

# Model 515 Flow Computer

## Operation Manual

### Application CR02

Ratio/Blending Process Controller  
for  
Volumetric Analog Flowmeters



31 August 2021

## **Model 515 Flow Computer - Operation Manual**

© Contrec Limited 2021

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.

Part of the software embedded in this product is eCos - Embedded Configurable Operating System, a trademark of Red Hat. Portions created by Red Hat are Copyright © 1998, 1999, 2000 Red Hat, Inc. (<http://www.redhat.com>). All rights reserved

The software in this product was in part provided by Red Hat and any express or implied warranties, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose are disclaimed. In no event shall the author be liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including, but not limited to, procurement of substitute goods or services; loss of use, data, or profits; or business interruption) however caused and on any theory of liability, whether in contract, strict liability, or tort (including negligence or otherwise) arising in any way out of the use of this software, even if advised of the possibility of such damage.

### **Contrec Limited**

Riverside, Canal Road, Sowerby Bridge,  
West Yorkshire HX6 2AY UNITED KINGDOM  
Tel: +44 1422 829944  
Email: [sales@contrec.co.uk](mailto:sales@contrec.co.uk)

**Website: [www.contrec.co.uk](http://www.contrec.co.uk)**

### **Contrec Systems Pty Ltd**

5 Norfolk Avenue Ringwood, Melbourne 3134 AUSTRALIA  
Tel: +61 4 413 505 114  
Email: [info@contrec.com.au](mailto:info@contrec.com.au)

### **Contrec - USA, LLC**

916 Belcher Drive Pelham AL 35124 USA  
Tel: +1 (205) 685 3000 Fax: +1 (205) 685 3001  
Email: [contrec@contrec-usa.com](mailto:contrec@contrec-usa.com)




**Publication No: 515-CR02-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.

# Contents

---

## 1 Introduction

|                        |   |
|------------------------|---|
| Features               | 1 |
| Overview               | 1 |
| Calculations           | 2 |
| Analog Input Scaling   | 2 |
| Displayed Information  | 2 |
| Main Menu Variables    | 3 |
| Communications         | 3 |
| Isolated Outputs       | 3 |
| Relay Outputs          | 3 |
| Software Configuration | 4 |
| Approvals              | 4 |

## 2 Specifications

|                     |   |
|---------------------|---|
| Specification Table | 7 |
|---------------------|---|

## 3 Installation & Maintenance

|   |    |
|---|----|
| Installation Instructions               | 9  |
| Cleaning and Decontamination            | 9  |
| Panel Mounting                          | 9  |
| Electrical Connection                   | 10 |
| Rear Panel Connections                  | 10 |
| Terminal Designations                   | 11 |
| Terminal Wiring Insulation              | 12 |
| Relay Wiring                            | 12 |
| Mains Power Wiring                      | 12 |
| Inputs                                  | 13 |
| Analog Input Connections                | 13 |
| Logic Input Connection                  | 14 |
| Outputs                                 | 15 |
| 4-20mA Output Connection                | 15 |
| Pulse Output Connection                 | 16 |
| Control Relays (Alarms)                 | 17 |
| RC Network for Interference Suppression | 18 |
| Communications                          | 19 |
| COM-1 RS-232 Port                       | 19 |
| COM-2 RS-485 Port Option                | 19 |
| COM-2 Ethernet Port Option              | 20 |
| Mains Connection                        | 20 |
| Earthing and Shielding                  | 20 |

---

|                                    |    |
|------------------------------------|----|
| Disconnection Device . . . . .     | 20 |
| Maintenance Instructions . . . . . | 20 |
| Battery Replacement . . . . .      | 21 |
| Battery Type . . . . .             | 21 |

#### 4 Operation

|   |    |
|---|----|
| Normal Operation Mode . . . . .         | 23 |
| Default Variable & Total . . . . .      | 23 |
| Status LEDs . . . . .                   | 23 |
| Front Panel Keys . . . . .              | 24 |
| Remote Reset . . . . .                  | 24 |
| Main Menu Items . . . . .               | 25 |
| Detail and Basic Menu . . . . .         | 26 |
| Peak Flowrates . . . . .                | 26 |
| Setpoints . . . . .                     | 26 |
| Data Logs . . . . .                     | 27 |
| Model Information . . . . .             | 29 |
| Process Control Modes . . . . .         | 30 |
| Logic Input Controls . . . . .          | 33 |
| Tuning the Control Loop . . . . .       | 33 |
| Tuning the Ratio Trim Control . . . . . | 34 |

#### 5 Instrument Calibration

|  |    |
|--|----|
| Introduction . . . . .                             | 37 |
| Calibration View Mode . . . . .                    | 38 |
| Calibration Set Mode . . . . .                     | 38 |
| Changing the Instrument Settings . . . . .         | 40 |
| Program Backup & Reports . . . . .                 | 41 |
| Backup via 500 Series Program Manager . . . . .    | 41 |
| Printing Configuration Report . . . . .            | 41 |
| Upload and Clone of Application Software . . . . . | 41 |
| Calibration Menu Tree . . . . .                    | 42 |
| Instrument Settings . . . . .                      | 44 |
| Units of Measurement . . . . .                     | 44 |
| Parameters . . . . .                               | 45 |
| Inputs . . . . .                                   | 47 |
| Outputs . . . . .                                  | 49 |
| Alarms . . . . .                                   | 52 |
| Communications . . . . .                           | 53 |
| Time Settings and Data Logging . . . . .           | 55 |
| General Setup Parameters . . . . .                 | 58 |
| Test Menu . . . . .                                | 60 |
| System Messages . . . . .                          | 61 |
| Error Messages . . . . .                           | 61 |
| Warning Messages . . . . .                         | 62 |

---

|   |    |
|---|----|
| <b>6 Communications</b>                     |    |
| Overview                                    | 63 |
| Hardware Interconnection                    | 63 |
| Protocols                                   | 65 |
| Simple ASCII Protocol                       | 65 |
| Requests Format                             | 65 |
| Instrument Responses                        | 67 |
| Corrupted or Invalid Requests               | 70 |
| Modbus RTU Protocol                         | 71 |
| List of Data Registers                      | 73 |
| Printer Protocol                            | 77 |
| Types of Printouts                          | 78 |
| Printer Data Control                        | 81 |
| <br>  |    |
| <b>Appendix A Glossary</b>                  |    |
| Glossary                                    | 83 |
| <br>  |    |
| <b>Appendix B Model Numbers</b>             |    |
| Product Codes                               | 85 |
| Custom Version Codes                        | 86 |
| Application Information Code                | 86 |
| <br>  |    |
| <b>Appendix C Ethernet Port &amp; Setup</b> |    |
| Ethernet Port                               | 88 |
| Connecting 515 Ethernet to Networks/Routers | 88 |
| Connecting DataMod via Ethernet             | 89 |
| <br>  |    |
| <b>Index</b>                                | 91 |





# List of Figures

---

|    |   |    |
|----|---|----|
| 1  | Typical Application Diagram . . . . .                   | 4  |
| 2  | 500 Series Instrument Panel Mounting . . . . .          | 9  |
| 3  | Rear Panel Connections - Original . . . . .             | 10 |
| 4  | Rear Panel Connections - New RS-485 Version . . . . .   | 10 |
| 5  | Rear Panel Connections - New Ethernet Version . . . . . | 11 |
| 6  | Externally Powered Voltage Transmitter . . . . .        | 13 |
| 7  | Internally Powered Voltage Transmitter . . . . .        | 13 |
| 8  | Externally Powered Current Loop . . . . .               | 14 |
| 9  | Internally Powered Current Loops . . . . .              | 14 |
| 10 | Logic Inputs Connection Diagram . . . . .               | 15 |
| 11 | Output 4-20mA Connection Diagram . . . . .              | 15 |
| 12 | Output Pulse Connection Diagram . . . . .               | 16 |
| 13 | Relay Connection Diagram . . . . .                      | 17 |
| 14 | RS-485 Interface Connections . . . . .                  | 19 |
| 15 | Logged Data Display Methods . . . . .                   | 28 |
| 16 | Calibration Menu Tree Sheet 1 . . . . .                 | 42 |
| 17 | Calibration Menu Tree Sheet 2 . . . . .                 | 43 |
| 18 | RS-232 Cable Connections to a Computer . . . . .        | 63 |
| 19 | RS-485 Connections . . . . .                            | 64 |
| 20 | DataMod - Modbus Connection Settings . . . . .          | 89 |



# Chapter 1

## Introduction

---

### Features

- Tailored for volumetric analog input such as vortex flowmeters
- Uses PI Loop Control
- Pump demand contact
- Selection of various control modes
- Process Inhibit (flushing) and Forced Local (manual) control available via Modbus and external logic inputs
- Allows for cascade trim control when ratio of totals is required
- Allows for non-linear correction
- Selection of Detail or Basic main menu to suit operator and application
- Selection of second language and user tags
- RTC logging with over 1000 entries
- 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 CR02 application is a single loop process controller measuring the volume flow in a main and process lines using analog flow inputs. It can operate in local (manual) or in loop, ratio or blend (auto) flow control modes and it has a tuning menu to easily determine the Proportional Band and Integral Time values used in the PI control algorithm.

The main and process flows are used to determine the net volume flow. The operator can view the actual ratio and deviation and has the ability to change the controlling setpoint directly from the main menu if access has been authorized.

The PI control of the process flow is via a 4-20mA proportional valve or pump controller. It has integral wind-up protection and a deadband and output ramp time can be programmed to reduce wear on valves and actuators and provide for bumpless operation.

## Calculations

There are three types of control modes in which the process flow is dependent on the main flow. These are RATIO, BLEND-1 and BLEND-2 modes where the relationship between the flows are as follows:

Ratio Control Mode.

The process flow is a ratio of the main flow (0 to 400% range).

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

Blend Control Modes.

These modes cater for blending points before and after the main flowmeter. The process flow is a ratio of the net (combined) flow (0 to 80% 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 data logging of over 1000 entries of the variables as displayed on the main menu.

## Main Menu Variables

| Main Menu Variables        | Default Units       | Variable Type |
|----------------------------|---------------------|---------------|
| Net Volume                 | m <sup>3</sup>      | Total         |
| Net Flowrate               | m <sup>3</sup> /min | Rate          |
| Main Line Volume           | m <sup>3</sup>      | Total         |
| Main Line Flowrate         | m <sup>3</sup> /min | Rate          |
| Process Line Volume        | m <sup>3</sup>      | Total         |
| Process Line Flowrate      | m <sup>3</sup> /min | Rate          |
| Process Ratio              | %                   | Rate          |
| Process Control Output     | %                   | Rate          |
| Process Flowrate Deviation | %                   | Rate          |

## 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 44.

## 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. The type of output is determined by the nature of the assigned variable. Totals are output as pulses and rates are output as 4-20mA signals. One output is standard, a second output is available as an option.

## Relay Outputs

The relay output 1 provides a pump demand contact and the other relays can be used as fully programmable alarms for any rate type variable. Two relays are standard with an additional two available in the advanced option.

## 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.

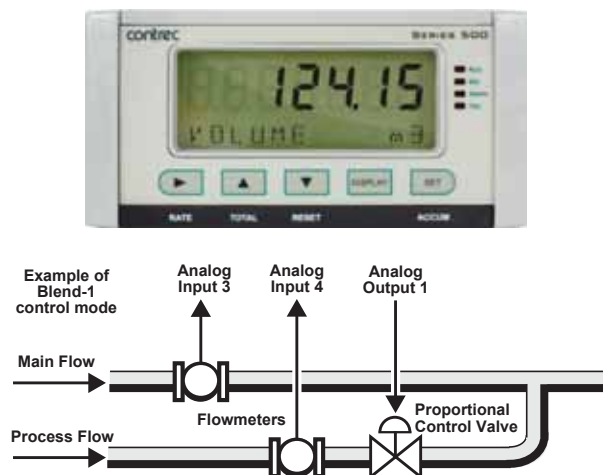


Figure 1 Typical Application Diagram

## 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

|   |   |
|---|---|
| <p><b>Operating Environment</b></p> <p><b>Temperature</b> +5°C to +40°C (standard - no coating)<br/>-20°C to +60°C (with conformal coating)<br/>-30°C to +60°C (ExD housing with heater)</p> <p><b>Humidity</b> 0 to 95% non condensing (conformal coating)<br/>5% to 85% non condensing (no coating)</p> <p><b>Power Supply</b> 100-240 V AC (+/-10%) 50-60 Hz (+/-10%) or 12-28 V DC</p> <p><b>Consumption</b> 10W (max) Overvoltage category II</p> <p><b>Protection</b> Sealed to IP65 (Nema 4X) when panel mounted</p> <p><b>Dimensions (panel option)</b> 147mm (5.8") width<br/>74mm (2.9") height<br/>170mm (6.6") depth (behind the panel)</p> | <p><b>Analog Input (General)</b></p> <p><b>Overcurrent</b> 100mA absolute maximum rating (30mA for 4-20mA inputs)</p> <p><b>Update Time</b> &lt; 1.0 sec</p> <p><b>Configuration</b> 4-20mA, 0-5V and 1-5V input</p> <p><b>Non-linearity</b> Up to 20 correction points (some inputs)</p>   |
| <p><b>Display</b></p> <p><b>Type</b> Backlit LCD with 7-digit numeric display and 11-character alphanumeric display</p> <p><b>Digits</b> 15.5mm (0.6") high</p> <p><b>Characters</b> 6mm (0.24") high</p> <p><b>LCD Backup</b> Last data visible for 15min after power down</p> <p><b>Update Rate</b> 0.3 second</p>  | <p><b>4-20mA Input</b></p> <p><b>Impedance</b> 100 Ohms (to common signal ground)</p> <p><b>Accuracy</b> 0.05% full scale (20°C)<br/>0.1% (full temperature range, typical)</p>   |
| <p><b>Non-volatile Memory</b></p> <p><b>Retention</b> &gt; 30 years</p> <p><b>Data Stored</b> Setup, Totals and Logs</p>  | <p><b>0-5 or 1-5 Volts Input</b></p> <p><b>Impedance</b> 10MOhms (to common signal ground)</p> <p><b>Accuracy</b> 0.05% full scale (20°C)<br/>0.1% (full temperature range, typical)</p>  |
| <p><b>Approvals</b></p> <p><b>Interference</b> CE compliance</p> <p><b>Enclosure</b> IECEx, ATEX and CSA approved enclosures available for hazardous areas</p>  | <p><b>Logic Inputs</b></p> <p><b>Signal Type</b> CMOS, TTL, open collector, reed switch</p> <p><b>Overvoltage</b> 30V maximum</p>   |
| <p><b>Real Time Clock (Optional)</b></p> <p><b>Battery Type</b> 3 volts Lithium button cell<br/>- For Issue 7 option card, type CR2450N manufactured by Renata only<br/>- For conformal coated 'C' version, type BR2032 manufactured by Panasonic only<br/>- For non-conformal coated versions, type BR2032 and CR2032 manufactured by Panasonic or Sony</p> <p><b>Battery Life</b> 5 years (typical)</p>   | <p><b>Relay Output</b></p> <p><b>No. of Outputs</b> 2 relays plus 2 optional relays</p> <p><b>Voltage</b> 250 volts AC, 30 volts DC maximum (solid state relays use AC only)</p> <p><b>Current</b> 3A maximum - mechanical relays<br/>1.5A maximum - solid state relays</p>   |
|   | <p><b>Communication Ports</b></p> <p><b>Ports</b> COM-1 RS-232 port<br/>COM-2 RS-485 or Ethernet port (optional)</p> <p><b>Baud Rate</b> 2400 to 19200 baud</p> <p><b>Parity</b> Odd, even or none</p> <p><b>Stop Bits</b> 1 or 2</p> <p><b>Data Bits</b> 8</p> <p><b>Protocols</b> ASCII, Modbus RTU, Modbus TCP/IP (Ethernet Port), Printer</p> |
|   | <p><b>Transducer Supply</b></p> <p><b>Voltage</b> 8 to 24 volts DC, programmable</p> <p><b>Current</b> 70mA @ 24V, 120mA @ 12V maximum</p> <p><b>Protection</b> Power limited output</p>  |

