Model 515 Flow Computer

Operation Manual

Application CB02

Blending Controller
for
Volumetric Frequency Flowmeters

contrec

31 August 2021

Model 515 Flow Computer - Operation Manual

The instructions given herein cover the general description, installation, operation and maintenance of the subject equipment. Contrec Limited. reserves the right, without prior notice, to make engineering refinements that may not be reflected in this manual.

Should any questions arise which cannot be answered specifically by this manual, they should be directed to Contrec Limited for further detailed information and technical assistance.

Contrec Limited will not accept any liability for either direct or consequential damages resulting from the use or misapplication of the contents of this manual.

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Publication No: 515-CB02-OM - 31 August 2021

Safety Notice

The information in this safety notice is for the prevention of injury to personnel and damage to the instrument.

The manufacturer assumes no liability for injury or damage caused by misuse of the instrument or for modifications made to the instrument.

This document must be consulted in all cases where the following “Caution” safety symbol is used : 

Qualified Personnel

The instrument must be installed, operated and serviced by persons who have been properly trained and authorised. Personnel must read and understand this manual prior to installation and operation of the instrument. Refer to section 3 for further information regarding permitted maintenance operations. The safety of any system incorporating the equipment is the responsibility of the assembler of the system.

Static Hazard

The 500 series flow computer uses high speed CMOS circuitry which is sensitive to static damage. The user should observe accepted safety practices for handling electronic devices, especially during servicing. Once the unit is installed, grounded and interconnected, the chances of static damage are greatly reduced.

Voltage Hazard

Before connecting power to the instrument, ensure that the supply voltage for the AC or DC input is suitable. The AC voltage rating is as stated on the instrument rating plate. Personnel should take all due care to avoid electric shock. **For safe operation it is essential to connect a mains safety earth to the A.C. power inlet.** Do not operate at altitudes above 2000m.

Welding Hazard

Do not perform electric welding in close proximity to the instrument or its interconnecting cables. If welding in these areas must be performed, disconnect all cables from the instrument. Failure to do so may result in damage to the unit.

Moisture Hazard

To avoid electrical faults and corrosion of the instrument, do not allow moisture to remain in contact with the instrument. Operate only in a clean, dry and pollutant-free environment.

Operating & Storage Temperature

Operating: If a heater is being used, **DO NOT** isolate the instrument in temperatures below -20°C.

Storage: **DO NOT** store the equipment below -20°C.

Disconnection Device

When powered from a mains supply this unit requires the provision of a suitable mains isolation device, capable of interrupting both poles of the supply and meeting your local wiring regulations, to be suitably located and easily accessible near to the installed instrument. It must be marked as the disconnecting device for the equipment. It must be suitably rated with respect to the cross sectional area of the supply conductors.

Instrument Disposal

Contrec instrumentation should not be thrown into the general waste system.

If within EU member states, this instrument should be disposed of according to the guidelines set by the WEEE (Waste Electrical and Electronic Equipment) directive 2012/19/EU. If outside of the EU, this equipment should be responsibly disposed of according to local and national regulations for EEE (Electrical and Electronic Equipment).

By not discarding of this product along with other house hold waste you are preserving natural resources and reducing waste sent to landfill and incinerators.

Remove batteries and dispose of separately (see *Disposal of Batteries*) before disposal of Contrec instrumentation.

Disposal of Batteries

Batteries have an environmental impact. Safe and responsible disposal should be undertaken.

In all EU member states, as per Directive 2006/66/EC, batteries must not be thrown away with general waste. Contact your local environmental authority for information regarding disposal or recycling of used batteries, alternatively they can be returned directly to Contrec Ltd. for disposal.

Please Contact Contrec Ltd before returning batteries for disposal.

Explanation of IEC Symbols Used

You should familiarise yourself with the following symbols which are used both within this manual and on the instrument itself.

This document must be consulted in all cases where the following “Caution” safety symbol is used.

DC Input (DC).

AC Input (AC).

Protective Earth Terminal.

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Features

- Tailored for volumetric frequency flow input
- ID validation (iButton or RFID), preprogrammed ratio %
- Pump demand contact
- Selection of various modes of operation
- Process line control via DCV (digital control valve)
- Remote PERMISSIVE input to control delivery's state
- Displays general purpose analog inputs
- Includes user programmable value into delivery log
- Allows for non-linear correction
- Storage of 1000 transactions with time and date stamp
- Selection of Detail or Basic main menu to suit operator and application
- Selection of second language and user tags
- Pulse width and scaling of pulse output
- 4-20mA retransmission
- Available protocols on communication ports including Printers, Modbus RTU and TCP/IP
- Front panel adjustment of 8-24V DC output voltage
- Backlit display with LCD backup

Overview

The 515 CB02 application is a secure blending controller measuring the volume flow in a main and process lines using frequency flow inputs.

The main and process flows are used to determine the net volume flow. The operator can view the ratio of totals as well as the ratio of flow rates.

The control of the process flow is via a digital control valve. The control responsiveness and flowrate deadband can be adjusted to reduce wear on valves.

The instrument can be set to prompt for a valid ID-Tag before a delivery can be commenced. The valid ID-Tag also sets the pre-programmed target ratio % and is stored as a part of the logged transaction record.

Calculations

The total and flowrate are derived from accurately measured frequency and the number of received pulses.

volume = pulses / k-factor

volume flow = frequency / k-factor

The controller caters for blending points before and after the main flowmeter. The process flow is a ratio of the net (combined) flow (0 to 100% range).

$$Ratio\% = \frac{P_{flow}}{Net_{flow}} \times 100$$

Analog Input Scaling

The analog inputs in this instrument are scaled by the following general formula:

$$f(A) = P_{min} + (P_{max} - P_{min}) \cdot A^*$$

where:

P_{min} = minimum point (equivalent to offset)

P_{max} = maximum point ($P_{max} - P_{min}$ is equivalent to span)

A^* = normalised signal (0 to 1) with correction applied for a flow input

Correction Type

- LINEAR: $A^* = A$ when the instrument is not required to apply correction
- NON-LINEAR: $A^* = A_C$ when the instrument applies correction from the points in the correction table

Displayed Information

The front panel display shows the current values of the input variables and the results of the calculations.

The instrument can be supplied with a real-time clock for storage of up to 1000 transactions with time and date stamps.

Main Menu Variables

Main Menu Variables	Default Units	Variable Type
*Net Volume	L	Total
Net Flowrate	L/min	Rate
Main Line Volume	L	Total
Main Line Flowrate	L/min	Rate
*Process Line Volume	L	Total
Process Line Flowrate	L/min	Rate
Process Volumetric Ratio	%	Rate
Process Flowrate Ratio	%	Rate
Process Flowrate Deviation	L/min	Rate
*Analog Input 1	metres	Rate
*Analog Input 2	metres	Rate
*Target Ratio	- - -	- - -
User Value	- - -	- - -
Batch ID Tag	- - -	- - -

* These variables form the Basic (simplified) main menu in factory default configuration.

Units of Measurement

In the 500 Series instruments there is a wide range of available units of measurement to be selected from. These can be viewed and selected either during initial Software Configuration via the 500 Series Program Manager (see below) or from within the instrument's calibration settings (if access has been granted) as per **Units of Measurement** on page 40.

Communications

There are two communication ports available as follows:

- COM-1 RS232 port
- COM-2 RS485 port (optional) or Ethernet (optional)

The ports can be used for remote data reading, printouts and for uploading and downloading of the application software to the instrument.

Isolated Outputs

The opto-isolated outputs can re-transmit any main menu variable. Totals are output as pulses and rates are output as 4-20 mA signals. Alternatively, the outputs can be configured to provide application specific digital signals like flow error, pump demand, etc.

Relay Outputs

The relay outputs 3 and 4 control the blending flow via a digital control valve. The relay output 2 provides a pump demand contact and the relay 1 can be used as a fully programmable alarm for any rate type variable.

Software Configuration

The instrument can be programmed to suit the particular application needs and the flexible I/O can be assigned as required. Program settings can be changed either via the front panel (depending on assigned access levels) or via the 500 Series Program Manager (500-PM software).

The 500-PM software is a free comprehensive configuration tool and resource centre that can be used to further tailor an instrument to suit specific application needs including units of measurement, custom tags and text, access levels and more.

The software is a Windows based program that is freely available from the download section of the Contrec website. The program can be used to create a custom version of an existing application to be saved for backup purposes and/or to generate a PDF of configuration report for record keeping.

The instrument stores all set-up parameters, totals and logged data in non-volatile memory with at least 30 years retention.

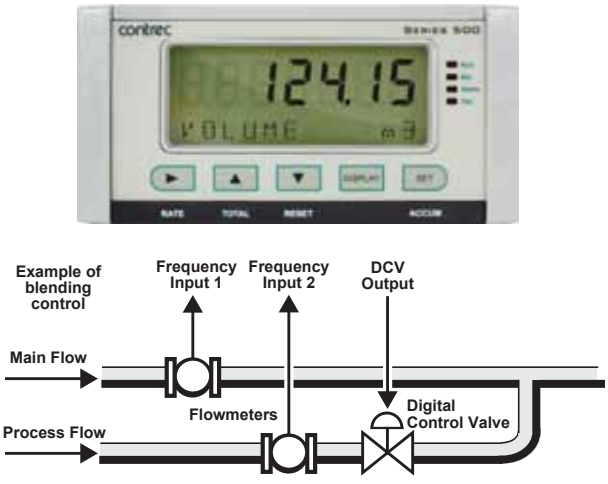


Figure 1 Typical Application Diagram

Approvals

This instrument conforms to the EMC-Directive of the Council of European Communities 2014/30/EU, the LVD safety directive 2014/35/EU and the following standards:

- *EN61326:2013* Electrical equipment for measurement, control and laboratory use – EMC requirements: Industrial Environment.
- *EN61010:2010* Safety requirements for electrical equipment for measurement, control, and laboratory use.

In order to comply with these standards, the wiring instructions in **Chapter 3 - Installation & Maintenance** must be followed.

FCC Declaration

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. Contrec Ltd is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device might not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

Chapter 2
Specifications

Specification Table

Operating Environment

Temperature	+5°C to +40°C (standard - no coating) -20°C to +60°C (with conformal coating) -30°C to +60°C (ExD housing with heater)
Humidity	0 to 95% non condensing (conformal coating) 5% to 85% non condensing (no coating)
Power Supply	100-240 V AC (+/-10%) 50-60 Hz (+/-10%) or 12-28 V DC
Consumption	10W (max) Overvoltage category II
Protection	Sealed to IP65 (Nema 4X) when panel mounted
Dimensions (panel option)	147mm (5.8") width 74mm (2.9") height 170mm (6.6") depth (behind the panel)

Display

Type	Backlit LCD with 7-digit numeric display and 11-character alphanumeric display
Digits	15.5mm (0.6") high
Characters	6mm (0.24") high
LCD Backup	Last data visible for 15min after power down
Update Rate	0.3 second

Non-volatile Memory

Retention	> 30 years
Data Stored	Setup, Totals and Logs

Approvals

Interference	CE compliance
Enclosure	IECEx, ATEX and CSA approved enclosures available for hazardous areas

Real Time Clock (Optional)

Battery Type	3 volts Lithium button cell - For Issue 7 option card, type CR2450N manufactured by Renata only - For conformal coated 'C' version, type BR2032 manufactured by Panasonic only - For non-conformal coated versions, type BR2032 and CR2032 manufactured by Panasonic or Sony
Battery Life	5 years (typical)

Frequency Input (General)

Range	0 to 10kHz for Pulse input type 0 to 5 kHz for Coil & NPS input types
Overvoltage	30V maximum
Update Time	0.3 sec
Cutoff frequency	Programmable
Configuration	Pulse, coil or NPS input
Non-linearity	Up to 10 correction points

Pulse

Signal Type	CMOS, TTL, open collector, reed switch
Threshold	Signals switch below 1.3 & above 2 volts

Coil

Signal Type	Turbine and sine wave
Sensitivity	15mV minimum amplitude (typical)

NPS

Signal Type	NPS sensor to Namur standard

Analog Input (General)

Overcurrent	100mA absolute maximum rating (30mA for 4-20mA inputs)
Update Time	< 1.0 sec
Configuration	RTD, 4-20mA, 0-5V and 1-5V input
Non-linearity	Up to 20 correction points (some inputs)

RTD Input

Sensor Type	PT100 & PT500 to IEC 751
Connection	Four Wire
Range	-200°C to 350°C -200°C to 800°C (PT100 extended range)
Accuracy	0.1°C typical 0.2°C typical (PT100 extended range)

4-20mA Input

Impedance	100 Ohms (to common signal ground)
Accuracy	0.05% full scale (20°C) 0.1% (full temperature range, typical)

0-5 or 1-5 Volts Input

Impedance	10MOhms (to common signal ground)
Accuracy	0.05% full scale (20°C) 0.1% (full temperature range, typical)

Logic Inputs

Signal Type	CMOS, TTL, open collector, reed switch
Overvoltage	30V maximum

Relay Output

No. of Outputs	2 mechanical relays plus 2 solid state relays or 4 solid state relays
Voltage	250 volts AC, 30 volts DC maximum (solid state relays use AC only)
Current	3A maximum - mechanical relays 1.5A maximum - solid state relays

Communication Ports

Ports	COM-1 RS-232 port COM-2 RS-485 or Ethernet port (optional)
Baud Rate	2400 to 19200 baud
Parity	Odd, even or none
Stop Bits	1 or 2
Data Bits	8
Protocols	ASCII, Modbus RTU, Modbus TCP/IP (Ethernet Port), Printer, ID-Tag, ID-RF-1

Transducer Supply

Voltage	8 to 24 volts DC, programmable
Current	70mA @ 24V, 120mA @ 12V maximum
Protection	Power limited output

Isolated Output

No. of Outputs	2 configurable outputs
Configuration	Pulse/Digital or 4-20mA output

Pulse/Digital Output

Signal Type	Open collector
Switching	200mA, 30 volts DC maximum
Saturation	0.8 volts maximum

4-20mA Output

Supply	9 to 30 volts DC external
Resolution	0.05% full scale
Accuracy	0.05% full scale (20°C) 0.1% (full temperature range, typical)

Important: Specifications are subject to change without notice.

Chapter 3
Installation & Maintenance

Installation Instructions

The safety of any system incorporating the equipment is the responsibility of the assembler of the system and should be installed such that there is no risk of impact damage.

This instrument is intended for fixed installation only, e.g. within a panel or cabinet, and is not intended for desktop use. It is not suitable for outdoor use unless fitted into an appropriate outdoor enclosure with a minimum type 3, IP54, rating. The instrument has a 'Pollution degree II' rating.

Cleaning and Decontamination

For general maintenance or to clean an instrument suitable for return to a service centre for repair or inspection, use only a damp cloth and mild detergent. Do not use abrasive cleaners or high pressure water jets. An instrument must be decontaminated before returning. The marking label can be cleaned with 35% Isopropanol or mild detergent.

Panel Mounting

The instrument should be located in an area with a clean, dry atmosphere that is also relatively free of shock and vibration.

The standard mounting procedure is panel mounting in a cutout that is 139mm wide by 67mm high. Two side clips secure the unit into the panel.

Figure 2 shows the panel mounting requirements for the 500 Series Instrument.

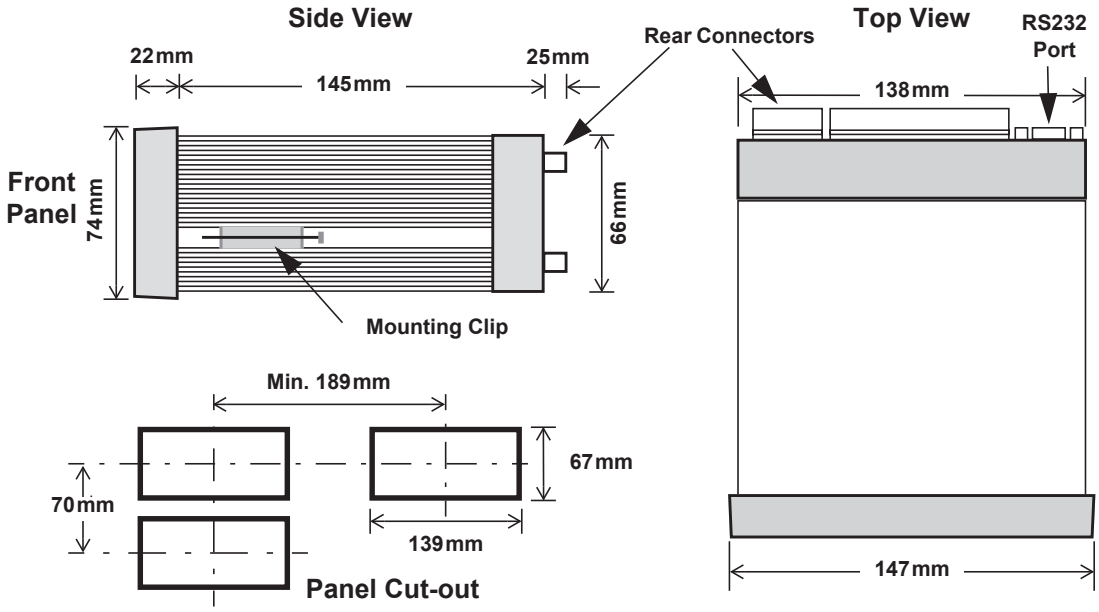


Figure 2 500 Series Instrument Panel Mounting

Electrical Connection

Rear Panel Connections

Note: Depending on the specification and age of the instrument, there are different versions of the upper option card. Ensure the instrument is wired as per the correct terminal designation printed on the rear of the instrument bezel and below.

Figure 3 shows the connections on the original rear panel of the instrument where relays 1 to 4 (terminals 32-35) share a single Relay Common (terminal 31). Note: The 5 way relay terminal block is GREEN.

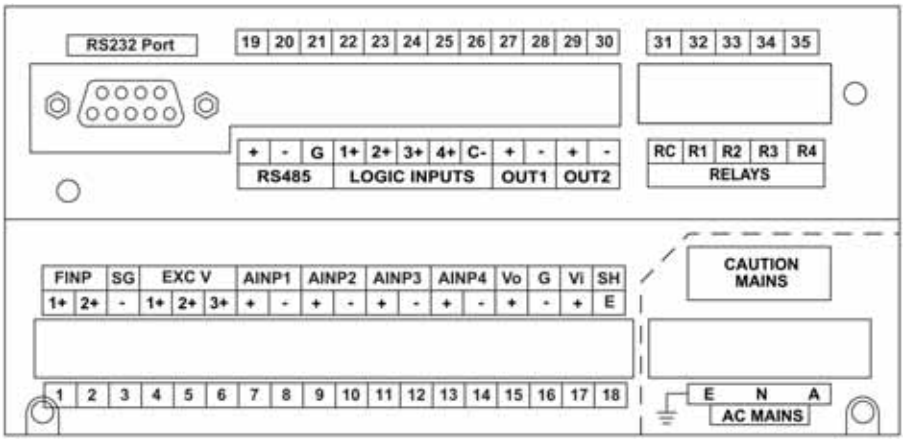


Figure 3 Rear Panel Connections - Original

On the newer rear panel option cards the instrument relays 1 and 2 (terminals 32-33) share Relay Common 1-2 (terminal 31) and relays 3 and 4 (terminals 34-35) share Relay Common 3-4 (terminal 36).
Note: On these option cards the 6 way relay terminal block is ORANGE.

