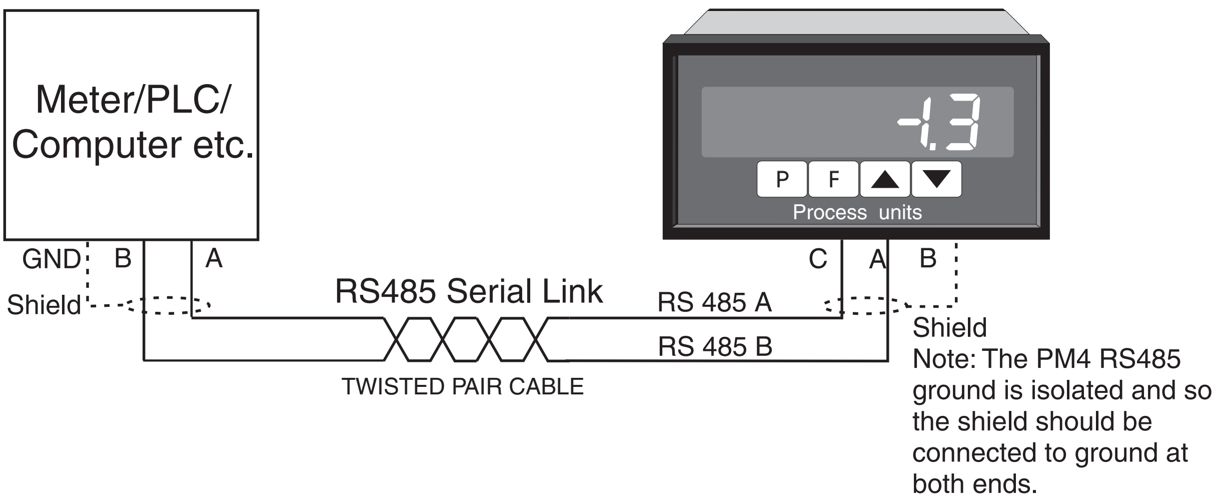
Use 3 core shielded cable for RS232 connections. RS232 connections generally have Rx at the PM4 connected to Tx at the PLC/Computer etc. and TX at the PM4 connected to Rx at the PLC/Computer etc. RS232 connections are usually rated to a maximum cable length of approximately 15 metres and are single ended in operation i.e. only one device can be connected to the PM4. An RS232 to RS485 converter may be used to increase the cable length and number of unit connections.




Note: If a serial plus analog retransmission board is used then the PM4 serial connections are: D Tx, E Gnd, F Rx

## 9.3 System interconnections - RS485 Connections

RS485 connections use shielded, twisted pair wires. RS485 is rated to a maximum cable length of approximately 1200 metres and will allow connection of up to 32 terminals on the serial link. For cable runs of longer than a few metres terminating resistors may be required across the A and B terminals to reduce the possibility of signal corruption due to line reflections. The terminating resistors are only required at the first and last units on the RS485 link.



# 10 Serial (RS232 and RS485) commands

The RS232/485 interface communication mode is user selectable at the **O.Put** function. The selections available at the **O.Put** function other than **m.buS** and **A.buS** are covered in this section of the addendum. Refer to "Modbus communication" section 11 for details of the **m.buS** mode. The **A.buS** mode is a special communications mode used only with the optional Windows live data and logging software option currently which is not available on all PM4 instruments. The **diSP**.**Cont** and **POLL** modes available operate as follows:-

## 10.1 diSP - Image display mode

This is a one way communications mode in which the display value on the instrument is sent via RS232 or RS485 as raw data in the following format:

<ESC>IXYYYY

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

This information is output every display update (typically approx. 4 times per second). The number of image bytes sent depends on the number of display digits present. This mode is suitable only when the receiving unit is produced by the same manufacturer as the PM4. The most common usage would be to provide slave displays for the measuring instrument. The slave displays would automatically detect the image mode data and display the correct value accordingly. The data is in seven segment display image i.e. Bit 0 is segment A, Bit 1 is segment B etc.

## 10.2 Cont - Continuous output mode

In this mode the display value is continually sent via the RS232/485 interface in ASCII format with 8 data bits + 1 stop bit. Data will be updated at slightly less than the sample rate for the instrument being used. Note: some instruments have a function named **SErL** which allows special selection of **Cont** output e.g. peak held value in continuous mode, check this function setting and the instruction manual for the instrument to determine the output if this function is fitted. The standard format for **Cont** mode is as follows:-

<STX>XYYYY<CR>

| | | |
|---|---|---|
| Where | <STX> | is the ASCII Start of text character (2 Dec., 02 Hex.) |
| | X | is an ASCII Space character (32 Dec., 20 Hex.) for a positive value or |
| | X | is the ASCII character "-" (45 Dec., 2D Hex) for a negative value |
| | YYYY | is the display value in ASCII (number of digits depends on number of display digits e.g. 4 digits plus decimal point, if used, for a 4 digit display) |
| | <CR> | is the ASCII Carriage return character (13 Dec., 0D Hex.) |

e.g.: If the display is showing 123456 then the instrument will send 02 31 32 33 34 35 36 0D (HEX) to the host. The table below shows the outputs for instruments with more than one possible display value.

| Model | **Continuous output** Note decimal points will also be sent if displayed |
|---|---|
| PM4-2CO | <STX>WWWWWW,YYYYYY,XZZZZZZ<CR> where:<br>WWWWWW is the channel 1 value (up to 6 characters/spaces)<br>YYYYYY is the channel 2 value (up to 6 characters/spaces)<br>"," is a comma (44 dec, 2C hex)<br>X is a space for positive value or "-" sign<br>ZZZZZZ is the temperature value (up to 6 characters/spaces) |
| PM4-CO | <STX>YYYYYY,XZZZZZZ<CR> where:<br>YYYYYY is the measured value e.g. conductivity (up to 6 characters/spaces)<br>"," is a comma (44 dec, 2C hex)<br>X is a space or "-" sign<br>ZZZZZZ is the temperature value (up to 6 characters/spaces) |
| PM4-IV3 | **In arithmetic mode:** <STX>XUUUU, XVVVV,XWWWW,XZZZZ<CR><br>Where: X can be a number, space or"-" sign i.e. number range available is -9999 to 99999<br>UUUU is the arithmetic result<br>VVVV is channel 1 value<br>WWWW is channel 2 value<br>ZZZZ is channel 3 value<br>**In scan mode:** <STX> XVVVV,XWWWW,XZZZZ<CR><br>Where: X can be a number, space or "-" sign i.e. number range available is -9999 to 99999<br>VVVV is channel 1 value<br>WWWW is channel 2 value<br>ZZZZ is channel 3 value |
| PM4-IVT | With **SErL** function set to **LivE**: <STX>XYYYYYY<CR> where:<br>X is a space or "-" sign<br>YYYYYY is the rate value (up to 6 characters/spaces)<br>With **SErL** function set to **totL**: <STX>XZZZZZZ<CR> where:<br>X is a space or "-" sign<br>ZZZZZZ is the total value (up to 6 characters/spaces)<br>With **SErL** function set to **diSP** the value displayed at the time i.e. total or rate value will be transmitted in the formats desribed above.<br>With **SErL** function set to **both**: <STX>XYYYYYY,XZZZZZZ<CR> where:<br>X is a space or "-" sign<br>YYYYYY is the rate value (up to 6 characters/spaces),ZZZZZZ is the total value (up to 6 characters/spaces) |
| PM4-LN2 | **In arithmetic mode:** <STX>XUUUU,XVVVV,XWWWW <CR><br>Where: X can be a number, space or"-" sign i.e. number range available is -9999 to 99999<br>UUUU is the arithmetic result<br>VVVV is channel 1 value<br>WWWW is channel 2 value<br>**In scan mode:** <STX> XVVVV,XWWWW<CR><br>Where: X can be a number, space or "-" sign i.e. number range available is -9999 to 99999<br>VVVV is channel 1 value<br>WWWW is channel 2 value |