**Isolated Output**

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

**Pulse/Digital Output**

|                    |   |
|--------------------|---|
| <b>Signal Type</b> | Open collector                              |
| <b>Switching</b>   | 200mA, 30 volts DC maximum                  |
| <b>Saturation</b>  | 0.8 volts maximum                           |
| <b>Pulse Width</b> | Programmable: 10, 20, 50, 100, 200 or 500ms |

**4-20mA Output**

|                   |   |
|-------------------|---|
| <b>Supply</b>     | 9 to 30 volts DC external   |
| <b>Resolution</b> | 0.05% full scale  |
| <b>Accuracy</b>   | 0.05% full scale (20°C)<br>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.

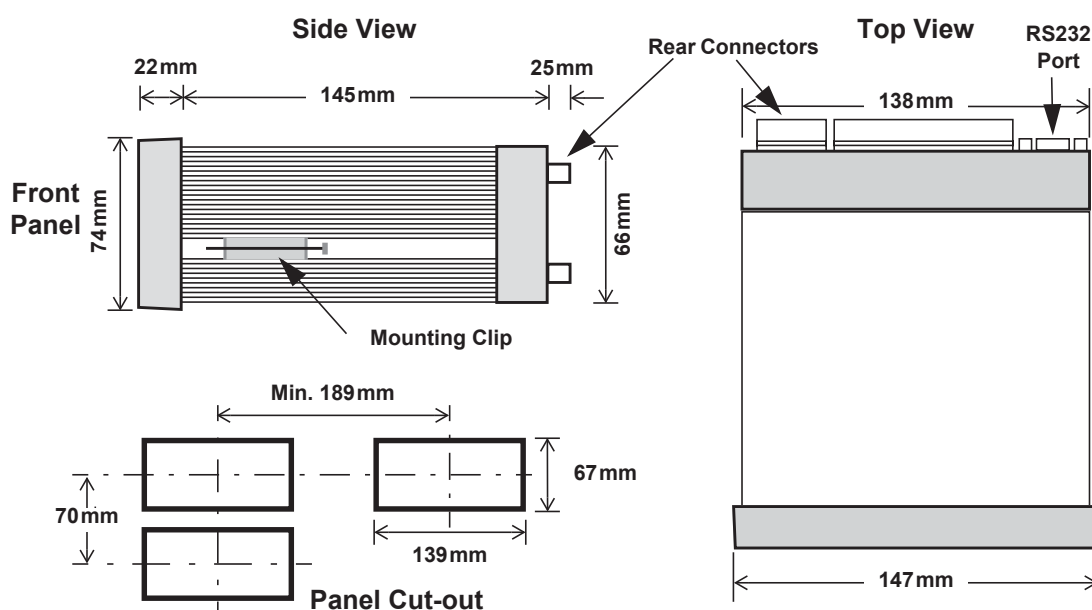


Figure 2 500 Series Instrument Panel Mounting

# 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.

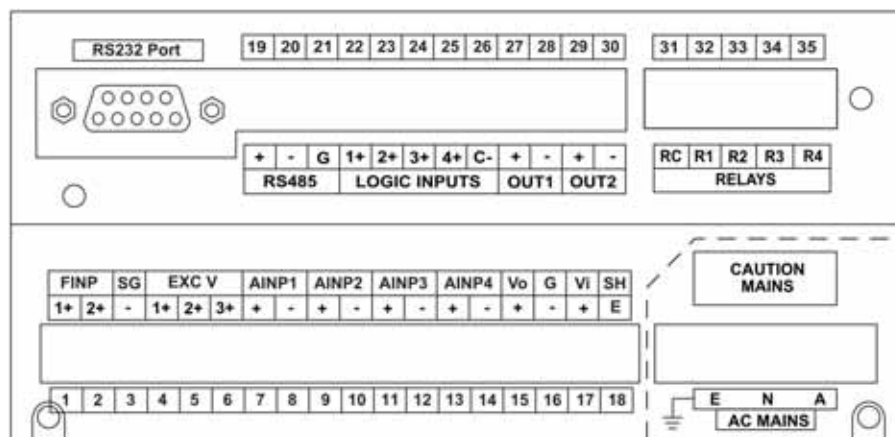


Figure 3 Rear Panel Connections - Original

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).

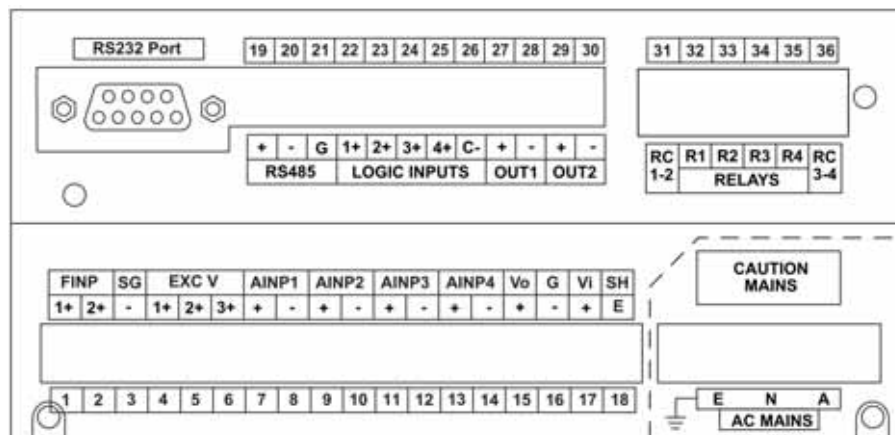


Figure 4 Rear Panel Connections - New RS-485 Version

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

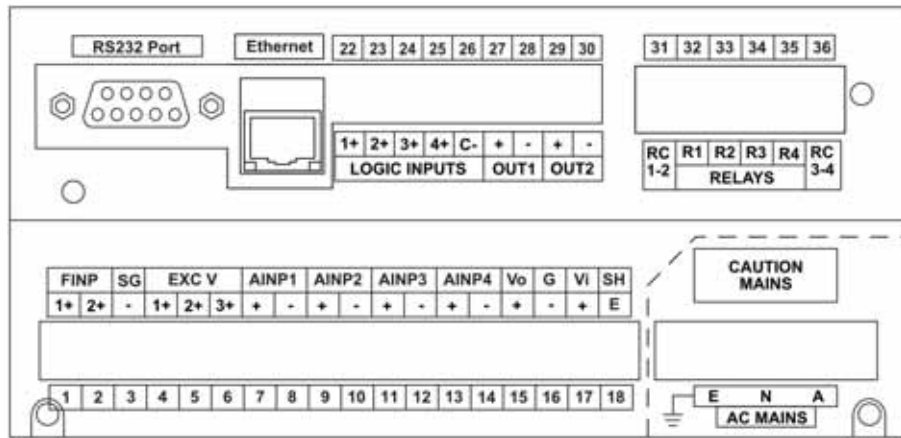


Figure 5 Rear Panel Connections - New Ethernet Version

### Terminal Designations

| Terminal Label | Designation | Comment               | Terminal Label         | Designation      | Comment      |   |  |
|----------------|-------------|-----------------------|------------------------|------------------|--------------|---|--|
| 1              | FINP 1+     | Frequency Input 1+    | Not used               | 19               | RS485 (+)    | Optional RS485 port may be replaced by Ethernet port. |  |
| 2              | FINP 2+     | Frequency Input 2+    | Not used               | 20               | RS485 (-)    |   |  |
| 3              | SG -        | Signal ground         | Not used               | 21               | RS485 ground |   |  |
| 4              | EXC V 1+    | Excitation Term 1+    | Not used               | 22               | 1+           | Switch 1  | Inhibit Process Flow                                   |
| 5              | EXC V 2+    | Excitation Term 2+    | Not used               | 23               | 2+           | Switch 2  | Forced Local (manual) Control                          |
| 6              | EXC V 3+    | Excitation Term 3+    | Not used               | 24               | 3+           | Switch 3  | Remote Reset   |
| 7              | AINP1 +     | Analog Input ch 1 (+) | Not used               | 25               | 4+           | Switch 4  | CAL Switch – In field access protection                |
| 8              | AINP1 -     | Analog Input ch 1 (-) | Not used               | 26               | C-           | Signal ground   |  |
| 9              | AINP2 +     | Analog Input ch 2 (+) | Not used               | 27               | +            | Output ch 1 (+)                                       | Process control output                                 |
| 10             | AINP2 -     | Analog Input ch 2 (-) | Not used               | 28               | -            | Output ch 1 (-)                                       |  |
| 11             | AINP3 +     | Analog Input ch 3 (+) | Main Flow Input        | 29               | +            | Output ch 2 (+)                                       |  |
| 12             | AINP3 -     | Analog Input ch 3 (-) |                        | 30               | -            | Output ch 2 (-)                                       |  |
| 13             | AINP4 +     | Analog Input ch 4 (+) | Process Flow Input     | 31               | RC           | Relay Common 1-2                                      | <i>Term 31 - Common 1-4 on legacy option card</i>      |
| 14             | AINP4 -     | Analog Input ch 4 (-) |                        | 32               | R1           | Relay 1   | Pump demand  |
| 15             | Vo +        | 8-24 volts DC output  | Overload protected     | 33               | R2           | Relay 2   | Alarm  |
| 16             | G -         | DC Ground             |                        | 34               | R3           | Relay 3   |  |
| 17             | Vi +        | DC power input        | DC power in 12-28V     | 35               | R4           | Relay 4   |  |
| 18             | SH E        | Shield terminal       |                        | 36               | RC           | Relay common 3-4                                      | <i>Term 36 only available on new style option card</i> |
| E              | AC MAINS E  | Mains ground          | AC power in 100-240VAC | RS232 COM-1 port |              | 9-pin serial port                                     |  |
| N              | AC MAINS N  | Mains neutral         |                        |                  |              |   |  |
| A              | AC MAINS A  | Mains active          |                        |                  |              |   |  |

## 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. (0.75mm<sup>2</sup>, 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 0.75mm<sup>2</sup> (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

## Analog Input Connections

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

### 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.

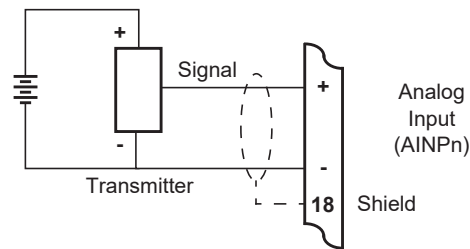


Figure 6 Externally Powered Voltage Transmitter

Connect internally powered voltage transmitters as shown in Figure 7.

