ADP15
Versatile Indicator/Controller

THE QUEEN'S AWARDS FOR ENTERPRISE 2009

User Manual
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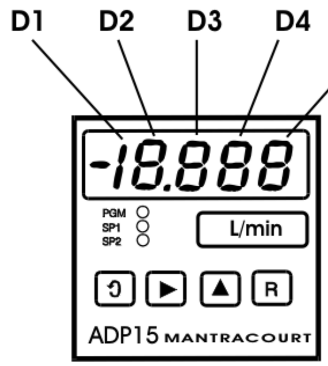
The ADP15 Quick User Guide

The Front Control Panel

All user controls, displays and indicators are mounted on the front panel which provides a 4.5 digit, LED display four flush mounted keys and three LED indicators.



The front panel components are identified as follows:-
D1 - 1/2 digit
D2 - Decade 1
D3 - Decade 2
D4 - Decade 3
D5 - Decade 4

PGM - Program Mode
SP1 - Set Point 1
SP2 - Set Point 2

Front Panel Guide

[↺] Used to scroll through and change the set up data by displaying mnemonics for each configurable parameter, followed by the appropriate data. When in programming mode it should be noted that the first digit in the display may not be visible, but the program indicator light PGM will be flashing to indicate that the instrument is in programming mode, even though no digits can be seen to be flashing.
The [↺] key has a secondary function when not in programming mode. In conjunction with the [▶] key a print function can be initiated. (If a print option is fitted.)

[▶] The [↺] key has a secondary function when not in programming mode. In conjunction with the [▶] key a print function can be initiated. (If a print option is fitted.)
Selects the display digit required. Selection value is indicated by a flashing digit and flashing PGM indicator light.
It also operates as a control key in conjunction with:
The [↺] key for a print function from the rear panel remote.
The [▲] key for Peak Hold / Latched Relay Reset
The [R] key for an Count Reset function.

[▲] Increments each selected display digit 0-9.
Pressing the [▲] key under programming conditions will display the leading digit as either 1, -1, or a blank display for zero.
The secondary function operates as a Peak Hold / Latched Relay Reset in conjunction with the [▶] key.

[R] Resets the display to the input variable and enters new data in the ADP15-FPT memory. Returns the display to the current value after Hold.
The secondary function operates an Count Reset in conjunction with the [▶] key
NOTE: Secondary functions require the [▶] key to be pressed and released, followed within 1 second by the appropriate function key.
[▶] then [↺] for Print Select
[▶] then [▲] for peak Hold/Latched Relay Reset
[▶] then [R] for Count Reset

If during the programming sequence, selection is not completed, the display will revert to the input variable after 30 seconds.
The display module is fitted with 2 security links which, when removed, allows the user to disable keypad programming.

The Configurable Parameters

- These parameters or programmable functions are provided in the ADP to allow the user good flexibility for monitor and control applications.
- Parameters are included as constants in the ADP database and are accessed and checked via the keypad or the communications port.
- Data which is entered by the user is retained by EEPROM for up to 10 years without back up power.
- New data, when entered, overwrites previous entries when the [R] or [↺] key is pressed unless the EEPROM has been disabled via the communications port.

Configurable Parameters

DISPLAY	FUNCTION	RANGE	FUNCTION
SP1	Set Point 1	±19999	Sets first output trip or control
SP2	Set Point 2	±19999	Sets second output trip or control
HYS	Hysteresis	0-19999 in real display units	Sets hysteresis applied to SP1 & SP2 when used for ON/OFF control units
OL	Output Latch	Latch set by Code in Range 0-3	Allows SP1 &/or SP2 to be latched until reset externally or via communications port.

Output Latch Codes

SP1	SP2	Code
Unlatched	Unlatched	0
Latched	Unlatched	1
Unlatched	Latched	2
Latched	Latched	3

DISPLAY	FUNCTION	RANGE	FUNCTION
OA	Output Action (Inversion) of SP1 & SP2	Action set by Code in Range 0-15	Sets output relay action. Can be set to 'normal' or 'inverted' operation for either or both set points. Gives fail safe operation of any alarm combination, High-High, High-Low, Low-High & Low-Low. Also selects whether analogue outputs controlled by display module or PID element in CPU. Inversion of the analogue output. The value of the OA to be entered in the algebraic sum of the following components:- SP1 Inverted =1 SP2 Inverted =2 PID on Analogue Output =4 AN-OP Inverted =8
Pb	Proportional Band	0 to 1024	'O' Selects 'Ont'. 'Offt' or 'dA' mode 1-1023 Selects PID mode and value of proportional band, in displayed units. 1024 Selects Integral 'It' only control
Ont	Output on delay	0-255	When PID is not used, (PB=0) the mnemonic (Ont) sets a delay on time for SP1 & SP2 set in seconds.
Or (It)	Integral	0 to 6000	Selects integral value for PID control in seconds/repeat. 0= Proportional only control
OFFt	Output off Delay	0 to 255	When PID is not used, (PB=0) the mnemonic (Offt) sets a delay off time for SP1 SP2 set in seconds.
Or (dt)	Derivative Time	0 to 255	Selects derivative value for PID control. 0 = OFF (no derivative)
dA	Display Averaging & Peak Hold	0 to 15	When PID is not used, (PB=0) the mnemonic, (dA) sets a display averaging update rate. Readings may be averaged over a number of updates and can be set as follows: Display update time 0 = 1 readings (standard) approx 0.4S 1 = 2 readings approx 0.8S 2 = 4 readings approx 1.6S 3 = 8 readings approx 3.2S 4 = 16 readings approx 6.4S 5 = 32 readings approx 12.8S 6 = 64 readings approx 25.6S 7 = Fast update mode approx 0.1S A peak hold function, which will display the highest recorded value of the measured input, can be set by adding 8 to any of the above settings. To reset Peak Hold press the ▶ key, then within 1 second, press the ▲ key. Can also be reset externally or via comms.

Or (ct)	Cycle time	1 to 255	Set time in seconds for one complete power cycle output of PID power (time proportioned through SP1).
IPL	Input Low	-19999 to 19999	For linear analogue inputs, used to set the required display reading when an analogue input is at its minimum value. Also provides an OFFSET for value for nonlinear analogue inputs.
Or (IpOf)	Offset (Preset)	-19999 to 19999	For rate/totaliser inputs, the value provides an offset or for totaliser, a count reset value.
IPH	Input High	±19999	For linear analogue inputs, used to set the required display reading when an analogue input is at its maximum value.
Or (IpSf)	Scale Factor	0-1.9999	Applies a variable gain to the rate/totaliser reading 1.0000 for unity (0.5000 to halve the display value.)
OPL	Output Low	±19999	Used to set the display value at which the minimum analogue output is required.
OPH	Output High	±19999	Used to set the display value at which the maximum analogue output is required.
IP	Input Select	0 to 65	Used to set up the ADP15 for the input to be monitored.

Linear Input Codes

IP = 0 Scaling Between ±19999
IP = 1 Scaling divide by 10, ±1999

Thermocouple Input Codes

Thermocouple Code	ADP15 Range	Readout	Resolution	Range
B	+400°C to +1820°C	Centigrade	0.1	26
			1.0	27
		Fahrenheit	0.1	42
			1.0	43
E	-230°C to +1000°C	Centigrade	0.1	28
			1.0	29
		Fahrenheit	0.1	44
			1.0	45
J	-170°C to +760°C	Centigrade	0.1	30
			1.0	31
		Fahrenheit	0.1	46
			1.0	47
K	-230°C to +130°C	Centigrade	0.1	32
			1.0	33
		Fahrenheit	0.1	48
			1.0	49
N	-200°C to +1300°C	Centigrade	0.1	40
			1.0	41
		Fahrenheit	0.1	56
			1.0	57
R	0°C to 1760°C	Centigrade	0.1	34
			1.0	35
		Fahrenheit	0.1	50
			1.0	51
S	0°C to 1760°C	Centigrade	0.1	36
			1.0	37
		Fahrenheit	0.1	52
			1.0	53
T	-220°C to +400°C	Centigrade	0.1	38
			1.0	39
		Fahrenheit	0.1	54
			1.0	55

Resistance Thermometer Input Codes		
Display Limits	**Resolution**	**Code**
Fahrenheit	0.1	58
Fahrenheit	0.1	59
Centigrade	1.0	60
Centigrade	1.0	61

Input Codes for Frequency & RPM		
Type	**Code**	**Divide by 10**
Period in mS	2	3
Period in µS	6	7
Frequency	12	13
RPM (0.1 resolution)	14	15
RPM	16	17

Totaliser Input Codes

Selection of the totaliser function is achieved by the selection of the IP code 64 (65 for divide by 10) and also by setting DIL switches. For details, see setting up procedures in the instruction manual.

Display	**Function**	**Range**	**Function**
dP-r	Decimal Point & Reset	Range 0 to 61 Code dP Position	to set the required position of the decimal point on the display and to set the rear contact actions for count reset &/or peak hold & Reset latched relay &/or reset & /or Print. Or any combinations of these.
		0 19999	
		1 1.9999	
		2 19.999	
		3 199.99	
		4 1999.9	
		5 19999.	
			To make reset input active on any or all of the following add to dP-r No. as follows:
		8	Reset totaliser count
		16	Reset latched relays or peak hold (Note: Latched relays are not available with peak hold).
		32	Activate print
cP		0-129	Comms Protocol
		0-127	= Printer
		128	= 'FAST' MANTRABUS
		129	= 'ASCII'
SdSt	Serial Device Station	Set by code in range 0 to 254	Used to set individual address of each ADP when communications port is used. NB: changes can only be made via the keypad.
or			
(Prnt)		Option 0-9*	Details of the printer mode and print format. Appropriate data will be supplied with the printer.
(Lab)		Option 0-75	Label number to print engineering units.
Ln		0-19,999	To set Log number. Reset on power up.
(Inp)	Input Variable		Automatically returns the ADP15 to the input again after scrolling sequence is completed and updates permanent memory.

Note: Invalid parameter values - Should an invalid figure be entered against any parameter, it will be rejected and the display will return to show the parameters mnemonic.

* This number range will increase as new printer options become available.

Contents Pages

Chapter 1 Introduction to ADP15

The ADP15 provides high accuracy monitoring and loop control for a wide variety of industrial applications. The system uses a powerful micro processor together with an extremely accurate A-D converter to give high resolution, full digital linearisation and scaling of input variables, conversion to real engineering units and simplified setting of operational parameters.

Depending upon the build configuration, the ADP15 can accommodate analogue or pulse inputs, outputs consisting of analogues for conditioning, re-transmission and control: digital signals for alarm and control functions and a communications facility for data exchange for up to 254 ADPs connected to one host computer or PLC.

The ADP15 is designed to suit the characteristics of all commonly used industrial transducers. This feature, in conjunction with the facility to choose from a number of input modules, ensures compatibility with a wide range of input sources.

Applications
An Indicator - displaying in real engineering units, the precise value of the input variable on a 4.5 digit display.

As a Limit Alarm/Controller - operating relays if the monitored process moves out of limits. The range of control being from simple ON/OFF operation to full 3 term PID with time proportioning and valve control. Trip values (set points), Hysteresis, relay operation and time delays are preset from the keypad. These values are set in real engineering units.

A Signal Conditioner - converting the input signal to an opto-isolated analogue current or voltage output. The conditioning circuits allow the display and output to be scaled to the full input range or only part of it, achieving very high resolution. Scaling is carried out via the keypad.

A Communications Module - with the capacity to link 254 ADP units via a serial connection to a host computer or PLC, either as data acquisition units or local elements in a distributed control network.

A Printer Driver - A printer version of the ADP15 enables the ADP15 to print its current display value to a printer via its communications port. This display value can either be assigned a date and time stamp and/or log number depending on the user set options entered and the type of printer selected.

Easy to Use
The ADP15 is supplied fully calibrated and the microprocessor provides the user with built in fixed linearisation for all thermocouples, PT100 and COS Ø power factor inputs.
Alternatively, linear inputs can be scaled by simply entering two known input values from which the ADP15 will display the complete range of the input variable in real engineering terms.
This feature enables simple replication of data by copying parameters from one
ADP to another without the need for instrument readjustment. When copying across, performance characteristics, accuracy and resolution are precisely the same as the original.

System Configuration
The ADP15 consists of individual base units plus appropriate supplementary modules.
Each base unit is fitted with a CPU, dedicated input module and power supply specified by the user. Output modules are optional and consist of any combination of analogue, alarm /control and communications facility.

ADP15 modules are mounted on a backplane contained in a moulded Noryl case with removable fascia.

All connections to the ADP15 are made via screw terminals on the rear of the unit. Installation options include panel mounting or standard DIN rail mounting.

The Basic Indicator
In its simplest form, an ADP15 operates as a passive indicator, providing a continuous display of the input variables.

The basic ADP15 indicator provides programmable functions, input scaling and linearisation, set point indicators and a display of the input variable.
Operating parameters such as range limits and set points are entered via a simple keypad on the front of the unit.

Display is by 4.5 digit, red LEDs with a range of -19999 to +19999 which show user-entered information and the value of the monitored input. The display can be scaled in real engineering units for which a selection of legend labels are provided.

Preset data can be accessed and displayed at any time without affecting monitoring or control functions. (Display 'freeze' and peak hold features are available and are accessed from the keypad).

ON/OFF status indications of control set points are displayed by two red LEDs below the 4.5 digit display. A third red LED will indicate when the ADP is in program mode.

All parameters entered by the user are stored in EEPROM for up to 10 years even when power is disconnected. No back up power supply being required.

Operational security is ensured by the use of disabling links which prevent unauthorized keypad entries.

These storage and security features allow the ADP to operate as an indicator for prolonged periods without attention.

The Base Unit
All basic ADP15 units are fitted with modules for data processing, display, input and power supply functions.

All output module functions and communications module are optional. The layout of an ADP with a typical complement of modules is shown in Figure 1.1

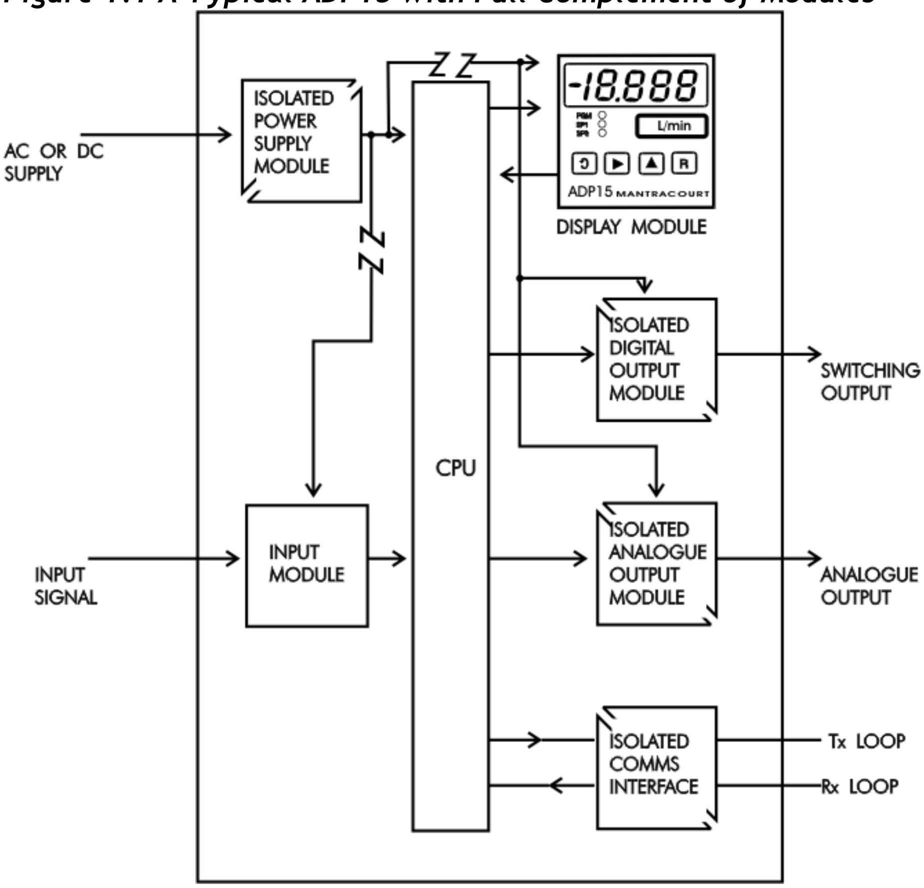
Signal Transmitter and Limit Alarms
If the ADP15 is required to perform analogue output and alarm/control functions, the base unit configuration is extended to include the appropriate output modules.

These are chosen from a range of analogue modules, alarm control modules and a communications module. All input and output modules are fully isolated which allows the user to maximize the choice of grounding points, so avoiding earth loops and minimizing the effects of interference. An ADP can accommodate one of each type of module up to a maximum of three modules - see Figure 1.1

Multiple ADP Applications
Up to 254 ADP15 units can be installed at different locations and linked to a host computer. Most PC or main frame computers are suitable for this purpose.
Alternatively a PLC can be used. Control and monitoring facilities are then available to the host enabling all user configurable parameters to be read or modified and controller status to be examined.

To achieve communications, it is necessary to fit the communications module option to the ADP. See Figure 1.1

Figure 1.1 A Typical ADP15 with Full Complement of Modules



The Power Supply
Each ADP unit can be supplied to operate from any of the following power supplies:

220/230V AC 10W
110V AC 10W
18-60V DC 10W

All power supply inputs are transformer isolated by the ADP power supply module. Incoming power supply cables are connected to the appropriate terminals provided on the unit mounting accessories. Note: **(All supplies should be externally protected (fused).)**

The CPU Module

The CPU controls all input/output functions, processes non linear inputs, provides conversion to any chosen engineering unit and facilitates the entry of programmable functions.

Non linear inputs are digitally linearised using a polynomial technique for high accuracy and resolution.

A pre-programmed database provides scaling and linearisation for all common types of non linear transducers. Constants and required values entered via the keypad or communications module are held in EEPROM which provides storage for up to 10 years without back up power.
A code for each transducer and input module type is entered from the keypad and is used to set up the CPU. In response to this, the CPU produces the appropriate scaling and conversion data to match the transducer.

