



Thermatel® Mass Flow Transmitter Model TA1

Instruction Manual and Parts List



The advanced microprocessor provides accurate temperature compensation as the process temperature changes.

Each instrument is factory calibrated in a NIST flow standard to provide highest level of accuracy. The electronics permit the user to configure the instrument for the pipe or duct size, zero and span, units of measurement, alarms, and other user specific requirements.

The instrument provides two 4–20 mA output signals; one for flow measurement, and one for temperature. Each 4–20 signal can be configured from the instrument.

PRINCIPLE OF OPERATION

The flow element of the TA1 Mass Flow Transmitter utilizes a heater and two resistant temperature detectors (RTDs). The heater and the active RTD are contained in one sensor; the second sensor contains the reference RTD and a mass balancing element.

The reference RTD measures the temperature of the process where the flow element is installed. A constant power is provided to the heated sensor. The active RTD measures the temperature of the heated sensor. The electronics measures the temperature difference between the active and reference RTD.

There is an inherent non-linear relationship between the temperature difference and the mass flow rate. The microprocessor-based electronics convert the temperature difference signal to provide a linear measurement of the mass flow rate. The electronics also provide advanced temperature compensation which automatically adjusts the flow measurements for changes in process temperature.

The 4–20 mA output signal can be adjusted to provide maximum resolution of flow measurement over the desired range of the instrument. A separate 4–20 mA signal provides an output signal of the process temperature. Both 4–20 mA signals can be wired for either active or passive operation. Refer to wiring section, pages 4 and 5.

Optional relays provide low or high flow alarm indication and can be used for diagnostics.

UNPACKING

Unpack the instrument carefully, making sure all components have been removed from the packing material. Inspect all components for damage, and report any concealed damage to the carrier within 24 hours. Check the contents of the carton, making sure it agrees with the packing slip and the purchase order. Verify that the model number imprinted on the nameplate matches the number on the packing slip and the purchase order. Report any discrepancies to the factory. Check and record the serial number for future reference when ordering parts.

TABLE OF CONTENTS

PAGE

Description	1
Principle of Operation	1
Unpacking	1
Quick Start	2
Installation	3
Electrostatic Discharge Handling Procedure	4
Wiring	4
Software Configuration	6
Digital Communication RS-485/Modbus Protocol	21
Troubleshooting	22
Maintenance	22
Agency Approvals	23
Specifications	23
Model Number	26
Replacement parts	30
Glossary	31

DESCRIPTION

The Thermatel Mass Flow Transmitter Model TA1 provides high performance measurement of the mass flow of air and other gases. Using a heated sensor, the mass flow is determined by accurately measuring the temperature difference between the heated sensor and the reference sensor. Heat transfer is due to the mass of the gas flowing past the sensor providing a measurement of the mass flow rate.

QUICK START

PROBE INSTALLATION

Insert the probe into the pipe or duct, ensuring that the appropriate upstream and downstream dimensions are obtained. It is preferred to have as much straight run as possible. Refer to Magnetrol bulletin 54-131 (STI bulletin 95-165) for additional information on probe location. It is generally suggested that the sensor be mounted on the centerline of the pipe. Insure that the flow arrow on the probe is positioned in the direction of the flow. Refer to Figure 1.

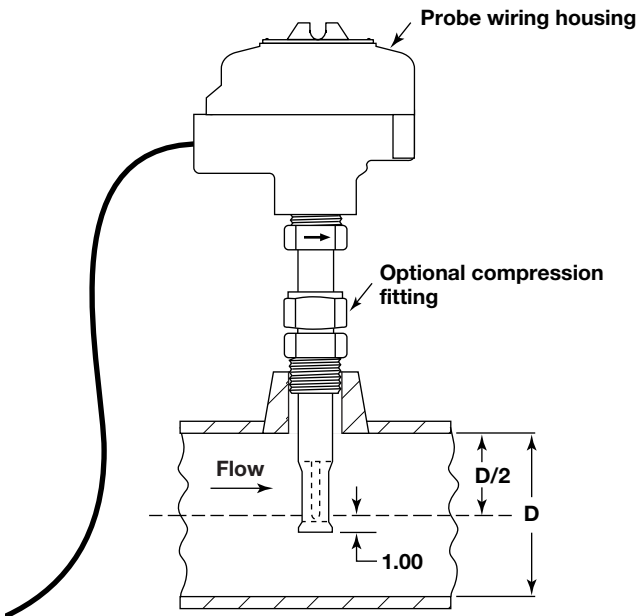


Figure 1

WIRING

Open the cover of the enclosure and locate the input power connections, the 4–20 mA output connections, and the relay connections as show below. Make connections between the probe and the electronics to terminal block TB11. Refer to Figure 2

CONFIGURATION

The instrument is configured at the factory with the application information provided with the order. If configuration information was not provided at the time of order, then the information used during the calibration is utilized. To quickly configure the instrument or change the configuration, push the logo button (Ⓜ) located at the upper right on the keypad (refer to Figure 3), then enter the requested information. Simply enter the pipe or duct area in square inches and the 4 and 20 mA points for the flow and temperature readings.

The configuration software is easily followed. Simply press ENT to enter or change a value and ↑ or ↓ (up or down arrow) to select. If → appears on the second line, enter the number using the keypad, and press ENT.

The complete configuration may be viewed using the software menu which begins on page 8.

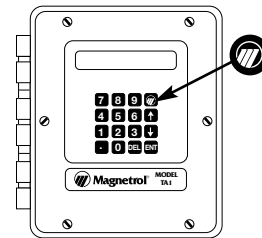


Figure 3

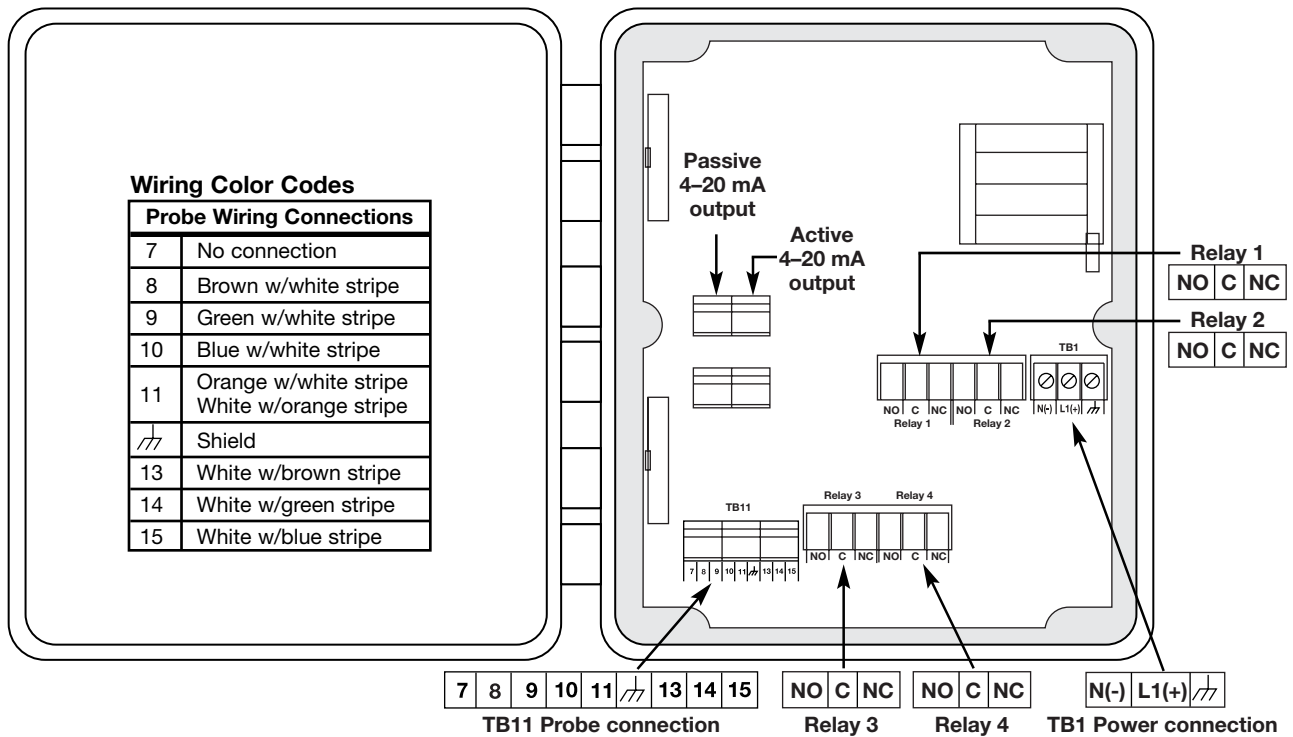


Figure 2

INSTALLATION

CAUTION: The probe and electronics are calibrated and shipped as a matched set. The model number is indicated on both the electronics nameplate and the probe housing nameplate; verify that they are the same.

NOTE: The instrument is rated per IEC 1010 for use in Installation Category II, Pollution Degree 2.

ELECTRONICS

The electronics are rated for use in Class I, Division 2 areas. The enclosure is also rated NEMA 4X.

The remote electronics should be installed in an easy to access location within 250 feet of the sensor location. The electronics should not be installed in areas where ambient temperature exceeds +160° F (+70° C). If ambient temperatures are less than -4° F (-20° C), then the optional heater is recommended. Provide watertight seals for all wiring entrances in the enclosure to maintain the NEMA 4X rating.

Mount the enclosure to a wall or flat surface using the appropriate screws or bolts. The mounting tabs on the back of the enclosure may be rotated to the sides or top and bottom to facilitate mounting. Refer to Figure 15.

NOTE: A switch or circuit breaker shall be installed in close proximity to the equipment and within easy reach of the operator. It shall be marked as the disconnecting device for the equipment.

PROBE

The probe enclosure is rated explosion proof for Class I, Division 1 service. The enclosure is also rated NEMA 4X. Use appropriate NEC section when installing the instrument.

Proper installation of the probe in the pipe or duct is essential for accurate flow measurement. Normal procedures for installing any type of flow element should be followed. Refer to Magnetrol bulletin 54-131 (STI bulletin 95-165) for additional information on probe location.

Arrows are etched on the sides of the probe to designate flow direction. The instrument is calibrated with the flow in this direction. Ensure that the flow arrows are oriented in the direction of flow. Refer to Figure 4.

It is generally recommended that the sensor be located in the center of the pipe. This location provides less sensitivity to changes in flow profile. The probe's length should be specified to position the sensor in the desired location. Sensors mounted through compression fittings have the ability to field adjust the sensor to the desired location by using the dimensions as shown in Figure 4.

Various methods of mounting the probe are available, including compression fittings, threaded, and flanged connections. Refer to probe model numbers.

The insertion probe can be installed through a compression fitting. The use of a bored-through fitting for 3/4" outside diameter tube is recommended.

Pressure ratings of the compression fitting are:

Stainless steel ferrules	1500 psig at 70° F 1375 psig at 400° F
Teflon ferrules	100 psig

NOTE: The sensor must be installed in a location where moisture cannot drip or come in contact with the heated element. Any contact with condensed moisture in the gas flow will cause a false high flow indication.

FLOW BLOCKAGE

The TA1 Mass Flow Transmitter measures the velocity flowing past the sensor, and then determines the flow rate by multiplying the area by the velocity. The probe blocks a portion of the pipe reducing the effective cross sectional area of the pipe and creating a higher velocity. The TA1 compensates for this error by correcting the measured flow by the probe blockage.

NOTE: If equipment is used in a manner not specified by manufacturer, protection provided by equipment may be impaired.