| | |
|---|---|
| PM4-PH | <STX>XYYYYYY<CR> where:<br>X is a space or “-” sign<br>YYYYYY is the pH or Redox (ORP) value (up to 6 characters/spaces)<br>Note: temperature value is not transmitted in this mode. |
| PM4-RS | Arithmetic, Scan or CS mode <STX>XUUUUUUUU, XVVVVVVVV, XWWWWWWWW, XZZZZZZZZ etc up to 8 channels <CR> where:<br>X is a space or “-” sign<br>NMEA mode <STX>UUUUUUUU <CR> where:<br>UUUUUUUU is wind direction |
| PM4-RT8 | <STX>XUUUUUU, XVVVVVV,XWWWWWW,XZZZZZZ etc up to 8 channels <CR> where:<br>X is a space or “-” sign<br>UUUUUU is channel 1 temperature, VVVVVVV is channel 2 temperature etc. |
| PM4-TR or PM4-QC | Rate mode: <STX>XYYYYYY<CR> where:<br>X is a space or “-” sign<br>YYYYYY is the rate value (up to 6 characters/spaces)<br>Total mode: <STX>XZZZZZZ<CR> where:<br>X is a space or “-” sign<br>ZZZZZZ is the total value (up to 6 characters/spaces)<br>Both mode (rate/total): < STX>XYYYYYY,XZZZZZZ<CR> where:<br>X is a space or “-” sign<br>YYYYYY is the rate value (up to 6 characters/spaces)<br>“,” is a comma (44 dec, 2C hex)<br>ZZZZZZ is the total value (up to 6 characters/spaces) |

## 10.3 POLL - Host Controlled Transmit Mode

This mode requires a host computer or PLC to poll the instrument to obtain display or other information or reset various setpoint parameters. Terminal communications software is required when using POLL mode with a PC. Data is in ASCII format with 8 data bits + 1 stop bit. Addresses are offset by 32 Dec. i.e. address 1 is 33 Dec. When polling the PM4 it is essential that the command characters are sent with less than a 10mS delay between them. This normally means that each command line must be sent as a whole string e.g. <STX>PA<CR> is sent as one string rather than <STX> on one line followed by P etc. If testing using at terminal program this is normally achieved by allocating a command string to a function key. Whenever the function key is operated the whole string is sent. The format used is ASCII (8 data bits + 1 stop bit) so, for instance, if address 1 is used then the string <STX>PA<CR> must be put into the terminal program as:

∧BP!∧M

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

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

| | |
|---|---|
| <STX>CA<CR> | (Standard read etc.) |
| <STX>CA<CR>N<CR>XYYYY | (Set Value Command) |

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

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

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

e.g. ∧BP!∧M using a terminal program (address 1). Instructs unit to return the primary display value. The primary value is the main reading.
Format of returned data is:

<ACK>PAXYYYY<CR>

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

The number of display characters returned depends on the number of display digits present. If the decimal point is non zero then it will be sent in the appropriate place as "." (46 Dec, 2E Hex). The primary display for most instruments is the main reading, in some instruments the main reading may not be obvious, for those instruments the primary display value is shown in the table below.

| **Model** | **Primary display value** |
|---|---|
| PM4-2CO | Channel 1 value |
| PM4-IV3 | Channel 0 (result) in **ArtH** mode<br>Use <STX>1A<CR> or <STX>2A<CR> or <STX>3A<CR> to poll for channels 1, 2 and 3 respectively in either **ArtH** or **SCAN** mode operation<br>Use <STX>QA<CR> to poll for all channels. The format of returned data will be the same as that sent in continuous cont mode (see previous section) |
| PM4-LN2 | Channel 0 (result) in **ArtH** mode<br>Use <STX>1A<CR> or <STX>2A<CR> to poll for channels 1 and 2 respectively in either **ArtH** or **SCAN** mode operation<br>Use <STX>QA<CR> to poll for all channels. The format of returned data will be the same as that sent in continuous cont mode (see previous section) |
| PM4-IVT | Rate value |
| PM4-LN | Linearised value from table |
| PM4-LNT | Linearised Rate value |
| PM4-RT8 | Highest channel value is returned when <STX>PA<CR>. Individual channels can be polled using channel number instead of "P" e.g. <STX>3A<CR> will return channel 3 value |
| PM4-TR and PM4-QC | Total in **totl** mode, rate in both **rAtE** and **both** modes |

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

e.g. ∧BS!∧M using a terminal program (address 1). Instructs unit to return the secondary display value. If no secondary display value is used the instrument will return the primary display value. Format of returned data is:

<ACK>SAXYYYY<CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | S | echo command received "S" (83 Dec, 53 Hex) |
| | A | is the responding units address |
| | X | SPACE for positive and "-" for negative |
| | YYYY | is the display value in ASCII |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

The number of display characters returned depends on the number of display digits present. If the decimal point is non zero then it will be sent in the appropriate place as "." (46 Dec, 2E Hex). The secondary display value, for instruments using a second display value rather than repeating the primary display value or returning the special function value, is shown in the table below.

| Model | Secondary display value |
|---|---|
| PM4-C0 | Temperature value |
| PM4-2C0 | Temperature value |
| PM4-IVT | Total value |
| PM4-LNT | Total value |
| PM4-RTC | Returns the number of seconds elapsed since midnight |
| PM4-RT8 | Lowest channel value is returned |
| PM4-TR and PM4-QC | Total in both mode |
| Other PM4's | Returns primary display value or remote input special function value |

**3. Transmit Tertiary Display Value:** <STX>TA<CR>

e.g. ∧BT!∧M using a terminal program (address 1). Instructs unit to return the tertiary display value. If no tertiary display value is used the instrument will return an invalid command character "?".
Format of returned data is:

<ACK>TAXYYYY<CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | T | is the echo command received "S" (84 Dec, 54 Hex) |
| | A | is the responding units address |
| | X | SPACE for positive and "-" for negative |
| | YYYY | is the display value in ASCII |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

The number of display characters returned depends on the number of display digits present. If the decimal point is non zero then it will be sent in the appropriate place as "." (46 Dec, 2E Hex). The tertiary display value, for instruments using a tertiary display value, is shown in the table below.

| Model | Tertiary display value |
|---|---|
| PM4-2C0 | Channel 2 value |
| PM4-IVT | Total value |
| PM4-LN | Input (INPt) value if linearising table is on |
| PM4-LNT | Input (INPt) value if linearising table is on |
| PM4-RT8 | Average of all channels value is returned Maximum difference between channels can be obtained using <STX>QA<CR> |
| PM4-PH | Temperature value |
| Other PM4's | Returns invalid command "?" character |

**4. Reset Special Function Value:** <STX>RA<CR>

e.g. ∧BR"∧M using a terminal program (address 2). Instructs the unit to reset the remote input function value if applicable. For example the ZErO remote input function (r.INP) can be used to reset the total or zero the display via the serial link i.e. with r.INP set to ZErO a <STX>RA<CR> command sent to the instrument via the serial line will cause the display to zero.
Format of returned data is:-

<ACK>RA<CR>

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

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

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

e.g. ∧BL"∧M2∧M to read alarm 2 low setpoint value using a terminal program (address 2). Instructs the unit to return the low alarm setpoint value of the relay requested by the N character. i.e. when this command is sent the PM4 will return the alarm low setpoint value. The alarm value can be altered if required via the "Set low alarm setpoint" command which follows.
Format of returned data is:

<ACK>LANXYYYY<CR>

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

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

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

e.g. ∧BH*∧M1∧M to read alarm 1 high setpoint value using a terminal program (address 10). Instructs the unit to return the high alarm setpoint value of the relay requested by the N character. i.e. when this command is sent the PM4 will return the alarm high setpoint value. The alarm value can be altered if required via the "Set high alarm setpoint" command which follows.