Figure 4 shows the new option card with the RS-485 port (terminals 19-21).

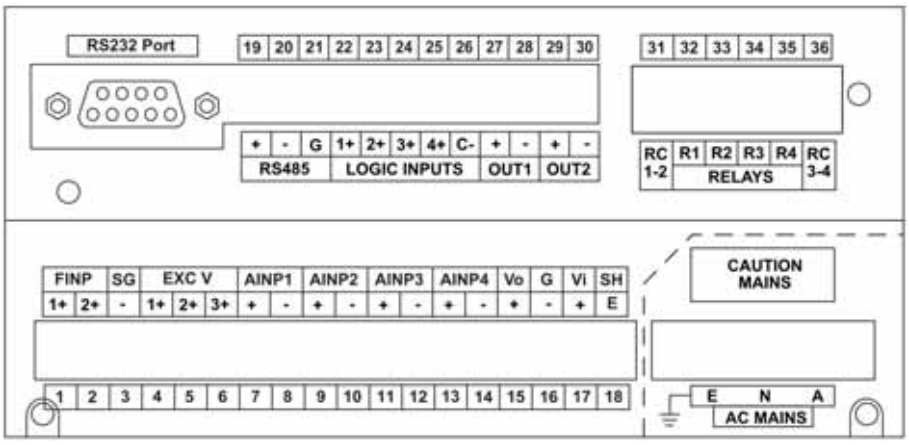


Figure 4 Rear Panel Connections - New RS-485 Version

Figure 5 shows the new option card with the optional Ethernet port in place of RS-485 port (terminals 19-21).

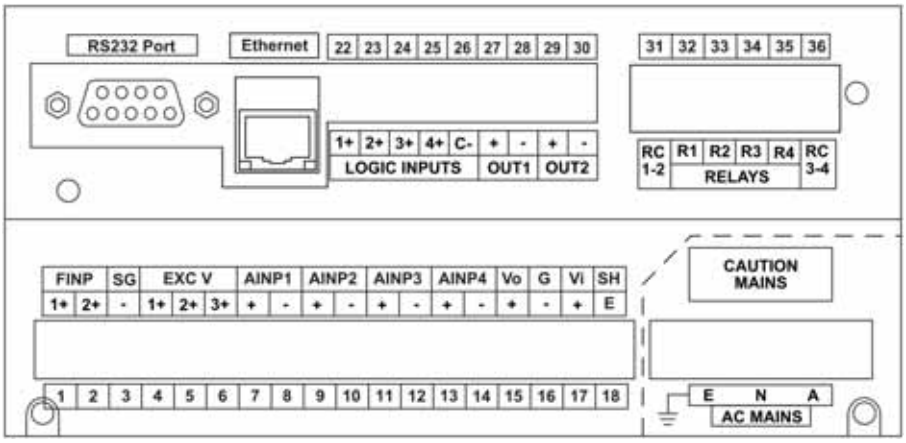


Figure 5 Rear Panel Connections - New Ethernet Version

Terminal Designations

Terminal Label			Designation	Comment
1	FINP	1+	Frequency Input 1+	Main Flow Input
2	FINP	2+	Frequency Input 2+	Process Flow Input
3	SG	-	Signal ground	
4	EXC V	1+	Excitation Term 1+	Not used
5	EXC V	2+	Excitation Term 2+	For AINP1 RTD Input
6	EXC V	3+	Excitation Term 3+	For AINP2 RTD Input
7	AINP1	+	Analog Input ch 1 (+)	General Purpose Input 1
8		-	Analog Input ch 1 (-)	
9	AINP2	+	Analog Input ch 2 (+)	General Purpose Input 2
10		-	Analog Input ch 2 (-)	
11	AINP3	+	Analog Input ch 3 (+)	Not used
12		-	Analog Input ch 3 (-)	
13	AINP4	+	Analog Input ch 4 (+)	Not used
14		-	Analog Input ch 4 (-)	
15	Vo	+	8-24 volts DC output	Overload protected
16	G	-	DC Ground	
17	Vi	+	DC power input	DC power in 12-28V
18	SH	E	Shield terminal	
E	AC MAINS	E	Mains ground	AC power in 100-240VAC
N		N	Mains neutral	
A		A	Mains active	

Terminal Label			Designation	Comment
19	RS485 COM-2 port	+	RS485 (+)	Optional RS485 port may be replaced by Ethernet port.
20		-	RS485 (-)	
21		G	RS485 ground	
22	LOGIC INPUTS	1+	Switch 1	Permissive Input
23		2+	Switch 2	
24		3+	Switch 3	Remote Reset
25		4+	Switch 4	CAL Switch – In field access protection
26		C-	Signal ground	
27	OUT1	+	Output ch 1 (+)	
28		-	Output ch 1 (-)	
29	OUT2	+	Output ch 2 (+)	
30		-	Output ch 2 (-)	
31	RELAYS	RC	Relay Common 1-2	*Term 31 - Common 1-4 on legacy option card*
32		R1	Relay 1	Alarm
33		R2	Relay 2	Pump demand
34		R3	Relay 3 (DCV Open)	Digital control valve
35		R4	Relay 4 (DCV Hold)	
36		RC	Relay common 3-4	*Term 36 only available on new style option card*
RS232 COM-1 port			9-pin serial port	

Terminal Wiring Insulation

Terminals 1-30 are all rated at <35Vdc and wiring with basic insulation is adequate.

Use copper conductors only.

Relay Wiring

Relay terminals are 31-35 or 31-36 depending on the version of option card fitted. When controlling circuits powered by mains, or voltages >35Vdc, it is necessary to use UL/CSA approved cabling with supplementary insulation and a current capacity suitable for the connected circuit. (0.75mm², 6A current capacity is sufficient).

Use copper conductors only. The maximum current must be <5A as stated in the Specifications.

Mains Power Wiring

Only use UL/CSA approved cabling with supplementary insulation and copper conductors. A minimum cable cross section area of 0.75mm² (18 AWG) is required. However, this must be selected with respect to the installed overcurrent protection device and in accordance with the local relevant Electrical Code of Practice as dictated by the Authority Having Jurisdiction (AHJ).

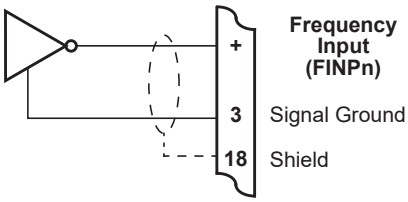
The terminal designations (L/N/E) are clearly indicated just above the mains input connector on the rear panel of the instrument.

Inputs

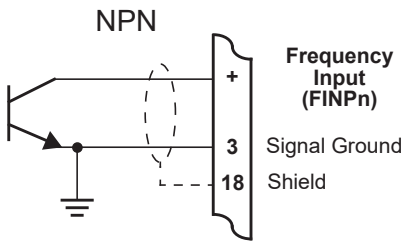
Frequency Input Connection

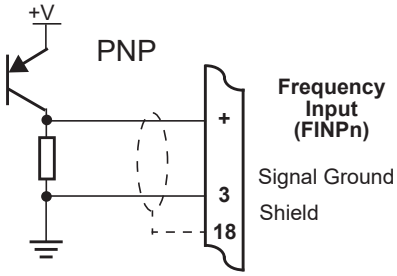
Connect pulse or frequency input signals from devices such as: TTL, CMOS, open collector, reed relay switch, coil and Namur proximity switch, as shown below. For better signal integrity, it is recommended to use shielded cable. Refer to **Terminal Designations** on page 11 for specific terminal numbers for this application.

Squarewave, CMOS or TTL

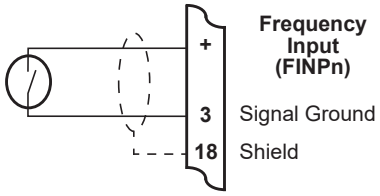


Open Collector

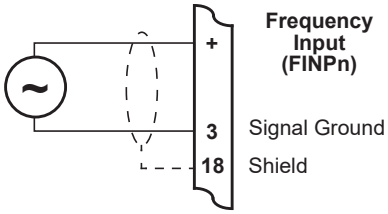




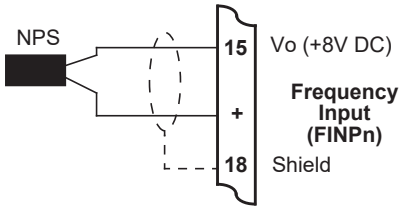
Reed Relay Switch



Coils - with 15mV minimum amplitude (typical)



Namur Proximity Switch



Analog Input Connections

All analog inputs can accept DC signals ranging from 0-5V, 1-5V and current signals from 4 to 20 mA.

Analog Inputs 1 and 2 (AINP1 / AINP2) can also accept an RTD input (PT100 or PT500) as well as the standard 0-5 V, 1-5V and 4 to 20 mA input.

CAUTION

Applying levels of input current above the absolute maximum rating (100mA or 30mA for 4-20mA inputs) may cause permanent damage to the input circuitry.

0-5 and 1-5 Volt Inputs

For externally powered voltage transmitters, connect each transmitter to a pair of input terminals as shown in Figure 6. Refer to **Terminal Designations** on page 11 for specific terminal numbers for this application.

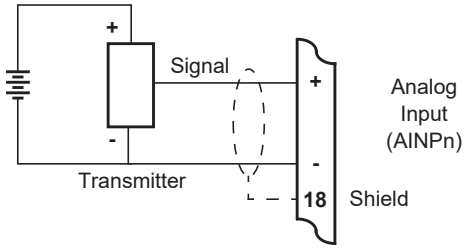


Figure 6 Externally Powered Voltage Transmitter

Connect internally powered voltage transmitters as shown in Figure 7.

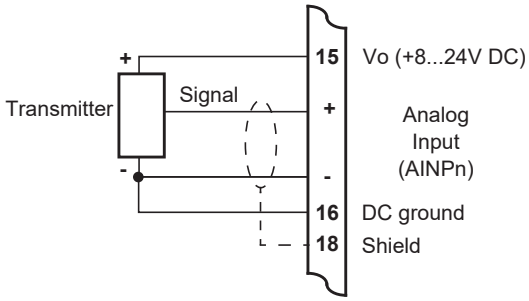


Figure 7 Internally Powered Voltage Transmitter

4-20 mA Inputs

For externally powered current loops, connect each transmitter to a pair of input terminals as shown in Figure 8. **Terminal Designations** on page 11 for specific terminal numbers for this application.

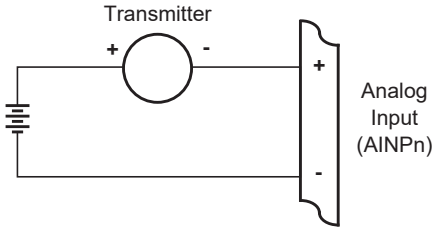


Figure 8 Externally Powered Current Loop

The internal overload-protected power supply has sufficient power for three current loops at 24 V DC (more current loops can be supplied by using a reduced voltage setting). Connect internally powered current loops as shown in Figure 9.

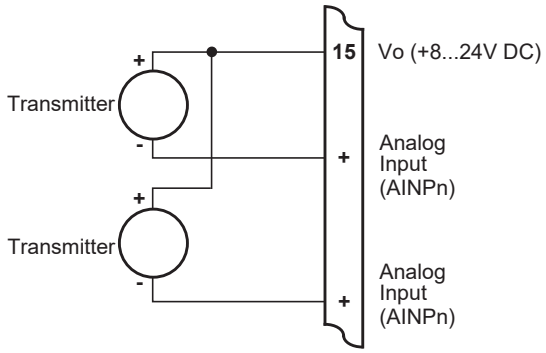


Figure 9 Internally Powered Current Loops

RTD Input

Analog Inputs 1 and 2 (AINP1/AINP2) are available for RTD connection. The instrument uses 4-wire RTDs to provide optimum accuracy and stability. It is recommended to use shielded twisted pairs and to have cable length no longer than 50 metres.

Connect RTD inputs as shown in Figure 10.

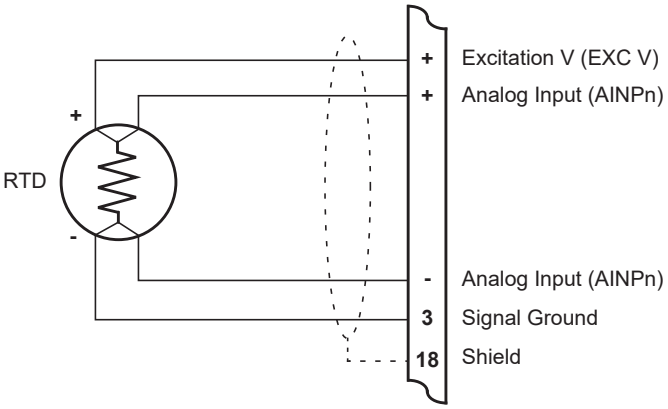


Figure 10 RTD Connection

Excitation terminal 2 (pin 5) must be used in conjunction with AINP1. Excitation terminal 3 (pin 6) must be used in conjunction with AINP2.

It is possible to use two-wire or three-wire RTDs. However, four wires must be taken to the RTD, with the signal and current wires joined as close to the RTD as possible.

Note: The RTD has no polarity and can be connected in either direction. However, the excitation and the positive analog input must be connected to one side of the RTD. Similarly, the Signal Ground and the negative analog input must be connected to the other side of the RTD.

Logic Input Connection

These inputs are designed to be connected to CMOS, TTL, open collector signals or a voltage free contact switch. A minimum activation time of 300ms is required to guarantee reading of an input.

It is possible to read the status of all the logic inputs via a Modbus register even if they are not used for a control purpose in the application.

A remote push-button key can be connected to the Logic Inputs as shown below. **Logic Input Control** on page 31 describes the function of the inputs.

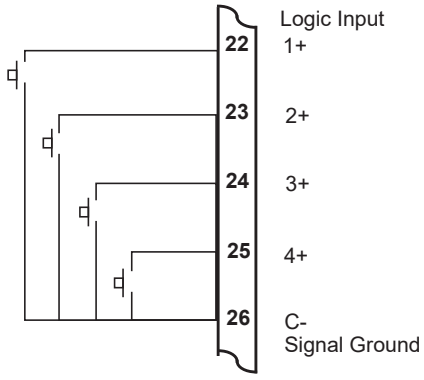


Figure 11 Logic Inputs Connection Diagram

Outputs

The advanced option for the instrument provides two opto-isolated output ports. Either or both can be used for 4-20mA or pulse outputs.

CAUTION

Due to the dual-purpose nature of the outputs, take care not to set the output as an open collector pulse type signal when connected to a 4-20mA loop circuit.

4-20 mA Output Connection

Figure 12 shows the connections for a 4-20 mA output. Output channel 1 uses terminals 27 (+) and 28 (-), output channel 2 uses terminals 29 (+) and 30 (-).

Maximum Load Resistance = (Supply - 9) / 0.02 ohms

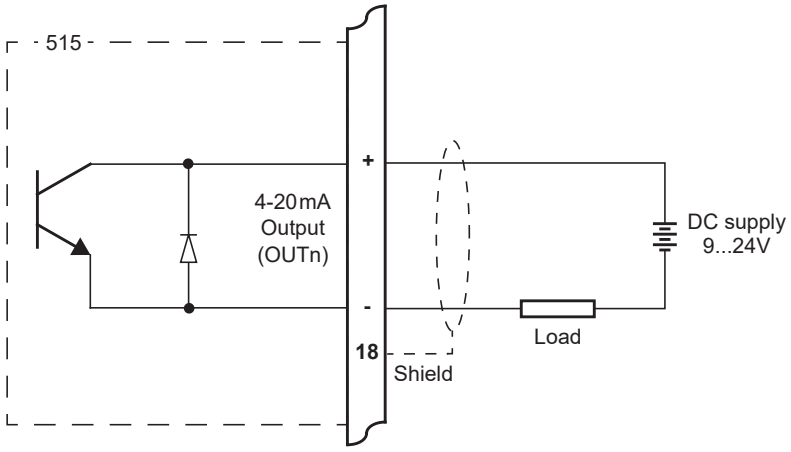


Figure 12 Output 4-20 mA Connection Diagram

Pulse Output Connection

Figure 13 shows a connection example for a pulse output. Output channel 1 uses terminals 27 (+) and 28 (-). Output channel 2 uses terminals 29 (+) and 30 (-).

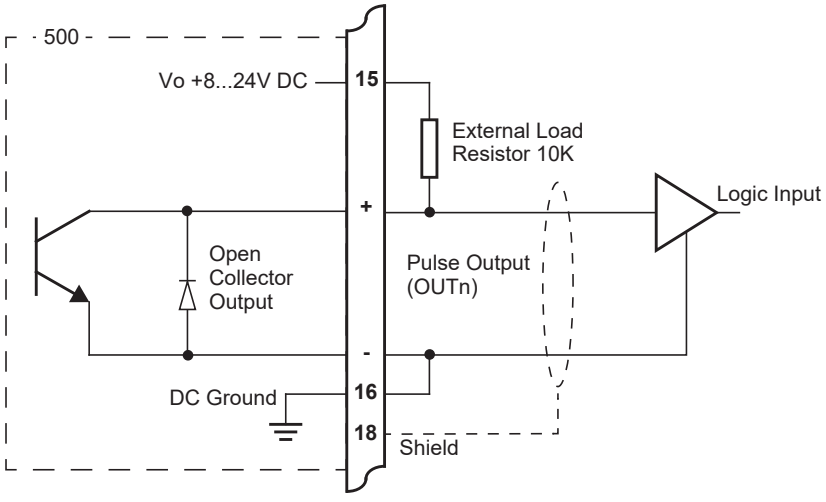


Figure 13 Output Pulse Connection Diagram

Control Relays (Alarms)

The solid state relay outputs 3 and 4 provide DCV control. The relay output 2 provides a pump demand contact and the relay 1 can be used for alarms on any rate type variable.

The operation of alarm relay(s) can be set to various modes as described in **Alarms** on page 51. On the newer option card the separate common terminal for relays 1 and 2 and another common terminal for relays 3 and 4 allow for different signal or supply types to be connected to the control or alarm devices, as shown in Figure 14.