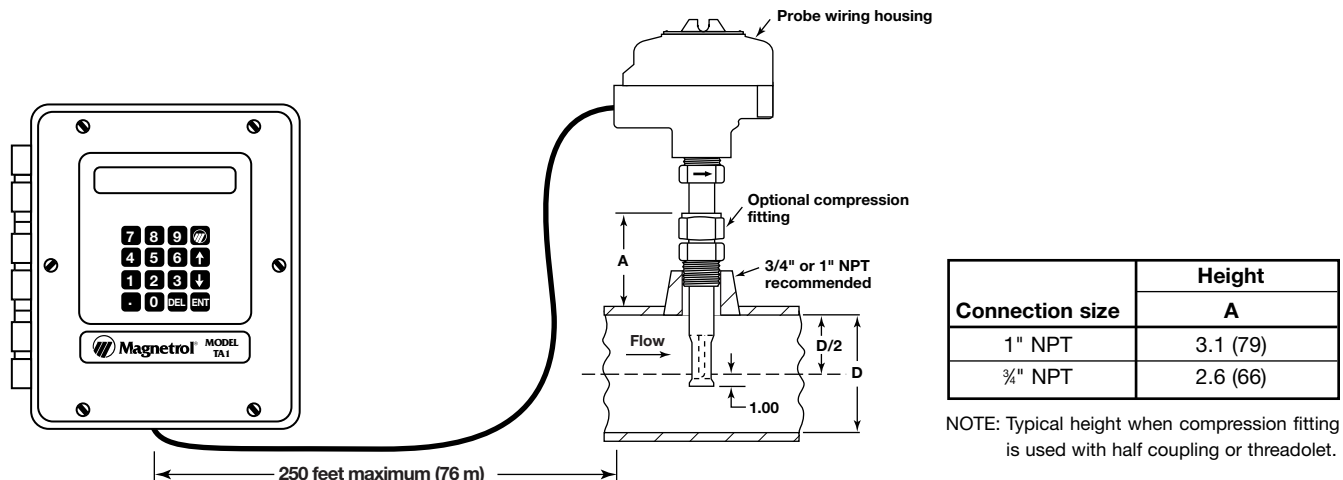


Figure 4

ELECTROSTATIC DISCHARGE (ESD) HANDLING PROCEDURE

Magnetrol's electronic instruments are manufactured to the highest quality standards. These instruments utilize electronic components which may be damaged by static electricity present in most work environments. The following steps are recommended to reduce the risk of component failure due to electrostatic discharge:

1. Ship and store circuit boards in anti-static bags. If an anti-static bag is not available, wrap board in aluminum foil. Do not place boards on foam packing materials.

2. Use a grounding wrist strap when installing and removing circuit boards. A grounded workstation is also recommended.
3. Handle printed circuit boards only by the edges. Do not touch components or connector pins.
4. Ensure that all electrical connections are completely made and none are partial or floating. Ground all equipment to a good earth ground.

WIRING

WIRING

There are three predrilled holes in the enclosure for connecting 1/2" conduit. Generally, these are used as: one for input power; one for cable to the probe; and one for communications (4–20 mA and relays).

PROBE WIRING

The probe housing contains a terminal block for ease of wiring between the probe and the electronics. Connections from the probe to the terminal strip are prewired at the factory. An 8-wire shielded interconnecting cable (Belden 8104) from the probe housing to the instrument is required. Refer to Figure 6 for wiring connections for TB11.

The layout of the main circuit board giving all user interface points is shown in Figure 6.

GROUND CONNECTION

To prevent electromagnetic noise, the instrument must be grounded in accordance with Article 250 of the National Electric Code. Ground wires shall be terminated at the conduit connection using grounding bushings or other similar device as discussed in NEC Article 250-72. Metal conduit must be utilized to ensure proper ground connection.

Grounding of the electronics is accomplished with a ground wire between the ground terminal in TB1 and the conduit ground.

Probe housing must be grounded via protective ground screw in the base of the housing.

Wiring Color Codes

Probe Wiring Connections to TB11	
7	No connection
8	Brown/white stripe
9	Green/white stripe
10	Blue/white stripe
11	Orange/white stripe White/orange stripe
⎓	Shield
13	White/brown stripe
14	White/green stripe
15	White/blue stripe

Wiring Color Codes

Probe Wiring Connections Probe Housing	
1	Green/white stripe
2	White/green stripe
3	Blue/white stripe
4	White/blue stripe
5	Brown/white stripe
6	White/brown stripe
7	Orange/white stripe White/orange stripe
8	Shield

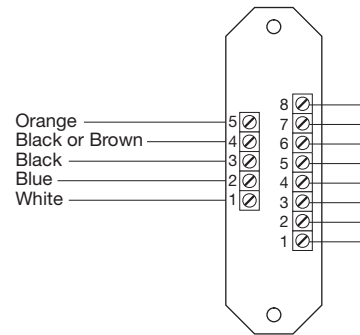


Figure 5
Probe Enclosure Wiring Connections

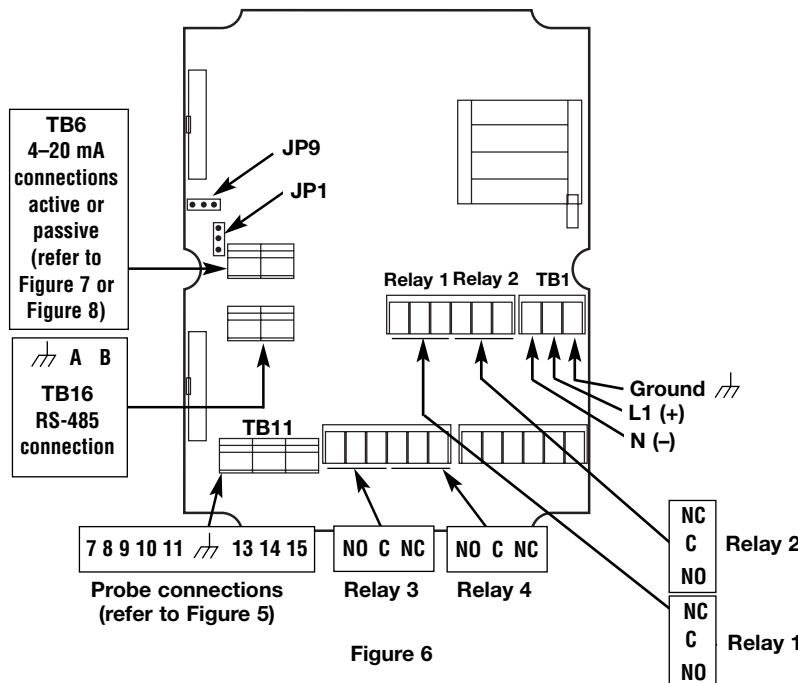


Figure 6

WIRING cont.

RELAY OUTPUT WIRING

The instrument can be supplied with up to four isolated SPDT relays, rated at 10 amp at 120 VAC or 5 amp at 240 VAC. The relays can be configured for use as high or low level alarm contacts. In addition, Relay 1 can be configured, via software, to de-energize only in the event a fault condition is detected.

All relay terminals are labeled **C** for common, **NC** for normally closed, **NO** for normally open. Refer to Figure 6.

POWER CONNECTION

The instrument is factory wired to accept 24 VDC, 120 VAC, or 240 VAC. Check the nameplate to ensure that the instrument matches the desired input power.

All power wiring connections are made to terminal block TB1. Refer to Figure 6.

NOTE: Use a minimum of 14-AWG wire for power and ground field wires. For supply connection, use wire with a minimum rating of +75° C as required by process conditions.

4-20 mA DC OUTPUT

Two 4–20 mA output connections are available at terminal block TB6. These output signals are electrically isolated from the instrument, but are not isolated with respect to each other. Either an active or passive connection may be selected.

To obtain an active 4–20 mA output signal, the positive connection for each loop is made to ACT+. The negative connection is made as follows (refer to Figure 7):

Flow signal	1ACT-
Temperature signal	2ACT-

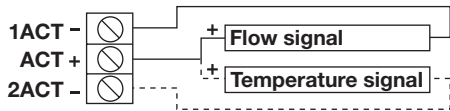


Figure 7

A passive 4–20 mA signal requires an external DC power supply (maximum voltage of 32 VDC). The negative connection of the power supply is connected to -PAS (refer to Figure 8):

The positive connection is:

Flow signal	+PAS1
Temperature signal	+PAS2

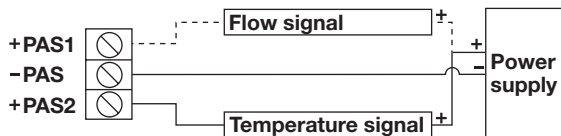


Figure 8

NOTE: The active circuit shares a common positive while the passive circuit shares a common negative. If both a flow and temperature signal are desired using a PLC, it is recommended that the flow signal be treated as an active circuit while the temperature signal be handled as a passive circuit.

CLOSING THE COVER

After all wiring connections are complete, close and secure the cover using the six screws.

CAUTION: Do not overtighten the securing screws. Do not use an electrical drive. Overtightening can result in cracking of the housing resulting in leakage into the housing.

RS-485/MODBUS OUTPUT

Modbus communication via RS-485 is available at terminal block TB16.

The terminals are marked A and B, which correspond to similar connections in the control room.

NOTE: Polarity among units in the loop must be observed.

The shield is connected to the /// terminal.

Jumper JP1 provides the terminal resistor if the instrument is the last instrument in a daisy chain configuration. The position of the jumper at JP1 should be set as follows (refer to Figure 9):

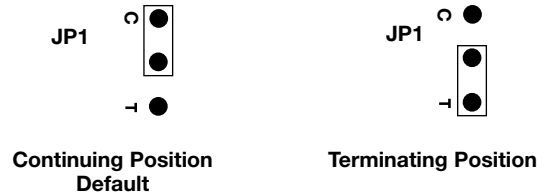


Figure 9

RS-232 CONNECTION

The RS-232 Connection on TB7 is currently not utilized.

Jumper JP9 provides the selection of either RS-232 or RS-485 connection. The jumper must be left in the position indicated below.

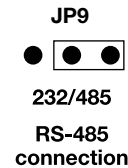


Figure 10

MODBUS WIRING

Refer to Modbus section on page 21 for wiring information.

SOFTWARE CONFIGURATION

The electronics of the instrument are easy to set up and configure for the user's specific requirements. If previously specified, the configuration menu is loaded into the instrument at the factory. If not, or if the user wants to modify the configuration settings, follow these instructions for configuring the instrument. The primary structure of the software is divided into six main groups:

Measured Values	View selected values
System Config	First time configuration (essential programming information)
I/O Config	Configure all input/output functions
Advanced Config	Additional configuration which affects the units operation
Diagnostics	Test functions
Run Mode	Normal operating mode

All input of information is done via the keypad located on the front of the instrument.

PASSWORD








CAUTION: The instrument is shipped from the factory with the password 100. If the password is misplaced or forgotten, please consult the factory for assistance.

A password protection system restricts access to portions of the menu which affect the unit's operation and configuration. The password will be requested whenever programming changes are requested.

The password may be changed to any four digit number. This procedure is described under ADV CONFIG menu on page 19.

OPERATOR KEYPAD

All unit configuration instructions in this manual will appear on the instrument display. The following keys are used:

-  UP arrow: Scroll to the previous menu item or enter "e" for exponential
-  DOWN arrow: Scroll to the next menu item or enter negative number.
-  ENT: ENTER: Enter next menu level or confirm information of the current menu item.
-  DEL: DELETE: To exit the current item/menu level or delete an entry.
-  0-9: Numeric input of data.
-  .: Decimal point.
-  QuickCal mode.