The CPU continuously scans the input module and every 400mS linearises, scales and displays the input variable.
The A-D converter on analogue input modules is controlled by the CPU; data collection and digitization being carried out as the CPU cycles round.

The Display Module

The display module consists of a keypad, digital display and status LEDs.

The keypad has four square, flush mounted keys behind a protective membrane, providing mode selection and data entry. The ADP can then be programmed for the appropriate transducer and the operating parameters can be pre-set.
The digital display consists of five, seven segment, red LEDs to form a 4.5 digit indicator.
The left hand digit will indicate 1, -1 or - and a blank display, the remaining four digits displaying digits 0 to 9.
Security links are fitted to the display module to allow the user to disable the keypad after programming or to allow only viewing of the parameters.

The Input Modules

Input modules are selected by the user to suit the appropriate applications.
Selection is from a range of linear analogue modules (voltage or current), non linear analogue modules (temperature measurement) or digital input modules (rate, frequency, totalise, quadrature).

All signal conditioning and excitation appropriate to the input is carried out by the ADP.
The analogue input modules carry an A-D converter and associated circuits, selected to suit the type of input transducer signal.
The digital input modules are fitted with prescaler circuits to give unity, divide by 10, 100, 1000 and 10,000. Scaled outputs cater for different input ranges.
Input levels are Logic AC or DC.
Variable input scaling is a function of software.

Table 1.1 summarises the range of input modules available.

Table 1.1 Input Module

Input Source **Linear Analogue Inputs**	**Range Minimum**	**Range Maximum**	**Module Ref**
DC voltage	-19.999mV	+19.999mV	DCV1
DC voltage	-199.99mV	+199.99mV	DCV2
DC voltage	-1.999V	+1.999V	DCV3
DC voltage	-19.999V	+19.999V	DCV4
DC voltage	-199.99V	+199.99V	DCV5
DC current	-1.999mA	+1.999mA	DCA1
DC current	3.5mA	20.5mA	DCA2E
DC current	-19.999mA	+19.999mA	DCA3
DC current	-199.99mA	+199.99mA	DCA4
AC voltage	0	199.99mV	ACV1
AC voltage	0	1.9999V	ACV2
AC voltage	0	19.999V	ACV3
AC voltage	0	199.99V	ACV4
AC current	0	1.0A	ACA
Potentiometer	0R	100R-10K	RL
Pressure	0.95mV/V	+3.8mV/V	PS

All linear analogues can be keypad scaled to any desired display range.

Non-Linear Analogue Inputs			
Thermocouple type B	+400 to	+1820 ºC	T6
Thermocouple type E	-230 to	+1000 ºC	T8
Thermocouple type J	-170 to	+760 ºC	T2
Thermocouple type K	-230 to	+1300 ºC	T1
Thermocouple type N	-200 to	+1300 ºC	T7
Thermocouple type R	0 to	+1760 ºC	T3
Thermocouple type S	0 to	+1760 ºC	T4
Thermocouple type T	-220 to	+400 ºC	T5
Resistance sensor PT10	-190 to	+850 ºC	PT100

All non-linear analogues can be keypad set for
ºC, ºF or ºK with 0.1º or 1.0º resolution.

Input Source	Range Minimum	Range Maximum	Module Ref
Digital or Pulse Input			
Period Frequency RPM Pulse totalising Quadrature/position totalising	0.1µS 0.48Hz 28.8RPM 1 1	1999.9mS 50kHz 3,000,000RPM 65000 ±I65000	RTL RTL RTL RTL TLQ

All input rates can be scaled to any desired range via the keypad and input prescaler switch.

Note: Complete ordering codes are given in Chapter 9

Output Modules
Output modules are selected by the user to suit the appropriate application.
Selection is from a range of analogue modules providing linearised voltage or current outputs, digital modules producing alarm/control or triac outputs, printer, pulse and a communications module.

Analogue Output Modules
A wide range of analogue output modules are available offering five DC current ranges, four DC voltage and a frequency output, summarized in Table 1.2.

All outputs are fully linearised, opto isolated and digitally generated.
Analogue output signals are generated by the CPU from the displayed input variable. Thus, output signals are normally related to displayed input values except where PID is used. A software option is included to provide control on the analogue output from the PID element in the CPU so that when programmed by the user, outputs are related to PID power levels and NOT to the displayed input signal. In this mode, the analogue output cannot be scaled.

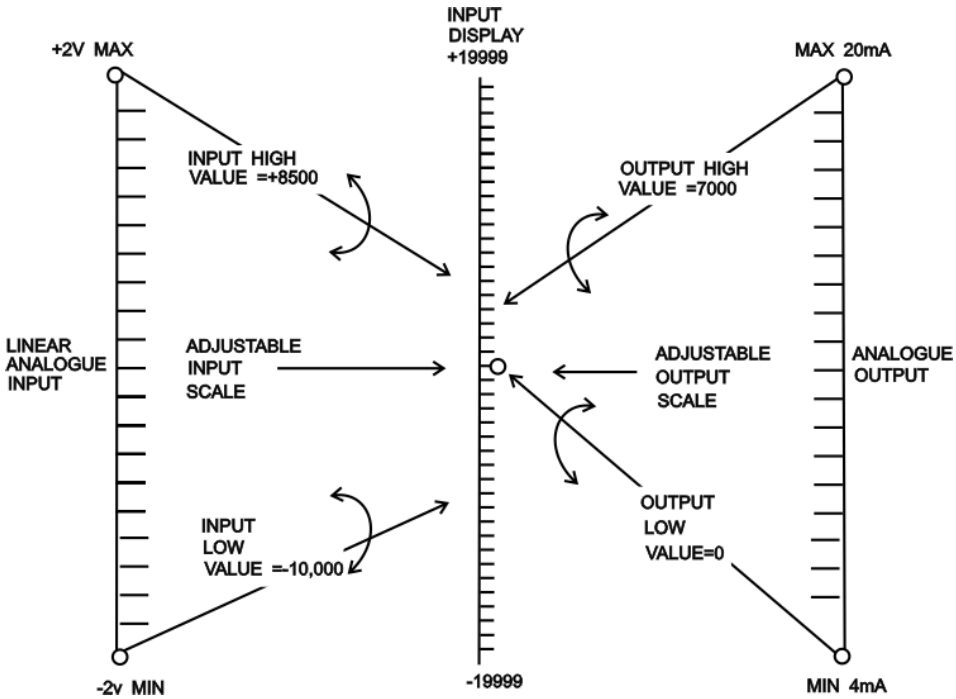
Table 1.2 Analogue Output Module Summary

Output	Range	Module Ref
DC Voltages	0V to 1V 0V to 5V 1V to 5V 0V to 10V	V1 V2 V3 V4
DC Current	0 to 1mA 0 to 20mA 4 to 20mA 10 to 50mA 0 to 5mA	A1 A2 A3 A4 A5
Frequency Output	18.204Hz to 2352.9Hz (1)	

Note (1). With coarse adjustment from prescaler for divide by 1,2,4,8,16,32,64 or 128 selectable by internal DIL switches.
For ordering codes see Chapter 9

Input/Output Scaling Principles
Example: - 2V to +2V input with min input value =-10,000, max input value =8500
4 to 20mA output, with low output value =0, high output value =7000

Figure 1.2 Analogue Input/Output Scaling



Analogue input/output scaling, showing the effect of user settable variables for input high, input low and output low.

Digital Output Modules

Several digital output modules are available, consisting of relay driver types with ON/OFF or PID control. If required, latching outputs can be selected via the keypad; reset action being achieved by keypad, contact closure from the rear panel or via the communications module.
Set points and hysteresis can also be set via the keypad.
Relay and triac outputs can also be inverted via the keypad.
Adjustable time delays are provided, selected via the keypad for independent ON and OFF control actions.

These relay operations are controlled by set point values,
Hysteresis values, output inversion time delays or by the PID time proportioning output on set point 1.

Table 1.3 Digital Output Module Summary

Type	**Function**	**Module Ref**
SPCO	1 relay on Set Point 1	R1
DPCO	1 relay on Set Point 1	R2
SPCO	2 relays on Set Points 1 and 2	R3
SPCO	1 relay on Set Point 2	R4
DPCO	1 relay on Set Point 2	R5

Chapter 2 Installing the ADP15

In order to maintain compliance with the EMC Directive 2004/108/EC the following installation recommendations should be followed.

Inputs: Use individually screened twisted multipair cable. (e.g. FE 585-646)
The pairs should be :
pins 1 & 6
pins 2 & 5
pins 3 & 4
Terminate all screens at pin 1 of the input. The screens should not be connected at the transducer end of the cables.

Comms Port: Use individually screened twisted multipair cable. (e.g. FE 118-2117)
The pairs should be:
-Tx & +Tx
-Rx & +Rx
Terminate screens at SCR (pin 1 of the input on ADP15).
The screens should not be connected at the host port.

Analogue Output: Use screened twisted pair cable. (e.g. RS 626-4761)

Terminate screen at pin 1 of the input.
The screen should not be connected at the host port.

Pin 1 of the input should be connected to a good Earth. The Earth connection should have a cross-sectional area sufficient enough to ensure a low impedance, in order to attenuate RF interference.

Cable Information (For Reference only)

Country	Supplier	Part No	Description
UK	Farnell	118-2117	Individually shielded twisted multipair cable (7/0.25mm)- 2 pair Tinned copper drain. Individually shielded in polyester tape. Diameter: 4.1mm Capacitance/m: core to core 115 pF & core to shield 203 pF
UK	Farnell	585-646	Individually shielded twisted multipair cable (7/0.25mm)- 3 pair Tinned copper drain. Individually shielded in polyester tape. Diameter: 8.1mm Capacitance/m: core to core 98 pF & core to shield 180 pF
UK	RS	626-4761	Braided shielded twisted multipair cable (7/0.2mm)- 1 pair Miniature- twin -round Diameter: 5.2 mm Capacitance/m: core to core 230 pF & core to shield 215 pF

Environmental Requirements

ADP15 units can operate in any industrial environment provided the following limits are not exceeded at the point of installation:
Temperature: -10 ºC to 50 ºC
Humidity: 95 % non condensing

Three power supply options are available and must be specified on ordering.
Units can operate from any one of the following

220/230V AC, 50/60Hz	10W
110V AC, 50/60Hz	10W
9 – 32V DC,	10W (start up current - 3Amps for 20mS)

Unpacking

Carefully remove the ADP15 unit from its packing and ensure that the module configuration code is as ordered (see Chapter 9). Check that the unit, mounting and connection accessories are complete and undamaged.

Equipment

The ADP15 equipment consists of the following:

i. ADP15 unit
ii. A terminal board to suit the installation
iii. Installation clamps to suit the installation
iv. Appropriate legend card
v. Securing screws (These are normally fitted to the installation clamps)

Terminal Boards

Connection between the ADP15 unit and input/output signals, including power supplies, are made via a terminal board at the rear of the unit. Two types of board are available, the choice depending upon the method of unit installation.
Panel and DIN rail terminal boards P and D are shown in figures 2.1 and 2.3

Figure 2.1 Fixed Terminal Board (Panel Mounted)

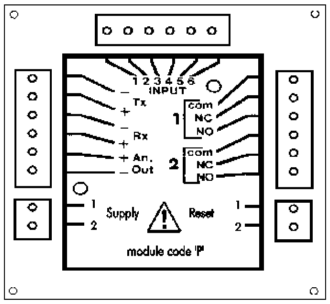


Figure 2.2 Dimensions for Panel Mounting

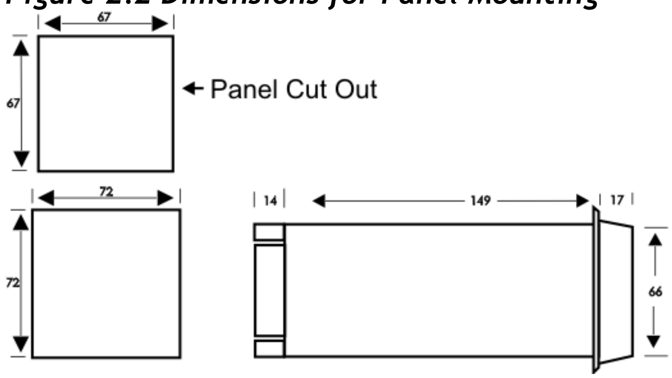


Figure 2.3 DIN Rail Mounted Terminal Board (DIN 1 & DIN 3)

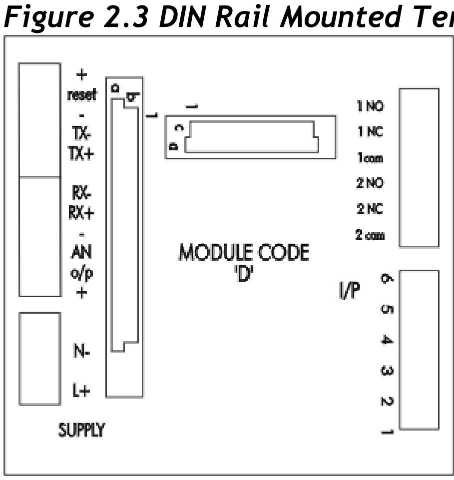
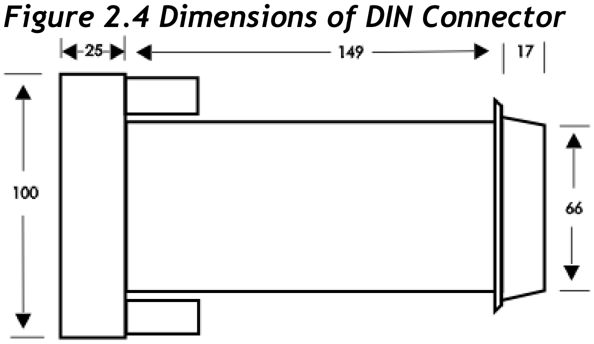


Figure 2.4 Dimensions of DIN Connector



Connecting the Power Supply

Connect power supplies as follows:

110 / 230V AC Live to 2
110 / 230V AC Neutral to 1
DC Positive to 2
DC Negative to 1

Connecting the Outputs

1 **Analogue Outputs** Connect the analogue output cable to the + and - AN O/P terminals on the terminal board.
NOTE: If it is required to earth the analogue output, it should be done via the -ve terminal.

2

Relay Outputs	Setpoint	Connection
(1) **RL1** 1 SPCO relay on SP1	1	COM 1 NC NO
(2) **RL2** 1 DPCO relay on SP1	1	COM 1 NC NO
	1	COM 2 NC NO
(3) **RL3** 2 SPCO relay on SP1 & SP2	1	COM 1 NC NO
	2	COM 2 NC NO
(4) **RL4** SPCO relay on SP2	2	COM 2 NC NO
(5) **RL5** DPCO relay on SP2	2	COM 1 NC NO
	2	COM 2 NC NO

Reset Terminals

3.If a signal is to be used to reset latched relays or Peak Hold or Count Reset, it should be connected to the reset terminals. The reset signal must be derived from a volt free contact or NPN transistor. Observing the following limits.

Voltage: 5v dc Positive applies to the contact (RESET) from the ADP15
Current: 5mA Maximum
Duration: 0.5 seconds Minimum
The reset can also be used for print triggering on printer drive option.

Connecting the Inputs

1 Linear Analogue Inputs-See Chapter 4 Section 1
2 Temperature Inputs-See Chapter 4 Section 2
3 Rate/Totalizer Inputs-See Chapter 4 Section 3

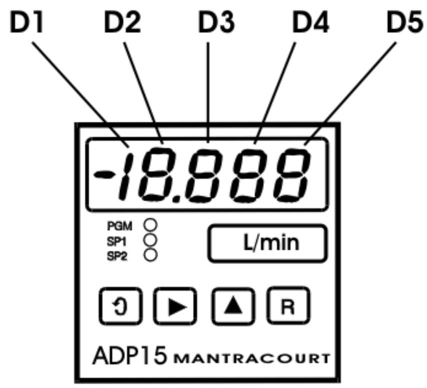
Chapter 3 The ADP15 Controls & Parameters

The Front Control Panel

All user controls, displays and indicators are mounted on the front panel which provides a 4.5 digit, LED display four flush mounted keys and three LED indicators.

Figure 3.1 Front Control Panel

The figure below shows the layout. The functions are summarized in table 3.1
For simplicity, the front panel components shown in Figure 3.1 are identified as follows:



D1 - 1/2 digit	D5 - Decade 4
D2 - Decade 1	SP1 - Set Point 1
D3 - Decade 2	SP2 - Set Point 2
D4 - Decade 3	PGM - Program

The Configurable Parameters

A series of parameters or programmable functions are provided in the ADP15 to allow the user good flexibility for monitor and control applications.
These parameters are included as constants in the ADP15 database and are accessed and checked via the keypad or the communications port.
Data which is entered by the user is retained by EEPROM for up to 10 years without back up power.
New data, when entered, overwrites previous entries when the [R] or the [↺] key is pressed unless the EEPROM has been disabled via the communications port. (See Table 3.1)

Front Control Panel Guide

Table 3.1

	Used to scroll through and change the set up data by displaying mnemonics for each configurable parameter, followed by the appropriate data. When in programming mode it should be noted that the first digit in the display may not be visible, but the program indicator light PGM will be flashing to indicate that the instrument is in programming mode, even though no digits can be seen to be flashing. The [↺] key has a secondary function when not in programming mode. In conjunction with the [▶] key a print function can be initiated. (If a print option is fitted.)
	Selects the display digit required. Selection value is indicated by a flashing digit and flashing PGM indicator light. It also operates as a control key in conjunction with: The [↺] key for a print function from the rear panel remote (ii) The [▲] key for Peak Hold / Latched Relay Reset (iii) The [R] key for a Count Reset function.

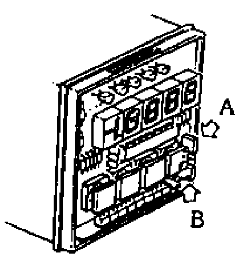
▲ Increments each selected display digit 0-9.
Pressing the ▲ key under programming conditions will display the leading digit as either 1, -1, or a blank display for zero.
The secondary function operates as a Peak Hold / Latched Relay Reset in conjunction with the ▶ key.

R Resets the display to the input variable and enters new data in the ADP15 memory. Returns the display to the current value after Hold.
The secondary function operates an Count Reset in conjunction with the ▶ key.
NOTE: Secondary functions require the ▶ key to be pressed and released, followed within 1 second by the appropriate function key.