Format of returned data is:

<ACK>HANXYYYY<CR>

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

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

**7. Set Low Alarm Setpoint:** <STX>lA<CR>N<CR>YYYY<CR>

e.g. ∧Bl!∧M1∧M500∧M to set alarm 1 low setpoint to 500 using a terminal program (address 1). Instructs unit to change value of low alarm setpoint of the relay selected by the N character. The alarm value can be examined if required via the "Read low alarm setpoint" command which has been described previously.
Format of returned data is:-

<ACK>lANXYYYY<R>

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

If setpoint number specified is not present the return string will have the setpoint number set to zero (i.e.: <ACK>lA0XYYYY).

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

e.g. ∧Bh!∧M1∧M1000∧M to set alarm 1 high setpoint to 1000 using a terminal program (address 1). Instructs unit to change value of high alarm setpoint of the relay selected by the N character. The alarm value can be examined if required via the "Read high alarm setpoint" command which has been described previously.
Format of returned data is:-

<ACK>hANXYYYY<CR>

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

If setpoint number specified is not present the return string will have the setpoint number set to zero (i.e.: <ACK>hA0XYYYY).

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

e.g. ∧BI!∧M using a terminal program (address 1) Instructs unit to return the model and software version number of the instrument.
Format of returned data is:-

<ACK>IACCX.X<CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | I | is echo command received “I” (73 Dec, 49 Hex) |
| | A | is the responding units address |
| | CC | is a 2 character model identifier (e.g.: tr) |
| | X.X | is the version number (e.g..: “0.1”) |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

**10. Invalid Command**

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

<ACK>?A<CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | ? | is the character “?” (63 Dec, 3F Hex) |
| | A | is the responding units address |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

If the address received from the host does not match the units address then the unit will not respond at all. Other commands may be added to suit the particular configuration of each instrument. Value read commands will have the same format as the “Transmit Primary Value” command. Set Value commands will have the same format as the “Set Low Alarm Setpoint” command etc.

## 10.4 Functions applicable to model PM4-WT only

The serial commands which follow are available for use with model PM4-WT only

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

e.g. ∧BT!∧M using a terminal program (address 1). Instructs the unit to tare the instrument using the current display value (if tare has been selected in special functions mode).
Format of returned data is:-

<ACK>TA<CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | T | is echo command received “T” (84 Dec, 54 Hex) |
| | A | is the responding units address |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

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

**B. Read Default Calibration Channel:** <STX>CA<CR>

e.g. ∧BC!∧M using a terminal program (address 1) This command reads the default calibration channel. If the external inputs or the P button are configured to change the calibration channel selection then the channel used for the actual gain may not be the default calibration channel. If

using the serial interface to change the default calibration channels then the P button or external input settings should not be set to C.SEL.
Format of returned data is:-

<ACK>CA<channel number> <CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | C | is echo command received “C” (67 Dec, 43 Hex) |
| | A | is the responding units address |
| | channel number | is the channel number 1 or 2 |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

**C. Set Default Calibration Channel:** <STX>cA<CR> <channel number> <CR>

e.g. ∧Bc!∧M2∧M to set default channel to 2 using a terminal program (address 1). This command sets the default calibration channel. If the external inputs or the P button are configured to change the calibration channel selection then the channel used for the actual gain may not be the default calibration channel. If using the serial interface to change the default calibration channels then the P button or external input settings should not be set to CAL.S.
Format of returned data is:-

<ACK>cA<channel number> <CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | c | is echo command received “c” (99 Dec, 63 Hex) |
| | A | is the responding units address |
| | channel number | is the channel number 1 or 2 |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

**D. Read ADC Calibration Gain:** <STX>GA<CR>

e.g. ∧BG”∧M using a terminal program (address 2).

This is set for the default calibration channel. If the external inputs or the P button are configured to change the calibration channel selection then the channel used for the actual gain may not be the default calibration channel. If using the serial interface to change the default calibration channels then the P button or external input settings should not be set to CAL.S. Note: The gain reading is only valid on the actual instrument it is read from and may give errors if used with other instrument. Format of returned data is:-

<ACK>GA<adc gain> <CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | G | is echo command received “G” (71 Dec, 47 Hex) |
| | A | is the responding units address |
| | adc gain | is the adc gain as a floating point number |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

**E. Set ADC Calibration Gain:** <STX>gA<CR> <adc gain> <CR>

e.g. ∧Bg”∧M0.0002134∧M using a terminal program (address 2). This is set for the default calibration channel. If the external inputs or the P button are configured to change the calibration channel selection then the channel used for the actual gain may not be the default calibration channel. If using the serial interface to change the default calibration channels then the P button or external input settings should not be set to CAL.S. Note: The value returned may not be exactly the same as the number sent. The internal floating point accuracy is only to around 24 bits and some rounding in the last digits may occur.
Format of returned data is:-

<ACK>gA<adc gain> <CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | g | is the echo command received “g” (103 Dec, 67 Hex) |
| | A | is the responding units address |
| | adc gain | is the adc gain as a floating point number |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

**F. Read ADC Zero Offset:** <STX>ZA<CR>

e.g. ∧BZ!∧M using a terminal program (address 1). This is set for the default calibration channel. If the external inputs or the **P** button are configured to change the calibration channel selection then the channel used for the actual gain may not be the default calibration channel. If using the serial interface to change the default calibration channels then the **P** button or external input settings should not be set to **CAL.S**.
Format of returned data is:-

<ACK>ZA<adc zero> <CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | Z | is the echo command received “Z” (90 Dec, 5A Hex) |
| | A | is the responding units address |
| | adc zero | is the adc gain as a floating point number |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

**G. Set ADC Calibration Zero:** <STX>zA<CR><adc zero> <CR>

e.g. ∧Bz!∧M-00120.321∧M using a terminal program (address 1). This is set for the default calibration channel. If the external inputs or the **P** button are configured to change the calibration channel selection then the channel used for the actual gain may not be the default calibration channel. If using the serial interface to change the default calibration channels then the **P** button or external input settings should not be set to **CAL.S**. Note: The value returned may not be exactly the same as the number sent. The internal floating point accuracy is only to around 24 bits and some rounding in the last digits may occur.
Format of returned data is:-

<ACK>zA<adc zero> <CR>

| | | |
|---|---|---|
| Where: | <ACK> | is Acknowledge (6 Dec, 06 Hex) |
| | z | is the echo command received “z” (122 Dec, 7A Hex) |
| | A | is the responding units address |
| | adc zero | is the adc gain as a floating point number |
| | <CR> | is a Carriage Return (13 Dec, 0D Hex) |

**Host Timing Requirements for RS485 Operation:**

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

## 10.5 ASCII Code Conversion Listing

ASCII for control characters is shown in brackets. e.g. STX may in some cases be entered as ∧B.