When the symbol \updownarrow is displayed on the top line, push ENT to program this selection, or press \uparrow \downarrow to proceed to the next selection.

When the symbol \updownarrow is displayed on the bottom line, push \uparrow \downarrow to change the selection; then push ENT to accept.

When the symbol \rightarrow is displayed on the bottom line, enter the value, then push ENT to accept.

NOTE: Pressing DEL will back you out of the configuration menu and return you to run mode.

NOTE: If a key is not pressed for 5 minutes, the display returns to the run mode.

SOFTWARE CONFIGURATION cont.

DEFINITIONS

The following symbols and definitions are used in the software configuration:

Calibration factor: Changes in flow profile will affect the measurements of the TA1. Advanced users have the ability to adjust the measurements for changes in flow profile using a multi-function polynomial relationship in the form of:

$$\text{Corrected flow} = a+bx+cx^2+dx^3+ex^4$$

The default is $b = 1$; and a , c , d , and $e = 0$. To use the correction factor, develop a relationship between the flow measured by the TA1 and the flow measured by a second flowmeter. Curve fit the fifth order polynomial (above) using the output of the TA1 for X (units of SFPM) and the output of the second flowmeter for corrected flow. Then enter the appropriate values in the Advanced Configuration menu, page 19.

Mass flow: Measured in various units, typically LB/Hr or KG/Hr. An input of the cross sectional area of the pipe or duct is required.

STP conditions: The mass flow rate is based on a given set of Standard Temperature and Pressure (STP) conditions. Magnetrol uses default of 70° F and one (1) atmosphere for STP conditions. The STP conditions may be modified to match the user's standards. If the STP conditions are modified, the TA1 will recalculate the flow rates at the specified STP conditions.

The advanced configuration menu permits the user to enter any desired temperature and cycle between selection of one (1) bar or one (1) atmosphere of pressure.

Totalized flow: Provides a measurement of the total flow in units specified.

Velocity: Measured in SF/M (standard feet per minute) or NM/M (normal meters per minute). This is the mass velocity directly measured by the instrument referenced to the appropriate standard conditions.

Volume flow: Measured in various units, typically SCFM (standard cubic feet per minute) or NCMH (normal cubic meters per hour), referenced to standard conditions. An input of the cross sectional area of the pipe or duct is required to obtain this value.

TAG LINE

Initially the tag line on the display reads "Magnetrol Int'l". This can be changed from the advanced configuration section of the software.

The cursor appears in the left position. To change the position at that location, use the \uparrow or \downarrow arrow keys. Pressing the \odot key will start scrolling the characters; pressing the \odot a second time causes a faster scroll. To stop scrolling, press any key. To move to the next position, press the ENT key; to return to the previous position, press the DEL key.

Pressing the ENT key moves the cursor to the right. When it reaches the rightmost position, pressing the ENT key one additional time exits and saves changes (password protected).

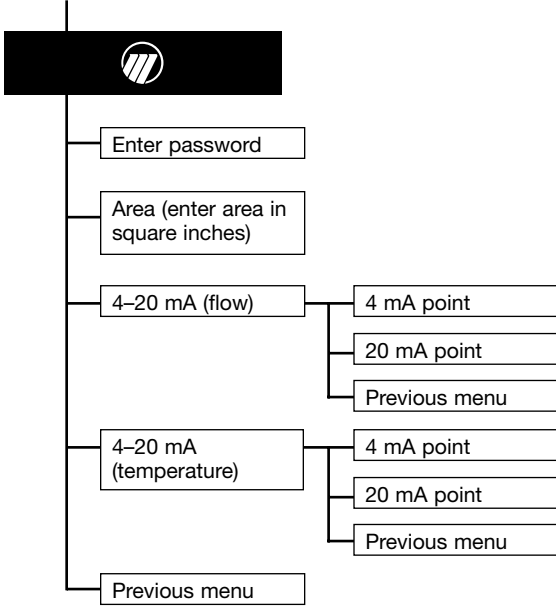
Pressing the DEL key moves the cursor to the left. When it reaches the leftmost position, pressing the DEL key exits the menu and restores the previous tag line.

SOFTWARE CONFIGURATION cont.

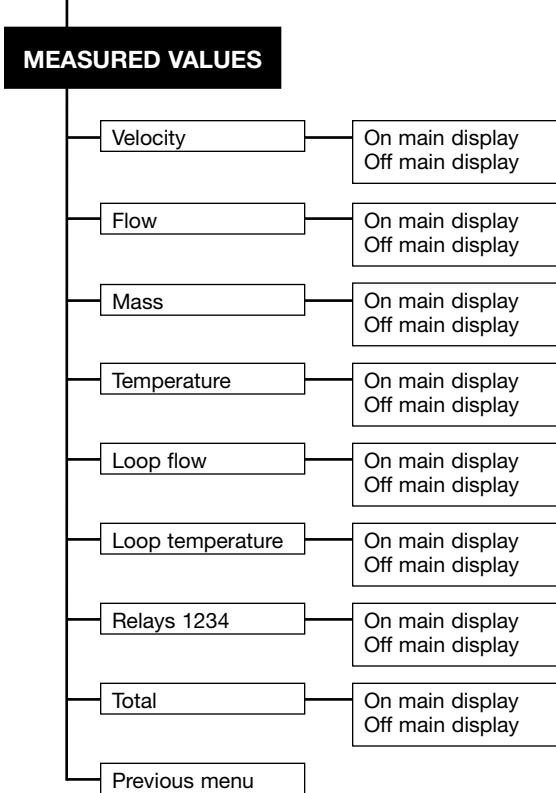
GENERAL PROGRAMMING MENU

Following is the general menu structure used in the Mass Flow Transmitter. Use the UP or DOWN arrow key (↑ ↓) to scroll through any portion of the menu, press ENT key to make a selection, and press DEL to backup.

QUICK START



RUN MODE

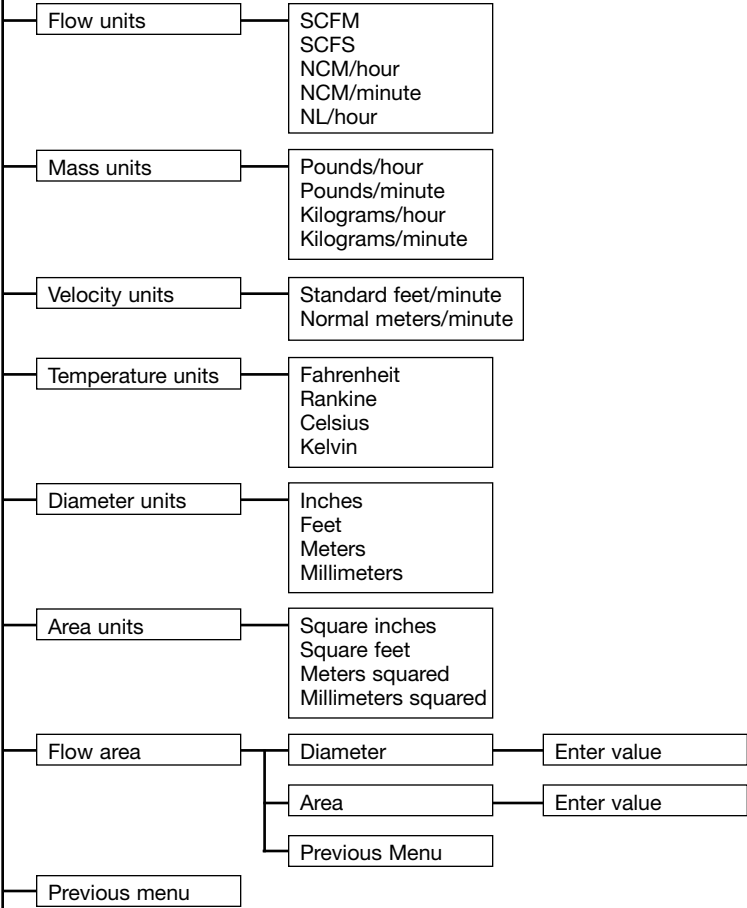


SOFTWARE CONFIGURATION cont.

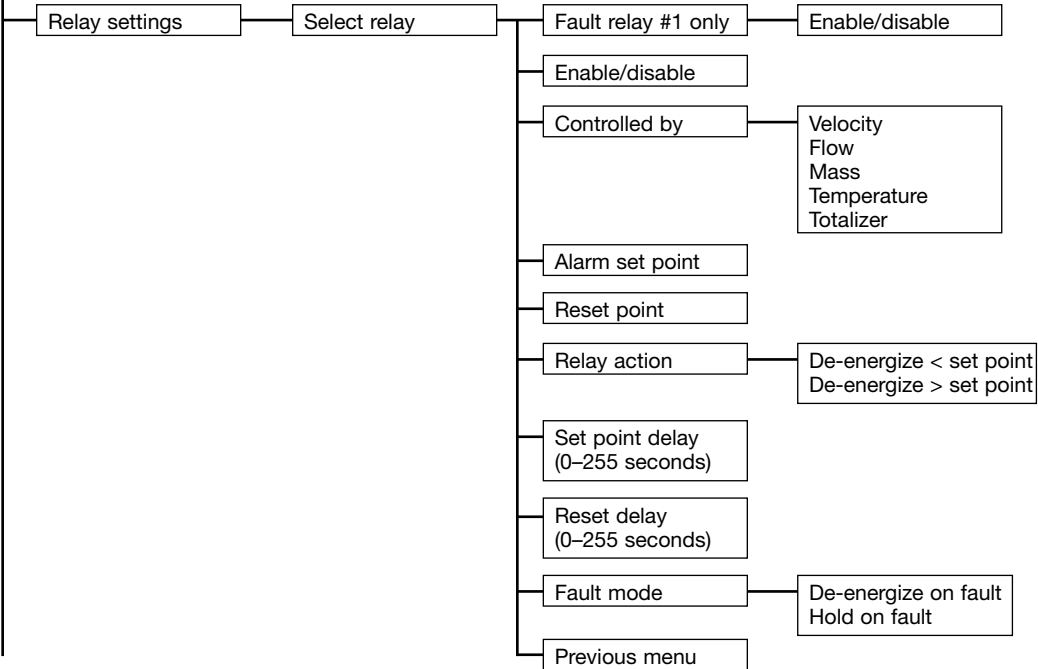
GENERAL PROGRAMMING MENU cont.