▶ then ↺ for Print Select
▶ then ▲ for peak Hold/Latched Relay Reset
▶ then R for Count Reset

If during the programming sequence, selection is not completed, the display will revert to the input variable after 2 minutes.
The display module is fitted with 2 security links which, when removed, allows the user to disable keypad programming. (see figure 3.2)
To gain access to the security links a removable fascia is fitted to the case front. This also provides access for fitting the legend label.
Remove link ‘A’ to disable all four keys. Remove link 'B' (figure 3.2) to disable the ▶ and ▲ keys, allowing all parameters to be viewed but not changed.

Figure 3.2 Keypad Security Links



IMPORTANT NOTE: Never fit a link across the two middle pins.
Once the fascia is removed the ADP15 electronics assembly can be withdrawn leaving the case and field wiring in place.

Table 3.2 Configurable Parameters

Display Function (In order of Display)		**Range**	**Function**
SP1	Set Point 1	-19999 to +19999	Sets first output trip or control (Chapter 5 refers)
SP2	Set Point 2	-19999 to +19999	Sets second output trip or control (Chapter 5 refers)
HYS	Hysteresis	0 to +19999 in real display units	Sets hysteresis applied to SP1 and SP2 when used for ON/OFF control units (Chapter 5 refers)
OL	Output Latch	Latch set by code in range0-3 as shown in Table 5.1	Allows SP1 and/or SP2 to be latched until reset externally, from the keypad or via communications port.
OA	Output Action (Inversion) of SP1 & SP2	Action set by code in range0-15 as shown in Table 5.2	Sets output relay action. Can be set to 'normal' or 'inverted' operation for either or both set points. Gives fail safe operation of any alarm combination, High-High, High-Low, Low-High & Low-Low. (Chapter 5 refers) Also selects whether analogue outputs controlled by display module or PID element in CPU Inversion of the analogue output
Pb	Proportional Band	0 to 1024	'O' Selects 'Ont'.'Offt' or 'da' function 1-1023 Selects PID mode and value of proportional band, in displayed units. 1024 Selects Integral 'It' only control
Ont	Output on delay	0 to 255	When PID is not used, (PB=0) the mnemonic (Ont) sets a delay on time for SP1 & SP2. Set in seconds. Or
(It)	Integral	0 to 6000	Selects integral value for PID control in seconds/repeat. 0= Proportional only control.
OFFt	Output off delay	0 to 255	When PID is not used,(PB=0) the mnemonic (Offt) sets a delay off time for SP1 & SP2 set in seconds. Or
(dt)	Derivative Time	0 to 255	Selects derivative value for PID control. 0 = OFF (no derivative)
dA	Display Averaging & Peak Hold	0 to 15	When PID is not used,(PB=0) the mnemonic (dA) sets a display averaging update rate. Readings may be averaged over a number of updates and can be set as follows:

			Display update time 0 = 1 readings (standard) approx. 0.4S 1 = 2 readings approx. 0.8S 2 = 4 readings approx. 1.6S 3 = 8 readings approx. 3.2S 4 = 16 readings approx. 6.4S 5 = 32 readings approx. 12.8S 6 = 64 readings approx. 25.6S 7 = Fast update mode approx. 0.1S A peak hold function, which will display the highest recorded value of the measured input, can be set by adding 8 to any of the above settings. To reset Peak Hold press the ▶ key, then within 1 second, press the ▲ key. Can also be reset externally or via comms. Or
(ct)	Cycle time	1 to 255	Set time in seconds for one complete power cycle output of PID power (time proportioned through SP1).
IPL	Input Low	-19999 to 19999	For linear analogue inputs, used to set the required display reading when an analogue input is at its minimum value. Also provides an OFFSET for value for non linear analogue Inputs. Or
(IpOf)	Offset Factor	-19999 to 19999	For rate/totaliser inputs, the value provides an offset or for totaliser, a count reset value.
IPH	Input High	-19999 to +19999	For linear analogue inputs, used to set the required display reading when an analogue input is at its maximum value. Or
(IpSf)	Scale Factor	0 - 1.9999	Applies a variable gain to the rate /totaliser reading 1.0000 for unity (0.5000 to halve the display value.)
OPL	Output Low	-19999 to+19999	Used to set the display value at which the minimum analogue output is required.
OPH	Output High	-19999 to+19999	Used to set the display value at which the maximum analogue output is required.
IP	Input Select	0 to 65	Used to set up the ADP15 for the input to be monitored.(See Chap 4)

dP-r	Decimal Point & Reset	range 0 to 61 Code dP Position 0 19999 1 1.9999 2 19.999 3 199.99 4 1999.9 5 19999.	To set the required position of the decimal point on the display and to set the rear contact actions for count reset &/or peak hold &/or latched relay reset &/or print. Or any combination of these. To make reset input active on any or all of the following add to dP-r No. as follows:
		8	Reset totaliser count
		16	Reset latched relays or peak hold
		32	Activate print
		(Note: Latched relays are not available with peak hold)	
cP		0-129	Comms Protocol 0 to 127 = Printer 127 = Continuous ASCII stream of display data transmitted on every display update. 128 = 'Fast' MANTRABUS 129 = 'ASCII'
SdSt	Serial Device Station	Set by code in range 0 to 254	Used to set individual address of each ADP when communications port is used. NB: changes can only be made via the keypad (Chapter 7 refers).
(Lab)	Option 0-75		Label number to print engineering units. (See Chapter 7)
Ln		0-19,999	To set Log number. Reset on power up.
rS		0-255	Sets display resolution 0 & 1 = Resolution of 1 least significant digit. 2-255 = Resolution setting of last digits.
Inp	Input Variable		Automatically returns the ADP to the input again after scrolling sequence is completed and updates permanent memory.

Note: Invalid parameter values - Should an invalid figure be entered against any parameter, it will be rejected and the display will return to show the parameter.
* This number range will increase as new printer options become available.

Chapter 4 Section 1 Linear Analogue Inputs

ADP offers the following range of pre calibrated, linear analogue inputs.

Input Source	Range Minimum	Range Maximum	Resolutions	Module Code
DC Voltage	-19.999mV	+19.999mV	1µV	DCV1
DC Voltage	-199.99mV-	+199.99mV	10µV	DCV2
DC Voltage	1.999V	+1.999V	100µV	DCV3
DC Voltage	-19.999V	+19.999V	1mV	DCV4
DC Voltage	-199.99V	+199.99V	10mV	DCV5
DC Current	-1.9999mA	+1.9999mA	100nA	DCA1
DC Current	+3.500mA	+20.5mA	425nA	DCA2E
DC Current	19.999mA	+19.999mA	1µA	DCA3
DC Current	-199.99mA	+199.99mA	10µA	DCA4
AC Voltage	0	199.99mV	5µV	ACV1
AC Voltage	0	1.9999V	50µV	ACV2
AC Voltage	0	19.999V	500µV	ACV3
AC Voltage	0	199.99V	5mV	ACV4
AC Current	0	1.0A	25µA	ACA 5Hz to 6KHz
Potentiometer	0R	100R - 10K	0.0025%	RL
Pressure (10V Excitation)	0.5mV/V	200 mV/V	0.0025%	PS

Setting the Conditions for Linear Inputs

To monitor the analogue input, the unit must be programmed for the appropriate input module and select the required resolution.

The two input code (IP) options offer scaling of the input for:

IP = 0. Scaling between -19999 to +19999
IP = 1. Scaling divide by 10, -1999 to +1999

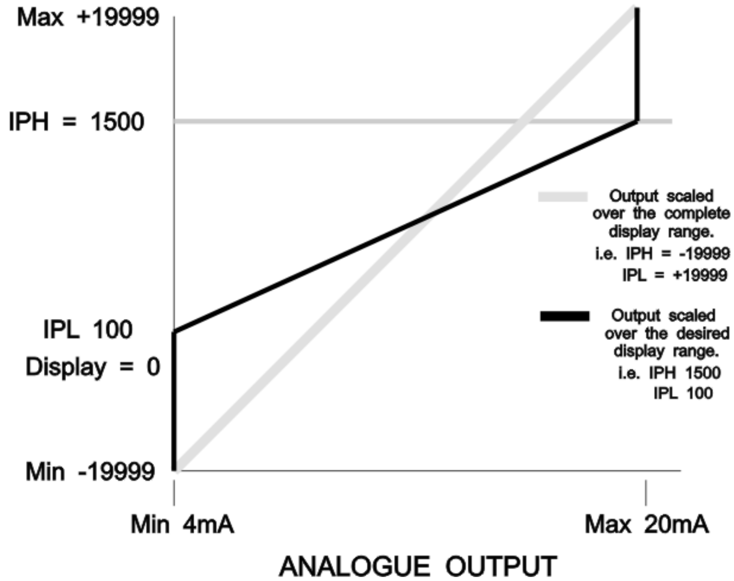
Input Scaling

Input scaling factors are set by the user and determine the display range over which the analogue module operates.(IPL) Input Low - This sets the displayed value at the modules minimum input.(IPH) Input High - This sets the displayed value at maximum input. If the calculated display is outside the range defined by IPL and IPH, the analogue input will be over-ranged.

Example: Assume a 4-20mA input module is required to provide an input of 4mA at 100 and 20mA at 1500.
Set IPL at 100 and IPH at 1500

It will be necessary to determine IPL and IPH by graphical or mathematical means if the known display values do not coincide with the minimum and/or maximum analogue input.

Figure 4.1.1 Analogue Input



Method of Calculating IPL & IPH from any known Input and Display Values

$$IPL = \text{Low Display} - \frac{(\text{Display span})\ (\text{Low input} - \text{Min input})}{(\text{High input} - \text{Low input})}$$

$$IPH = \text{High Display} + \frac{(\text{Display Span})\ (\text{Max input} - \text{High input})}{(\text{High input} - \text{Low input})}$$

High Input = Known high input value
Low Input = Known low input value
Min Input = Lowest measurable value of input PBC fitted
Max Input = Highest measurable value of input PCB fitted
Display span = Highest required display value minus lowest required display value.
Example:

Using a 4.20mA input PCB, requiring a display of 200 at 6mA and 8000 at 12mA

	Minimum	**Known Low**	**Known High**	**Maximum**
Display Value	IPL	200	8000	IPH
Input Value	4mA	6mA	12mA	20mA

$$IPL = 200 - \frac{(7800)\ (6-3.5)}{(12-6)} \qquad = 200 - \frac{(7800 \times 2.5)}{(\ 6\ )}$$

IPL = 200 - 3250

<u>IPL = -3050</u>

$$IPH = 8000 + \frac{(7800)\ (20.5 - 12)}{(12-6)} \qquad = 8000 + \frac{(7800 \times 8.5)}{(\ 6\ )}$$

$$IPH = 8000 + \frac{66300}{6}$$

<u>IPH = 19050</u>

Note 1: If IPL or IPH are greater than ± 19999, then divide both IPL and IPH by 10. This will give less resolution.
Note 2: Decimal point can be placed anywhere to suit reading.

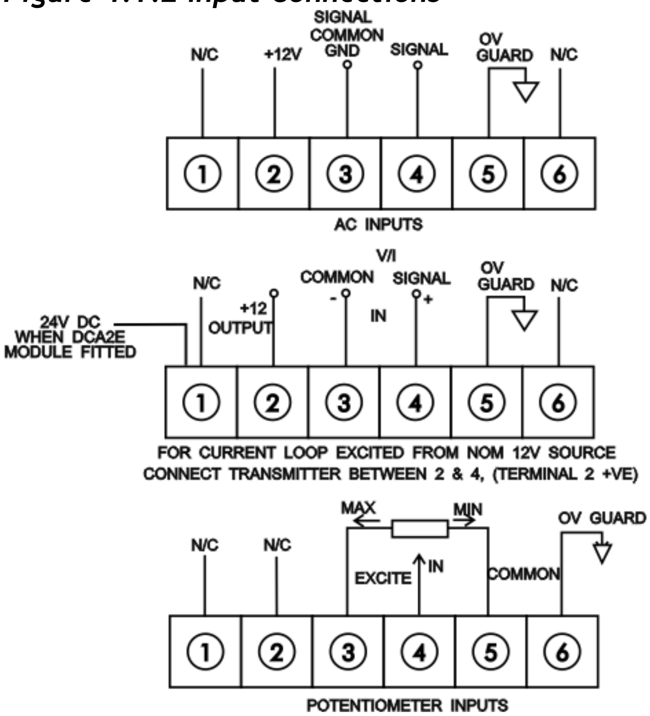
Connecting the Inputs

WARNING: ENSURE POWER IS SWITCHED OFF BEFORE MAKING CONNECTIONS TO THE ADP

Connect AC, DC, pressure or potentiometer inputs as shown in Figure 4.1.1.

Note: AC and DC floating inputs should be earthed via terminals 3 or 5.
Potentiometer floating inputs should be grounded via terminals 5 or 6.

Figure 4.1.2 Input Connections



Pressure Input

The input module provides for direct connection to any pressure or strain sensor.
A 10 volt excitation is provided and it is monitored to compensate for any variation due to supply drift, load regulation or voltage drop in the cable between the sensor and the ADP. The supply current is 150mA. Inductive and capacitive filters are used on all input excitation to give high noise immunity. Sensitivity is pre set via DIL switches to 0.5, 0.8, 1.0, 1.25, 1.5, 2.0, 2.5, 3.5, 5, 10, 20, 50, 100 and 200mV/V.

SW1 mV/V	1	2	3	4	5	6	7	8
0.5	-	x	x	-	-	x	x	x
0.8	-	x	-	-	-	-	x	x
1.0	-		x	x	-	-	-	-
1.25	-	-	x	-	-	x	x	-
1.5	-	-	x	-	-	-	-	-
2.0	-	-	-	x	x	-	-	-
2.5	-	-	-	x	-	x	-	-
3.5	-	-	-	-	x	x	-	-
5.0	-	-	-	-	x	-	-	-
10.0	-	-	-	-	-	x	-	-
20.0	-	-	-	-	-	-	x	x
50.0	-	-	-	-	-	-	-	x
100.0	-	-	-	-	-	-	-	-
200.0	x	-	-	-	-	-	-	-

x = ON - = OFF
mV/V = ±mV/V nominal full range gain within ±3%

Hardware Configuration

The ADP15 is supplied set to ±2.5mV/V maximum output. To check that the pressure transducer and application is within this range, apply the following formula:

$$\frac{\text{Maximum Pressure x transducer output voltage}}{\text{Pressure transducer rated range}}$$

From the resultant figure select the next highest mV/V setting from the table.
Before any calibration can be set, it will be necessary to decide upon the calibration values and place the decimal point in the appropriate position. To do this, scroll through the parameters, entering the password as appropriate, until the decimal point parameter is reached (dP-r).
Once the decimal point is set, the auto calibration parameters can be set in real engineering terms.

Auto Calibration

Connect transducer, switch on the ADP15. The display will light up. Allow a warm up period of 10 minutes before carrying out the procedure as follows;
a) Press the [↻] key until PASS appears.
b) Enter the password using [▶] and [▲] keys, then press [↻] key.
c) Keep pressing the [↻] key until CALL (Cal Low) appears.
d) Press the [▶] key and check that the program light flashes.*
**IMPORTANT NOTE: Always ensure that the programmer indicator flashes, even though the displayed value may not need to change.*
e) Check that the displayed value agrees with the low calibration pressure applied to the transducer (this may be zero).
If this is not correct, alter the display value by pressing the [▶] & [▲] keys.
Ensure that the strain gauge is free from disturbance and press the [↻] key to capture and calibrate the CALL value.
f) CALH (Cal High) now appears on the display.
g) Press the [▶] key and check that the program light flashes.
h) Apply the known higher value pressure.
Check that the displayed value agrees with the high calibration pressure applied to the transducer.
If this is not correct, alter the display value by pressing the [▶] & [▲] keys.
Ensure that the transducer is free from disturbance and press the [R] key. The display will now indicate the transducer auto calibrated high value.

Note 1: The Calibration value is not entered into the memory until either the [↻] key or the [R] key is pressed.
Note 2: CALH must always be greater than CALL, in both weight and entered values.
Note 3: Pressing the [R] key at any time will return the display to normal operation.
Note 4: For best accuracy and resolution, the calibration pressure should be approximately 75% of the transducer capacity.
Note 5: For range check before Auto Cal, set CAL H to O and display will be that of the A/D counts. It is important that the A/D span between the CALL pressure and CALH pressure, is greater than the span of the values entered for CALL and CALH, otherwise the display resolution will not be 1digit.
Note 6: CALH can be set before CALL if required.
Note 7: CALH and CALL can be programmed individually with any time period between provided that the [R] reset key is pressed to store the value.

