Sarasota CM515

Density Converter
User Guide for Gas Applications
P/N HB-CM515-DG01

Revision D

Part of Thermo Fisher Scientific

Thermo SCIENTIFIC

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User Guide for Gas Applications
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Revision History

Revision Level	Date	Comments
A	10-08	Initial release (per ERO 6609).
B	03-09	Revised per ECO 6804.
C	06-10	Revised per ECO 7402.
D	01-11	Revised per ECO 7628.

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Contents

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 authorized. Personnel must read and understand this manual prior to installation and operation of the instrument.

Static Hazard

The Sarasota CM515 density converter uses high speed CMOS circuitry which is sensitive to static damage. 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. Take all steps necessary 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
Product Overview

Introduction

Thermo Fisher Scientific's Sarasota CM515 density converter accepts inputs from Sarasota density meters, temperature and pressure transmitters, and an unassigned input enabling a variable to be connected as an input to the user defined function (look-up table).

The converter calculates line (measured) density from the density meter period output and uses it together with temperature and pressure readings to derive density at reference conditions and calculate specific gravity and other density related variables.

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

The density converter includes the following features:

- Pulse input for density
- Temperature and pressure inputs for density conversion to reference conditions
- Conversion based on a variety of general gas equations
- Customer defined function (look-up table)
- Versatile user input available on main menu
- Selection of second language and user tags
- RTC logging with over 1000 entries
- 4–20 mA retransmission
- Infrared RS232, RS232 with DB9 connector, and RS485 communication ports
- Front panel adjustment of 8–24 Vdc output voltage
- Backlit display

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 line density calculations are based on accurately measured average period of pulses coming from density meters such as the Thermo Scientific Sarasota FD910 industrial liquid density meter. A variety of calculations are available to suit the nature of the gas and the measurement conditions. The calculations are valid for the vapor phase of a gas.

Equations of State:

- Ideal Gas
- Redlich Kwong
- Soave
- Peng-Robinson

Equation Sets

Measured line density

$$\rho = \rho \times DCF + D\_OFFSET,$$

where

ρ = measured line density

DCF = density correction factor (default 1.0)

D_OFFSET = density offset (default 0.0).

Equations of State

In this instrument, the calculation of gas properties can be based on one of the following equations of state. These equations are based around the general gas law that relates pressure (P), temperature (T), Universal Gas Constant (R), and compressibility (Z) to the volume (V):

$$PV = ZRT.$$

The method by which each equation determines the compressibility factor differs, meaning it is more suited to certain gas types and conditions.

Ideal Gas

The ideal gas laws are implemented. No compensation is made for gas compressibility (ideal gas law deviations).

Redlich Kwong (RK)

The RK equation of state is implemented. The user must enter an isentropic exponent, critical pressure, and temperature for the gas or an average isentropic exponent and a quasi critical temperature and critical pressure for a gas mixture.

Soave-Redlich Kwong

This is a modification to RK and can give slightly better results. The user must enter an isentropic exponent, an Acentric factor, and a critical pressure and temperature for the gas or an average isentropic exponent, an average Acentric factor, and a quasi critical temperature and critical pressure for a gas mixture.

Peng Robinson

This is another variation. The user must enter an isentropic exponent, an Acentric factor, and a critical pressure and temperature for the gas or an average isentropic exponent, an average Acentric factor, and a quasi critical temperature and critical pressure for a gas mixture.

Critical Temperature and Pressure

The Critical Temperature and Pressure can be entered as constants or approximated by quadratic equation as functions of Specific Gravity:

$$T_C = T_0 \times \left(1 + A_T \times SG + B_T \times SG^2\right)$$
$$P_C = P_0 \times \left(1 + A_P \times SG + B_P \times SG^2\right)$$

Set coefficients A and B to zero if no SG approximation is required.

User Defined Function

The user defined function allows you to set up a table defining two output variables (OUT-A and OUT-B) as a function of two input variables (INP-X and INP-Y). Such a table enables the computation of more complex non-linear custom functions based on the main menu variables. The Program Manager configuration software allows you to customize the table as well as other parameters before downloading embedded software into the instrument. For further details of these equations or restrictions of use please refer to the appropriate standard or relevant documents.

Analog Input Scaling

The analog inputs in the Sarasota CM515 are scaled by the following general formula:

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

where

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

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

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

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.

This application indicates the type of pressure value being displayed as either gauge or absolute by adding 'A' or 'G' to the units of measurement.

Main Menu Variables

Table 1–1.

Main Menu Variables	Default Units	Variable Type
Density (Line)	kg/m^3	Rate
Period	µs	Rate
Density (Reference)	kg/m^3	Rate
Temperature	°C	Rate
Pressure	kPa	Rate
Specific Gravity	E+0	Rate
Z-Factor (Line)	E+0	Rate
Z-Factor (Reference)	E+0	Rate
Molecular Weight	E+0	Rate
Critical Temperature	°C	Rate
Critical Pressure	kPa	Rate
User Input	---	Rate
User Output A	---	Rate
User Output B	---	Rate

Refer to "Available Units of Measurement" (Appendix C) for the list of available units.

Communications

The instrument comes standard with an infrared RS232 port, RS232 port with DB9 connector, and RS485 port. These ports can be used for remote data reading, printouts, and for initial application loading of the instrument.

Isolated Outputs

The opto-isolated outputs can retransmit 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 4–20 mA signals. One output is standard, and a second output is available as an option.

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, with an additional two relays optionally available.

Software Configuration

The instrument can be further tailored to suit specific application needs including units of measurement, custom tags, or access levels. Instrument parameters including units of measurement can be programmed in the field, according to the user access levels assigned to parameters. All setup parameters, totals, and logged data are stored in non-volatile memory with at least 30 years retention.

Temperature & Pressure Input Types

Temperature sensor input can be PT100, PT500, 4–20 mA, 0–5 V, or 1–5 V signals.

Pressure sensor input can be 4–20 mA, 0–5 V, or 1–5 V signals.

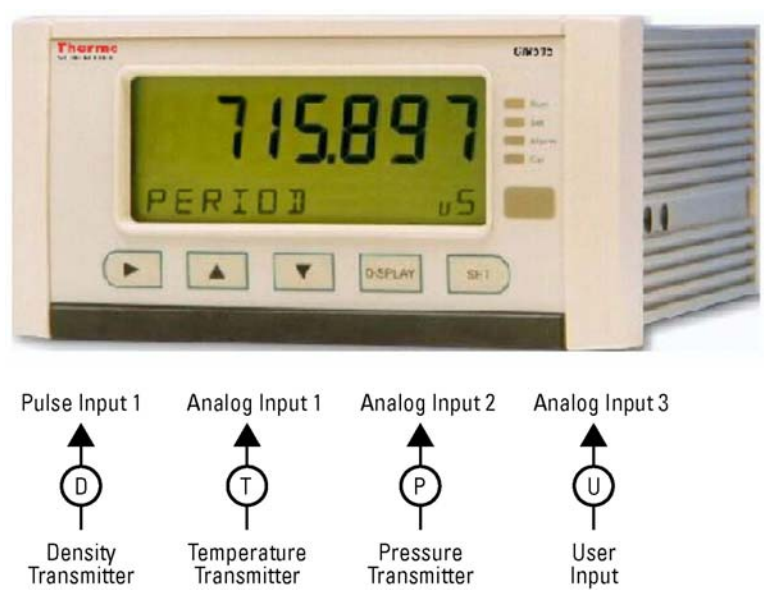


Figure 1–1. Typical application diagram

Approvals

The Sarasota CM515 conforms to the EMC-Directive of the Council of European Communities 89/336/EEC and the following standards:

- Generic Emission Standard EN 50081-1 Residential, Commercial & Light Industry Environment.
- Generic Emission Standard EN 50081-2 Industrial Environment.
- 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 the installation chapter (Chapter 2) must be followed.

Chapter 2
Installation

Note Installation must be carried out in accordance with local site requirements and regulations. ▲

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 (5.48 x 2.64 in). Two side clips secure the unit into the panel. The figure below shows the panel mounting requirements.

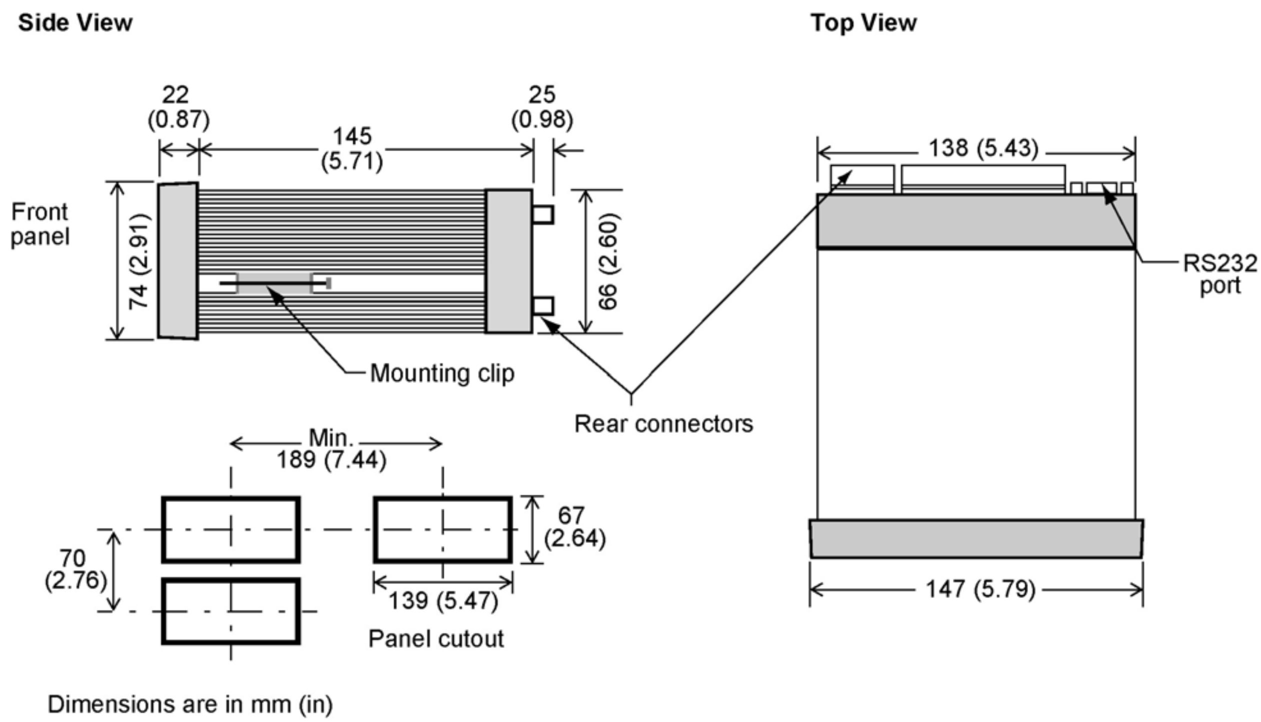


Figure 2–1. Panel mounting for Sarasota CM515

Electrical Connection

Rear Panel Connections

The figure below shows the connections on the rear panel of the instrument.

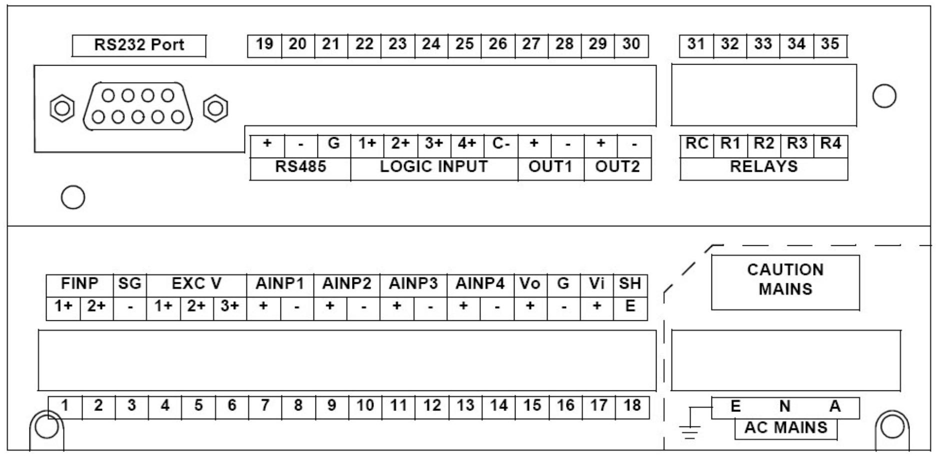


Figure 2–2. Rear panel connections

Reference the following table for terminal designations.

Table 2–1. Terminal designations

Terminal Label			Designation	Comment
1	FINP	1+	Frequency Input 1+	Density input (pulse)
2	FINP	2+	Frequency Input 2+	Not used
3	SG	-	Signal ground	
4	EXC V	1+	Excitation Term 1+	Not used
5	EXC V	2+	Excitation Term 2+	For AINP1 RTD input
6	EXC V	3+	Excitation Term 3+	
7	AINP1	+	Analog input ch 1 (+)	Temperature input
8		-	Analog input ch 1 (-)	
9	AINP2	+	Analog input ch 2 (+)	Pressure input
10		-	Analog input ch 2 (-)	
11	AINP3	+	Analog input ch 3 (+)	User input
12		-	Analog input ch 3 (-)	User input
13	AINP4	+	Analog input ch 4 (+)	
14		-	Analog input ch 4 (-)	

Terminal Label			Designation	Comment
15	Vo	+	8–24 Vdc output	Overload protected
16	G	-	DC ground	
17	Vi	+	DC power input	DC power in 12–28 V. See Note 1.
18	SH	E	Shield terminal	
E		E	Mains ground	
N	AC Mains	N	Mains neutral	AC power in 95–135 V or 190–260 V. See Note 2.
A		A	Mains active	
19		+	RS485 (+)	
20	RS485	-	RS485 (-)	RS485 port
21		G	RS485 ground	
22		1+	Switch 1	
23		2+	Switch 2	
24	Logic inputs	3+	Switch 3	
25		4+	Switch 4	
26		C-	Signal ground	
27	OUT 1	+	Output ch 1 (+)	
28		-	Output ch 1 (-)	
29	OUT2	+	Output ch 2 (+)	Optional output
30		-	Output ch 2 (-)	
31		RC	Relay common	
32	Relays	R1	Relay 1	
33		R2	Relay 2	
34	Relays	R3	Relay 3	Optional relays
35		R4	Relay 4	
RS232 port			9-pin serial port	

Notes

1. The DC power supply needs to support at least 500 mA current.

2. Use the internal switch setting to select AC voltage input range.

Inputs

Frequency (Pulse) 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, use shielded cable. Refer to "Rear Panel Connections" for specific terminal numbers for this application.