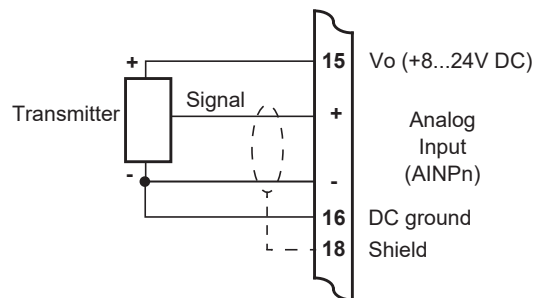


Figure 7 Internally Powered Voltage Transmitter

### 4-20mA 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.

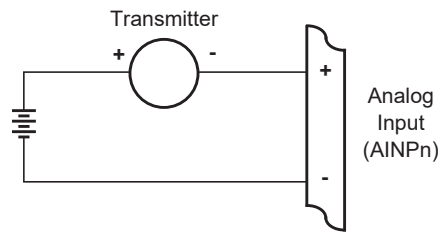


Figure 8 Externally Powered Current Loop

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

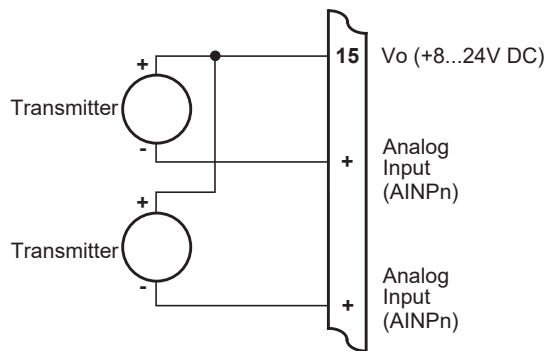


Figure 9 Internally Powered Current Loops

## 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 Controls** on page 33 describes the function of the inputs.

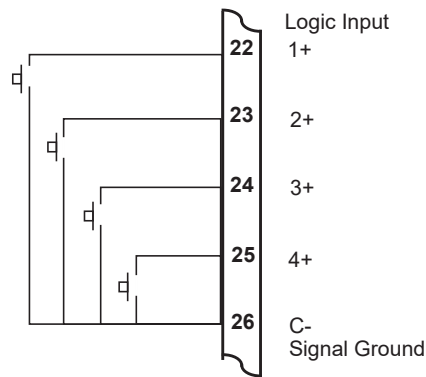


Figure 10 Logic Inputs Connection Diagram

## 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.

### 4-20mA Output Connection

Figure 11 shows the connections for a 4-20mA output. Output channel 1 uses terminals 27 (+) and 28 (-), output channel 2 uses terminals 29 (+) and 30 (-).

$$\text{Maximum Load Resistance} = (\text{Supply} - 9) / 0.02 \text{ ohms}$$

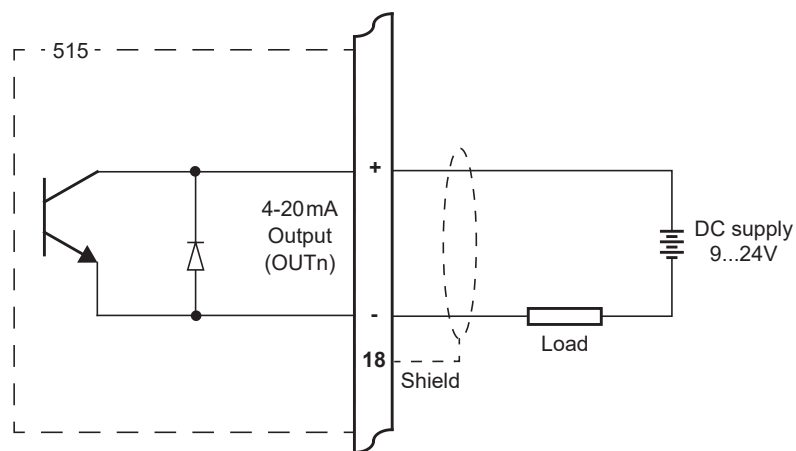
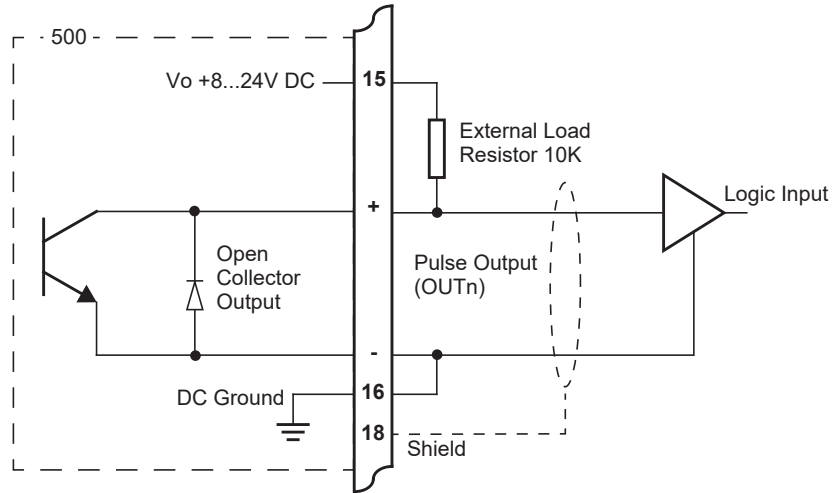


Figure 11 Output 4-20mA Connection Diagram

## Pulse Output Connection

Figure 12 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 12 Output Pulse Connection Diagram*

## Control Relays (Alarms)

The relay output 1 is dedicated as a pump demand contact. It disconnects the pump if the instrument operates in RATIO or BLEND mode and either the Ratio Setpoint is set to zero, or Inhibit Input is active, or the main flow stays at zero longer than preprogrammed delay. The other relays can be used for alarms on any rate type variable. Two relays are standard with an additional two available in the advanced option.

The operation of alarm relay(s) can be set to various modes as described in [Alarms](#) on page 52. 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 13.

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.

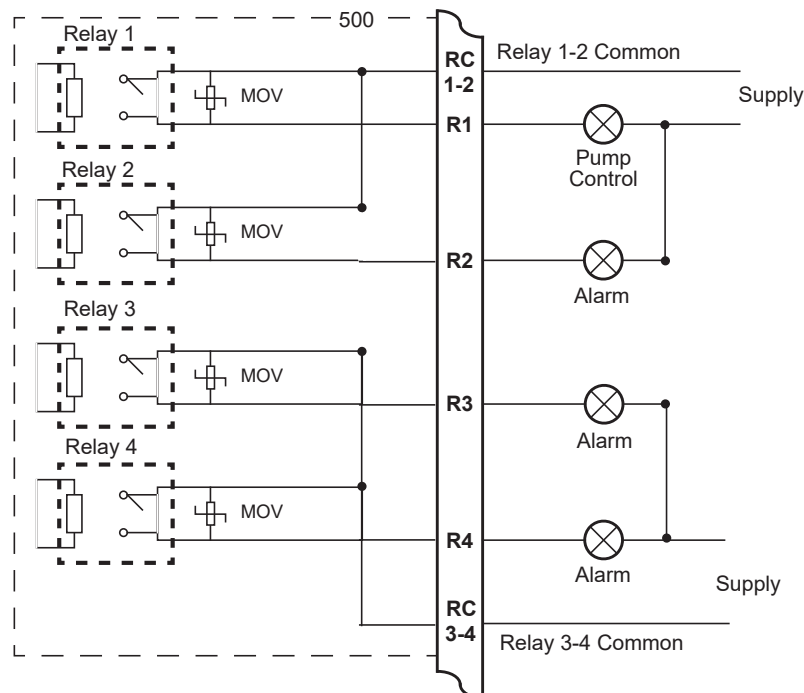


Figure 13 Relay Connection Diagram

## 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  $\mu\text{F}$  and 100  $\Omega$  will usually suffice. Note that only mains-approved RC suppression networks should be used.

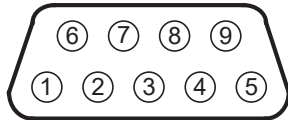
The basic principle of the operation is that the capacitor prevents a series of sparks arcing across the contact as the contact breaks. The series resistor limits the current through the contact when the contact first makes.

## 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 14 shows the connection of several instruments to a computer using the RS-485 port.

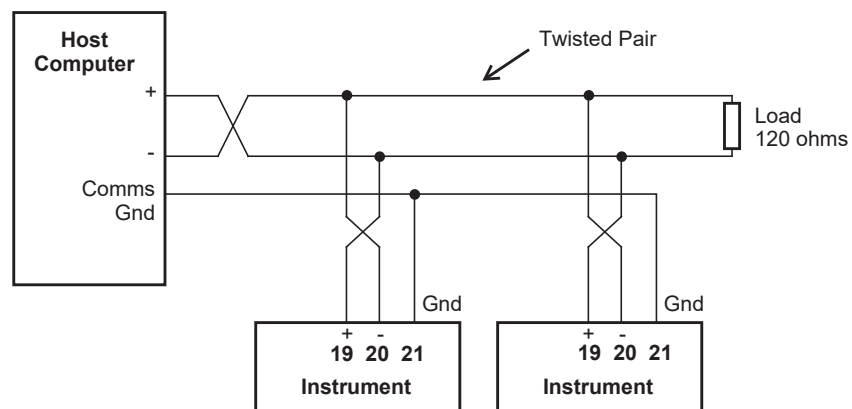


Figure 14 RS-485 Interface Connections

## 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** Fast Flashing LED: The 'Inhibit Process Flow' feature is active
- Slow Flashing LED: The 'Force Local' (manual) mode is active
- 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 or to initiate a printout if the printer option has been selected. The printout is activated with a single press while the Total Reset function has different operation modes that are selectable during instrument calibration as follows:

- NONE - The user cannot reset the non-accumulated totals.
- INSTANT - When the user presses the **RESET** key, the instrument resets all non-accumulated totals.
- DELAYED - When the user holds the **RESET** key for two seconds, the instrument resets all non-accumulated totals.

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 or to display the peak value for the currently displayed flowrate. See below for further details of peak flowrates.

## 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.

| <b>DISPLAY</b><br>↓ | <b>Description</b>   | <b>Options</b>   |
|---------------------|--|--|
| N-VOL               | Net volume   | Hold the <b>ACCUM</b> key to display accumulated total   |
| N-FLOW              | Net flowrate   | Hold the <b>ACCUM</b> key to display peak value  |
| M-VOL               | Main line volume   | Hold the <b>ACCUM</b> key to display accumulated total   |
| M-FLOW              | Main line flowrate   | Hold the <b>ACCUM</b> key to display peak value  |
| P-VOL               | Process line volume  | Hold the <b>ACCUM</b> key to display accumulated total   |
| P-FLOW              | Process line flowrate  | Hold the <b>SET</b> key to display (or edit) the controlling setpoint  |
| RATI O              | Process ratio  | Hold the <b>SET</b> key to display (or edit) the controlling setpoint  |
| P-CTRL              | Process control output   | Hold the <b>SET</b> key to display (or edit) the controlling setpoint  |
| DEVI AT             | Process flowrate deviation                                       | Hold the <b>SET</b> key to display (or edit) the controlling setpoint  |
| REPORT PRI NT       | Only shown in Detail Menu if a printer protocol is used          | Hold the <b>SET</b> 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 <b>SET</b> key to display data logs as described in <b>Data Logs</b> on page 27                       |
| MODEL I NFO         | Only shown in Detail Menu  | Hold the <b>SET</b> key to display the Model information as described in <b>Model Information</b> on page 29   |
| CAL MENU            | Only shown in Detail Menu  | Hold the <b>SET</b> key to enter Calibration View mode as described in <b>Calibration View Mode</b> on page 38 |

## 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](http://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:

di spl ay DETAI L MENU.

When switching to the Basic menu the display will briefly show:

di spl ay BASI C 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

## Peak Flowrates

The peak value for the currently displayed flowrate can be viewed by holding the **ACCUM** key. The peak value is the average over a 15 minute period since the last reset of totals or powering on of the instrument. Dashes are shown for this value after a reset or power on until the first averaging period has passed.

## 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 can store a total of 1530 log entries which are distributed over the log intervals as follows:

- 800 hourly logs
- 400 daily logs
- 200 weekly logs
- 100 monthly logs
- 30 yearly logs

Note that the totals are saved as accumulated totals.

If the number of log entries exceeds the programmed number for a particular time interval, the oldest log entry is overwritten by the newest one for that time interval.

The log entries are recorded at the following times:

|       |   |
|-------|---|
| HOUR  | 00 minutes each hour                                  |
| DAY   | 00 hours and 00 minutes each day                      |
| WEEK  | 00 hours and 00 minutes each Monday                   |
| MONTH | 00 hours and 00 minutes on the first day of the month |
| YEAR  | 00 hours and 00 minutes on the first day of the year. |

### 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 hourly log. The timebase and number of the log are shown, for example LH-001.

3. 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 hourly log number 006 at 15:00 (3:00 pm) on 16 January 2018. The day and month alternate with the year in the bottom right hand corner.



Figure 15 shows how to display the logged data.

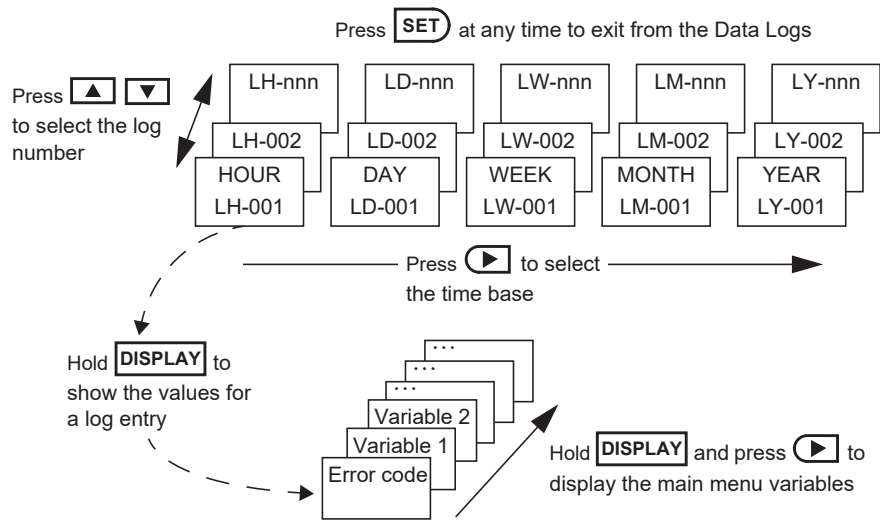


Figure 15 Logged Data Display Methods

## Model Information

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

| DISPLAY<br>↓                  | Description   |
|-------------------------------|---|
| 2-1--S-<br>515 MODEL          | The hardware model code. Refer to <b>Product Codes</b> on page 85 for more information.   |
| ----FF<br>CR02 INPUT          | The Application number and the assignment of the inputs. Refer to <b>Application Information Code</b> on page 86 for more information.  |
| 3_0_000<br>500-PM VERS        | The version of 500-Series Program Manager from which the application software was compiled.   |
| 026357<br>CUSTOM VERS         | The Customer version code for this installation. Refer to <b>Custom Version Codes</b> on page 86 for more information.  |
| 123456<br>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 UNI T- 1.  |
| 16-15<br>EDITED 27/08<br>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<br>FLASH V-019        | The instrument Class and Flash (bootloader) version.  |
| 5<br>POWER CYCLE              | The number of power cycles that have occurred since the application software was installed.   |
| 1<br>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<br>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.

## Process Control Modes

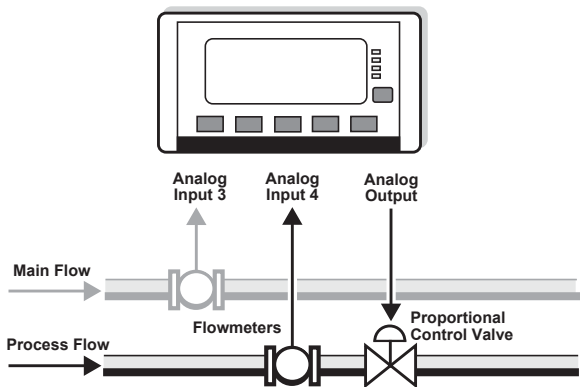
This instrument can operate in several process control modes including:

- Local (manual) mode
- Loop mode
- Tune mode (only available in calibration set mode)
- Ratio mode
- Blend-1 mode (for blending point after main flowmeter)
- Blend-2 mode (for blending point before main flowmeter)

In all of these modes, except Blend-2, the Net flow is the combination of the Main and Process flows. In Blend-2 the Main flow equals the Net flow.