Figure 4.1.3 Pressure Input Connection

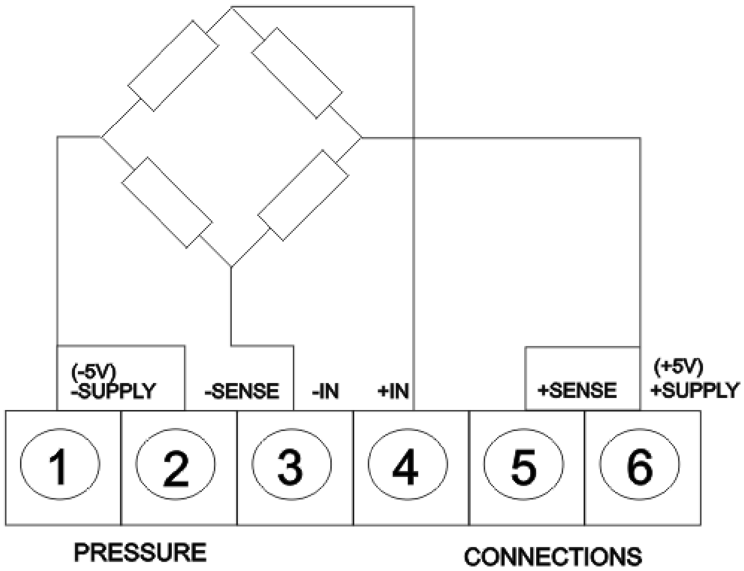


Figure 4.1.4 ADP Module Layout

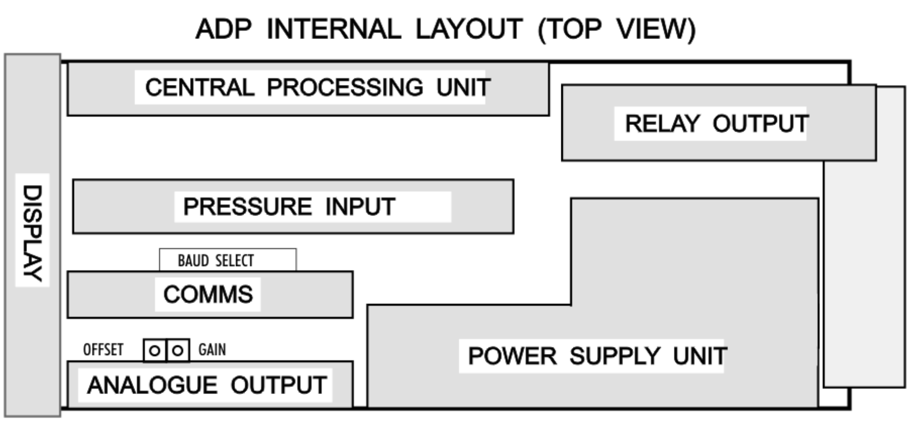
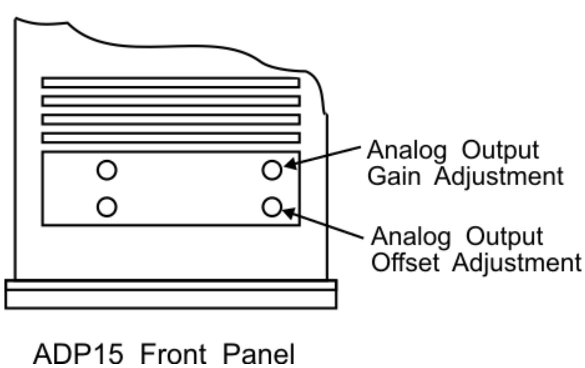


Figure 4.1.5 Analogue Output Gain and Offset Adjustment



Chapter 4 Section 2 Temperature Inputs

Temperature Inputs

The ADP15 provides very accurate temperature measurement from thermocouple or resistance thermometer inputs.

The microprocessor linearises the input signal with accuracy ensured by the application of a polynominal expression.

This arrangement provides a high resolution digital readout in units of Centigrade, Fahrenheit or Kelvin, as required.

Resolution of either 0.1 or 1.0 degree can be selected from the keypad.
The input type must be selected on ordering as detailed in the ordering codes (see Chapter 9).

Thermocouple Cold Junction Compensation

Cold junction compensation is provided for the ADP15 by the inclusion of an external sensor. Alternatively, the sensor can be fitted internally or remotely if required.

For maximum accuracy, the junction compensation should be installed as close as possible to the junction of copper or non thermocouple connector cables.
The ADP is normally supplied with the junction compensation fitted to the terminal board (See fig 4.2.2). Table 4.2.1 summarises the most commonly used thermocouples and the associated ADP input modules which should be selected.

Setting Up Codes for Thermocouples

To monitor temperature inputs from a thermocouple, set the (IP) code to select the pre calibrated analogue input module, together with the required display value and resolution (See Table 4. 2.1).

(IPL) must be set to zero for any of these display options. However, if any offset factor is required e.g. to compensate for minor temperature discrepancies between cold junction and thermocouple cable, set the (IPL) to the required offset value.

Alternatively, small offsets may be applied via the offset potentiometer which can be accessed through the top of the ADP case.
(See Figure 4.2.1.)

Should a display be required in degrees Kelvin, it will be necessary to select the (IP) on 0ºC and set the (IPL) to +273ºC.

Figure 4.2.1 Thermocouple Connectors

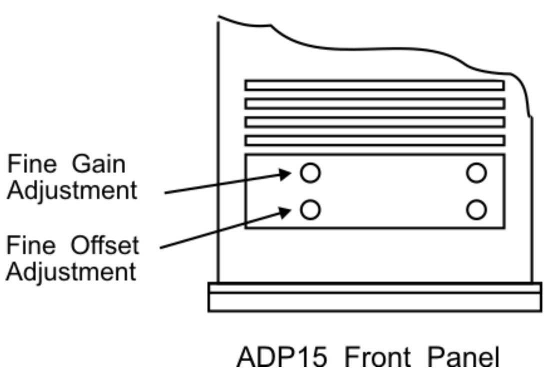


Table 4.2.1. - Thermocouple Input Codes

Thermocouple Type	ADP Range	Readout	Resolution	Code Module	ADP Input
		Centigrade	0.1	26	
B	+400ºC		1.0	27	
	to+1820ºC	Fahrenheit	0.1	42	T6
				43	
E	-230ºC	Centigrade	0.1	28	
	to+1000ºC		1.0	29	T8
			0.1	44	
		Fahrenheit	1.0	45	
J	-170ºC	Centigrade	0.1	30	
	to+760ºC		1.0	31	T2
			0.1	46	
		Fahrenheit	1.0	47	
K	-230ºC to	Centigrade	0.1	32	
	+1300ºC		1.0	33	T1
			0.1	48	
		Fahrenheit	1.0	49	
		Centigrade	0.1	40	
N	-200ºCto		1.0	41	T7
	+1300ºC		0.1	56	
		Fahrenheit	1.0	57	
R	0ºC to	Centigrade	0.1	34	
	1760ºC		1.0	35	
			0.1	50	T3
		Fahrenheit	1.0	51	
S	0ºC to	Centigrade	0.1	36	
	1760ºC		1.0	37	T4
			0.1	52	
		Fahrenheit	1.0	53	
T	-220ºC to	Centigrade	0.1	38	
	+400ºC		1.0	39	T5
			0.1	54	
		Fahrenheit	1.0	55	

Connecting the Thermocouple

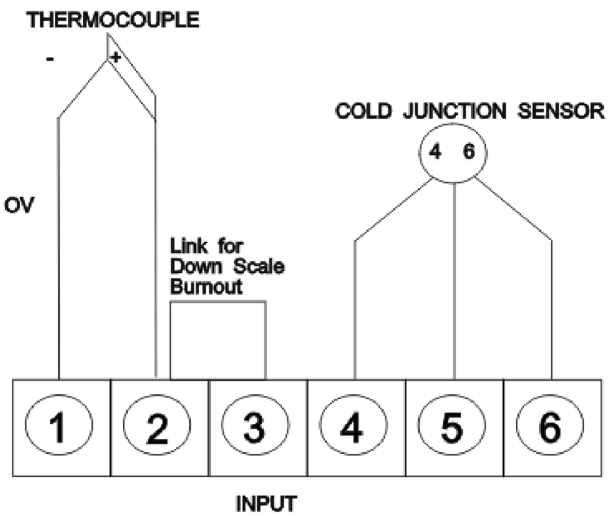
WARNING: ENSURE POWER IS SWITCHED OFF BEFORE MAKING CONNECTION TO THE ADP

1. Connect the thermocouple to the ADP terminal board as shown in Figure 4.2.2
Note: If the thermocouple has a floating input, connect terminal 1 to ground.

2. The external cold junction sensor is always connected between input terminals 4 and 6. If no external sensor is used, link terminals 4 & 6

3. Normally, thermocouple burnout is indicated by upscale overrange. If downscale indication is required, link terminals 2 & 3

Figure 4.2.2 Thermocouple Connectors



Resistance Thermometers

This is normally a PT100 type of RTD.
Resistance thermometer connections to the ADP depend upon the lead configuration, which is itself determined by the required level of accuracy. For applications where a high accuracy measurement is not required a 2 or 3 wire installation is adequate. For high accuracy, a 4 wire connection should be used to compensate for lead resistance and connector losses.

Setting up Codes for Resistance Thermometers

To monitor temperature inputs from an RTD, set the IP code to select the pre calibrated analogue input module, together with the required display value and resolution as summarised below.

Display Units	Resolution	Code
Centigrade	0.1	60
Centigrade	1.0	61
Fahrenheit	0.1	58
Fahrenheit	1.0	59

IPL must be set to zero for any of these display options, however, if any offset factor is required e.g. to compensate for minor temperature discrepancies between cold junction and thermocouple cable, set the (IPL) to the required offset value. Alternatively, small offsets may be applied via the offset potentiometer, which can be accessed through the top of the ADP15 case.
See Figure 4.2.1.

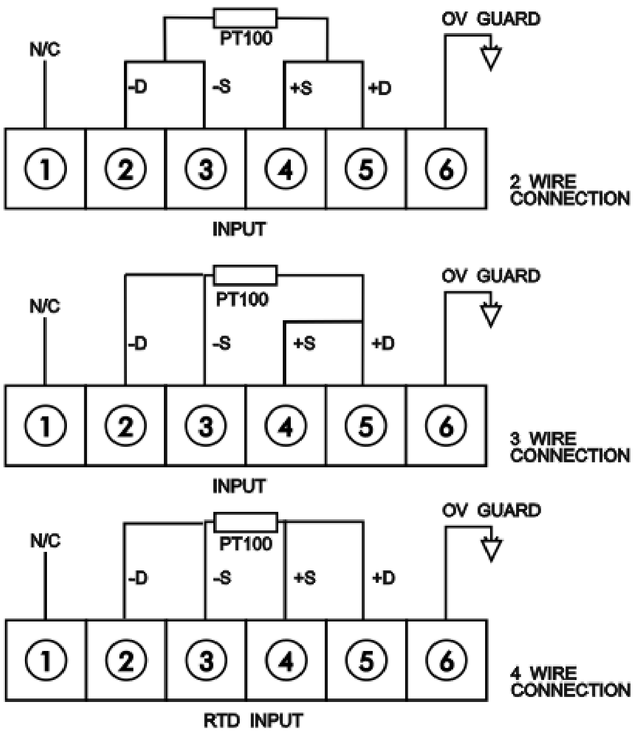
Should a display be required in degrees Kelvin, it will be necessary to select the (IP) on 0ºC and set the (IPL) to+273ºC.

Connecting the Resistance Thermometer

Connect the resistance thermometer to the ADP terminal board as shown in Figure 4.2.3 using the terminals appropriate to 2, 3 and 4 wire connections.

Note: It is recommended that 4 core screened cable is used for this connection with terminal 6 used for screen and ground.
If, however, this is not practical, terminal 2 may be used for guard and ground.

Figure 4.2.3 RTD Connections



Chapter 4 Section 3 Rate/Totaliser

General Description

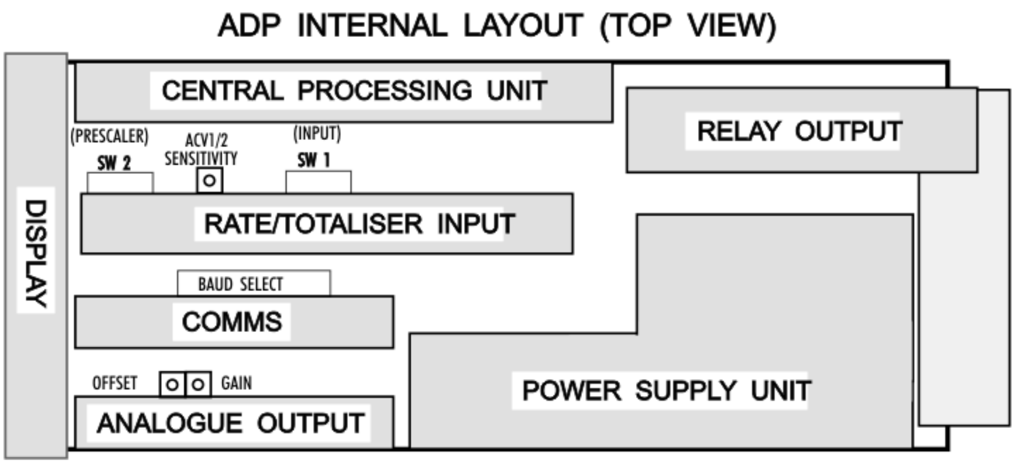
The module allows the monitoring of frequency, RPM, period or pulse totalising from a wide range of transducers, the details of which are shown in Table 4.3.1

The module can be configured for any of the functions referred to in Table 4.3.1 and transducer types, by DIL switches keypad set parameters and connections. See Table 4.3.2

Setting up the Rate/Totaliser Module

Unclip the fascia, remove the screws under the display module and withdraw the back-plane until the rate/totaliser module is identified.

Figure 4.3.1 ADP Module Layout



Setting up the Input

The types of input chosen will depend upon the sensor requirements and can be determined from the table:

Table 4.3.1

Type	High Pulse Level	Threshold	Hysteresis	Input Impedance	Excitation
DCV	5-30V	3.5V	1.5V Typical	100K min or 5K6	5V, 50mA
ACV1	±30mV to 35V	*20mV-2V	*5mV to180mV	5K min	5V, 50mA
ACV2	±3V to 35V	*2.5V-35V	*120mV- 2.0V	5K min	5V, 50mA
AC/DCmV	±15mV - 5V	8mV	2mV	10M	5V, 50mA
NAMUR	2.5 to 17mA	1.6mA	90uA	680R	8.3V, 50mA

*Adjustable by potentiometer.
When selecting the type of input required by the sensor, from Table 4.3.1, set the DIL switches on SW1, as shown in Table 4.3.2 (The ADP layout diagram Fig 4.3.1 refers.)

Table 4.3.2 Input Configuration

Type	SW1) Switch Settings
	* *
	1 2 3 4 5 6 7 8
ACV1	1 0 1 0 1 x 0 1
ACV2	1 1 0 0 1 x 0 1
AC/DC mV	0 0 1 0 1 x 0 1
NAMUR	1 1 0 0 1 x 0 1
DCV (pull up for volt free or contact type inputs)	1 0 0 1 0 x 0 1
DCV (pull down for voltage fed inputs up to 30V)	1 0 0 0 1 x 0 1
DCV (Standard CMOS type input)	1 0 0 0 0 x 0 1

Legend

1 - Switch 'on'

0 - Switch 'off'

x - See Note 1

* - See Note 2

Note 1: Switch 6 selects a low pass filter with a 10uS time constant on DCV Input only
Note 2: For totalising, set switch 7 'on' and 8 'off' on all ranges

Setting the Prescaler

Depending upon the rate of the frequency, RPM or period to be measured or the maximum desired count of the totaliser, it will be necessary to select the prescaler by setting the DIL switches on SW2 as shown in the Table 4.3.3 below.

Table 4.3.3

Prescaler	(SW2) Switch Settings
	1 2 3 4 5 6
Divide x 1	x 1 0 0 0 0
Divide x 10	x 0 1 0 0 0
Divide x 100	x 0 0 1 0 0
Divide x 1,000	x 0 0 0 1 0
Divide x 10,000	x 0 0 0 0 1

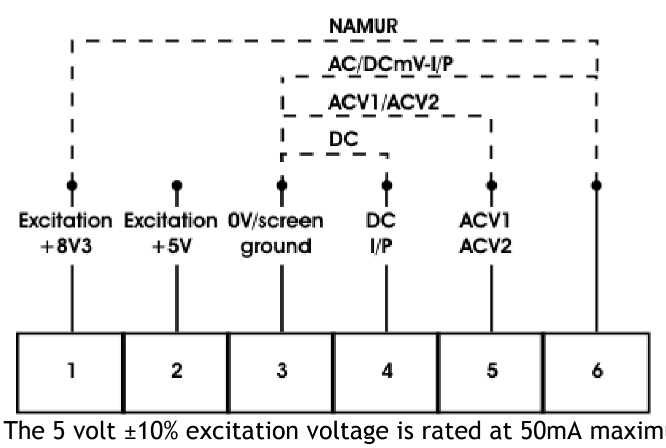
Legend
1 - Switch 'on'
0 - Switch 'off'
x - Not used

Note 1: Select only one switch to the 'on' position
Note 2: It will be necessary to increase the prescale divide factor by setting the switch to a higher position if the input is overrange.

Connecting the Rate/Totaliser Input

WARNING: ENSURE THE POWER IS SWITCHED OFF BEFORE MAKING CONNECTIONS TO THE ADP

Connect the appropriate input to the terminal block as indicated on next page:



The 5 volt ±10% excitation voltage is rated at 50mA maximum via a 10 Ohm protection resistor.
The 8V3 ±1% excitation voltage is rated at 50mA maximum and is short circuit protected.

Totaliser Measurement

Totaliser measurement is obtained by a count of input pulses which can be scaled to the desired display range by setting scale and offset factors, together with the prescaler set from DIL switches on the module.

The pulse totaliser provides an incremental totalising count, with a display maximum of 19,999 and a count maximum of 65,535 after the application of the prescaler.

The count can be keypad scaled using scaling and offset factors. See Scaling section on page 37

A count can be reset by a keypad sequence, an external volt free contact, (by adding 8 to the DP-r value) the communications module or a reset on power up.

The maximum input frequency after prescaler is 8KHz.

Totaliser Input Code Selection

Selection of the totaliser function is achieved by the selection of the IP code 64 (65 for divide by 10) and also by setting DIL switches (SW1) ensure 7 is on and 8 is off.

Rate Measurement

Rate measurements are achieved by measuring the period between input signals.
From this, period measurements, frequency and RPM can be derived.
These measurements can be scaled to any desired display range by setting scale and offset factors from the keypad together with a prescaler set from DIL switches on the module.
SW1 7 off, 8 on, and IP set by key pad to table 4.3.4

Period (Time measurement between pulses)

Period measurements from 20μS to 1999.9mS can be monitored by means of prescaler and is divided into 2 ranges:

Input Code

The input code (IP) sets the type of rate measurement required i.e. Period,
Frequency, RPM and is selected from the table below:-

Table 4.3.4

Type	Code	Divide by 10
Frequency	12	13
RPM High Resolution	14	15
RPM	16	17
Period in mS	2	3
Period in μS	6	7

(i) Period in mSeconds

Table 4.3.5 Period mS Fixed Scale

Prescale	Divide by 1	Divide by 10	Divide by 100	Divide by 1000	Divide by 10000
Input	0.2mS to 1999.9mS	0.02mS to199.99mS	0.02mS to19.999mS	20μS to1999.9μS 0.1μS	20μS to199.99μS
Resolution	0.1mS	0.01mS	0.001mS	0.1μS	0.01μS
Noise	0.1mS	0.01mS	0.001mS		0.01μS

(ii) Period in µSeconds

Table 4.3.6 Period µS Unity Scale (IPSF 1.0000)

Prescale	Divide by 1	Divide by 10	Divide by 100
Input	150µS to 19999µS	20µS to 999.9µS	20µS to 199.99µS
Resolution	1.0µS	0.1µS	0.01µS
Noise	3.0µS	0.3µS	0.03µS

NB: These tables only apply when the scale factor is set to unity and the offset is zero.