There is also an equipment failure alarm option. This alarm can have normally closed (open) contacts which open (close) when the instrument displays any error message as listed in **Error Messages** on page 61, or if there is a loss of power to the instrument.

The output characteristics of the relays are:

Maximum Voltage	30 volts DC or 250 volts AC
Maximum Current	3 A for EMR, 1.5A for SSR

Note: Solid state relays (SSR) use AC voltage only.

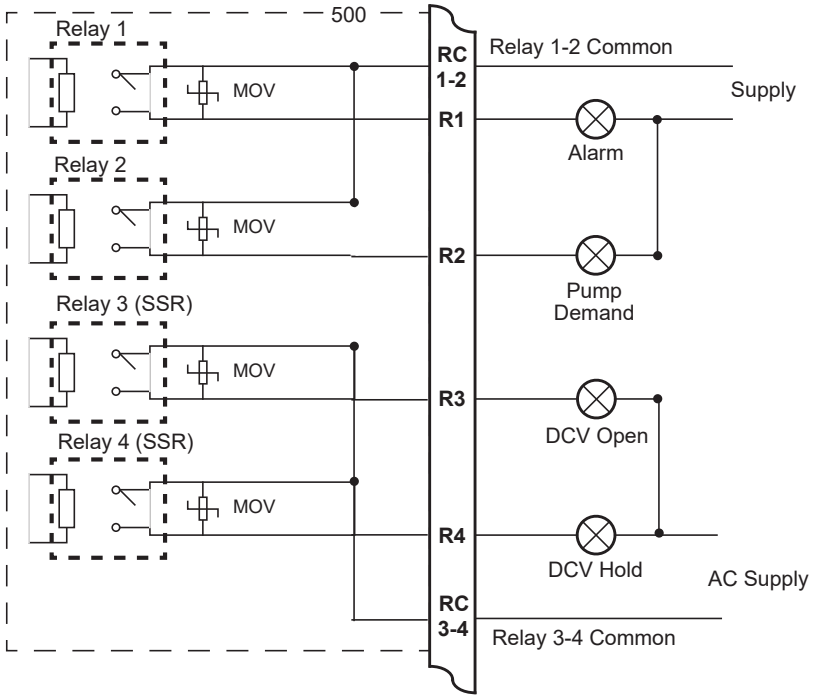


Figure 14 Relay Connection Diagram

RC Network for Interference Suppression

When driving highly inductive loads with the relay outputs, it is recommended to use RC suppression networks (often called “Snubbers”) for the following reasons:

- To limit the amount of electrical noise caused by arcing across the contacts, which may, in extreme cases, cause the microprocessor to act erratically.
- To protect the relay contacts against premature wear through pitting.

RC suppression networks consist of a capacitor and series resistor and are commonly available in the electrical industry. The values of R and C are dependent entirely on the load. However, if the user is unsure of the type of snubber to use, values of 0.25 µF and 100 Ω will usually suffice. Note that only mains-approved RC suppression networks should be used.

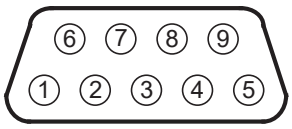
The basic principle of the operation is that the capacitor prevents a series of sparks arcing across the contact as the contact breaks. The series resistor limits the current through the contact when the contact first makes.

Communications

The communication protocols are described in **Communications** on page 63.

COM-1 RS-232 Port

The COM-1 RS-232 port has a 9-pin DB female connector and has the following pinout:



Pin 1	Not used
Pin 2	Transmit (TxD)
Pin 3	Receive (RxD)
Pin 4	Not used
Pin 5	Ground
Pin 6	Not used
Pin 7	Handshake line (CTS)
Pin 8	RTS Out
Pin 9	Not used

Note: The instrument does not require a null-modem cable for connection to a personal computer. Refer to **Hardware Interconnection** on page 63 for cable termination requirements.

COM-2 RS-485 Port Option

Up to 32 units can be connected to a common RS-485 bus. Each unit has a unique address that the host computer uses to identify each instrument. Figure 15 shows the connection of several instruments to a computer using the RS-485 port.

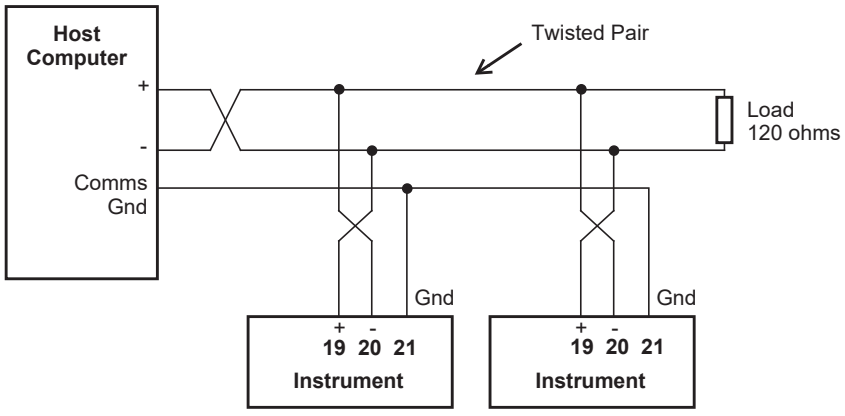


Figure 15 RS-485 Interface Connections

COM-2 Ethernet Port Option

An Ethernet module is an available option, in place of the RS-485 port, if Modbus TCP/IP connection is required. In the programming communication settings, COM-2 should be set to RTU (Modbus), 19200 Baud rate, even parity and 1 stop bit.

Mains Connection

Earthing and Shielding

A case earthing point is provided via the mains inlet. Note that this earthing point is for the case only and there is electrical isolation between this point and all electronic circuits. For EMC purposes, or when the instrument is connected to mains, this point must be connected to a good earth.

It is a good practice to use shielded cable for all signal connections to the instrument. Care must be taken to separate signal cables from power cables to minimize interference.

Overall earth should be connected at the instrument end only. This connection should be as short as possible and connected to the earthing point on the rear terminal at pin 18.

Disconnection Device

When powered from a mains supply this unit requires the provision of a suitable mains isolation device, capable of interrupting both poles of the supply and meeting your local wiring regulations, to be suitably located and easily accessible near to the installed instrument. It must be marked as the disconnecting device for the equipment. It must be suitably rated with respect to the cross sectional area of the supply conductors.

Maintenance Instructions

Occasionally it may be necessary to open the unit in order to change the Real Time Clock battery. No other service operations are permitted. In order to perform these operations and maintain safety it is essential to follow the instructions below. If mounted in an ExD enclosure, before proceeding, refer to the ExD manual for further information. This work may need to be scheduled and carried out in accordance with the local electrical Code of Practice.

Battery Replacement

INSTRUMENT MUST BE POWERED DOWN

1. Remove the top row of terminal blocks (19-36) and any communication cables if applicable.

2. Remove the two pan head machine screws on each side of the rear panel.

3. Withdraw the option card from the instrument.

4. Firmly press the battery holder tab to release the coin cell battery.

5. Identify the part number of the coin cell which is clearly marked on one side of the cell.

6. Firmly press the replacement coin cell into the holder

7. Reverse steps 1-3 for re assembly.

Battery Type

Only the battery type and manufacturer stated below should be used.

1. Instruments manufactured with issue 7 option card – CR2450N, Manufacturer RENATA ONLY*

2. Conformal coated “C” version - Type BR2032, manufacturer Panasonic ONLY.

3. Non Conformally coated versions :- BR2032, CR2032, Sony or Panasonic ONLY.

*Issue 7 option card can be identified with 6 way (31-36) ORANGE relay connector.

Chapter 4
Operation

Normal Operation Mode

In normal operation mode, you press the buttons on the front panel to display the values recorded and calculated by the instrument. There are five categories of information that the instrument can display:

- Totals
- Rates
- Process variables
- Control setpoints
- Instrument settings

For each total, there is an associated rate as follows:

Total	Rate
Net Volume	Net Flowrate
Main Line Volume	Main Line Flowrate
Process Line Volume	Process Line Flowrate

Default Variable & Total

In some applications, a particular variable or particular set of total and rate is of more interest than others, and for this reason a default variable and a default total (and its associated rate) can be assigned during instrument calibration. These defaults are used in the following ways:

- The default total (and rate) determines what comes first in the sequence of totals and rates that are displayed with the front panel keys.
- The default variable determines what the display returns to if the display timeout option is enabled and no buttons are pressed for the selected period (usually 30 seconds). It also determines what is displayed on power up.

Status LEDs

The status LEDs illuminate to show the following conditions:

Run Solid LED: delivery is in progress
Flashing LED: delivery has reached the flushing stage
Set The instrument is in Calibrate Set mode.
Alarm The instrument has an error, as indicated on the display panel.
Cal The instrument is in Calibrate View mode.

Front Panel Keys

For most actions with the front panel keys, you can hold a key to scroll through the values or options, instead of repeatedly pressing the key.

RATE Press the **RATE** key to display the rate that is associated with the currently displayed total. If an item other than a rate or total is displayed, press the **RATE** key to display the "default rate". When a rate is displayed, press or hold the **RATE** key to display the other rate variables in turn.

TOTAL Press the **TOTAL** key to display the total that is associated with the currently displayed rate. If an item other than a rate or total is displayed, press the **TOTAL** key to display the "default total". When a total is displayed, press or hold the **TOTAL** key to display the other total variables in turn.

RESET Use the **RESET** key to clear the totals when delivery is not in progress or to initiate a printout if the printer option has been selected. The printout is activated with a single press while the reset of the totals requires a press and hold for two seconds. The instrument generates three beeps when it resets the totals and two beeps when a printout is started.

DISPLAY Press the **DISPLAY** key to step or scroll through the main menu items.

ACCUM Hold the **ACCUM** key to display the accumulated value for the currently displayed total.

Remote Reset

The Remote Reset on logic input 3 (LINP3) has the same function as the front **RESET** key, as described above.

Main Menu Items

The main menu in this instrument consists of the following items. The DISPLAY key is used to step or scroll through the list.

DISPLAY ↓	Description	Options
N-VOL	*Net volume	Hold the ACCUM key to display accumulated total
N-FLOW	Net flowrate	
M-VOL	Main line volume	Hold the ACCUM key to display accumulated total
M-FLOW	Main line flowrate	
P-VOL	*Process line volume	Hold the ACCUM key to display accumulated total
P-FLOW	Process line flowrate	
R-VOL	Process volumetric ratio	
R-FLOW	Process flowrate ratio	
DEVIAT	Process flowrate deviation	
AINP1	*Analog input 1	
AINP2	*Analog input 2	
TARGET	*Target ratio %	Hold the SET key to edit the controlling setpoint if enabled
USER VALUE	User entered value	Hold the SET key to edit the current User Value if enabled (see below for details)
ID-TAG	Only shown if ID-TAG authorisation is configured	Validate ID tag before delivery is started as described in **ID Tag Validation** on page 31
REPORT PRINT	Only shown in Detail Menu if a printer protocol is used	Hold the SET key to print log report as defined in the TM/LOG section of calibration
LOGGED DATA	Only shown in Detail Menu if real-time clock option is installed	Hold the SET key to display data logs as described in **Data Logs** on page 26
MODEL INFO	Only shown in Detail Menu	Hold the SET key to display the Model information as described in **Model Information** on page 28
CAL MENU	Only shown in Detail Menu	Hold the SET key to enter Calibration View mode as described in **Calibration View Mode** on page 34

* These variables form the Basic (simplified) main menu in factory default configuration.

Detail and Basic Menu

The 515 instrument has the option to switch the main menu from the full Detail menu to a Basic menu. The Detail menu includes all of the main menu variables and the HOLD SET sub menu items as listed above. In the Basic menu only the application or operator essential main menu variables are shown. The main menu variables to be shown in the basic menu need to be selected in the 500 Series Program Manager prior to the application software being downloaded to the instrument. The 500 Series Program Manager (500-PM) is Windows based configuration and resource tool for the 500 Series and is freely available from the www.contrec.co.uk website.

To switch between the Detail and Basic menu, while in the main menu, press and hold the DISPLAY and SET keys together for 5 seconds. When switching to the Detail menu the display will briefly show:
display DETAIL MENU.
When switching to the Basic menu the display will briefly show:
display BASIC MENU.

When the application software is first installed, the default is the Detail menu. From that point, the menu type is saved and restored on power cycle. The menu type will need to be Detail to access the CAL MENU

User Value

SET Hold the SET key to edit the current User Value while viewing the User Value in the main menu. The display of the User Value will change from view mode to edit mode after 2 seconds if access has been enabled in calibration. Once in edit mode the **Set** indicator will illuminate and the User Value can be changed. The User Value is stored in the delivery log and can be used as an Operator Identifier.

Setpoints

SET Hold the SET key to display (or edit) the controlling setpoint while viewing one of the process variables. The display of the setpoint will change from view mode to edit mode after 2 seconds if access has been enabled in calibration. Once in edit mode the **Set** indicator will illuminate and the setpoint values are changed in exactly the same way as in calibration set mode.

Data Logs

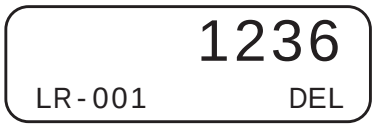
The instrument will log up to 1000 deliveries (batches) if the real-time clock option is installed. The logs are taken at the end of each batch. Each entry has a log number, a delivery number and a time and date stamp. When the number of log entries exceeds 999 the oldest log entry is overwritten by the newest one.

View Data Logs

Use the following procedure to view the data that has been logged by the instrument:

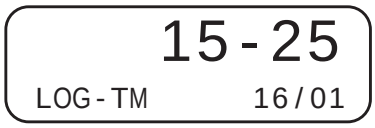
1. Press the DISPLAY key to scroll through the menu to the LOGGED DATA prompt.
2. Hold the SET key.

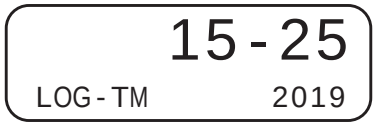
The system displays the most recent log record first. The log record number and corresponding delivery number are shown, for example LR-001 and DEL 1236.



3. Use the ▲ or ▼ keys to scroll to the delivery number or log record of interest.
4. Press the DISPLAY key to show the information stored in the selected log record. Each log record consists of:
   - time and date stamp,
   - error code
   - totals for the delivery.
5. While holding the DISPLAY key use the ▶ key to step through the stored information.
6. While holding the DISPLAY key use the RESET key to print the data for the displayed log if the printer option has been selected.

The following example shows the format of the time and date stamp at 15:25 (3:25 pm) on 16 January 2018. The day and month alternate with the year in the bottom right hand corner.





Model Information

The model information items display the hardware, software and application versions of the instrument. This information is mainly for service personnel.

DISPLAY ↓	Description
2-1--S- 515 MODEL	The hardware model code. Refer to **Product Codes** on page 87 for more information.
FFAA-- CB02 INPUT	The Application number and the assignment of the inputs. Refer to **Application Information Code** on page 88 for more information.
3_0_000 500-PM VERS	The version of 500-Series Program Manager from which the application software was compiled.
026357 CUSTOM VERS	The Customer version code for this installation. Refer to **Custom Version Codes** on page 88 for more information.
123456 ABC123 S/N	The instrument serial number and unit tag. The serial number is on the top line and unit tag is on the bottom left. Both items are entered when the instrument application software is initially loaded. The default unit tag is UNIT-1.
16-15 EDITED 27/08 2019	The time and date when the calibration of the instrument was last edited. The format of the time and date is the same as for the data logs. This example shows 16:15 (4:15pm) on the 27th August 2019. This function is available only if the instrument has the real time clock option.
CLASS-3 FLASH V-019	The instrument Class and Flash (bootloader) version.
5 POWER CYCLE	The number of power cycles that have occurred since the application software was installed.
1 WDT RESET	The number of 'watchdog timer' (WDT) resets that have occurred since the application software was installed. The WDT Reset count is only shown if a WDT Reset has occurred.
HOLD.RST CONFIG PRINT	If the printer protocol is assigned to one of the communication ports, the prompt to print the full program configuration report will be shown. Hold Reset to start the printing of the configuration report. The report will be in a similar format to the report generated by the 500-Series Program Manager.

Press SET at any time to exit from the Model information.

Blending Operation

The blending (process) line flow is controlled via a digital control valve (DCV) connected to the two solid state relay outputs. During delivery, the blending flow is controlled as the ratio of the net (combined) flow.

The instrument can operate in the following modes:

- PRESET
- ON-OFF
- RELEASE (only available in calibration set mode)

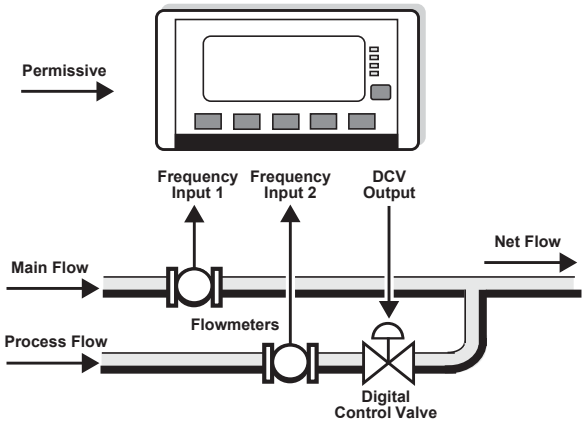
In the PRESET mode, the remote PERMISSIVE input (Logic Input 1) or Modbus RTU command is used to control the delivery's state (non-idle Modbus commands override the remote input). The delivery is registered as started when PERMISSIVE input is activated (or Modbus RUN command is received). The delivery is registered as finished when PERMISSIVE input is deactivated (or Modbus STOP command is received). The delivery logging occurs when the net flow actually stops.

In the ON-OFF (manual) mode the presence of the actual flow is used to determine the delivery's state. The delivery is registered as started when the net flow starts, and the delivery is finished and logged when the net flow stops. In this mode the Logic Input 1 inhibits the blending (process) line flow if de-activated (open circuit).

The RELEASE mode is only accessed from within the calibration mode and allows the operator to view the concise list of key parameters and gain immediate feedback for easier DCV control loop tuning. The control and tuning of the process line in this mode is independent of the main flow (deliveries are not registered in this mode). The optimal control can be achieved by adjusting the deadband and control factor parameters at the specified flowrate. The control factor allows the system response to be fine tuned by scaling the control signal (lower values will slow down the DCV operation).