RUN MODE

SYSTEM CONFIG

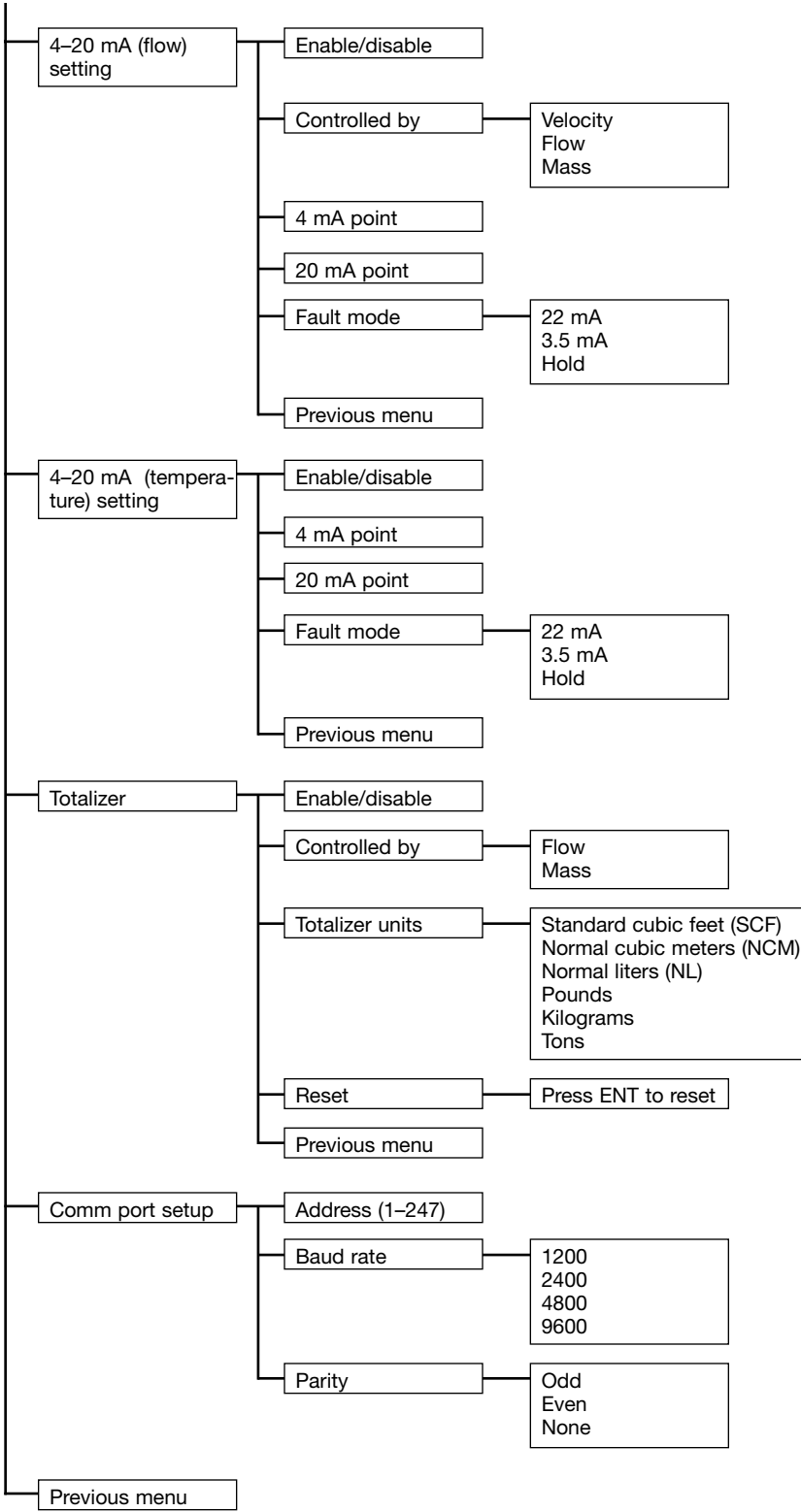


I/O CONFIGURATION



SOFTWARE CONFIGURATION cont.

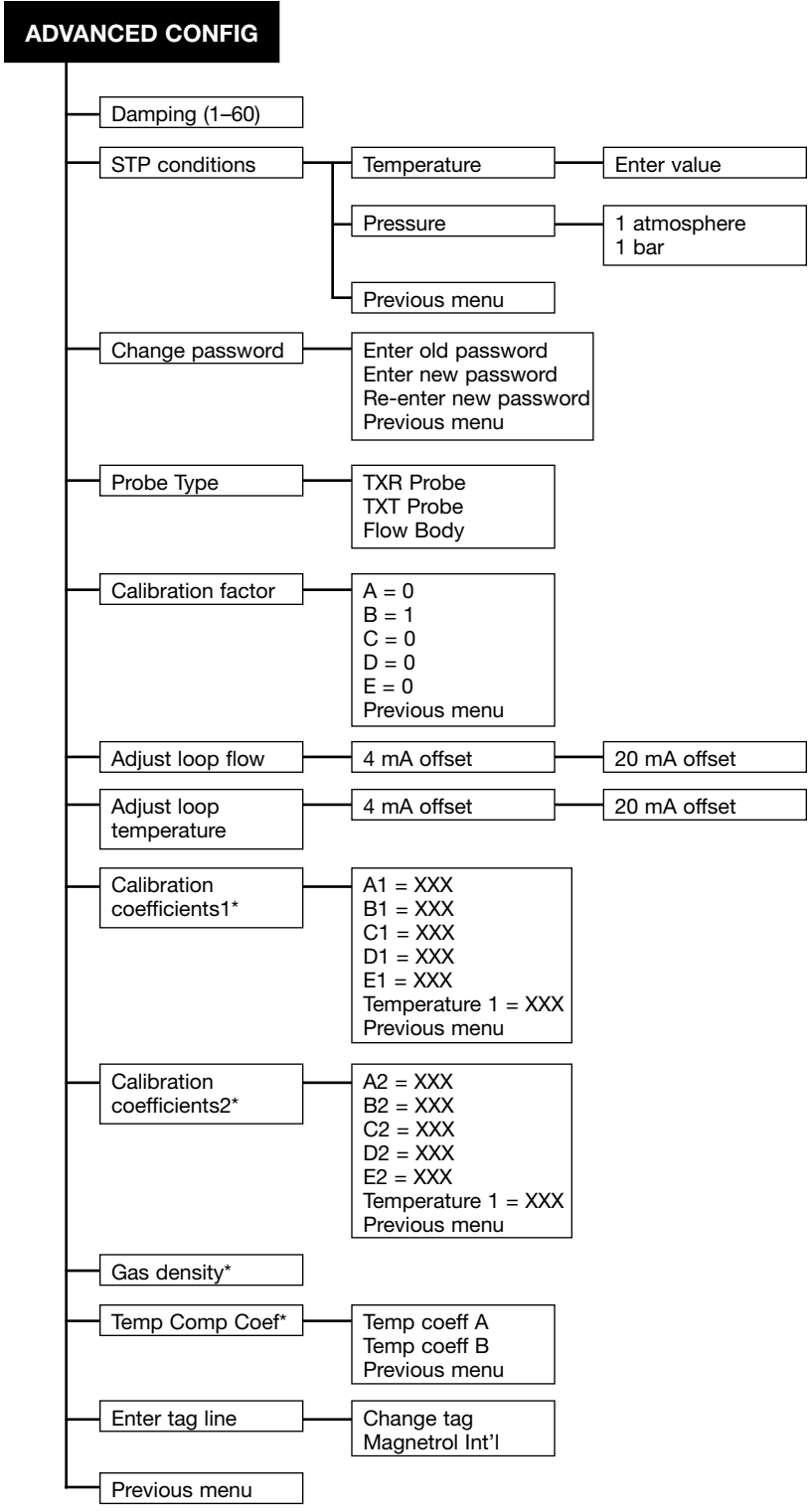
GENERAL PROGRAMMING MENU cont.



SOFTWARE CONFIGURATION cont.

GENERAL PROGRAMMING MENU cont.

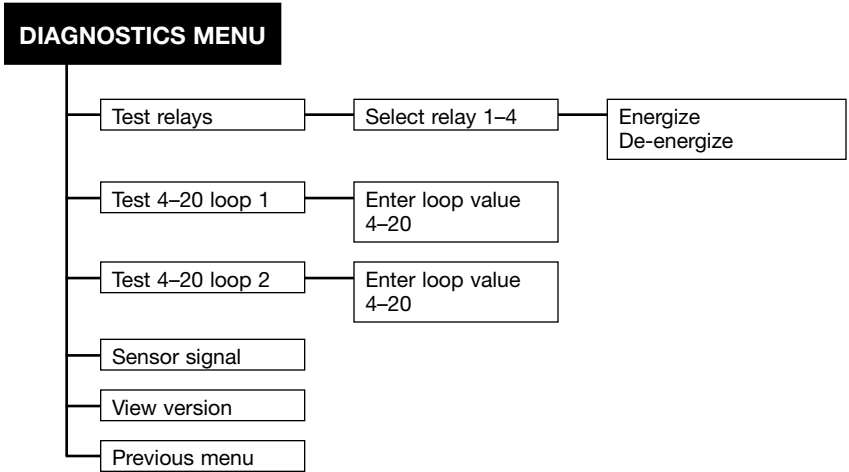
RUN MODE



*These values are "Read Only;" contact Magnetrol to change data.

SOFTWARE CONFIGURATION cont.

GENERAL PROGRAMMING MENU cont.



MAIN MENU

The main menu is used to access the various subroutines. From the Run mode, press ↑ or ↓ to enter the Main Menu. The chart at right defines the various selections available from the Main Menu

Main Menu			
Display		Option	Action if ENT is pressed
Measured Values ←↓ to select	↕	Press ENT to select or ↑ or ↓ to continue.	Enter Measured Values menu
System Config ←↓ to select	↕	Press ENT to select or ↑ or ↓ to continue.	Enter System Configuration menu
I/O Config ←↓ to select	↕	Press ENT to select or ↑ or ↓ to continue.	Enter I/O Configuration menu
ADV Config ←↓ to select	↕	Press ENT to select or ↑ or ↓ to continue.	Enter Advanced Configuration menu
Diagnostics ←↓ to select	↕	Press ENT to select or ↑ or ↓ to continue.	Enter Diagnostics menu
Run mode ←↓ to select	↕	Press ENT to select or ↑ or ↓ to continue.	Enter Run mode

SOFTWARE CONFIGURATION cont.

QUICK START

Quick Start				
Display	Option	Action if ENT is Pressed	Option	Action if ENT is Pressed
Enter password	Enter password	Proceed with Quick Start		
Area xxx in ^2 ⬆	Press ENT to change area or to continue to next selection.	Area → xxxx in^2	Enter area of pipe or duct in square inches and press ENT.	
4-20 mA (flow) ← to select ⬆	Press ENT to select or ↑ or ↓ to continue to next selection.	4 mA point XXX SCFM ⬆	Press ENT to select or ↑ or ↓ to continue to next selection.	Enter flow value in SCFM representing 4 mA; press ENT.
		20 mA point XXXXX SCFM ⬆	Press ENT to select or ↑ or ↓ to continue to next selection.	Enter flow value in SCFM representing 20 mA; press ENT.
		Previous menu ← to select ⬆	Press ENT to return to main menu or ↑ or ↓ to return to 4-20 mA (flow) setting.	
4-20 mA (temp) ← to select ⬆	Press ENT to select or ↑ or ↓ to continue to next election.	4 mA point XX F ⬆	Press ENT to select or ↑ or ↓ to continue to next selection.	Enter temperature in degrees F representing 4 mA; press ENT.
		20 mA point XXX F ⬆	Press ENT to select or ↑ or ↓ to continue to next selection.	Enter temperature in degrees F representing 20 mA; press ENT.
		Previous menu ← to select ⬆	Press ENT to return to main menu or ↑ or ↓ to return to 4-20 mA (temperature) setting.	
Previous menu	Press ENT to return to run mode or ↑ or ↓ to return to area setup.			

SOFTWARE CONFIGURATION cont.

MEASURED VALUES

The measured values menu is used to display current measured values and to determine which units will be shown on the display during run mode.

Access the Measured Values menu by pressing ↓ or ↑ from the run menu; press ENT. The display then cycles through the various values and permits these values to be displayed during run mode.

To display an item during the RUN mode, press ENT when that selection is displayed; then press ↑ or ↓ until “ON Main Display” is indicated on the second line. Then push ENT.