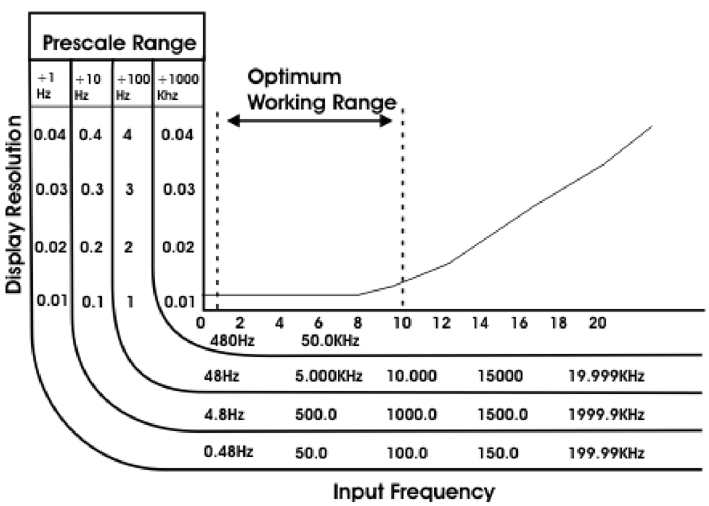
Frequency

Frequency measurements from 0.48Hz to 50KHz can be monitored be means of prescaler.

Table 4.3.7

Prescale Range	Divide by 1	Divide by 10	Divide by 100	Divide by 1000
Full input Range	0.48Hz to199.99Hz	4.8Hz to1999.9Hz	48Hz to19.999KHz	480Hz 50KHz
Optimum Input Range	0.48Hz to100.00Hz	4.8Hz to 1KHz	48Hz to 10KHz	480Hz 50KHz

Figure 4.3.2 Frequency Unity Scale Inputs



Worst noise level = 3 x resolution for the same input frequency
Note: This applies when the scale factor is set to unity and the offset is zero.

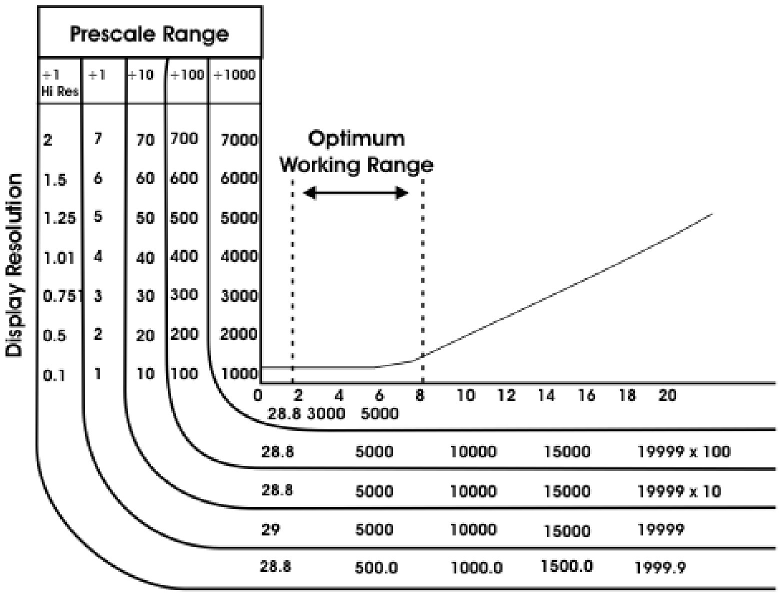
RPM

RPM measurements from 28.8 to 3 million can be monitored be means of prescaler and high resolution range and represented by 1 pulse per revolution.

Table 4.3.8 RPM Unity Scale

Prescale Range	Divide by 1 High (0.1) *Resolution*	Divide by 1	Divide by 10	Divide by 100	Divide by 1000
Full Input Range	28.8 to 1999.9	29 to 19999	28.8 to 19999 x 10	28.8 100 19999 x 100	28.8x 1000 3000 x 1000
Optimum	28.8 to 500	29 to 7000	28.8 x 10 to 700 x 10	28.8 x 100 to 7000 x 100	28.8 x 1000 3000 x 1000

Figure 4.3.3 RPM Unity Scale Range



Input RPM
Worst Noise Level = 3 x resolution for the same input

Count/Rate Scaling

Scaling/Rate

The count/rate input can be represented over any display range by applying keypad set parameters known as scale and offset factors.
The actual count/rate would be displayed when the scale factor is unity (1.0000) and offset factor is zero.
The scale factor applies a variable gain to the count/rate and is set by the mnemonic (IPSF)

IPSF is calculated as follows:

$$\text{IPSF} = \frac{\text{Required change in display digits}}{\text{Change in count/rate value}}$$

IPSF has a range of 0.0001 to 1.9999

The offset factor is added to or subtracted from zero offset displayed value and is set by the mnemonic (IPOF).

IPOF is calculated as follows:

IPOF = Required display digits - (IPSF x required count/rate value)

IPOF has a range from -12767 to +19999

Scaling Example:-

For a low frequency input of 139Hz, a display of 46 litres per minute is required for a high frequency input of 710Hz, a display of 250 litre per minute is required.

Scale Factor - IPSF = $\frac{250 - 46}{710 - 139} = \frac{204}{571} = 0.3573$

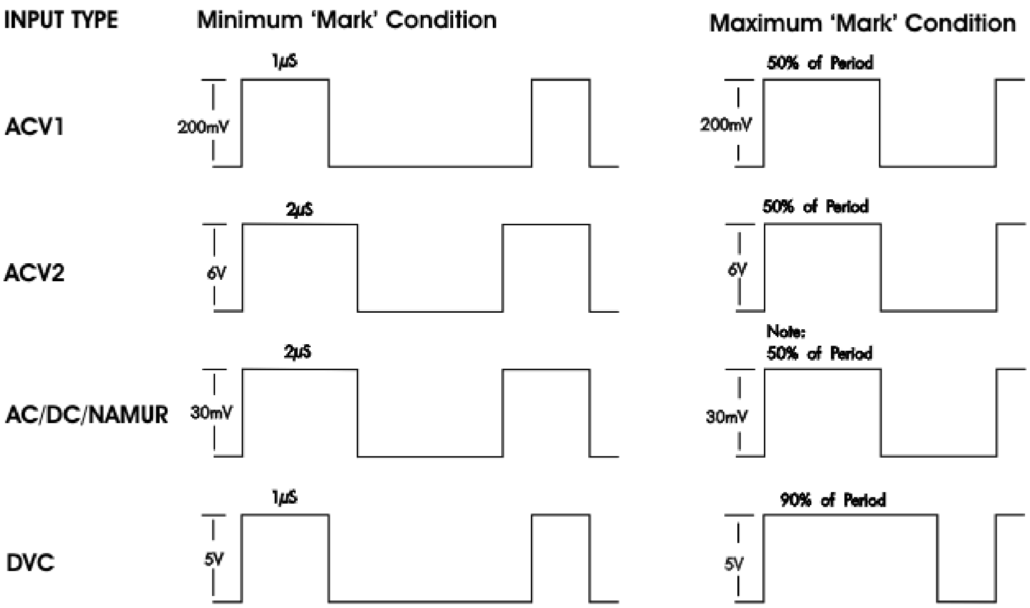
Therefore IPSF = 0.3573

Offset Factor - IPOF = 250 - (0.3573 x 710) = -3.683

Therefore IPOF = - 3.683

RTL Module Inputs

The RTL module can accept four types of input as follows:-



Notes : Minimum period equals 20µS
: For ACV2 inputs over 6V with greater than 50% 'Mark' use ACV1.

Chapter 4 Section 4 TLQ Quadrature Input Module

Introduction

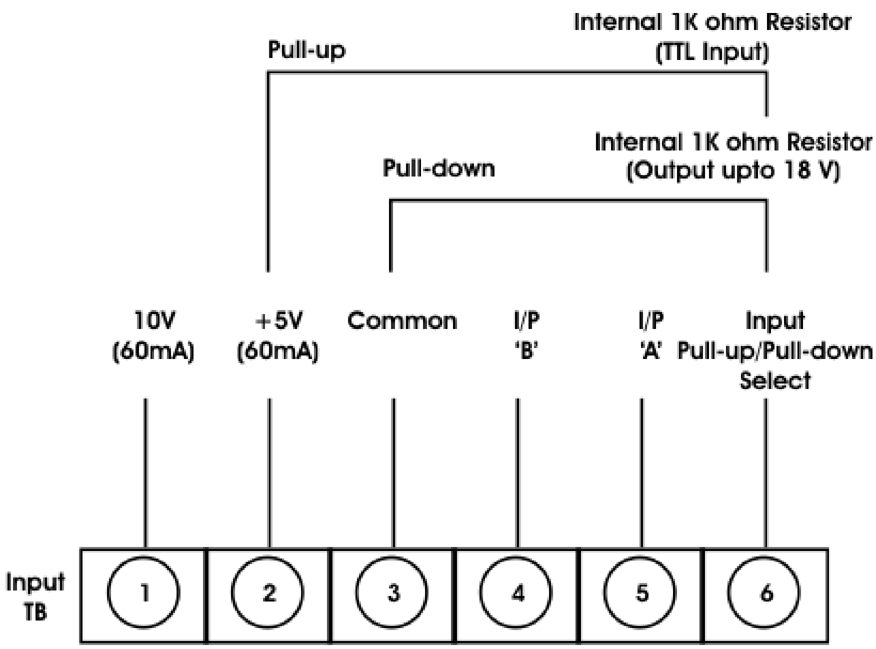
This module is used with incremental rotary shaft or linear encoders. Information is obtained from incremental encoders by counting; the disc pattern in this case consists of a number of radial lines, equally spaced to give a specified number of 'increments' per revolution.
The number of increments can be selected according to the information required i.e. 360 lines will give 1 count per 0.1mm.
Alternatively, if one complete revolution produces 100mm of linear movement, 1000 lines would give 1 count per 0.1mm.
The output form an incremental encoder can take three forms. Square wave is the most commonly used format but sine wave and pulsed output are also available.
In its simplest form the incremental encoder with sine or square wave outputs has only one channel (A). This allows position and speed to be calculated, but direction of travel cannot be determined, This is often referred to as 'tachometer output'. In order to derive direction, a second channel (B) is added and 90 degree phase shift between A & B channels allows direction sensing to be carried out. Channel A will lead channel B for a clockwise rotation and vice versa for counter clockwise.
Sometimes, due to restrictions in size, the disc pattern is unable to produce sufficient resolution for a particular application. To overcome this problem, a multiplication method can be used.
With pulse multiplication, the disc resolution can be increased 1, 2 or 4 times by generating pulses on the leading and falling edges of the original quadrature signals. On this module, four edge detections will give one display count.
When using this method, direction sensing is also carried out with pulses appearing on specific channel according to the direction of rotation, or linear movement.

TLQ Quadrature Input Specifications

Inputs:	Quadrature, 2 inputs A and B phase shifted, for up/down count. Suitable for 5 volt logic, open collector NPN or PNP.
Input Voltage Level:	Low less than 1V0.High greater than 3V0
Input Frequency:	0 - 8KHz (125µs between edges)
Input Impedance:	1 Kohm to +5V or 0V (linked via the rear connector)
Maximum Input Counts (Edges):	268 million
Scaling - Division Factor (DF)	0 = 1.0 1 = 0.1 2 = 0.001 3 = 0.0001
Fine scale factor =	x 0.04 x 1.9990 (inset by (IPSF) = 400 to 19999, (10,000 being unity)) With a scale factor of unity, 1 display count given for each input edge.
Maximum preset (ISOF) =	± 12,000

Mnemonics	SP1-	Set Point 1
	SP2 -	Set Point 2
	HYS -	Hysteresis
	OL -	N/A (always zero)
	OA -	Output Action
	DF-	Division Factor
	IPOF-	Display Preset
	IPSF-	Fine Scale Factor
	OPL-	Output Low
	OPH-	Output High
	IP-	N/A (always zero)
	DP-	Decimal Point Position
	CP-	Communictions Protocol Fast MANTRABUS format only)
	SDST-	Comms Station Number

Figure 4.4.1 Connecting the Quadrature Input



Chapter 4 Section 5 C69C LVDT Supplementary Information

Excitation voltages	2.6 volts RMS ± / 0.15 volts
Excitation frequency	1, 2, 3, 4, or 5 KHz selected by DIL switches
Sensitivity	20mV, 50mV, 100mV, 200mV, 500mV, 1V, 2V, 5V and 10V. Full range operation for a full scale reading of the ADP, preset to within 5%, selected by DIL switches.
Calibration	By software, auto calibration, no user adjustable potentiometers. Accuracy ±2 display digits as set in calibration mode, subject to change with temperature and non-linearity as detailed below.
Offset Adjustment	Initially achieved by auto calibration. In addition, user offset using keypad and display.
Gain drift	75 ppm per degree C typical, 200 ppm per degree C, maximum.

Offset drift	For sensitivity	Typical ppm/°C	Max ppm/°C
	20mV	35	150
	50mV	18	90
	100mV	15	70
	200mV	10	60
	500mV	10	60
	1V-10V	10	55

Non linearity	±/0.05% FS typical, ±/0.1% FS maximum
Drive impedance	68 ohms minimum
Connection	4 wires. 2 for primary, 2 for secondary Wired in series with a common floating. 1 x zero volt for screen/earth
Protection	Input protected against short circuit

NB. Please refer to the ADP15 details for all setting up, connections and communications. 'In Flight' compensation values are not required with an LVDT and no PID control is offered

Figure 4.5.1 LVDT Rear Panel Connections

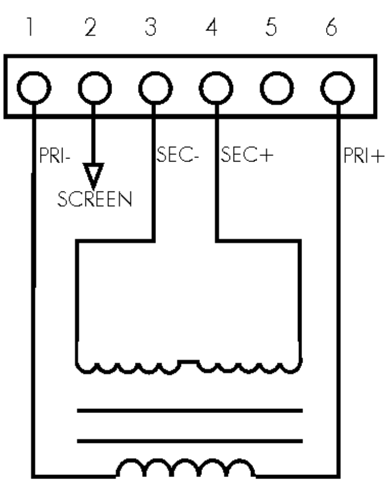
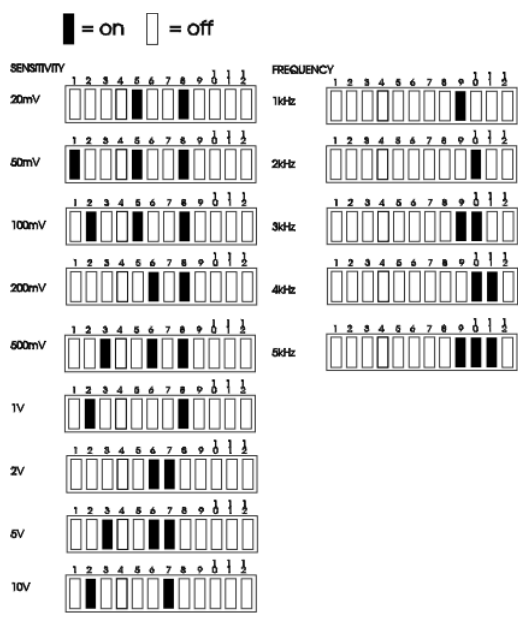


Figure 4.5.2 LVDT Switch Settings



Chapter 5 Relay Output Module

General Description

Relay output modules provide output control signals which can be used for switching functions such as ON/OFF control, PID control and alarm indications. The relays are activated by the values programmed for the Set Points. The output configuration will be for open or closed relay contacts and latching, relay inversion, time delays and hysteresis.

The relay output module options are as follows:

Table 5.1

Output	Function
1 Relay 1 Relay 2 Relays 1 Relay 1 Relay	SPCO on SP1 DPCO on SP1 SPCO on SP1or SP2 SPCO on SP2 DPCO on SP2

The connections for which are shown in Chapter 2.

Module Functions

The ADP can be programmed so that the relay output module reacts to all or any of the following functions:

- Set points
- Hysteresis
- Relay inversion
- Latching
- Time Delays
- PID

Set Points (SP)

Set points are used to produce output signals at any required value so that the operation of the monitored process can be maintained to pre-set levels.
Any excursion beyond set points will activate the relay(s) to provide status indications or initiate control as required.
Two set points (SP1) and (SP2) can be programmed to suit different applications.
The actions of either or both set points can be inverted if required.
For normal operation, the set point output is active until the input reaches the set point level. In this condition, when the input value is less that the set point, the SP indicator is on and the output relay is energised producing a closed circuit on a normally open circuit output.
For an inverted operation, the reverse conditions apply.
Normal and inverted action is determined by the direction of the input value as it changes.
For example:

A High-High operation allows for a rising input value to operate on two set points to define an acceptable quantity or band of operation, providing 1 alarm and 1 shut down or a 2 stage control i.e. fast and slow feed.

A Low-Low operation operates on a falling value.
A High-Low operation will operate on a rising or falling value, setting a' pass band' by one set point operating normally and the other being an inverted action.

Hysteresis (HYS)

Once a hysteresis value has been set, it will be applied to both set points entered.
It is effective for both normal and inverted action.

When hysteresis is applied to set points with normal action, the input is allowed to rise to the set point value and the output is then turned off. The output is held off until the input value has dropped to the set point minus the Hysteresis value.

For inverted action, the input drops to the set point and the output goes off and comes on again when the input rises to the set point plus the Hysteresis value.

Latching Outputs (OL)

The latching facility allows the relay module output to be held until reset either by keypad, external remote or via the communications port.
Latching is applied to the off status of the relay SP1 or SP2.