The pump demand relay 1 disconnects the pump if the instrument operates in RATIO or BLEND mode and either the Ratio Setpoint is set to zero, or Inhibit Input is active, or the main flow stays at zero longer then preprogrammed delay.

### Local Mode



The desired process control output (P-CTRL %) is manually set via the front panel or serial communications.

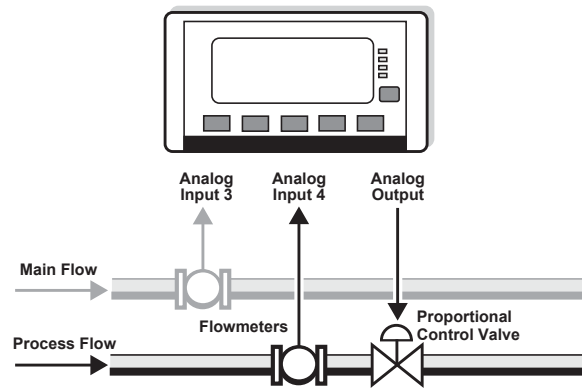
The output signal is used to drive the proportional control valve to the desired position.

The control of the process line is independent of the main flow.

The main flow input can be used and measured but is not necessary.



### Loop Mode



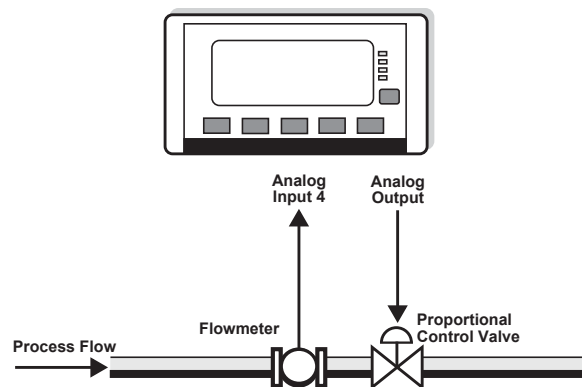
The desired process flowrate set point (P-FLOW SP) is set via the front panel or serial communications.

The PI controlled output signal is used to maintain the desired process flowrate via the proportional control valve.

The control of the process line is independent of the main flow.

The main flow input can be used and measured but is not necessary.

### Tune Mode - CAL MODE ONLY

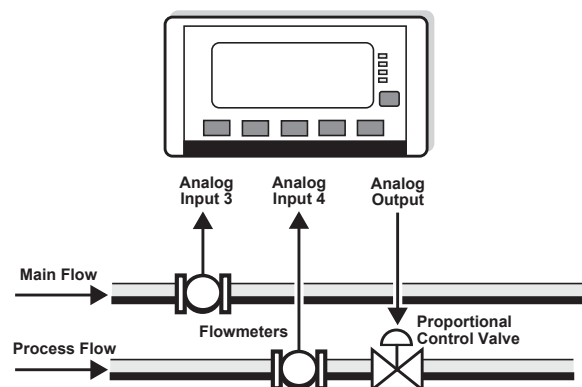


This mode is only accessed from within calibration mode and allows the operator to view a concise list of key parameters and gain immediate feedback. The Proportional Band (P-BAND) and Integral Time (I-TIME) are entered to tune the system.

For details on this method see below: **”Tuning the Control Loop”**.

The control and tuning of the process line in this mode is independent of the main flow.

### Ratio Mode



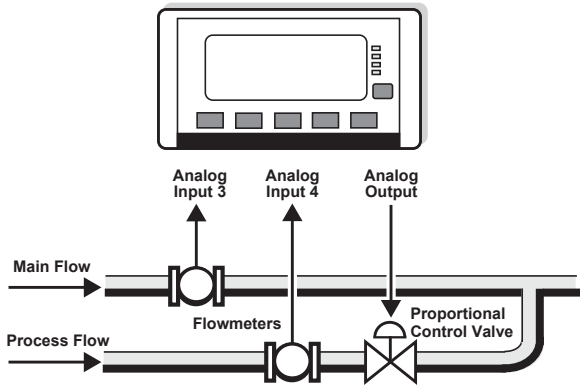
The desired process ratio set point (RATIO %) is set via the front panel or serial communications.

The PI controlled output signal is used to maintain the desired process flowrate via the proportional control valve.

The desired process flow is determined as a ratio of the main flow (0 to 400% range) i.e.

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

**Blend-1 Mode**



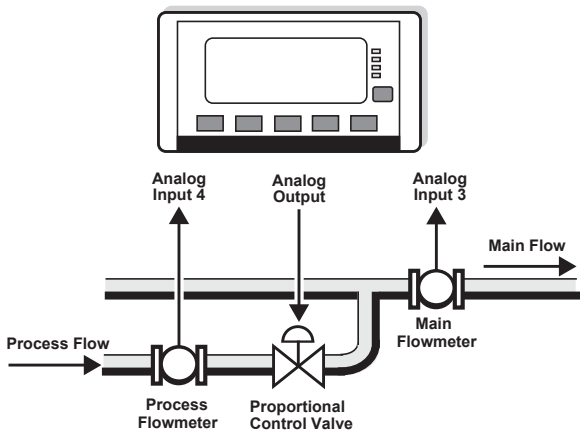
The desired blending ratio set point (RATIO %) is set via the front panel or serial communications.

The PI controlled output signal is used to maintain the desired process flowrate via the proportional control valve.

The desired process flow is determined as a ratio of the net (combined) flow (0 to 80% range). i.e.

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

**Blend-2 Mode**



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

The PI controlled output signal is used to maintain the desired process flowrate via the proportional control valve.

The desired process flow is determined as a ratio of the main (net) flow (0 to 80% range). i.e.

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

---

## Logic Input Controls

The active level of logic input control signals is determined by the 'Loop Control Active Signal' parameter, which can be set to either an OPEN or CLOSED circuit.

Logic input 1 has the function of 'Inhibit Process Flow'. This feature allows the process flow to be disabled to assist in 'flushing' of the system or for deliveries of the main product to be made without the process product being added. This input will inhibit the process flow while the signal is in the active state by forcing the process control output to drive to zero. While the inhibit input is active, the 'Run' led on the front panel will flash fast and any flow detected on either the main or process flow inputs still will be counted.

Logic input 2 has the function of forcing 'local' loop output control mode providing convenient means for temporary switching to this mode without going into CAL mode. While the logic input 2 is active, the 'Run' led on the front panel will flash slow.

Note: Logic input 1 has highest priority.

For connection details, refer to [Logic Input Connection](#) on page 14.

## Tuning the Control Loop

The Process Controller has a special control mode within the Parameters section of calibration to assist in tuning the control loop. This mode provides a concise list of key parameters and allows for immediate feedback. The basic principle in tuning the loop is to gradually adjust the Proportional Band (P-BAND) and the Integral Time (I-TIME) and observe the response to a step change in the setpoint.

The tune menu provides for this by allowing the P-BAND and I-TIME to be programmed and then a Process Flow (P-FLOW) setpoint value can be entered. The next items in the menu are the actual live process variable and the deviation from the target value, so that the response of the system to a setpoint change can be observed. Unless the menu is quit the program will step back to start of the tuning menu so that new values of P-BAND and I-TIME can be entered and the effect of a step change in the setpoint be monitored.

This sequence is followed for all modes where the flow in the process line is controlled. The tuning procedure is as follows:

1. Before tuning the control loop it is essential to program in the correct parameters for the flowmeters, including filtering.
2. The actual Process Flow Range (P-FLOW RANGE) should be measured (or estimated) and entered. It can be determined in Local mode by setting the output to 100% (20mA) and observing the steady state flowrate.
3. With the Loop Error Deadband (D-BAND) and the Output Ramp Time (R-TIME) set at zero, the I-TIME should be set to zero (disabled) and the P-BAND set at 150%.

Gradually decrease the P-BAND value until the system begins to oscillate when a small step change of the setpoint is introduced. When this occurs, double the value of the P-BAND.

4. Next set the I-TIME to 20 seconds and gradually decrease the value until the system again begins to oscillate when a small step change of the setpoint is introduced. When this occurs double the value of the I-TIME.
5. The Ratio Trim Time can now be tuned if required (see below: **Tuning the Ratio Trim Control**) or the Deadband and the Output Ramp Time can now be programmed as required.

The system should be tuned around the flowrate at which the eventual system will operate. The stability of the loop should then be checked at various flowrates and setpoints.

## Tuning the Ratio Trim Control

The ratio trim control is a unique feature that can be used when it is critical for the totals to maintain the correct ratio. If enabled (non-zero), the trim control will modify the process flow to achieve the correct ratio between the totals.

The trim time feature is implemented as a cascade control, a combination of two controllers, where the output signal from one controller forms the setpoint of the other. Cascade control is used when there are two or more available measurements (flowrate and total), but only one manipulated variable (the process flowrate).

Trim control only applies to the Ratio and Blend control modes. The Trim Time (T-TIME) is entered as a part of the parameters menu in calibration when either of these modes are selected.

---

At the end of these menus there is the RATIO setpoint, the actual live process variable and the deviation from the target value, so that the response of the system to a setpoint change can be observed. Unless the menu is quit the program will step back to start of the menu so that a new T-TIME value can be entered and the effect of a step change in the setpoint be monitored.

The trim time for a system is somewhat arbitrary. The actual value to be used for the trim time is very much dependent on the operator's desired behaviour of the system. A short T-TIME will mean that the totals will reach the desired ratio in a shorter time in response to a step change in setpoint. However the faster the response the greater likelihood of flowrate overshoot.

Alternatively a long T-TIME will have much less risk of flowrate overshoot but it would require a longer time for the totals to reach the desired ratio in response to a step change in setpoint.

The trimming is not based on the actual values of the totals but on additional registers which count in unison with the displayed totals. These additional internal registers are reset whenever:

- the Control Mode is changed,
- the Ratio Setpoint is changed,
- the Totals are cleared.
- the flow control exception is raised.

Follow this sequence for tuning the trim time for the ratio and blend control modes if trim control is required:

- 1.** Before tuning the trim control it is essential that the control loop has been tuned first.
- 2.** With the Loop Error Deadband (D-BAND) and the Output Ramp Time (R-TIME) set at zero the T-TIME should be initially entered as 4 times the Integral Time.

Introduce a step change in the setpoint and observe the response of the system.

- 3.** Increase or decrease the T-TIME to achieve the desired response.
- 4.** The Deadband and the Output Ramp Time can now be programmed as required.

The stability of the loop should be again checked at a few different working flowrates and ratios.



# 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 41

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.



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.



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

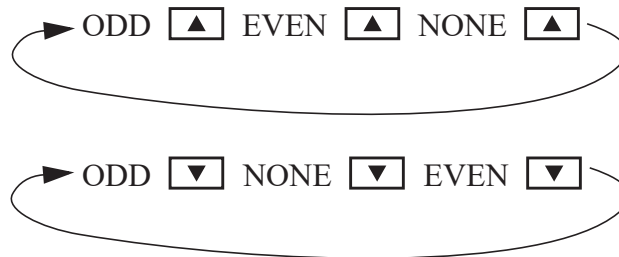
## Changing the Instrument Settings

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 be 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](http://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 29. 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](http://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.

