Model 505 Flow Computer

Operation Manual

Application FC01

Single Channel Flow Computer for Volumetric Frequency Flowmeter

8 June 2007
Model 505 Flow Computer - Operation Manual

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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.

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.

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 serial number plate. Personnel should take all due care to avoid electric shock.

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.
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Chapter 1
Introduction

Features

- Tailored for volumetric frequency flow input
- Versatile “user value” available on main menu
- Allows for non-linear correction
- Selection of second language and user tags
- RTC logging with up to 100 entries at user-specified scheduled times
- Infra-red communications port on front panel
- Pulse width and scaling of pulse output
- 4-20mA retransmission
- Selectable protocols on serial ports including Modbus RTU and Printer output
- Front panel adjustment of 8-24V DC output voltage
- Backlit display
- LCD backup

Overview

The 505 FC01 application pack is a rate totaliser for the measurement of fluid. It uses the frequency output from a volumetric flowmeter and it can accept a frequency or pulse input from a wide range of flowmeters.

The flow computer displays the flow rate, resettable total and the accumulated total in the units of measure according to the purchase order.

The instrument is compatible with a wide range of flowmeter frequency outputs, including millivolt signals, reed switches, Namur proximity switches and pulse trains via its smart front-panel program selection.

A freely programmable “user value” on the main menu can serve as a setpoint for the 4-20mA output or as an operator identifier to be logged.
Calculations

The following equations identify the derivation of some of the displayed variables. If your interest is more in the operation of the instrument, you can skip this section and allow the instrument to take care of the calculations.

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

\[
\text{volume} = \frac{\text{pulses}}{k\text{-factor}}
\]
\[
\text{volume flow} = \frac{\text{frequency}}{k\text{-factor}}
\]

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 up to 100 entries of the variables as displayed on the main menu.

Main Menu Variables

<table>
<thead>
<tr>
<th>Main Menu Variables</th>
<th>Default Units</th>
<th>Variable Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Ltr</td>
<td>Total</td>
</tr>
<tr>
<td>Volume Flowrate</td>
<td>L/min</td>
<td>Rate</td>
</tr>
<tr>
<td>User Value</td>
<td>- - -</td>
<td>Rate</td>
</tr>
</tbody>
</table>

Refer to Available Units of Measurement on page 60 for the list of available units.

Communications

There are three communication ports available as follows:

- RS-232 port (standard)
- RS-485 port (standard)
- Infra-red port (on front panel - display panel option)

The ports are available for remote data reading, printouts and for initial application loading of the instrument.
Retransmission Outputs

The instrument can re-transmit any main menu variable. The digital outputs can re-transmit totals as pulses. If the instrument has the advanced option, it outputs rates as a 4-20mA signal.

Relay Outputs

The relay alarms can be assigned to any of the main menu variables of a rate type. The alarms can be fully configured including hysteresis. Two relays are standard.

Software Configuration

The instrument can be further tailored to suit specific application needs including units of measurement, custom tags, second language or access levels. A distributor can configure these requirements before delivery.

Instrument parameters including units of measurement can be programmed in the field, according to the user access levels assigned to parameters by the distributor.

All set-up parameters, totals and logged data are stored 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 89/336/EEC and the following standards:

- Generic Immunity Standard EN 50082-1 Residential, Commercial & Light Industry Environment.
- Generic Immunity Standard EN 50082-2 Industrial Environment.

In order to comply with these standards, the wiring instructions in Chapter 3 - Installation must be followed.
# Chapter 2
## Specifications

### General

<table>
<thead>
<tr>
<th>Operating Environment</th>
<th>Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature</strong></td>
<td><strong>Frequency Input (General)</strong></td>
</tr>
<tr>
<td>0°C to +60°C (conformal coating) +5°C to +40°C (no coating)</td>
<td><strong>Range</strong> 0 to 10kHz</td>
</tr>
<tr>
<td><strong>Humidity</strong></td>
<td><strong>Overvoltage</strong> 30 V maximum</td>
</tr>
<tr>
<td>0 to 95% non condensing (conformal coating) 5% to 85% non condensing (no coating)</td>
<td><strong>Update Time</strong> 0.3 sec</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td><strong>Cutoff frequency</strong> Programmable</td>
</tr>
<tr>
<td>95...135 V AC or 190...260 V AC or 12...28 V DC</td>
<td><strong>Configuration</strong> Pulse, coil or NPS input</td>
</tr>
<tr>
<td><strong>Consumption</strong></td>
<td><strong>Non-linearity</strong> Up to 10 correction points</td>
</tr>
<tr>
<td>Typically 6W</td>
<td><strong>Pulse</strong></td>
</tr>
<tr>
<td><strong>Protection</strong></td>
<td><strong>Signal Type</strong> CMOS, TTL, open collector, reed switch</td>
</tr>
<tr>
<td>Sealed to IP65 (Nema 4X) when panel mounted</td>
<td><strong>Threshold</strong> 1.3 volts</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td><strong>Coil</strong></td>
</tr>
<tr>
<td>147mm (5.8&quot;) width</td>
<td><strong>Signal Type</strong> Turbine and sine wave</td>
</tr>
<tr>
<td>74mm (2.9&quot;) height</td>
<td><strong>Sensitivity</strong> 15mV p-p minimum</td>
</tr>
<tr>
<td>167mm (6.6&quot;) depth</td>
<td><strong>NPS</strong></td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td><strong>Signal Type</strong> NPS sensor to Namur standard</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td><strong>Configuration</strong> One input set as one of front five keys</td>
</tr>
<tr>
<td>LCD with 7-digit numeric display and 11-character alphanumeric display (backlit option)</td>
<td><strong>Remote Key Input</strong></td>
</tr>
<tr>
<td><strong>Digits</strong></td>
<td><strong>Signal Type</strong> CMOS, TTL, open collector, reed switch</td>
</tr>
<tr>
<td>15.5mm (0.6&quot;) high</td>
<td><strong>Configuration</strong> One input set as one of front five keys</td>
</tr>
<tr>
<td><strong>Characters</strong></td>
<td><strong>Outputs</strong></td>
</tr>
<tr>
<td>6mm (0.24&quot;) high</td>
<td><strong>Relay Output</strong></td>
</tr>
<tr>
<td><strong>LCD Backup</strong></td>
<td><strong>No. of Outputs</strong> 2 relays</td>
</tr>
<tr>
<td>Last data visible for 15min after power down (optional)</td>
<td><strong>Voltage</strong> 250 volts AC, 30 volts DC maximum</td>
</tr>
<tr>
<td><strong>Update Rate</strong></td>
<td><strong>Current</strong> 3A maximum</td>
</tr>
<tr>
<td>0.3 second</td>
<td><strong>Non-volatile Memory</strong></td>
</tr>
<tr>
<td><strong>Retention</strong></td>
<td>&gt; 30 years</td>
</tr>
<tr>
<td><strong>Data Stored</strong></td>
<td>Setup, Totals and Logs</td>
</tr>
</tbody>
</table>

### Approvals

<table>
<thead>
<tr>
<th><strong>Interference</strong></th>
<th><strong>Enclosure</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>CEE compliance</td>
<td>ATEX, FM, CSA and SAA approved enclosures available for hazardous areas</td>
</tr>
</tbody>
</table>

### Real Time Clock (Optional)

<table>
<thead>
<tr>
<th><strong>Battery Type</strong></th>
<th><strong>Battery Life</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>3 volts Lithium button cell (CR2032)</td>
<td>5 years (typical)</td>
</tr>
</tbody>
</table>
## Specifications