| ASCII char. | Decimal | Hex | ASCII char. | Decimal | Hex | ASCII char. | Decimal | Hex |
|---|---|---|---|---|---|---|---|---|
| NUL (∧@) | 00 | 00 | + | 43 | 2B | V | 86 | 56 |
| SOH (∧A) | 01 | 01 | , | 44 | 2C | W | 87 | 57 |
| STX (∧B) | 02 | 02 | - | 45 | 2D | X | 88 | 58 |
| ETX (∧C) | 03 | 03 | . | 46 | 2E | Y | 89 | 59 |
| EOT (∧D) | 04 | 04 | / | 47 | 2F | Z | 90 | 5A |
| ENQ (∧E) | 05 | 05 | 0 | 48 | 30 | [ | 91 | 5B |
| ACK (∧F) | 06 | 06 | 1 | 49 | 31 | \ | 92 | 5C |
| BEL (∧G) | 07 | 07 | 2 | 50 | 32 | ] | 93 | 5D |
| BS (∧H) | 08 | 08 | 3 | 51 | 33 | ∧ | 94 | 5E |
| HT (∧I) | 09 | 09 | 4 | 52 | 34 | _ | 95 | 5F |
| LF (∧J) | 10 | 0A | 5 | 53 | 35 | ‘ | 96 | 60 |
| VT (∧K) | 11 | 0B | 6 | 54 | 36 | a | 97 | 61 |
| FF (∧L) | 12 | 0C | 7 | 55 | 37 | b | 98 | 62 |
| CR (∧M) | 13 | 0D | 8 | 56 | 38 | c | 99 | 63 |
| SO (∧N) | 14 | 0E | 9 | 57 | 39 | d | 100 | 64 |
| SI (∧O) | 15 | 0F | : | 58 | 3A | e | 101 | 65 |
| DLE (∧P) | 16 | 10 | ; | 59 | 3B | f | 102 | 66 |
| DC1 (∧Q) | 17 | 11 | < | 60 | 3C | g | 103 | 67 |
| DC2 (∧R) | 18 | 12 | = | 61 | 3D | h | 104 | 68 |
| DC3 (∧S) | 19 | 13 | > | 62 | 3E | i | 105 | 69 |
| DC4 (∧T) | 20 | 14 | ? | 63 | 3F | j | 106 | 6A |
| NAK (∧U) | 21 | 15 | @ | 64 | 40 | k | 107 | 6B |
| SYN (∧V) | 22 | 16 | A | 65 | 41 | l | 108 | 6C |
| ETB (∧W) | 23 | 17 | B | 66 | 42 | m | 109 | 6D |
| CAN (∧X) | 24 | 18 | C | 67 | 43 | n | 110 | 6E |
| EM (∧Y) | 25 | 19 | D | 68 | 44 | o | 111 | 6F |
| SUB (∧Z) | 26 | 1A | E | 69 | 45 | p | 112 | 70 |
| ESC (∧[) | 27 | 1B | F | 70 | 46 | q | 113 | 71 |
| FS (∧\) | 28 | 1C | G | 71 | 47 | r | 114 | 72 |
| GS (∧∧) | 29 | 1D | H | 72 | 48 | s | 115 | 73 |
| RS (∧) | 30 | 1E | I | 73 | 49 | t | 116 | 74 |
| US (∧_) | 31 | 1F | J | 74 | 4A | u | 117 | 75 |
| SP ( ) | 32 | 20 | K | 75 | 4B | v | 118 | 76 |
| ! | 33 | 21 | L | 76 | 4C | w | 119 | 77 |
| ” | 34 | 22 | M | 77 | 4D | x | 120 | 78 |
| # | 35 | 23 | N | 78 | 4E | y | 121 | 79 |
| $ | 36 | 24 | O | 79 | 4F | z | 122 | 7A |
| % | 37 | 25 | P | 80 | 50 | { | 123 | 7B |
| & | 38 | 26 | Q | 81 | 51 | \| | 124 | 7C |
| ’ | 39 | 27 | R | 82 | 52 | } | 125 | 7D |
| ( | 40 | 28 | S | 83 | 53 | ˜ | 126 | 7E |
| ) | 41 | 29 | T | 84 | 54 | DEL | 127 | 7F |
| * | 42 | 2A | U | 85 | 55 | | | |

# 11 Modbus communication

This section covers the use of Modbus RTU communications when using the PM4 monitor. When using Modbus communications the instrument must be set up electrically for RS232 or RS485 communications and the PM4 **O.Put** function must be set to **n̄.buS**. Modbus is not available in all instruments, see section 11.3 for a list of PM4 instruments in which Modbus is available. Functions 1 and 3 are available on all these models. Function 6 and 16 is currently only available on the PM4-CO, PH, RS and PM4-WT models.

**Modbus commands**

Note: the maximum recommended baud rate is 9600, do not use modbus address 0. The following commands are available:

## 11.1 Function 1 - Read coil status

Reads the ON/OFF status of the relay coils. Broadcast is not supported. Relays 1 to 4 are addressed as 0 to 3. Logic 1 = ON, Logic 0 = OFF. To read the coil status a query is sent to the PM4, the PM4 then responds to the query. An example of a query to read coils 1 to 4 from the PM4 at address 2 is given below.

| **Field name** | **Example (Hex)** |
|---|---|
| Unit address | 02 |
| Function | 01 |
| Starting address Hi | 00 |
| Starting address Lo | 00 |
| Number of points Hi | 00 |
| Number of points Lo | 04 |
| Error check (LRC or CRC) Hi | – (automatically generated number) |
| Error check (LRC or CRC) Lo | – (automatically generated number) |

An example of a response is given in the table below:

| **Field name** | **Example (Hex)** |
|---|---|
| Unit address | 02 |
| Function | 01 |
| Byte count | 01 |
| Data coils (7 to 1) | 04 |
| Error check (LRC or CRC) Hi | – (automatically generated number) |
| Error check (LRC or CRC) Lo | – (automatically generated number) |

The status of the relay coils is shown in the Data 04 (hex) or binary 0100. Relay 1 is indicated by the LSB. The status of the relays is therefore: Relay 1 - OFF, Relay 2 - OFF, Relay 3 - ON, Relay 4 - OFF

## 11.2 Function 3 - Read holding registers

This function reads the binary contents of the holding registers in the PM4 being addressed. Each value is stored in the PM4 as a 32 bit value stored in two 16 bit registers per set of values i.e. 4 bytes per set of values. Note: an overrange indication value depends on the number of display digits e.g. for a 5 digit display 100,000 decimal or 186A0 hex indicates a positive overrange and -20,000 decimal or FFFFB1E0 hex will represent a negative overrange since these numbers are just outside the display range of a 5 digit display (99999 to -19999). The register allocation depends on model type, see the register table overleaf. An example of a query to read holding registers 1 to 8 from the PM4 at address 1 is given below.

| **Field name** | **Example (Hex)** |
|---|---|
| Unit address | 01 |
| Function | 03 |
| Starting address Hi | 00 |
| Starting address Lo | 00 |
| Number of points Hi | 00 |
| Number of points Lo | 08 |
| Error check (LRC or CRC) Hi | 44 (automatically generated number) |
| Error check (LRC or CRC) Lo | 0C (automatically generated number) |

This would be transmitted as 01 03 00 00 00 08 44 0C where:
01 is the unit address (set at the PM4 Addr function)
03 is the function number (function 3)
00 00 is the starting address of zero. Note addresses 0 to 7 correspond to registers 1 to 8.
00 08 is the number of points required (08 hex.)
44 0C is the error check (generated by the modbus program)

An example of a response is given below:

| **Field name** | **Example (Hex)** |
|---|---|
| Unit address | 01 |
| Function | 03 |
| Byte count | 10 |
| Data Hi (register 1) | 00 |
| Data Lo (register 1) | 00 |
| Data Hi (register 2) | 00 |
| Data Lo (register 2) | 3E |
| Data Hi (register 3) | 00 |
| Data Lo (register 3) | 00 |
| Data Hi (register 4) | 00 |
| Data Lo (register 4) | 3E |
| Data Hi (register 5) | 00 |
| Data Lo (register 5) | 00 |
| Data Hi (register 6) | 01 |
| Data Lo (register 6) | 3D |
| Data Hi (register 7) | 00 |
| Data Lo (register 7) | 00 |
| Data Hi (register 8) | 05 |
| Data Lo (register 8) | 8B |
| Error check (LRC or CRC) Hi | 84 (automatically generated number) |
| Error check (LRC or CRC) Lo | 65 (automatically generated number) |