Pressing ⇅ moves up and down the left column; press ← to select the item to show on main display.

Measured Values			
Display	Option	Action if ENT is Pressed	Comments
Velocity xxxxx units	⇅ Press ENT to select or ↑ or ↓ to continue to next selection.	Press ↑ or ↓ to cycle between “ON Main Display” and “OFF Main Display”; press ENT to select.	
Flow xxxxx units	⇅ Press ENT to select or ↑ or ↓ to continue to next selection.	Press ↑ or ↓ to cycle between “ON Main Display” and “OFF Main Display”; press ENT to select.	
Mass xxxxx units	⇅ Press ENT to select or ↑ or ↓ to continue to next selection.	Press ↑ or ↓ to cycle between “ON Main Display” and “OFF Main Display”; press ENT to select.	Required input of Area in System Config to calculate.
Temp xxxxx units	⇅ Press ENT to select or ↑ or ↓ to continue to next selection.	Press ↑ or ↓ to cycle between “ON Main Display” and “OFF Main Display”; press ENT to select.	
Loop Flow xxxxx mA	⇅ Press ENT to select or ↑ or ↓ to continue to next selection.	Press ↑ or ↓ to cycle between “ON Main Display” and “OFF Main Display”; press ENT to select.	
Loop Temp xxxxx mA	⇅ Press ENT to select or ↑ or ↓ to continue to next selection.	Press ↑ or ↓ to cycle between “ON Main Display” and “OFF Main Display”; press ENT to select.	
Relays 1234 * = ENRG	⇅ Press ENT to select or ↑ or ↓ to continue to next selection.	Press ↑ or ↓ to cycle between “ON Main Display” and “OFF Main Display”; press ENT to select.	Displays Relay status; * signifies that the indicated relay is energized.
Total xxxxx units	⇅ Press ENT to select or ↑ or ↓ to continue to next selection.	Press ↑ or ↓ to cycle between “ON Main Display” and “OFF Main Display”; press ENT to select.	Totalizer must be enabled in I/O Configuration menu for this section to be displayed.
Previous menu ← to select	Press ENT to return to main menu or ↑ or ↓ to continue to selection.		Return to previous menu or cycle through measured values.

SOFTWARE CONFIGURATION cont.

SYSTEM CONFIGURATION MENU

The System Configuration menu is used to select the display units and enter specific information for the application. Enter this section by pushing ENT when System Config \updownarrow is displayed.

To calculate the flow or mass, it is necessary to accurately enter the area of the pipe or duct. If the pipe or duct is circular, simply enter the value of the diameter; the cross sectional area of the pipe is automatically calculated. If the duct is rectangular, skip over the entry of diameter, and directly enter the cross sectional area in the area section. The instrument will then back calculate an equivalent diameter.

System Configuration			
Display	Option	Action if ENT is Pressed	Comments
Flow Units SCFM \updownarrow	Press ENT to obtain choice of flow units or \uparrow or \downarrow to select next item.	Press \uparrow or \downarrow to cycle between options; press ENT to select.	Choice of SCFM, SCFS, NCM/Hr, NCM/M, NL/Hr
Mass Units Pounds/hour \updownarrow	Press ENT to obtain choice of mass units or \uparrow or \downarrow to select next item.	Press \uparrow or \downarrow to cycle between options; press ENT to select.	Choice of pounds/hour, pounds/minute, kilograms/hour, kilograms/minute.
Velocity Units SF/minute \updownarrow	Press ENT to obtain choice of velocity units or \uparrow or \downarrow to select next item.	Press \uparrow or \downarrow to cycle between options; press ENT to select.	Choice of SF/minute (standard, feet per minute) or NM/minute (normal meters per minute).
Temp Units Fahrenheit \updownarrow	Press ENT to obtain choice of temperature units or \uparrow or \downarrow to select next item.	Press \uparrow or \downarrow to cycle between options; press ENT to select.	Choice: Fahrenheit, Rankine, Celsius, Kelvin.
Diameter Units Value \updownarrow	Press ENT to obtain choice of measurement units or \uparrow or \downarrow to select next item.	Press \uparrow or \downarrow to cycle between options; press ENT to select.	Choice inches, feet, meters, millimeters.
Area Units Value \updownarrow	Press ENT to obtain choice of area units or \uparrow or \downarrow to select next item.	Press \uparrow or \downarrow to cycle between options; press ENT to select.	Choice of square inches, square feet, meters squared, millimeters squared.
Flow Area \leftarrow to select \updownarrow	Press ENT to calculate flow area or \uparrow or \downarrow to select next item.	Press \uparrow or \downarrow to cycle between options; press ENT to select.	Enter the cross sectional area of the pipe or duct or the pipe diameter.
		Diameter \updownarrow \rightarrow value	Enter the diameter (if circular), press ENT to continue or press \uparrow or \downarrow .
		Area \updownarrow \rightarrow value	The cross sectional area of the pipe is calculated based upon the diameter entered. If a square duct, enter the area.
		Previous menu \leftarrow to select	Press ENT to return to menu or \uparrow or \downarrow to return to flow area.
Previous Menu \leftarrow to select \updownarrow	Press ENT to return to main menu or \uparrow or \downarrow to return to Flow units.		Return to previous menu or cycle through System Configuration menu again.

I/O CONFIGURATION MENU

The I/O Configuration menu is used to setup the operations of the relays (if provided), 4–20 mA outputs, totalizer, and the communication parameters. The I/O Configuration menu is accessible by pushing \updownarrow from the RUN menu until the display reads:

I/O Config \updownarrow
 \leftarrow to select

Press ENT.

The I/O Configuration menu consists of five main sections described at right. Press ENT to enter the subroutine to setup the appropriate settings or \updownarrow to proceed to the next item.

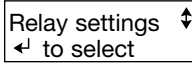
I/O Configuration	
Display	Comments
Relay Settings \leftarrow to select \updownarrow	Configure the relays (if provided).
4–20 mA (flow) \leftarrow to select \updownarrow	Configure the 4–20 mA flow signal.
4–20 mA (temp) \leftarrow to select \updownarrow	Configure the 4–20 mA temperature signal.
Totalizer \leftarrow to select \updownarrow	Configure the totalizer.
Comm Port Setup \leftarrow to select \updownarrow	Configure the communication port settings.
Previous Menu \leftarrow to select \updownarrow	Return to the previous (Main) menu.

SOFTWARE CONFIGURATION cont.

I/O CONFIGURATION MENU cont.

Relay Settings

This subroutine is accessible from the I/O Configuration menu by pressing ENT when the following is displayed:



Relay 1 can be configured as a fault relay. If the instrument's diagnostics detect any failure, or the instrument does not pass self-test, the fault relay will de-energize. Optionally, Relay 1 can be setup for regular relay operation. Relays can be controlled by velocity, flow, mass, temperature, or totalizer.

The relays can be configured so that there is some hysteresis between alarm set point and alarm reset points. This is accomplished by entering different values for the relay alarm set and alarm reset points.

Fail-safe condition of the relay is set via the software, such that the relay is either de-energized (DNRG) when actual conditions are less than set point, or de-energized when the actual conditions are greater than the set point. Refer to Figures 11.

ALARM ACTION

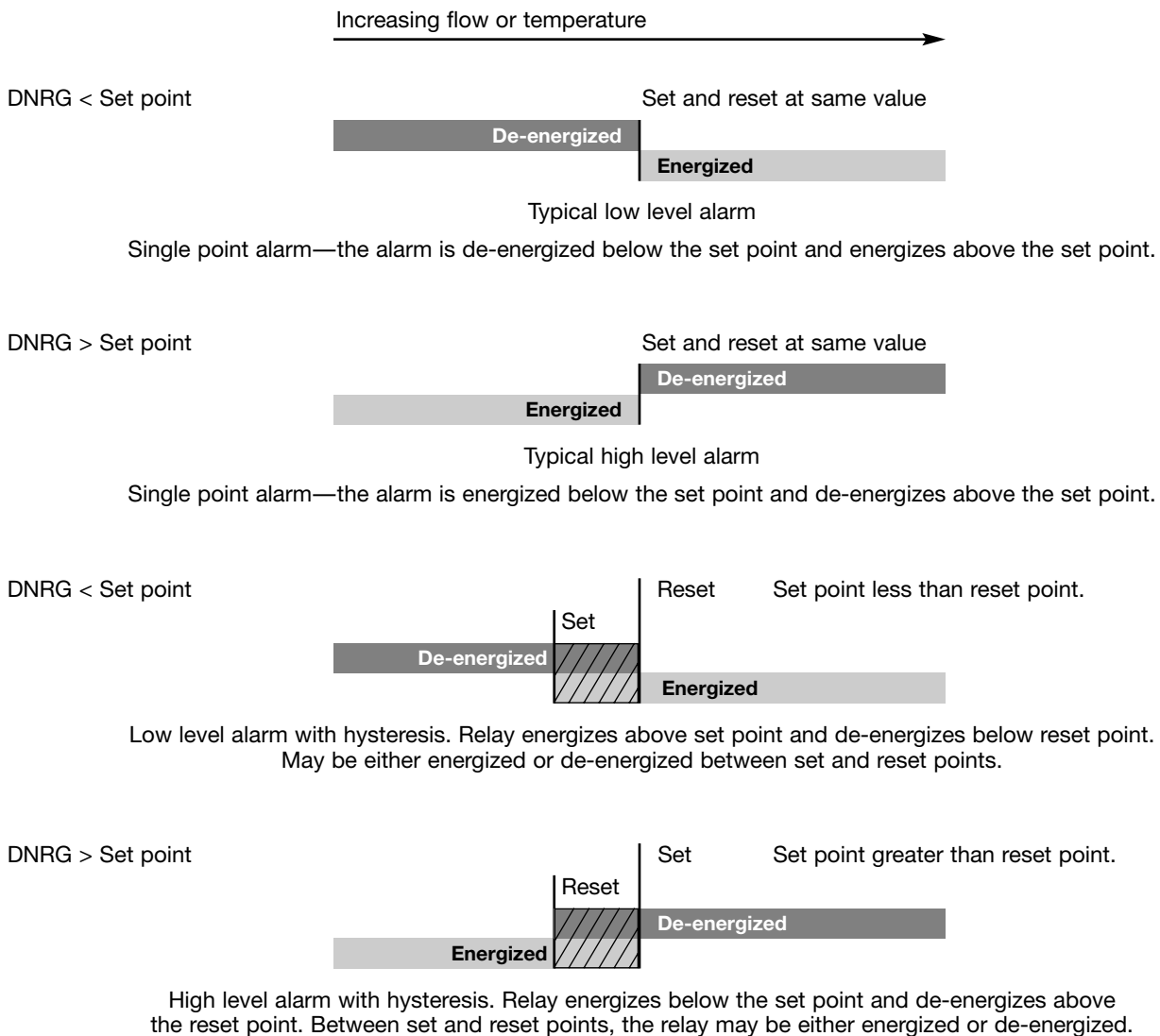


Figure 11

SOFTWARE CONFIGURATION cont.

I/O CONFIGURATION MENU cont.

Relay Settings cont.