### Communication Ports

<table>
<thead>
<tr>
<th>Ports</th>
<th>RS-232 port</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RS-485 port</td>
</tr>
<tr>
<td></td>
<td>Infra-red port (optional)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Baud Rate</th>
<th>2400 to 19200 baud</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parity</td>
<td>Odd, even or none</td>
</tr>
<tr>
<td>Stop Bits</td>
<td>1 or 2</td>
</tr>
<tr>
<td>Protocols</td>
<td>Modbus RTU, Printer</td>
</tr>
</tbody>
</table>

### Transducer Supply

<table>
<thead>
<tr>
<th>Voltage</th>
<th>8 to 24 volts DC, programmable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>70mA @ 24V, 120mA @ 12V maximum</td>
</tr>
<tr>
<td>Protection</td>
<td>Power limited output</td>
</tr>
</tbody>
</table>

### Pulse/Digital Output

<table>
<thead>
<tr>
<th>Signal Type</th>
<th>Open collector, non-isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching</td>
<td>200mA, 30 volts DC maximum</td>
</tr>
<tr>
<td>Saturation</td>
<td>0.8 volts maximum</td>
</tr>
<tr>
<td>Pulse Width</td>
<td>Programmable: 10, 20, 50, 100, 200 or 500ms</td>
</tr>
</tbody>
</table>

### 4-20mA Output (Optional)

<table>
<thead>
<tr>
<th>Supply</th>
<th>24 volts DC internal, non-isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>0.05% full scale</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.05% full scale (20°C)</td>
</tr>
<tr>
<td></td>
<td>0.1% (full temperature range, typical)</td>
</tr>
</tbody>
</table>

---

*Important: Specifications are subject to change without notice.*
Chapter 3
Installation

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 139 mm wide by 67 mm 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

Figure 3 shows the connections on the rear panel of the instrument.

Figure 3 Rear Panel Connections

Terminal Designations

<table>
<thead>
<tr>
<th>Terminal Label</th>
<th>Designation</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RS485 +</td>
<td>RS485 (+)</td>
</tr>
<tr>
<td>2</td>
<td>RS485 -</td>
<td>RS485 (-)</td>
</tr>
<tr>
<td>3</td>
<td>G</td>
<td>Comms ground</td>
</tr>
<tr>
<td>4</td>
<td>RS232 Tx</td>
<td>RS232 data out</td>
</tr>
<tr>
<td>5</td>
<td>RS232 Rx</td>
<td>RS232 data in</td>
</tr>
<tr>
<td>6</td>
<td>C</td>
<td>CTS (Clear to send)</td>
</tr>
<tr>
<td>7</td>
<td>Io</td>
<td>+ 4-20mA output</td>
</tr>
<tr>
<td>8</td>
<td>SG</td>
<td>- Signal Ground 0V</td>
</tr>
<tr>
<td>9</td>
<td>Li</td>
<td>+ Logic input</td>
</tr>
<tr>
<td>10</td>
<td>D OUT</td>
<td>1+ Open collector o/p 1</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>2+ Open collector o/p 2</td>
</tr>
<tr>
<td>12</td>
<td>li</td>
<td>+ 4-20mA input</td>
</tr>
<tr>
<td>13</td>
<td>SG</td>
<td>- Signal Ground 0V</td>
</tr>
<tr>
<td>14</td>
<td>Fi</td>
<td>+ Frequency input</td>
</tr>
<tr>
<td>15</td>
<td>Vo</td>
<td>+ 8-24 volts DC output</td>
</tr>
<tr>
<td>16</td>
<td>G</td>
<td>- DC Ground</td>
</tr>
<tr>
<td>17</td>
<td>Vi</td>
<td>+ DC power input</td>
</tr>
<tr>
<td>18</td>
<td>SH</td>
<td>E Shield terminal</td>
</tr>
<tr>
<td>19</td>
<td>RELAYS R1</td>
<td>Relay 1</td>
</tr>
<tr>
<td>20</td>
<td>RELAYS RC</td>
<td>Relay Common</td>
</tr>
<tr>
<td>21</td>
<td>RELAYS R2</td>
<td>Relay 2</td>
</tr>
<tr>
<td>E</td>
<td>AC Mains E</td>
<td>Mains ground</td>
</tr>
<tr>
<td>N</td>
<td>AC Mains N</td>
<td>Mains neutral</td>
</tr>
<tr>
<td>A</td>
<td>AC Mains A</td>
<td>Mains active</td>
</tr>
<tr>
<td>RS232 port</td>
<td></td>
<td>9-pin serial port</td>
</tr>
</tbody>
</table>
Inputs

Frequency Input Connection

Connect pulse or frequency input signals from devices such as: TTL, CMOS, open collector, reed relay switch, coil and Namur proximity switch, as shown below. For better signal integrity, it is recommended to use shielded cable. Refer to Terminal Designations on page 8 for specific terminal numbers for this application.

Squarewave, CMOS or TTL

Open Collector

Reed Relay Switch

Coils - with 15 millivolts peak to peak AC minimum

Namur Proximity Switch
Logic Input Connection

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

Remote Key Input

Connect a remote push-button key to the Logic Input as shown below. Refer to REMOTE KEY on page 30 to define the function of the key.

![Logic Input Connection Diagram](image)

Outputs

The basic instrument has two pulse outputs. The advanced option also provides a 4-20mA output port.

4-20mA Output Connection

Figure 5 shows the connections for a 4-20mA output.

Maximum Load Resistance = 900 ohms

![Output 4-20mA Connection Diagram](image)
Pulse Output Connection

Figure 6 shows a connection example for a pulse output. Output channel 1 uses terminals 10 (+) and 8 (-). Output channel 2 uses terminals 11 (+) and 8 (-).

Control Relays (Alarms)

The standard instrument has two alarm relays, which can be used to drive external devices such as external relays, lamps, and audible alarms. The operation of each alarm relay can be set to various modes as described in Alarms on page 31.

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 41, 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

**Note**: Solid state relays use AC voltage only.
When driving highly inductive loads with the relay outputs, it is recommended to use RC suppression networks (often called “Snubbers”) for the following reasons:

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

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

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

Communications

The communication protocols are described in Communications on page 43.

RS-232 Port

The standard RS-232 port uses terminals 4, 5 and 6 on the rear panel.

The extra RS-232 port 9-pin DB female connector has the following pinout:
Installation

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Note: The instrument does not require a null-modem cable for connection to a personal computer. Refer to Hardware Interconnection on page 43 for cable termination requirements.

**Infra-red Port** (Display Panel Option)

The infra-red port is located at the front panel, directly below the row of status indicators. The main function of this port is for retrieving current or logged data with a PC that has an infra-red port.

**RS-485 Port**

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

<table>
<thead>
<tr>
<th>Pin 1</th>
<th>Not used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 2</td>
<td>Transmit (TxD)</td>
</tr>
<tr>
<td>Pin 3</td>
<td>Receive (RxD)</td>
</tr>
<tr>
<td>Pin 4</td>
<td>Not used</td>
</tr>
<tr>
<td>Pin 5</td>
<td>Ground</td>
</tr>
<tr>
<td>Pin 6</td>
<td>Not used</td>
</tr>
<tr>
<td>Pin 7</td>
<td>Handshake line (CTS)</td>
</tr>
<tr>
<td>Pin 8</td>
<td>RTS Out</td>
</tr>
<tr>
<td>Pin 9</td>
<td>Not used</td>
</tr>
</tbody>
</table>

*Figure 8  RS-485 Interface Connections*
Earthing and Shielding

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.
Chapter 4
Operation

Normal Operation

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

• Totals
• Rates
• Process variables
• Instrument settings

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

<table>
<thead>
<tr>
<th>Total</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Volume Flowrate</td>
</tr>
</tbody>
</table>

Default Total

In some applications, one set of variables is of more interest than others, and for this reason a default total and its associated rate can be assigned during instrument calibration. This default total can be used in two ways:

• The default variables come first in the sequence of totals and rates that are displayed with the front panel keys.
• If the display timeout option is enabled and no buttons are pressed for the selected period (usually 30 seconds) the display returns to the default total.