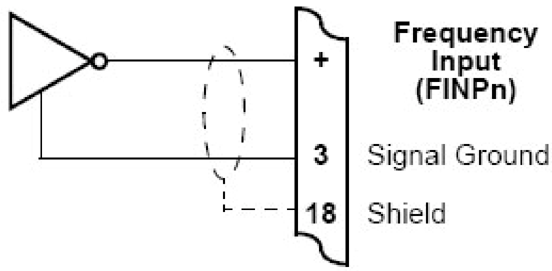


Figure 2–3. Squarewave, CMOS, or TTL

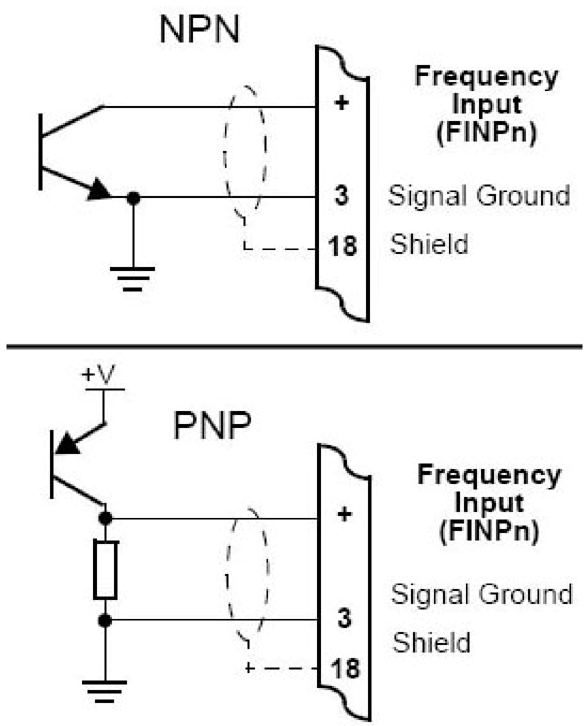


Figure 2–4. Open collector

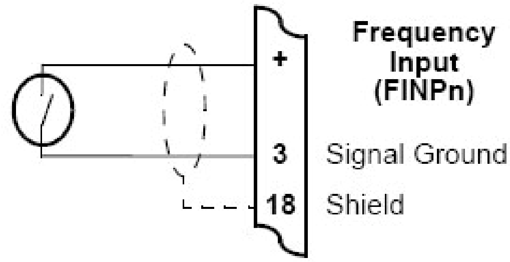


Figure 2–5. Reed relay switch

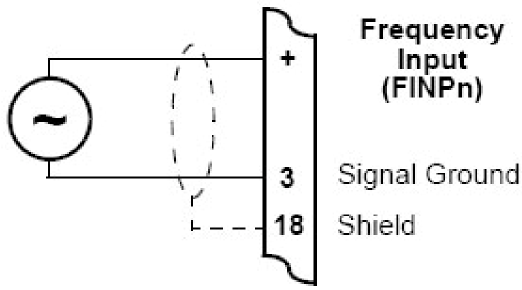


Figure 2–6. Coils with 15 mV peak-to-peak AC minimum

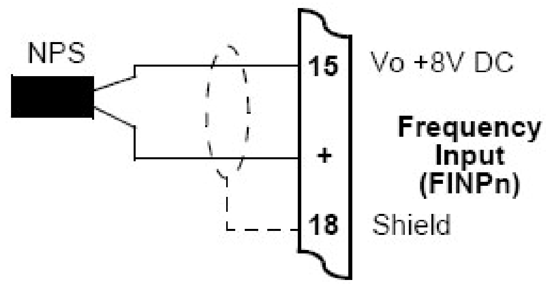


Figure 2–7. Namur proximity switch

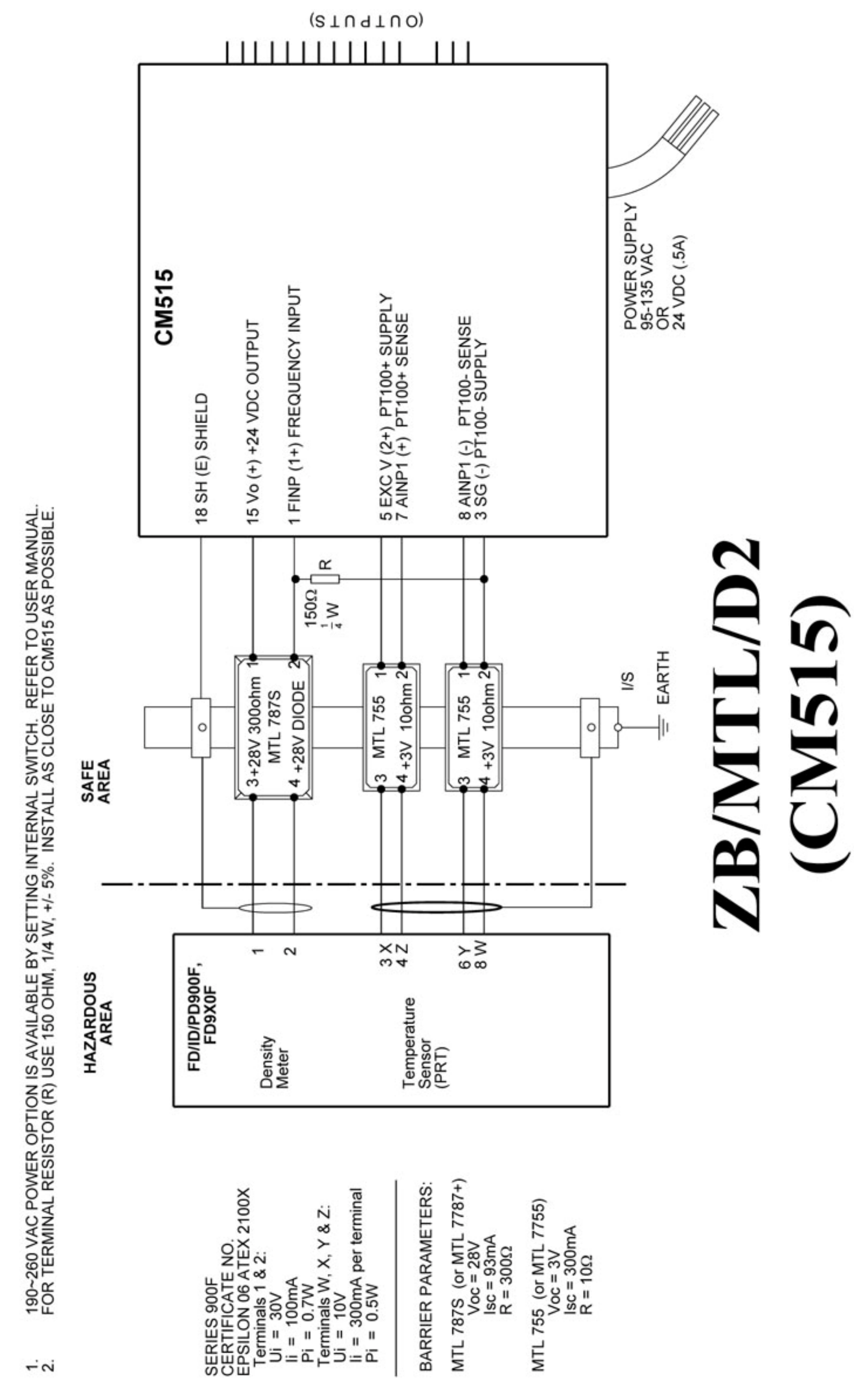


Figure 2–8. Wiring diagram 1 of 3 (AD-6502, rev. B)

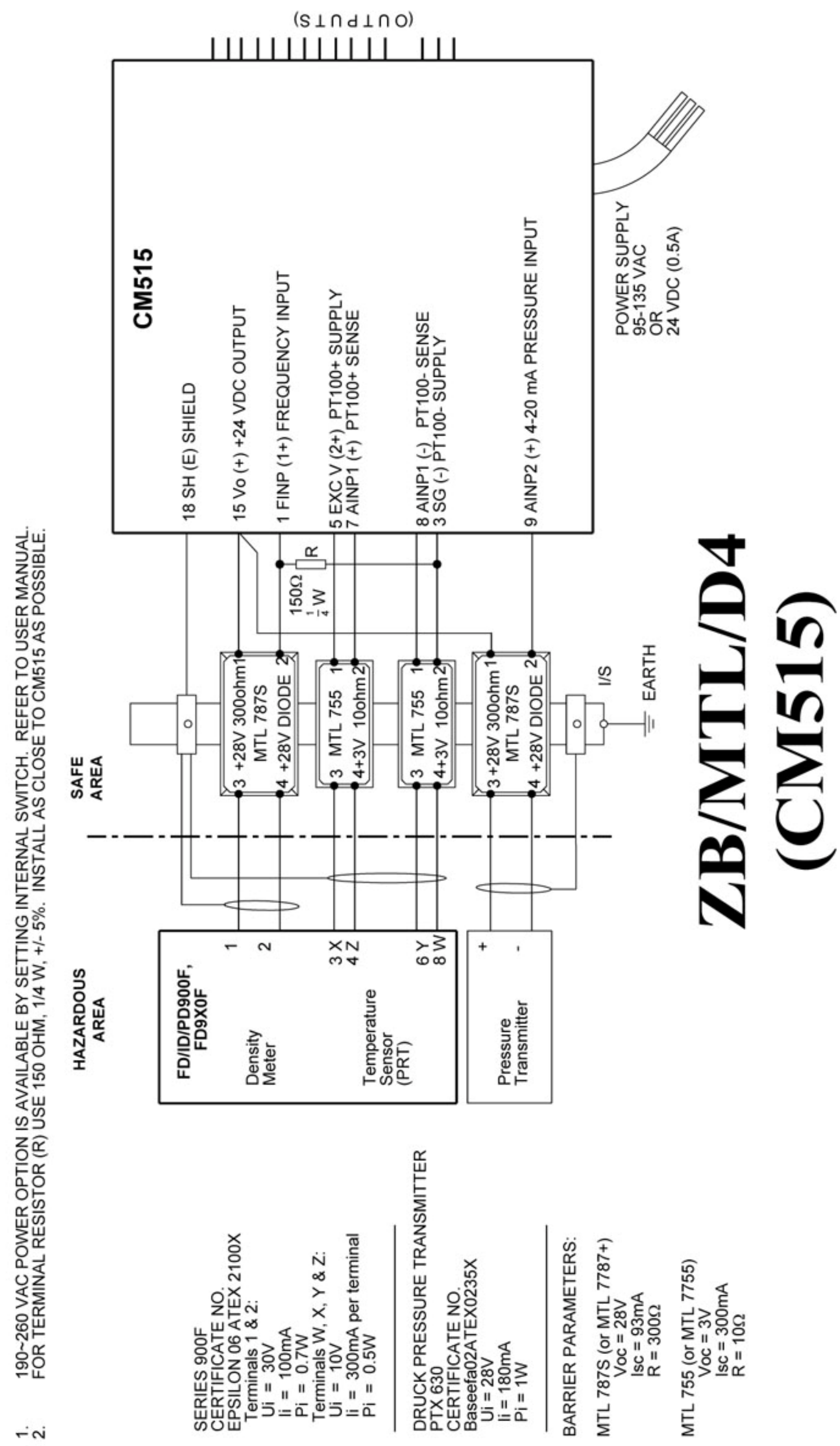


Figure 2–9. Wiring diagram 2 of 3 (AD-6502, rev. B)

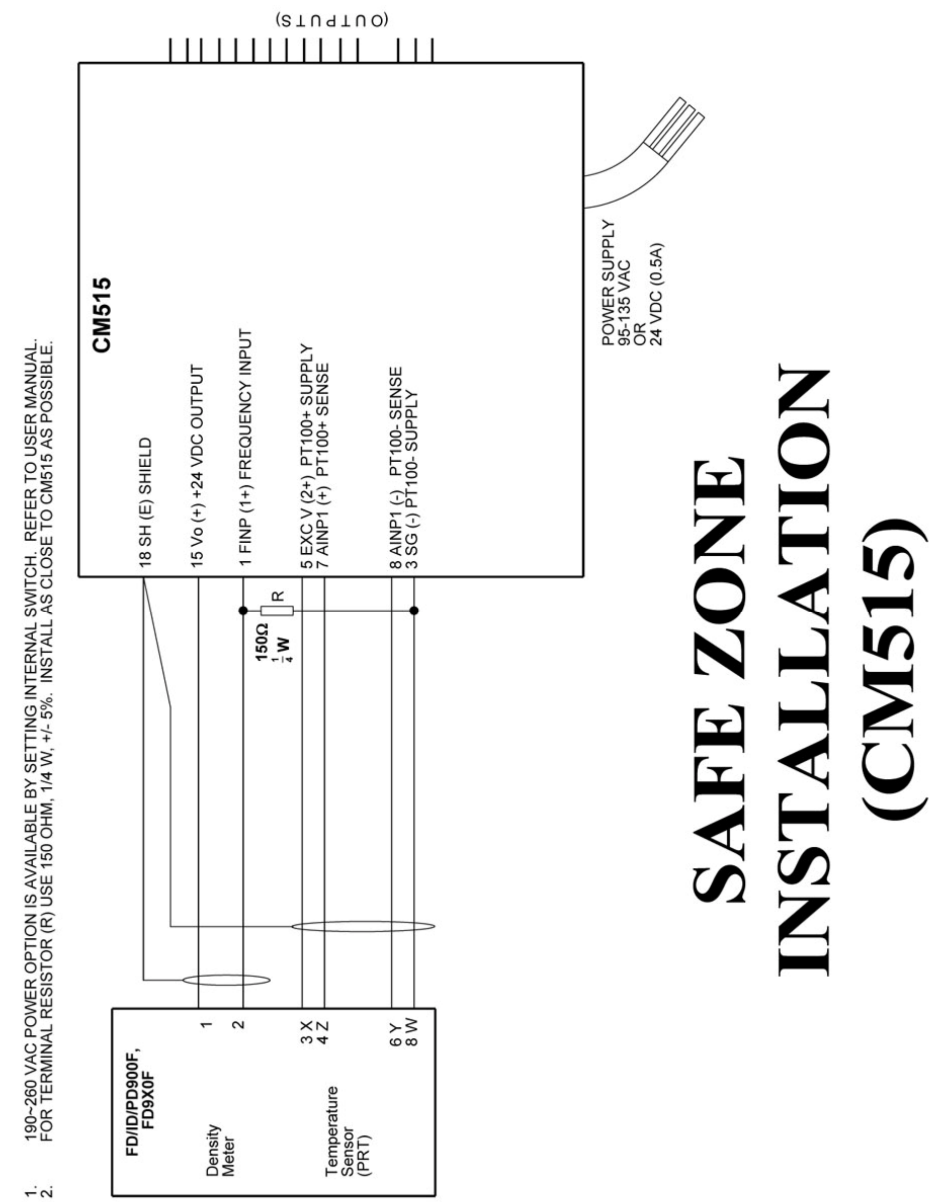


Figure 2–10. Wiring diagram 3 of 3 (AD-6502, rev. B)

Analog Input Connections

All analog inputs can accept DC signals ranging 0–5 V and 1–5 V and current signals 4–20 mA. Analog Input 1 (AINP1) can also accept an RTD input (PT100 or PT500) as well as the standard 0–5 V, 1–5 V, and 4–20 mA input.

Refer to "Rear Panel Connections" for specific terminal numbers for these applications.

Caution Applying levels of input current above the absolute maximum rating (100 mA) may cause permanent damage to the input circuitry. ▲

0–5 V & 1–5 V Inputs

For externally powered voltage transmitter, connect each transmitter to a pair of input terminals.

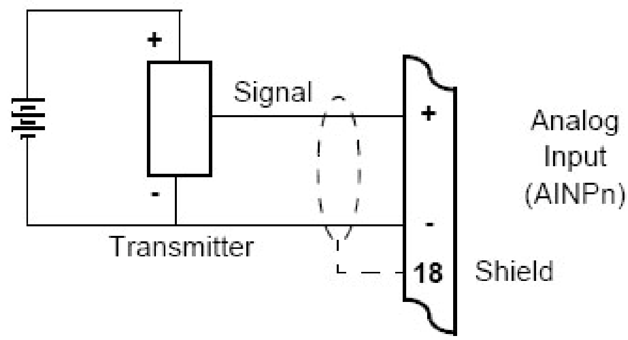


Figure 2–11. Externally powered voltage transmitter

Connect internally powered voltage transmitters as shown below.