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

tx: 01 03 00 00 00 08 44 0C
rx: 01 03 10 00 00 00 3E 00 00 00 3E 00 00 01 3D 00 00 05 8B 84 65
If the instrument were model PM4-TR (see register table which follows) then the data received (rx:) is interpreted as follows:
01 is the address of the PM4-TR
03 denotes function 3
10 is the byte count (10 hex., 16 decimal) i.e. 16 bytes at 4 bytes per set of data
00 00 00 3e is the rate value 3e hex., 62 decimal (requires 4 bytes i.e. 2 registers)
00 00 00 3e is the same rate value again
00 00 01 3d is the total value (13d hex., 317 decimal)
00 00 05 8b is the grand total value (58b hex., 1419 decimal)
84 65 is the error check value generated

## 11.3 Register table

| Address | Register | Register contents.<br>Modbus is available in PM4 models, 2C0, CO, IV, IVT, IV3, LN, LN2, PH, RS, RT8, SSI, TCR, TR and WT (rate values returned for IVT, linearised values for LN) | Comments/variations |
|---|---|---|---|
| 0x00 | 1 | Display value high word | PM4-TR Rate value high word<br>PM4-IV3 Arithmetic result (channel 0) high word<br>PM4-2CO channel 1 value high word |
| 0x01 | 2 | Display value low word | PM4-TR Rate value low word<br>PM4-IV3 Arithmetic result (channel 0) low word<br>PM4-2CO channel 1 value low word |
| 0x02 | 3 | Valley memory high word | PM4-TR Rate value high word<br>PM4-2CO channel 2 value high word |
| 0x03 | 4 | Valley memory low word | PM4-TR Rate value low word<br>PM4-2CO channel 2 value low word |
| 0x04 | 5 | Peak memory high word | PM4-TR Total value high word<br>PM4-2CO, CO and PH temperature or default temperature high word |
| 0x05 | 6 | Peak memory low word | PM4-TR Total value low word<br>PM4-2CO, CO and PH temperature or default temperature low word |
| 0x06 | 7 | Display hold high word | PM4-TR Grand total value high word<br>PM4-2CO not used<br>PM4-CO and PH peak memory high word |
| 0x07 | 8 | Display hold low word | PM4-TR Grand total value low word<br>PM4-2CO not used<br>PM4-CO and PH peak memory low word |
| 0x08 | 9 | A1Hi setpoint high word | |
| 0x09 | 10 | A1Hi setpoint low word | |
| 0x0A | 11 | A2Hi setpoint high word | |
| 0x0B | 12 | A2Hi setpoint low word | |
| 0x0C | 13 | A3Hi setpoint high word | |
| 0x0D | 14 | A3Hi setpoint low word | |
| 0x0E | 15 | A4Hi setpoint high word | |
| 0x0F | 16 | A4Hi setpoint low word | |
| 0x10 | 17 | A1Lo setpoint high word | |
| 0x11 | 18 | A1Lo setpoint low word | |
| 0x12 | 19 | A2Lo setpoint high word | |
| 0x13 | 20 | A2Lo setpoint low word | |
| 0x14 | 21 | A3Lo setpoint high word | |
| 0x15 | 22 | A3Lo setpoint low word | |
| 0x16 | 23 | A4Lo setpoint high word | |
| 0x17 | 24 | A4Lo setpoint low word | |

| | | | |
|---|---|---|---|
| 0x18 | 25 | Decimal point value | PM4-TR rate decimal point only, PM4-IV3 and PM4-LN2 channel 0 decimal point<br>PM4-2CO channel 1 decimal point |
| 0x19 | 26 | Channel 1 decimal point value | PM4-IV3 and PM4-LN2 only<br>PM4-2CO channel 2 decimal point<br>PM4-CO and PH temperature decimal point |
| 0x1A | 27 | Channel 2 decimal point value | PM4-2CO temperature decimal point otherwise PM4-IV3 and PM4-LN2 only |
| 0x1B | 28 | Channel 3 decimal point value | PM4-IV3 only |
| 0x20 | 33 | Channel 1 value high word | PM4-IV3, PM4-RT8 and PM4-LN2 (linearised value if table used) only |
| 0x21 | 34 | Channel 1 value low word | PM4-IV3, PM4-RT8 and PM4-LN2 (linearised value if table used) only |
| 0x22 | 35 | Channel 2 value high word | PM4-IV3, PM4-RT8 and PM4-LN2 (linearised value if table used) only |
| 0x23 | 36 | Channel 2 value low word | PM4-IV3, PM4-RT8 and PM4-LN2 (linearised value if table used) only |
| 0x24 | 37 | Channel 3 value high word | PM4-IV3 and PM4-RT8 only |
| 0x25 | 38 | Channel 3 value low word | PM4-IV3 and PM4-RT8 only |
| 0x26 | 39 | Channel 4 value high word | PM4-RT8 only |
| 0x27 | 40 | Channel 4 value low word | PM4-RT8 only |
| 0x28 | 41 | Channel 5 value high word | PM4-RT8 only |
| 0x29 | 42 | Channel 5 value low word | PM4-RT8 only |
| 0x2A | 43 | Channel 6 value high word | PM4-RT8 only |
| 0x2B | 44 | Channel 6 value low word | PM4-RT8 only |
| 0x2C | 45 | Channel 7 value high word | PM4-RT8 only |
| 0x2D | 46 | Channel 7 value low word | PM4-RT8 only |
| 0x2E | 47 | Channel 8 value high word | PM4-RT8 only |
| 0x2F | 48 | Channel 8 value low word | PM4-RT8 only |
| 0x30 | 49 | Highest channel high word | PM4-RT8 only |
| 0x31 | 50 | Highest channel low word | PM4-RT8 only |
| 0x32 | 51 | Lowest channel high word | PM4-RT8 only |
| 0x33 | 52 | Lowest channel low word | PM4-RT8 only |
| 0x34 | 53 | Average channel high word | PM4-RT8 only |
| 0x35 | 54 | Average channel low word | PM4-RT8 only |
| 0x36 | 55 | Difference channel high word | PM4-RT8 only |
| 0x37 | 56 | Difference channel low word | PM4-RT8 only |
| 0x38 | 57 | Difference from channel 1 high word | PM4-RT8 only |
| 0x39 | 58 | Difference from channel 1 low word | PM4-RT8 only |

| | | | |
|---|---|---|---|
| 0x100 | 257 | Modbus set A1Hi setpoint high word | PM4-CO, PH and WT only |
| 0x101 | 258 | Modbus set A1Hi setpoint low word | PM4-CO, PH and WT only |
| 0x102 | 259 | Modbus set A2Hi setpoint high word | PM4-CO, PH and WT only |
| 0x103 | 260 | Modbus set A2Hi setpoint low word | PM4-CO, PH and WT only |
| 0x104 | 261 | Modbus set A3Hi setpoint high word | PM4-CO, PH and WT only |
| 0x105 | 262 | Modbus set A3Hi setpoint low word | PM4-CO, PH and WT only |
| 0x106 | 263 | Modbus set A4Hi setpoint high word | PM4-CO, PH and WT only |
| 0x107 | 264 | Modbus set A4Hi setpoint low word | PM4-CO, PH and WT only |
| 0x108 | 265 | Modbus set A1Lo setpoint high word | PM4-CO, PH and WT only |
| 0x109 | 266 | Modbus set A1Lo setpoint low word | PM4-CO, PH and WT only |
| 0x10A | 267 | Modbus set A2Lo setpoint high word | PM4-CO, PH and WT only |
| 0x10B | 268 | Modbus set A2Lo setpoint low word | PM4-CO, PH and WT only |
| 0x10C | 269 | Modbus set A3Lo setpoint high word | PM4-CO, PH and WT only |
| 0x10D | 270 | Modbus set A3Lo setpoint low word | PM4-CO, PH and WT only |
| 0x10E | 271 | Modbus set A4Lo setpoint high word | PM4-CO, PH and WT only |
| 0x10F | 272 | Modbus set A4Lo setpoint low word | PM4-CO, PH and WT only |

Notes: the peak memory, valley memory and display hold will only respond to the command if a remote input or P button function is set for the function required.