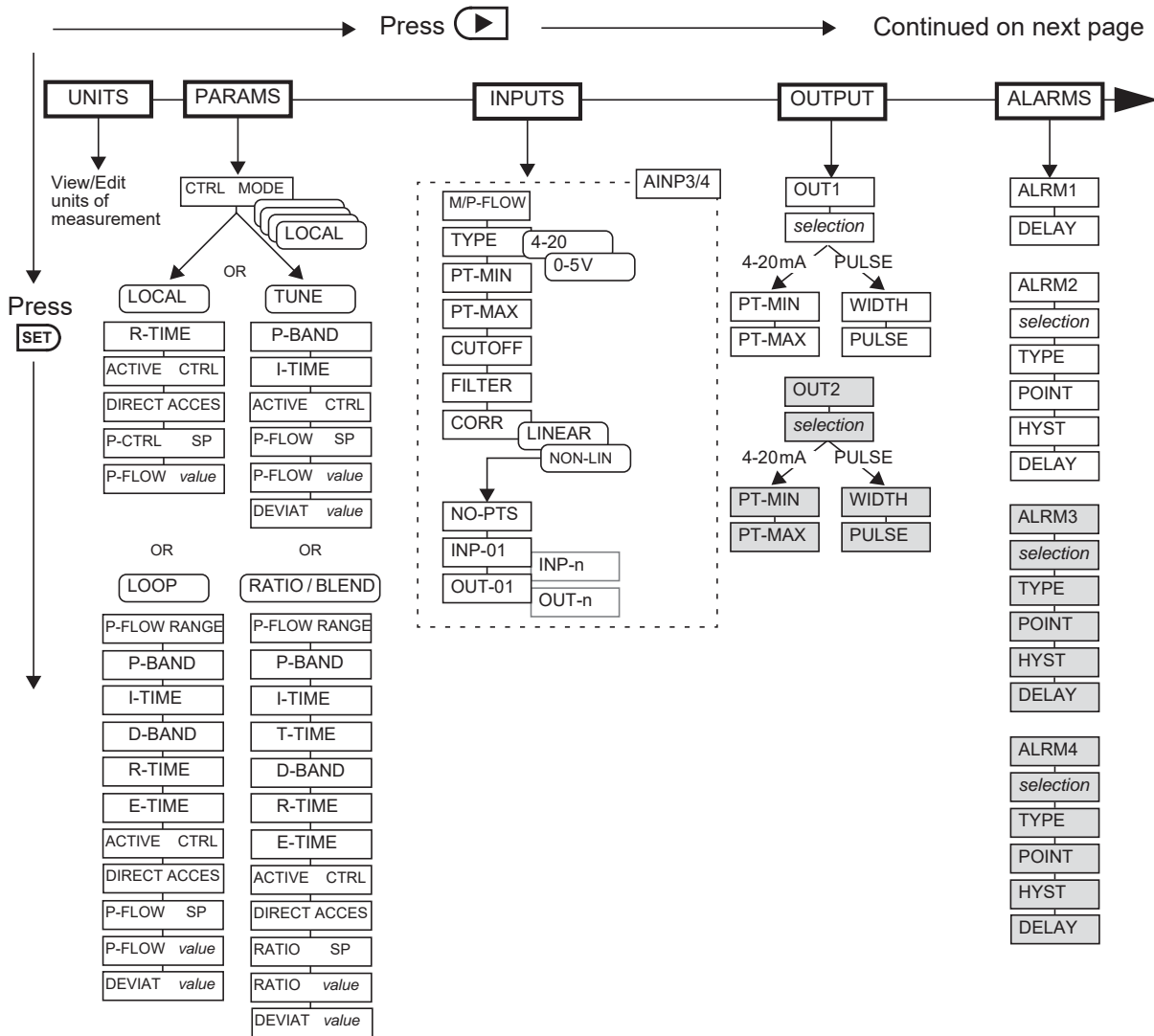
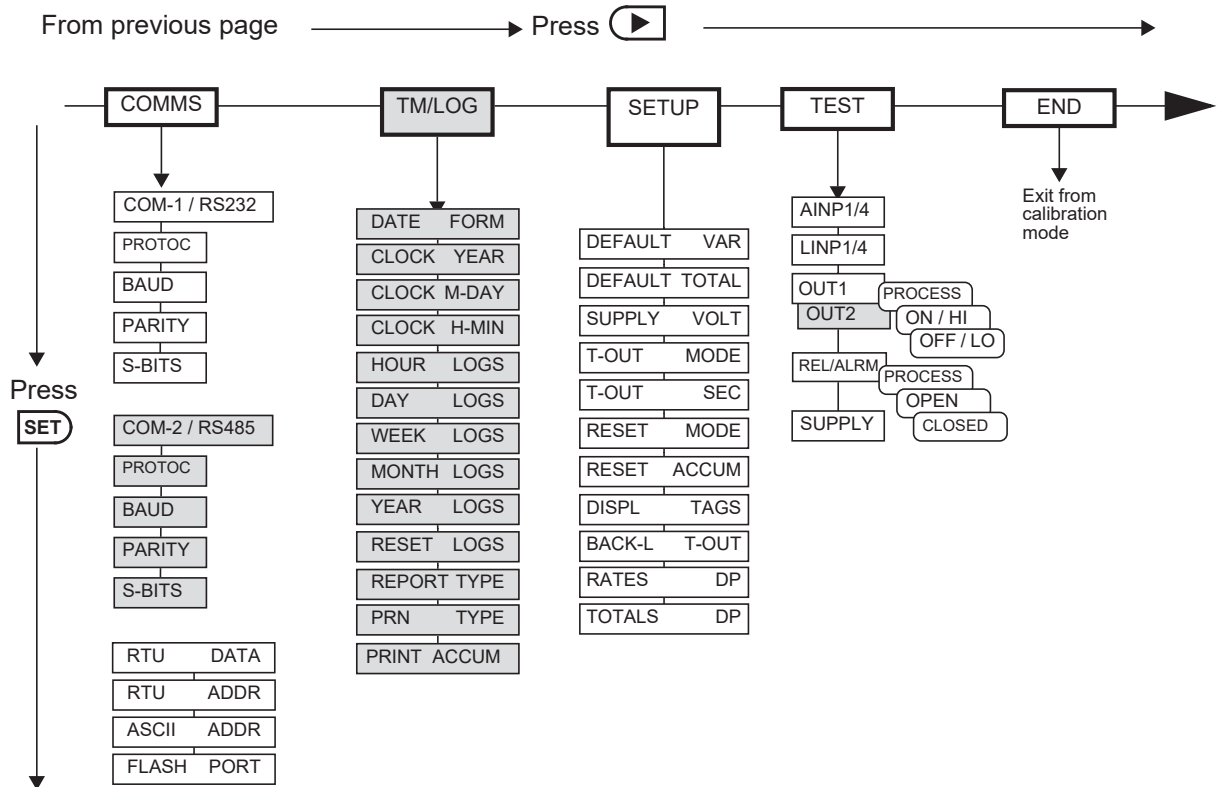



Figure 16 Calibration Menu Tree Sheet 1



 The shaded boxes indicate hardware options

Hold  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.

|  ↓ |  → <b>UNITS</b> PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END   |
|---|---|
| I TEM <i>n</i> <i>unit</i>  | <p>The units for main menu or calibration items can be viewed by pressing the  key.</p> <p>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.</p> <p>Press  or  to select the required units.</p>  |
| ACCEPT    UNI TS  | <p>The Accept Units prompt will only appear if one or more of the units have been changed.</p> <p><b>IMPORTANT:</b> 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.</p> <p>Press  or  to select YES, then press the  key. The instrument makes three beeps to confirm the reset command.</p> <p>The message -RESET- PLEASE WAIT will be displayed as the instrument exits calibration mode and completes a full re-boot sequence.</p> |

## Parameters

|   |  |
|---|--|
|  ↓   |  → UNITS <b>PARAMS</b> INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END  |
| CTRL      MODE  | <p>Select the required loop control mode.</p> <p>Press  or  to select either: LOCAL, LOOP, TUNE, RATIO, BLEND-1 or BLEND-2.</p> <p>Refer to <b>Process Control Modes</b> on page 30 for descriptions of each mode.</p>                   |
| <p><b>Note:</b> The items actually shown under the PARAMS menu are dependent on the CONTROL MODE chosen above. Items that are not relevant for that mode will not appear.</p> |  |
| P-FLOW      RANGE   | <p>The process or loop flow range is the maximum flowrate that the system will achieve on the process flow line. This value is used by the loop control algorithm and is entered in the same units as the main menu Process Flowrate variable. It can be determined by setting the process control setpoint to 100% whilst in LOCAL mode and observing the flowrate.</p>                                   |
| P-BAND      %   | <p>The proportional band of PI control algorithm.</p> <p>Enter the value in percentage. For means of determining this value see <b>Tuning the Control Loop</b> on page 33.</p>   |
| I - TIME      SEC   | <p>The loop integral time of PI control algorithm. This parameter should be programmed as a non-zero value to enable the integral term in the control algorithm.</p> <p>Enter the value in seconds. For means of determining this value see <b>Tuning the Control Loop</b> on page 33.</p>   |
| T - TIME      SEC   | <p>The loop ratio trim time. The integral time of cascade trim control can be used when it is critical for the totals to maintain the correct ratio. If enabled (non-zero), the trim control will modify the process flow to achieve the correct ratio between the totals.</p> <p>Enter the value in seconds. For means of determining this value see <b>Tuning the Ratio Trim Control</b> on page 34.</p> |
| D-BAND      %   | <p>The loop error deadband can be programmed to prevent the output continuously changing and thereby reducing wear on valves and actuators. Enter the value as a percentage of the Flow Range parameter.</p> <p>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).</p>                      |

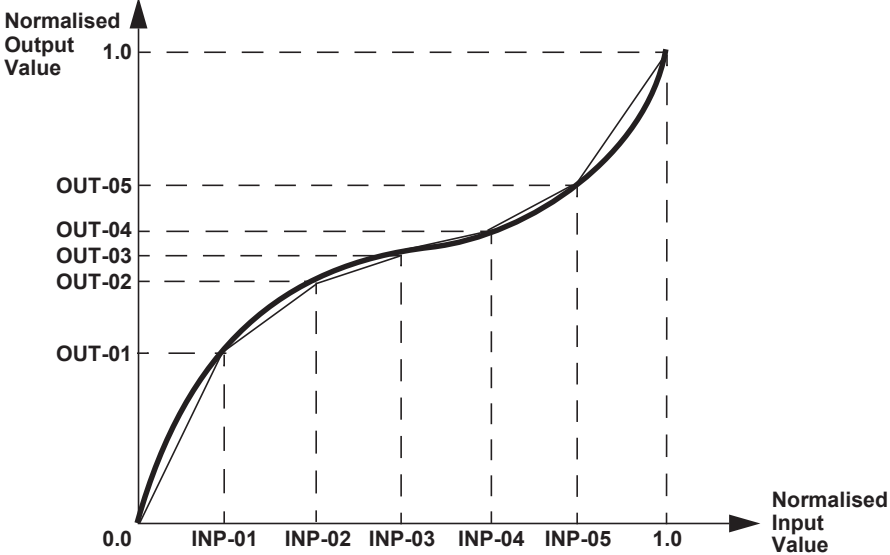
|   |       |  |
|---|-------|--|
| <b>SET</b> ↓  |       | ▶ → UNITS <b>PARAMS</b> INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END  |
| R-TIME  | SEC   | The ramp time limits the rate of change of the loop output signal and assists in bumpless loop operation when changing operation mode or loop parameters. It represents the minimum time required for the output signal to traverse between saturation points (i.e. from 0 to 100% or vice versa).   |
| E-TIME  | SEC   | The loop control error time allows an exception to be raised when the loop output stays in saturated condition longer than the programmed error time (i.e. the loop cannot be controlled). To disable this exception set the loop control error time to zero.  |
| ACTIVE  | CTRL  | This parameter allows to choose whether open or closed circuit controls the process flow:<br>- Logic Input 1 inhibits process flow (highest priority)<br>- Logic Input 2 forces 'local' loop output control mode<br><br>Press ▲ or ▼ to select OPEN or CLOSED.   |
| DIRECT  | ACCES | If the direct access is enabled then the operator is able to enter edit mode for the controlling setpoint directly from the main menu by holding the <b>SET</b> key while viewing the setpoint. If disabled the setpoint can only be changed from within calibration set mode (or via serial communications, see below). Select the direct access mode as required.<br><br>Press ▲ or ▼ to select ENABLE or DISABLE. |
| <b>Modbus Accessible Parameters</b>   |       |  |
| The following PARAMS menu item(s) are also accessible via Modbus communications. For Modbus register listing, refer to <b>Instrument Configuration Parameters</b> on page 76. |       |  |
| P-CTRL  | SP    | Loop/Process control signal setpoint. This setpoint is only available for LOCAL control mode.  |
| If LOCAL control mode the live P-FLOW value is now shown to give immediate feedback without leaving calibration set mode.   |       |  |
| P-FLOW  | SP    | Loop/Process flowrate setpoint. This setpoint is only available for LOOP control and TUNE modes. The value of the setpoint must not be greater than the process flow range (P-FLOW RANGE).   |
| If LOOP control or TUNE mode the live P-FLOW and DEVIATION values are now shown to give immediate feedback without leaving calibration set mode.                              |       |  |
| RATIO   | SP    | Loop ratio setpoint. This setpoint is only available for RATIO and BLEND control modes. For ratio mode the allowable range is 0 to 399.999%. For blend mode the value must be within the range 0 to 80%.   |
| If RATIO or BLEND control mode the live RATIO and DEVIATION values are now shown to give immediate feedback without leaving calibration set mode.                             |       |  |



## Inputs

| <input type="button" value="SET"/> ↓     |  | <input type="button" value="▶"/> → UNITS PARAMS <b>INPUTS</b> OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END   |
|--|--|--|
| <b>Analog Input 3 &amp; 4</b>            |  |  |
| I NPUT<br>M-FLOW AI NP3<br>P-FLOW AI NP4 |  | Analog Input Channels 3 and 4 are assigned as volumetric flowrate inputs. Channel 3 is used for measuring the main line flow and channel 2 is used for the process line flow.  |
| TYPE AI NP3<br>AI NP4                    |  | Select the type of analog input source.<br><br>Press <input type="button" value="▲"/> or <input type="button" value="▼"/> to select 0-5V, 1-5V or 4-20mA.  |
| PT-MI N AI NP3<br>PT-MAX AI NP4          |  | Enter the value of the measured parameter (in the defined engineering units) that corresponds to the minimum input signal level. The minimum point is commonly set at a base flowrate of 0.0.<br><br>Enter the value of the measured parameter (in the defined engineering units) 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.<br><br>For example, if the source signal is 4 mA at a minimum volumetric flowrate of 2 m <sup>3</sup> /M, enter 2 as the minimum point. If the source signal is 20mA at a maximum volumetric flowrate of 250m <sup>3</sup> /M, enter 250 as the maximum point. |
| CUTOFF AI NP3<br>AI NP4                  |  | The Cut-off is the lowest value that the instrument reads from the input sensor. The cut-off setting is the percentage of the span of the input values.<br><br>All inputs at or below the cut-off value are considered negligible to the instrument and are ignored. In this case, the instrument uses the minimum value (set at PT-MIN).  |
| FI LTER AI NP3<br>AI NP4                 |  | 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.<br><br>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.<br><br>The value A is the filter constant that the user can set.  |

| <b>SET</b> ↓ |                  | ▶ → UNITS PARAMS <b>INPUTS</b> OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END  |                                    |                                    |
|--------------|------------------|--|------------------------------------|------------------------------------|
|              |                  | <b>Filter setting A</b>  | Seconds to reach 90% of full swing | Seconds to reach 99% of full swing |
|              |                  | 0  | 0                                  | 0                                  |
|              |                  | 2  | 2                                  | 4                                  |
|              |                  | 4  | 4                                  | 8                                  |
|              |                  | 6  | 5                                  | 10                                 |
|              |                  | 10   | 8                                  | 15                                 |
|              |                  | 15   | 12                                 | 23                                 |
|              |                  | 20   | 14                                 | 27                                 |
|              |                  | 25   | 18                                 | 34                                 |
|              |                  | 35   | 25                                 | 48                                 |
|              |                  | 45   | 32                                 | 62                                 |
|              |                  | 60   | 42                                 | 82                                 |
|              |                  | 75   | 52                                 | 102                                |
|              |                  | 90   | 62                                 | 122                                |
|              |                  | 99   | 68                                 | 134                                |
|              |                  | The input filter range is from 0 to 99. A setting of 0 (zero) means that there is no filtering.  |                                    |                                    |
| CORR         | AI NP3<br>AI NP4 | Analog input non-linearity can be corrected as follows: <ul style="list-style-type: none"> <li>• LINEAR</li> <li>• NON-LINEAR to use the following linearity correction parameters</li> </ul> Use <input type="button" value="▲"/> or <input type="button" value="▼"/> to select LINEAR or NON-LINEAR.                         |                                    |                                    |
| NO-PTS       | AI NP3<br>AI NP4 | <i>This parameter is available for viewing and editing only when the correction type is set to Non-linear.</i> <p>Enter the number of non-linearity correction points.</p> Press <input type="button" value="▲"/> or <input type="button" value="▼"/> to select a number between 1 and 20 for the number of correction points. |                                    |                                    |

|  |  |
|--|--|
| <p><b>SET</b> ↓</p>                            | <p>→ UNITS PARAMS <b>INPUTS</b> OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END</p>   |
| <p>I NP-01 AI NP3<br/>to AI NP4<br/>I NP-n</p> | <p><i>This parameter is available for viewing and editing only when the correction type is set to Non-linear.</i></p> <p>Enter the normalised input value for the correction point.</p> <p>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.</p> <p>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.</p>  <p>You can press the <b>DISPLAY</b> key to skip the non-linear points and go to the next item.</p> |
| <p>OUT-01 AI NP3<br/>to AI NP4<br/>OUT-n</p>   | <p><i>This parameter is available for viewing and editing only when the correction type is set to Non-linear.</i></p> <p>Enter the normalised output value for the correction point.</p>   |