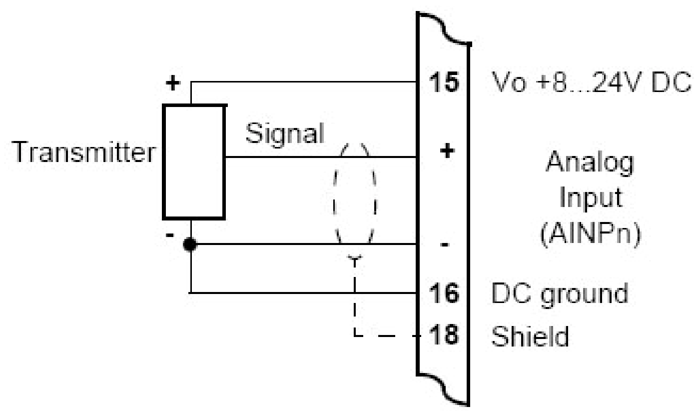


Figure 2–12. Internally powered voltage transmitter

4–20 mA Inputs

For an externally powered current loop, connect the transmitter to the input terminals as shown below.

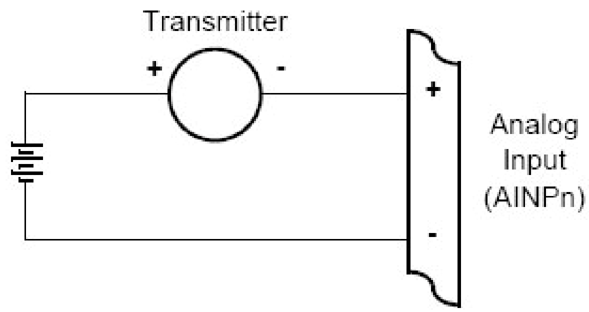


Figure 2–13. Externally powered current loop

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

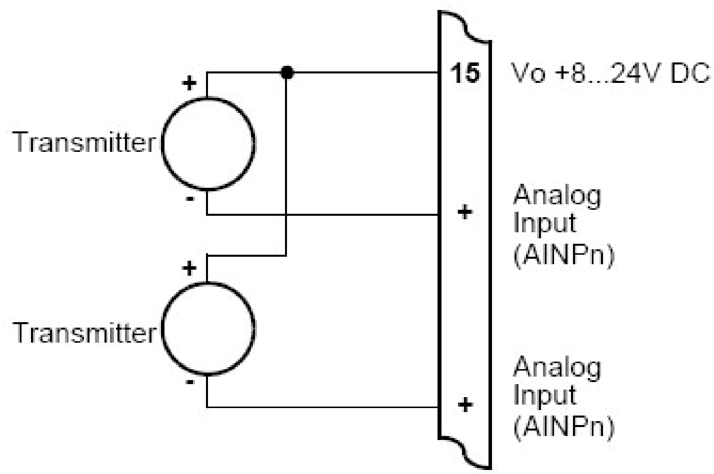


Figure 2–14. Internal power current loop

RTD Input

The instrument uses 4-wire RTDs to provide optimum accuracy and stability. It is not necessary to have equal cable lengths for the 4-wire RTDs, but they should be no longer than 50 meters (164.04 feet). It is also recommended to use shielded twisted pairs.

Connect RTD inputs as shown below.

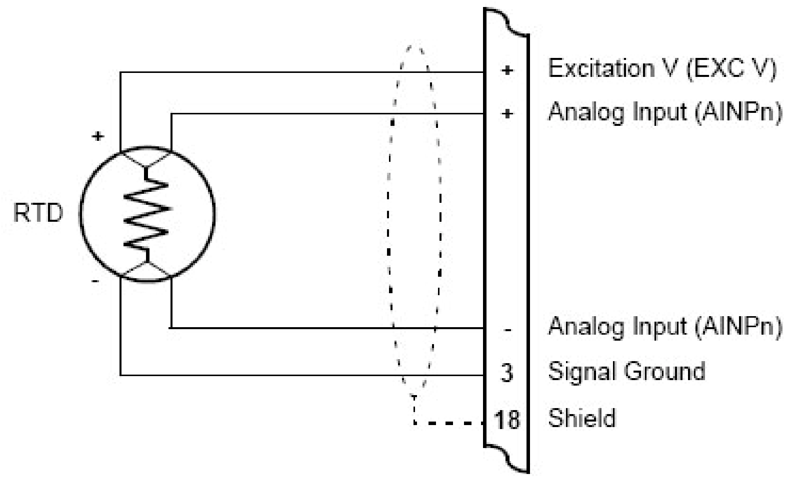


Figure 2–15. RTD connection

Only analog input 1 (AINP1) is available for RTD connection.

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

It is possible to use 2-wire or 3-wire RTDs. However, four wires must be taken to the RTD, with the signal and current wires joined as close to the RTD as possible.

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

Logic Input Connection

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

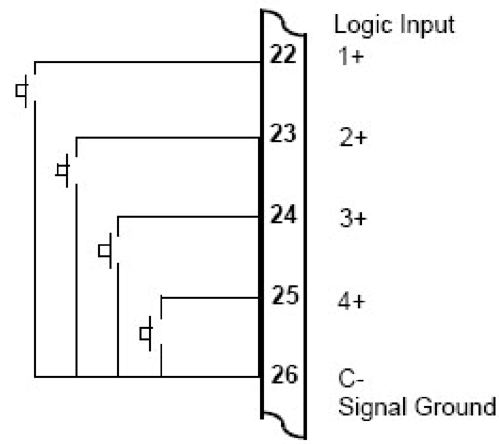


Figure 2–16. Logic inputs connection diagram

Outputs

The advanced option for the instrument provides two opto-isolated passive 4–20 mA output ports.

4–20 mA Output Connection

Figure 2–14 shows the connections for a 4–20 mA output. Output channel 1 uses terminals 27 (+) and 28 (-), and output channel 2 uses terminals 29 (+) and 30 (-).

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

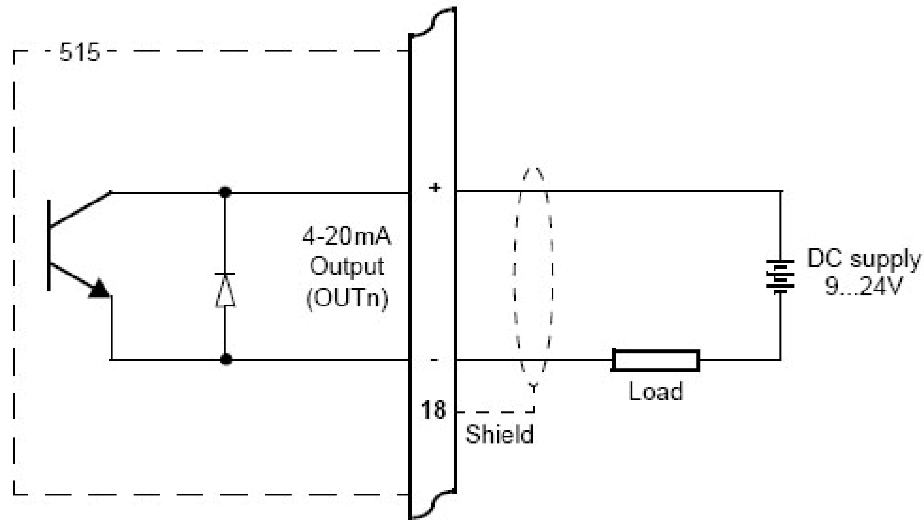


Figure 2–17. Output 4–20 mA connection diagram

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 advanced option has four alarm relays. The operation of each alarm relay can be set to various modes as described in “Alarms” in Chapter 4.

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” in Chapter 4 or if there is a loss of power to the instrument.

The output characteristics of the relays are:

Maximum voltage: 30 Vdc or 250 Vac

Maximum current: 3 A

Note Solid state relays use AC voltage only. ▲

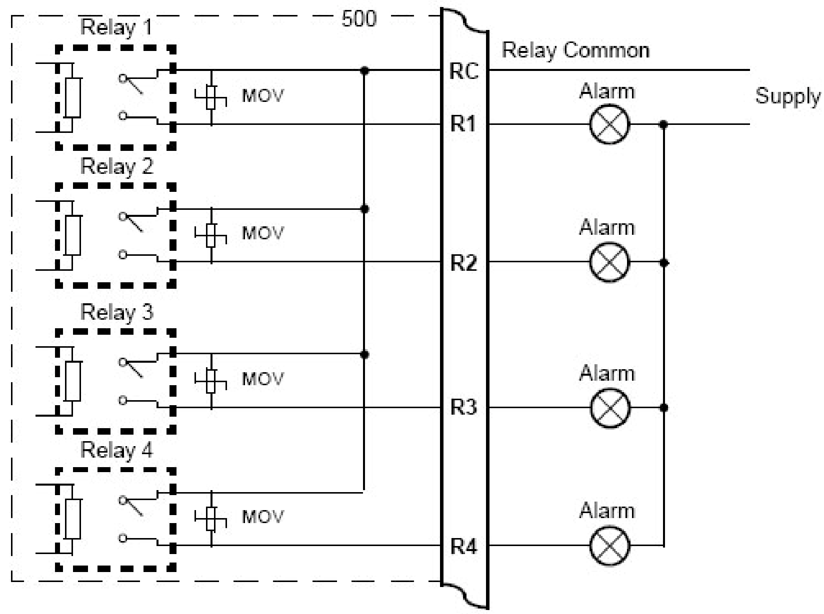


Figure 2–18. Relay connection diagram

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 cause the microprocessor to act erratically in extreme cases.
- 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 you are 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

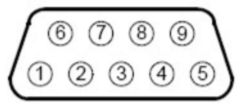
The communication protocols are described in “Protocols” in Chapter 5.

Infrared RS232 Port

The infrared RS232 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 infrared port.

RS232 Port

The RS232 port has a DB9 female connector. The pinout is shown below.



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

Figure 2–19. RS232 pinout

Note The instrument does not require a null modem cable for connection to a PC. Refer to “Hardware Interconnection” in Chapter 5 for cable termination requirements. ▲

RS485 Port

Up to 32 units can be connected to a common RS485 bus. Each unit has a unique address that the host computer uses to identify each instrument. The figure below shows the connection of several instruments to a computer using the RS485 port.

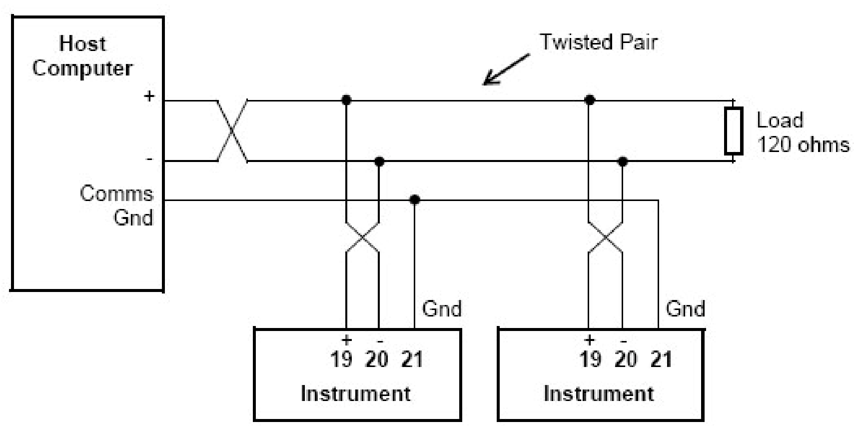


Figure 2–20. RS485 interface connections

Earthing & 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 3
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.

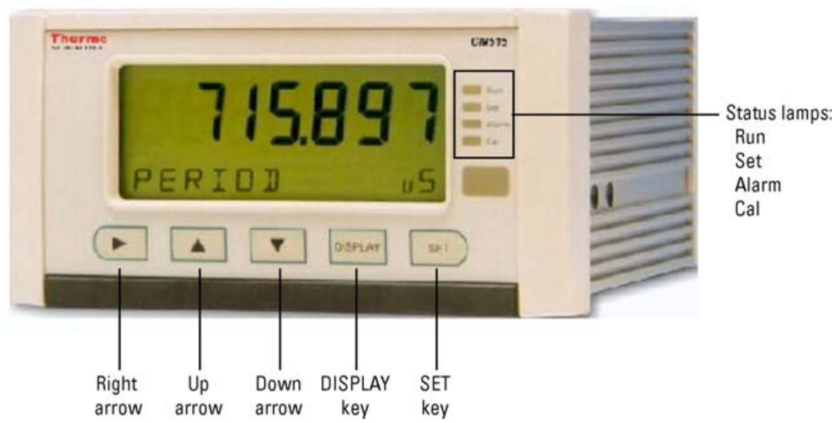


Figure 3–1. Front panel interface

There are different categories of information that the instrument can display. They are process variables and instrument settings.

Default Variable

In some applications, one variable is of more interest than others. For this reason, a default variable can be assigned during instrument calibration. 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 variable.

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 en 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.

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

Main Menu Items

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

Table 3–1. Main menu items

DISPLAY ↓	Description	Options
D--LINE	Density (Line)	
PERIOD	Period	Hold the SET key to display or edit the default period.
D--REF	Density (Reference)	
TEMP	Temperature	
PRESS	Pressure	Hold the SET key to view the absolute value if the type of pressure sensor is set to GAUGE.
SG	Specific Gravity	
Z--LINE	Z-Factor (Line)	
Z--REF	Z-Factor (Reference)	
MW	Molecular Weight	
Tc	Critical temperature	
Pc	Critical pressure	
USER INPUT	User input	
USER OUT--A	User output A	
USER OUT--B	User output B	
REPORT PRINT	Only shown if print option is selected.	Hold the SET key to print log report as defined in the TM/LOG menu (Chapter 4).
LOGGED DATA	Only shown if real-time clock option is installed.	Hold the SET key to display data logs as described in "Data Logs" later in this chapter.

DISPLAY ↓	Description	Options
MODEL INFO		Hold SET key to display the model information as described in "Model Information" later in this chapter.
CAL MENU		Hold the SET key to enter Calibration View mode as described in "Calibration View Mode" in Chapter 5.

Default Period

Hold the SET key to display or edit the default period constant while viewing the live period. The display of the default period will change from view mode to edit mode after two seconds if access has been enabled in calibration. Once in edit mode, the Set indicator will illuminate and the value is changed in exactly the same way as in calibration set mode. If testing is required, then set the default period to a non-zero value, and the instrument will use this value instead of the live pulse input.

Data Logs

The instrument will log the main menu variables if the real-time clock option is installed. The logs are at fixed intervals of hours, days, weeks, months, and years. The instrument can store a total of more than 1000 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. 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 time base and number of the log are shown, for example LH-001.

3. While holding the DISPLAY key, use the down arrow 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.

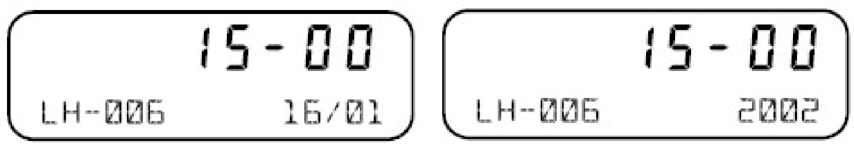


Figure 3–2.

Figure 3–3 shows how to display the logged data.