Table 5.2 Output Latch Codes (OL)

SP1	SP2	Code
Unlatched	Unlatched	0
Latched	Unlatched	1
Unlatched	Latched	2
Latched	Latched	3

Display OL and enter required code using the keypad as detailed in Chapter 3.
Please Note: Latching Outputs cannot be used with PID

Output Action (OA)

The output action facility allows the user to determine whether set points produce normal or inverted output operation. If an analogue output module is also fitted, the output action function determine whether the modules output is inverted or not and if PID power level is also directed to the analogue output. The output action (OA) is entered by a code to suit the requirements of the user.

Output Action options are available.
The value of the OA to be entered in the algebraic sum of the following components:

Table 5.3

SP1 Inverted	= 1
SP2 Inverted	= 2
PID on Analogue Output	= 4
AN-OP Inverted	= 8

Example 1: If SP1 requires to be inverted and PID on the analogue output, enter 4 + 1 = 5.

Example 2: To invert the analogue output and invert SP2, enter 8 + 2 = 10

Delay Timers

For applications where PID is not used (PB=0)and time delayed outputs are specified, 'ON' and delay 'OFF' times can be set via the keypad.

Delay On Timer

The delay on timer applies to SP1 and SP2 and initiates a delay before either set point can turn on. The delay timer will be reset if the off state is called for during the delay time. This is set by ‘ont’ code in seconds ranging from 0 to 255.

Delay Off Timer

The delay off timer applies to SP1 and SP2 and initiates a delay before either set point can turn off. The delay timer will be reset is the on state is called for during the delay time. This is set by ‘oFFt’ code in seconds ranging from 0 to 255.

PID Functions

The four components of a PID function are proportional band (Pb), integral time (It) and derivative time (dt). The cycle time is set by input code (ct).

To set the proportional band, display (Pb) and enter the required operating band in terms of the displayed units as described in Chapter 3.

When PB is selected, the Relay 1 (SP1) is used by the PID as a time proportional output.

PID Empirical Tuning

1. Set Pb to the max 1023 and ct to a low value consistent with the mechanical constraints and system requirements.

2. Vary the input or the set point and note the system response, reduce the Pb by half and repeat, continue to reduce Pb until the process starts to oscillate, then increase Pb until it is stable.

3. Set the integral time to max (6000) and reduce it in stages until the proportional offset is eliminated. There should be a slow oscillation around set point.

4. Set a low value of dt and gradually increase this until the slow oscillation ceases.

5. Lower the value of Pb and increase the value of dt after each change, disturb the process and check that control is maintained. The final setting will be that which gives satisfactory control in the presence of these small disturbances.

6. The following equation must be applied to ensure that the system operates correctly

$$\frac{ct}{Pb \times it}$$

must be greater than the constant .00012255 where Pb is expressed in whole numbers, ignoring any decimal point setting.

i.e. 100.0 will be taken as 1000

Chapter 6 Analogue Outputs

Module Types

Ten types of analogue output are available, offering five DC current ranges, four DC voltage ranges and a frequency output.
All outputs are fully linearised, fully scalable, optically isolated and generated from the displayed input value.

Table 6.1 Analogue Output Modules

Output	Range	Module Ref
DC Voltage	0V to 1V	V1
DC Voltage	0V to 5V	V2
DC Voltage	1V to V	V3
DC Voltage	0V to 10V	V4
DC Voltage	± 10V	V6
DC Current	0 to 1mA	A1
DC Current	0 to 20mA	A2
DC Current	4 to 20mA	A3
DC Current	10 to 50mA	A4
DC Current	0 to 5mA	A5

Specification for Analogue Outputs Modules - A1, A2, A4 and A5

Parameter	Min	Typical	Max	Units
Zero temperature coefficient	-	0.0007	-	% FSD/ºC
Span temperature coefficient	-	0.0017	-	% FDS/ºC
Resolution	As display resolution	-	15 Bits	–
Linearity	-	-	0.003	% FSD
90 day Stability offset	-	0.0021	-	% FSD
90 day Stability gain	-	0.0017	-	% FSD
Max peak to peak noise	-	-	0.5	% FSD
Operating temperature range	-10	-	50	ºC

Module Specific	Min	Typical	Max	Units
Speed of response from display to An-op *See note*				
To settle within 1% of FS for a step change of 12.5%	-	1.9	-	S
To settle within 10% of FS for a step change of 12.5%	-	0.25	-	S
To settle within 1% of FS for a step change of 100%	-	3.1	-	S

Note: Response values are given from display to analogue.
Output scaling, OPL = -19999, OPH = 19999

Specification for Analogue Outputs Module - A3

Parameter	Min	Typical	Max	Units
Zero temperature coefficient	-	0.0007	-	% FSD/ºC
Span temperature coefficient	-	0.0017	-	% FSD/ºC
Resolution	As display resolution	-	15 Bits	
Linearity	-	-	0.003	% FSD
90 day Stability offset	-	0.0021	-	% FSD
90 day Stability gain	-	0.0017	-	% FSD
Max peak to peak noise	-	-	0.5	% FSD
Operating temperature range	-10	-	50	ºC

Module Specific	Min	Typical	Max	Units
Speed of response from display to An-op *See note*				
To settle within 1% of FS for a step change of 12.5%	-	0.37	-	S
To settle within 10% of FS for a step change of 12.5%	-	0.07	-	S
To settle within 1% of FS for a step change of 100%	-	0.8	-	S

Note: Response values are given from display to analogue.
Output scaling, OPL = -19999, OPH = 19999.

Specification for Analogue Outputs Module - V1, V2, V3 and V6

Parameter	Min	Typical	Max	Units
Output Load Current	0	-	50	mA
Zero temperature coefficient	-	0.0007	-	% FSD/ºC
Span temperature coefficient	-	0.0017	-	% FSD/ºC
Resolution	As display resolution	-	15 Bits	
Linearity	-	-	0.003	% FSD
90 day Stability offset	-	0.0021	-	% FSD
90 day Stability gain	-	0.0017	-	% FSD
Max peak to peak noise	-	-	0.14	% FSD
Operating temperature range	-10	-	50	ºC

Module Specific	Min	Typical	Max	Units
Speed of response from display to An-op *See note*				
To settle within 1% of FS for a step change of 12.5%	-	1.9	-	S
To settle within 10% of FS for a step change of 12.5%	-	0.25	-	S
To settle within 1% of FS for a step change of 100%	-	3.1	-	S

Note: Response values are given from display to analogue.
Output scaling, OPL = -19999, OPH = 19999.

Specification for Analogue Outputs Module V4

Parameter	Min	Typical	Max	Units
Output Load Resistance	5000	-	-	ohms
Output Load Current	-	-	2	mA
Zero temperature coefficient	-	0.0007	-	% FSD/ºC
Span temperature coefficient	-	0.0017	-	% FSD/ºC
Resolution	As display resolution	-	15 Bits	
Linearity	-	-	0.003	% FSD
90 day Stability offset	-	0.0021	-	% FSD
90 day Stability gain	-	0.0017	-	% FSD
Max peak to peak noise	-	-	0.5	% FSD
Operating temperature range	-10	-	50	ºC

Module Specific	Min	Typical	Max	Units
Speed of response from display to An-op *See note*				
To settle within 1% of FS for a step change of 12.5%	-	0.37	-	S
To settle within 10% of FS for a step change of 12.5%	-	0.07	-	S
To settle within 1% of FS for a step change of 100%	-	0.8	-	S

Note: Response values are given from display to analogue.
Output scaling, OPL = -19999, OPH = 19999.

Pulse Output Module (F1)

The module provides a varying frequency transistor switching output, between 2V min and 20V max, at a maximum current of 20mA.
A frequency range of between 0.142Hz and 2352.9Hz is available by means of prescaler. Scaling is provided by means of OPL and OPH as illustrated in Figure 6.1

The prescaler will give divisions of 1, 2, 4, 8, 16, 32, 64 and 128 by means of 8 DIL switches on the module.

Table 6.2

Switch Position	Divide Ratio	Frequency Range
1	1	18.204Hz-> 2352.90Hz
2	2	9.102Hz-> 1176.45 Hz
3	4	4.551Hz-> 588.26Hz
4	8	2.276Hz-> 294.11Hz
5	16	1.138Hz-> 147.06Hz
6	32	0.569Hz-> 73.528Hz
7	64	0.284Hz-> 36.764Hz
8	128	0.142Hz-> 18.382Hz

Output Available on Rear Panel

AN. Out+ =Positive Output
AN. Out- =Negative Output

Frequency 18.204Hz to 2352.9Hz

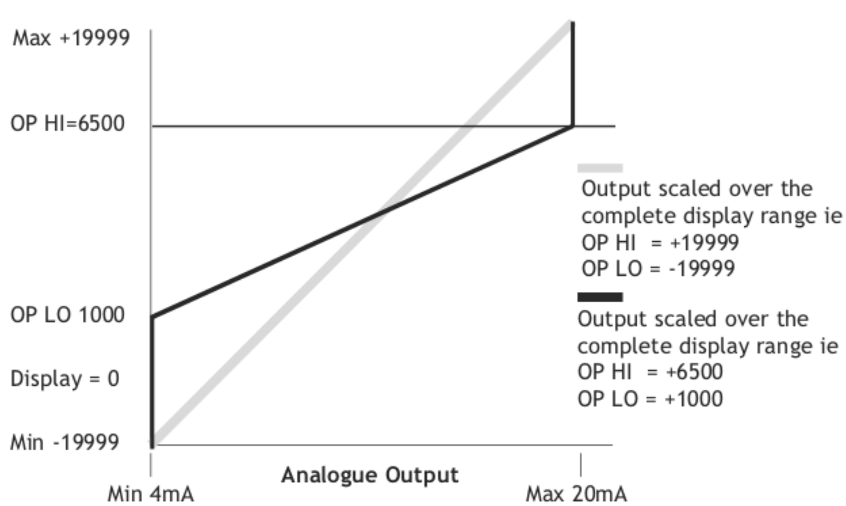
Output Scaling

Output scaling factors are set by the user and determine the display range over which the analogue module operates.
(OPL) Output Low - This sets the displayed value at the modules minimum output.
(OPH) Output High - This sets the displayed value at maximum output. If the display is outside the range defined by OPL and OPH, the analogue output will remain constant at its minimum or maximum output value.

Example: Assume a 4-20mA output module is required to provide an output of 4mA for 1000Kg and 20mA for 6500Kg. Set OPL to 1000 and OPH to 6500

It will be necessary to determine OPL and OPH by graphical or mathematical means if the known display values do not coincide with the minimum and/or maximum analogue output.

Figure 6.1 Analogue Output



Method of Calculating OPL & OPH from any known Output and Display Values

$$OPL = \text{Low Display} - \frac{(\text{Display span})\ (\text{Low output - Min output})}{(\text{High output - Low output})}$$

$$OPH = \text{High Display} + \frac{(\text{Display Span})\ (\text{Max output - High output})}{(\text{High output - Low output})}$$

Low output = Known low output
High output = Known high output
Min output = Lowest measurable value of output module
Max output = Highest measurable value of output module
Display span = Highest required display value minus lowest required display value.

Example:
Using a 4.20mA output module where it is required to produce 6mA at a display value of 400 and 18mA at a display value of 1100.

$$OPL = 400 \quad \frac{-(\ (700)\ (6 - 4)\ )}{(18 - 6)} \quad = 400 - \frac{(1400)}{12}$$

$$OPL = 400 - 116.66$$

$$\underline{OPL = 283.34}$$

$$OPH = 1100 \quad \frac{+700)\ (20 - 18)}{(18 - 6)} \quad = 1100 + \frac{(700 \times 2)}{12}$$

$$OPH = 1100 + 116.66$$

$$\underline{OPH = 1216.66}$$

Note 1: OPH must be greater than OPL
Note 2: If OPL or OPH are greater than ± 19999 then divide both OPL and OPH by 10, this will give less resolution.
Decimal point can be placed anywhere to suit reading.
Decimal point can be placed anywhere to suit reading.

Chapter 7 The Communications Port

Introduction

The ADP15 communications port provides for a 2 way data link. An intelligent host e.g. Personal Computer, Main Frame or PLC is able to acquire the ADPs displayed value and read or modify the user configurable parameters.

One communications format is an industry standard 20mA current loop offering high noise immunity and isolation over distances up to 1Km using ASCII or high integrity fast data protocol. In multiple unit applications, the IF25 interface is available providing electrically isolated RS232 compatibility for up to 25 ADPs.

In larger installations, multiple IF25s can be combined for expansion up to
254 ADPs.

ADP integrity is ensured by pre-programmed default parameters should a loss of communications with the host occur.

Alternatively an isolated communications module offers either RS232 or RS485 connection using ASCII and MANTRABUS protocols for connection to TDP, DP printers, PC and PLCs

Serial Communication Protocol

General

Incoming data is continually monitored by the ADP on its serial input line.
Each byte of data is formatted as an eight bit word without parity, preceded by one start bit and followed by one stop bit.

Transmission and reception of data up to 19.2K Baud is possible, the actual rate being selected by an eight-position slide switch on the communications module (of which only 7 positions are used). The Baud rate depends upon the communications, hardware specification, distance and cable type.

MANTRABUS - selected when CP is 128

To signify commencement of a new 'block' of data, the HEX number FFH is used as a 'frame' character, followed by the station number of the unit under interrogation. This is entered via the ADP keypad under mnemonic SDSt and ranges from 0-254).

The ADP acts upon incoming data only if its own station number immediately follows the FFH character.

New data must be received as a string of four nibbles (bits 7-4 set to zero) which are assembled into two bytes and written into the variables store within the ADP. The most significant nibble must be received first and the last nibble must have the most significant bit (bit 7) set to indicate the end of data. This is followed by the checksum.
The data transmitted from the ADP is always sent as complete bytes. The station number precedes the data and the checksum follows the data. The data format used is signed 15 Bit. The most significant Bit of the most significant Byte is set for negative numbers.

Operation

There are two modes of operation, namely data requests by the host controller and data changes. Data requests from the ADP consists of either a complete dump of the data variables stores in RAM or the display reading.
Data changes consist of writing new data to ADP variables, thus changing parameters such as Set Points, PID etc.
An acknowledgement message is returned to the ADP to indicate that the new data has been acted upon.

Updating

The required mode or variable to be updated is determined by the station number followed by the command byte.
An EXOR checksum consisting of the station number command byte and any following data must be appended to the received data. It is most important that the byte proceeding the checksum must have its most significant bit set to signify the end of the data.
The ADP worked out its own checksum and, if it disagrees with the received one, a not acknowledge (NAK) message is returned.

Communications Commands

The following is a list of commands available for reading to or writing from the ADP.

Command No.

DEC	HEX	Description	
1	1	Request all data includes Process Variable Input	
2	2	Request display data	
3	03	Set Point 1	SP1
4	04	Set Point 2	SP2
5	05	Hysteresis	HYS
6	06	Output Latch	OL
7	07	Output Mode Select	OA
8	08	Proportional Band	PB
9	09	Integral Time	IT (ont)
10	0A	Differential Time	DT (oFFt)
11	0B	Cycle Time	CT (da)
12	0C	Input Low	IPL
13	0D	Input High	IPH
14	0E	Output Low	OPL
15	0F	Output High	OPH
16	10	Input Range Select	IP
17	11	Decimal Point Position	DP-r
18	12	Station No.	SDST
19	13	EEPROM Enable/Disable Flag	---
20	14	Output Relay Reset	---
21	15	Totaliser Count Reset	---
22	16	Peak Hold Reset	---

COMMAND 1 Request For All Data:

DATA TRANSMITTED TO ADP FOR COMMAND 1

0FFH, Station Number, 081H, Chksum

Where Chksum = Station number EXOR with 081H
Example: To obtain a complete dump of the variables in the ADP whose Station number is 47 send the following Data:-

0FFH, 02FH, 081H, 0AEH
|
Note MS Bit Set

Response to COMMAND 1 from ADP

BYTE	Description
1	Station No.
2,3	Display
4,5	SP1
6,7	SP2
8,9	Hysteresis
10,11	Output Latch
12,13	Output select (norm/inv, Analogue out = display or PID power)
14,15	Proportional Band
16,17	Integral Time
18,19	Derivative Time
20,21	Cycle Time
22,23	Input Low
24,25	Input High
26,27	Output Low
28,29	Output High
30,31	Input Select
32	PID power output level
33	Decimal point position
34,35	Station No.
36	EEPROM Enable/Disable Flag
37	Output relay status (0HH - both relays off,80H = relay 1 on, 40H = relay 2 on, C0H = both relays on)
38	EXOR checksum of all the above data and Station No. NOTE: Most significant byte proceeds least significant byte for data sent

COMMAND 2 Request Display Data

DATA transmitted to ADP for Command 2.

0FFH, Station number,082H,Chksum

Where chksum = Station number EXOR with 082H
Example: To obtain the display reading of an ADP whose station number is 47 send the following Data:

```
 0FFH,02FH, 082H, 0ADH
              |
      Note MS Bit set
```

Response to COMMAND 2 from ADP

BYTE	
1	Station No.
2	Display reading M.S. Byte.
3	Display reading L.S. Byte.
4	EXOR checksum of above data and Station No.

If, when using COMMAND 1 or 2, an error is detected by the ADP, then the NOT ACKNOWLEDGEMENT string is transmitted by the ADP.(NAK)

COMMANDS 3 TO 18: Write Data to ADP Parameter

Commands 3 to 18 all have the same format.
Format for data transmitted to ADP fo Commands 3 to 18:-

0FFH, Station No, COMMAND No, MSN, NMSN, NLSN, LSN, CHKSUM

Where MSN	=	Most significant nibble of data
NMSN	=	Next most significant nibble of data
NLSN	=	Next least significant nibble of data
LSN	=	Least significant nibble of data with MSBIT set
CHKSUM	=	The following EXOR'd with each other, Station number, command number, MSN,NMSN, NLSN, LSN with MSBIT set.

Example: To change SP1 to 200.0 on an ADP whose station number is 47. The following data is set.
Please note the following points apply:-

1. The decimal point is ignored i.e. 200.0 equals 2000 digits
2. The data so sent in HEX nibbles so 2000 = 00H.07H, 0DH, 00H

0FFH,02FH, 03H, 00H, 07H, 0DH, 80H, 0A6H

Note MS Bit Set

Response to COMMAND 3 to 22

If the data has been accepted by the ADP the following acknowledgement string is transmitted by the ADP.