Typical Blending Configurations

Blend Point After the Main Line Meter



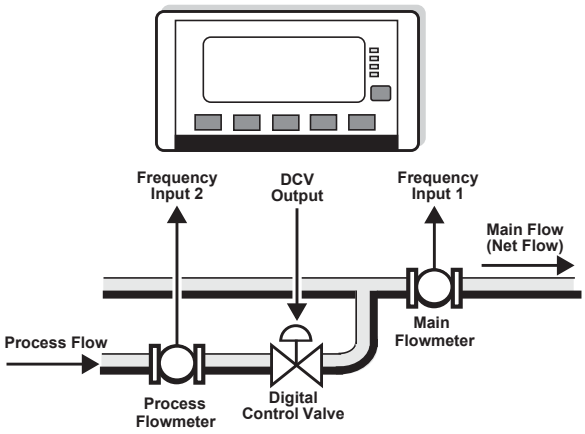
The desired blending ratio set point (RATIO %) is set via the front panel or serial communications.

The two solid state relays are used to maintain the desired process flowrate by controlling the digital control valve.

The desired process flow is determined as a ratio of the net (combined) flow (0 to 100% range). i.e.

$$Ratio\% = \frac{P_{flow}}{M_{flow} + P_{flow}} \times 100$$

Blend Point Before the Main Line Meter



The desired blending ratio set point (RATIO %) is set via the front panel or serial communications.

The two solid state relays are used to maintain the desired process flowrate by controlling the digital control valve.

The desired process flow is determined as a ratio of the main (net) flow (0 to 100% range). i.e.

$$Ratio\% = \frac{P_{flow}}{M_{flow}} \times 100$$

Resetting Totals

The instrument totals are reset by different means:

- At the end of a delivery, you can press the **RESET** key to reset the totals.
- Totals will automatically reset when the next delivery starts.

Logic Input Control

This instrument allows for remote operation via the logic inputs on the rear terminals. The logic inputs have the following functions:

- Logic Input 1 - Permissive

For connection details, refer to **Logic Input Connection** on page 16.

ID Tag Validation

If this feature has been enabled, a valid Identification Tag must be detected and authorised before the operator is able to start a batch. The ID Tag is read via an external module that has been connected and assigned to one of the physical communication ports. The instrument in the idle state (assuming a permissive is connected or not required) will scroll a prompt to 'Validate ID Tag'.

Note: An ID Tag can be an iButton 'Touch key' or an RFID transponder, read by one of the supported reader modules and protocols.

If an invalid ID Tag is presented the instrument will beep and display "ID FAIL" and will return to its idle state. If a valid ID Tag is presented, the instrument will beep and display "ID GOOD" before scrolling a prompt to 'Start Delivery'. If the operator does not wish to proceed, they can press and hold the RESET key to abort the start and return to the ID Tag prompt.

To be 'valid' an ID Tag must have been pre-stored into the instruments memory either through the **General Setup Parameters** on page 56 or via Modbus communication using **Instrument Configuration Parameters**.

The ID Tag is shown in the main menu items and is stored as a part of the logged delivery data. This recorded ID code can be used to link deliveries to external customer or user data bases.

Digital Control Valve Connection

This instrument provides two solid state relay outputs to operate a DCV for blending line control. The relay 4 should be connected to the HOLD valve solenoid (usually normally open) and the relay 3 should be connected to the OPENING valve solenoid (usually normally closed).

IMPORTANT: Only AC power should be used for these outputs.

It is also possible to configure the opto-isolated DC outputs to provide Increase/Decrease control signals that may be more suitable for other types of blend control systems, including stepper motor driven valves, etc.

Blending Errors

The instrument has the ability to raise an alarm when it detects a loss of flow, an overflow, or a leakage in the system.

- **No Flow Error** - The no flow condition is detected when the flow timeout expires during a delivery. There must not be a period of no flow greater than the timeout value during the delivery.
- **Overflow Error** - The overflow condition is detected when the flow continues longer than the timeout period after the controller has attempted to stop the flow.
- **Leakage Error** - The leakage condition is detected when an amount greater than the acceptable total is received with no delivery in progress.

The point at which these errors are detected is dependent on the values programmed into the calibration parameters FLOW TIMEOUT and ACCEPTABLE TOTAL. The open collector outputs can be assigned to activate when one of the flow errors occurs. Refer to **Instrument Settings** for more details.

Chapter 5
Instrument Calibration

Introduction

The 500 Series instrument calibration settings can be programmed via the front panel, according to program access levels explained below, or via the 500 Series Program Manager - a freely available Windows based configuration and resource tool.

After an instrument has been configured by either means to suit the application requirements, the settings can be recorded or application software backups or instrument clones created as explained further in **Program Backup & Reports** on page 37

You can view or change the settings of the instrument according to the access level for each parameter as set by the manufacturer. There are four levels of access to the parameters as follows:

- **Not visible** - you cannot display or edit the parameter.
- **Display only** - you can display the parameter, but you cannot change the setting.
- **Programmable** - you can change the setting of the parameter in Calibration Set mode.
- **Password protected** - you can change the setting of the parameter in Calibration Set mode only if you enter the correct password.
- **CAL switch protected** - you can change the setting of the parameter in Calibration Set mode only if you enter by using the CAL switch on Logic Input 4 to accept the password.

Note: When you enter Calibration Set mode, the instrument prompts to enter a password only if the password setup via the 500 Series Program Manager is non-zero (000000 is the factory default value). Entering any value at the password prompt will allow to change the settings of the “programmable” parameters, but the correct password must be entered to change the password-protected parameters. Likewise, the CAL switch (Logic Input 4) must be used to enter Calibration Set mode to change the CAL switch protected parameters.

Calibration View Mode

Use the following procedure to view the calibration settings of the instrument:

1. Press DISPLAY to scroll to the CAL MENU prompt.
2. Hold the SET key.

The instrument beeps once, illuminates the **Cal** indicator and shows CAL on the display panel.

- Press ▶ to scroll through the flashing menu headings.
- Press SET to scroll through submenu items.
- Hold DISPLAY to return to the main calibration menu.

3. To exit from the Calibration View mode, press ▶ to scroll to the END option and press SET.

   The instrument returns to Normal Operation mode.

Calibration Set Mode

In Calibration Set mode, you can change the settings of the "programmable" parameters. You must enter the system password to change the setting of the "password-protected" parameters and you must use the CAL switch on Logic Input 4 to access the "Cal switch protected" parameters.

Use the following procedure to enter Calibration Set mode:

1. Press DISPLAY to scroll to the CAL MENU prompt.
2. Hold the SET key.

The instrument beeps once, illuminates the **Cal** indicator and shows CAL on the display panel.

3. Press ▶ to select any flashing menu heading except END.
4. Hold the SET key for two seconds, or if "Cal switch protected" items exist the CAL switch can be closed for two seconds.

   The instrument prompts for a password to be entered if the password is non-zero, otherwise the password prompt is skipped.

5. If the password prompt is shown, press ▲ or ▼ to change the value of the current digit. To select the next digit, press ▶.
6. Press SET or use the CAL switch on Logic Input 4 (if "Cal switch protected" items exist) to accept the password and proceed.
7. Proceed and observe the access confirmations.

- If the CAL switch is used and the password is correct, the instrument makes two beeps and displays message:
  -EDIT- CS_PW MODE
  and enables you to change "programmable", "password protected" and "CAL switch protected" parameters.
- If the CAL switch is used but the password has been skipped or is incorrect, the instrument makes one beep and displays message:
  -EDIT- CAL_SW MODE
  and enables you to change "programmable" and "CAL switch protected" parameters.
- If the SET key is pressed and the password is correct the instrument makes two beeps and displays the message:
  -EDIT- PASSW MODE
  and enables you to change the "programmable" and "password-protected" parameters.
- If the SET key is pressed but the password has been skipped or is incorrect, the instrument makes one beep and displays the message:
  -EDIT- PROG MODE
  and enables you to change only the "programmable" parameters.

Run
Set
Alarm
Cal

The instrument illuminates both the **Cal** and **Set** indicators.

8. Edit the instrument parameters as required. The programmable values are indicated by the flashing display.

- To change a numerical value, press ▲ to increase a value, or press ▼ to decrease a value. Press a key momentarily to change the value one number at a time. Hold a key to scroll through the numbers. To proceed to next digit, press ▶.
- To change an option setting, press ▲ or ▼ to scroll through the options.

9. Press SET to accept the currently displayed value and proceed to the next parameter. You can press DISPLAY to briefly view the current edit mode: -EDIT- XXXXXX MODE, as described in step 6 above. Continue to hold the DISPLAY key to return to the main calibration menu.

10. To exit from Calibrate Set mode, press ▶ to scroll through the main calibration menu to END, then press SET. Otherwise, to quick exit from any menu, you can press and hold SET for two seconds or, if "Cal switch protected" items exist, the CAL switch can be closed for two seconds.

Run
Set
Alarm
Cal

The instrument makes two beeps and cancels the **Cal** and **Set** indicators.

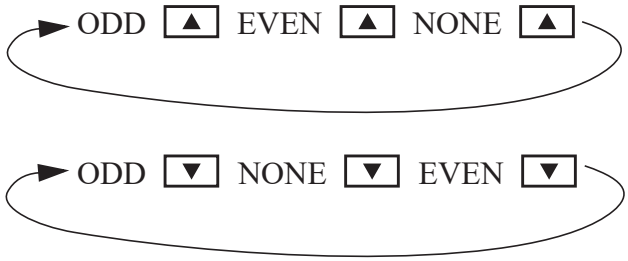
Changing the Instrument Settings

In Calibration Set mode, the display flashes the item that can be changed. For option settings, the display flashes the complete option. For a numeric parameter, the display flashes one digit at a time, you can change the value of the flashing digit as required, then move the flashing cursor to change another digit.

Note: When you change the setting of a parameter, the instrument records the result as soon as you move to another parameter, or exit from the Calibration Set mode.

Changing Option Settings

When you display an option that can be changed, the entire option flashes on the display, such as the choices of ODD, EVEN or NONE for the communications parity bit checking. Press [▲] or [▼] to change the option. You can "scroll" through the options in either direction to make a selection as shown below.



Changing Numeric Settings

The display flashes the digit that can be changed.

Press [▶] to select the digit that you wish to change.

Press [▲] or [▼] to increase or decrease the value of the selected digit.

Changing the Decimal Point

To change the position of the decimal point, press [▶] to move the flashing selection until the decimal point flashes. Press [▲] or [▼] to move the decimal point to the right or left as required.

Units of Measurement

The calibration of some parameters is based on the units that are defined for the relevant variables. These units of measurement can been viewed in the UNITS menu in the Instrument Settings section below.

Program Backup & Reports

Backup via 500 Series Program Manager

As well as programming the 500 Series instruments via the front panel (according to program access levels), the 500-PM software can be used to create a custom version of the application software and program parameters preset prior to downloading the application software. Backups of customised applications can be saved as downloadable APX or APL files and the full configuration reports printed or saved as PDF. The 500-PM is a Windows based programming tool and resource centre and is freely available from the Contrec www.contrec.co.uk website.

Instruments are often supplied from the factory with the default application software, but it is by using 500-PM software that program access levels are set, USER text and messages customised and print headers and footers entered.

Printing Configuration Report

To assist in keeping an audit trail of the program settings and changes made via the front panel, the 515 instrument provides the ability to print the configuration to a local printer if one has been connected and assigned to one of the 515 communication ports.

The prompt to hold the Reset key to print the configuration report
HOLD.RST CONFIG PRINT
is found at the end of the Model Info menu, described in **Model Information** on page 28. The report can be lengthy and adequate printer paper must be available (Note: This feature is available starting from version 3.0.377).

Upload and Clone of Application Software

To assist in maintaining a backup for important applications and installations, the 500-Series Program Utility software (500-LT, version 3.0.377 or higher) can be used to upload the instruments application software with all of the current program settings.

The 500-LT (PM Lite) program is a Windows based computer program which can be downloaded for free from the Contrec www.contrec.co.uk website and is part of the package when the Contrec 500 Series Program Manager is installed. The 500-LT provides the option to ‘Upload Application’ or ‘Upload Report Only’. To use either upload functionality, the 515 port being used must have printer (PRN) protocol assigned to it.

Once uploaded to the 500-LT, the report can be viewed or printed. The Upload Application is automatically saved as an APL file. The file can be used then or reopened later to download to another 515 instrument (of the same or higher class) to create a clone of the original instrument.

Calibration Menu Tree

Figure 16 and Figure 17 show the keys for moving around the calibration menu tree in Calibration View or Set mode.

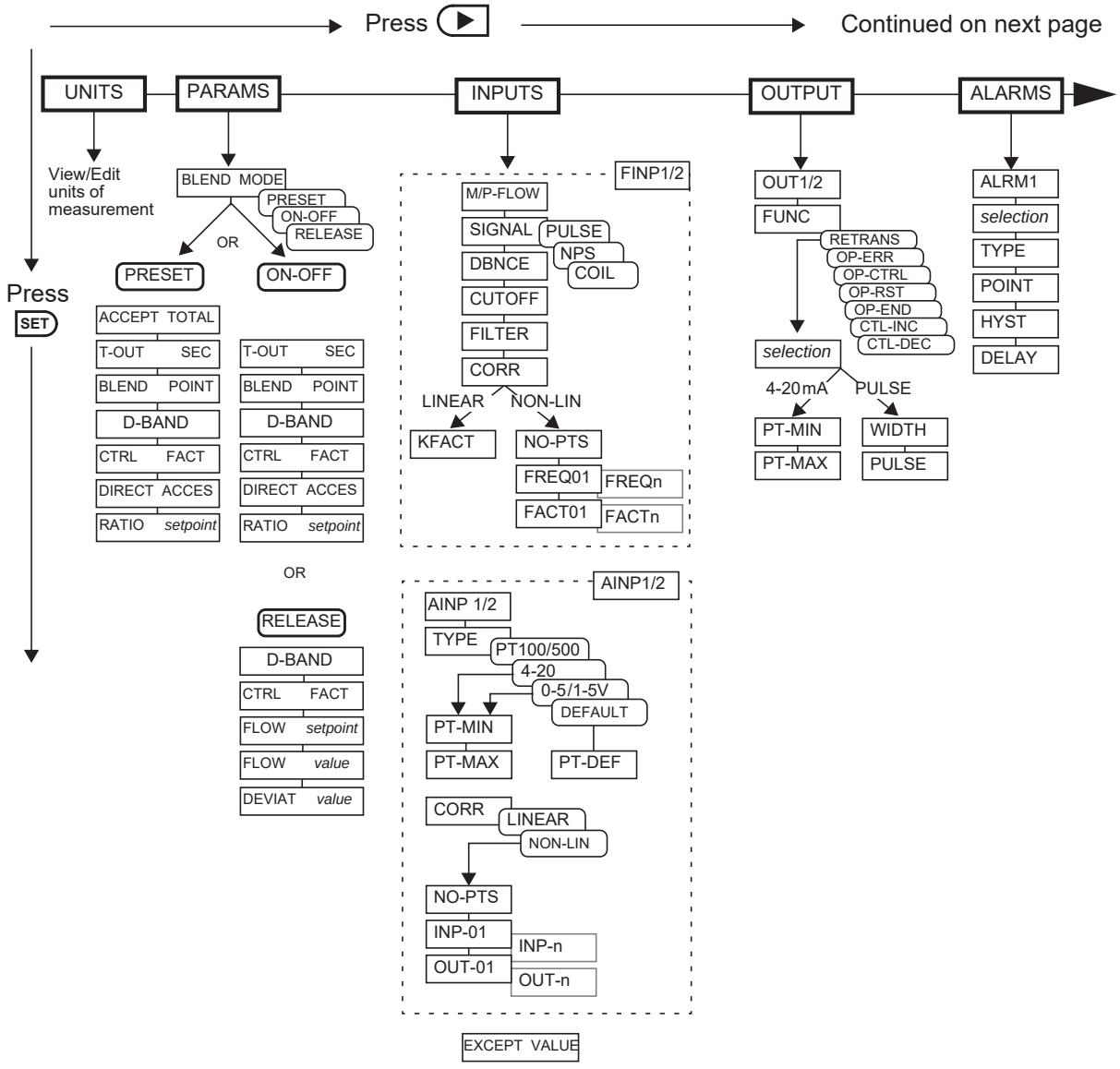
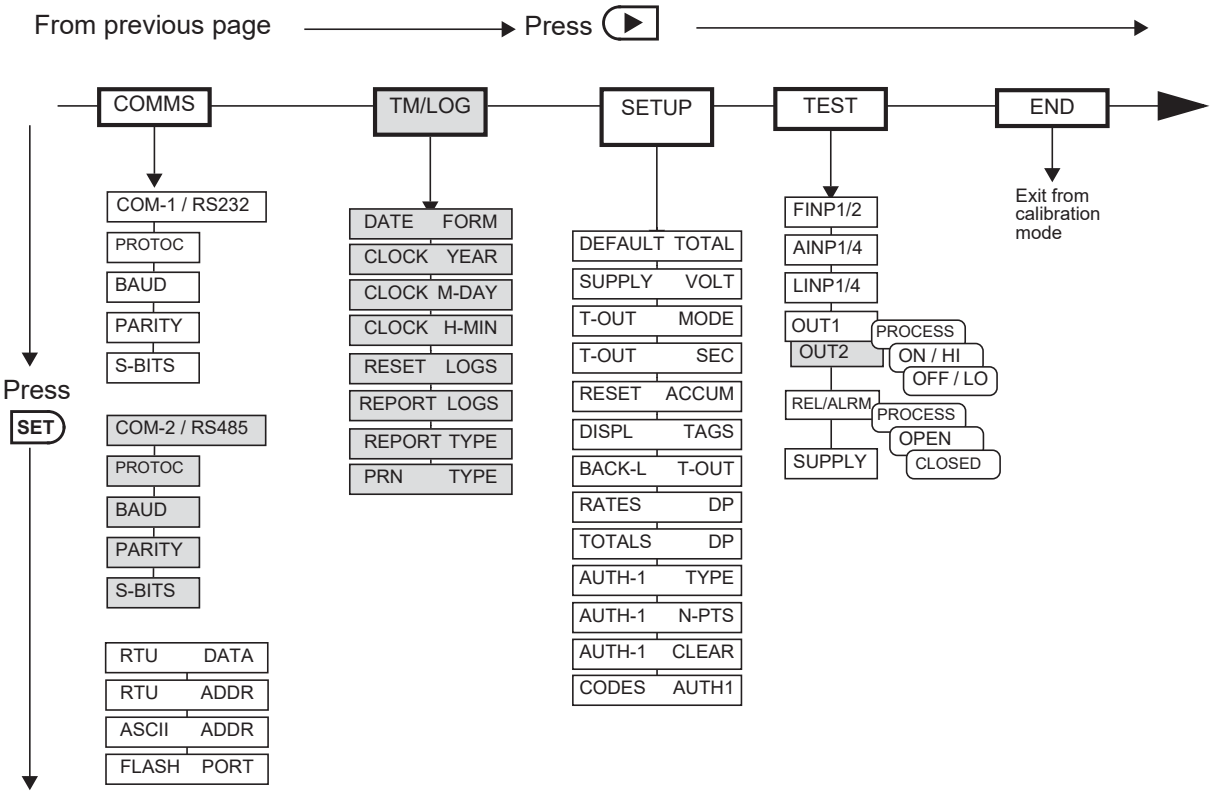


Figure 16 Calibration Menu Tree Sheet 1



The shaded boxes indicate hardware options

Hold **DISPLAY** at any point to return to the main calibration menu.