Status Lamps

The status lamps illuminate to show the following conditions:

- **Run** The host computer is downloading the application software.
- **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 all resettable 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 four reset 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.
- **CAPTURE** - When the user presses the **RESET** key, the instrument resets all non-accumulated totals, with the last value being displayed for 15 seconds. Totalising is maintained in the background while the captured value is held on the display.

The instrument makes 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.

### 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.

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th><strong>Options</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VOLUME</strong></td>
<td>Hold the <strong>ACCUM</strong> key to display accumulated total</td>
</tr>
<tr>
<td><strong>FLOW</strong></td>
<td>Hold the <strong>ACCUM</strong> key to display peak value</td>
</tr>
</tbody>
</table>
**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.

**User Value**

Hold the **SET** key to edit the current User Value while viewing the User Value in the main menu. The display of the User Value will change from view mode to edit mode after 2 seconds if access has been enabled in calibration. Once in edit mode the **Set** indicator will illuminate and the User Value is changed in exactly the same way as in calibration set mode.

The User Value can be used in a range of ways. The value (as any other main menu variable) is logged and can be freely assigned to outputs or alarms. It can be entered in the range of 0 to 999999.9. Some examples of uses for the User Value are as an Operator Identifier or a Control Setpoint.

**Data Logs**

The instrument will log the main-menu variables if real-time clock option is installed. The logs are at fixed intervals which can be programmed to a combination of hours, days, weeks, months and years. The instrument can store a total of 100 log entries.
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. Also note that the totals are saved as accumulated totals.

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 2002. The day and month alternate with the year in the bottom right hand corner.

![Log entry example](image)

Figure 9 shows how to display the logged data.

![Logged Data Display Methods](image)
Model Information

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

<table>
<thead>
<tr>
<th>DISPLAY</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 1 - F - 505 MODEL</td>
<td>The hardware model code. Refer to Product Codes on page 57 for more information.</td>
</tr>
<tr>
<td>FC01 INPUT</td>
<td>The Application number and the assignment of the inputs. Refer to Application Information Code on page 58 for more information.</td>
</tr>
<tr>
<td>0 1 0 1.002 FC01 VERS</td>
<td>The version of software loaded into the instrument.</td>
</tr>
<tr>
<td>0 2 6 3 5 7 CUSTOM VERS</td>
<td>The Customer version code for this installation. Refer to Custom Version Codes on page 58 for more information.</td>
</tr>
<tr>
<td>1 2 3 4 5 6 ABC123 S/N</td>
<td>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. If the unit tag is not used the default tag, UNIT, will be used.</td>
</tr>
<tr>
<td>1 6 - 1 5 EDITED 27/08 2002</td>
<td>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 2002. This function is available only if the instrument has the real time clock option.</td>
</tr>
</tbody>
</table>

Press SET at any time to exit from the Model information.
Chapter 5
Instrument Calibration

Introduction

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.

**Note:** When you enter Calibration Set mode, the instrument requests you to enter a password. Any value will allow to change the settings of the “programmable” parameters, but the correct password must be entered to change the password-protected parameters.

Calibration View Mode

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


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.
   - Press [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.

Use the following procedure to enter Calibration Set mode:

1. Press \[ \text{DISPLAY} \] to scroll to the \[ \text{CAL MENU} \] prompt.
2. Hold the \[ \text{SET} \] key.
   
   The instrument beeps once, illuminates the \textbf{Cal} indicator and shows \textbf{CAL} on the display panel.
3. Press \[ \text{ } \rightarrow \text{ } \] to select any flashing menu heading except \textbf{END}.
4. Hold \[ \text{SET} \] for two seconds.
   
   The instrument requests a password.
5. Press \[ \text{▲} \] or \[ \text{▼} \] to change the value of the current digit. To select the next digit, press \[ \text{ } \rightarrow \text{ } \].
6. Press \[ \text{SET} \] to accept the password.
   
   • The instrument makes two beeps for a correct password entry and enables you to change the “programmable” and “password-protected” parameters.
   
   • The instrument makes one beep for an incorrect password entry and enables you to change only the “programmable” parameters.
   
   The instrument illuminates both the \textbf{Cal} and \textbf{Set} indicators.
7. Edit the instrument parameters as required. The programmable values are indicated by the flashing display.
   
   • To change a numerical value, press \[ \text{▲} \] to increase a value, or press \[ \text{▼} \] 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 \[ \text{ } \rightarrow \text{ } \].
   
   • To change an option setting, press \[ \text{▲} \] or \[ \text{▼} \] to scroll through the options.
8. Press \[ \text{SET} \] to accept the currently displayed value and proceed to the next parameter. You can press \[ \text{DISPLAY} \] to return to the main calibration menu.
9. To exit from Calibrate Set mode, press \[ \text{ } \rightarrow \text{ } \] to scroll through the main calibration menu to \textbf{END}, then press \[ \text{SET} \]. Otherwise, from any menu, you can press and hold \[ \text{SET} \] for two seconds.
   
   The instrument makes two beeps and cancels the \textbf{Cal} and \textbf{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.

![Option Choices](image)

Changing Numeric Settings

The display flashes the digit that can be changed.

![Numeric Flashing Digit](image)

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 calibration below.
Calibration Menu Tree

Figure 10 and Figure 11 show the keys for moving around the calibration menu tree in Calibration View or Set mode.

Figure 10  Calibration Menu Tree Sheet 1
The shaded boxes indicate advanced options.

Press \textbf{DISPLAY} at any point to return to the main calibration menu.

Press \textbf{ } at any I/O assignment position to move to the next I/O assignment in the submenu (eg pressing \textbf{ } on ALRM1 will move you to ALRM2)

\textit{Figure 11 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.

The units for main menu or calibration items can be viewed by pressing the \( \text{SET} \) key.

The units of measurement are password protected. To edit the units the correct password must be entered on entry to EDIT mode.

Press \( \text{UP} \) or \( \text{DOWN} \) to select the required units. Refer to Available Units of Measurement on page 60 for the list of available units.

### Table: Units of Measurement

<table>
<thead>
<tr>
<th>ITEM ( n )</th>
<th>unit</th>
<th>The units for main menu or calibration items can be viewed by pressing the ( \text{SET} ) key.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCEPT UNITS</td>
<td></td>
<td>The Accept Units prompt will only appear if one or more of the units have been changed.</td>
</tr>
</tbody>
</table>

**IMPORTANT:** Accepting the change of units will initiate a master reset. All calibration parameters will revert to their default value (i.e. those values included in the downloaded instrument software). All totals and any logged information will be cleared.

Press \( \text{UP} \) or \( \text{DOWN} \) to select YES, then press the \( \text{SET} \) key. The instrument makes three beeps to confirm the reset command.