Station number,06H (ACK)

If there are any errors with the data received by the ADP then the following Not Acknowledgement (NAK) string is transmitted by the ADP:-

Station number,015H (NAK)

COMMAND 19: EEPROM Enable/Disable

The EEPROM disable facility can be used for any of the following:
cycles to EEPROM to limit degradation.

II. Change data in the ADP RAM only, allowing EEPROM to hold power up values.
III. Leave base constants in the EEPROM for later update to RAM which allows manipulation of the data before writing to the RAM.

Writing new data from the RAM to the EEPROM.

EEPROM disable is achieved by writing 0100H to the ADP via command 19. In this state all writing to, or reading from the EEPROM is inhibited.

The EEPROM can be re-enabled in two ways:

By writing 0200H via command 19.
This writes the current contents of the variables store in the ADP into the EEPROM.
By writing 0400H via command 19.
This updates the variables store from the current contents of the EEPROM.
Examples
To disable the EEPROM on an ADP whose Station number is set to 47

0FFH 02FH 013H 00H 01H 00H 080H 0BDH

To re-enable the EEPROM and update the RAM with the old EEPROM constants:

0FFH 02FH 013H 00H 04H 00H 080H 0B8H

To re-enable the EEPROM and update it with the new RAM Data:

0FFH 02FH 013H 00H 080H 0BEH

For response see 'Response to Command 3 to 22'.

COMMAND 20: Output Relay Reset

DATA transmitted to ADP for Command 20

FFH, Station Number, 094H, CHKSUM

Where CHKSUM = Station Number EXOR with 094H
Example: To output a relay reset to an ADP whose
Station Number is set to 47

0FFH, 02FH, 094H, 0BBH
|
Note MS BIT SET

For response by ADP see 'Response to Commands 3 to 22'

COMMAND 21: Totalized Count Reset

DATA transmitted to ADP for Command 21
0FFH, Station Number, 095H, CHKSUM

Where CHKSUM = Station Number EXOR with 095H
Example: To output a totalizer count reset command to an ADP whose
Station Number is set to 47

0FFH, 02FH, 095H, 0BAH
|
Note MS BIT SET

For response by ADP see 'Response to Commands 3 to 22'

COMMAND 22: Peak Hold Reset

DATA transmitted to ADP for Command 22

0FFH, Station Number, 096H, CHKSUM

Where CHKSUM = Station Number EXOR with 096H
Example: To output a Peak Hold reset to an ADP whose
Station Number is set to 47

0FFH, 02FH, 096H, 0B9H
|
Note MS Bit Set

For response by ADP see ‘Response to Commands 3 to 22’

Example of a Basic Code to Communicate with MANTRABUS

open the serial port with no handshaking

```
OPEN"COM2:4800,N,8,1,RS,DS,BIN" FOR RANDOM AS#1
```

request display from device 1

Frame FF	**Station No 1**	**Command 2 And add 80 hex to this byte as it is the last before as the checksum**	**Checksum of all bytes except frame**

```
talk$=CHR$(&HFF)+CHR$(&H1)+CHR$(&H82)+CHR$(&H1 XOR&H82)
```

print the string to the port

```
PRINT#1,talk$;
```

(must add semicolon after string to stop transmitting a carriage return)
wait for a while (this depends on how many bytes you are expecting and the baud rate!)
input all the bytes in the serial buffer

```
input.from.adp$=INPUT$(LOC(1),#1)
```

ASCII Format - Selected when CP = 129

The serial data to and from the ADP is formatted as eight bit words with no parity preceded by one start bit and followed by one stop bit. The baud rate (up to 9.6k Baud) is selected on the COMMS module. All communications are carried out using the standard ASCII character set. Incoming line feeds and spaces are ignored; upper and lower case letters are permitted. The incoming data is continually monitored for Carriage Return characters (Chr$13D). If one is received the next three characters (000 - 999) are compared with the ADP station number (SDST) previously entered via the keypad. N.B. leading zeros must be included. If no match is found the data that follows is ignored.

The next characters received (up to 4 max) are decoded as the ‘label’, ie. which variable in the ADP is to be acted upon. If the label is received incorrectly and cannot be decoded the ADP will return a ‘?’ followed by a C.R. character. If the received label is followed by a C.R. the ADP will return the current value of the variable in question. **(Because there is no hardware handshaking, all transmission from the ADP is performed one character at a time upon receiving a Null character (Chr$0) prompt from the Host system. Thus for every character transmitted a prompt character is required.)** The output from the ADP is an ASCII string of sixteen characters the last one being C.R.
The first four characters are the Station No. (with leading zeros if necessary) followed by a space. The label then follows with spaces added if required to make a total of four characters. The next seven characters is the numerical value of the required variable with polarity, spaces, d.p. and leading zeros added as required.

If the received label is followed by an ‘=’ character the ADP accepts the following numerical data (which must be terminated by a C.R.) and updates the variable in question and returns a C.R. character to the host when prompted. Data input is reasonably flexible. If all five digits are entered, no decimal point need be included. If less than five digits are entered with no decimal point then the last digit is assumed to be the units.

Under normal circumstances the EEPROM in the ADP continually refreshes the working RAM. However, it can be disabled via the serial input, by sending the instruction ‘DROM = 256’ after the Station No. In this condition all read/write operations to or from the EEPROM are inhibited. There are two instructions which will re-enable the EEPROM:‘ERRD’ - this performs a read from the EEPROM and updates the working RAM with the contents of the EEPROM.

1) ‘ERWR’ - this instruction writes the new RAM values into the EEPROM.

In both cases the EEPROM continues to refresh the RAM.

Instruction Set for ASCII Serial Communications

Request for data:

DATA sent to ADP			**Data returned from ADP**			
CR xxx		DISP	CR	xxx 'SPACE'	DISP	YYYYYY CR
Station No.	label		Station No.	label	numerical value	
CR xxx		DOSP	CR	xxx 'SPACE'	DOSP	'SPACE' ? CR
Station No.	label		numerical value	Station No.,	incorrect label, numerical value.	

Data Sent to ADP Data Returned from ADP

CR xxx (SP1=100.0)	CR
Station No.,	label numerical value
CR xxx (SP3=100.0)	?CR
Station No.,	incorrect label numerical value

Table 7.1

Labels	**Description**
DISP	DISPLAY READING
SP1	SET POINT 1
SP2	SET POINT 2
HYS	HYSTERESIS
OL	OUTPUT LATCH
OA	OUTPUT ACTION
PB	PROPORTIONAL BAND
IT(Ont)	INTEGRAL TIME (ON TIME)
DT(OFFt)	DIFFERENTIAL TIME (OFF TIME)
CT(dA)	CYCLE TIME (DISPLAY AVERAGING)
IPL	INPUT LOW
IPH	INPUT HIGH
OPL	OUTPUT LOW
OPH	OUTPUT HIGH
IP	INPUT RANGE SELECT
DP	DECIMAL POINT
SDST	STATION NUMBER
DROM	DISABLE EEPROM (DROM = 256)
ERRD	ENABLE EEPROM AND READ FROM IT
ERRW	ENABLE EEPROM AND WRITE TO IT
PID	OUTPUT POWER FACTOR (0-255)
RLYS	OUTPUT RELAY STATUS (0 = BOTH OFF, 1 = RELAY 1 ON. 2 = RELAY 2 ON, 3 = BOTH RELAYS ON)
RES	OUTPUT RELAY RESET
TARE	TOTAL COUNT RESET
PKR	PEAK HOLD RESET

ADP15 Printer Format

(CP must be set between 0 - 127)
Printer selection enables the ADP15 to print its current display value to a printer via its communications port. This display value can either be assigned a date and time stamp and/or a log number depending on the user set options entered under mnemonic 'CP'. The log number can be reset or preset using the mnemonic 'Ln'. This value is not saved on power fail. A label can be suffixed to the printed display value using the mnemonic 'LAb'. A large range of

labels are available to the user. To initiate the printer function press the ▶ key followed within 1 second by the ⟲ key. The printer function can also be initiated from remote contact by adding 32 to dP r.
The time and date are set in the TDP printer itself using its own menu. The printer allows the entry of an additional custom text message.
Three connections are required between the ADP15 communications port and the printer with a maximum cable length of 100 metres. (See Figures 7.1, 7.2 & 7.3 for details)
All standard ADP15 options are available with the exception of the communications modules, which cannot be connected when the printer option is used.
NOTE: When using RS232 module the printer is not isolated from the input.

Additional Mnemonics for the Printer Operation:

When the printer option is fitted further mnemonics are included to the normal range. After the dP r mnemonic are the following:-

CP At this mnemonic the printer type and print format number is selected. This number being appropriate to the type of printer used. Details are advised with each type of printer selected.
Present Types Available are:--For the ITT IPP-144-40E printer the following numbers apply
For the ITT IPP-144-40E printer the following numbers apply:

0 Prints a sequential log number with the current display and unit of measure.
e.g. 00014 0011.3 mV DC

1 Prints date and time with a sequential log number, current display and unit of measure
e.g. 00015 0001.7 mV DC
12:05:06 12:05:06

2 Prints a sequential log number, current display, unit of measure with a customer text message No.1
e.g. ADP PRINTER
00012 0023.6 mV DC

3 Prints date and time with a sequential log number, current display, unit of measure and a customer text message No.1
e.g. ADP PRINTER
00013 0023.6 mV DC
22.05.06 12:03:04

4-7 Digitec 6700 series

8-9 Amplicon AP24 and AP40

10 Eltron LP2142 - (The label file must be called 'MEL' and the label must contain a LOG NUMBER, THE DISPLAY VARIABLE & a LABEL (not zero).

12 ASCII string on print command

127 Continuous ASCII stream of the display data, transmitted on every display update

NOTE:1 9 gives an inverted print output.
NOTE:2 It is anticipated that further types of printer will be added, and additional numbers will be allocated as appropriate.

LAb Label Number
A label number can be selected for the appropriated unit of measure.
See table below:

Note: 0 = NO LABEL

0 BLANK

1 Deg R	18 m	35 ton	52 RPM1000	69 Hours
2 Deg C	19 in	36 %Dev	53 Hz	70 Nm
3 Deg F	20 ft	37 W	54 kHz	71 PSI
4 Kelvin	21 degrees	38 kW	55 V DC	72 g
5 lb/in2	22 L/s	39 MW	56 mV DC	73 Counts
6 bar	23 L/min	40 pH	57 A DC	74 Pa
7 mbar	24 L/h	41 ppm	58 mA DC	
8 kPa	25 gals/s	42 uS	59 V AC	
9 atm	26 gal/min	43 Ohms	60 mV AC	
10 mmHg	27 gal/h	44 m/s	61 A AC	
11 inHg	28 %RH	45 ft/min	62 N	
12 inH2O	29 gram	46 RPM	63 nm/S	
13 cmHg	30 kg	47 RPMx10	64 gals	
14 mm	31 lb	48 RPMx100	65 mins	
15 Wh	32 kWh	49 cos @	66 Litres	
16 dB	33 mile/h	50 km/h	67 knots	
17 tonne	34 %	51 ms	68 s	

Ln — Log Number
A range of numbers 0 to 19,999 is available. Any sequential number logging activity can be preset as desired, between these numbers. The number will reset to zero after 19,999. The log number is not saved on power fail and resets to zero on power up.

Provision is made in the ADP15 for communications via one of two module options:

SO1 — The 20m Amp current loop module, for connection to an IF25 interface.

COM 1 — An RS232/485 isolated module, for connection to a Printer PC or PLC, in a single or multiple function

Figure 7.1 COM 1 Isolated RS232/485 Communications Module

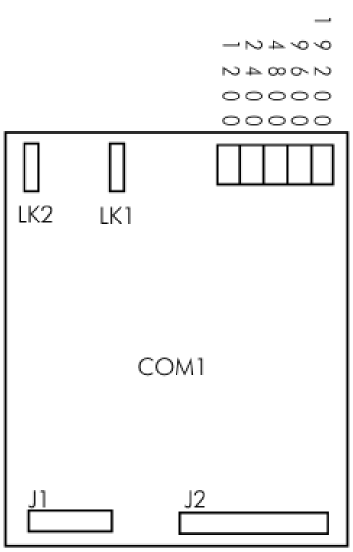
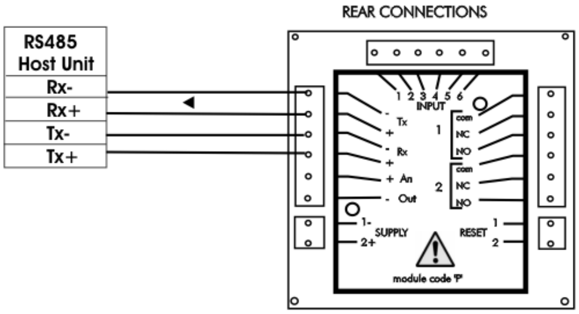


Figure 7.2 COM 1 Isolated RS232/485 Communications Module



RS485 Mode Connections
Note: When multi dropping, the last device should be terminated with 120R, by fitting link LK2 on the COM1 modules.

Figure 7.3 Connecting Multiple Units on RS485

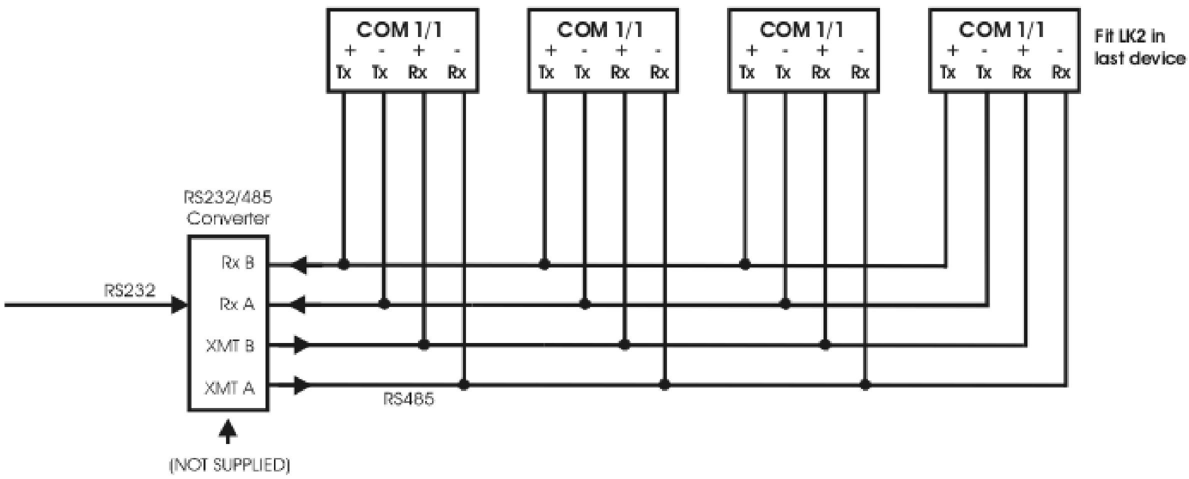
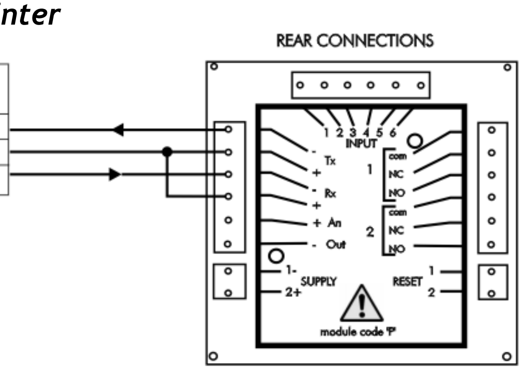


Figure 7.4 RS232 Mode to Printer

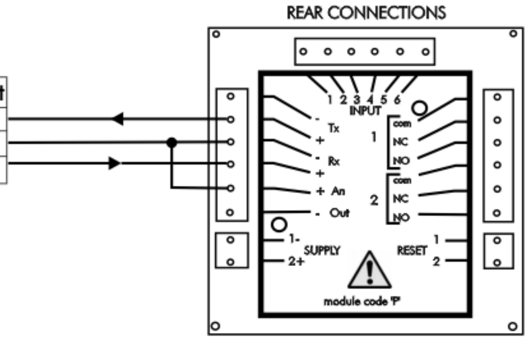
Signal	ITT Ipp 144-40E Interface 1	Amplicon AP24/AP40
Rx	2	15
GND	1 & 5	3
Tx	8	P



Note: LK1 for RS232 operation

Figure 7.5 RS232 Mode to PC

PC Signal	9 Way 'D' Skt	25 Way 'D' Skt
Rx	2	3
GND	5	7
Tx	3	2



Note: LK1 must be made for RS232 operation

NOTE:
When using an RS232 to RS485 converter which has a non-biased receiver, the following actions are recommended:-

To bias the device:

1 Terminate the receiver with 140R in place of the usual 120R
2 Fit a 1.5K from the receive negative to the receiver +5V supply, or a 3K3 to the +12V supply.
3 Fit a 1.5K from the receive positive to the receiver supply Ground.