Press ▶ at any I/O assignment position to move to the next I/O assignment in the submenu (eg pressing ▶ on ALRM1 will move you to ALRM2 if it exists)

Figure 17 Calibration Menu Tree Sheet 2

Instrument Settings

Units of Measurement

The Units menu allows the units to be viewed and edited if necessary without the reloading of new application software. Any change in units will result in a full reset to initially downloaded settings. Therefore, any required changes to units of measurement should be made before changing any other settings.

SET ↓	▶ → **UNITS** PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END
ITEM *n* *unit*	The units for main menu or calibration items can be viewed by pressing the SET key. The units of measurement are password protected or will be protected by the CAL switch if any instrument setting has an access level of 'CAL Switch Protected'. To edit the units the correct password must be entered or CAL switch used on entry to EDIT mode. Press ▲ or ▼ to select the required units.
ACCEPT UNITS	The Accept Units prompt will only appear if one or more of the units have been changed. **IMPORTANT:** Accepting the change of units will initiate a master reset. All calibration parameters will revert to their default value (i.e. those values included in the downloaded instrument software). All totals and any logged information will be cleared. Press ▲ or ▼ to select YES, then press the SET key. The instrument makes three beeps to confirm the reset command. The message -RESET- PLEASE WAIT will be displayed as the instrument exits calibration mode and completes a full re-boot sequence.

Parameters

SET ↓	▶ → UNITS **PARAMS** INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END
BLEND MODE	Select the required blend operation mode. • **PRESET** - delivery controlled by logic input or Modbus RTU. • **ON-OFF** - delivery controlled by flow presence. • **RELEASE** - release flow (loop tuning, only available in calibration mode). Press ▲ or ▼ to select either: PRESET, ON-OFF, or RELEASE. Refer to the section **Blending Operation** on page 29 for descriptions of each mode.
Note: The items actually shown in the PARAMS menu are dependent on the BLEND MODE chosen above. Items that are not relevant for that mode will not appear. Use the Calibration Menu Tree as a guide to the relevant items.	
ACCEPT TOTAL	The acceptable total is the minimum total for the system leakage to be logged (a value of zero disables logging of leakages). It also allows small totals due to "meter skips" and vibration to be discarded without being considered as a valid delivery.
T-OUT SEC	The flow timeout determines the length of no flow time that the instrument will wait during a delivery before raising a no flow error. It also determines when an overflow error is raised if flow does not cease within the timeout period after the controller attempts to stop the flow. A value of zero disables these flow timeout features. Enter the value in seconds.
BLEND POINT	Blend point location: AFTER: after main line meter BEFORE: before main line meter
D-BAND *Units*	The control deadband can be programmed to prevent the output continuously changing and thereby reducing wear on valves and actuators. While the main menu Deviation (error) is within the deadband, the process control signal will remain steady (i.e. the error is treated as zero in the algorithm).
CTRL FACT	The control scaling factor allows fine tuning of the system response by scaling the control signal. Set the factor to lower values to slow down the valve operation.
P-FLOW SP	Loop/Process flowrate setpoint. This setpoint is only available in RELEASE (tuning) operation mode.

SET ↓	▶ → UNITS **PARAMS** INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END
DIRECT ACCES	If the direct access is enabled, the operator is able to enter edit mode for some parameters directly from the main menu by holding the SET key (see **Main Menu Items** on page 25 for more details). If disabled, these parameters can only be changed from within the calibration set mode or via Modbus RTU serial communication. Press ▲ or ▼ to select ENABLE or DISABLE.
Modbus Accessible Parameters The following PARAMS menu item(s) are also accessible via Modbus communications. For Modbus register listing, refer to **Instrument Configuration Parameters** on page 76.	
RATIO SP	Target ratio setpoint.

Inputs

SET ↓	▶ → UNITS PARAMS **INPUTS** OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END
Frequency Input 1 & 2	
INPUT M_FLOW FINP1 P-FLOW FINP2	Frequency Input Channels 1 and 2 are assigned as volumetric flow inputs. Channel 1 is for measuring the main line flow and channel 2 is for the process line flow.
SIGNAL FINP1 FINP2	Frequency input signal type. Press ▲ or ▼ to select COIL, NPS or PULSE.
DBNCE FINP1 FINP2	Switches and relays have metal contacts to make and break circuits. The contact bounce introduces random signals into the circuit. The instrument has a debounce circuit to eliminate this problem. **Note:** When the debounce circuit is enabled, the maximum input frequency for large amplitude signals is limited to approximately 500 Hz. For low amplitude signals, the maximum frequency can be approximately 200 Hz. Press ▲ or ▼ to select ENABLE or DISABLE.

<table>
<tr><td>SET ↓</td><td>▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END</td></tr>
<tr><td>CUTOFF F1NP1
F2NP2</td><td>The Cut-off is the lowest frequency for which the instrument continues to calculate a rate from the flowmeter.

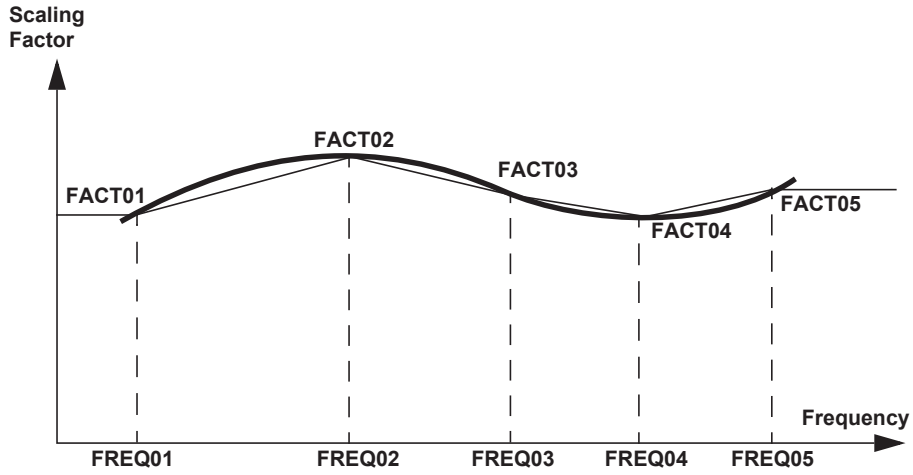
The value for the cut-off is specified as the frequency of the flowmeter in Hertz.

Be careful when setting low cut-off values because the display update time for the flow rate becomes very long. For example, if the cut-off is set to 0.01 Hz and the measured flow stops, the instrument continues to display the flow rate for 100 seconds before it can determine that the flow has actually stopped.</td></tr>
<tr><td>FILTER F1NP1
F2NP2</td><td>Input fluctuations caused by pulsating flow tend to create distortion in the input readings of the rate. The instrument has a digital filter that averages out these fluctuations.

As a guide to the degree of filtering to use, the following table shows the response time (in seconds) to reach 90% and 99% of a step change in input.

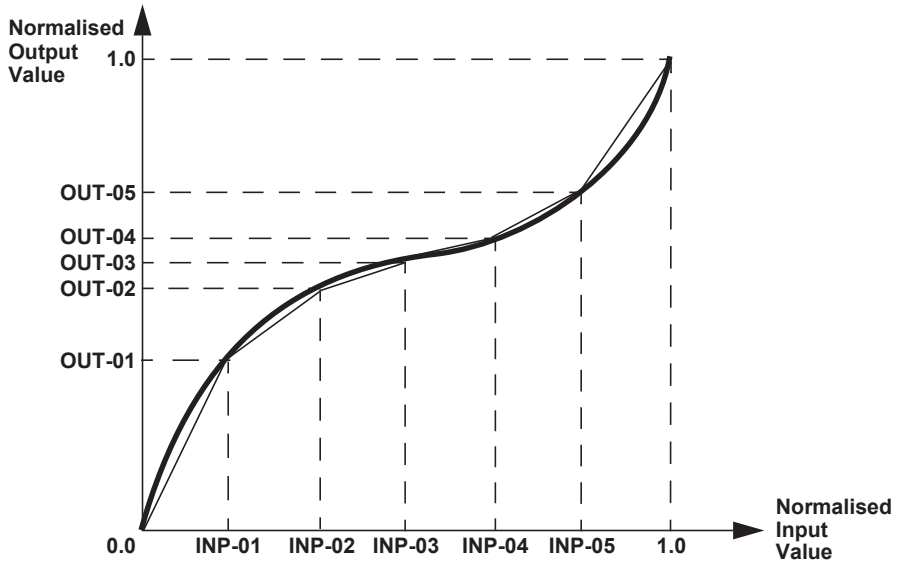
The value A is the filter constant that the user can set.
<table>
<tr><th>Filter setting A</th><th>Seconds to reach 90% of full swing</th><th>Seconds to reach 99% of full swing</th></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>2</td><td>2</td><td>4</td></tr>
<tr><td>4</td><td>4</td><td>8</td></tr>
<tr><td>6</td><td>5</td><td>10</td></tr>
<tr><td>10</td><td>8</td><td>15</td></tr>
<tr><td>15</td><td>12</td><td>23</td></tr>
<tr><td>20</td><td>14</td><td>27</td></tr>
<tr><td>25</td><td>18</td><td>34</td></tr>
<tr><td>35</td><td>25</td><td>48</td></tr>
<tr><td>45</td><td>32</td><td>62</td></tr>
<tr><td>60</td><td>42</td><td>82</td></tr>
<tr><td>75</td><td>52</td><td>102</td></tr>
<tr><td>90</td><td>62</td><td>122</td></tr>
<tr><td>99</td><td>68</td><td>134</td></tr>
</table>
The input filter range is from 0 to 99. A setting of 0 (zero) means that there is no filtering.</td></tr>
<tr><td>CORR F1NP1
F2NP2</td><td>If the input sensor has non-linear characteristics, select NON-LINEAR to apply correction factors to the input signal.

Use ▲ or ▼ to select LINEAR or NON-LINEAR.</td></tr>
</table>

SET ↓	▶ → UNITS PARAMS **INPUTS** OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END
KFACT1 *unit* KFACT2 *unit*	*This parameter is available for viewing and editing only when the correction type is set to Linear.* The K-factor of the flowmeter is the number of pulses from the flowmeter per unit of volume. The K-factor cannot be 0 (zero).
NO-PTS FINP1 FINP2	*This parameter is available for viewing and editing only when the correction type is set to Non-linear.* Enter the number of non-linearity correction points. Press ▲ or ▼ to select a number between 1 and 10 for the number of correction points.
FREQ01 FINP1 *to* FREQ*n* FREQ01 FINP2 *to* FREQ*n*	*This parameter is available for viewing and editing only when the correction type is set to Non-linear.* Enter the frequency for this correction point. The instrument uses linear interpolation between the correction points except that the correction factor for FREQ01 is used from 0 Hz up to FREQ01. Similarly, the instrument maintains the correction factor for the highest frequency setting up to the maximum input frequency. The following diagram shows the scaling factors at different frequencies for a hypothetical flowmeter. The heavy black line represents the actual scaling factor of the flowmeter. The light black line is the approximation that the instrument uses.  Enter the lowest correction factor frequency as FREQ01 and proceed up to the highest frequency. You can press the DISPLAY key to skip the non-linear points and go to the next item.

SET ↓	▶ → UNITS PARAMS **INPUTS** OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END
FACT01 FINP1 *to* FACT*n* FACT01 FINP2 *to* FACT*n*	*This parameter is available for viewing and editing only when the correction type is set to Non-linear.* Enter the scaling factor for this correction point in the same units of measure as the single K-factor above. The correction factor cannot be 0 (zero).
Analog Inputs 1 & 2	
INPUT AINP1 AINP1 AINP2 AINP2	For this application, Analog Input Channels 1 and 2 serve as the general purpose inputs and can be used for reading fluid levels, etc.
TYPE AINP1 AINP2	Select the type of analog input source. Press ▲ or ▼ to select 0-5V, 1-5V, 4-20mA, PT100, PT500 or DEFAULT.
PT-DEF AINP1 AINP2	The Default Point is a fixed value that the instrument uses when the Input Type is set to DEFAULT or Default Value On Exception has been ENABLED. You can use the Default value instead of a sensor signal for testing purposes, or if the sensor is faulty. You can set the default value during instrument commissioning so that it is available immediately if you select the Default input type at a later date. Enter the value in the engineering units of assigned variable.
PT-MIN AINP1 PT-MAX AINP2	*The Minimum Point and Maximum Point parameters are only for 0-5V, 1-5V and 4-20mA inputs.* Enter the value of the measured parameter that corresponds to the minimum input signal level. The minimum point is commonly referred to as the base value. Enter the value of the measured parameter that corresponds to the maximum input signal level. The maximum point is the same as the base value (set at the minimum point) plus the span value. For example, if the source signal is 4mA for a level of 1.0 metre, enter 1.000 for the minimum point. If the source signal is 20mA for a level of 5 metres, enter 5.000 as the maximum point.

SET ↓	▶ → UNITS PARAMS **INPUTS** OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END
CORR AINP1 AINP2	Analog input non-linearity can be corrected as follows: • LINEAR • NON-LINEAR to use the following linearity correction parameters Use ▲ or ▼ to select LINEAR or NON-LINEAR.
NO-PTS AINP1 AINP2	*This parameter is available for viewing and editing only when the correction type is set to Non-linear.* Enter the number of non-linearity correction points. Press ▲ or ▼ to select a number between 1 and 20 for the number of correction points.

SET ↓	▶ → UNITS PARAMS **INPUTS** OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END
INP-01 AINP1 *to* AINP2 INP-*n*	*This parameter is available for viewing and editing only when the correction type is set to Non-linear.* Enter the normalised input value for the correction point. The instrument uses linear interpolation between the correction points. An input and an output value are entered for each correction point. The values are normalised between the minimum point (0.0) and the maximum point (1.0). Only the points between 0 and 1 are required to be entered and should be entered in ascending order. The following diagram shows a 5 point linearised representation of the input for a hypothetical flowmeter. The heavy black line represents the actual input from the flowmeter. The light black line is the approximation that the instrument uses.  You can press the DISPLAY key to skip the non-linear points and go to the next item.

SET ↓	▶ → UNITS PARAMS **INPUTS** OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END
OUT - 01 AINP1 *to* AINP2 OUT - *n*	*This parameter is available for viewing and editing only when the correction type is set to Non-linear.* Enter the normalised output value for the correction point.
EXCEPT VALUE	This option allows you to choose which value the instrument will use for the analog input that raised an exception. The exception message will continue to be displayed until the fault is rectified or the input type is set to DEFAULT in calibration set mode. Press ▲ or ▼ to select the value on exception as follows: NONE Value will be set to zero DEFAULT Value will be set to the default point if exists, otherwise zero BOUNDS Value will be set to the boundary limit (min or max point)

Outputs

SET ↓	▶ → UNITS PARAMS INPUTS **OUTPUTS** ALARMS COMMS TM/LOG SETUP TEST END
FUNC OUT*n*	The isolated output can function as either a passive 4-20 mA output, or a pulse/logic open collector output: • **RETRANS** - Retransmit totals as a pulse output or rates type variables as a 4-20mA signal. • **OP-ERR** - An error signal that will become active for the no flow, overflow or leakage error conditions. • **OP-CTRL** - A control signal that is active during a batch, can be used as a pump control or indicator. • **OP-RST** - A control signal that produces a 300ms pulse that can be used to reset remote counters etc. Activates when the controller's total(s) are reset. • **OP-END** - A control signal that reflects the End of Operation condition (Note: not applicable if Blend mode is ON-OFF). • **CTL-INC** - A process flow 'increase' control output signal. • **CTL-DEC** - A process flow 'decrease' control output signal. Press ▲ or ▼ to select the function required.

SET ↓	▶ → UNITS PARAMS INPUTS **OUTPUTS** ALARMS COMMS TM/LOG SETUP TEST END
PULSE OUT*n* or 4-20	If above function is set for retransmission, you can assign any of the "main menu" variables to an output. The nature of the output depends on the assigned variable. Totals are output as pulses and rates are output as 4-20 mA passive signals. Press ▲ or ▼ to select the variable that is required as an output. The top of the display shows the type of output signal that is assigned to the variable. **CAUTION** Due to the dual-purpose nature of the outputs, take care not to set the output as an open collector pulse type signal when connected to a 4-20 mA loop circuit.
WIDTH OUT*n*	*The Output Pulse Width is available for viewing and editing only when the assigned variable is a total (pulse output) type.* Pulse output is usually used to drive remote counters. Set the pulse width (in milliseconds) as required by the remote counter. Press ▲ or ▼ to set to: 10, 20, 50, 100, 200 or 500 ms.
PULSE OUT*n*	*The Output Pulse Factor is available for viewing and editing only when the assigned variable is a total (pulse output) type.* The Output Pulse Factor is the scaling factor for the retransmission of the measured total quantity. For example, if "volume" is chosen as an output variable and engineering unit is cubic metres, then a pulse factor of 1.000 generates one pulse for 1 m^3. Similarly, a pulse factor of 3.000 generates one pulse for 3 m^3. For more information, see **Output Pulse Factor** on page 50. The output pulse factor cannot be 0 (zero).

SET ↓	▶ → UNITS PARAMS INPUTS **OUTPUTS** ALARMS COMMS TM/LOG SETUP TEST END
PT-MIN OUT*n* PT-MAX OUT*n*	*The Output Minimum Point and Maximum Point are available for viewing and editing only when the assigned variable is a rate (4-20mA output) type.* The output minimum value corresponds to the 4mA point and the output maximum value corresponds to the 20mA point. Setting the output range differently from the input range enables the instrument to amplify the input signal. You can drive a chart recorder that "zooms in" on a specified range of values instead of displaying the full operating range of the transducer. For example, if "volume flow" is chosen as an output variable and engineering unit is cubic metres per minute, then setting the minimum point to 30 and the maximum point to 100 would reflect the volumetric flow rate range of 30 to 100m^3/min. At rates above the maximum and below the minimum points, the output remains at 20mA and 4mA respectively.

Output Pulse Factor

Increasing the output pulse width reduces the maximum frequency at which a total variable can be retransmitted. Pulses will be missed if the output cannot "keep up" with the rate of total counts. You can use the output pulse factor to ensure that this maximum is not reached.