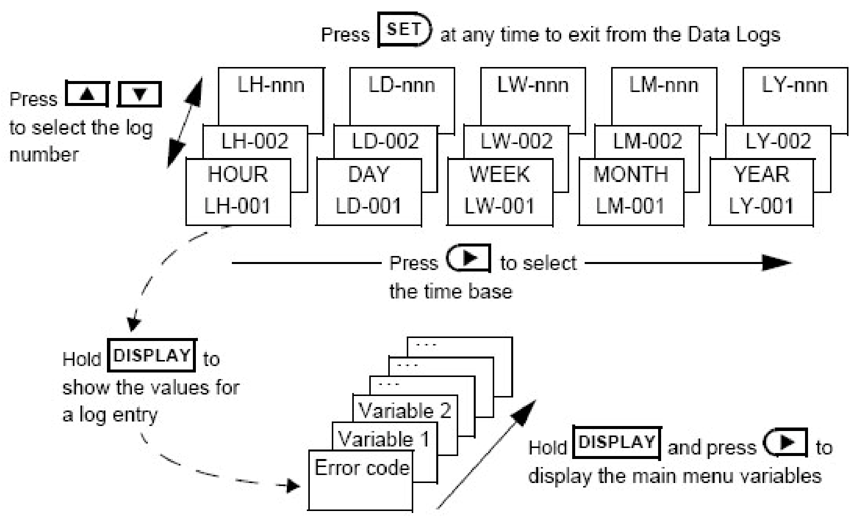


Figure 3–3. Logged data display methods

Model Information

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

Table 3–2. Model information menu items

DISPLAY ↓	Description
- 1 - - F - 515 MODEL	The hardware model code. Refer to "Product Codes" in Appendix A.
d - t P U - DG01 INPUT	The application number and the assignment of the inputs. Refer to "Application Information Code" in Appendix A.
0 10 1.002 DG01 VERS	The version of the software loaded into the instrument.
123456 ABC123 S/N	The instrument serial number and unit tag. The serial number is on the top line, and the 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.
16 - 15 EDITED 27/08 2002	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 (4:15 PM) on 27 August 2002. This function is available only if the instrument has the real-time clock option.

Press the SET key at any time to exit the Model Information menu.

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Chapter 4
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 access levels:

- 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 prompts you for a password. Any value will allow you to change the settings of the parameters with the programmable level of access, but the correct password must be entered to change parameters with password protection. ▲

Calibration View Mode

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

1. Press the DISPLAY key 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.
   a. Press the right arrow to scroll through the flashing menu headings.
   b. Press the SET key to scroll through submenu items.
   c. Press the DISPLAY key to return to the main calibration menu.

3. To exit Calibration View mode, use the right arrow to scroll to the END option, and press the SET key. The instrument returns to normal operating 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 parameters that are password protected. Use the following procedure to enter Calibration Set mode.

1. Press the DISPLAY key 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 the right arrow to select any flashing menu heading except END.

4. Hold the SET key for two seconds. The instrument requests a password.

5. Enter the password, pressing the up and down arrows to change the value of the current digit. To select the next digit, press the right arrow.

6. Press the SET key to accept the password.

   The instrument beeps twice if the password is correct and allows you to change the parameters with programmable and password protection levels of security.

   The instrument beeps once if the password is incorrect and allows you to change only the parameters with a programmable security level.

   The instrument illuminates both the Cal and Set indicators.

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

   To change a numerical value, press the up arrow to increase a value or the down arrow 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 the next digit, press the right arrow. Scroll through options by pressing the up or down arrow.

8. Press the SET key to accept the currently displayed value and proceed to the next parameter. You can press the DISPLAY key to return to the main calibration menu.

9. To exit from Calibrate Set mode, press the right arrow to scroll through the main calibration menu to END, and then press the SET key. Otherwise, you can press and hold the SET key for two seconds from any menu.

   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, and 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 communication parity bit checking. Press the up or down arrow to change the option. You can scroll through the options in either direction to make a selection as shown below.

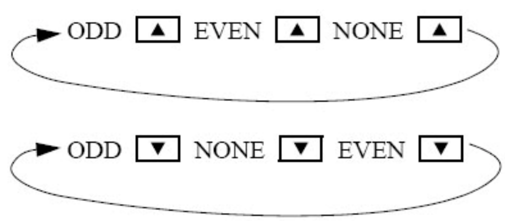

Figure 4–1.

Changing Numeric Settings

Press the right arrow to select the digit you wish to change. The display flashes the digit that can be changed. Press the up and down arrows to increase and decrease the value of the selected digit.

Figure 4–2.

To change the position of the decimal point, press the right arrow to move to the decimal point. It begins flashing. Press the up or down arrow 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.

Calibration Menu Tree

The two figures on the following pages show how to move around the calibration menu tree in Calibration View or Calibration Set mode.

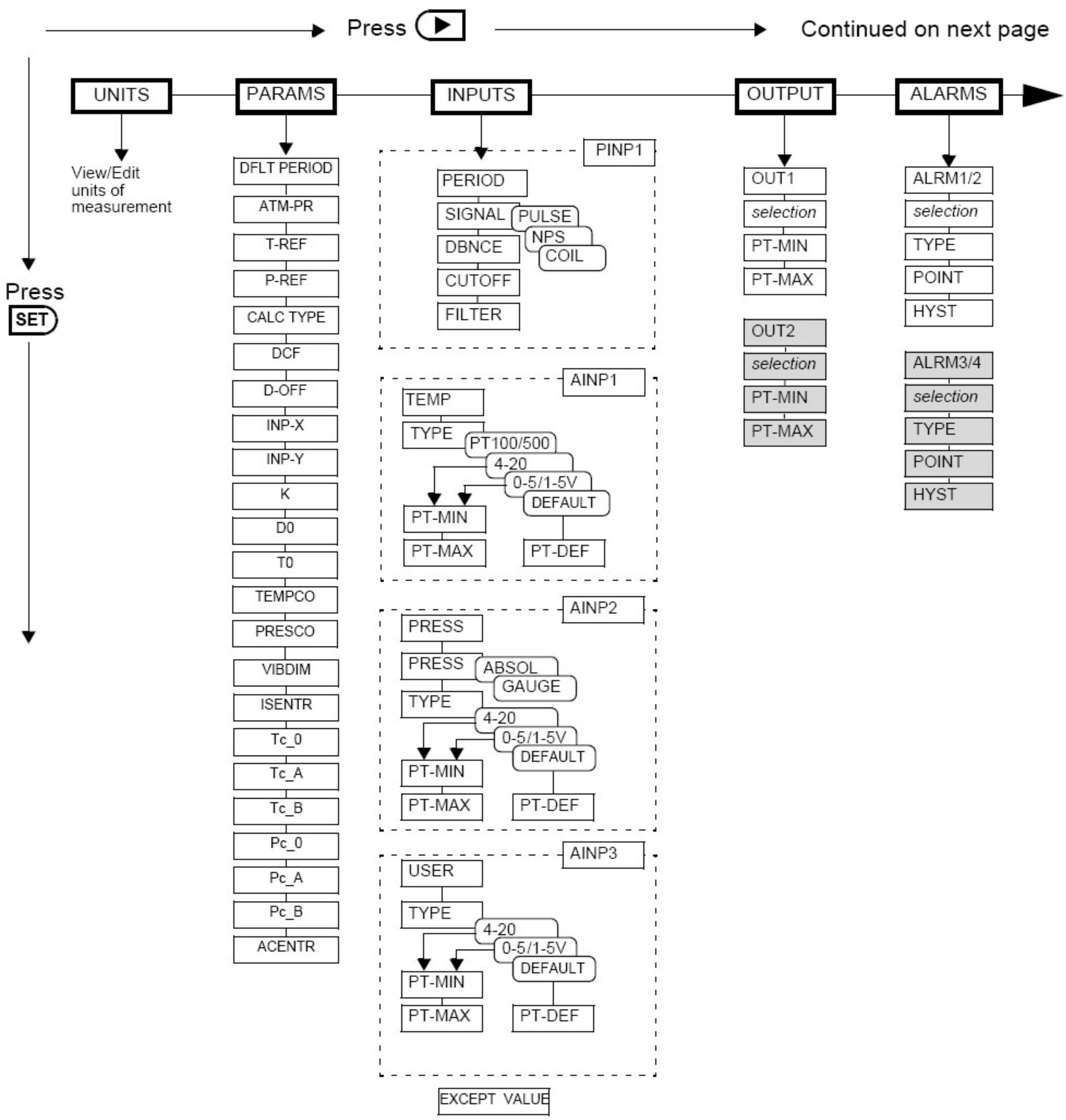

Figure 4–3. Calibration menu tree, sheet 1

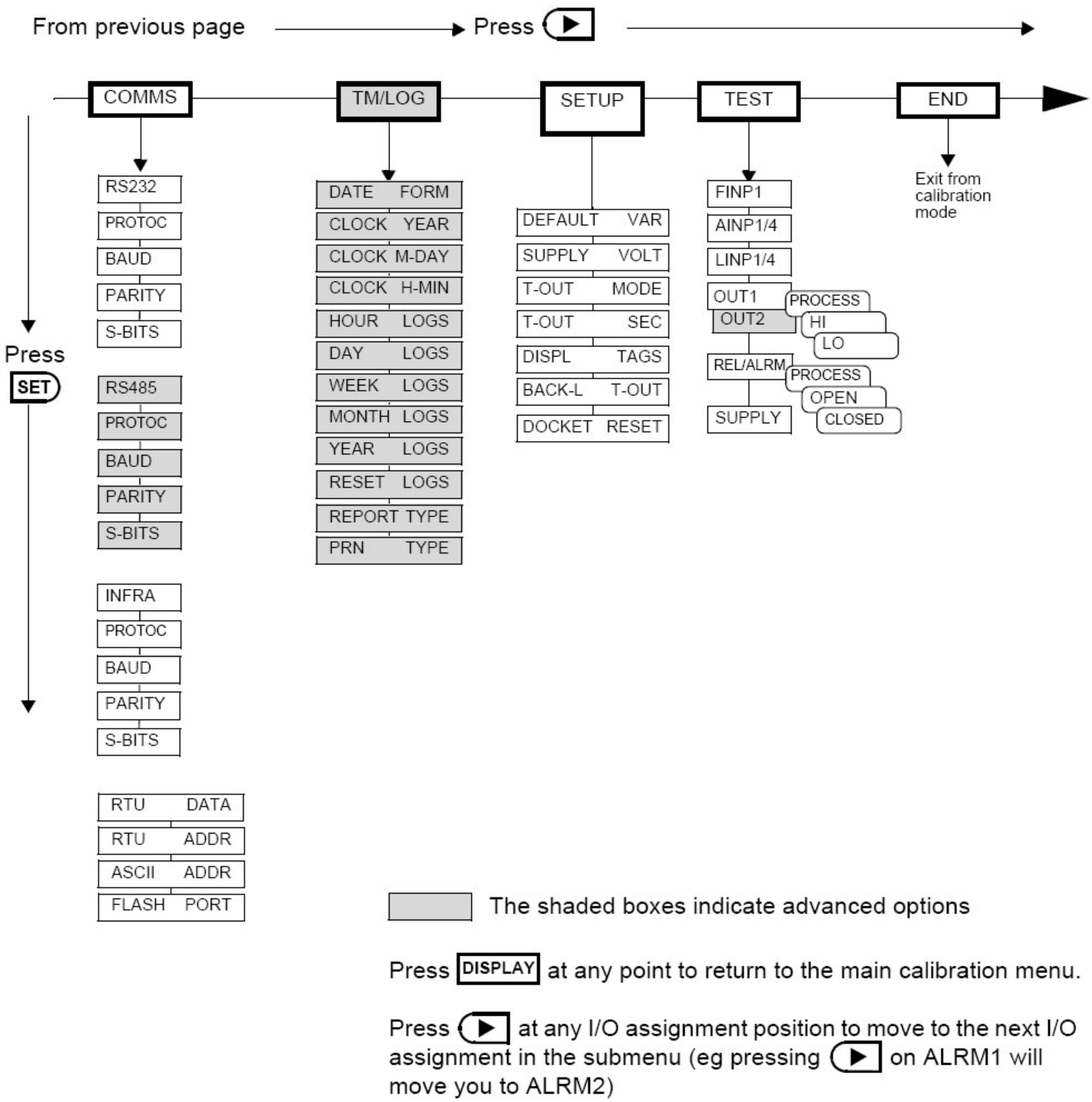

Figure 4–4. Calibration menu tree, sheet 2

Instrument Settings

Units of Measurement

The Units menu allows you to view and edit the units 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.

Table 4–3. Units menu

SET ↓	Comments
ITEM *n* *unit*	The units for main menu or calibration items can be viewed by pressing the SET key. The units of measurement are password protected. To edit, the correct password must be entered on entry to EDIT mode. Press the up or down arrow to select the required units. Refer to "Available Units of Measurement" (Appendix C) for the list of available units.
ACCEPT UNITS	This prompt will only appear if a unit has been changed. IMPORTANT: Accepting the change of units will initiate a master reset. All calibration parameters will revert to default values (i.e. those values included in the downloaded instrument software). All totals and any logged information will be cleared. Press the up or down arrow to select YES, and then press the SET key. The instrument makes three beeps to confirm the reset command. The message -RESET- PLEASE WAIT will be displayed as the instrument exits calibration mode and completes a full reboot sequence.

Parameters

The Parameters menu items are listed in the following table.

Table 4–4. Parameter menu items

SET ↓		Comments
DEFLT	*unit*	You can set this default period parameter to non-zero value for testing purposes (the instrument uses the default period value instead of the live pulse input when the default period is not equal to 0). You can also easily access the default period from the main menu by pressing and holding the SET key when displaying live period.
ATM-PR	*unit*	If the pressure sensor is configured as a Gauge type sensor, the instrument adds the atmospheric pressure to the measured pressure to determine the absolute pressure. Set the atmospheric pressure (absolute) according to the height above sea level. The commonly used value is 101.325 kPAA.
T-REF	*unit*	Enter the reference (base) temperature for the calculation of corrected density. The commonly used values are 15°C or 60°F.
P-REF	*unit*	Enter the reference (base) absolute pressure for the calculation of the corrected density. The commonly used value is 101.325 kPAA.
CALC	TYPE	Select the type of calculations (Equations of State) to suit the conditions and nature of the gas: IDEAL: Ideal Gas REDLICH: Redlich-Kwong (1949) SOAVE: Soave-Redlich-Kwong (1972) PENG: Peng-Robinson (1976) For more details on each calculation type, refer to "Calculations" in Chapter 2. Press the up or down arrow to select the calculation type as required.
DCF D-OFF	*unit* *unit*	Enter the density correction factor and the density offset. These parameters allow you to adjust line density by the use of a multiplier and a fixed offset: Used Density = Line Density * DCF + Doff.
VAR	INP-X INP-Y	Select a main menu variable to assign as the Input X (Y) to the pre-programmed user defined function look-up table. Note that the user defined function look-up table is constructed and downloaded from the Program Manager as part of the embedded software. The table provides two outputs (OUT-A and OUT-B) as main menu variables. Press the up or down arrow to select the variable as required.

SET ↓	Comments
K *unit*	Enter the density meter calibration factor.
D0 *unit*	Enter the density meter calibration constant (density).
T0 *unit*	Enter the density meter calibration constant (period).
TEMPCO *unit*	Enter the density meter temperature coefficient.
PRESCO *unit*	Enter the density meter pressure coefficient.
VIBDIM *unit*	Enter the density meter vibration element dimension.
ISENTR EXP	Enter the isentropic exponent of the gas required for density calculations.
Tc _0 *unit* Tc _A *unit*	This parameter is applicable when the calculation type is not Ideal Gas. Enter the base critical temperature of the gas. Some sample values are shown in "Properties of Selected Gases" (Appendix D).
Tc _B	This parameter is applicable when the calculation type is not Ideal Gas. Enter the critical temperature approximation coefficients (derived from the gas properties). The critical temperature will be calculated as the function of Specific Gravity (SG): Tc = Tc_0 * (1 + Tc_A * SG + Tc_B * SG * SG). This may allow for better approximation of the critical gas parameters. Set these coefficients to zero if no SG approximation is required.
Pc _0 *unit* Pc _A *unit*	This parameter is applicable when the calculation type is not Ideal Gas. Enter the base critical pressure of the gas. Some sample values are shown in "Properties of Selected Gases" (Appendix D).
Pc _B	This parameter is applicable when the calculation type is not Ideal Gas. Enter the critical pressure approximation coefficients (derived from the gas properties). The critical pressure will be calculated as the function of Specific Gravity (SG): Pc = Pc_0 * (1 + Pc_A * SG + Pc_B * SG * SG). This may allow for better approximation of the critical gas parameters. Set these coefficients to zero if no SG approximation is required.
ACENTR FACT	This parameter is applicable when the calculation type is Soave-Redlich-Kwong or Peng-Robinson. Enter the acentric factor of the gas.