The message -RESET- PLEASE WAIT will be displayed as the instrument exits calibration mode and completes a full re-boot sequence.
Parameters

<table>
<thead>
<tr>
<th>SET</th>
<th>➤</th>
<th>PARAMS</th>
<th>INPUTS</th>
<th>OUTPUTS</th>
<th>ALARMS</th>
<th>COMMS</th>
<th>TM/LOG</th>
<th>SETUP</th>
<th>TEST</th>
<th>END</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIRECT ACCESS</td>
<td>If the direct access is enabled then the operator is able to enter edit mode for the User Value directly from the main menu by holding the SET key while viewing the parameter. If disabled the parameter can only be changed from within calibration set mode (or via serial communications, see below). Select the direct access mode as required. Press ▲ or ▼ to select ENABLE or DISABLE.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Modbus Accessible Parameters

The following PARAMS menu item is also accessible via Modbus communications. For Modbus register listing, refer to .

| USER VALUE | Enter the User Value as required. This parameter can accept a value in the range 0 to 999999.9 |

Inputs

<table>
<thead>
<tr>
<th>SET</th>
<th>➤</th>
<th>UNITS</th>
<th>PARAMS</th>
<th>INPUTS</th>
<th>OUTPUTS</th>
<th>ALARMS</th>
<th>COMMS</th>
<th>TM/LOG</th>
<th>SETUP</th>
<th>TEST</th>
<th>END</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Input</td>
<td>For this application, the Frequency Input is assigned to volume flowrate.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INPUT</td>
<td>FLOW</td>
<td>FINP</td>
<td>Frequency input signal type. Press ▲ or ▼ to select COIL, NPS or PULSE.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIGNAL</td>
<td>FINP</td>
<td>Switches and relays have metal contacts to make and break circuits. The contact bounce introduces random signals into the circuit. The instrument has a debounce circuit to eliminate this problem.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DBNCE</td>
<td>FINP</td>
<td><strong>Note:</strong> When the debounce circuit is enabled, the maximum input frequency for large amplitude signals is limited to approximately 500Hz. For low amplitude signals, the maximum frequency can be approximately 200Hz. Press ▲ or ▼ to select ENABLE or DISABLE.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Cut-off is the lowest frequency for which the instrument continues to calculate a rate from the flowmeter.

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

Be careful when setting low cut-off values because the display update time for the flow rate becomes very long. For example if the cut-off is set to 0.01 Hz, and the measured flow stops, the instrument continues to display the flow rate for 100 seconds before it can determine that the flow has actually stopped.

Input fluctuations caused by pulsating flow tend to create distortion in the input readings of the rate. The instrument has a digital filter that averages out these fluctuations.

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

The value A is the filter constant that the user can set.

<table>
<thead>
<tr>
<th>Filter setting A</th>
<th>Seconds to reach 90% of full swing</th>
<th>Seconds to reach 99% of full swing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>15</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>20</td>
<td>14</td>
<td>27</td>
</tr>
<tr>
<td>25</td>
<td>18</td>
<td>34</td>
</tr>
<tr>
<td>35</td>
<td>25</td>
<td>48</td>
</tr>
<tr>
<td>45</td>
<td>32</td>
<td>62</td>
</tr>
<tr>
<td>60</td>
<td>42</td>
<td>82</td>
</tr>
<tr>
<td>75</td>
<td>52</td>
<td>102</td>
</tr>
<tr>
<td>90</td>
<td>62</td>
<td>122</td>
</tr>
<tr>
<td>99</td>
<td>68</td>
<td>134</td>
</tr>
</tbody>
</table>

The input filter range is from 0 to 99. A setting of 0 (zero) means that there is no filtering.

If the input sensor has non-linear characteristics, select NON-LINEAR to apply correction factors to the input signal.

Use ▲ or ▼ to select LINEAR or NON-LINEAR.
**KFACT unit**  
This parameter is available for viewing and editing only when the correction type is set to Linear.

The K-factor of the flowmeter is the number of pulses from the flowmeter per unit of volume (or mass). The K-factor cannot be 0 (zero).

**NO-PTS FINP**  
This parameter is available for viewing and editing only when the correction type is set to Non-linear.

Enter the number of non-linearity correction points.

Press ▲ or ▼ to select a number between 1 and 10 for the number of correction points.

**FREQ01 to FREQ0n FINP**  
This parameter is available for viewing and editing only when the correction type is set to Non-linear.

Enter the frequency for this correction point.

The instrument uses linear interpolation between the correction points except that the correction factor for FREQ01 is used from 0Hz up to FREQ01. Similarly, the instrument maintains the correction factor for the highest frequency setting up to the maximum input frequency.

The following diagram shows the scaling factors at different frequencies for a hypothetical flowmeter. The heavy black line represents the actual scaling factor of the flowmeter. The light black line is the approximation that the instrument uses.

![Diagram showing scaling factors at different frequencies](image)

Enter the lowest correction factor frequency as FREQ01 and proceed up to the highest frequency. You can press the DISPLAY key to skip the non-linear points and go to the next item.
### Outputs

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLUME</td>
<td>You can assign any of the “total” main menu variables to a pulse output.</td>
</tr>
<tr>
<td>WIDTH</td>
<td>Pulse output is usually used to drive remote counters. Set the pulse width</td>
</tr>
<tr>
<td>PULSE</td>
<td>The Output Pulse Factor is the scaling factor for the retransmission of the</td>
</tr>
<tr>
<td>V-FLOW</td>
<td>You can assign any of the “rate” main menu variables to the 4-20mA output.</td>
</tr>
</tbody>
</table>

**Fact01 FINP to Factn**

*This parameter is available for viewing and editing only when the correction type is set to Non-linear.*

Enter the scaling factor for this correction point.

The correction factor cannot be 0 (zero).

**REMOTE KEY**

You can assign the remote key input to duplicate any one of the key switches on the front panel.

Press ▲ or ▼ to select NO-1 through NO-5 as the key on the front panel (from left to right) that is set as the remote key input. Select NONE to disable the remote key function.

**VOLUME OUT**

You can assign any of the “total” main menu variables to a pulse output.

Press ▲ or ▼ to select the variable that is required as an output.

**WIDTH OUT**

Pulse output is usually used to drive remote counters. Set the pulse width (in milliseconds) as required by the remote counter.

Press ▲ or ▼ to set to: 10, 20, 50, 100, 200 or 500ms.

**PULSE OUT**

The Output Pulse Factor is the scaling factor for the retransmission of the measured total quantity.

For example, if “volume” is chosen as an output variable and engineering unit is cubic metres, then a pulse factor of 1.000 generates one pulse for 1 m³. Similarly, a pulse factor of 3.000 generates one pulse for 3 m³.

For more information, see **Output Pulse Factor** on page 31.

The output pulse factor cannot be 0 (zero).

**V-FLOW A-OUT**

You can assign any of the “rate” main menu variables to the 4-20mA output.

Press ▲ or ▼ to select the variable that is required as an output.
Output Pulse Factor

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

The maximum pulse output frequency is determined by:

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

The minimum pulse factor required is determined by:

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

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

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

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

Alarms

The alarm relay(s) can be assigned to rate variables such as volume flowrate, 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 41, or if there is a loss of power to the instrument.