The maximum pulse output frequency is determined by:

$$\frac{1000}{(2 \times \text{pulse width in ms})}\text{Hz}$$

The minimum pulse factor required is determined by:

$$\frac{\text{max rate of total}}{\text{max pulse output frequency}}$$

For example: To calculate the required pulse factor to avoid losing counts in retransmission if a total counts at a maximum rate of 75 units/sec (Hz) and the required pulse width of a remote counter is at least 50ms:

The maximum pulse output frequency is: $\frac{1000}{2 \times 50} = 10\text{Hz}$

The minimum pulse factor for that frequency is: $\frac{75}{10} = 7.5$

Alarms

The alarm relay(s) can be assigned to rate variables such as flow rate, or set as an equipment failure alarm.

The alarm switches “on” whenever an alarm condition exists. The alarm switches “off” when the alarm condition no longer exists. However, you may need to configure external alarm devices that require acknowledgement for cancelling an alarm.

Equipment Failure Alarm

Any alarm relay can be assigned as an equipment failure alarm. This alarm setting can have normally closed (open) contacts that open (close) when the instrument displays any error message as listed in **Error Messages** on page 61.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS **ALARMS** COMMS TM/LOG SETUP TEST END
RELAY ALRM*n*	Select a rate variable to assign to the alarm relay. **Note:** If the alarm type is set to “equipment alarm”, this relay assignment setting is ignored. Press ▲ or ▼ to select the variable that is required as an alarm.
TYPE ALRM*n*	The options available for alarm types are as follows: • HI-NO - High Alarm, contacts are Normally Open • HI-NC - High Alarm, contacts are Normally Closed • LO-NO - Low Alarm, contacts are Normally Open • LO-NC - Low Alarm, contacts are Normally Closed • BD-NO - Band Alarm, contacts are Normally Open • BD-NC - Band Alarm, contacts are Normally Closed • AL-NO - Equipment Alarm, contacts are Normally Open • AL-NC - Equipment Alarm, contacts are Normally Closed Press ▲ or ▼ to select the type of alarm required.
POINT ALRM*n*	*The Alarm Setpoint is available for viewing and editing for any alarm type except ‘equipment alarms’.* The Alarm Setpoint is the value (in engineering units of assigned variable) at which the alarm condition occurs and therefore the alarm is on. Each alarm is completely independent, e.g. a High alarm does NOT need to have a higher setpoint than the a Low alarm.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS **ALARMS** COMMS TM/LOG SETUP TEST END
HYST ALRM*n*	*The Alarm Hysteresis is available for viewing and editing for any alarm type except 'equipment alarms'.* Alarm hysteresis loops occur when the alarm toggles continuously on and off when the process variable is close to the setpoint. For a high alarm, the alarm activates when the value of the variable rises above the alarm setpoint and deactivates when the value falls below the alarm setpoint minus the amount of the hysteresis setting (if any). For a low alarm, the alarm activates when the value of the variable falls below the alarm setpoint and deactivates when the value rises above the alarm setpoint plus the amount of the hysteresis setting (if any). For a band alarm, the alarm activates whenever the value of the variable is outside the setpoint plus or minus the amount of the hysteresis. For example, with a high alarm setpoint of 200, and a hysteresis setting of zero, a value oscillating between 197 and 202 will cause the alarm to toggle on at 200 and toggle off below 200. However, if the hysteresis is set to 5, the value of the variable must fall below 195 to cancel the alarm. The alarm will reactivate only when the value again rises above 200.
DELAY ALRM*n*	The Alarm Delay is programmed in seconds and can be used to eliminate undesired alarm activation during start-up or shutdown operation.

Communications

The instrument has the following communication ports:

- **COM-1 RS-232 Port** - A 9-pin female connector on the rear panel of the instrument.
- **COM-2 RS-485 or Ethernet Port** (optional) - Terminals or socket on the rear panel. Ethernet connection requires COM-2 setting to be: RTU (Modbus), 19200 Baud rate, even parity and 1 stop bit.
- **COM-3 Port** - A special communications port that is only applicable to some applications.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS **COMMS** TM/LOG SETUP TEST END
PROTOC COM-*n*	The Communications Protocols can be assigned to the communication ports as follows (a protocol cannot be assigned to more than one port at a time): • **ASCII** - Simple ASCII • **RTU** - Modbus RTU • **ID-RF-1** - Pepperl+Fuchs ASCII protocol (IQT*-*-R4-V1 devices) • **ID-TAG** - iButton LINK45 protocol • **PRN** - Printer Protocol • **NONE** - If a port is not being used, set the protocol to NONE. Printer Protocol (PRN) is only available if the option with Real Time Clock is installed. For the selected port, press ▲ or ▼ to select the desired protocol.
BAUD COM-*n*	The Baud setting is the speed of the communication port in data bits per second. The baud rate of the instrument must match the baud rate of the communication device that the instrument is connected to. Use ▲ or ▼ to select 2400, 4800, 9600 or 19200 baud.
PARITY COM-*n*	The Parity bit helps to detect data corruption that might occur during transmission. The parity bit setting of the instrument must match the parity bit setting of the communication device that the instrument is connected to. Press ▲ or ▼ to select EVEN, ODD, or NONE.
S-BITS COM-*n*	The Stop bit indicates the end of a transmission. Stop bits can be 1 or 2 bit periods in length. The stop bit setting of the instrument must match the stop bit setting of the communication device that the instrument is connected to. Press ▲ or ▼ to select 1 or 2 stop bits.
RTU DATA	The Modbus RTU data format for the 2-register (4-byte) values can be set as either floating point or long integer values. Use ▲ or ▼ to select FLOAT or INTEGER.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS **COMMS** TM/LOG SETUP TEST END
RTU ADDR	The Modbus RTU protocol address must be in the range of 1 to 247. When multiple instruments (slaves) are connected to one communication device (master), each assigned address must be unique. **Note:** The master device uses the RTU address 0 (zero) for broadcasting to all connected slave units.
ASCII ADDR	The ASCII protocol address identifies each communicating device. The address must be in the range of 1 to 255. When multiple instruments (slaves) are connected to one computer (master), each assigned address must be unique.
FLASH PORT	The Flash Driver Port assignment defines the communication port for downloading software into the instrument. The default setting of this assignment is the RS-232 port. The Ethernet port, if fitted, cannot be used as the Flash port. Press ▲ or ▼ to select RS-232 (COM-1), RS-485 (COM-2) or NONE.

Time Settings and Data Logging

Instrument Clock

Note: The real-time clock is part of the advanced option package.

The instrument has a real-time clock for recording logged events. The clock displays the time and the date. The date format can be set to European format (day/month/year) or American format (month/day/year). The time clock uses the 24-hour format.

The clock will continue to operate for up to 5 years (typically) on the internal battery if there is no power connected to the instrument. Therefore, after an interruption to the power supply, the instrument recommences normal operation although there will be no data recorded during the period without a power supply.

Note: If there is an interruption to the power supply and the battery has failed, the instrument displays an error message when the power supply is restored. In this case, you should set the current time and date so that the instrument continues to log data at the correct times.

Data Logging

The instrument will log a total of 1000 deliveries (batches) if the real-time clock option is installed. The logs are taken at the end of each batch.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS **TM/LOG** SETUP TEST END
DATE FORM	Clock Date Format The European date format is: dd/mm/yyyy or (Day-Month). The American date format is: mm/dd/yyyy or (Month-Day). Press ▲ or ▼ to select DAY-M or M-DAY
CLOCK YEAR	The Clock Year defines the current year for the real-time clock.
CLOCK M-DAY	The Clock M-DAY setting defines the current month and date for the real-time clock. This parameter is programmed in Month-Day format for both European and American date formats.
CLOCK H-MIN	The Clock H-MIN setting is the current time in hours and minutes for the real-time clock.
RESET LOGS	Reset the logged data. You may need to reset (clear) the logged data if you change the time/log settings. Press ▲ or ▼ to select YES, then press the SET key. The instrument makes three beeps to confirm the reset command.
REPORT LOGS	The Printer Protocol Report Logs defines the number of latest logs to be included into a printable report. Set the number of logs between 1 and 99.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS **TM/LOG** SETUP TEST END
REPORT TYPE	The Printer Protocol Report Type determines the nature of the printout from the REPORT PRINT - HOLD.SET prompt in the main menu. The following report types available in this instrument are: • REP-10 Preset number of latest logs Press ▲ or ▼ to select Report Type.
PRN TYPE	The Printer Protocol Printer Type allows the nature of the printer being used to be specified. The following printer types available in this instrument are: • PRN-01 Generic computer printer • PRN-02 Generic roll printer (prints first line first) • PRN-03 Slip printer TM295 • PRN-04 Label (roll) printer - Citizen CMP30L Press ▲ or ▼ to select Printer Type.

General Setup Parameters

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG **SETUP** TEST END
DEFAULT TOTAL	The instrument displays the default Total when the user presses the TOTAL key or when the timeout period has elapsed if it is enabled. Press ▲ or ▼ to select the default total display.
SUPPLY VOLT	The instrument provides a power-limited supply for external transducers. Press ▲ or ▼ to set the transducer supply voltage between 8 and 24 volts DC as required.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG **SETUP** TEST END
T-OUT MODE	If the Display Timeout mode is enabled, and there is no user activity for the defined timeout period, the display panel returns to the default display. This function is useful for the following reasons: • to return the display to a preferred variable after the user has finished reading other information, • to cancel the calibration mode and return to the default display if the user does not exit from the calibration mode for any reason. Press ▲ or ▼ to select the display timeout function as follows: • **DISABLE** - Timeout is completely disabled. • **EN DISP** - Timeout is enabled during Normal mode and Calibration View mode. • **EN EDIT** - Timeout is enabled during Calibration Set mode. • **EN ALL** - Timeout is enabled for all modes.
T-OUT SEC	The Display Timeout period defines the delay for the Display Timeout mode if it is enabled. The display timeout period can be from 10 to 99 seconds.
RESET ACCUM	The Reset Accumulated Totals function clears all of the accumulated totals and the non-accumulated totals. Press ▲ or ▼ to select YES, then press the SET key. The instrument makes three beeps to confirm the reset command.
DISPL TAGS	The Display Tags option determines whether the instrument displays the default display tags or the user-defined tags. The display tag setting also defines whether the instrument displays the default error and warning messages, or the user-defined messages. **Note:** The user-defined tags can be entered into the instrument only by the manufacturer or the distributor. Press ▲ or ▼ to select the Display Tags option as follows: • **DEFAULT** - the instrument displays the default (English) tags • **USER** - the instrument displays the user-defined tags.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG **SETUP** TEST END
BACK - L T - OUT	If the backlight timeout is enabled, and there is no user activity (any keys pressed) for a period of 10 seconds, the display backlight switches off to save power. The backlight switches on when a key is pressed. Select the backlight timeout mode as required. Press ▲ or ▼ to select ENABLE or DISABLE.
RATES DP	This parameter sets the maximum number of decimal places for displaying or printing main menu rates.
TOTALS DP	This parameter sets the maximum number of decimal places for displaying or printing main menu totals.
AUTH - 1 TYPE	The instrument can be configured to ensure authorisation is granted before a batch can be commenced. The authorisation code will be logged as part of a batch delivery record and can be included on a printed docket. The Authorisation Type can be set to the following: • **ID-NONE** - Authorisation is not required • **ID-TAG** - Authorisation is required before a batch can start. If ID-TAG is selected, one of the ID tag protocols (ID-TAG or ID-RF-1) must be assigned to one of serial ports in **Communications** on page 52. Press ▲ or ▼ to select the authorisation type.
AUTH - 1 N - PTS	The instrument can store up to 100 valid authorisation codes. To reduce the need to step through an unnecessary number of unused points this parameter allows the number of code points to be entered. Press ▲ or ▼ to select a number between 1 and 100.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG **SETUP** TEST END
AUTH-1 CLEAR	This function allows the user to clear all of the stored authorisation codes. Press ▲ or ▼ to select YES, then press the SET key. The instrument makes three beeps to confirm the clear command.
ID-001 AUTH1 *to* ID-*nnn* AUTH1	The new authorisation code is entered by touching the relevant ID security tag to the tag reader. The new tag number overwrites any existing number in that location. If the wrong tag is entered it can be overwritten with the correct key or cleared by pressing and holding the RESET key. These authorisation codes can also be accessed and edited via Modbus communications, see **Valid Identification Tag Numbers** on page 77. The instrument also allows to assign a target ratio percentage to each ID Tag. The list of options provides 16 different values from 0% to 100%. Press ▲ or ▼ to assign a desired ratio percentage to the current tag.

Test Menu

The Test menu enables you to view the inputs and outputs to and from the instrument.

In Calibration Set mode you can control the outputs and the alarms as described in the table below.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP **TEST** END
FINP*n* Hz	The frequency of the input to FINP*n* is displayed in Hertz.
AINP*n* *Units*	The units are displayed according to the calibration setup for the analog input. If unused or set to Default the input is 4-20mA and displayed in mA.
LINP*n* STATE	You can view the state of the logic inputs. If the input is an open contact or inactive it will display **HI**. If the input is a closed contact or active it will display **LO**.

SET ↓	▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP **TEST** END
OUT*n* STATE	You can control the state of the outputs. Press the ▲ or ▼ keys to set the output state as follows: • **PROCESS** - the output depends on the current values of the inputs and the calculations that the instrument performs. For a pulse output, such as a total, the output produces a pulse train as follows: • **ON** - a pulse train with a pulse width as set in the Outputs menu. • **OFF** - no output. For a 4-20 mA output, such as a rate, the output is as follows: • **HI** - the output is set to 20 mA. • **LO** - the output is set to 4 mA.
ALRM*n* *or* REL - *n* STATE	You can control the state of the relays (alarms). Press the ▲ or ▼ keys to set the selected relay as follows: • **PROCESS** - the relay operates according to the current values of the inputs and the relay settings as programmed. • **OPEN** - the relay output contacts are set to "open". • **CLOSED** - the relay output contacts are set to "closed".
SUPPLY V	You can display the actual DC output supply voltage, which may help with troubleshooting. If the actual supply voltage is lower than the preset value (refer to **General Setup Parameters** on page 56) it may indicate that the output is overloaded.

System Messages

The instrument displays messages for defined events and fault conditions.

The manufacturer or distributor can enter user-defined text for the messages. This user-defined text is displayed, instead of the default (English) messages, when the Display Tags option in the Setup menu is set to USER.

Error Messages

Failure of Analog Input Sensor

If there is a failure of an analog input sensor for a process parameter such as level of fluid, the instrument sets the value of that parameter in accordance with the **EXCEPT VALUE on page 48** and displays the relevant error message. The input sensor and connections need to be inspected and may require replacement.

Override Error Condition

While a fault is being rectified on an analog input for a process parameter, an operator with calibration access can set the Analog Input Signal Type to DEFAULT and the Analog Input Default Point to a typical process value. If there are no other faults, the instrument continues to operate by using the default value.

The instrument displays error messages as described in the following table:

Error Messages	Status Code	Description
CPU Card Failure	20	There are failed components on the CPU card and technical support is required.
Power Supply is Low	21	The input and/or output power supply voltage is too low, ensure that: (a) input power supply voltage is within the specified range (b) output power supply is not overloaded.
New/Failed Battery - Set Time	22	The real-time clock has lost the correct time because the battery has failed, or there is a new battery. Set the current time and date (in the TM/LOG menu) to clear the error message and to continue data logging at the correct times. **Note:** The instrument can continue operating with a failed battery, but the correct time will be lost if there are interruptions to the power supply.

Error Messages	Status Code	Description
Analog Input 1 Signal Failure	01	The analog input 1 signal is outside allowed limits. To deactivate the error, the Analog Input Signal Type can be set to DEFAULT to use a programmed default value instead of the sensor signal.
Analog Input 2 Signal Failure	02	The analog input 2 signal is outside allowed limits. To deactivate the error, the Analog Input Signal Type can be set to DEFAULT to use a programmed default value instead of the sensor signal.
No Flow Detected	12	The “no flow” condition is detected when the flow timeout expires during a delivery. There must not be a period of no flow greater than the timeout value during the delivery.
Overflow Detected	13	The “overflow” condition is detected when the flow continues longer than the timeout period after attempting to stop the flow.
Leakage Detected	14	The “leakage” condition is detected when an amount greater than the acceptable total is received without starting a delivery.

Warning Messages

The instrument displays warning messages as described in the following table:

Warning Messages	Description
Value Has Been Set to Default	You have entered an invalid value for a parameter. Therefore, the instrument has set the default value.
Already Assigned to Other Port	You have tried to assign a particular protocol type to more than one serial communication port. The instrument has set the protocol to NONE.
Assign ID-Tag to Port	Access (authorisation) via an ID tag was chosen, and an ID tag protocol must be assigned to one of the communication ports.

Prompt Messages

The instrument displays prompt messages as described in the following table:

Prompt Messages	Description
Validate ID Tag	Validate ID Tag to proceed with delivery.
Start Delivery	Activate delivery via Permissive Input or Modbus RTU command.

Chapter 6
Communications

Overview

This chapter describes the communications between the instrument and another communicating device such as a computer or a printer. You should have relevant information about the devices to which the instrument will be connected. Some connection examples are included in this manual, however, the operation and connection of other devices is outside the scope of this manual.

Hardware Interconnection

The instrument has two communication ports:

- COM-1 RS-232 port on the rear panel (DB9 female connector)
- COM-2 RS-485 port on the rear panel (optional) or Ethernet (optional)

The appropriate interface and protocols are selected during calibration.

COM-1 RS-232 Port

The COM-1 RS-232 port provides communication between the instrument and one other device such as a host computer or a printer.

Note: A printer must have a serial port to be able to be directly connected to the flow computer. It is not possible to communicate directly with a printer via a parallel port.

Computers use either a DB9 or a DB25 connector, and the connections to each type are shown in Figure 18.

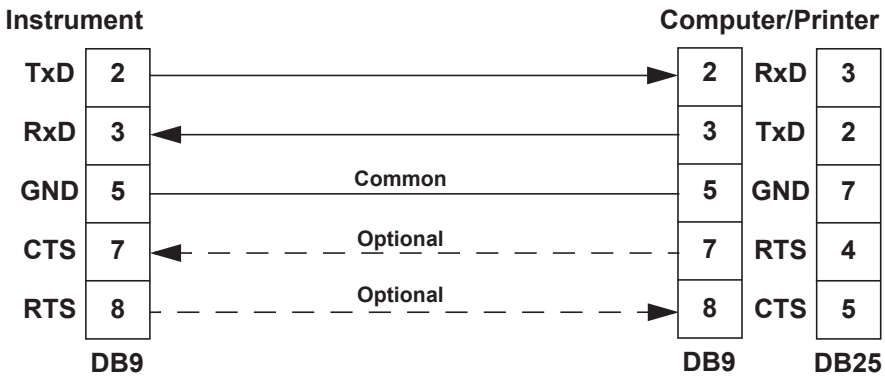


Figure 18 RS-232 Cable Connections to a Computer

Note: The instrument requires a cable with straight-through connections. Do not use a null modem cable for RS-232 connection to a computer.