For alarm relay registers value of 8000 0000 hex indicates that the relay setpoint is turned off (disabled).

## 11.4 Function 6 Preset single register and function 16 Preset multiple registers

The registers for these modes are shown below, this mode is currently only available on model PM4-CO. PH, RS and WT panel meter. Note that when using these modes the alarm values are not stored in EPROM memory. If any alarm values are set in EPROM memory via settings entered directly via the instrument keypads in FUNC or CAL mode then these values will be the default settings which can then be overwritten by function 6 or 16 commands.

A value of 8000 0000 hex will turn off (disable) the setpoint.

| Address | Register | Description |
|---|---|---|
| 0x100 | 257 | Alarm relay 1 high setpoint high word |
| 0x101 | 258 | Alarm relay 1 high setpoint low word |
| 0x102 | 259 | Alarm relay 2 high setpoint high word |
| 0x103 | 260 | Alarm relay 2 high setpoint low word |
| 0x104 | 261 | Alarm relay 3 high setpoint high word |
| 0x105 | 262 | Alarm relay 3 high setpoint low word |
| 0x106 | 263 | Alarm relay 4 high setpoint high word |
| 0x107 | 264 | Alarm relay 4 high setpoint low word |
| 0x108 | 265 | Alarm relay 1 low setpoint high word |
| 0x109 | 266 | Alarm relay 1 low setpoint low word |
| 0x10A | 267 | Alarm relay 2 low setpoint high word |
| 0x10B | 268 | Alarm relay 2 low setpoint low word |
| 0x10C | 269 | Alarm relay 3 low setpoint high word |
| 0x10D | 270 | Alarm relay 3 low setpoint low word |
| 0x10E | 271 | Alarm relay 4 low setpoint high word |
| 0x10F | 272 | Alarm relay 4 low setpoint low word |

An example of using function 6 to set Alarm 1 high setpoint to 2C (44 dec.) at an PM4 with address 2 is:

| Field name | Example (Hex) |
|---|---|
| Unit address (node number) | 02 |
| Function | 06 |
| Register address Hi | 01 |
| Register address Lo | 00 |
| Value Hi | 00 |
| Value Lo | 2C |
| Error check (LRC or CRC) | – |

An example of a function 6 response is given below:

| Field name | Example (Hex) |
|---|---|
| Unit address (node number) | 02 |
| Function | 06 |
| Register address Hi | 01 |
| Register address Lo | 00 |
| Value Hi | 00 |
| Value Lo | 2C |
| Error check (LRC or CRC) | – |

An example of using function 16 to set Alarm 1 high setpoint to 2C (44 dec.) and Alarm 2 high setpoint to 50 (80 dec.) at an PM4 with address 2 is:

| Field name | Example (Hex) |
|---|---|
| Unit address (node number) | 02 |
| Function | 10 |
| Register starting address Hi | 01 |
| Register starting address Lo | 00 |
| Number of registers Hi | 00 |
| Number of registers Lo | 02 |
| Byte count | 04 |
| Data Hi | 00 |
| Data Lo | 2C |
| Data Hi | 00 |
| Data Lo | 50 |
| Error check (LRC or CRC) | – |

An example of a function 16 response is as follows:

| Field name | Example (Hex) |
|---|---|
| Unit address (node number) | 02 |
| Function | 10 |
| Register starting address Hi | 01 |
| Register starting address Lo | 00 |
| Number of registers Hi | 00 |
| Number of registers Lo | 02 |
| Error check (LRC or CRC) | – |

# 12 Analog PI control output

PI control functions will only be seen if PI control software is available for the instrument and if the optional isolated analog or dual isolated analog output is fitted. In dual analog instruments only the first output can be set for PI control output.

The PI (proportional + integral) control output may be configured for proportional only (i.e. integral gain set to 0.000) or proportional + integral control. The control output may be link selected as either a 4-20mA, 0-1VDC or 0-10VDC signal. Using the control function settings described below the instrument will vary the control output signal in such a way that the process being monitored is kept as close as possible to the control setpoint. The control may be turned on or off via the **rEC ctrl** function. When the **rEC ctrl** function is set to **OFF** the output will act as a retransmission output rather than a control output and the PI control functions will not be seen. When set to **on** the PI control functions will be seen but the standard retransmission functions (e.g. **rEC_** and **rEC‾** ) will not.

The ▲ or ▼ buttons may be used to view the control setpoint when PI control is used. The best PI control results are usually achieved by initially configuring as a proportional only controller and introducing the Integral control once stable results have been obtained from proportional only control.

## 12.1 Proportional control output

For proportional only control the output is found from:

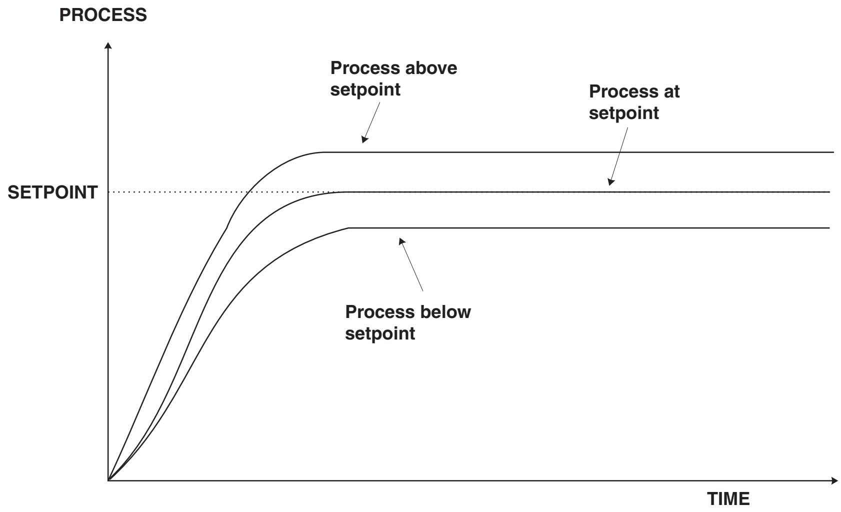
$$Proportional\,control\,output = Error \times Proportional\,gain + Offset$$

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

## 12.2 PI analog control setpoint

| | |
|---|---|
| **Display:** | **C. SEt** |
| **Range:** | Any display value |
| **Default Value:** | **0** |

The control setpoint is set to the value in displayed engineering units required for control of the process. The controller will attempt to vary the control output to keep the process variable at the setpoint. Note that the control setpoint can be made available in **FUNC** mode and in some cases in "easy access" mode via the **rEC SPAC** function described in this chapter.