## Outputs

|  |  |
|--|--|
| <p><b>SET</b> ↓</p>  | <p>→ UNITS PARAMS INPUTS <b>OUTPUTS</b> ALARMS COMMS TM/LOG SETUP TEST END</p> |
| <p><b>Note:</b> In the factory default version of this application output channel 1 (OUT1) is dedicated as the 4-20mA Process Control signal. Output channel 2 can be freely configured.</p> |  |

| <div style="border: 1px solid black; padding: 2px; display: inline-block;">SET</div> ↓ | <div style="border: 1px solid black; padding: 2px; display: inline-block;">▶</div> → UNITS PARAMS INPUTS <b>OUTPUTS</b> ALARMS COMMS TM/LOG SETUP TEST END  |
|--|---|
| PULSE or 4-20      OUTn  | <p>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 4-20mA passive signals.</p> <p>Press <div style="border: 1px solid black; padding: 1px 5px;">▲</div> or <div style="border: 1px solid black; padding: 1px 5px;">▼</div> 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.</p> <p style="text-align: center;"><b>CAUTION</b></p> <p style="text-align: center;">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.</p> |
| WI DTH      OUTn   | <p><i>The Output Pulse Width is available for viewing and editing only when the assigned variable is a total (pulse output) type.</i></p> <p>Pulse output is usually used to drive remote counters. Set the pulse width (in milliseconds) as required by the remote counter.</p> <p>Press <div style="border: 1px solid black; padding: 1px 5px;">▲</div> or <div style="border: 1px solid black; padding: 1px 5px;">▼</div> to set to: 10, 20, 50, 100, 200 or 500ms.</p>  |
| PULSE      OUTn  | <p><i>The Output Pulse Factor is available for viewing and editing only when the assigned variable is a total (pulse output) type.</i></p> <p>The Output Pulse Factor is the scaling factor for the retransmission of the measured total quantity.</p> <p>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<sup>3</sup>. Similarly, a pulse factor of 3.000 generates one pulse for 3 m<sup>3</sup>.</p> <p>For more information, see <b>Output Pulse Factor</b> on page 51.</p> <p>The output pulse factor cannot be 0 (zero).</p>   |

| SET ↓            | ▶ → UNITS PARAMS INPUTS <b>OUTPUTS</b> ALARMS COMMS TM/LOG SETUP TEST END   |
|------------------|---|
| PT-MIN<br>PT-MAX | <p>OUT<sub>n</sub><br/>OUT<sub>n</sub></p> <p><i>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.</i></p> <p>The output minimum value corresponds to the 4mA point and the output maximum value corresponds to the 20mA point.</p> <p>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.</p> <p>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<sup>3</sup>/min. At rates above the maximum and below the minimum points, the output remains at 20mA and 4mA respectively.</p> |

### 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:

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

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

## Alarms

Relay 1 in this application is dedicated to the Pump Control function and only has the Delay program item available.



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.

|                                      |          |   |
|--------------------------------------|----------|---|
| <input type="button" value="SET"/> ↓ |          | <input type="button" value="▶"/> → UNITS PARAMS INPUTS OUTPUTS <b>ALARMS</b> COMMS TM/LOG SETUP TEST END  |
| RELAY                                | ALRM $n$ | <p>Select a rate variable to assign to the alarm relay.</p> <p><b>Note:</b> If the alarm type is set to “equipment alarm”, this relay assignment setting is ignored.</p> <p>Press <input type="button" value="▲"/> or <input type="button" value="▼"/> to select the variable that is required as an alarm.</p>   |
| TYPE                                 | ALRM $n$ | <p>The options available for alarm types are as follows:</p> <ul style="list-style-type: none"> <li>• HI-NO    - High Alarm,            contacts are Normally Open</li> <li>• HI-NC    - High Alarm,            contacts are Normally Closed</li> <li>• LO-NO    - Low Alarm,                contacts are Normally Open</li> <li>• LO-NC    - Low Alarm,                contacts are Normally Closed</li> <li>• BD-NO    - Band Alarm,               contacts are Normally Open</li> <li>• BD-NC    - Band Alarm,               contacts are Normally Closed</li> <li>• AL-NO    - Equipment Alarm,        contacts are Normally Open</li> <li>• AL-NC    - Equipment Alarm,        contacts are Normally Closed</li> </ul> <p>Press <input type="button" value="▲"/> or <input type="button" value="▼"/> to select the type of alarm required.</p> |

|  ↓ |          |  → UNITS PARAMS INPUTS OUTPUTS <b>ALARMS</b> COMMS TM/LOG SETUP TEST END  |
|---|----------|--|
| POINT   | ALRM $n$ | <p><i>The Alarm Setpoint is available for viewing and editing for any alarm type except 'equipment alarms'.</i></p> <p>The Alarm Setpoint is the value (in engineering units of assigned variable) at which the alarm condition occurs and therefore the alarm is on.</p> <p>Each alarm is completely independent, e.g. a High alarm does NOT need to have a higher setpoint than the a Low alarm.</p>   |
| HYST  | ALRM $n$ | <p><i>The Alarm Hysteresis is available for viewing and editing for any alarm type except 'equipment alarms'.</i></p> <p>Alarm hysteresis loops occur when the alarm toggles continuously on and off when the process variable is close to the setpoint.</p> <p>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).</p> <p>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).</p> <p>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.</p> <p>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.</p> |
| 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.

| <input type="button" value="SET"/> ↓ |               | <input type="button" value="▶"/> → UNITS PARAMS INPUTS OUTPUTS ALARMS <b>COMMS</b> <small>TM/LOG SETUP TEST END</small>  |
|--------------------------------------|---------------|--|
| PROTOD                               | COM- <i>n</i> | <p>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):</p> <ul style="list-style-type: none"> <li>• <b>ASCII</b> - Simple ASCII</li> <li>• <b>RTU</b> - Modbus RTU</li> <li>• <b>PRN</b> - Printer Protocol</li> <li>• <b>NONE</b> - If a port is not being used, set the protocol to NONE.</li> </ul> <p>Printer Protocol (PRN) is only available if the option with Real Time Clock is installed.</p> <p>For the selected port, press <input type="button" value="▲"/> or <input type="button" value="▼"/> to select the desired protocol.</p> |
| BAUD                                 | COM- <i>n</i> | <p>The Baud setting is the speed of the communication port in data bits per second.</p> <p>The baud rate of the instrument must match the baud rate of the communication device that the instrument is connected to.</p> <p>Use <input type="button" value="▲"/> or <input type="button" value="▼"/> to select 2400, 4800, 9600 or 19200 baud.</p>   |
| PARI TY                              | COM- <i>n</i> | <p>The Parity bit helps to detect data corruption that might occur during transmission.</p> <p>The parity bit setting of the instrument must match the parity bit setting of the communication device that the instrument is connected to.</p> <p>Press <input type="button" value="▲"/> or <input type="button" value="▼"/> to select EVEN, ODD, or NONE.</p>   |
| S-BI TS                              | COM- <i>n</i> | <p>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.</p> <p>Press <input type="button" value="▲"/> or <input type="button" value="▼"/> to select 1 or 2 stop bits.</p>  |
| RTU                                  | DATA          | <p>The Modbus RTU data format for the 2-register (4-byte) values can be set as either floating point or long integer values.</p> <p>Use <input type="button" value="▲"/> or <input type="button" value="▼"/> to select FLOAT or INTEGER.</p>   |



| <input type="button" value="SET"/> ↓ |      | <input type="button" value="▶"/> → UNITS PARAMS INPUTS OUTPUTS ALARMS <b>COMMS</b> <small>TM/LOG SETUP TEST END</small>  |
|--------------------------------------|------|--|
| RTU                                  | ADDR | <p>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.</p> <p><b>Note:</b> The master device uses the RTU address 0 (zero) for broadcasting to all connected slave units.</p>   |
| ASCII                                | ADDR | <p>The ASCII protocol address identifies each communicating device.</p> <p>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.</p>  |
| FLASH                                | PORT | <p>The Flash Driver Port assignment defines the communication port for downloading software into the instrument.</p> <p>The default setting of this assignment is the RS-232 port. The Ethernet port, if fitted, cannot be used as the Flash port.</p> <p>Press <input type="button" value="▲"/> or <input type="button" value="▼"/> to select RS-232 (COM-1), RS-485 (COM-2) or NONE.</p> |

## 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 can store over 1000 log entries of the main-menu variables. There are 800 hourly, 400 daily, 200 weekly, 100 monthly and 30 yearly logs. The log parameters (below) for each timebase are used to determine the number of records to be included in a report print out if the printing option is used.

|  ↓ |       |  → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS <b>TM/LOG</b> SETUP TEST END   |
|---|-------|---|
| DATE  | FORM  | <p>Clock Date Format</p> <p>The European date format is: dd/mm/yyyy or (Day-Month).</p> <p>The American date format is: mm/dd/yyyy or (Month-Day).</p> <p>Press  or  to select DAY-M or M-DAY</p> |
| 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.   |
| HOUR  | LOGS  | <p>Set the number of Hourly Logs to appear on the printed log report.</p> <p>The hourly log entry occurs at 00 minutes each hour.</p>   |
| DAY   | LOGS  | <p>Set the number of Daily Logs to appear on the printed log report.</p> <p>The daily log entry occurs at 00 hours and 00 minutes each day.</p>   |
| WEEK  | LOGS  | <p>Set the number of Weekly Logs to appear on the printed log report.</p> <p>The weekly log entry occurs at 00 hours and 00 minutes each Monday.</p>  |
| MONTH   | LOGS  | <p>Set the number of Monthly Logs to appear on the printed log report.</p> <p>The monthly log entry occurs at 00 hours and 00 minutes on the first day of the month.</p>  |
| YEAR  | LOGS  | <p>Set the number of Yearly Logs to appear on the printed log report.</p> <p>The yearly log entry occurs at 00 hours and 00 minutes on the first day of the year.</p>   |

| <b>SET</b> ↓ | <b>▶</b> → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS <b>TM/LOG</b> SETUP TEST END  |
|--------------|---|
| RESET LOGS   | <p>Reset the logged data. You may need to reset (clear) the logged data if you change the time/log settings.</p> <p>Press <b>▲</b> or <b>▼</b> to select YES, then press the <b>SET</b> key. The instrument makes three beeps to confirm the reset command.</p>   |
| REPORT TYPE  | <p>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:</p> <ul style="list-style-type: none"> <li>• REP-01 Hourly Logs Report</li> <li>• REP-02 Daily Logs Report</li> <li>• REP-03 Weekly Logs Report</li> <li>• REP-04 Monthly Logs Report</li> <li>• REP-05 Yearly Logs Report</li> <li>• REP-06 Previous Day's 24 Hour Report (0Hr – 23Hr, minimum 48 hourly logs required)</li> </ul> <p>Press <b>▲</b> or <b>▼</b> to select Report Type.</p> |
| PRN TYPE     | <p>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:</p> <ul style="list-style-type: none"> <li>• PRN-01 Generic computer printer</li> <li>• PRN-02 Generic roll printer (prints first line first)</li> <li>• PRN-03 Slip printer TM295</li> <li>• PRN-04 Label (roll) printer - Citizen CMP30L</li> </ul> <p>Press <b>▲</b> or <b>▼</b> to select Printer Type.</p>   |
| PRINT ACCUM  | <p>Select whether the accumulated totals are printed in addition to the non-accumulated totals for printer protocol.</p>  |

## General Setup Parameters

| SET ↓         | ▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG <b>SETUP</b> TEST END   |
|---------------|---|
| DEFAULT VAR   | <p>Select the main menu variable to display on power up or when the display timeout period has elapsed if it is enabled.</p> <p>Press ▲ or ▼ to select the default variable display.</p>  |
| DEFAULT TOTAL | <p>The instrument displays the default Total when the user presses the <b>TOTAL</b> key.</p> <p>Press ▲ or ▼ to select the default total display.</p>   |
| SUPPLY VOLT   | <p>The instrument provides a power-limited supply for external transducers.</p> <p>Press ▲ or ▼ to set the transducer supply voltage between 8 and 24 volts DC as required.</p>   |
| T-OUT MODE    | <p>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.</p> <p>This function is useful for the following reasons:</p> <ul style="list-style-type: none"> <li>• to return the display to a preferred variable after the user has finished reading other information,</li> <li>• to cancel the calibration mode and return to the default display if the user does not exit from the calibration mode for any reason.</li> </ul> <p>Press ▲ or ▼ to select the display timeout function as follows:</p> <ul style="list-style-type: none"> <li>• <b>DISABLE</b> - Timeout is completely disabled.</li> <li>• <b>EN DISP</b> - Timeout is enabled during Normal mode and Calibration View mode.</li> <li>• <b>EN EDIT</b> - Timeout is enabled during Calibration Set mode.</li> <li>• <b>EN ALL</b> - Timeout is enabled for all modes.</li> </ul> |
| T-OUT SEC     | <p>The Display Timeout period defines the delay for the Display Timeout mode if it is enabled.</p> <p>The display timeout period can be from 10 to 99 seconds.</p>  |

| <b>SET</b> ↓     | ▶ → UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG <b>SETUP</b> TEST END   |
|------------------|---|
| RESET      MODE  | <p>The Totals Reset mode can be configured to reset the non-accumulated totals to zero.</p> <p>Press <b>▲</b> or <b>▼</b> to select the reset mode as follows:</p> <ul style="list-style-type: none"> <li>• <b>NONE</b> - The user cannot reset the non-accumulated totals.</li> <li>• <b>INSTANT</b> - When the user presses the <b>RESET</b> key, the instrument resets all non-accumulated totals.</li> <li>• <b>DELAYED</b> - When the user presses the <b>RESET</b> key and holds it for two seconds, the instrument resets all non-accumulated totals.</li> </ul>   |
| RESET      ACCUM | <p>The Reset Accumulated Totals function clears all of the accumulated totals and the non-accumulated totals.</p> <p>Press <b>▲</b> or <b>▼</b> to select YES, then press the <b>SET</b> key. The instrument makes three beeps to confirm the reset command.</p>  |
| DI SPL      TAGS | <p>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.</p> <p><b>Note:</b> The user-defined tags can be entered into the instrument only by the manufacturer or the distributor.</p> <p>Press <b>▲</b> or <b>▼</b> to select the Display Tags option as follows:</p> <ul style="list-style-type: none"> <li>• <b>DEFAULT</b> - the instrument displays the default (English) tags</li> <li>• <b>USER</b> - the instrument displays the user-defined tags.</li> </ul> |
| BACK-L    T-OUT  | <p>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.</p> <p>Press <b>▲</b> or <b>▼</b> to select ENABLE or DISABLE.</p>   |
| RATES      DP    | <p>This parameter sets the maximum number of decimal places for displaying or printing main menu rates.</p>   |
| TOTALS     DP    | <p>This parameter sets the maximum number of decimal places for displaying or printing main menu totals.</p>  |