<table>
<thead>
<tr>
<th>RELAY</th>
<th>ALRM&lt;sub&gt;n&lt;/sub&gt;</th>
<th>Select a rate variable to assign to the alarm relay.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Note:</strong> If the alarm type is set to “equipment alarm”, this relay assignment setting is ignored.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press  &lt;sup&gt;▲&lt;/sup&gt; or  &lt;sup&gt;▼&lt;/sup&gt; to select the variable that is required as an alarm.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TYPE</td>
<td>ALRM&lt;sub&gt;n&lt;/sub&gt;</td>
<td>The options available for alarm types are as follows:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• HI-NO — High Alarm, Normally Open contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• HI-NC — High Alarm, Normally Closed contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• LO-NO — Low Alarm, Normally Open contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• LO-NC — Low Alarm, Normally Closed contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• BD-NO — Band Alarm, Normally Open contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• BD-NC — Band Alarm, Normally Closed contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• AL-NO — Equipment Alarm, Normally Open contacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• AL-NC — Equipment Alarm, Normally Closed contacts</td>
</tr>
<tr>
<td>Press  &lt;sup&gt;▲&lt;/sup&gt; or  &lt;sup&gt;▼&lt;/sup&gt; to select the type of alarm required.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| POINT  | ALRM<sub>n</sub> | The Alarm Setpoint is available for viewing and editing for any alarm type except ‘equipment alarms’. |
|        |                 | The Alarm Setpoint is the value (in engineering units of assigned variable) at which the alarm condition occurs and therefore the alarm is on. |
|        |                 | Each alarm is completely independent, e.g. a High alarm does NOT need to have a higher setpoint than the a Low alarm. |
## Instrument Calibration

### Communications

The instrument has three communication ports:

- **RS-232 Port** - Three terminals on the rear of the instrument. There is also an optional 9-pin female connector on the rear panel of the instrument.
- **Infra-red Port** - (Display panel option only) Located on the front panel, below the status indicators.
- **RS-485 Port** - Terminals on the rear panel.

### Alarm Hysteresis

The Alarm Hysteresis is available for viewing and editing for any alarm type except ‘equipment alarms’.

Alarm hysteresis loops occur when the alarm toggles continuously on and off when the process variable is close to the setpoint.

For a high alarm, the alarm activates when the value of the variable rises above the alarm setpoint and deactivates when the value falls below the alarm setpoint minus the amount of the hysteresis setting (if any).

For a low alarm, the alarm activates when the value of the variable falls below the alarm setpoint and deactivates when the value rises above the alarm setpoint plus the amount of the hysteresis setting (if any).

For a band alarm, the alarm activates whenever the value of the variable is outside the setpoint plus or minus the amount of the hysteresis.

For example, with a high alarm setpoint of 200, and a hysteresis setting of zero, a value oscillating between 197 and 202 will cause the alarm to toggle on at 200 and toggle off below 200. However, if the hysteresis is set to 5, the value of the variable must fall below 195 to cancel the alarm. The alarm will reactivate only when the value again rises above 200.
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):

- **RTU** - Modbus RTU available for all ports
- **PRN** - Printer Protocol available for RS232 and RS485
- **NONE** - If a port is not being used, set the protocol to NONE.

Printer Protocol (PRN) is only available if the option with Real Time Clock is installed.

For the selected port, press ▲ or ▼ to select the desired protocol.

The Baud setting is the speed of the communication port in data bits per second.

The baud rate of the instrument must match the baud rate of the communication device that the instrument is connected to.

Use ▲ or ▼ to select 2400, 4800, 9600 or 19200 baud.

The Parity bit helps to detect data corruption that might occur during transmission.

The parity bit setting of the instrument must match the parity bit setting of the communication device that the instrument is connected to.

Press ▲ or ▼ to select EVEN, ODD, or NONE.

The Stop bit indicates the end of a transmission. Stop bits can be 1 or 2 bit periods in length. The stop bit setting of the instrument must match the stop bit setting of the communication device that the instrument is connected to.

Press ▲ or ▼ to select 1 or 2 stop bits.

The Modbus RTU data format for the 2-register (4-byte) values can be set as either floating point or long integer values.

Use ▲ or ▼ to select FLOAT or INTEGER.
### Time Settings and Data Logging

#### Instrument Clock

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

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

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

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

#### Data Logging

The instrument will log the main-menu variables if real-time clock option is installed. The logs are at fixed intervals which can be programmed to a combination of hours, days, weeks, months and years. The instrument can store a total of 100 log entries. For example, you can specify 40 hourly logs, 30 daily logs, 15 weekly logs, 10 monthly logs and 5 yearly logs.

---

| RTU ADDR | The Modbus RTU protocol address must be in the range of 1 to 247. When multiple instruments (slaves) are connected to one communication device (master), each assigned address must be unique.
| Flash Port | The Flash Driver Port assignment defines the communication port for downloading software into the instrument. The default setting of this assignment is the RS-232 port. Press ▲ or ▼ to select RS-232, RS-485, or INFRA. |
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 parameters (below) for each timebase also determine the number of records to be included in a report print out if the printing option is used.

<table>
<thead>
<tr>
<th>MODE</th>
<th>UNITS</th>
<th>PARAMS</th>
<th>INPUTS</th>
<th>OUTPUTS</th>
<th>ALARMS</th>
<th>COMMS</th>
<th>TM/LOG</th>
<th>SETUP</th>
<th>TEST</th>
<th>END</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE</td>
<td>FORM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Clock Date Format

The European date format is: dd/mm/yyyy or (Day-Month).

The American date format is: mm/dd/yyyy or (Month-Day).

Press ↑ or ↓ to select DAY-M or M-DAY

Clock Year

The Clock Year defines the current year for the real-time clock.

Clock M-DAY

The Clock M-DAY setting defines the current month and date for the real-time clock. This parameter is programmed in Month-Day format for both European and American date formats.

Clock H-MIN

The Clock H-MIN setting is the current time in hours and minutes for the real-time clock.

Hours Logs

Set the number of Hourly Logs to be recorded and to appear on the printed log report.

The hourly log entry occurs at 00 minutes each hour.

Days Logs

Set the number of Daily Logs to be recorded and to appear on the printed log report.

The daily log entry occurs at 00 hours and 00 minutes each day.

Weeks Logs

Set the number of Weekly Logs to be recorded and to appear on the printed log report.

The weekly log entry occurs at 00 hours and 00 minutes each Monday.

Months Logs

Set the number of Monthly Logs to be recorded and to appear on the printed log report.

The monthly log entry occurs at 00 hours and 00 minutes on the first day of the month.
<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEAR LOGS</td>
<td>Set the number of Yearly Logs to be recorded and to appear on the printed log report. The yearly log entry occurs at 00 hours and 00 minutes on the first day of the year.</td>
</tr>
<tr>
<td>RESET LOGS</td>
<td>Reset the logged data. You may need to reset (clear) the logged data if you change the time/log settings. Press ▲ or ▼ to select YES, then press the SET key. The instrument makes three beeps to confirm the reset command.</td>
</tr>
</tbody>
</table>
| REPORT TYPE | The Printer Protocol Report Type determines the nature of the printout from the REPORT PRINT - HOLD.SET prompt in the main menu. The following report types available in this instrument are:  
- REP-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’s 24 Hour Report (0Hr – 23Hr, minimum 48 hourly logs required)  
Press ▲ or ▼ to select Report Type. |
| PRN TYPE | The Printer Protocol Printer Type allows the nature of the printer being used to be specified. The following printer types available in this instrument are:  
- PRN-01 Generic computer printer  
- PRN-02 Generic roll printer (prints first line first)  
- PRN-03 Slip printer TM295  
Press ▲ or ▼ to select Printer Type. |
| PRINT ACCUM | Select whether the accumulated totals are printed in addition to the non-accumulated totals for printer protocol. |
## General Setup Parameters

<table>
<thead>
<tr>
<th>SET ↓</th>
<th>UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END</th>
</tr>
</thead>
</table>
| **DEFAULT TOTAL** | The instrument displays the default Total when the user presses the TOTAL key.  
If the display timeout is enabled, the instrument displays the default Total when there is no user action for the period of the display timeout period.  
Press ▲ or ▼ to select the default total display. |
| **SUPPLY VOLT** | The instrument provides a power-limited supply for external transducers.  
Press ▲ or ▼ to set the transducer supply voltage between 8 and 24 volts DC as required. |
| **T-OUT MODE** | If the Display Timeout mode is enabled, and there is no user activity for the defined timeout period, the display panel returns to the default display.  
This function is useful for the following reasons:  
• to return the display to a preferred variable after the user has finished reading other information,  
• to cancel the calibration mode and return to the default display if the user does not exit from the calibration mode for any reason.  
Press ▲ or ▼ to select the display timeout function as follows:  
• **DISABLE** - Timeout is completely disabled.  
• **EN DISP** - Timeout is enabled during Normal mode and Calibration View mode.  
• **EN EDIT** - Timeout is enabled during Calibration Set mode.  
• **EN ALL** - Timeout is enabled for all modes. |
| **T-OUT SEC** | The Display Timeout period defines the delay for the Display Timeout mode if it is enabled.  
The display timeout period can be from 10 to 99 seconds. |
RESET MODE

The Totals Reset mode can be configured to reset the non-accumulated totals to zero.