## 12.3 PI analog control on or off

**Display:** rEC ctrl
**Range:** on or OFF
**Default Value:** OFF

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

## 12.4 PI analog control span

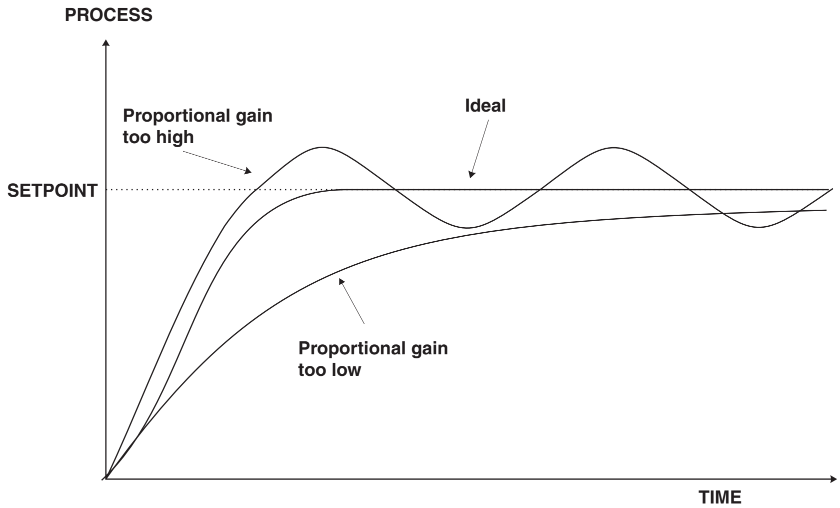
**Display:** C. SPAn
**Range:** 0 to any positive display value
**Default Value:** 0

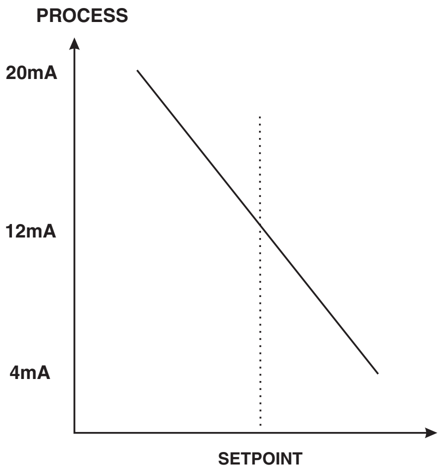
The function of the control span is to define the limit to which the proportional control values will relate. The span value defines the range over which the input must change to cause a 100% change in the control output when the proportional gain is set to 1.000. This function affects the overall gain of the controller and is normally set to the process value limits that the controller requires for normal operation. For example if the control setpoint (C.SEt) is 50.0 and the C.SPn is 15 then an error of 15 from the setpoint will cause a 100% change in proportional control output. For example, assuming that the control output is a 4-20mA signal, with C.SEt at 50.0, C.SPn at 15.0, C.PG at 1.000 and C.P0 at 0.000 a display reading of 35.0 or lower (C.SEt - C.SPn) the control output will be at 100% i.e. 20mA. The control output will then gradually fall as the display value reaches the setpoint.

## 12.5 PI analog proportional gain

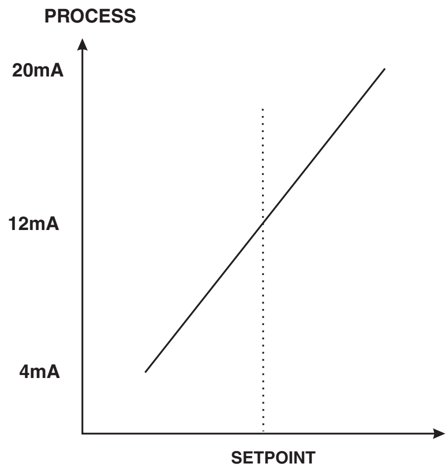
**Display:** C_PG
**Range:** -32.767 to 32.767 number of display digits allowing
**Default Value:** 0.000

The proportional gain is the ratio between the change in measured input and change in control output. Too much proportional gain will result in instability. Example 1, if the proportional gain is set to 1.000 and the measured input changes by 100% of the span set in C.SPn then the output will change by 100%. Example 2, if the proportional gain is set to 2.000 and the measured input changes by 50% of the range set in C.SPn then the output will change by 100%. Example 3, if the proportional gain is set to 2.000 and the measured input changes by 25% of the range set in C.SPn then the output will change by 50%. Setting a negative proportional gain will reverse the control output.




Positive C.PG value e.g. 1.000



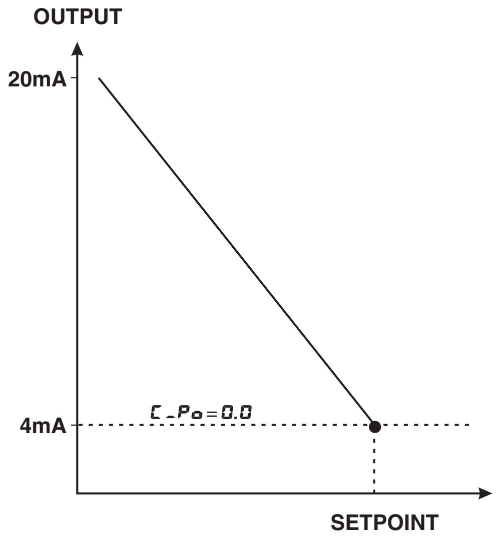

Negative C.PG value e.g. - 1.000

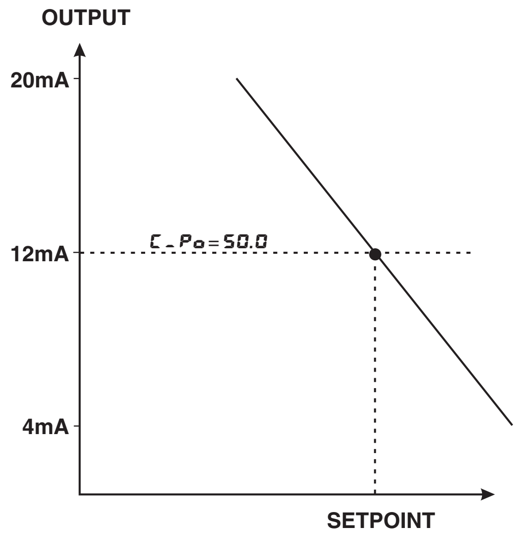
| This table shows the effect of the output current of changing proportional gain and offset with the following settings: **C.SPN** = **2.00**, **C.I G** = **0.000** | | | |
|---|---|---|---|
| **C.SEt** | **C_PG** | **C_Po** | **Effect on analog output (4-20mA used in this example)** |
| **7.00** | **1.000** | **0.0** | Reading of 5.00 or below - 20mA output<br>Reading of 5.00 to 7.00 - mA output decreasing as reading approaches 9.00<br>Reading 7.00 or above - 4mA output |
| **7.00** | **1.000** | **100.0** | Reading of 7.00 or below - 20mA output<br>Reading of 7.00 to 9.00 - mA output decreasing as reading approaches 9.00<br>Reading 9.00 or above - 4mA output |
| **7.00** | **1.000** | **50.0** | Reading of 6.00 or below - 20mA output<br>Reading of 6.00 to 8.00 - mA output decreasing as reading approaches 8.00 with 12mA output at 7.00<br>Reading 8.00 or above - 4mA output |
| **7.00** | **0.500** | **50.0** | Reading 5.00 or below - 20mA output<br>Reading 5.00 to 9.00 - mA output decreasing as reading approaches 9.00 with 12mA output at 7.00<br>Reading 9.00 or above - 4mA output |
| **7.00** | **- 1.000** | **50.0** | Reading of 6.00 or below - 4mA output<br>Reading of 6.00 to 8.00 - mA output increasing as reading approaches 8.00 with 12mA output at 7.00<br>Reading 8.00 or above - 20mA output |