Inputs

The Inputs menu items are listed in the following table.

Table 4–5. Inputs menu: Pulse input items

SET ↓	Comments
INPUT PERIOD PINP1	For this application, pulse input 1 is assigned to period.
SIGNAL PINP1	Pulse input 1 signal type. Press the up or down arrow to select COIL, NPS, or PULSE.
DBNCE PINP1	Switches and relays have metal contacts to make and break circuits. The contact bounce introduces random signals into the circuit. The instrument has a debounce circuit to eliminate this problem. Note: When the debounce circuit is enabled, the maximum input frequency for large amplitude signals is limited to approximately 500Hz. For low amplitude signals, the maximum frequency can be approximately 200Hz. Press the up or down arrow to select ENABLE or DISABLE.
CUTOFF PINP1	The cutoff is the lowest pulse frequency for which the instrument continues density calculations. The value for the cutoff is specified as the frequency of the pulse densitometer in Hz.
FILTER PINP1	Input fluctuations may create distortions in input readings. The instrument has a digital filter that can average 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 you can set.

Table 4–6. Filter response time

Filter Setting A	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
15	12	23
20	14	27
25	18	34
35	25	48

Filter Setting A	Seconds to Reach 90% of Full Swing	Seconds to Reach 99% of Full Swing
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 means that there is no filtering.

Figure 4–5. Inputs menu: Analog input 1 items

SET ↓	Comments
INPUT TEMP AINP1	For this application, analog input channel 1 is assigned to temperature.
TYPE AINP1	Select the type of analog input source. Press the up or down arrow to select 0–5 V, 1–5 V, 4–20 mA, PT100, PT500, or DEFAULT.
PT-DEF AINP1	The default point is a fixed value that the instrument uses when the input type is set to Default or Default Value On Exception has been chosen. You can use the default value instead of a sensor signal for testing purposes or if the sensor is faulty. You can set the default value during instrument commissioning so that it is available immediately if you select the default input type at a later date. Enter the value in the engineering units of assigned variable.
PT-MIN AINP1 PT-MAX	The Minimum Point and Maximum Point parameters are only for 0–5 V, 1–5 V, and 4–20 mA inputs. Enter the value of the measured parameter that corresponds to the minimum input signal level. The minimum point is commonly referred to as the base value. Enter the value of the measured parameter that corresponds to the maximum input signal level. The maximum point is the same as the base value (set at the minimum point) plus the span value. For example, if the source signal is 4 mA for a temperature of 10°C, enter 10 for the minimum point. If the source signal is 20 mA for a temperature of 200°C, enter 200 as the maximum point.

Table 4–7. Inputs menu: Analog input 2 items

SET ↓	Comments
INPUt PRESS AINP2	For this application, analog input channel 2 is assigned to pressure.
PRESS AINP2	Select the type of analog pressure sensor. For a gauge type sensor, the instrument adds the atmospheric pressure as defined in the Parameters menu. The pressure will be displayed as absolute or gauge, whichever is selected, and indicated with 'A' or 'G' at the end of the pressure units. However, the pressure value when logged or read via serial communications will always be absolute. Press the up or down arrow to select ABSOL or GAUGE.
TYPE AINP2	Select the type of analog input source. Press the up or down arrow to select 0–5 V, 1–5 V, 4–20 mA, or DEFAULT.
PT-DEF AINP2	The default point is a fixed value that the instrument uses when the input type is set to Default or Default Value On Exception has been chosen. You can use the default value instead of a sensor signal for testing purposes or if the sensor is faulty. You can set the default value during instrument commissioning so that it is available immediately if you select the default input type at a later date. Enter the value in the engineering units of assigned variable.
PT-MIN AINP2 PT-MAX	Enter the value of the measured parameter that corresponds to the minimum input signal level. The minimum point is commonly referred to as the base value. Enter the value of the measured parameter that corresponds to the maximum input signal level. The maximum point is the same as the base value (set at the minimum point) plus the span value. For example, if the source signal is 4 mA for a pressure of 1.000 MPa, enter 1.000 as the minimum point. If the source signal is 20 mA for a pressure of 5.000 MPa, enter 5.000 as the maximum point.

Table 4–8. Inputs menu: Analog input 3 items

SET ↓	Comments
INPUt USER AINP3	For this application, analog input channel 3 is assigned to user input.
TYPE AINP3	Select the type of analog input source. Press the up or down arrow to select 0–5 V, 1–5 V, 4–20 mA, or DEFAULT.
PT-DEF AINP3	The default point is a fixed value that the instrument uses when the input type is set to Default or Default Value On Exception has been chosen. You can use the default value instead of a sensor signal for testing purposes or if the sensor is faulty. You can set the default value during instrument commissioning so that it is available immediately if you select the default input type at a later date. Enter the value in the engineering units of assigned variable.
PT-MIN AINP3 PT-MAX	Enter the value of the measured parameter that corresponds to the minimum input signal level. The minimum point is commonly referred to as the base value. Enter the value of the measured parameter that corresponds to the maximum input signal level. The maximum point is the same as the base value (set at the minimum point) plus the span value.
EXCEPT VALUE	This option allows you to choose which value the instrument will use for the analog input that raised an exception. The exception message will continue to be displayed until the fault is rectified or the input type is set to Default in calibration set mode. Press the up or down arrow to select the value on exception as follows: NONE: Value will be set to zero. DEFAULT: Value will be set to the default point if exists, otherwise zero. BOUNDS: Value will be set to the boundary limit (min or max point).

Outputs

The Outputs menu items are listed in the following table.

Table 4–9. Outputs menu

SET ↓		Comments
VAR	OUT*n*	You can assign any of the main menu variables to the 4–20 mA outputs. Press the up or down arrow to select the variable that is required as an output.
PT-MIN PT-MAX	OUT*n* OUT*n*	The output minimum value corresponds to the 4 mA point and the output maximum value corresponds to the 20 mA point. Setting the output range differently from the input range enables the instrument to amplify the input signal. You can drive a chart recorder that “zooms in” on a specified range of values instead of displaying the full operating range of the transducer. For example, if temperature is chosen as an output variable and the engineering unit is °C, then setting the minimum point to 20 and the maximum point to 100 would reflect the temperature range of 20°C to 100°C. At values below the minimum and above the maximum points, the output remains at 4 mA and 20 mA respectively.

Alarms

The alarm relay(s) can be assigned to main menu variables such as temperature or set as an equipment failure alarm. The alarm switches on whenever an alarm condition exists and 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” later in this chapter.

Table 4–10. Alarms menu items

SET ↓		Comment
RELAY	ALRM*n*	Select a main menu variable to assign to the alarm relay. Note: If the alarm type is set to equipment alarm, this relay assignment setting is ignored. Press the up or down arrow to select the variable that is required as an alarm.

SET ↓	Comment
TYPE ALRM*n*	The options available for alarm types are as follows: HI-NO: High Alarm, Normally Open contacts HI-NC: High Alarm, Normally Closed contacts LO-NO: Low Alarm, Normally Open contacts LO-NC: Low Alarm, Normally Closed contacts BD-NO: Band Alarm, Normally Open contacts BD-NC: Band Alarm, Normally Closed contacts AL-NO: Equipment Alarm, Normally Open contacts AL-NC: Equipment Alarm, Normally Closed contacts Press the up or down arrow to select the type of alarm required.
POINT ALRM*n*	The Alarm Setpoint is available for viewing and editing 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 Low alarm.
HYST ALRM*n*	The Alarm Hysteresis is available for viewing and editing for any alarm type except equipment alarms. Alarm hysteresis loops occur when the alarm toggles continuously on and off when the process variable is close to the setpoint. For a high alarm, the alarm activates when the value of the variable rises above the alarm setpoint and deactivates when the value falls below the alarm setpoint minus the amount of the hysteresis setting (if any). For a low alarm, the alarm activates when the value of the variable falls below the alarm setpoint and deactivates when the value rises above the alarm setpoint plus the amount of the hysteresis setting (if any). For a band alarm, the alarm activates whenever the value of the variable is outside the setpoint plus or minus the amount of the hysteresis. For example, with a high alarm setpoint of 200, and a hysteresis setting of zero, a value oscillating between 197 and 202 will cause the alarm to toggle on at 200 and toggle off below 200. However, if the hysteresis is set to 5, the value of the variable must fall below 195 to cancel the alarm. The alarm will reactivate only when the value again rises above 200.

Communications

The instrument has three communication ports:

- Infrared RS232 port: Located on the front panel, below the status indicators.
- RS232 port: A DB9 female connector on the rear panel of the instrument.
- RS485 port: Terminals on the rear panel.

Table 4–11. Comms menu items

SET ↓	Comment
PROTOC RS232 RS485 INFRA	The communications protocols can be assigned to the communication ports as follows (a protocol cannot be assigned to more than one port at a time): ASCII:-Simple ASCII, available for all ports 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 the up or down arrow to select the desired protocol.
BAUD RS232 RS485 INFRA	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. Press the up or down arrow to select 2400, 4800, 9600, or 19200 baud.
PARITY RS232 RS485 INFRA	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 the up or down arrow to select EVEN, ODD, or NONE.
S-BITS RS232 RS485 INFRA	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 the up or down arrow to select 1 or 2 stop bits.
RTU DATA	The Modbus RTU data format for the 2-register (4-byte) values can be set as either floating point or long integer values. Use the up or down arrows to select FLOAT or INTEGER.

SET ↓	Comment
RTU ADDR	The Modbus RTU protocol address must be in the range of 1 to 247. When multiple instruments (slaves) are connected to one communication device (master), each assigned address must be unique. Note: The master device uses the RTU address 0 (zero) for broadcasting to all connected slave units.
ASCII ADDR	The ASCII protocol address identifies each communicating device. The address must be in the range of 1 to 255. When multiple instruments (slaves) are connected to one computer (master), each assigned address must be unique.
FLASH PORT	The flash driver port assignment defines the communication port for downloading software into the instrument. The default setting of this assignment is the RS232 port. Press the up or down arrow to select RS232, RS485, or INFRA.

Time Settings & 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 five 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 restarts 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 of hours, days, weeks, months, and years. 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

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 also determine the number of records to be included in a report printout if the printing option is used.

Table 4–12. TM/LOG menu items

SET ↓	Comment
DATE FORM	Clock / Date format. The European date format is dd/mm/yyyy or (day-month). The American date format is mm/dd/yyyy or (month-day). Press the up or down arrow 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.
HOUR LOGS	Set the number of hourly logs to appear on the printed log report. The hourly log entry occurs at 00 minutes each hour.
DAY LOGS	Set the number of daily logs to appear on the printed log report. The daily log entry occurs at 00 hours and 00 minutes each day.
WEEK LOGS	Set the number of weekly logs to appear on the printed log report. The weekly log entry occurs at 00 hours and 00 minutes each Monday.

SET ↓	Comment
MONTH LOGS	Set the number of monthly logs 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.
YEAR LOGS	Set the number of yearly logs 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.
RESET LOGS	Reset the logged data. You may need to reset (clear) the logged data if you change the time / log settings. Press the up or down arrow to select YES, and then press the SET key. The instrument makes three beeps to confirm the reset command.
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 (0 hr – 23 hr, minimum 48 hourly logs required) Press the up or down arrow to select report type.
PRN TYPE	The Printer Protocol Printer Type allows you to specify the nature of the printer being used. 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 the up or down arrow to select printer type.

General Setup Parameters

The Setup menu items are listed in the following table.

Table 4–13. Setup menu

SET ↓	Comments
DEFAULT VAR	If the display timeout is enabled, the instrument displays the default variable when there is no user action for the period of the display timeout period. Press the up or down arrow to select the default variable display.
SUPPLY VOLT	The instrument provides a power-limited supply for external transducers. Press the up or down arrow 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 as it returns the display to a preferred variable after you have finished reading other information. Additionally, it cancels the calibration mode and returns to the default display if you do not exit from the calibration mode for any reason. Press the up or down arrow to select the display timeout function. The following selections are available: 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.
DISPL TAGS	The display tags option determines whether the instrument displays the default display tags or the user-defined tags. The display tag setting also defines whether the instrument displays the default error and warning messages or the user-defined messages. Note: The user-defined tags can be entered into the instrument only by the manufacturer or the distributor. Press the up or down arrow to select the display tags option as follows: DEFAULT: The instrument displays the default (English) tags USER: The instrument displays the user-defined tags

SET ↓	Comments
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 the up or down arrow to select ENABLE or DISABLE.
DOCKET RESET	The docket reset function resets the numbering of printed dockets. Press the up or down arrow to select YES, and then press the SET key. The instrument makes three beeps to confirm the reset command.

Test Menu

The Test menu enables you to view the inputs and outputs to and from the instrument. In Calibration Set mode, enter the program password, and you can control the outputs and the alarms as described in the table below.

Table 4–14. Test menu

SET ↓	Comments
PINP1 uS	The period of the pulse input to PINP1 is displayed in microseconds.
AINP*n* *units*	The units are displayed according to the calibration setup for the analog input. If unused or set to default, the input is 4–20 mA and displayed in mA.
LINP*n* STATE	You can view the state of the logic inputs. If the input is an open contact or inactive it will display HI. If the input is a closed contact or active it will display LO.
OUT*n* STATE	You can control the state of the outputs. Press the up or down 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 (normal operation). HI: The output is set to 20 mA. LO: The output is set to 4 mA.
ALRM*n* STATE *or* REL-*n*	You can control the state of the relays (alarms). Press the up or down 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 (normal operation). OPEN: The relay output contacts are set to “open”. CLOSED: The relay output contacts are set to “closed”.

SET ↓	Comments
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, it may indicate that the output is overloaded.

System Messages

The instrument displays messages for defined events and fault conditions. The manufacturer or distributor can enter user-defined text for the messages. This user-defined text is displayed, instead of the default (English) messages, when the display tags option in the Setup menu is set to USER.

Error Messages

Failure of Analog Input Sensor

If there is a failure of an analog input sensor for a process parameter such as temperature or pressure, the instrument displays the relevant error message and can be programmed to set the value of that parameter to 0 or the boundary limit. The input sensor and connections need to be inspected and may require replacement. The instrument also sets the results of calculations that depend on the failed input(s) to 0 when the input value defaults to 0.

Default Value on Exception

If Default Value on Exception has been enabled in the INPUTS section of calibration, the default value will automatically be used so that all calculations can continue. The error message will still continue to scroll across the display until the fault is corrected at which point the calculations will revert to using the live input.

Override Error Condition

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

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

Table 4–15. Error messages

Error Message	Description
CPU Card Failure	There are failed components on the CPU card and technical support is required.
Power Supply is Low	The input and / or output power supply voltage is too low. Ensure that: (a) Input power supply voltage is within the specified range. (b) Output power supply is not overloaded.
New/Failed Battery – Set Time	The real-time clock has lost the correct time because the battery has failed or there is a new battery. Set the current time and date (in the TM/LOG menu) to clear the error message and to continue data logging at the correct times. Note: The instrument can continue operating with a failed battery, but the correct time will be lost if there are interruptions to the power supply.
Temperature Sensor Failure	The temperature sensor (analog input 1) has failed. To deactivate the error, the analog input signal type can be set to Default to use a programmed default value instead of the sensor signal.
Pressure Sensor Failure	The pressure sensor (analog input 2) has failed. To deactivate the error, the analog input signal type can be set to Default to use a programmed default value instead of the sensor signal.
User Sensor Failure	The user sensor (analog input 3) has failed. To deactivate the error, the analog input signal type can be set to Default to use a programmed default value instead of the sensor signal.
Temp/Pressure is Out of Range	The temperature and / or pressure inputs are outside of the allowed calculation range.
Invalid Reference Parameter	The reference parameter is outside of the allowed range. The reference temperature and pressure (specified in the Parameters menu) should be programmed within the defined calculation limits for the chosen fluid.
Invalid Gas Property	The gas property is outside of the allowed range.