Press ▲ or ▼ to select the reset mode as follows:

- NONE - The user cannot reset the non-accumulated totals.
- INSTANT - When the user presses the \textbf{RESET} key, the instrument resets all non-accumulated totals.
- DELAYED - When the user presses the \textbf{RESET} key and holds it for two seconds, the instrument resets all non-accumulated totals.
- CAPTURE - When the user presses the \textbf{RESET} key, the instrument resets all non-accumulated totals, with the last value being displayed for 15 seconds. Totalising is maintained in the background while the captured value is held on the display.

RESET ACCUM

The Reset Accumulated Totals function clears all of the accumulated totals and the non-accumulated totals.

Press ▲ or ▼ to select YES, then press the \textbf{SET} key. The instrument makes three beeps to confirm the reset command.

DISPL TAGS

The Display Tags option determines whether the instrument displays the default display tags or the user-defined tags. The display tag setting also defines whether the instrument displays the default error and warning messages, or the user-defined messages.

\textbf{Note:} The user-defined tags can be entered into the instrument only by the manufacturer or the distributor.

Press ▲ or ▼ to select the Display Tags option as follows:

- DEFAULT - the instrument displays the default (English) tags
- USER - the instrument displays the user-defined tags.

BACK-L T-OUT

If the backlight timeout is enabled, and there is no user activity (any keys pressed) for a period of 10 seconds, the display backlight switches off to save power. The backlight switches on when a key is pressed. Select the backlight timeout mode as required.

Press ▲ or ▼ to select ENABLE or DISABLE.

RATES DP

This parameter sets the maximum number of decimal places for displaying or printing main menu rates.

TOTALS DP

This parameter sets the maximum number of decimal places for displaying or printing main menu totals.
Test Menu

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

In Calibration Set mode, (by entering the system password) you can control the outputs and the alarms as described in the table below.

<table>
<thead>
<tr>
<th>SET ↓</th>
<th>UNITS PARAMS INPUTS OUTPUTS ALARMS COMMS TM/LOG SETUP TEST END</th>
</tr>
</thead>
<tbody>
<tr>
<td>FINP</td>
<td>Hz</td>
</tr>
<tr>
<td>RINP</td>
<td>mA</td>
</tr>
<tr>
<td>LINP$n$ STATE</td>
<td>You can view the state of the logic input. If the input is an open contact or inactive it will display HI. If the input is a closed contact or active it will display LO.</td>
</tr>
</tbody>
</table>
| OUT$n$ STATE | You can control the state of the outputs. Press the ▲ or ▼ keys to set the output state as follows:  
  • PROCESS - the output depends on the current values of the inputs and the calculations that the instrument performs.  
  • ON - the output is a pulse train with a pulse width as set for the particular output in the Outputs menu.  
  • OFF - no output. |
| A-OUT STATE | You can control the state of the outputs. Press the ▲ or ▼ keys to set the output state as follows:  
  • PROCESS - the output depends on the current values of the inputs and the calculations that the instrument performs.  
  • HI - the output is set to 20mA.  
  • LO - the output is set to 4mA. |
| ALRM$n$ STATE or REL-$n$ | You can control the state of the relays (alarms). Press the ▲ or ▼ keys to set the selected relay as follows:  
  • PROCESS - the relay operates according to the current values of the inputs and the relay settings as programmed.  
  • OPEN - the relay output contacts are set to “open”.  
  • CLOSED - the relay output contacts are set to “closed”. |
| SUPPLY | V               |

You can display the actual DC output supply voltage, which may help with troubleshooting.

If the actual supply voltage is lower than the preset value (refer to General Setup Parameters on page 38) it may indicate that the output is overloaded.
System Messages

The instrument displays messages for defined events and fault conditions.

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

Error Messages

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

<table>
<thead>
<tr>
<th>Error Messages</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Card Failure</td>
<td>There are failed components on the CPU card and technical support is required.</td>
</tr>
<tr>
<td>Power Supply is Low</td>
<td>The input and/or output power supply voltage is too low, ensure that: (a) input power supply voltage is within the specified range</td>
</tr>
<tr>
<td></td>
<td>(b) output power supply is not overloaded.</td>
</tr>
<tr>
<td>New/Failed Battery - Set Time</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td>TM/LOG menu) to clear the error message and to continue data logging at the correct times.</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> The instrument can continue operating with a failed battery, but the correct time will be lost if there are interruptions to the</td>
</tr>
<tr>
<td></td>
<td>power supply.</td>
</tr>
<tr>
<td>Value Has Been Set to Default</td>
<td>You have entered an invalid value for a parameter. Therefore, the instrument has set the default value.</td>
</tr>
<tr>
<td>Over Total Limit - Maximum Set</td>
<td>You have exceeded the maximum number of logging entries for the combined time bases. The instrument has set the current log setting to</td>
</tr>
<tr>
<td></td>
<td>the remaining maximum number.</td>
</tr>
<tr>
<td>Already Assigned to Other Port</td>
<td>You have tried to assign a particular protocol type to more than one serial communication port. The instrument has set the protocol to</td>
</tr>
<tr>
<td></td>
<td>NONE.</td>
</tr>
</tbody>
</table>

Warning Messages

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

<table>
<thead>
<tr>
<th>Warning Messages</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Has Been Set to Default</td>
<td>You have entered an invalid value for a parameter. Therefore, the instrument has set the default value.</td>
</tr>
<tr>
<td>Over Total Limit - Maximum Set</td>
<td>You have exceeded the maximum number of logging entries for the combined time bases. The instrument has set the current log setting to</td>
</tr>
<tr>
<td></td>
<td>the remaining maximum number.</td>
</tr>
<tr>
<td>Already Assigned to Other Port</td>
<td>You have tried to assign a particular protocol type to more than one serial communication port. The instrument has set the protocol to</td>
</tr>
<tr>
<td></td>
<td>NONE.</td>
</tr>
</tbody>
</table>
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 three communication ports:
• RS-232 port on the rear panel (plus extra DB9 female connector)
• RS-485 port on the rear panel
• Infra-red port on the front panel (display panel option only)

The appropriate interface and protocols are selected during calibration.

RS-232 Port

The 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 12.
**Communications**

Figure 12 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.

**RS-485 Port**

The 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 13. Up to 32 units can be connected to the interface at a maximum distance of 1200 metres.

Figure 13 RS-485 Connections
Infra-red Port

The infra-red port is located on the front panel of the instrument. The infra-red port uses the Infra-red Developers Association (IrDA) physical layer format of signal encoding and decoding.

The nature of the infra-red port requires the communicating device to be located close to the front of the instrument. Therefore, its main use would probably be for reloading the instrument application software, or occasional collection of data, rather than continuous communications.