## 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 <b>TEST</b> END   |
|--|-------|---|
| AI NP <sub>n</sub>                           | 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.   |
| LI NP <sub>n</sub>                           | STATE | You can view the state of the logic inputs. If the input is an open contact or inactive it will display <b>HI</b> . If the input is a closed contact or active it will display <b>LO</b> .  |
| OUT <sub>n</sub>                             | STATE | <p>You can control the state of the outputs. Press the ▲ or ▼ keys to set the output state as follows:</p> <ul style="list-style-type: none"> <li>• <b>PROCESS</b> - the output depends on the current values of the inputs and the calculations that the instrument performs.</li> </ul> <p>For a pulse output, such as a total, the output produces a pulse train as follows:</p> <ul style="list-style-type: none"> <li>• <b>ON</b> - a pulse train with a pulse width as set in the Outputs menu.</li> <li>• <b>OFF</b> - no output.</li> </ul> <p>For a 4-20mA output, such as a rate, the output is as follows:</p> <ul style="list-style-type: none"> <li>• <b>HI</b> - the output is set to 20mA.</li> <li>• <b>LO</b> - the output is set to 4mA.</li> </ul> |
| ALRM <sub>n</sub><br>or<br>REL- <sub>n</sub> | STATE | <p>You can control the state of the relays (alarms). Press the ▲ or ▼ keys to set the selected relay as follows:</p> <ul style="list-style-type: none"> <li>• <b>PROCESS</b> - the relay operates according to the current values of the inputs and the relay settings as programmed.</li> <li>• <b>OPEN</b> - the relay output contacts are set to “open”.</li> <li>• <b>CLOSED</b> - the relay output contacts are set to “closed”.</li> </ul>  |
| SUPPLY                                       | V     | <p>You can display the actual DC output supply voltage, which may help with troubleshooting.</p> <p>If the actual supply voltage is lower than the preset value (refer to <a href="#">General Setup Parameters</a> on page 58) it may indicate that the output is overloaded.</p>   |

## 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

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:<br>(a) input power supply voltage is within the specified range<br>(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.<br><br><b>Note:</b> The instrument can continue operating with a failed battery, but the correct time will be lost if there are interruptions to the power supply. |
| Main Flow Input Failure       | 03          | The main line flowrate transmitter (analog input 3) has failed.  |
| Process Flow Input Failure    | 04          | The process line flowrate transmitter (analog input 4) has failed.   |
| Loop Control Error            | 12          | The loop control error is detected when the loop output stays in the saturated condition longer than the programmed loop control error time. To disable this exception set the loop control error time to zero.  |

## Warning Messages

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

| <b>Warning Messages</b>        | <b>Description</b>   |
|--------------------------------|--|
| Value Has Been Set to Default  | You have entered an invalid value for a parameter. Therefore, the instrument has set the default value.  |
| Over Total Limit - Maximum Set | You have exceeded the maximum number of logging entries for the combined time bases. The instrument has set the current log setting to the remaining maximum number.   |
| 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.   |
| SP Over Limit - Maximum Set    | The control setpoint is greater than the allowed value. The instrument has set the value to the maximum limit.<br><br>Either the process flow setpoint is greater than the flow range value or the ratio setpoint in blend mode is greater than 80%. |



# 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.

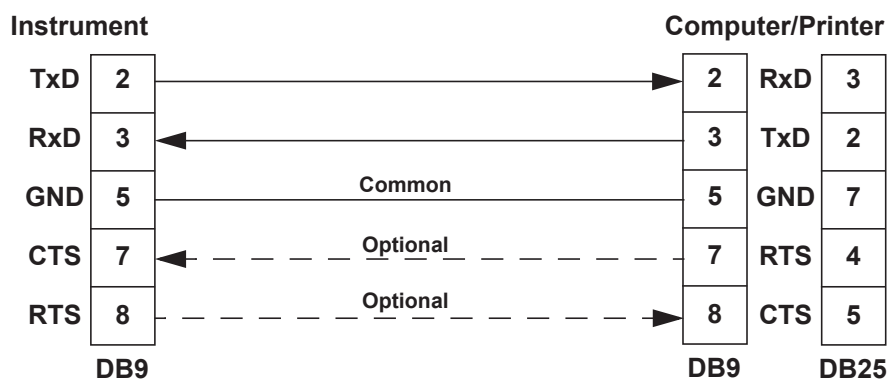


Figure 18 RS-232 Cable Connections to a Computer

**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.

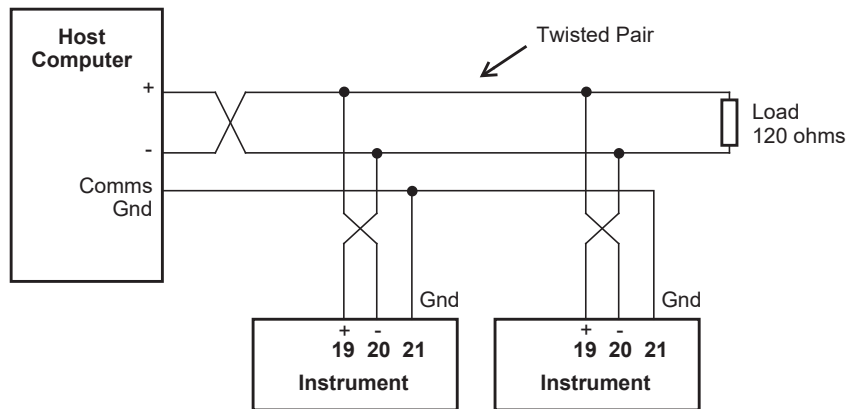


Figure 19 RS-485 Connections

### 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 88 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
- **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 53.

- **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.
- **Printer** - In the Printer protocol there is a selection of printer types. Please refer to the **Printer Protocol** on page 77 for full details.

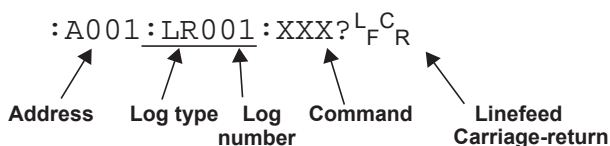
## Simple ASCII Protocol

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 53 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 timebased or event-based logs. Data can also be from the current process variables with either the accumulated or non-accumulated (resettable) totals. All logged records of the process variables contain the accumulated totals.

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. Likewise, there is only one set of current process variables with “non-accumulated totals”, therefore it also ignores any log number included in the request.

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

| <b>Log Type</b>                                  |
|--|
| LH - hourly log                                  |
| LD - daily log                                   |
| LW - weekly log                                  |
| LM - monthly log                                 |
| LY - yearly log                                  |
| LE - last edit log                               |
| 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 LH003 would return the data for the log entry two hours prior to the most recent hourly log entry. If the current time is between 9:00am and 10:00am, the most recent hourly log LH001 was recorded at 9:00. Therefore, LH002 is for 8:00 and LH003 is for 7:00. After 10:00am in this example, LH003 becomes the 8:00 log.

## Instrument Responses

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

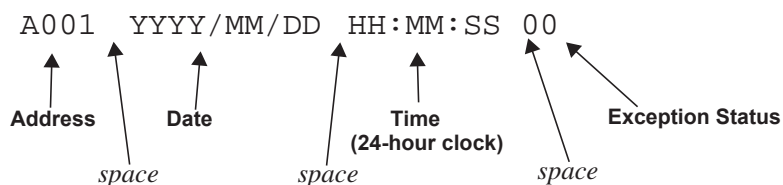
```

HEADERLFCR
DATALFCR
DATALFCR
.
.
.
DATALFCR
LFCR
    
```

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:

|                       |   |   |   |   |   |   |   |       |    |    |       |                     |    |             |    |    |    |       |                     |    |    |    |    |    |    |
|-----------------------|---|---|---|---|---|---|---|-------|----|----|-------|---------------------|----|-------------|----|----|----|-------|---------------------|----|----|----|----|----|----|
| 8 9 1 2 3 . 4 5 6     |   |   |   |   |   |   |   | M W h |    |    |       |                     |    | E N E R G Y |    |    |    |       |                     |    |    |    |    |    |    |
| 1                     | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9     | 10 | 11 | 12    | 13                  | 14 | 15          | 16 | 17 | 18 | 19    | 20                  | 22 | 23 | 24 | 25 | 26 | 27 |
| Value (aligned right) |   |   |   |   |   |   |   |       |    |    | space | Unit (aligned left) |    |             |    |    |    | space | Item (aligned left) |    |    |    |    |    |    |

**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? ...<br>: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.

```
: A 0 0 1 : R V A ? 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.

```
A 0 0 1 2 0 0 2 / 0 3 / 1 4 1 8 : 2 5 : 0 0 0 0 LF CR
      6 . 1 1 6 M W h E N E R G Y LF CR
      1 6 . 5 7 3 M W P O W E R LF CR
    1 3 2 0 . 5 3 0 m 3 V O L U M E LF CR
      5 8 . 3 0 0 m 3 / M V - F L O W LF CR
    7 6 2 7 . 1 1 7 K G M A S S LF CR
      3 4 4 . 4 6 0 K G / M M - F L O W LF CR
      2 3 0 . 0 0 0 D E G C T E M P LF CR
      1 . 2 6 0 M P A P R E S S LF CR
      0 . 1 7 4 m 3 / K G S P - V O L LF CR
    2 8 8 6 . 7 6 0 K J / K G S P - E N T LF CR
LF CR
```

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

```
: A 0 0 1 : R V D ? LF CR
```

The instrument response would be similar to the following:

```
A 0 0 1 2 0 0 2 / 0 3 / 1 4 1 8 : 2 5 : 0 0 0 0 LF CR
      1 2 6 . 4 5 5 m 3 V O L U M E LF CR
      2 0 . 4 3 7 m 3 / M V - F L O W LF CR
LF CR
```

## Log Request

The log request asks the instrument how many logs it stores in the particular timebase. These are the values described in [Time Settings and Data Logging](#) on page 55.

| Command | Description  |
|---------|--|
| :RLH?   | Return the number of hourly logs                         |
| :RLD?   | Return the number of daily logs                          |
| :RLW?   | Return the number of weekly logs                         |
| :RLM?   | Return the number of monthly logs                        |
| :RLY?   | Return the number of yearly logs                         |
| :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 hourly logs that the instrument stores:

```
: A 0 0 1 : R L H ? LF CR
```

The instrument response would be similar to the following:

```
A 0 0 1 2 0 0 2 / 0 3 / 1 4 1 8 : 2 5 : 0 0 0 0 LF CR
2 4 LF 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:

```
: A 0 0 1 : R C L ? LF CR
```