Relay Settings			
Display	Option	Action if ENT is Pressed	Comments
Select Relay → 1	↕ Select Relay to configure; then press ENT.		Selects the relay (#1–4) to configure.
Fault Relay (#1) Disable	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle through enable or disable; press ENT to select.	Relay 1 can be configured as a fault relay or as standard discrete output.
Enable/Disable Enable	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle through enable or disable; press ENT to select.	Enable or disable the operation of the relay.
Controlled by Flow	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↕ to select the input controls operation of the relay; press ENT to select.	Choices are velocity, flow, mass, temperature, totalizer.
Alarm Set Point xx.xx units	↕ Press ENT to change or ↑ or ↓ to continue.	Enter relay set point using the keypad; press ENT.	Appropriate units are selected based upon choice under Controlled By.
Reset Point xx.xx units	↕ Press ENT to change or ↑ or ↓ to continue.	Enter relay reset point using the keypad; press ENT.	Appropriate units are selected based upon choice under “Controlled By.”
Relay Action DNRG<setpoint	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle between “DNRG < set point” or “DNRG > set point” operation; press ENT.	Determines if the relay is de- energized at conditions less than or greater than the set point.
Set Point Delay 0 sec	↕ Press ENT to change or ↑ or ↓ to continue.	Enter time delay using keypad; press ENT.	Enter desired time delay (0–255 seconds).
Reset Delay 0 sec	↕ Press ENT to change or ↑ or ↓ to continue.	Enter time delay using keypad; press ENT.	Enter desired time delay (0–255 seconds).
Fault mode DNRG on Fault	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle between “DNRG on Fault” and “HOLD on Fault.”	Selects if relay will de-energize or hold the output state in event of system fault.
Previous Menu ← to select	↕ Press ENT to return to main menu or ↑ or ↓ to review relay selection.		

I/O CONFIGURATION MENU cont.

4–20 mA

There are two 4–20 mA output loops which are independently configured. One loop is for the flow signal, the second is for the temperature output. The configuration menu for each loop is the same with the exception of the units.

To configure the 4–20 mA loop in the I/O Configuration menu, scroll down until the display shows:

4–20 mA ↕ ← to select

4–20 mA			
Display	Option	Action if ENT is Pressed	Comments
Enable/Disable Enable	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle through options.	Enable or disable the 4–20 mA output signal.
Controlled by flow	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle between velocity, flow, or mass.	Not required on 4–20 (temp) loop.
4 mA Point xxxxx units	↕ Press ENT to change or ↑ or ↓ to continue.	Set 4 mA value.	Enter desired 4 mA output. Units are selected based upon “Controlled By.”
20 mA Point xxxxx units	↕ Press ENT to change or ↑ or ↓ to continue.	Set 20 mA value.	Enter desired 20 mA output.
Fault Mode 22 mA	↕ Press ENT to reset or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle between 22 mA, 3.5 mA, or hold.	Select status of 4–20 mA output in event of a unit fault.
Previous Menu ← to select	↕ Press ENT to return to previous menu or ↑ or ↓ to review 4–20 mA settings.		

SOFTWARE CONFIGURATION cont.

I/O CONFIGURATION MENU cont.

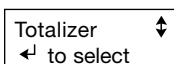
Totalizer

The totalizer in the TA1 maintains a continuous, running total of the flow in selectable units. The totalizer utilizes eeprom memory, eliminating the need for a battery backup. The totalizer can be reset to zero via the software configuration menu or by the Modbus communication.

The totalizer displays the totalized flow or mass with up to eight significant digits. As the total increases, the decimal point will move to always display the largest eight significant digits. After the total exceeds eight significant digits, the totalizer will display the total in scientific notation.

The totalizer must be enabled from the Totalizer section of the I/O Configuration menu. In the event of a power failure, the totalizer will typically lose less than one minute of data.

The totalizer function configures the operation and resets the totalizer. To configure the totalizer in the I/O Configuration menu, scroll down until the display shows:



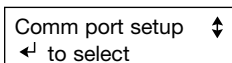
Totalizer			
Display	Option	Action if ENT is Pressed	Comments
Status Disable	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle through options.	Enable or disable the totalizer.
Controlled by flow	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle between flow or mass.	Totalizer will total either flow or mass.
Totalizer units units	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle between SCF, NCM, NL, pounds, Kg, tons.	Totalizer units based upon "Controlled By" selection.
Reset ← to select	↕ Press ENT to reset or DEL to return	Reset totalizer to 0000.	
Previous Menu ← to select	↕ Press ENT to return to previous menu or ↑ or ↓ to review totalizer settings.		

NOTE: The totalizer must be enabled for the value to be displayed under "Measured Values."

I/O CONFIGURATION MENU cont.

Communication Port Setup

The Communication Port Setup function configures the Modbus digital communication of the instrument. To configure the Communication Port, in the I/O Configuration menu, scroll down until the display shows:



Communication Port Setup			
Display	Option	Action if ENT is Pressed	Comments
Address (1-247) 1	↕ Press ENT to change or ↑ or ↓ to continue.	Enter address via keypad.	Set the specific address for this instrument. Ensure that no other instrument uses this same address.
Baud Rate 9600	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle between 1200, 2400, 4800, 9600.	Sets communication speed from instrument.
Parity Even	↕ Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle between Odd, Even, or None.	Sets the parity bit. Must match Modbus settings of user's system.
Previous Menu ← to select	↕ Press ENT to return to previous menu or ↑ or ↓ to review settings.		

SOFTWARE CONFIGURATION cont.

ADVANCED CONFIGURATION MENU

The Advanced configuration menu sets advanced parameters not normally used in the operation of the instrument. Access the Advanced Configuration Menu from the Run mode by pushing either the ↑ or ↓ arrow until the display shows:

Adv config ↕
 ↵ to select

Advanced Configuration Menu			
Display	Option	Action if ENT is Pressed	Comments
Damping (1-60) 1 ↕	Press ENT to change or ↑ or ↓ to continue.	Enter damping factor via keypad.	Increase the damping factor to decrease the effect of turbulence.
STP Conditions ↵ to select ↕	Press ENT to change or ↑ or ↓ to continue.	Permit review or entry of STP conditions.	Refer to Definitions section (page 7) for information on STP conditions.
Change Password ↵ to select ↕	Press ENT to change or ↑ or ↓ to continue.	1. Enter old password; press ENT. 2. Enter new password; press ENT. 3. Re-enter new password.	Change the instrument's password.
Cal Factor ↵ to select ↕	Press ENT to change or ↑ or ↓ to continue.		Refer to Definitions section (page 7) for information on calibration factors.
Probe Type TXR ↕	Press ENT to change or ↑ or ↓ to continue.	Press ↑ or ↓ to cycle through TXR, TXT probe, or TFT flow body, press ENT to select	Probes have different blockage factors. See nameplate for probe type.
Adj Loop Flow ↵ to select	Press ENT to change or ↑ or ↓ to continue.		
		4 mA Offset	Use ↑ or ↓ arrow keys to adjust actual output current until 4 mA is exact.
		20 mA Offset	Use ↑ or ↓ arrow keys to adjust actual output current until 20 mA is exact.
Adj Loop Temp ↵ to select	Press ENT to change or ↑ or ↓ to continue.		
		4 mA Offset	Use ↑ or ↓ arrow keys to adjust actual output current until 4 mA is exact.
		20 mA Offset	Use ↑ or ↓ arrow keys to adjust actual output current until 20 mA is exact.
Cal Coeff 1 & 2 ↵ to select ↕	Press ENT to review or ↑ or ↓ to continue.	Review values of factory calibration data.	Read only values of factory calibration coefficients.
Gas Density 7.50e-02 lb/Ft3 ↕	Press ENT to change or ↑ or ↓ to continue.	Review values of gas density at STP conditions.	Read only values of gas density at 70° F and 14.7 psia
Temp Comp Coef ↵ to select	Press ENT to change or ↑ or ↓ to continue.	Review factory calibration information.	Read only values of factory data; contact Magnetrol to change.
Tag Line	Press ENT to change or ↑ or ↓ to continue.	Change tag line.	Refer to page 7 to change tag line.
Previous Menu ↵ to select	Press ENT to return to previous menu or ↑ or ↓ to review selection.		

SOFTWARE CONFIGURATION cont.

DIAGNOSTICS MENU

The Diagnostics menu provides a method of testing the instrument's functionality. It also has useful information for troubleshooting. Access to Diagnostics menu is obtained from the Run mode by pushing either the ↑ or ↓ arrows until the display shows:

Diagnostics ← to select	↕
----------------------------	---

Communication Port Setup				
Display	Option	Action if ENT is Pressed	Comments	
Test Relays ← to select	↕	Press ENT to test or ↑ or ↓ to continue.	Select relay to test, ENT, then. use ↑ or ↓ to energize/de-energize relay.	Allows user to energize any relay individually. Press ENT when complete.
Test 4–20 Loop1 ← to select	↕	Press ENT to test or ↑ or ↓ to continue.	Enter desired current output.	Allows user to output desired 4–20 mA on loop 1 (flow). Press ENT when complete.
Test 4–20 Loop2 ← to select	↕	Press ENT to test or ↑ or ↓ to continue.	Enter desired current output.	Allows user to output desired 4–20 mA on loop 2 (temperature). Press ENT when complete.
Sensor Signal xxxxxxxxxx	↕	Press ↑ or ↓ to continue.		Displays value from sensor of the flow rate.
View Version # xxxxxxxxxx	↕	Press ↑ or ↓ to continue.		Display software version number.
Previous Menu ← to select		Press ENT to return to previous menu or ↑ or ↓ to review selection.		

DIGITAL COMMUNICATION RS-485/MODBUS PROTOCOL

INTRODUCTION

This section of the manual provides basic information on Modbus communication with the TA1 Thermal Mass Flow Transmitter. It is assumed for this manual that the user has a working knowledge of Modbus communication and RS-485 wiring practice.

IMPLEMENTATION

Magnetrol provides this guide to explain the operation of the Modbus protocol per Modicon® document PI-MBUS-300. The Modbus protocol provides frames for the transmission of messages between master and slaves.

Magnetrol implementation of the Modbus protocol provides for the passing of measured and calculated variables and diagnostics in data registers. Data is set in these registers as integer values, status summary words (packed bits), or individual flags (single bits). The information in the message is the address of the intended device, what the device must do, the data needed to perform the action, and a means of checking errors. The slave reads the message, and, if there is no error, it performs the task and sends a response back to the master.

The information in the response message is the slave address, the action performed, the result of the action and a means of checking errors. Certain characteristics of the Modbus protocol are fixed, such as **frame format**, **frame sequences (synchronization)**, handling of communications errors and **exception conditions**, and the **functions**

performed. Other characteristics are user selectable. These are **transmission medium** and **transmission mode**, RTU or ASCII. The user characteristics are set at each device and the **configuration** cannot be changed when the system is running.

TRANSMISSION MEDIUM

The transmission medium selected for Magnetrol devices is RS-485. The RS-485 standard is the most versatile of the EIA interface standards. RS-485 permits multi-drop network connections on two wires and provides reliable serial data communication for:

- Distances up to 5000 feet
- Data rates up to 9600 bps
- 31 slave devices
- 1 master device

One master and up to 31 slave devices may be multi-dropped on a single RS-485 communication bus.

TRANSMISSION MODE

Modbus provides two types of formats, Modbus RTU and Modbus ASCII. Magnetrol devices support the Remote Terminal Unit (RTU) mode of transmission. RTU provides improved error detection capabilities and higher throughput than the ASCII mode.

DIGITAL COMMUNICATION RS-485/MODBUS PROTOCOL (cont.)

CONFIGURATION

The Modbus port on the Magnetrol device must be configured to establish communications. The keypad allows the user to set the Magnetrol device RS-485/Modbus port to match the RS-485/Modbus master. The address, baud rate, and parity must be configured through the keypad.

Magnetrol device addresses provide unique identification for each device. This address may range from 1 to 247 and must be unique. Each Magnetrol device only responds when a poll has been sent to its unique address by the master.