SO1 - 20m Amp Current Loop Communications Module:

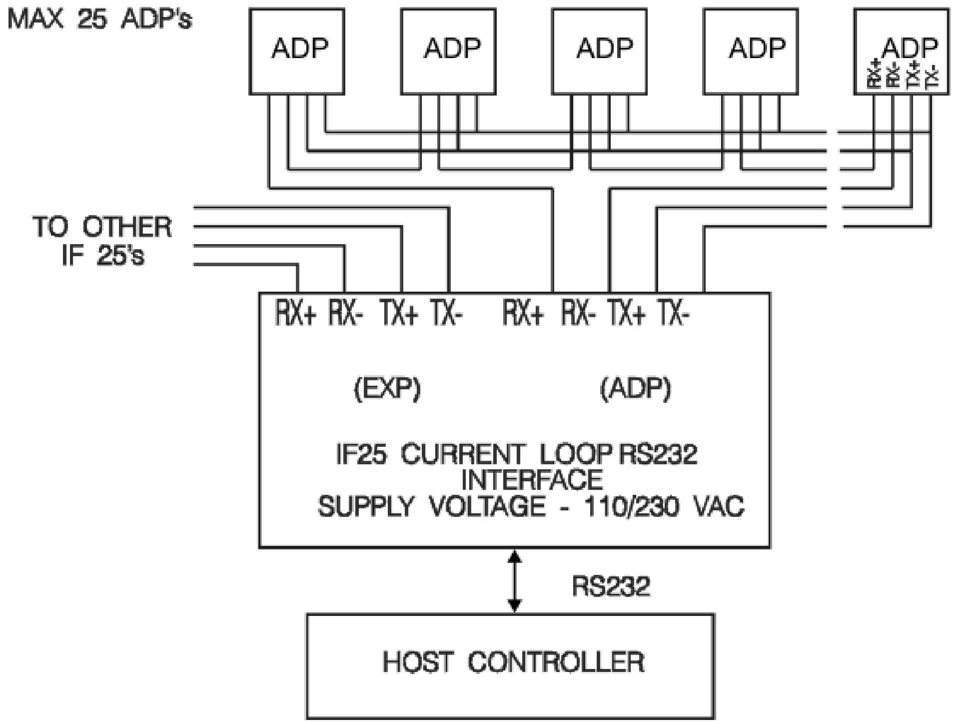
The current loop module makes provision for the connection of up to 25, ADP15 units to the IF25 current loop interface unit which can then be connected via an isolated RS232 port, to the host controller PC or PLC.
All ADP15 transmit connections are paralleled with receive inputs connected in series.
Expansion is achieved by the provision of further IF25 units; for the connection of up to 254 separate instruments.

SO1 (Current Loop)

Table 7.2

Position 1 = 300
Position 2 = 600
Position 3 = 1200
Position 4 = 2400
Position 5 = 4800
Position 6 = 9600
Position 7 = 19200.   (MANTRABUS ONLY)

Figure 7.6 Connecting Multiple ADP's



Connecting Multiple ADPs to the IF25 Interface
Notes

1) Maximum loop voltage is 50V dc.
2) Loop is isolated from host and ADPs. Loop should be earthed via Rx - on IF25/254
3) IF25 used for up to 25 ADPs.
4) At 19,200 Baud, max. cable length is 100m metres, using cable type BICC H8085.

Chapter 8 Trouble Shooting Guide

This chapter is designed to assist in the identification of problems relating to the installation and setting up of the ADP15.

1. General Connection and setup parameters.

No display on power up.

a) Check supply is present at the ADP terminals.
b) If supply is correct contact your Distributor.

Front panel keys do not function.

a) Ensure both links 'A' and 'B' are fitted to display module. Refer to Chapter 3 - Keypad Security Links.

Unable to enter data using ▶ key and ▲ key.

a) Ensure link 'B' is fitted to display module.

2. Relay Output Module

Incorrect Relay Operation

a) Check set point and hysteresis values are correct.
b) Check latching and inversion settings in output action (OA) are correct.
c) Check connections to output terminals.

Remote function (Peak Hold / Latched , printer fails to operate)

a) Check 'DP-r' for correct value to ensure desired function selected.
b) Check connections to 'remote' terminals.

3. MANTRABUS/ ASCII Format

No Communications

a) Check that a comms module is fitted.
b) Check CS1TAR EEPROM fitted on FAST
   or Check CS2TAR EEPROM fitted on ASCII
c) Check connections to ADP from IF25 are correct.
d) Check IF25 green LEDs are on and RX LED is on and TX LED is off.
e) Press TX TEST , TX LED should light.
f) Check RS232 connections from the host to the IF25 are correct.
g) Check SdSt, serial device station number is correct.
h) Check Baud rate settings on ADP's are correct for the host.
i) Check host comms port is set to 8 bit word, 1 start bit, 1 stop bit, no parity.
j) Check correct protocol is being observed by the host.

Chapter 9 ADP15 Specifications & Order Codes

Linear Input Modules

Table 9.1

RANGE			**90 Day Accuracy (Typical)**		
Input Code	**Minimum**	**Maximum**	**Resolution**	**± % of Input**	**±**
DCV1	-19.999mV	+19.999mV	1µV	0.06	6µV
DCV2	-199.99mV	+199.99mV	10µV	0.04	30µV
DCV3	-1.9999V	+1.9999V	100µV	0.04	300µV
DCV4	-19.999V	+19.999V	1mV	0.04	3mV
DCV5	-199.99V	+199.99V	10mV	0.04	30mV
DCA1	-1.9999mA	+1.9999mA	100nA	0.1	500nA
DCA2E	3.5mA	+20.50mA	400nA	0.1	2µA
DCA3	-19.999mA	+19.999mA	1µA	0.1	5µA
DCA4	-199.99mA	+199.99mA	10µA	0.1	50µA
ACV1	0	199.99mV	5µV	0.5	250uV
ACV2	0	1.9999V	50µV	0.5	2.5mV
ACV3	0	19.999V	500µV	0.5	25mV
ACV4	0	199.99V	5mV	0.5	250mV
ACA	0	1.0A	25µA	1.0	1.25mA
RL	0R	100R-10K	0.0025%	0.1 0.	1% FSD
PS	-0.95mV/V	+3.8mV/V	0.0025%	0.08	0.05% FSD
PS Excitation voltage = 10V @ 40mA					

Scaling: Full keypad scaling by setting minimum and maximum display points using IPL and IPH.
Factory preset calibration by 15-turn trimmers for offset and gain.

Software Option

Analogue Integrator - Up/Down Totaliser, Module code /ATL
This module will totalise with time any linear analogue input.
Input is scaled in the normal manner to give engineering units. This value is then totalised with time and displayed.
Display of ‘live’ input can also be selected.

Scaling

Normalised to 1 hour e.g. for a steady input value applied for 1 hour would result in that value being added to the display. Normalisation can be scaled from 0.5 hours to 20,000 hours and offset by setting of keyboard values.

Totalised value is retained during loss of power.
Accuracy = Analogue input accuracy ± 0.005%
Reset = By external volt free contact.

Temperature Inputs

Table 9.2

Code	Probe Type	Range C Min	Max	Res. C	90 Day Accuracy (Typical) ± % of Reading ± C.	
Pt	Pt 100	-190.0	+850.0	0.1	0.08	0.35
T1	K	-230.0	+1300.0	0.1	0.05	0.6
T2	J	-170.0	+760.0	0.1	0.07	0.6
T3	R	0.0	+1760.0	0.1	0.06	1.1
T4	S	0.0	+1760.0	0.1	0.08	1.5
T5	T	-220.0	+400.0	0.1	0.1	0.5
T6	B	+400.0	+1820.0	0.1	0.08	1.5
T7	N	-200.0	+1300.0	0.1	0.05	0.6
T8	E	-230.0	+1000.0	0.1	0.06	0.6

Adjustment and Trim
Zero/offset adjustment via keypad.
Calibration set at factory by internal 15-turn trimmers.

Thermocouple Cold Junction Compensation: by rear sensor, range -10 to +80 ºC, accuracy ±0.5 C over range 0 to 50ºC.

Broken Sensor Indication: Rtd. Open and short circuit by upscale overrange.
Thermocouple: Open circuit by upscale overrange, or down scale by fitting rear link.

Sensor Current: RTD 1mA. Thermocouple 20nA for upscale burnout.
Rate/Totaliser Input Module Code RTL

Rate specifications

Table 9.3

Ranges available from keypad with prescaler set to unity

Keypad Range	Full Input Range	Optimum Input Range	Worst Resolution
Low frequency	0.48 to 199.99Hz	4.0 to 50.00Hz	0.1Hz
High frequency	15.36 to 199.99Hz	18.0 to 100.00Hz	0.01Hz
Low RPM	28.8 to 1999.9RPM	140.0 to 1400.0RPM	1 RPM
High RPM	921 to 19999RPM	1800 to 7500	1 RPM
mS period	0.2 to 1999.9mS	0.2 to 1999.9mS	0.1mS
μS period	150 to 19999Sμ	150 to 19999μS	1μS
Maximum input frequency : 50KHz			

Scaling: All ranges can be fully scaled using offset and gain keypad values and prescaler divide by 10, 100, 1000 and 10,000.

Totaliser specifications
Default range will increment the display by 1 count for each pulse received.
Scaling: Count increment is variable from 2.0x to 0.00001x display counts for each input pulse (by IPH and prescaler).'Zero' range: 12767 to +19999 (by IPL)
Maximum input frequency: 8KHz on divide by 1, 50KHz on divide by 10 or greater.
Reset 'Zero': By external volt free contact or communications.

Electrical Inputs For Rate & Totaliser

Table 9.4

Type	High Pulse Level	Threshold	Hysteresis	Input Impedance	Excitation
DCV	5-30V	3.5V	1.5V Typical	100K min or 5K6	5V, 50mA
ACV1	±30mV to 35V	*20mV-2V	*5mV to 180mV	5K min	5V, 50mA
ACV2	±3V to 35V	*2.5V-35V	*120mV- 2.0V	5K min	5V, 50mA
AC/DCmV	±15mV - 5V	8mV	2mV	10M	5V, 50mA
NAMUR	2.5 to 17mA	1.6mA	90uA	680R	8.3V, 50mA

The input types are selected by rear panel and DIL switches. (DCV 5K6 can be pull up or down).

Quadrature Input (Up/Down Totaliser or position indicator)
Module Code TLQ
Two Schmitt triggered logic inputs with externally selected 1K pull-up or pull-down resistors.
Excitation voltage: 5V and 10V, both protected by 3R3 resistors.
Maximum input voltage: 3.5V to 12V
Input frequency: 8KHz maximum (125μS between edges).
Input count range: 268 million (edges).
Scaling: By keypad, provides divide by 0.5 to 20,000 and offset of ±19999.
Display reset: By external volt free contact or communications.

DC Analogue Outputs

Table 9.5

Code	RANGE Min	Max	
V1	0	1V	V1 to V4 max current out 50mA
V2	0	5V	
V3	1	5V	
V4	0	10V	
V6	-10	+10	
A1	0	1mA	A1 to A5 max voltage out 20V
A2	0	20mA	
A3	3.5	20.5mA	
A4	10	50mA	
A5	0	5mA	

Accuracy: Typical ± 0.08% of output, ± 0.08% FSD
Isolation: ±130V RMS or DC to any other port.
Resolution: as display resolution, max 15 bits plus.
Ranging: fully keypad scalable over desired display range.
Calibration: by 15-turn presets for gain and offset.
PID: Power level, when selected = 12 bit resolution output.
Inversion: By keypad code.

Frequency Output Module
Provides a varying frequency output from the displayed input variable.
Frequency range: 18.204Hz min 2352.9Hz max

Scaling:
By keypad OPL = Display point for minimum frequency.
OPH = Display point for maximum frequency.
With course adjustment from prescaler for divide by 1, 2, 4, 8, 16, 32, 64 or 128 selectable by internal DIL switches.

Output: Transistor switch, 2V min to 20V, 20mA max.
Isolation: ±130V RMS or DC to any other port.

Alarm/Control Outputs

Table 9.6

Code	Type	Function
R1	SPCO	1 relay on set point 1
R2	DPCO	1 relay on set point 1
R3	SPCO	2 relays on set points 1 and 2
R4	SPCO	1 relay on set point 2
R5	DPCO	1 relay on set point 2

Relays: 230V @ 5A a.c. resistive. Isolation ±130V RMS or DC
Triacs: 230V @ 2A a.c. resistive. Zero crossing. Isolation ±130V RMS or DC

Keypad programmable options: - see configurable parameters for Hysteresis, Latching, Output Inversion, Delay Times, PID values and Time Proportioning.

Communications Port Code S1 or S2

Operation

All ADP display data can be accessed via the communications port along with relay, PID power and EEPROM status. All ADP user configurable data can be changed including EEPROM enable/disable and relay reset. (ADP address can not be changed)

Connection:	4 wire for 2 x 20mA isolated loops for transmit and receive
Max Cable Length:	1km (depending on baud rate and cable used)
Baud Rates:	300, 600, 1200, 2400, 9600 (19200 S1 version)
Electrical Isolation:	±130V RMS or DC to any other port.
Format :	S1 = High speed, high data integrity using checksum and ACK/NAK handshaking. S2 = ASCII format for easy use.
RS232 to 20mA IF25 Interface	Connection to RS232 via separate IF25 interface which will support up to 25 ADP15s. Up to 10 IF25s can be directly wired together to support 250 ADP15s from 1 RS232 port.

Power Supplies

Code	Type
230	220V - 230V A.C 50-60Hz 10W
110	110V - 120V A.C 50-60Hz 10W
12/24	9 - 32V DC 10W isolated

Base ADP

Input Filter Programmable to average up to 64 display updates.

Display

Analogue update 0.4s.
Rate update 0.4s or 4 x input period whichever is the greater.
7 segment LED 4.5 digit 10mm.
3 x 3mm LEDs 2 for relay status, 1 for programme and hold indication.

Controls

4 membrane panel keys with tactile feedback. 1 [scroll] scroll key to view/update parameter.
1 [▶] digit select key. 1 [▲] digit increment key. 1 [R] reset key. Keypad disable by internal links under front panel.
Hold function by [▶] digit select key when in input mode.

Data Retention/Protection

Retention, 10 years for set up values, minimum of 10,000 write set up cycles.
Protection of data and functions, Watchdog timer giving repeat auto resets.
Impending power fail detection and shut down. Low power detection and hold off.

Environmental

Storage temperature	-20 to +70 ° C
Operating temperature	-10 to +50 ° C
Relative humidity	95% maximum
Front panel sealing	IP65

CE Approvals

European EMC Directive	2004/108/EC BS EN 61326-1:2006 BS EN 61326-2-3:2006
Low Voltage Directive	2006/95/EC BS EN 61010-1:2001 Rated for Basic Insulation Normal Condition Pollution Degree 2 Permanently Connected Insulation Category lll

Physical

Case Size:	DIN 72 x 72 x 163mm (Excluding mounting terminal)
Material:	Grey Noryl, flame retardant
Weight:	750g
Terminals:	2.5mm screw clamp type
Accessibility:	All electronics removable through front panel leaving field wiring and case in situ.

Order Codes

Inputs	Type	Cdde
Pt100 Resistance Bulb.		PT
Thermocouple -	Type K	T1
	Type J	T2
	Type R	T3
	Type S	T4
	Type T	T5
	Type B	T6
	Type N	T7
	Type E	T8
DC Volts	±20mV	DCV1
	±200mV	DCV2
	±2V	DCV3
	±20V	DCV4
	±200V	DCV5
	±2mA	DCA1
DC Current	3.5 to 20.50mA	DCA2E
	±20mA	DCA3
	±200mA	DCA4
AC Volts	0-200mV	ACV1
	0-2V	ACV2
	0-20V	ACV3
	0-200V	ACV4
AC Current	0-1A	ACA
Potentiometer. Suits any 100R - 10K		RL
Rate and Totaliser Inputs	V, AC, mV, 5V	
	Logic and NAMUR	RTL
Quadrature. Position/Totaliser		TLQ
Pressure, excitation 40mA @ 10V		PS

Software Options on Input

Type	Code
Analogue type totaliser/Intergrator	/ATL
Auto Calibration	/ACL
Auto Zero	/AZ

Output – Analogue DC

Type	Code
None required	0
0-1V	V1
0-5V	V2
1-5V	V3
0-10V	V4
±10V	V6
0-1mA	A1
0-20mA	A2
4-20mA	A3
10-50mA	A4
0-5mA	A5
Pulse/Frequency	F1

Software Options on Output

Type	Code
ALARM CONTROL Valve control requires R3	 /P2

Outputs - Communications

Type	Code
None required 20mA Current Loop RS232/485	0 S1 Com1

Outputs – Alarm Control

Type	Code
None required	0
1 relay SP1 - SPCO	R1
1 relay SP1 - DPCO	R2
2 relays SP1 & SP2 - SPCO	R3
1 relay SP2 - SPCO	R4
1 relay SP2 - DPCO	R5

Power Supplies

Type	Code
230V, AC 50/60Hz	230
110V, AC 50/60Hz	110
12/24V DC (9 -32 range)	12/24

Mounting

Type	Code
Flush front of panel	P
DIN Rail Adapter	D
IP65 Panel Gasket	/G

Accessories

Type	Code
RS232 - 20mA, 25 way, COMMS interface	 IF25
Printers, panel mounting:	
RS232 Standard Data	DP
RS232, Time, Date, Data	TDP

Example of a typical ADP15 build code is as follows: **ADP15-PT-A3-S1-R3-230-P**
Where:

PT	=Pt100 RTD sensor
A3	= 4-20mA output
S1	= MANTRABUS
R3	= 2 relays, single pole changeover
230	= 220/230V AC supply
P	= Panel mounting

Instrument Setup Record Sheet

Product
Product Code
Serial No
Tag No
Date
Location
Measurement type, range & engineering units
Communication / Baud Rate

ADP15	**Value**
SP1	
SP2	
HYS	
OL	
OA	
Pb	
Ont (It)	
OFFt (dt)	
dA (Ct)	
IPL (IPOF)	
IPH (IPSF)	
OPL	
OPH	
IP	
dP r	
CP	
SdSt or LAb	
Ln (for printer)	
rS	

W A R R A N T Y

All ADP products from Mantracourt Electronics Ltd., ('Mantracourt') are warranted against defective material and workmanship for a period of (3) three years from the date of dispatch.
If the 'Mantracourt' product you purchase appears to have a defect in material or workmanship or fails during normal use within the period, please contact your Distributor, who will assist you in resolving the problem. If it is necessary to return the product to 'Mantracourt' please include a note stating name, company, address, phone number and a detailed description of the problem. Also, please indicate if it is a warranty repair.
The sender is responsible for shipping charges, freight insurance and proper packaging to prevent breakage in transit.
'Mantracourt' warranty does not apply to defects resulting from action of the buyer such as mishandling, improper interfacing, operation outside of design limits, improper repair or unauthorised modification.
No other warranties are expressed or implied. 'Mantracourt' specifically disclaims any implied warranties of merchantability or fitness for a specific purpose. The remedies outlined above are the buyer's only remedies. 'Mantracourt' will not be liable for direct, indirect, special, incidental or consequential damages whether based on the contract, tort or other legal theory.
Any corrective maintenance required after the warranty period should be performed by 'Mantracourt' approved personnel only.

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CE

In the interests of continued product development, Mantracourt Electronics Limited reserves the right to alter product specifications without prior notice.
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