Warning Messages

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

Table 4–16. Warning messages

Warning Message	Description
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.

Chapter 5
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:

- Infrared RS232 port: Located on the front panel, below the status indicators.
- RS232 port: A DB9 female connector on the rear panel of the instrument.
- RS485 port: Terminals on the rear panel.

The appropriate interface and protocols are selected during calibration.

Infrared RS232 Port

The infrared RS232 port is located on the front panel of the instrument. The port uses the Infrared Developers Association (IrDA) physical layer format of signal encoding and decoding. The nature of the infrared port requires the communicating device to be located close to the front of the instrument. Therefore, its main use is for reloading the instrument application software or occasional collection of data, rather than continuous communications.

RS232 Port

The RS232 port with DB9 connector 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 connect directly 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 5–1.

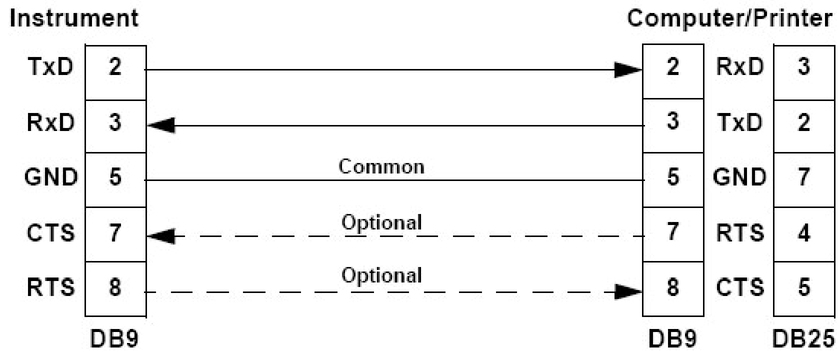

Figure 5–1. RS232 cable connections to a computer

Note The instrument requires a cable with straight-through connections. Do not use a null modem cable for RS232 connection to a computer. ▲

RS485 Port

The RS485 port enables communication with multiple devices. Each device has a unique address so that the master device can communicate with specific slave devices.

On RS485 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 multi-drop configuration as shown in the following figure. Up to 32 units can be connected to the interface at a maximum distance of 1200 meters.

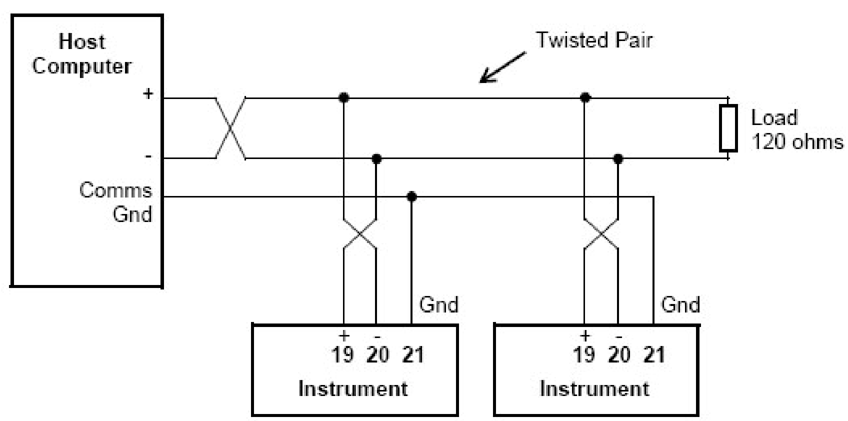

Figure 5–2. RS485 connections

Protocols

The communication protocols listed below are available. Each protocol is discussed in further detail later in this chapter

- ASCII: Simple ASCII, available for all ports. In this ASCII protocol, each command and response is a string of ASCII characters. The main advantages of this mode are that it allows extended time intervals to occur between characters without causing a timeout error and messages can be sent and monitored easily with a simple ASCII terminal.
- RTU: Modbus RTU, available for all ports. Modbus RTU is an industry-standard protocol that 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.
- PRN: Printer Protocol, available for RS232 and RS485. Choose from a selection of printer types.
- 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. ▲

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:

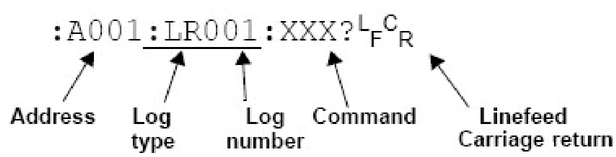

Figure 5–3.

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.

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

Log Type & Number

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

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

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

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

- LH: hourly log
- LD: daily log
- LW: weekly log
- LM: monthly log
- LY: yearly log
- LE - last edit log

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 9:00 AM and 10:00 AM, the most recent hourly log LH001 was recorded at 9:00 AM. Therefore, LH002 is for 8:00 AM, and LH003 is for 7:00 AM. After 10:00 AM in this example, LH003 becomes the 8:00 AM log.

Instrument Responses

The instrument response time to any inquiry is not more than 300 ms. Responses from the instrument are in the following format:

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

The components of the response message are described in the following sections.

Header

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

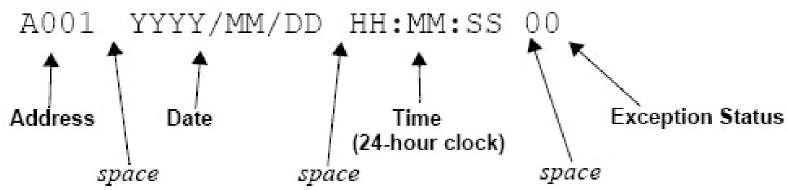

Figure 5–4. Header format

The 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" later in this chapter.

Data

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

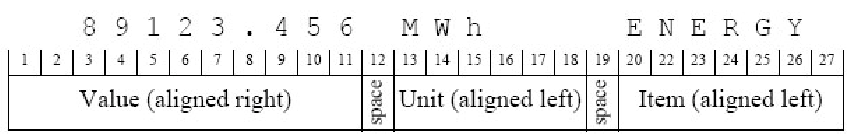

Figure 5–5. Data format

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.

Figure 5–1. Variables request

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

Variables Request & Response Example

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

```
:A001:RVA?<LF><CR>
```

A hypothetical instrument response is shown on the following page.

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

Log Request

The log request asks the instrument how many logs it stores in the particular time base. These are the values described in “Time Settings and Data Logging” in Chapter 4.

Table 5–17. Log request

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-time based logging)

Log Request & Response Example

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

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

The instrument response would be similar to the following:

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

Clear Data Request

The clear data request asks the instrument to clear the data in the selected registers. There is one clear data request command:

:RCL? – Clear the logs except for the "last edited" log

Clear Data Request Example

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

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

The instrument response would be similar to the following:

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

Instrument Information Request

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

:RIG? – Return the general information about the instrument such as the model number, application number, version and serial numbers. These items are returned as a block in the same format as shown on the display in the Model Info menu.

Instrument Information Request Example

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

```
:A001:RIG?LFCR
```

The following is an example of an instrument response:

```
A001 2002/03/14 18:25:00 00LFCR
515    MODEL  -11-F-LFCR
SC01   INPUT  F-TP--LFCR
SC01   VERS  0101.001LFCR
CUSTOM VERS   000001LFCR
UNIT   S/N    123456LFCR
LFCR
|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 inquiry.

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 functions codes.

Table 5–18. 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 listed in the following table.

Table 5–19. Exception codes

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 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.

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 & 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.

Table 5–20.

Register	Name	Comments	R or R/W	Type
1	Density (Line)	Process Variables	R	DT*
3	Period		R	DT
5	Density (Ref)		R	DT
7	Temperature		R	DT
9	Pressure		R	DT
11	Specific Gravity		R	DT
13	Z-Factor (Line)		R	DT
15	Z-Factor (Ref)		R	DT
17	Molecular Weight		R	DT
19	Critical Temperature		R	DT
21	Critical Pressure		R	DT
23	User Input		R	DT
25	User Output A		R	DT
27	User Output B		R	DT
29	Reserved	Current Date/Time or Logged Date/ Time Stamp (see register 38).	R	DT
31	Year		R / W	I†
32	Month		R / W	I
33	Date	Only current Date/Time can be edited.	R / W	I
34	Hour		R / W	I
35	Minute		R / W	I
36	Second		R	I
37	Log Type	00 = hourly or log records 01 = daily 02 = weekly 03 = yearly 05 = last edit of calibration	R / W	I
38	Log Number	If set to 0, current variables and Date / Time are retrieved	R / W	I
39	Clear Data	01 = clear logs	W	I
40	Reserved			

*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 registers. See the table below. ▲

Table 5–21.

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.

Instrument Exception Status

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

Table 5–22.

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

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

Instrument Control & I/O

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

Table 5–23.

Register	Name	Comments	R or R/W	Type
42	Reserved			
43	Logic Inputs	0 to 15 Binary representation of logic inputs B0 = 0/1 (LSB), input 1 activated / deactivated B1 = 0/1, input 2 activated / deactivated B2 = 0/1, input 3 activated / deactivated B3 = 0/1, input 4 activated / deactivated	R	I
44	Operation Mode	Representation of operation mode 0 = Idle / Local Idle state	R	I
45	Relay State	0 to 15 Binary representation of relay state 0 = open; 1 = closed B0 = relay 1 (LSB) B1 = relay 2 B2 = relay 3 B3 = relay 4	R	I*
46	Relay Control	0 to 15 Binary representation of relay control. 0 = open; 1 = closed B0 = relay 1 (LSB) B1 = relay 2 B2 = relay 3 B3 = relay 4	R/W	I
47	Relay Control Source	0 to 15 Binary representation of relay control source. 0 = local (controlled by instrument operation); 1 = RTU (controlled by Modbus register 46) B0 = relay 1 (LSB) B1 = relay 2 B2 = relay 3 B3 = relay 4	R/W	I
48	Reserved		R	L†
51 to 99	Reserved			

Register	Name	Comments	R or R/W	Type
101	Analog In. 1	Raw analog input data. 4–20 mA inputs are read in amperes. 0–5 V or 1–5 V inputs are read in volts. RTD inputs are read in Kelvin. Unused inputs are configured as 4–20 mA.	R	DT‡
103	Analog In. 2		R	DT
105	Analog In. 3		R	DT
107	Analog In. 4		R	DT

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

†L = Long Integer (2 register = 4 bytes)

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

Printer Protocol

A printer protocol is available in the Sarasota CM515. It provides the ability to print out live data, individual logged data, and some report-style printing of logged data. Printing methods and formats are described below.

Note Printer output is only available with the real-time clock option. ▲

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 is available at the end of the TM-LOG calibration menu.

Report Types

The report types are listed below.

- 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 (0–23 hr, minimum 48 hourly logs required)

The number of logs printed in each report is determined by the values programmed in the TM-LOG menu.

Printer Types

The available printers are listed below.

- 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 four header lines and three 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, contact Thermo Fisher.

Types of Printouts

Live Data

The down arrow, 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. A format sample is provided below.

```
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
Variable            unit    value
Variable            unit    value
etc.

Custom Footer Line 1
Custom Footer Line 2
Custom Footer Line 3
-------------------------------------------   <separation line>
```

Note Blank header and footer lines are not printed. ▲

Docket Number

The docket number that appears on the live data printout indicates the print number. The Docket Reset parameter allows you to clear this number if required.

DOCKET No.   000256

Instrument Serial Number & Unit Tag

The instrument serial number and unit tag is the same as the information shown in the Model Info menu (Chapter 3).

Individual Log Data

When in the Log Menu, hold the DISPLAY key to view the data of the log of interest, and press the down arrow 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. The format of the printout is the same as the live data printout, which is shown below.

```
Custom Header Lines

Instrument Serial No. & Tag

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

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

Log Report Printing

As there is the likelihood that the reports can be of a considerable length, it is strongly recommended that only the 80 column printer with Z fold (tractor feed) paper be used. This is just as much for the memory storage of 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. A sample of log report format is shown on the following page.

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
Variable unit value
etc.

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

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

ETC

Custom Footer Lines
-- *<separation line>*

Reports will print in the historical order, and for those logs that have no data (unit was powered off at the time, for example), the print will show "Data not available" as shown below.

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

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

-- *<separation line>*
Log No. Date & Time & Status
Variable unit value
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 0 hour to 23 hour 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 Sarasota CM515 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 being engaged, or power being removed. The specific behavior 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 communication timeout expires, the print will commence.

COMMS TIMEOUT

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

- If the flow of data is stopped due to software or hardware handshaking and is not allowed to resume before the communications timeout.
- If the printer type is PRN-03 Slip printer and a paper status is requested but no response is received within the timeout period.
- 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.

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Chapter 6

Troubleshooting Sarasota SG901 / CM515 Density Systems

This chapter provides basic troubleshooting steps for problems that may arise when using the Sarasota CM515 density converter with the Sarasota SG901 with frequency output.

Warning This section provides troubleshooting guidance to instrument technicians experienced with working on process instruments with low and medium voltage supplies, intrinsically safe or explosion proof / flame proof protected equipment, and connections to pressurized gas systems. It is assumed that the user is qualified to work on these types of instruments without specific warnings of electric shock or high pressure gas release hazards. ▲

The Sarasota SG901 consists of three instruments combined with a sample system, which has various options and an optional electric heater or steam enclosure heater mounted in a cabinet. These instruments are:

- Thermo Scientific Sarasota FD900 density meter
- PT100 thermometer element included in the density meter
- Pressure transmitter

Note Users should be familiar with operating the Sarasota CM515 and Sarasota SG901 and with servicing the Sarasota FD900. Refer to the user guides for each instrument (HB-CM515-DG01, HB-SG901, and HB-ID/ FD900). ▲

Note It is assumed that the system is in service and has product running through it. ▲

Table 6–1. Troubleshooting steps for Sarasota SG901 / CM515 density systems

Symptom	Possible Fault	Resolution / Further Investigation
Sarasota CM515 display is blank or backlight is not on.	- No power to instrument. - Display is configured to switch off after a predetermined time.	- If there is no power to the instrument the RUN LED will not be lit. In this case, check power at the terminal connections. - If power is available at the terminals, check the DC voltage available at the EXC V terminals (with respect to Ground). If voltage is available here, the PSU is operational. - If voltage is not available, the PSU is faulty and requires repair. - If power is available and the RUN LED is lit, press the **DISPLAY** key. If the display comes on, it is likely that it is configured to go off after a set period of inactivity. Change the configuration to disable display timeout.
System gives Zero reading for SG.	- Density calculated value is zero or negative.	- If the main density is zero, check the period input. If the period input is close to the expected period (read from the calibration sheet), check if pressure and temperature readings are within the expected ranges. If the period, pressure, and temperature readings are in the correct ranges, verify the entered constants T0, D0, K, TC, and PC are correct as per the calibration sheet 1 (constants for 15°C). - If the temperature is in gross error, check the thermometer connections and configuration. - If the connections are correct at the Sarasota CM515, check the configuration. Also verify the thermometer values are correct at the meter connections (WY and XZ).
System gives Zero reading for SG.	- Temperature is in gross error. - Pressure reading is –ve.	- If the temperature is in gross error, check the thermometer connections and configuration. - If the connections are correct at the Sarasota CM515, check the configuration. Also verify the thermometer values are correct at the meter connections (WY and XZ). Check that any fitted barriers are continuous (no blown barriers fuses).
System gives Zero reading for SG.	- Pressure input is incorrect.	Check the following: - Input is connected correctly. - Voltage available at the pressure transmitter terminals is greater than 8 volts. - Any fitted barriers are continuous (no blown barrier fuses). - Configured Full Scale and Zero are correct and the input is not set to default.
System gives Zero reading for SG.	- Period reads Zero or grossly outside expected values.	Check the following: - Voltage at the density meter terminals exceeds 10 volts. - The density input default value is set to zero (if a non-zero value is set, the meter will use the default value).