The RS-485 port of each device must be configured for a transmission speed (baud rate) to match the master's transmission speed. Selectable values are 1200, 2400, 4800, or 9600 bits per second.

The RS-485 port of each device must be configured for a parity check bit that matches the master. Selectable options are odd, even, and none.

FUNCTIONS

Each request frame contains a function code that defines the action expected of the target device. The meaning of the request data fields is dependent on the function code specified.

Function Code	Function	Information Type	MODBUS Nomenclature
03	Read	16-bit register	Read holding registers
04	Read	16-bit register	Read input registers
06	Write	16-bit register	Preset single register
16	Write	16-bit register	Force multiple registers

MODEL TA1 REGISTER MAPPING

Command	Register #	Operation	Comments
Fault Flags	30001	Read Only	Bits 0-7: Not used Bit 8: A/D converter fault Bit 9: Flow error Bit 10: Temperature error Bits 11-15: Not used
Relay status	30002	Read Only	Bits 0-7: Not used Bit 8: Relay 1 status Bit 9: Relay 2 status Bit 10: Relay 3 status Bit 11: Relay 4 status Bits 12-15: Not used 0 = de-energized 1 = energized
Totalizer clear	30003	Write Only	1: Clear totalizer data 0: No operation
Totalizer	30036 to 30037	Read Only	Totalizer value in units of standard cubic feet.
Velocity	30038 to 30039	Read Only	Velocity value in units of SFPM.
Mass	30040 to 30041	Read Only	Mass value in units of pounds per minute.
Flow	33042 to 30043	Read Only	Flow value in units of SCFM.
Temperature	30044 to 30045	Read Only	Temperature value in units of degrees celsius.

WIRING

Standard Belden 8451 shielded, twisted pair, 22-gauge stranded conductors may be used for interconnection of units.

Magnetrol part number 009-7146-XXX
(XXX = cable length in feet)

Example: 009-7146-050 = 50 feet of cable
(10 feet minimum (3 m), 5000 feet maximum (1524 m))

The preferred method of wiring is that all units be wired in parallel, refer to Figure 12. It is permissible to have branches, not exceeding five feet from the main wiring trunk as shown in diagram. One master with a maximum of 31 slave devices is allowable.

Connect terminal A from the master device to terminal A on all slave devices.

Connect terminal B from the master device to terminal B on all slave devices.

Connect shielding from ground of master to ground on all slave devices.

NOTE: Polarity among units in loop must be observed.

The master device and the last (farthest) slave device in the loop must have a termination resistor. This resistor is provided in the Model TA1 by jumper placement of JP1, refer to Figure 9 (page 5).

All slave devices in the loop, except the last (farthest) slave device, should have jumper JP1 in the "C" position for continuing. The last (farthest) slave device should have the jumper in the "T" position.

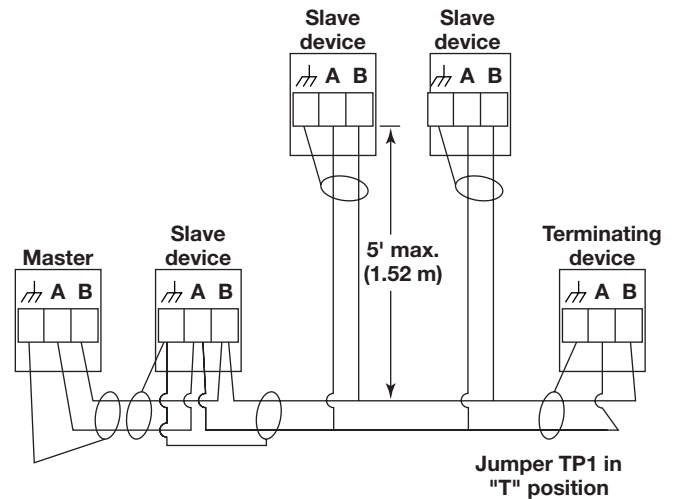


Figure 12

TROUBLESHOOTING

SOFTWARE

The following troubleshooting displays may occur on the instrument:

Message	Action
Password invalid	Re-enter data and correct password.
Err New Pwd Fail	When changing the password, the second entry of the new password does not match the first entry.
Error:max =	Entry of numeric data is outside the acceptable range. Maximum allowed value is displayed.
Error:min =	Entry of numeric data is outside the acceptable range. Minimum allowed value is displayed.

The instrument has self-diagnostics which will detect several specific faults. The following error messages can appear on the display:

Display	Action
Flow Error	Check the interconnecting wiring between the probe and the electronics. Check the resistance values (refer to Figures 13 and 14). Power down; power up.
Temp. Error	Check the interconnecting wiring between the probe and the electronics. Check the resistance values (refer to Figures 13 and 14). Power down; power up.
A/D Conv. Error	Power down, then power up. Call Magnetrol Technical Support (1-800-624-8765).

The following displays will only occur on reinitialization or in the event of eeprom memory failure. This is for information only; press DEL or ENT to proceed. This instrument must be reconfigured following the procedure in Software Configuration section on page 8.

Display	Failure or Occurrence
Probe Param Fail	eeprom memory failure for probe data storage.
Loop Preset Fail	eeprom memory failure for 4 mA or 20 mA point data storage.
Loop Par 1 Fail	eeprom memory failure for loop 1 data storage.
Loop Par 2 Fail	eeprom memory failure for loop 2 data storage.
Relay Param Fail	eeprom memory failure for relay data storage.
Sys Param Fail	eeprom memory failure for system parameter data storage.
Totalizer Loss!	eeprom memory failure for totalizer data storage.

RESISTANCE CHART

Figures 13 and 14 provide expected resistance value at the probe connection (TB11) in the remote electronics and at the probe enclosure.

Probe enclosure

Terminals	Expected Resistance
1-3	1,000 to 1,770 ohms
2-3	1,000 to 1,770 ohms
4-5	20 ohm

Figure 13

TB11

Terminals	Expected Resistance
8-9	1,000 to 1,770 ohms
8-10	1,000 to 1,770 ohms
8-11	20 ohm
13-14	1,000 to 1,770 ohms
13-15	1,000 to 1,770 ohms
8-13, 9-14, 10-15	Dependent on cable length, will be less than 2.0 ohms.

Figure 14

NOTE: When contacting Magnetrol for assistance, please provide measurement of the velocity and temperature from measured value and the signal strength from diagnostics menu.

MAINTENANCE

CLEANING

Depending upon the application, the sensor may require periodic cleaning. A buildup on the sensor will reduce the heat transfer, resulting in flow readings lower than expected. The frequency of cleaning is dependent upon the application.

Cleaning Procedure:

1. Remove probe from pipe/duct.
2. Wipe sensor tips with a clean cloth; if necessary, solvent may be used.
3. When sensors are clean, reinstall probe into pipe/duct.

AGENCY APPROVALS

FACTORY MUTUAL (FM)

MODEL	APPROVALS
Electronics: TA1-X2XX-110	Hazardous environments: Class I, Div. 2 Groups A, B, C, & D Class II, Div. 2 Groups F & G Class III Indoors and outdoors: NEMA Type 4X and IP 65
Probe: TXR-XXX0-XXX Flow Body: TFT-XXXX-000	Hazardous environments: Class I, Div. 1 Groups B, C, & D Class II, Div. 1 Groups E, F, G Class III (Maximum surface temperature of probe is +73° C above process temperature.) Indoors and outdoors: NEMA Type 4X and IP 65

CANADIAN STANDARDS ASSOCIATION (CSA)

MODEL	APPROVALS
Electronics: TA1-X2XX-110	Hazardous environments: Class I, Div. 2 Groups A, B, C, & D Class II, Div. 2 Groups E, F, G Class III Indoors and outdoors: Type 4X
Probe: TXR-XXX0-XXX Flow Body: TFT-XXXX-000	Hazardous environments: Class I, Div. 1 Groups C & D Class II, Div. 1 Groups E, F, & G Class III (Maximum surface temperature of probe is +73° C above process temperature.) Indoors and outdoors: Type 4X

These units have been tested to EN 61326 and are in compliance with the EMC Directive 89/336/EEC.



SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Description	Specification
Supply voltage	120 VAC, 50-60 Hz, +10%/-15% 240 VAC, 50-60 Hz, +10%/-15% 24 VDC, ±20%
Power consumption	12 watts maximum/15 VA maximum (without heater option) 62 watts maximum/65 VA maximum (with heater option)
Analog output signal Active	4-20 mA flow (isolated) 4-20 mA temperature (isolated) maximum 1,000 ohms loop resistance
Analog output signal Passive	4-20 mA flow (isolated) 4-20 mA temperature (isolated) loop resistance dependent on power supply
Digital output	RS-485/Modbus, RTU mode
Relays (optional)	0, 2, 4 10 amp SPDT resistive w/gold flash contacts
Fail-safe	Software selectable
Ambient temperature Electronics	Without heater and thermostat -4° to +160° F (-20° to +70° C) With heater and thermostat -40° to +160° F (-40° to +70° C)
Ambient temperature Sensor enclosure	-40° to +160° F (-40° to +70° C)
Display	Two-line alphanumeric LCD (16-characters per line)
Keypad	16-button integral to front panel
Humidity (electronics)	99% non-condensing
Cable length	250 feet (75 meters) maximum
Fuse size	Replaceable slow acting: 3/8 amp, 250 VAC for AC version 0.5 amp, 24 VDC version

PROBE SPECIFICATIONS

Description	Specification
Materials	316L stainless steel all welded
Process connections	Refer to model number optional hot tap
Pressure rating*	1500 psig @ +70° F (103 bar @ +21° C) 1375 psig @ +400° F (95 bar @ +200° C)
Temperature rating	-50° to +400° F (-45° to +200° C)

*Pressure rating dependent upon process connection.

FLOW BODY SPECIFICATIONS

Description	Specification
Materials	316/316L stainless steel all welded Carbon steel with stainless steel sensor
Process connections	NPT or 150 lb flange Refer to model number
Pressure rating	1500 psig @ +70° F (103 bar @ +21° C) 1100 psig @ +200° F (79 bar @ +200° C)
Temperature rating*	-50° to +400° F (-45° to +200° C)

*For operating temperatures between +250° F and +400° F (+120° C and +200° C), either use remote electronics or a longer length insertion probe to provide an additional four inches (100 mm) between the electronics and the compression fitting.

PERFORMANCE SPECIFICATIONS

Description	Specification
Flow range	25-40,000 SFPM (0.15-200 NM/sec) air reference to standard conditions. Higher ranges and other gases available, contact factory.
Temperature range	-50° to +400° F (-45° to +200° C)
Accuracy	±1% of reading +0.5% of full scale
Repeatability	±0.5% of reading
Linearity	Included in accuracy
Temperature coefficient	0.05%/° C
Turn down	100:1
Calibration	NIST traceable

SPECIFICATIONS cont.