The instrument response would be similar to the following:

```
A 0 0 1 2 0 0 2 / 0 3 / 1 4 1 8 : 2 5 : 0 0 0 0 LF 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 53.

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                 | <p style="text-align: center;">Process Variables</p> <p>By default totals are the Accumulated values. If current Non-accumulated (resettable) totals are required, set register 37 to 06. All logged totals are the Accumulated values.</p> | 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       | Process Ratio              |   | R  | P         |
| 15       | Process Control Output     |   | R  | P         |
| 17       | Process Flowrate Deviation |   | R  | P         |
| 19       |                            |   | R  | P         |
| 21       |                            |   | R  | P         |
| 23       |                            |   | R  | P         |
| 25       |                            |   | R  | P         |
| 27       |                            |   | R  | P         |
| 29       |                            | R   | P  |           |
| 31       | Year                       | <p style="text-align: center;">Current Date/Time or<br/>Logged Date/Time Stamp<br/>(see register 38 Log Number).<br/>Only current Date/Time can be edited</p>   | 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<br>01 - daily<br>02 - weekly<br>03 - monthly<br>04 - yearly<br>05 - last edit of calibration<br>06 - current totals are non-accumulated values, register 38 is ignored. | R/W       |
| 38       | Log Number                 | If set to 0, current variables and Date/Time are retrieved  | R/W  | I         |
| 39       | Clear Data                 | 01 - clear logs<br>02 - clear accumulated totals<br>03 - clear non-accumulated totals   | W  | I         |
| 40       | Reserved                   |   |  | 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<br>01 = analog input 1 failure<br>02 = analog input 2 failure<br>03 = analog input 3 failure<br>04 = analog input 4 failure<br>05 = invalid calibration parameter<br>06 = invalid reference parameter<br>07 = invalid property<br>08 to 09 reserved<br>10 = process parameters out of range<br>11 = no solution for internal calculations<br>12 = error detected: control failure<br>20 = system failure<br>21 = power supply is low<br>22 = new or failed clock battery<br>23 to 29 reserved<br>30 = alarm 1 active<br>31 = alarm 2 active<br>32 = alarm 3 active<br>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<br>0 = activated; 1 = deactivated<br><br>B0 = input 1 (LSB)<br>B1 = input 2<br>B2 = input 3<br>B3 = input 4 | R                       | I         |
| 44       | Operation Mode | Representation of operation mode<br><br>0 = Idle/Local Idle state<br>1 = Inhibited Inhibited state<br>2 = Local Forced to Local when in Loop mode         | R                       | I         |
| 45       | Relay State    | 0 to 15 Binary representation of relay state<br>0 = open; 1 = closed<br><br>B0 = relay 1 (LSB)<br>B1 = relay 2<br>B2 = relay 3<br>B3 = relay 4            | R                       | I         |

| Register | Name                  | Comments  | Read Only or Read/Write | Data Type |
|----------|-----------------------|---|-------------------------|-----------|
| 46       | Relay Control         | 0 to 15 Binary representation of relay control<br>0 = open; 1 = close<br><br>B0 = relay 1 (LSB)<br>B1 = relay 2<br>B2 = relay 3<br>B3 = relay 4   | R/W                     | I         |
| 47       | Relay Control Source  | 0 to 15 Binary representation of relay control source<br>0 = Local - controlled by instrument operation<br>1 = RTU - controlled by Modbus register 46<br><br>B0 = relay 1 (LSB)<br>B1 = relay 2<br>B2 = relay 3<br>B3 = relay 4 | R/W                     | I         |
| 48 to 50 | Reserved              |   |                         | I         |
| 51 to 99 | Instrument Parameters | See next table for details.   | R/W                     | P         |
| 101      | Analog Inp.1          | Raw analog input data<br>4-20mA inputs are read in Amperes<br>0-5V or 1-5V inputs are read in Volts<br>RTD inputs are read in degrees Kelvin<br>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 45.

| Register | Name                         | Comments | Read Only or Read/Write | Data Type |
|----------|------------------------------|----------|-------------------------|-----------|
| 51       | Loop Control Output Setpoint |          | R/W                     | P         |
| 53       | Loop Flowrate Setpoint       |          | R/W                     | P         |
| 55       | Loop Ratio Setpoint          |          | R/W                     | P         |
| 57 to 99 | Reserved                     |          | R/W                     | P         |

---

## 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-01      Hourly Logs Report
- REP-02      Daily Logs Report
- REP-03      Weekly Logs Report
- REP-04      Monthly Logs Report
- REP-05      Yearly Logs Report
- REP-06      Previous Day Hourly Logs (0Hr – 23Hr, minimum 48 hourly logs required)

The number of logs printed in each report is determined by the value programmed for each timebase 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*

|                       |             |                    |   |
|-----------------------|-------------|--------------------|---|
| <i>Total Variable</i> | <i>unit</i> | <i>value</i>       | <i>&lt;Resettable total first&gt;</i>   |
| <i>Total Variable</i> | <i>unit</i> | <i>value (acc)</i> | <i>&lt;Accumulated total second&gt;</i> |
| <i>Variable</i>       | <i>unit</i> | <i>value</i>       |   |
| <i>Variable</i>       | <i>unit</i> | <i>value</i>       |   |
| <i>etc.</i>           |             |                    |   |

*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 29



## 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 in each log entry all totals are stored as the Accumulated value, the printout will not have any resettable totals. The format of the printout with this exception is the same as the LIVE DATA printout:

### *Custom Header Lines*

*Instrument Serial No. & Tag*

*Log Date & Time & Status*

|                 |             |              |   |
|-----------------|-------------|--------------|---|
| <i>Variable</i> | <i>unit</i> | <i>value</i> | <i>&lt;example: total as Accum only&gt;</i> |
| <i>Variable</i> | <i>unit</i> | <i>value</i> |   |

*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>*

*Log No. Date & Time & Status*

|                 |             |              |   |
|-----------------|-------------|--------------|---|
| <i>Variable</i> | <i>unit</i> | <i>value</i> | <i>&lt;example: total as Accum only&gt;</i> |
| <i>Variable</i> | <i>unit</i> | <i>value</i> |   |

*etc.*

----- <separation line>  
*Log No. Date & Time & Status*  
*Variable            unit    value    <example: total as Accum only>*  
*Variable            unit    value*  
*etc.*

----- <separation line>  
*Log No. Date & Time & Status*  
*Variable            unit    value    <example: total as Accum only>*  
*Variable            unit    value*  
*etc.*

*Custom Footer Lines*

----- <separation line>

Reports such as “All Hourly 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.

*Log No. Date & Time & Status*  
*Variable            unit    value    <example: total as Accum only>*  
*Variable            unit    value*  
*etc.*

----- <separation line>

*Log No.    Data Not Available*

----- <separation line>

*Log No. Date & Time & Status*  
*Variable            unit    value    <example: total as Accum only>*  
*Variable            unit    value*  
*etc.*

If the unit is programmed for 0 logs for a particular time base then the report for that time base will only consist of the header and ID information and a “Data Not Available” message. Likewise for the 0Hr to 23Hr report to print the complete report there must be a minimum of 48 hourly logs programmed otherwise “Data Not Available” will be printed for the missing logs.

*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

---

|                              |   |
|------------------------------|---|
| <b>500-PM Software</b>       | 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. |
| <b>ASCII</b>                 | 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.   |
| <b>Modbus RTU</b>            | 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.  |
| <b>Normalised Input</b>      | A normalised input ranges from 0 to 1.000. For 4-20mA input, the signal is set to 0 at 4mA and the signal is set to 1.000 at 20mA.  |
| <b>Passive Output Signal</b> | Requires an external power supply.  |
| <b>Watchdog Timer (WTD)</b>  | 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   | - CR02             |   |
| 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                  | 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<br><i>(Previous Models: A = 110/120 VAC, E = 220/240 VAC)</i>                                      |
|   | D                  | Input for 12-28VDC power only   |
| Display Panel Options   | S                  | Standard option (now with backlight & LCD backup)<br><i>(original Full option: F, with Infra-Red comms, no longer available)</i>                |
| PCB Protection  | C                  | <b>Conformal coating</b> - required for maximum environmental operating range. Recommended to avoid damage from moisture and corrosion.         |
|   | N                  | <b>None</b> - suitable for IEC standard 654-1 Climatic Conditions up to Class B2 (Heated and/or cooled enclosed locations)                      |
| Application Pack Number   | CR02               | Defines the application software to be loaded into the instrument   |
| For example: Model No. 515.111USC<br>Displayed on the 500 Series as:<br>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 -<br>515      MODEL   |

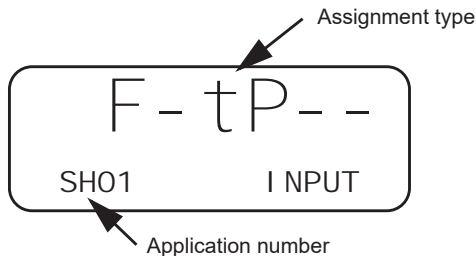
**Note:** Example full product part number is 515.111USC-CR02 (This is the number used for placing orders).

## Custom Version Codes

|  | Code |  | Description   |
|--|------|--|---|
| <b>Origin Code</b><br><b>Identifies Distributor</b>      | 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. |  |   |
| <b>User Language</b>                                     | 0    |  | English (Default)   |
|  | 1    |  | German  |
|  | 2    |  | Dutch   |
|  | 3    |  | French  |
|  | 4    |  | Spanish   |
|  | 5    |  |   |
|  | etc. |  |   |
| <b>Distributor's Code</b>                                | 000  |  | Distributor's own choice. Possibly a code that identifies the customer and the application. |
|  | ...  |  |   |
|  | 999  |  |   |
| For example: 02 3 157<br>Displayed on the 500 Series as: |      |  | 023157<br>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:

| <b>FINP1</b> | <b>FINP2</b> | <b>AINP1</b> | <b>AINP2</b> | <b>AINP3</b> | <b>AINP4</b> |
|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>X</b>     | <b>X</b>     | <b>X</b>     | <b>X</b>     | <b>X</b>     | <b>X</b>     |

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-tP-- 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.

The image shows a 'Modbus Connection Settings' dialog box with the following configuration:

- Transmission Mode:**  TCP/IP
- RTU Serial Settings:**
  - Serial Port: COM1
  - Baud Rate (bps): 19200
  - Data Bits:  8 bits
  - Parity:  Even
  - Stop Bits:  1 bit
- TCP/IP Settings:**
  - Host Name / IPv4 Address: 192.168.0.7
  - Port: 502
- Receive Timeout (sec): 2
- Maximum Retries: 2
- Slave Unit Address: 1

Buttons: OK, Cancel

*Figure 20 DataMod - Modbus Connection Settings*



# Index

---

## Numerics

0-5V input 13

4-20mA

input 13

output 15

500 Series Program Manager 4

500-PM software 4, 83

## A

ACCUM key 24

address, instrument 66

alarm

connection 17

delay 53

equipment failure 52

hysteresis 53

relays 52

setpoint 53

alarms menu 52

analog input

connections 13

scaling 2

application code 86

approvals 4

FCC Declaration 5

ASCII protocol 65

## B

back panel 10

backup

program 41

Program Manager 41

basic menu 26

battery

failed 61

life 55

new 61

battery replacement 21

battery type 21

baud rate 54

## C

CAL switch-protected parameter 37

calibration

backup, reports 41

menu 42

set mode 38

view mode 38

cleaning 9

clock

battery 55

date format 56

real-time 55

codes

application information 86

customer version 86

exception 75

product number 85

comm port

COM-1 RS-232 63

COM-2 RS-485 64

communication

connections 19

protocols 65

communications 3, 63

menu 53

connections

alarm 17

communication 63

communications 19

electrical 10

input 13

mains 20

output 15

control loop

tuning 33

control modes 30

customer version codes 86

customizing a printout 77

## D

daily logging 56

data log

viewing 27

---

data logging  
  daily 56  
  hourly 56  
  monthly 56  
  weekly 56  
  yearly 56  
date format 56  
declaration FCC 5  
decontamination 9  
default total 23  
default variable 23  
delay, alarm 53  
detail menu 26  
disconnection device 20  
display  
  specifications 7  
  timeout mode 58  
  timeout time 58  
DISPLAY key 24, 25  
display-only parameter 37

**E**  
earthing 20  
electrical connections 10  
equipment failure alarm 52  
error messages 61  
Ethernet COM-2 port 20, 64  
exception codes 75  
Exception Status 67

**F**  
features 1  
flash driver port assignment 55  
flushing 33  
format, date 56  
front panel  
  keys 24  
  LEDs 23

**G**  
glossary 83

**H**  
hardware connections 63  
hourly logging 56  
hysteresis, alarm 53

**I**  
inhibit active signal 33

inhibit process flow 33  
input  
  0-5V 13  
  4-20mA 13  
  connections 13  
    analog 13  
inputs menu 47  
installation 9  
instrument  
  address 66  
  request format 65  
  responses 67  
  settings 44  
interconnections, communication 63  
interference suppression 18  
isolated outputs 3

**K**  
key  
  ACCUM 24  
  DISPLAY 24, 25  
  RATE 24  
  RESET 24  
  TOTAL 24  
keys, front panel 24

**L**  
LEDs, status 23  
logged data 27  
  viewing 27  
logging  
  daily 56  
  hourly 56  
  monthly 56  
  weekly 56  
  yearly 56  
logic input connection 14  
logic input control 33

**M**  
main menu  
  basic and detailed 26  
main menu items 25  
mains connections 20  
maintenance 20

---

menu  
   alarms 52  
   calibration 42  
   comms 53  
   inputs 47  
   outputs 49  
   params 45  
   setup 58  
   test 60  
   tm/log 55  
   units 44

messages  
   error 61  
   system 61  
   warning 62

Modbus accessible parameters 46  
 Modbus data format 54  
 Modbus RTU protocol 71

mode  
   display timeout 58  
   normal operation 23  
   process control 30  
   set calibration 38  
   view calibration 38

model numbers 85  
 monthly logging 56  
 mounting 9

**N**

normal mode 23

number  
   model 85  
   serial 29

**O**

operation, control modes 30  
 operation, normal mode 23

output  
   connections 15  
     4-20mA 15  
     pulse 16  
   pulse factor 51

outputs menu 49

**P**

panel  
   LEDs 23  
   mounting 9  
   rear 10

parameter  
   CAL switch-protected 37  
   display-only 37  
   not visible 37  
   password-protected 37  
   programmable 37

parameters menu 45

parity bits 54

password-protected parameter 37

peak flowrates 26

port  
   assignment, flash driver 55  
   COM-1 RS-232 19, 53  
   COM-2 Ethernet 20, 64  
   COM-2 RS-485 19, 53  
   COM-3 53  
   flash driver assignment 55

power supply interruption 55

printer  
   data control 81  
   error messages 81  
   protocol 77  
   report types 77

printer types 77

printout  
   configuration report 41

printouts  
   individual logs 79  
   live data 78  
   log report 79  
   types 78

product number codes 85

Program Manager 41

programmable parameter 37

protocol  
   ASCII 65  
   communication 65  
   Modbus RTU 71  
   printer 77

pulse factor, output 51

pulse output 16

**R**

RATE key 24  
 real-time clock 55  
 rear panel 10  
 relay outputs 3  
 relays, alarm 52

---

Remote Reset 24  
RESET key 24  
responses, instrument 67  
RS-232 COM-1 port 19, 53  
RS-485 COM-2 port 19, 53  
RTU protocol 71

**S**  
scaling analog input 2  
serial number 29  
setpoint, alarm 53  
settings  
    instrument 44  
setup menu 58  
shielding 20  
snubber 18  
software configuration tool 4  
specifications 7  
standards 4  
status LEDs 23  
stop bits 54  
suppression, interference 18  
system  
    errors 61  
    messages 61  
    warnings 62

**T**  
terminal designations 11  
test menu 60  
timeout  
    mode 58  
    time 58  
tm/log menu 55  
TOTAL key 24  
total, default 23  
trim control  
    tuning 34  
tuning control loop 33  
tuning trim control 34

**U**  
unit tag 29  
units  
    menu 44  
units of measurement 3  
upload application software 41

**V**  
variable, default 23  
version, customer 86  
view data logs 27

**W**  
warnings 62  
watchdog timer (WDT) 29  
weekly logging 56  
wiring  
    insulation 12  
    mains power 12  
    relays 12

**Y**  
yearly logging 56