<table>
<tr><th>Symptom</th><th>Possible Fault</th><th>Resolution / Further Investigation</th></tr>
<tr><td>System gives wrong value for SG.</td><td>- One of the three inputs (pressure, temperature, density) is in error.</td><td>- Check that displayed density ($D_{(Line)}$) is the expected value for the process gas at the system pressure and temperature.
- Check that $D_{(Ref)}$ is approximately equal to:
$$D_{(Ref)} = D_{(Line)} \times \frac{P_{(Ref)}}{P_{(Line)}} \times \frac{T_{(Line)}}{T_{(Ref)}}$$
where P and T are in absolute values.
If $D_{(Ref)}$ is not within 1% of the calculated $D_{(Ref)}$ check the values Z and $Z_{(Ref)}$.</td></tr>
<tr><td>System gives abnormal Z and $Z_{(Ref)}$.</td><td>- Z or $Z_{(Ref)}$ is outside the range 0.98 to 1.2.</td><td>- A gas equation of state other than “Ideal” has been chosen, but Critical Pressure (Pc), Critical Temperature (Tc), or Acentric factor has not been set correctly. Either set the parameters or choose “Ideal” equation. If “Ideal” is chosen, Z and $Z_{(Ref)}$ will default to 1.</td></tr>
<tr><td>None of the above symptoms are apparent but the system gives excessive errors.</td><td>- Basic Density is in error.</td><td>- Check that VIBDIM constants (Set 1) are in use and that VibDim is per the calibration sheet and in the correct units.
- Check that DCF = 1 and D_{off} = 0 (unless the unit history shows that the density output has been adjusted during validation).
- If the above are not at fault, the meter should be cleaned and put back in service.</td></tr>
<tr><td>None of the above symptoms are apparent but the system gives excessive errors.</td><td>- Pressure is in error.</td><td>- If the pressure transmitter calibration is suspect, then recalibrate the pressure transmitter by connecting a reference pressure transmitter or indicator to the Validation gas input. Note that the reference indicator must have an accuracy of 0.1% and be in absolute units. Adjust the pressure using the input pressure regulator, and compare the Sarasota CM515 pressure reading to the indicator reading.
- The Pressure input can be corrected by setting the full scale pressure to the full scale indicated by the indicator at 20 mA output from the pressure transmitter. The Zero value can be calculated from:
$$Zero = Fs - \left[16 \times \frac{(Fs - Ap)}{(Fs_{mA} - Ap_{mA})}\right]$$
Where:
Fs = Measured full scale in Engineering Units at 20 mA
Ap = Measured Atmospheric Pressure in Engineering Units
Fs_{mA} = 20 mA
Ap_{mA} = mA at Atmospheric Pressure</td></tr>
</table>

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Chapter 7
Contact Information

If the unit is not performing satisfactorily, the local representative is your first contact for support and is well equipped to answer questions. You can also contact Thermo Fisher directly for application assistance.

Process Instruments		
1410 Gillingham Lane Sugar Land, TX 77478 USA +1 (800) 437-7979 +1 (713) 272-0404 direct +1 (713) 4573 fax	14 Gormley Industrial Avenue Gormley, Ontario L0H 1G0 CANADA +1 (905) 888-8808 +1 (905) 888-8828 fax	Unit 702-715, 7/F Tower West Yonghe Plaza No. 28 Andingmen East Street, Beijing 100007 CHINA +86 (10) 8419-3588 +86 (10) 8419-3580 fax
A-101, 1CC Trade Tower Senapati Bapat Road Pune 411 016 Maharashtra, INDIA +91 (20) 6626 7000 +91 (20) 6626 7001 fax	Ion Path, Road Three Winsford, Cheshire CW7 3GA UNITED KINGDOM +44 (0) 1606 548700 +44 (0) 1606 548711 fax	
www.thermoscientific.com		

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Appendix A
Model Information

Product Codes

Table A–1. Product codes for Sarasota CM515-DG01 (gas applications)

Code	Model Description
CM515111-110	Sarasota CM515 density converter configured for 110 Vac Must be located in a non-hazardous area, 95–135 Vac/190–260 Vac, 50/60 Hz single phase (voltage switchable). DC power connections included, 12–28 Vdc. Includes 4 inputs: 1 density meter frequency input and 3 analog inputs for temperature, pressure, and misc. user. Backlit display panel. LCD backup. Infrared RS232, RS232 with DB9 connector, and 2-wire RS485 with terminal connections. Clock and logging. Four electromechanical output relays.
CM515111-220	Sarasota CM515 density converter configured for 220 Vac Must be located in a non-hazardous area, 95–135 Vac/190–260 Vac, 50/60 Hz single phase (voltage switchable). DC power connections included, 12–28 Vdc. Includes 4 inputs: 1 density meter frequency input and 3 analog inputs for temperature, pressure, and misc. user. Backlit display panel. LCD backup. Infrared RS232, RS232 with DB9 connector, and 2-wire RS485 with terminal connections. Clock and logging. Four electromechanical output relays.
Code	Enclosure
N/A	Panel mount enclosure (standard)
515.2X	NEMA 4X enclosure
EX-410LS-5	Explosion proof enclosure with metric glands, ATEX/SAA
EX-410LC-5	Explosion proof enclosure with NPT glands, CSA
020050C1-AV12B	Heater, 110 Vac/40 W for CSA and ATEX enclosure
020050C2-AV12B	Heater, 220 Vac/40 W for CSA and ATEX enclosure

Table A–2. Spare parts

Part Number	Description
S515CPU	CPU and power supply PCB
S515OPT-0	Standard with RS232, 2 relays, 1 output channel, logic in
S515OPT-1	Advanced outputs with RS485 and clock
S515M	Aluminum case

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.

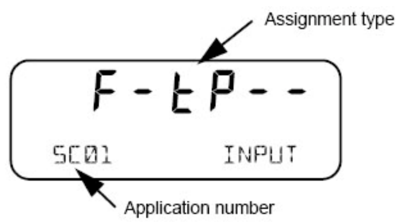

Figure A–1. Application information code

The application information code is returned as part of a general instrument request, as described in “Instrument Information Request” in Chapter 5.

The application number identifies the application. **SC01** indicates a steam flow computer for frequency flowmeter, and **GN02** indicates a natural gas flow computer for analog flowmeter.

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.

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

The codes are listed in the following table.

Table A–3. Application codes

Code	Description
-	Not used in this application
A	Indicates a generic analog input such as level
d	Indicates a density input
F	Indicates a generic flow input such as for volume or mass (frequency or analog)
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

Looking at the example below, you can determine that the instrument has frequency input 1 (FINP1) assigned to a flow input, analog input 1 (AINP1) assigned to a temperature input, and analog input 2 (AINP2) assigned as a pressure input. The other inputs are not used.

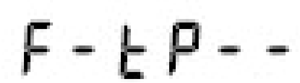

Figure A–2. Interpreting an application information code

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Appendix B
Specifications

Results may vary under different operating conditions.

Table B–1. Physical specifications

Dimensions (W x H x D)	147 x 74 x 167 mm (5.8 x 2.9 x 6.6 in)
Net weight	Typically 2.7 kg (6 lb)
Display	Backlit LCD with 7-digit numeric display and 11-character alphanumeric display Update rate of 0.3 seconds
Environmental rating	IP65 (NEMA 4X) when panel mounted
Ambient temperature range	-20°C to +60°C (-4°F to +140°F) conformal coating; +5°C to +40°C (+41°F to +104°F)
Ambient humidity	Up to 95% non-condensing
Data storage	Configuration settings and data retained in non-volatile storage
Communications	Infrared RS232, RS232 with DB9 connector, and 2-wire RS485 with terminal connections, baud rate 2400 to 19200 Protocols: ASCII, Modbus RTU, printer
Power	95–135 Vac; 190–260 Vac; 12–28 Vdc

Table B–2. Functional specifications

Frequency Input	
Range	0–10 kHz
Overvoltage	30 V maximum
Update time	0.3 s
Cutoff frequency	Programmable
Configuration	Pulse, coil, or NPS input
Non-linearity	Up to 10 correction points

Table B–2, cont.

Analog Input	
Overcurrent	100 mA absolute maximum rating
Update time	< 1.0 s
Configuration	RTD, 4–20 mA, 0–5 V and 1–5 V input
Non-linearity	Up to 20 correction points (flow inputs)
RTD input	Sensor type: PT100 and PT500 to IEC75 Connection: 4-wire Range: -200° to 350°C (-328°F to +662°F) Accuracy: 0.1°C typical
4–20 mA input	Impedance: 100 ohms (to common signal ground) Accuracy: 0.05% full scale (+ 20°C), 0.1% (full temperature range, typical)
0–5 or 1–5 V input	Impedance: 10 Mohms (to common signal ground) Accuracy: 0.05% full scale (+ 20°C), 0.1% (full temperature range, typical)
Logic Input	
Signal type	CMOS, TTL, open collector, reed switch
Overvoltage	30 V maximum
Relay Output	
Number of outputs	2 relays, plus 2 optional relays
Voltage	250 Vac, 30 Vdc maximum (solid state relays use AC only)
Current	3 A maximum
Transducer Supply	
Voltage	8–24 Vdc, programmable
Current	70 mA @ 24 V, 120 mA @ 12 V maximum
Protection	Power limited output
Isolated Output	
Number of outputs	1 configurable output, plus 1 optional
Configuration	Pulse/digital output: Signal type: open collector Switching: 200 mA, 30 Vdc maximum Saturation: 0.8 volts maximum 4–20 mA output: Supply: 9–30 Vdc external Resolution: 0.05% full scale Accuracy: 0.05% full scale (+20°C), 0.1% (full temperature range, typical)

Table B–3. Compliance

Quality Assurance	ISO 9001:2000
CE Mark	Compliant
Electromagnetic Compatibility (EN 61326:1997)	Compliant
Low Voltage Directive	Compliant
Approvals	ATEX, FM, CSA, and SAA approved enclosures available for hazardous areas

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Appendix C
Available Units of Measurement

The following is a list of the available units of measurement used across the range of Sarasota CM515 applications.

Table C–1.

Units Type	Available Units of Measurement
Volume	m^3, km^3, ltr, gal, KGal, MGal, ft^3, kft^3, Mft^3, bbl
Volume flow rate	m^3/s, m^3/min, m^3/h, m^3/D, L/s, L/min, L/h, Gal/s, Gal/min, Gal/h, KGal/D, MGal/D, ft^3/s, ft^3/min, ft^3/h, Mft^3/D, bbl/s, bbl/min, bbl/h, bbl/D
Volume K-factor	P/m^3, P/Ltr, P/Gal, P/ft^3, P/bbl
Mass	kg, g, Ton, lb, Klb
Mass flow rate	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, Klb/D
Mass K-factor	P/kg, P/g, P/Ton, P/lb, P/Klb
Energy	kJ, MJ, GJ, kWh, MWh, kBTU, Ton.h, therm, cal, kcal, Mcal
Power	kJ/h, MJ/h, GJ/h, kW, MW, kBT/M, kBT/h, Ton, therm/min, therm/h, kcal/h, Mcal/h
Energy K-factor	P/kJ, P/kWh, P/kBTU, P/Ton.h, P/therm, P/kcal
Temperature	Deg K, Deg C, Deg F, Deg R
Pressure	Pa, kg/m^2, kg/cm^2, kPa, MPa, mbar, bar, psi, Atm, inH_2O, mmH_2O
Density	kg/m^3, kg/Ltr, lb/ft^3, SG60F
Specific volume	M^3/kg, L/kg, ft^3/lb
Specific enthalpy	kJ/kg, BT/lb, cal/g, cal/kg, kcal/kg, Mcal/kg
Reynolds Number	E+0, E+3, E+6 (scaling for unitless variable)
Length (Level)	M, mm, cm, INCH, FOOT
Velocity	m/s, m/M, m/h, ft/s, ft/M, ft/h
Length K-factor	P/m, P/cm, P/INCH, P/FOOT
Area	M^2, ft^2
Ratio	%

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Appendix D
Reference Tables

Table D–1. Properties of Selected Gases

Gas	Specific Gravity	Critical Temperature		Critical Pressure		Acentric Factor
	SG	**°C**	**°F**	**kPa**	**psia**	**ω**
Acetylene	0.8990	35.15	95.27	6114	886.76	0.189
Air	1.0000	-140.90	-221.62	3747	543.46	0.035
Ammonia	0.5880	132.25	270.05	11353	1646.61	0.257
Argon	1.3793	-122.29	-188.12	4898	710.39	-0.002
Butane	2.0054	151.97	305.55	3796	550.56	0.200
Carbon Dioxide	1.5196	30.97	87.75	7374	1069.51	0.225
Carbon Monoxide	0.9671	-140.30	-220.54	3494	506.76	0.045
Chlorine	2.4482	143.85	290.93	7700	1116.79	0.069
Ethane	1.0382	32.17	89.91	4872	706.62	0.099
Ethylene	0.9686	9.19	48.55	5041	731.14	0.087
Helium	0.1381	-267.96	-450.32	227	32.92	-0.390
Hydrogen	0.0696	-240.17	-400.30	1293	187.53	-0.217
Hydrogen Chloride	1.1898	51.54	124.78	8310	1205.26	0.132
Hydrogen Sulfide	1.1767	100.25	212.45	8963	1299.97	0.090
Methane	0.5559	-82.59	-116.66	4599	667.03	0.011
Neon	0.6969	-228.75	-379.75	2760	400.30	-0.016
Nitrogen	0.9672	-146.95	-232.51	3398	492.84	0.037
Nitrous Oxide	1.5199	36.45	97.61	7255	1052.25	0.142
Oxygen	1.1048	-118.57	-181.42	5043	731.43	0.022
Propane	1.5226	96.68	206.02	4248	616.12	0.152

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Appendix E
Configuration Considerations when Using with Sarasota SG901

Purpose

When the Sarasota CM515 density converter is used in a Sarasota SG901 with frequency output system, the density converter can be configured to use different formula schemes to deal with gas compressibility, Critical Pressure, and Critical Temperature parameters. This appendix explains the different formula schemes available in the density converter and shows the basic configuration (in metric) of the Sarasota SG901 / CM515 system.

Equations

When using the Sarasota CM515 for D-ref (Density at Reference), MW (Molecular Weight) or SG (Specific Gravity) measurement, the user has a choice of which equations the converter will use for its calculation.

The equations of state available in the Sarasota CM515 are described in Chapter 1. It is suggested that either the Ideal or Soave equation is selected depending on the accuracy required and the gas data available.

There is an option to estimate Cp and Ct from specific gravity using two quadratic curve fits, one for Critical Pressure and one for Critical Temperature.

The curve is in the following form:

```
y = ax^2 + bx + c
```

where

y = either Critical Pressure or Critical Temperature

x = specific gravity

Both isentropic exponent and Acentric factor have to be fixed at the average for the gas mix. If RK is chosen then Acentric factor is not required.

To disable the Cp – Ct estimation, the fixed Cp and Ct should be entered into the Critical Pressure and Critical Temperature base locations while the Critical Pressure and Critical Temperature coefficients A and B are set to zero.

If the quadratic fit is to be used then the coefficients from the quadratic ax^2 + bx + c should be entered as below:

c is entered into the base location.

a is entered into the B coefficient.

b is entered into the A coefficient location.