## 12.6 PI analog proportional offset %

**Display:** **C_Po**
**Range:** **0.0** to **100.0**
**Default Value:** **0.0**

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




**Proportional only control examples**

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

$$Proportional\,control\,output = Error \times Proportional\,gain\, + Offset$$

$$Proportional\,control\,output = 10\% \times 1\, + 0\% = 10\%\,or\,5.6mA$$

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

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

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

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

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

$$Proportional\,control\,output = 10\% \times 2\, + 50\% = 55\%\,or\,12.8mA$$

## 12.7 Integral control output

The integral control output can be found from:

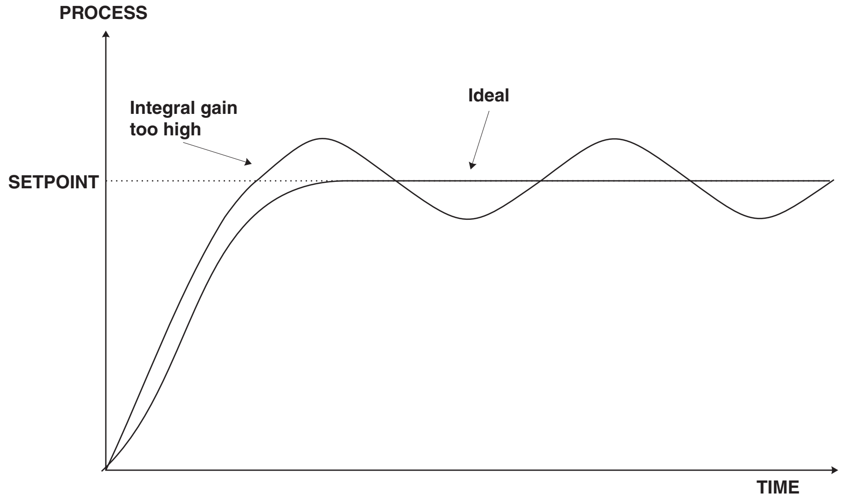
$$Integral\,control\,output = \frac{Error \times IG\, \times time(secs)}{60} + previous\,integral\,control\,output$$

Where $IG$ is the integral gain is set by the **C.IG** function.

## 12.8 PI analog integral gain

| | |
|---|---|
| **Display:** | **C.IG** |
| **Range:** | **-32.767** to **32.767** number of display digits allowing |
| **Default Value:** | **0.000** |

The integral control action will attempt to correct any offset which the proportional control action is unable to correct (e.g. errors due to a changing load). When the integral gain is correctly adjusted the control output is ramped up or down to maintain control by keeping the process variable at the same value as the control setpoint. An integral gain which is too large will cause a rapid response to any error but can also lead to overshooting and oscillation. An integral gain which is too small will slow the time taken to reach the setpoint. The optimum value chosen will depend on the lag time of the process and other control settings. Start with a low figure and increase until a satisfactory response time is reached. The integral gain figure has units of gain/minute. Setting a negative integral gain will reverse the integral control action. If introduction of an integral gain figure causes the error to increase i.e. the process value is moving further away from the setpoint then check the sign of the integral gain e.g. if it is negative change it to a positive value. Note that the sign of the integral gain value should be the same as the proportional gain value i.e. they should either both be positive or both be negative.




## 12.9 PI analog integral limit high

**Display:** CI L.H

**Range:** 0.0 to 100.0

**Default Value:** 0.0

The high limit sets the maximum control output for the integral term i.e. puts a high level limit to the integral control current or voltage output. The limit is used to reduce available output swing and hence limit the effect of integral control output build up which can cause overshoot and instability in the system. If the process value is not close to the setpoint value then the integral control will see a large error. Since integral control output increases with time, the longer an error is seen the more the integral control output will build up. Unless the output is limited then once the process reaches the setpoint the integral control output can be very large (e.g. 100%) causing the process value to overshoot the control setpoint. A setting which is too high will result in allowing the integral control output to cause overshooting. A setting which is too low will result in the integral control output being limited to an extent which means that the setpoint cannot be reached. Start with a low figure e.g. 10.0 and increase the value until a satisfactory response is reached. Maximum setting is 100.0 (100%). Having separate high and low limits is particularly useful if the process response is very one directional. For example in temperature control a heater may be used to give a fast response in heating a tank of liquid when the temperature falls below the setpoint. The heat of the liquid rises quickly but any overshoot will mean that the temperature is too high. The heater will be switched off but the tank of liquid will take a long time to cool to the setpoint level.

## 12.10 PI analog integral limit low

**Display:** CI L.L

**Range:** 0.0 to 100.0

**Default Value:** 0.0

This function sets the minimum control output for the integral term value and works in the same manner as C IL.H described above except that the setting controls the low swing.

## 12.11 PI analog setpoint access

**Display:** rEC SPAC

**Range:** on or OFF

**Default Value:** OFF

This function determines whether the control setpoint function C.SEt can be accessed via FUNC mode or whether entry via CAL mode is needed to access C.SEt. If the operator is to have access to the C.SEt function (via FUNC mode) then set the rEC SPAC function to on. To make the access to the C.SEt function more difficult (CAL mode) then set the rEC SPAC function to OFF. Note that in some models the control setpoint value can be reached and adjusted via the "easy access" mode (see "Explanation of functions" chapter in the main manual). The ACCS function must be set to EASY and the rEC SPAC function set to on to allow "easy access". This feature could be useful if the setpoint is to be frequently changed. If no rEC SPAC is set to on and ACCS is set to EASY but the easy access is not functioning then the "easy access" facility may not be available on that instrument.

## 12.12 Setting up the PI analog controller

1. Set the rEC ctrl function to on.
2. Set the control setpoint C.SEt to the required setting.
3. Set the proportional control span C.SPN as required.
4. Set the proportional gain C.PG to an arbitrary value e.g. 1.000.
5. Set the proportional offset C.PO to 0.0 (0%).
6. Set the integral gain C.I G to 0.000 (i.e. off).
7. Set the integral high and low limits to an arbitrary value e.g. 20.00.

Initialise the control system and monitor the control results. If the original settings causes process oscillations then gradually decrease the proportional gain until the oscillations decrease to an acceptable steady cycle. If the original settings do not cause process oscillations then gradually increase the proportional gain until a steady process cycling is observed. Once the steady state is achieved note the difference between the display value and the control setpoint value. Gradually increase or decrease the proportional offset value until the displayed value matches the control setpoint value. If process load changes occur then the proportional offset value may no longer be valid for offset free control. By introducing the integral action, setpoint offset caused by the process load changes will be minimised. Gradually increase the integral gain until the process begins to oscillate. Then reduce the integral gain slightly to regain the control with minimum oscillation. Alter the high and low integral limits to give the best regulation with minimum oscillation. Create a step change to the process conditions and observe the control results. It may be necessary to fine tune the settings to obtain optimum results. The table below summarises the effect of the main function settings.

| Setup functions | Symptom | Solution |
|---|---|---|
| Proportional gain | Slow response | Increase proportional gain |
| | High overshoot or oscillation | Decrease proportional gain |
| Proportional offset | Process continually either above or below setpoint | Increase or decrease offset to compensate |
| Integral gain | Slow response | Increase integral gain |
| | Instabillity or oscillation | Decrease integral gain |

# 13 Guarantee and service

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

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

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

When returning the product for service or repair a full description of the fault and the mode of operation used when the product failed must be given. In any event the manufacturer has no other obligation or liability beyond replacement or repair of this product.

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



This product is designed and manufactured in Australia.