Protocols

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

- **RTU** - Modbus RTU available for all ports
- **PRN** - Printer Protocol available for RS232 and RS485
- **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 33.

- **Modbus RTU** - Modbus RTU is an industry-standard protocol which allows the instrument to be easily connected to computers running supervisory software systems.
- **Printer** - In the Printer protocol there is a selection of printer types. Please refer to the Printer Protocol on page 52 for full details.
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.


**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:

<table>
<thead>
<tr>
<th>Address</th>
<th>Function</th>
<th>Data</th>
<th>CRC Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 byte</td>
<td>1 byte</td>
<td>n bytes</td>
<td>2 bytes</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>Read data register(s)</td>
<td>Obtain the content of one or more 2-byte data registers.</td>
</tr>
<tr>
<td>06</td>
<td>Preset data register</td>
<td>Preset one 2-byte data register.</td>
</tr>
<tr>
<td>07</td>
<td>Read status register</td>
<td>Obtain the content of 1-byte status register.</td>
</tr>
<tr>
<td>16</td>
<td>Preset data register(s)</td>
<td>Preset one or more 2-byte data registers.</td>
</tr>
</tbody>
</table>

**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:

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

**List of Data Registers**

The following list describes the addresses and meaning of the data registers in the instrument. The data values are expressed in the engineering units that were selected for the variables when the instrument settings were configured. The “Data Type” for the 2-register (4-byte) data values can be set in programming mode as Floating Point or Long Integer as described in the Communications section on page 33.

The registers are grouped in blocks that relate to a particular function of the instrument.

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

<table>
<thead>
<tr>
<th>Register</th>
<th>Name</th>
<th>Comments</th>
<th>Read Only or Read/Write</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Volume</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>3</td>
<td>Volume Flowrate</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>5</td>
<td>User Value</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>9</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>11</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>13</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>15</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>17</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>19</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>21</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>23</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>25</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>27</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>29</td>
<td>Reserved</td>
<td></td>
<td>R</td>
<td>DT</td>
</tr>
<tr>
<td>31</td>
<td>Year</td>
<td></td>
<td>R/W</td>
<td>I</td>
</tr>
<tr>
<td>32</td>
<td>Month</td>
<td></td>
<td>R/W</td>
<td>I</td>
</tr>
<tr>
<td>33</td>
<td>Date</td>
<td></td>
<td>R/W</td>
<td>I</td>
</tr>
<tr>
<td>34</td>
<td>Hour</td>
<td></td>
<td>R/W</td>
<td>I</td>
</tr>
<tr>
<td>35</td>
<td>Minute</td>
<td></td>
<td>R/W</td>
<td>I</td>
</tr>
<tr>
<td>36</td>
<td>Second</td>
<td></td>
<td>R</td>
<td>I</td>
</tr>
<tr>
<td>37</td>
<td>Log Type</td>
<td>00 - hourly or log records&lt;br&gt;01 - daily&lt;br&gt;02 - weekly&lt;br&gt;03 - monthly&lt;br&gt;04 - yearly&lt;br&gt;05 - last edit of calibration&lt;br&gt;06 - current totals are non-accumulated values, register 38 is ignored.</td>
<td>R/W</td>
<td>I</td>
</tr>
<tr>
<td>38</td>
<td>Log Number</td>
<td>If set to 0, current variables and Date/Time are retrieved</td>
<td>R/W</td>
<td>I</td>
</tr>
<tr>
<td>39</td>
<td>Clear Data</td>
<td>01 - clear logs&lt;br&gt;02 - clear accumulated totals&lt;br&gt;03 - clear non-accumulated totals</td>
<td>W</td>
<td>I</td>
</tr>
<tr>
<td>40</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* DT = Data Type of 2-register (4 byte) values can be set as Floating Point or Long Integer values
↑ I = Integer (2 bytes) (Holding Registers)
**Note:** The Floating Point variable is represented in IEEE-754 Floating Point 4-byte format and requires two 2-byte data registers:

<table>
<thead>
<tr>
<th>IEEE-754</th>
<th>Modicon Registers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st byte</td>
<td>low byte (register X)</td>
</tr>
<tr>
<td>2nd byte</td>
<td>high byte (register X)</td>
</tr>
<tr>
<td>3rd byte</td>
<td>low byte (register X+1)</td>
</tr>
<tr>
<td>4th byte</td>
<td>high byte (register X+1)</td>
</tr>
</tbody>
</table>

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

**Instrument Exception Status**

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

<table>
<thead>
<tr>
<th>Register</th>
<th>Name</th>
<th>Comments</th>
<th>Read Only or Read/Write</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>Exception</td>
<td>00 = no error</td>
<td>R</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>Status</td>
<td>01 = analog input 1 failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>02 = analog input 2 failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>03 = analog input 3 failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>04 = analog input 4 failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>05 = invalid calibration parameter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>06 = invalid reference parameter</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>07 = invalid property</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>08 to 09 reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 = process parameters out of range</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 = input is over limit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12 = flow error detected</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 = system failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>21 = power supply is low</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>22 = new or failed clock battery</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>23 to 29 reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 = alarm 1 active</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>31 = alarm 2 active</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>32 = alarm 3 active</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>33 = alarm 4 active</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* I = Integer (2 bytes) (Holding Registers)
## Instrument Control and I/O

This block of registers is available in some applications to give access to monitor and/or control some of the instrument.

<table>
<thead>
<tr>
<th>Register</th>
<th>Name</th>
<th>Comments</th>
<th>Read Only or Read/Write</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Relay State</td>
<td>0 to 15 Binary representation of relay state.</td>
<td>R</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = open; 1 = closed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B0 = relay 1 (LSB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B1 = relay 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Relay Control</td>
<td>0 to 15 Binary representation of relay control.</td>
<td>R/W</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = open; 1 = close.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B0 = relay 1 (LSB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B1 = relay 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Relay Control Source</td>
<td>0 to 15 Binary representation of relay control source.</td>
<td>R/W</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Local (controlled by instrument operation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = RTU (controlled by Modbus register 46).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B0 = relay 1 (LSB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B1 = relay 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51 to 99</td>
<td>Instrument Parameters</td>
<td>See next table for details.</td>
<td></td>
<td>DT</td>
</tr>
<tr>
<td>101</td>
<td>Analog Input</td>
<td>The input is configured for 4-20mA.</td>
<td>R</td>
<td>DT†</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The value will be read in Amperes.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* I = Integer (2 bytes) (Holding Registers)

† DT = Data Type of 2-register (4 byte) values can be set as Floating Point or Long Integer values
Instrument Configuration Parameters

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

The usage of these parameters can be dependent on other instrument settings. For full description, please refer to the “Modbus Accessible Parameters” in .

<table>
<thead>
<tr>
<th>Register</th>
<th>Name</th>
<th>Comments</th>
<th>Read Only or Read/Write</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>User Value</td>
<td></td>
<td>R/W</td>
<td>DT</td>
</tr>
<tr>
<td>53 to 99</td>
<td>Reserved</td>
<td></td>
<td>R/W</td>
<td>DT</td>
</tr>
</tbody>
</table>
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 are determined by the values 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

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 each 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 Line 1
- Custom Header Line 2
- Custom Header Line 3
- Custom Header Line 4

- Current Docket No.

Instrument Serial No. & Tag

- Current Date & Time & Status
- Total Variable
- Total Variable
- Variable
- Variable

- Custom Footer Line 1
- Custom Footer Line 2
- Custom Footer Line 3

------------------------------------------- <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 20.
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
Variable unit value <example: total as Accum only>
Variable unit value
etc.