The curve fit must be in the units chosen for the base location.

The table below gives an example of values to be used for Cp in bar A and Ct in Deg C. The table includes the Critical Temperature, Critical Pressure, and Acentric factor. The suggested fit data showing the coefficients assume an average Acentric factor based on a uniform equal % mix (16.6% of each component). Where the mix is predominately H2 and CH4, the Acentric factor should be adjusted to allow for this.

The Acentric factor can be adjusted to fit the normal proportions of the mix by taking the sum of the products of the gas constituent Acentric factor and the volume percent of each constituent.

Table E–1.

	Ct K	**CP Bar A**	**Acentric Factor**
H2	33.2	12.9696	-0.22
CH4	190.6	45.94076	0.008
C2H6	305.4	48.83865	0.098
C3H8	396.8	42.45518	0.152
C4H10	452.2	37.99688	0.193
C5H12	496.6	33.74123	0.251

Table E–2.

Data assuming curve fit gives ax^2 + bx +c CT is in K and CP is in bar A.			
Standard Form Coefficients	**a**	**b**	**c**
Sarasota CM515 Coefficients	B	A	Base
CT calc	-61.092	344.82	12.901
CP calc	-17.72	50.606	12.9
Acentric factor	0.0775	Isentropic exp	1.3

Critical Temperature and Critical Pressure

Unlike the Thermo Scientific Sarasota HC900 and Sarasota HME900, the Sarasota CM515 calculates compressibility using Critical Pressure and Critical Temperature rather than Az and Bz, which are derived (partially calculated) constants for the RK equation of state.

Where gas mixtures are used, pseudo Critical Pressure and Temperatures can be calculated. However, in SG applications there is the option of including a quadratic fit where Critical Pressure and Critical Temperature are inferred from SG.

The entry of Critical Pressure and Critical Temperature is arranged such that:

> If the entry of CT or CP is made as a Base figure with the values of Constants A and B set to zero, then the entered base figures are used as CT and CP.
>
> If the constants A and B are entered as non-zero values, then CT and CP are calculated as:

$$CT\ (or)\ CP = Base \times (1 + A \times SG + B \times SG2).$$

This allows the user to fit the basic constituents CT and CP values to a quadratic equation and then enter constants Critical Pressure Base, A, and B or Critical Temperature Base, A, and B. An example of this is shown below.

Table E–3.

		ATMOS	K	Bar		
	SG	**Cp**	**Ct**	**CP**	**CT Calc**	**CP Calc**
H2	0.069046	12.8	33.2	12.9696	36.41803155	16.30964
CH4	0.552364	45.34	190.6	45.94076	184.7276523	35.44646
C2H6	1.035683	48.2	305.4	48.83865	304.4954727	46.3046
C3H8	1.519001	41.9	396.8	42.45518	395.7214929	48.88407
C4H10	2.00232	37.5	452.2	37.99688	458.4057127	43.18487
C5H12	2.485639	33.3	496.6	33.74123	492.5481323	29.20699

The above table shows the CP and CT for typical gas constituents. The data was fitted to the curves in the equations below, and the CP Calc in bar and CT Calc in K are shown in the calc results.

Table E–4.

Data assuming curve fit gives ax^2 + bx +c CT is in K and CP is in bar A.			
Standard Form Coefficients	**a**	**b**	**c**
Sarasota CM515 Coefficients	B	A	Base
CT calc	-61.092	344.82	12.901
CP calc	-17.72	50.606	12.9
Acentric factor	0.0775	Isentropic exp	1.3
CT Entered	-4.73545	26.72816061	12.901
CP Entered	-1.37364	3.922945736	12.9

Note that the coefficients a, b, and c relate to the form A * SG^2 + B * SG + C. CT Entered and CP Entered relate the constants A, B, and C to the Entered CT or CP constants for the Sarasota CM515.

Note that A = b/base and B = A/base in each case.

General Configuration (Metric) for SG Measurement

During configuration of the Sarasota CM515, units and number formats are chosen to give sufficient resolution. For example, pressure displayed in bar gives display resolution of 0.001 bar. If this is not sufficient, the kPa may be chosen. However, care should be taken to ensure that the display does not overflow. For entry of numbers, exponential format may be chosen to maximize resolution. For example, the density meter constant K is always close to 1, so in order to enter the value to more than three decimal places, the notation 1.000 10^-3 may be chosen. The entry 1.12345 becomes 1234.5 * 10^-3.

In the Sarasota CM515, configure the items for the menus listed below as shown in the tables on the following pages.

- Variables menu
- Parameters menu
- Input menu
- Output menu
- Alarms menu
- Comms menu
- TM/LOG menu
- Setup menu

Table E–5. Variables menu items

Variables		Units	Resolution	Comments
Display	**Variable Name**			
D-LINE	Density (Line)	kg/m³	0.001 kg/m³	
PERIOD	Period	µs	1 ns	
D-REF	Density (Reference)	kg/m³	0.001 kg/m³	
TEMP	Temperature	°C	0.1°C	
PRESS	Pressure	bar	0.001 bar	
SG	Specific Gravity	E^-3	0.000001 SGU	
Z-LINE	Compressibility Factor (Line)	E^-3	0.000001	
Z-REF	Compressibility Factor (Reference)	E^-3	0.000001	
MW	Molecular Weight	E^0	0.001 MW	Can be set to E^-3 if greater resolution required.
Tc	Critical Temperature	Kelvin	0.001 K	
Pc	Critical Pressure	bar A	0.001 bar	Critical Pressure is normally only described to 1 DP.
USER INPUT	User input	No options		
USER OUT-A	User output A	No options		
USER OUT-B	User output B	No options		

Table E–6. Parameters menu items

Parameters		Setting	Units	Comments
Display	**Parameter Name**			
DEFLT *unit*	Default Period	0.00		Only set to a value for test purposes.
ATM-PR *unit*	Atmospheric Pressure	101.325	kPa Abs	Entry should be made exactly as it should appear on the display.
T-REF *unit*	Reference Temperature	0.00	°C	May be 15°C in some cases.
P-REF *unit*	Reference Pressure	101.325	kPa Abs	May be 100.000 kPa in some cases.
CALC TYPE	Calculation Type	IDEAL	N/A	
		SOAVE	N/A	Must enter Ct, Cp, and Acentric factor.
DCF *unit*	Line Density Correction Factor	1.0	E^0	
D-OFF *unit*	Line Density Correction Offset	0.00	kg/m^3	
VAR INP-X	User Defined Function Input X	Density Line	No options	Not required. Only set for standardization.
VAR INP-Y	User Defined Function Input Y	Temperature	No options	Not required. Only set for standardization.
	User Defined Function Table	No entry	No entry	
K *unit*	Spool K	Cal cert. value * 1000	E^-3	Enter in ns. Cal cert. value is in µs.
D0 *unit*	Spool D0	From cal cert.	kg/m^3	
T0 *unit*	Spool T0	From cal cert.	µs	
TEMPCO *unit*	Spool Tempco	Cal cert. value * 1000	ns/°C	Enter in ns. Cal cert. value is in µs.
PRESCO *unit*	Spool Presco	0.0	ns/bar	
VIBDIM *unit*	VIBDIM	15.8		
ISENTR EXP	Gas Isentropic Exponent	1.3		
Tc _0 *unit*	Gas Critical Temperature Base	Single gas Ct or gas mix quasi Ct	Units of Ct (°C or K)	
		12.901	K	

Parameters		Setting	Units	Comments
Display	Parameter Name			
Tc _A *unit* Tc _B	Gas Ct Coefficient A	0		
		344.82	No choice. From equation that gives K.	
	Gas Ct Coefficient B	0		
		-61.092	No choice. From equation that gives K.	
Pc _0 *unit*	Gas Critical Pressure Base	Singe gas Cp or gas mix quasi Cp	Units of Cp	
		12.9	bar A	
Pc _A *unit* Pc _B	Gas Cp Coefficient A	0		
		50.606	No choice. From equation that gives bar A.	
	Gas Cp Coefficient B	0		
		-17.72	No choice, but from equation that gives bar A.	
ACENTR FACT	Gas Acentric Factor	Single Gas Acentric Factor or Quasi Acentric Factor for Mix	No units	
		0.0775	No units	

Table E–7. Input menu items

Input		Setting	Units	Comments
Display	**Parameter Name**			
INPUT PERIOD PINP1	Pulse Input 1 Assignment	Density Line	Fixed default	
SIGNAL PINP1	Pulse Input 1 Signal Type	PULSE	Density pulse	
DBNCE PINP1	Pulse Input 1 Signal Debounce	DISABLE		
CUTOFF PINP1	Pulse Input 1 Frequency Cutoff	100		
FILTER PINP1	Pulse Input 1 Filtering	0		
INPUT TEMP AINP1	Analog Input 1 Assignment	Temperature	Fixed default	
TYPE AINP1	Analog Input 1 Signal Type	PT100		
PT-DEF AINP1	Analog Signal 1 Default Type	50	Deg C	Assume heated SG system and set to heater set temperature.
PT-MIN AINP1	Analog Input 1 Minimum Point	0	Deg C	
PT-MAX AINP1	Analog Input 1 Maximum Point	50	Deg C	
INPUT PRESS AINP2	Analog Input 2 Assignment	Pressure	Fixed default	
PRESS AINP2	Analog Input 2 Pressure Sensor Type	ABSOL (Absolute)		
TYPE AINP2	Analog Input 2 Signal Type	4–20 mA		
PT-DEF AINP2	Analog Input 2 Default	3.8	bar A	Set to the regulator pressure setting.
PT-MIN AINP2	Analog Input 2 Minimum Point	0	bar A	
PT-MAX AINP2	Analog Input 2 Maximum Point	4	bar A	
EXCEPT VALUE	Values on Exception	Default		

Table E–8. Output menu items

Output			Setting	Units	Comments
Display		Parameter Name			
VAR	OUT1	Output 1 Assignment	Specific Gravity		Unless SG not required.
PT-MIN	OUT1	Output 1 Minimum	0	SGU	Depends upon customer requirements.
PT-MAX	OUT1	Output 1 Maximum	2	SGU	Depends upon customer requirements.
VAR	OUT2	Output 2 Assignment	Molecular Weight		Unless MW not required.
PT-MIN	OUT2	Output 2 Minimum	2		Depends upon customer requirements.
PT-MAX	OUT2	Output 2 Maximum	58		Depends upon customer requirements.

Table E–9. Alarms menu items

Alarms			Setting	Comments
Display		Parameter Name		
RELAY	ALRM1	Alarm 1 Assignment	SG	Or on other variable according to customer requirement.
TYPE	ALRM1	Alarm 1 Type	LO-NC	Low alarm, Normally Closed contacts.
POINT	ALRM1	Alarm 1 Setpoint	0.02	
HYST	ALRM1	Alarm 1 Hysteresis	0.02	Or 10% below zero value.
RELAY	ALRM2	Alarm 2 Assignment	SG	Or on other variable according to customer requirement.
TYPE	ALRM2	Alarm 2 Type	HI-NC	High alarm, Normally Closed contacts.
POINT	ALRM2	Alarm 2 Setpoint	2.2	Or 10% above full scale.
HYST	ALRM2	Alarm 2 Hysteresis	0.1	Or 5% of alarm point.
RELAY	ALRM3	Alarm 3 Assignment	Density Line	Setting not important, as this is the equipment fail alarm.
TYPE	ALRM3	Alarm 3 Type	AL-NC	Equipment alarm, Normally Closed contacts.
POINT	ALRM3	Alarm 3 Setpoint	10	Ignored during running.
HYST	ALRM3	Alarm 3 Hysteresis	0.5	Ignored during running.
RELAY	ALRM4	Alarm 4 Assignment	Period	
TYPE	ALRM4	Alarm 4 Type	LO-NO	Alarm disabled.

Alarms		Setting	Comments
Display	**Parameter Name**		
POINT ALRM4	Alarm 4 Setpoint	-1	
HYST ALRM4	Alarm 4 Hysteresis	0	

Table E–10. Comms menu items

Comms		Setting
Display	**Parameter Name**	
PROTOC RS232	RS232 Protocol	RTU (Modbus RTU)
BAUD RS232	Baud	9600
PARITY RS232	Parity	None
S-BITS RS232	Stop Bits	1
PROTOC RS485	RS485 Protocol	RTU (Modbus RTU)
BAUD RS485	Baud	19200
PARITY RS485	Parity	None
S-BITS RS485	Stop Bits	1
PROTOC INFRA	IR Protocol	ASCII (Modbus ASCII)
BAUD INFRA	Baud	19200
PARITY INFRA	Parity	None
S-BITS RS485	Stop Bits	1
RTU ADDR	Modbus RTU Address	1
ASCII ADDR	Modbus ASCII Address	2
FLASH PORT	Flash Driver Port	RS232

Table E–11. TM/LOG menu items

TM/LOG		Setting
Display	**Parameter Name**	
DATE FORM	Clock Date Format	DAY-M (Day-Month)
CLOCK YEAR	Clock Year	
CLOCK M--DAY	Clock Date (Day-Month)	
CLOCK H--MIN	Clock Time (Hour Min)	
HOUR LOGS	Logging Hours	24
DAY LOGS	Logging Days	31
WEEK LOGS	Logging Weeks	4
MONTH LOGS	Logging Months	12
YEAR LOGS	Logging Years	2
RESET LOGS	Logging Reset	Password protected
REPORT TYPE	Printer Protocol Report Type	REP-01 (hourly logs report)
PRN TYPE	Print Protocol Printer Type	PRN-01 (generic computer printer)

Table E–12. Setup menu items

Setup		Setting	Units	Comments
Display	**Parameter Name**			
DEFAULT VAR	Default Variable	Specific Gravity		Depends upon customer outputs.
SUPPLY VOLT	Transducer Supply	24V		Default is 12V.
T-OUT MODE	Display Timeout Mode	DISABLE		
T-OUT SEC	Display Timeout Period	30		
DISPL TAGS	Display Tags	DEFAULT		
BACK-L T-OUT	Backlight Timeout	DISABLE		
DOCKET RESET	Docket Number Reset	Password protected		
	Password	000000		

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Glossary

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

absolute pressure Absolute Pressure = Atmospheric Pressure + Gauge Pressure. It is the combined local atmospheric pressure and the gauge pressure. All calculations are based on absolute values for pressure. Some sensors can directly measure the absolute pressure value while others measure gauge pressure. Pressure can be displayed as absolute or gauge and is indicated with an 'A' or 'G' appended to the pressure units of measure.

atmospheric & gauge pressure Some sensors only measure gauge pressure, in this case the atmospheric pressure must be programmed to determine the absolute value. The atmospheric value is affected by the altitude of the installation. The atmospheric pressure default is 101.325 kPa (14.696 psia) which is the standard value at sea level.

IrDA The Infrared Developers Association is a group of computer and software manufactures who have agreed on a format for communication among infrared devices.

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

molar mass Molar mass is the molecular weight, which is the mass of one mole of the substance.

normal conditions Normal conditions are defined as 0°C (273.15 K) and 101.325 kPa or 32°F (491.67°R) and 14.696 psia. A flow rate at normal conditions is indicated with an 'N' in the front of the corrected volume units of measure. Compare with "standard conditions".

normalized input A normalized input ranges from 0 to 1.000. For 4–20 mA input, the signal is set to 0 at 4 mA and to 1.000 at 20 mA.

passive output signal Requires an external power supply.

RTD Resistance temperature device.

Specific Gravity (SG) Specific Gravity is the ratio of the molar mass of a gas to the molar mass of air.

standard conditions Standard conditions are defined as 15°C (288.15K) and 101.325 kPa or 59°F (518.67°R) and 14.696 psia.

Universal Gas Constant (R) The Universal Gas Constant is used in the calculation of density at flowing conditions (8.314510 J/(mol*K).

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