COM-2 RS-485 Port Option

The COM-2 RS-485 port enables communication with multiple devices. Each device has a unique address so that the “master” device can communicate with specific “slave” devices.

On RS-485 links, an external terminating resistor must be connected at the furthest end of the cable. When multiple instruments are connected, they should be “daisy chained” in a multidrop configuration as shown in Figure 19. Up to 32 units can be connected to the interface at a maximum distance of 1200 metres.

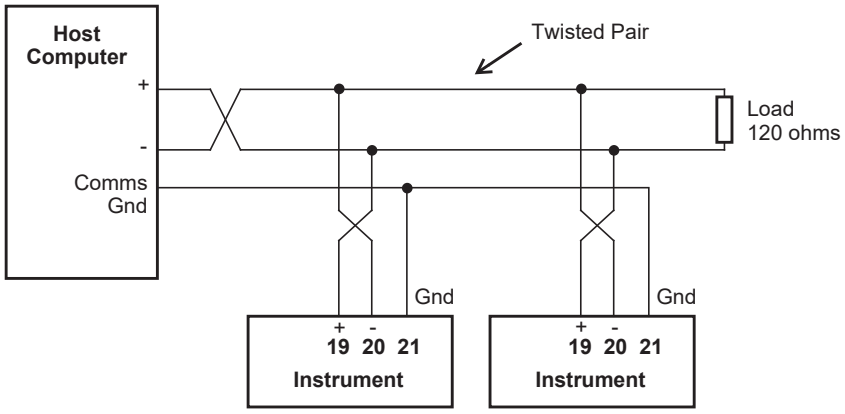


Figure 19 RS-485 Connections

COM-2 Ethernet Port Option

An Ethernet module is an available option, in place of the RS-485 port, if Modbus TCP/IP connection is required. In the programming communication settings, COM-2 should be set to RTU (Modbus), 19200 Baud rate, even parity and 1 stop bit.

For further advice and example of Ethernet port usage and setup, refer to **Ethernet Port & Setup** on page 90 in the Appendix.

Protocols

The communications protocols can be assigned to the communication ports on the instrument as follows:

- **ASCII** - Simple ASCII
- **RTU** - Modbus RTU
- **ID-RF-1** - Pepperl+Fuchs ASCII protocol (IQT*-*-R4-V1 devices)
- **ID-TAG** - iButton LINK45
- **PRN** - Printer Protocol
- **NONE** - If a port is not being used, set the protocol to NONE.

Note: The Printer Protocol is only available if the option with Real Time Clock is installed. Also a protocol cannot be assigned to more than one port at a time as described in **Communications** on page 52.

- **ASCII** - In this ASCII protocol each command and response is a string of ASCII characters. This proprietary protocol is developed by Contrec to allow for simple information interchange. The main advantages of this mode are that it allows extended time intervals to occur between characters without causing a timeout error and that messages can be sent and monitored easily with a simple ASCII terminal.
- **Modbus RTU** - Modbus RTU is an industry-standard protocol which allows the instrument to be easily connected to computers running supervisory software systems. The main advantage of this mode is that its greater character density allows better data throughput than ASCII mode, however each message must be transmitted in a continuous stream.
- **ID-RF-1 RFID** - This protocol allows an external Pepperl+Fuchs RFID reader module to be connected to 515 instrument to read identification tags to ensure only authorised deliveries are made.
- **iButton ID-TAG** - This protocol allows an external “ibutton LINK45” module to be connected to 515 instrument to read identification tags to ensure only authorised deliveries are made.
- **Printer** - In the Printer protocol there is a selection of printer types. Please refer to the **Printer Protocol** on page 79 for full details.

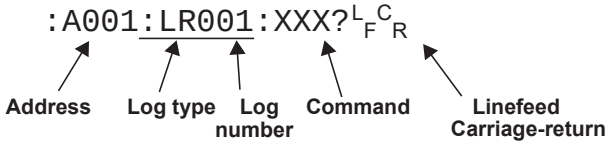
Simple ASCII Protocol

This simple ASCII protocol requires that all requests are initiated with a colon (:) and terminated with a carriage return ($^{C}_{R}$). The message termination can include a linefeed before the carriage-return ($^{L}_{F}{}^{C}_{R}$), but it is the carriage-return that acts as the message termination.

All responses by the instrument are terminated with a linefeed and a carriage-return ($^{L}_{F}{}^{C}_{R}$).

Requests Format

The format of a request to the instrument is as follows:



Each request must include the address and command portions. The underlined section is an optional part of the request string.

Address

In multipoint communications, each instrument must have a unique address and it is essential in the request for identifying a particular instrument. However, it may be set to 000, for special broadcast commands.

For single-instrument communications, the address can also be set to 000 in the request.

Refer to **Communications** on page 52 for setting the instrument address.

Note: The instrument always responds with its address in the header regardless of the type of request.

Log Type and Number

The log type and number enables a communicating device to retrieve data from the instrument.The data can be from the event-based logs or from the current process variables.

The log request is optional. If the log request is not included, or the log number is set to 000, the instrument returns the current process variables. If the log request is included, the log number defines the specific log entry by counting backwards. The most recent log entry for a timebase is 001.

The “last edit” log records the process variables at the time of the last exit from the calibration edit mode. There is only one “last edit” log, therefore, if a number is included in the request, the instrument ignores the number and returns the data at the time of the last edit.

The types of logs applicable to this instrument are as follows:

Log Type
LE - last edit log
LR - logged records (non-timebased logging)
LN - current totals displayed as Non-accumulated

The number of the log entry is the same as shown on the front panel of the instrument. For example, a request for LR003 would return the data for the log entry two batches prior to the most recent batch log entry.

Instrument Responses

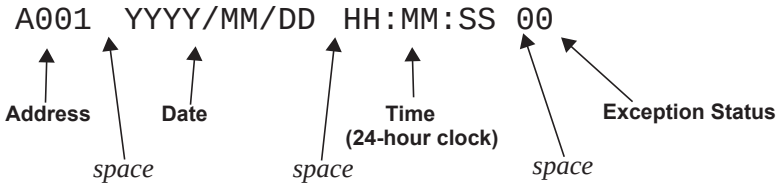
The instrument response time to any enquiry is no more than 300 ms. The responses from the instrument are in the following format:

HEADER$^{L}_{F}{}^{C}_{R}$
DATA$^{L}_{F}{}^{C}_{R}$
DATA$^{L}_{F}{}^{C}_{R}$
.
.
.
DATA$^{L}_{F}{}^{C}_{R}$
$^{L}_{F}{}^{C}_{R}$

The components of the response message are as follows:

Header

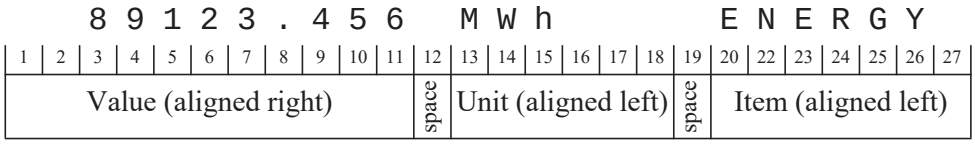
The format of the response header from the instrument is as follows:



The instrument **Exception Status** codes that the instrument returns for the ASCII protocol are the same as those described for the Modbus RTU protocol in **Instrument Exception Status** on page 75.

Data

The format of the data variables from the instrument is as follows:



Note: The decimal point in the Value is always at character position 8. Therefore whole numbers are aligned right at the decimal point, with trailing zeroes.

Variables Request

The variables request asks the instrument to return the value of one or more requested variables. All totals are transmitted as accumulated totals.

Command	Description
:RVA?	Return all variables
:RVD?	Return the default Total and Rate
:RV0? … :RV9?	Return the specific variable. The numbers relate to the position in the variables menu. For example, V0 is Energy, V1 is Power and so on.

Variables Request and Response Example

The following request is for the only instrument that is connected to the communication port to return the values of all main menu variables.

```
:A001:RVA? LF CR
```

The following is an example of a hypothetical instrument response. Refer to on page 5 for the list of variables that would be returned for this application.

```
A001  2002/03/14  18:25:00  00 LF CR
        6.116  MWh       ENERGY  LF CR
       16.573  MW        POWER   LF CR
    1320.530  m3        VOLUME  LF CR
       58.300  m3/M      V-FLOW  LF CR
    7627.117  KG        MASS    LF CR
      344.460  KG/M      M-FLOW  LF CR
      230.000  DEG  C    TEMP    LF CR
        1.260  MPA       PRESS   LF CR
        0.174  m3/KG     SP-VOL  LF CR
    2886.760  KJ/KG     SP-ENT  LF CR
LF CR
```

The following message to an instrument, requests the current values for the default rate and total:

```
:A001:RVD? LF CR
```

The instrument response would be similar to the following:

```
A001  2002/03/14  18:25:00  00 LF CR
      126.455  m3        VOLUME  LF CR
       20.437  m3/M      V-FLOW  LF CR
LF CR
```

Log Request

The log request asks the instrument how many logs will be included in a printed log report. These are the values described in **Time Settings and Data Logging** on page 54.

Command	Description
:RLR?	Return the number of log records (non-timebased logging)

Log Response Example

The following message asks the instrument with address 001 to return the number of log records that the instrument stores:

```
:A001:RLR?LF CR
```

The instrument response would be similar to the following:

```
A001  2002/03/14  18:25:00  00LF CR
24LF CR
LF CR
```

Clear Data Request

The clear data request asks the instrument to clear the data in the selected registers.

Command	Description
:RCN?	Clear the non-accumulated (resettable) totals
:RCA?	Clear the accumulated totals
:RCL?	Clear the logs except for the “last edited” log

Clear Data Request Example

The following message asks the instrument with address 001 to clear the logged data that the instrument stores:

```
:A001:RCL?LF CR
```

The instrument response would be similar to the following:

```
A001  2002/03/14  18:25:00  00LF CR
LF CR
```

Instrument Information Request

The Instrument Information request asks the instrument to return the general information about the model and version codes. The instrument exception status is returned as a part of the header as it is with the header for all command responses.

Command	Description
:RIG?	Return the general information about the instrument such as Model number, Application number, Version and Serial numbers etc. These items are returned as a block in the same format as shown on the display in the “Model Info” menu.

Instrument Information Response Example

The following message asks the instrument with address 001 to return the general information about the instrument:

```
: A 0 0 1 : R I G ? LF CR
```

The following is an example of a hypothetical instrument response:

```
A 0 0 1   2 0 0 2 / 0 3 / 1 4   1 8 : 2 5 : 0 0   0 0 LF CR
5 1 5         M O D E L     - 1 - - F - LF CR
S C 0 1       I N P U T     F - T P - - LF CR
S C 0 1       V E R S     0 1 0 1 . 0 0 1 LF CR
C U S T O M   V E R S       0 0 0 0 0 1 LF CR
U N I T       S / N         1 2 3 4 5 6 LF CR
LF CR
|1|2|3|4|5|6|7|8|9|10|11|12|13|14|15|16|17|18|19|20|21|22|23|24|25|26|27|28|29|
```

Corrupted or Invalid Requests

If the instrument receives a corrupted or incomplete request, there is no response. The instrument discards any partial request and waits for the next enquiry.

If the instrument receives a request message in the correct format, but for a non-existent option, it returns only the message header. For example, if the instrument received the following request variables message :A001:RVT? it will return only the header because there is no T option for the ‘Variables Request’ message.

Modbus RTU Protocol

Modbus RTU (remote terminal unit) is an industry standard protocol that allows the instrument to be easily interfaced to other communication devices.

The instrument implements the Modbus protocol as detailed in the *Modicon Modbus Protocol Reference Guide* PI-MBUS-300 Rev J (June 1996).

Message Format

In RTU mode, messages start with a silent interval of at least 3.5 character times. The first field transmitted is the device address. Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval. The entire message frame must be transmitted as a continuous stream. A typical message frame is shown below:

Address	Function	Data	CRC Check
1 byte	1 byte	n bytes	2 bytes

Except for broadcast messages, when a master device sends a query to a slave device, it expects a normal response. One of four possible events can occur from the master's query:

- If the slave device receives the query without a communication error, and can handle the query normally, it returns a normal response.
- If the slave does not receive the query due to a communication error, no response is returned. The master program has to process a timeout condition for the query.
- If the slave receives the query, but detects a communications error (parity or CRC), no response is returned. The master program has to process a timeout condition for the query.
- If the slave receives the query without a communication error, but cannot handle it (for example, if the request is to read a nonexistent register), the slave will return an exception response informing the master of the nature of the error.

Instrument Address

The address of the instrument is programmable in the range from 1 to 247. Some addresses are reserved according to PI-MBUS-300 and have a special meaning:

- 0 = Broadcast, no response required from slave devices
- 248 to 255 Reserved

Function Codes

The instrument accepts the following function codes:

Code	Name	Description
03	Read data register(s)	Obtain the content of one or more 2-byte data registers.
06	Preset data register	Preset one 2-byte data register.
07	Read status register	Obtain the content of 1-byte status register.
16	Preset data register(s)	Preset one or more 2-byte data registers.

Exception Response

The instrument forms an exception response by adding 80H to the function code and using an exception code as the 1-byte data field in the returned frame. Implemented exception codes are as follows:

Code	Name	Description
01	Illegal function	The function code is not a legal action for the slave.
02	Illegal data address	The data address is not a legal address for the slave.
03	Illegal data value	The data value is not a legal value for the slave.
05	Acknowledge	The slave has accepted the request and is processing it, but a long duration of time will be required to do so.
06	Slave device busy	The slave is engaged in processing a long duration program command. The master should re-transmit the message later when the slave is free.

List of Data Registers

The following tables describe the addresses and meaning of the data registers in the instrument. The registers are grouped in blocks that relate to a particular function of the instrument. The data values are expressed in the engineering units that were selected for the variables when the instrument settings were configured.

Note: Conventional numbering of registers often starts from 1, therefore be aware that “register 1” in this case has “address 0” and so on.

The data registers represent different data types as specified in the tables:

- I - Integer, 2 bytes (Holding Register)
- L - Long Integer, 4 bytes (2 registers)
- P - Programmable Format, 4 bytes (2 registers)

The “Programmable Format” data type for 4-byte (2 registers) data values can be set as either Floating Point or Long Integer via the “Data Type” program item as described **Communications** on page 52.

The Floating Point variable is represented in IEEE-754 Floating Point 4-byte format and requires two 2-byte data registers:

IEEE-754	**Modicon Registers**
1st byte	low byte (register X)
2nd byte	high byte (register X)
3rd byte	low byte (register X+1)
4th byte	high byte (register X+1)

This means that two data registers must be read or written to obtain, or preset, one data value.

Current and Logged Process Data

This block of registers is available for the retrieval of current or logged process data with its matching time and date information.

Use the log type and log number to retrieve the logged information from the appropriate register. If a particular log number does not exist, or the instrument does not have the optional real-time clock, the time and date stamp and associated variables are set to zero.

Register	Name	Comments	Read Only or Read/Write	Data Type
1	Net Volume	Process Variables	R	P
3	Net Flowrate		R	P
5	Main Line Volume		R	P
7	Main Line Flowrate		R	P
9	Process Line Volume		R	P
11	Process Line Flowrate		R	P
13	Volumetric Ratio		R	P
15	Flowrate Ratio		R	P
17	Flowrate Deviation		R	P
19	Analog Input 1		R	P
21	Analog Input 2		R	P
23	Target Ratio		R	P
25	User Value		R	P
27	Batch ID Tag		R	L
29			R	P
31	Year	Current Date/Time or Logged Date/Time Stamp (see register 38 Log Number). Only current Date/Time can be edited	R/W	I
32	Month		R/W	I
33	Date		R/W	I
34	Hour		R/W	I
35	Minute		R/W	I
36	Second		R	I
37	Log Type	00 - hourly or log records 01 - daily 02 - weekly 03 - monthly 04 - yearly 05 - last edit of calibration 06 - current totals are non-accumulated values, register 38 is ignored.	R/W	I
38	Log Number	If set to 0, current variables and Date/Time are retrieved	R/W	I
39	Clear Data	01 - clear logs 02 - clear accumulated totals 03 - clear non-accumulated totals	W	I
40	Number of ID Tags		R	I

Instrument Exception Status

This register is available to verify the status of the instrument.

Register	Name	Comments	Read Only or Read/Write	Data Type
41	Exception Status	00 = no error 01 = analog input 1 failure 02 = analog input 2 failure 03 = analog input 3 failure 04 = analog input 4 failure 05 = invalid calibration parameter 06 = invalid reference parameter 07 = invalid property 08 to 09 reserved 10 = process parameters out of range 11 = no solution for internal calculations 12 = error detected: no flow 13 = error detected: overflow 14 = error detected: leakage 20 = system failure 21 = power supply is low 22 = new or failed clock battery 23 to 29 reserved 30 = alarm 1 active 31 = alarm 2 active 32 = alarm 3 active 33 = alarm 4 active	R	I

Instrument Control and I/O

This block of registers is available in some applications to give access to important information in the instrument.

Register	Name	Comments	Read Only or Read/Write	Data Type
42	Reserved			I
43	Logic Inputs	0 to 15 Binary representation of logic inputs 0 = activated; 1 = deactivated B0 = input 1 (LSB) B1 = input 2 B2 = input 3 B3 = input 4	R	I
44	Operation State	Representation of operation status 0 = Reset 1 = Maintenance 2 = Completed 3 = Waiting to restart 4 = Paused 5 = Waiting for timeout 6 = Running (Slow Start) 7 = Running (Prestop) 8 = Running (Full Flow)	R	I

Register	Name	Comments	Read Only or Read/Write	Data Type
45	Relay State	0 to 15 Binary representation of relay state 0 = open; 1 = closed B0 = relay 1 (LSB) B1 = relay 2 B2 = relay 3 B3 = relay 4	R	I
46	Relay Control	0 to 15 Binary representation of relay control 0 = open; 1 = close B0 = relay 1 (LSB) B1 = relay 2 B2 = relay 3 B3 = relay 4	R/W	I
47	Relay Control Source	0 to 15 Binary representation of relay control source 0 = Local - controlled by instrument operation 1 = RTU - controlled by Modbus register 46 B0 = relay 1 (LSB) B1 = relay 2 B2 = relay 3 B3 = relay 4	R/W	I
48	Delivery Number	Holds the delivery number (batch record) for a current or stored transaction (determined by Modbus register 38)	R	L
50	Control Mode	0 = Idle/Local Control from logic inputs 1 = Stop Stop delivery 2 = Run Start delivery 3 = Reset Clear totals	R/W	I
51 to 99	Instrument Parameters	See next table for details.	R/W	P
101	Analog Inp.1	Raw analog input data 4-20mA inputs are read in Amperes 0-5V or 1-5V inputs are read in Volts RTD inputs are read in degrees Kelvin Unused inputs are configured as 4-20mA	R	P
103	Analog Inp.2		R	P
105	Analog Inp.3		R	P
107	Analog Inp.4		R	P

Instrument Configuration Parameters

This block of registers is available in applications to give access to some important instrument parameters (i.e. target setpoint, etc).