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

Log Report Printing

As there is the likelihood that the reports can be of a considerable length it is strongly recommended that only the 80 Column printer with Z fold (tractor feed) paper be used. This is just as much for the memory storage of printer as it is for the 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
Variable unit value <example: total as Accum only>
Variable unit value
etc.
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.

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.
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 printer being off-line, print head not engaged or 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

## Model Numbers

### Product Codes

<table>
<thead>
<tr>
<th>Model</th>
<th>Supplementary Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>505</td>
<td></td>
<td>- FC01</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Panel mount enclosure</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Field mount enclosure (not yet available)</td>
</tr>
<tr>
<td></td>
<td>3/5</td>
<td>Explosion proof Ex410 with metric glands (5 specifies heater version)</td>
</tr>
<tr>
<td></td>
<td>4/6</td>
<td>Explosion proof Ex410 with NPT glands (6 specifies heater version)</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td><strong>Basic</strong> - RS232 and RS485 serial ports, 2 relays, 2 pulse outputs, rear key input</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td><strong>Advanced</strong> - also includes 4-20mA o/p and Real-time clock for printer output and logging (100 logs)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>9-way DB connector for RS232 serial port</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>For 220/240VAC</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>For 110/120VAC</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>For DC power only 12-28VDC</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>Standard (no backlight, LCD backup or Infra-Red comms port)</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Fully optioned (with backlight, LCD backup and Infra-Red comms port)</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td><strong>Conformal coating</strong> - required for maximum environmental operating range. Recommended to avoid damage from moisture and corrosion.</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td><strong>None</strong> - suitable for IEC standard 654-1 Climatic Conditions up to Class B2 (Heated and/or cooled enclosed locations)</td>
</tr>
<tr>
<td></td>
<td>FC01</td>
<td>Defines the application software to be loaded into the instrument</td>
</tr>
</tbody>
</table>

For example: Model No. 505.112EFC
Displayed on the 500 Series as: (only h/w that affects the operation is represented)

- 505  MODEL

**Note:** Example full product part number is 505.112EFC-FC01 (This is the number used for placing orders).
# Custom Version Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Factory Default Application</td>
</tr>
<tr>
<td>01</td>
<td>Contrec Pty. Ltd. Melbourne Australia</td>
</tr>
<tr>
<td>02</td>
<td>Contrec Pty. Ltd. Sydney Australia</td>
</tr>
<tr>
<td>03</td>
<td>Contrec Europe Ltd. West Yorkshire UK</td>
</tr>
<tr>
<td>04</td>
<td>Contrec - USA, LLC. Pelham AL 35124 USA</td>
</tr>
<tr>
<td>05</td>
<td>Flowquip Ltd. Halifax UK</td>
</tr>
<tr>
<td>etc.</td>
<td></td>
</tr>
</tbody>
</table>

**Origin Code**  
Identifies Distributor

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>English (Default)</td>
</tr>
<tr>
<td>1</td>
<td>German</td>
</tr>
<tr>
<td>2</td>
<td>Dutch</td>
</tr>
<tr>
<td>3</td>
<td>French</td>
</tr>
<tr>
<td>4</td>
<td>Spanish</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>etc.</td>
<td></td>
</tr>
</tbody>
</table>

**User Language**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>Distributor’s own choice. Possibly a code that identifies the customer and the application.</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>999</td>
<td></td>
</tr>
</tbody>
</table>

**Distributor’s Code**

For example: 02 3 157  
Displayed on the 500 Series as: 02 3 157  
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.

![Diagram of Application Information Code](image)

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

- BC01 - single channel batch controller for frequency flow input.
- FC01 - single channel flow computer for frequency flow input

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

<table>
<thead>
<tr>
<th>FINP</th>
<th>AINP</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

The codes are as follows:

- - not used in this application
- A - indicates an analog flow input such as for volume or mass
- F - indicates a frequency flow input such as for volume or mass
- L - indicates a level input
- d - indicates a density input
- t - indicates a temperature input.

For example, FL is an instrument with FINP (frequency input) assigned to a flow input, AINP (analog input) assigned to a level input.
## Appendix B
### Units of Measurement

The following is a list of the available units of measurement used across the range of 500 Series applications.

<table>
<thead>
<tr>
<th>Units Type</th>
<th>Available units of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume</strong></td>
<td>m³, Km³, Ltr, Gal, KGal, MGal, ft³, kft³, Mft³, bbl</td>
</tr>
<tr>
<td><strong>Volume Flowrate</strong></td>
<td>m³/s, m³/min, m³/h, L/s, L/min, L/h, Gal/s, Gal/min, Gal/h, KGal/D, MGal/D, ft³/s, ft³/min,</td>
</tr>
<tr>
<td></td>
<td>ft³/h, Mft³/D, bbl/s, bbl/min, bbl/h, bbl/D</td>
</tr>
<tr>
<td><strong>Volume K-Factor</strong></td>
<td>P/m³, P/Ltr, P/Gal, P/ft³, P/bbl</td>
</tr>
<tr>
<td><strong>Mass</strong></td>
<td>kg, g, Ton, lb, Klb</td>
</tr>
<tr>
<td><strong>Mass Flowrate</strong></td>
<td>kg/s, kg/min, kg/h, g/s, g/min, g/h, Ton/min, Ton/h, Ton/D, lb/s, lb/min, lb/h, Klb/min, Klb/h,</td>
</tr>
<tr>
<td></td>
<td>Klb/D</td>
</tr>
<tr>
<td><strong>Mass K-Factor</strong></td>
<td>P/kg, P/g, P/Ton, P/lb, P/Klb</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>kJ, MJ, GJ, kWh, MWh, kBTU, Ton.h, therm, cal, kcal, Mcal</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>kJ/h, MJ/h, GJ/h, kW, MW, kBTU/M, kBTU/h, Ton, therm/min, therm/h, kcal/h, Mcal/h</td>
</tr>
<tr>
<td><strong>Energy K-Factor</strong></td>
<td>P/kJ, P/kWh, P/kBTU, P/Ton.h, P/therm, P/kcal</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>Deg K, Deg C, Deg F, Deg R</td>
</tr>
<tr>
<td><strong>Pressure</strong></td>
<td>Pa, kg/m², kg/cm², kPa, MPa, mbar, psi, Atm, inH₂O, mmH₂O</td>
</tr>
<tr>
<td><strong>Density</strong></td>
<td>kg/m³, kg/Ltr, lb/ft³, SG60F</td>
</tr>
<tr>
<td><strong>Specific Volume</strong></td>
<td>m³/kg, L/kg, ft³/lb</td>
</tr>
<tr>
<td><strong>Specific Enthalpy</strong></td>
<td>kJ/kg, BT/lb, cal/g, cal/kg, kcal/kg, Mcal/kg</td>
</tr>
<tr>
<td><strong>Reynolds Number</strong></td>
<td>E+0, E+3, E+6 (scaling for unitless variable)</td>
</tr>
<tr>
<td><strong>Length (Level)</strong></td>
<td>m, mm, cm, INCH, FOOT</td>
</tr>
<tr>
<td><strong>Velocity</strong></td>
<td>m/s, m/M, m/h, ft/s, ft/M, ft/h</td>
</tr>
<tr>
<td><strong>Length K-Factor</strong></td>
<td>P/m, P/cm, P/INCH, P/FOOT</td>
</tr>
<tr>
<td><strong>Area</strong></td>
<td>m², ft²</td>
</tr>
<tr>
<td><strong>Ratio</strong></td>
<td>%</td>
</tr>
</tbody>
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