The usage of these parameters can be dependent on other instrument settings. For full description, please refer to the ‘Modbus Accessible Parameters’ in **Parameters** on page 41.

Register	Name	Comments	Read Only or Read/Write	Data Type
51	Ratio Setpoint		R/W	P
53 to 99	Reserved		R/W	P

Valid Identification Tag Numbers

This block of registers is a list of the valid ID Tags that are authorised to start a delivery or batch. The security feature is only enabled if the ID-TAG protocol has been assigned to one of the communication ports. (A maximum of 100 ID Tag numbers can be stored in the instrument).

Register	Name	Comments	Read Only or Read/Write	Type
151	ID Tag 001		R/W	L
153	ID Tag 002		R/W	L
. . .	. . .		R/W	L
347	ID Tag 099		R/W	L
349	ID Tag 100		R/W	L

The highest nibble (4 bits) of each ID Tag value represents the blend % assigned to the ID Tag from a list of 16 options as follows:

0000 - 0%	0100 - 15%	1000 - 40%	1100 - 75%
0001 - 5%	0101 - 20%	1001 - 50%	1101 - 80%
0010 - 7%	0110 - 25%	1010 - 60%	1110 - 85%
0011 - 10%	0111 - 30%	1011 - 70%	1111 - 100%

ID Tag Protocols

Protocols are available in this application that allow the instrument to communicate with external ID Tag reader modules. Currently the supported modules are the “iButton LINK45” for Touch key ID Tags and Pepperl+Fuchs IQT*-*-R4-V1 devices for RFID ID Tags. These protocols allow the instrument to read identification tags to ensure that only authorised deliveries are made.

If the ID-TAG protocol is not assigned to any 515 communication port the security identification feature will be disabled. When enabled, the 515 instrument continually polls the reader module checking for the presence of an ID Tag. For details on the operating procedure, refer to refer to **ID Tag Validation** on page 31.

iButton ID Tag Protocol

The LINK45 module provides a 1-Wire to RS-232 interface with RJ45 connection to the read head and DB 9 female connection out. A null modem and DB 9 male to male gender changer is required to connect the LINK45 directly to the DB9 female RS-232 port on the 515.

An interface kit (TK-RS232-KIT) can be supplied as an accessory, complete with LINK45 module, mini null modem gender changer, stainless steel panel mounting read head and cable.

If the RS-232 port on the 515 is used for other communications, it is possible to connect the LINK45 module to the RS-485 port via a serial RS-232 to RS-485 converter.

The standard communication settings for the LINK45 module are 9600 baud, 8 bit, no parity and 1 stop bit.

RFID ID Tag Protocol

The RFID protocol, supporting the Pepperl+Fuchs IQT*-*-R4-V1 devices, can be assigned to the RS-232 (COM-1) and RS-485 (COM-2) ports, although it is worth noting that the supported P+F devices generally have RS-485 connections.

If the RS-485 port on the 515 is used for other communications, it is possible to connect the P+F device to the RS-232 port via a serial RS-485 to RS-232 converter.

The standard communication settings for the supported P+F modules are 19200 baud, no parity and 1 stop bit.

Printer Protocol

A printer protocol is available in the 500 Series. It provides the ability to print out live data, individual logged data and to do some report-style printing of logged data. The method of printing these and the format of the printouts is described below.

Note: Printer output is only available if the Real Time Clock option is fitted.

The selection of Printer Protocol can be made for the Communications Protocol options for the RS232 or RS485 port. A list of log report types and printer types available at the end of the TM-LOG calibration menu.

Report Types

The list of report types is as follows:

- REP-10 Latest Logs Report

The number of logs printed in each report is determined by the value programmed for Report Logs in the TM-LOG menu.

Printer Types

The list of available printers is as follows:

- PRN-01 Generic computer printer
- PRN-02 Generic roll printer (printing first line first)
- PRN-03 Slip Printer TM295
- PRN-04 Label (roll) printer - Citizen CMP30L

Customizing a Printout

A customized printout can be provided which can have up to 4 header lines and 3 footer lines. It is also possible to include or exclude certain main menu items on the printout. If any customizing of the printout is required discuss this with the distributor.

Types of Printouts

Live Data

The RESET key, when in main menu, is shared as the PRINT key if the printer protocol has been selected. A printout will be initiated whenever this key is pressed. If printing is not required, do not select printer protocol.

The format of this printout will be:

Custom Header Lines

Current Docket No.

Instrument Serial No. & Tag

Current Date & Time & Status
Variable unit value
Variable unit value
etc.

Custom Footer Lines
---------- *<separation line>*

(Note that blank header and footer lines are not printed).

Docket Number

The docket number that appears on the live data printout indicates the print number. This number is cleared when the Accumulated totals are reset. If the Reset Mode is set for Delayed, where a print can be generated without resetting the non-accumulated totals, an additional number in brackets will be shown that indicates the number of prints since the last reset. i.e.

DOCKET No. 000256 (000036)

Instrument Serial Number and Unit Tag

The instrument serial number and unit tag is the same as the information shown in the Model Info menu. For more details refer to **Model Information** on page 28

Individual Log Data

When in the Log Menu and while holding the DISPLAY key to view the data of the log of interest the RESET key can be pressed to initiate a printout of that log entry. The printout will have the time and date stamp corresponding to when the log was taken. After the print has been initiated there will be the opportunity to scroll to view another log entry and print again.

Since each log entry stores the delivery totals only, the printout will not have any accumulated totals. The format of the printout with this exception is the same as the LIVE DATA printout:

Custom Header Lines

Instrument Serial No. & Tag

Delivery Date & Time & Status
Variable unit value
Variable unit value
etc.

Custom Footer Lines
---------- *<separation line>*

Log Report Printing

As there is the likelihood that the reports can be of a considerable length it is strongly recommended that only the 80 Column printer with Z fold (tractor feed) paper be used. This is just as much for the memory storage of the printer as it is for reliable paper supply.

There is a HOLD.SET REPORT PRINT prompt under the main menu with the ability to print the pre-selected type of report. Pressing and holding the SET key for two seconds will initiate the printout. Any of the Log Reports will have the following format:

Custom Header Lines

Title of Report *<internally set, indicates report type>*

Current Date & Time
Instrument Serial No. & Tag

---------- *<separation line>*
Delivery No. Date & Time & Status
Variable unit value
Variable unit value
etc.

---------- *<separation line>*
Delivery No. Date & Time & Status
Variable unit value
Variable unit value
etc.

---------- *<separation line>*
Delivery No. Date & Time & Status
Variable unit value
Variable unit value

etc.

Custom Footer Lines
---------- *<separation line>*

Reports such as “Latest Logs” will print in the historical order, and for those logs that have no data (e.g. unit was powered off at the time) the print will show “Data not available”, i.e.

Delivery No. Date & Time & Status
Variable unit value
Variable unit value
etc.

---------- *<separation line>*
Del No. Data Not Available

---------- *<separation line>*
Delivery No. Date & Time & Status
Variable unit value
Variable unit value
etc.

If the unit is programmed for 0 logs for the latest log reports then the report will only consist of the header and ID information and a “Data Not Available” message.

Custom Header Lines

Title of Report

Current Date & Time
Instrument Serial No. & Tag

Data Not Available
Custom Footer Lines
---------- *<separation line>*

Printer Data Control

Some printers have limited data buffers and are therefore unable to collect all the print data being transmitted. The 500 Series has the capability of software handshaking. The Xon/Xoff characters can be used by any of the printer types to control the flow of data to ensure that data is not lost.

Some printers will also transmit an Xoff character in response to other events such as the printer being off-line, the print head not engaged or the power being removed. The specific behaviour of the printer being used should be noted.

Error Messages

There are two printer error messages that can be displayed.

PAPER OUT

This message is related to the Printer Type PRN-03 TM295 Slip printer. It is standard procedure with this printer to check for paper status before printing. If a print is attempted but there is no paper the PAPER OUT message will be scrolled. The instrument will continue to poll the printer for paper and if paper is detected before a communications timeout expires the print will commence.

COMMS TIMEOUT

This message is relevant for all printer types and will be activated for the following conditions.

1. If the flow of data is stopped due to software or hardware handshaking and is not allowed to resume before the communications timeout.

2. If Printer Type is PRN-03 Slip printer and a paper status is requested but no response is received within the timeout period.

3. Paper Out has been detected for Printer Type PRN-03 but no paper is inserted within the timeout period.

When a communications timeout error has been activated the message COMMS TIMEOUT will be scrolled once, the request to print will be cleared and the instrument will return to its normal mode.

Appendix A
Glossary

500-PM Software The 500 Series Program Manager (500-PM software) is a Windows based program that is freely available from the download section of the Contrec website. The program is a comprehensive configuration tool and resource centre that can be used to tailor an instrument to suit specific application needs including program settings, units of measurement, custom tags/text, access levels and more. Custom versions can be saved and configuration reports generated as a PDF.

ASCII American Standard Code for Information Interchange. For the ASCII protocol, the instrument receives and transmits messages in ASCII, with all command strings to the instrument terminated by a carriage return. Replies from the instrument are terminated with a line-feed and a carriage-return.

K-factor The K-factor is a constant value associated with frequency type flowmeters. It is a scaling factor used in calculations to determine flow rate.

Modbus RTU The Modbus protocol is a message structure for communications between controllers and devices regardless of the type of network. In RTU (remote terminal unit) mode, each 8-bit byte in a message contains two 4-bit hexadecimal characters. This mode has greater character density than ASCII and allows better data throughput than ASCII for the same baud rate.

Normalised Input A normalised input ranges from 0 to 1.000. For 4-20 mA input, the signal is set to 0 at 4 mA and the signal is set to 1.000 at 20 mA.

NPS Namur Proximity Switch.

Passive Output Signal Requires an external power supply.

Watchdog Timer (WTD) The WDT is used to monitor the activity of the micro processor and will force a reboot if the micro processor stops, while power is applied, due to any internal or external influences.

Appendix B
Model Numbers

Product Codes

Model	Supplementary Code						Description
515 .						**- CB02**	
Enclosure	1						Panel mount enclosure
	2						Field mount enclosure (NEMA 4X / IP66)
	3/5						Explosion proof Ex d (IECEx/ATEX), metric glands (5 specifies heater)
	4/6						Explosion proof Ex d (CSA), NPT glands (6 specifies heater)
Output Options		0				N/A	4 logic inputs, 1 isolated output, 2 relays (only relay type 1 is available), RS232 (DB9) communication port
		1					4 logic inputs, 2 isolated outputs, 4 relays, real-time clock data logging, RS232 (DB9) and RS485 communication ports
		2/3					4 logic inputs, 2 isolated outputs, 4 relays, real-time clock data logging, RS232 (DB9) and Ethernet/RF communication ports (not yet available)
Relay Type			1				Electromechanical relays only
			2				2 electromechanical and 2 solid state relays
			3				Solid state relays only (not yet available)
Power Supply				U			Inputs for 12-28VDC and 100-240 VAC, 50-60Hz *(Previous Models: A = 110/120 VAC, E = 220/240 VAC)*
				D			Input for 12-28VDC power only
Display Panel Options					S		Standard option (now with backlight & LCD backup) *(original Full option: F, with Infra-Red comms, no longer available)*
PCB Protection						C	**Conformal coating** - required for maximum environmental operating range. Recommended to avoid damage from moisture and corrosion.
						N	**None** - suitable for IEC standard 654-1 Climatic Conditions up to Class B2 (Heated and/or cooled enclosed locations)
Application Pack Number						**CB02**	Defines the application software to be loaded into the instrument
For example: Model No. 515.112USC Displayed on the 500 Series as: Note: The first character represents the CPU installed (factory use only). The remaining 6 characters only represent hardware that affects the operation.							2 - 1 - - S - 515 MODEL

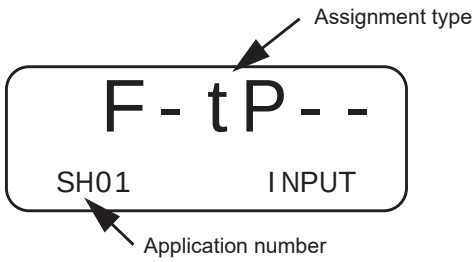
Note: Example full product part number is 515.112USC-CB02 (This is the number used for placing orders).

Custom Version Codes

	Code		Description
Origin Code **Identifies Distributor**	00		Factory Default Application
	01		Contrec Systems Pty. Ltd. Melbourne Australia
	02		Contrec Limited. West Yorkshire UK
	03		
	04		Contrec - USA, LLC. Pelham AL 35124 USA
	05		Flowquip Ltd. Halifax UK
	06		
	etc.		
User Language	0		English (Default)
	1		German
	2		Dutch
	3		French
	4		Spanish
	5		
	etc.		
Distributor's Code		000 … 999	Distributor's own choice. Possibly a code that identifies the customer and the application.
For example: 02 3 157 Displayed on the 500 Series as:			023157 CUSTOM VERS

Application Information Code

The Application Information code is an aid for users and service personnel to determine the type of inputs that are used in a particular application. The Application Information code is displayed on the instrument as shown below.



The Application Information code is returned as part of a General Instrument request (as described in **Instrument Information Request** on page 70).

The Application number identifies the application as in the following examples:

- SC01 - steam flow computer for frequency flow meter
- GN02 - natural gas flow computer for analog flow meter

The Input Assignment type indicates the physical input that is assigned to each input on the instrument. The code is made up from six characters as follows:

FINP1	FINP2	AINP1	AINP2	AINP3	AINP4
X	X	X	X	X	X

The codes are as follows:

- - - not used in this application
- A - indicates a generic analog input such as for density or level
- C - indicates a user code input
- d - indicates a density input
- F - indicates a generic flow input such as for volume or mass
- H - indicates a high flow input for stacked inputs
- L - indicates a low flow input for stacked inputs
- P - indicates a pressure input
- q - indicates a quadrature input
- t - indicates a temperature input.

For example, F - t P - - is an instrument with FINP1 (frequency input 1) assigned to a flow input, AINP1 assigned to a temperature input and AINP2 assigned as a pressure input. The other inputs are not used.

Appendix C
Ethernet Port & Setup

Ethernet Port

The optional Ethernet port simplifies the communication network and avoids the need for an external 3rd party Serial to Ethernet converter. It allows communications via an existing Ethernet network. In some installations you will need to speak with your network (IT) administrator in order to correctly set up your network. Applications, such as DataMod (available via Contrec), can communicate over the Ethernet network to perform remote monitoring and Data Logging operations.

Within the instrument's calibration menus the Ethernet port uses the settings for the RS-485 port that need to match a supplied Ethernet unit as follows:

- Protocol: RTU
- Baud Rate: 19200
- Data Bits: 8
- Parity: Even
- Stop Bits: 1

Data mapping follows the same convention applied to Modbus registers.

Connecting 515 Ethernet to Networks/Routers

Ethernet 515s are set as default to DHCP (Dynamic Host Configuration Protocol), which should allow your network/router to automatically find and assign an IP address to the instrument (providing there are addresses available). If your network cannot locate the instrument you may need to run the 'Digi Discovery' tool (Contrec guide available on request) or enter the Ethernet module's MAC address within your router settings. If required, the instrument can also be set to a static IP address, however it is strongly advised that only IT competent persons access and edit site network and 515 Ethernet settings. All Ethernet instruments are supplied with the Ethernet module MAC address printed on the outside of the enclosure and also printed directly onto the Ethernet Module itself (the Option card would need to be removed to view the physical Digi Ethernet module).

Contrec Limited will not be held responsible for any changes made to customer router and network settings. Further guides on how to access the module settings and discovering IP address' can be supplied upon request.

Connecting DataMod via Ethernet

Using the IP address that you or the network/router has assigned to the 515 instrument, enter this into the **Host Name / IPv4 Address** tab within DataMod's Modbus Connection Settings as per Figure 20.

Ensure all other settings are correct as per the **Datamod User Guide** and the **515 Ethernet Guide - Establishing a Connection to Datamod**. Both of these documents are available from Contrec on request.

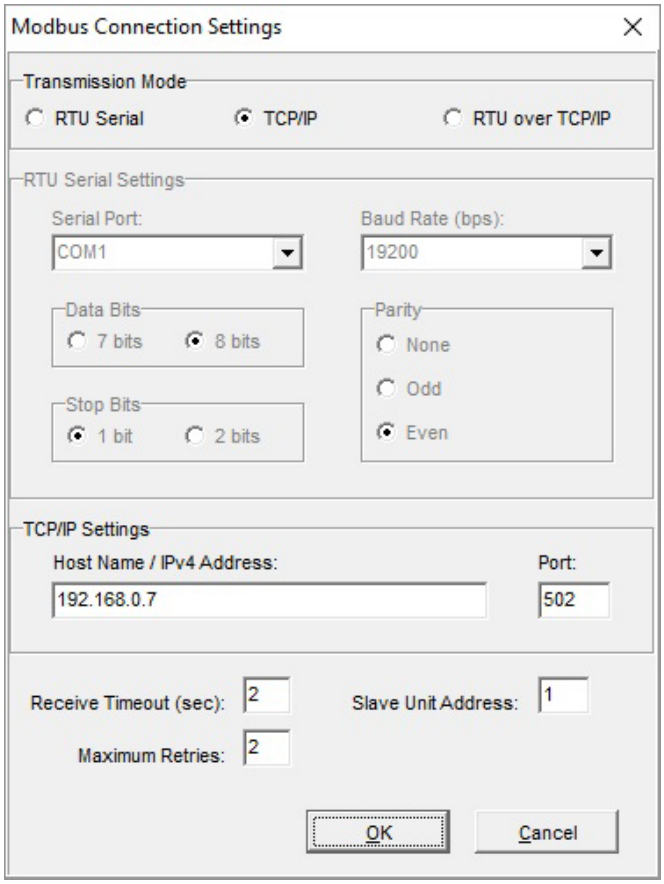


Figure 20 DataMod - Modbus Connection Settings

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