DIMENSIONAL SPECIFICATIONS INCHES (MM)

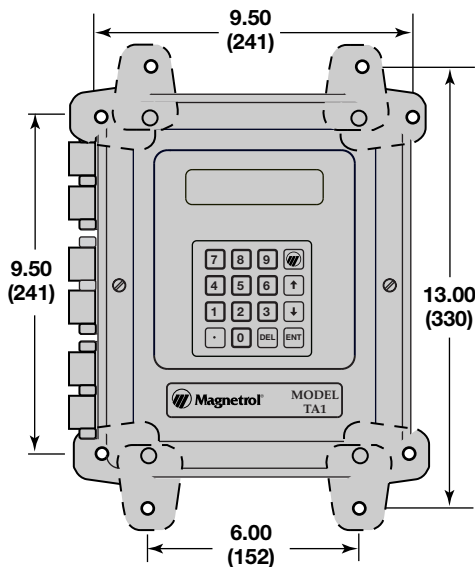


Figure 15
Electronics (front view)

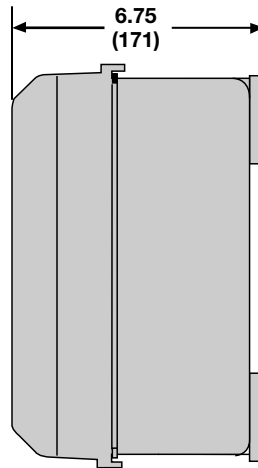


Figure 15
Electronics (side view)

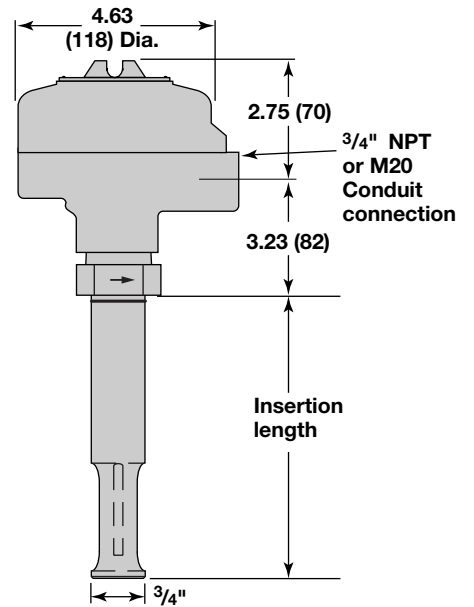


Figure 16
Insertion probe for use with
compression fitting

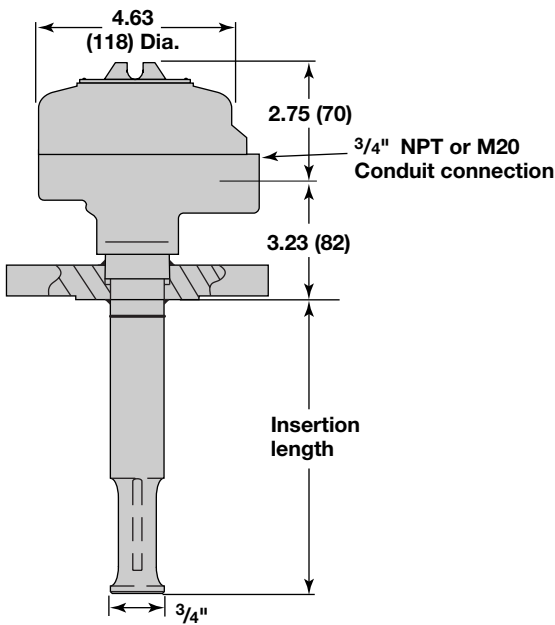


Figure 17
Probe with flange process connection

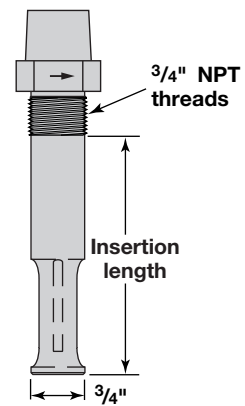


Figure 18
Insertion probe w/NPT threads

Mounting: The following optional parts are available for installing the TXR probe:

Connection size	Compression fitting	
	Teflon* ferrules	Stainless steel ferrules
1" NPT	011-4719-009 ①	011-4719-007 ②
3/4" NPT	011-4719-008 ①	011-4719-006 ②

① 100 psi maximum pressure rating
② 1500 psi maximum pressure rating

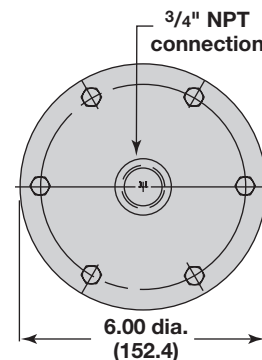
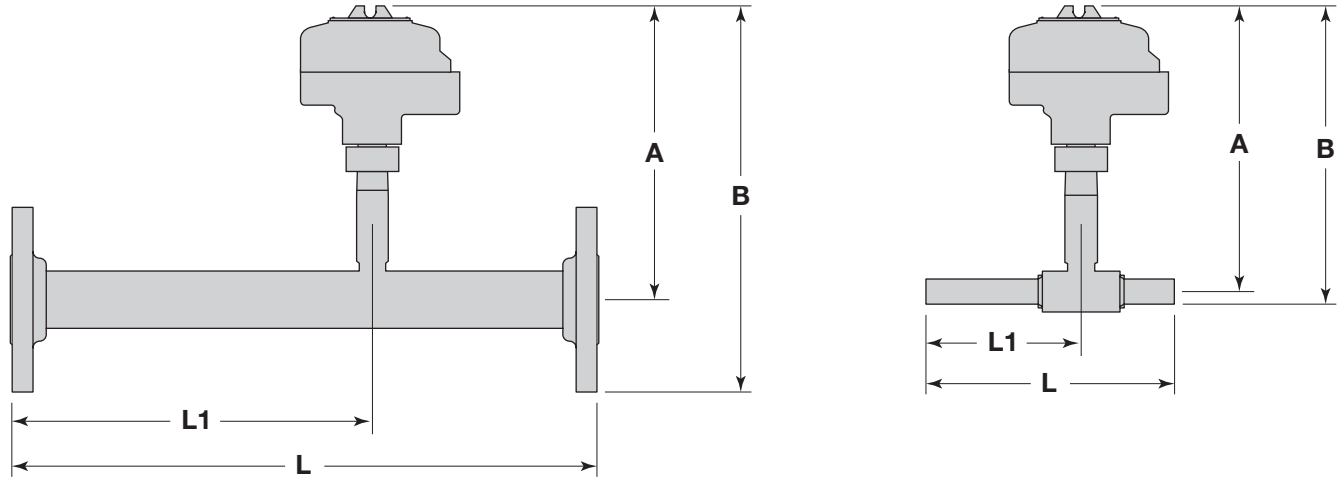


Figure 19
Duct mounting bracket with 3/4" NPT
Part number 089-7247-001

SPECIFICATIONS cont.

DIMENSIONAL SPECIFICATIONS INCHES (MM)



Code	Size	Length (L)		L1		Height to Centerline (A) inches (mm)	Overall Height (B)	
		With Flow Conditioning inches (mm)	Without Flow Conditioning inches (mm)	With Flow Conditioning inches (mm)	Without Flow Conditioning inches (mm)		NPT inches (mm)	Flange inches (mm)
0	½"	8 (203)	—	5 (127)	—	8.0 (203)	8.7 (221)	9.75 (248)
1	¾"	11.25 (381)	—	7.5 (190)	—	8.0 (203)	8.7 (221)	9.9 (251)
2	1"	15 (203)	—	10 (254)	—	8.0 (203)	8.7 (221)	10.1 (257)
3	1½"	19.5 (495)	7.5 (191)	12 (305)	3.75 (95)	8.35 (212)	9.3 (236)	10.85 (276)
4	2"	26 (660)	7.5 (191)	16 (406)	3.75 (95)	9.25 (235)	10.4 (264)	12.25 (311)
5	3"	39 (991)	10 (254)	24 (610)	5 (127)	9.25 (235)	N/A	13.0 (330)
6	4"	52 (1321)	12 (305)	36 (914)	6 (152)	9.25 (235)	N/A	13.75 (349)

FLOW BODY SIZING

The following table is a general guide on flow sizing.
Contact Magnetrol or your local representative for specific application information.

Code	Size	Air, N ₂ , O ₂	Natural Gas, Methane	Digester Gas	Propane	Hydrogen	CO ₂ , Argon
0	½"	65 SCFM 110 NM ³ /h	45 SCFM 76 NM ³ /h	25 SCFM 42 NM ³ /h	30 SCFM 51 NM ³ /h	15 SCFM 27 NM ³ /h	60 SCFM 105 NM ³ /h
1	¾"	120 SCFM 204 NM ³ /h	85 SCFM 140 NM ³ /h	45 SCFM 76 NM ³ /h	55 SCFM 93 NM ³ /h	30 SCFM 52 NM ³ /h	110 SCFM 190 NM ³ /h
2	1"	200 SCFM 340 NM ³ /h	140 SCFM 238 NM ³ /h	75 SCFM 127 NM ³ /h	95 SCFM 161 NM ³ /h	50 SCFM 85 NM ³ /h	190 SCFM 320 NM ³ /h
3	1½"	490 SCFM 833 NM ³ /h	340 SCFM 580 NM ³ /h	180 SCFM 310 NM ³ /h	230 SCFM 395 NM ³ /h	120 SCFM 208 NM ³ /h	465 SCFM 790 NM ³ /h
4	2"	715 SCFM 1220 NM ³ /h	505 SCFM 855 NM ³ /h	280 SCFM 480 NM ³ /h	350 SCFM 600 NM ³ /h	195 SCFM 332 NM ³ /h	680 SCFM 1155 NM ³ /h
5	3"	1765 SCFM 3000 NM ³ /h	1240 SCFM 2110 NM ³ /h	695 SCFM 1180 NM ³ /h	860 SCFM 1470 NM ³ /h	475 SCFM 812 NM ³ /h	1680 SCFM 2855 NM ³ /h
6	4"	3230 SCFM 5490 NM ³ /h	2260 SCFM 3845 NM ³ /h	1265 SCFM 2145 NM ³ /h	1575 SCFM 2675 NM ³ /h	865 SCFM 1478 NM ³ /h	3060 SCFM 5210 NM ³ /h

MODEL NUMBER

REMOTE TRANSMITTER WITH INSERTION PROBE

INPUT VOLTAGE

0	120 VAC
1	240 VAC
2	24 VDC
3	120 VAC with heater
4	240 VAC with heater

NUMBER OF RELAYS

0	None
2	Two
4	Four

CALIBRATION

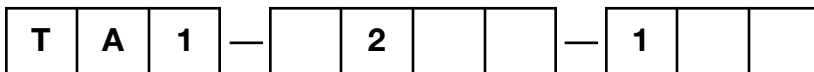
Actual Gas Calibration	
0	Special
1	Air
2	Nitrogen or Oxygen
3	Hydrogen
4	Natural Gas
5	Methane
6	Digester Gas
7	Propane
Air Equivalency Calibration	
9	Air Equivalency

PROBE HOUSING

1	FM/CSA approved
D	ATEX approved

CONDUIT CONNECTION

0	3/4" NPT
1	M20



MODEL NUMBER

INSERTION PROBE

UNIT OF MEASUREMENT

TER	Probe length in tenths of an inch
TMR	Probe length in centimeters

MATERIALS OF CONSTRUCTION

A	316/316L stainless steel
B	Hastelloy C-276

PROCESS CONNECTION

00	Compression fitting utilized ① ②	43	2" 150# ANSI raised face flange
11	3/4" NPT threaded	44	2" 300# ANSI raised face flange
21	1" NPT	BA	DN25 PN 16, DIN 2527, Form B
22	1" BSP	BB	DN25 PN 25/4, DIN 2527, Form B
23	1" 150# ANSI raised face flange	CA	DN40 PN 16, DIN 2527, Form B
24	1" 300# ANSI raised face flange	CB	DN40 PN 25/4, DIN 2527, Form B
33	1 1/2" 150# ANSI raised face flange	DA	DN50 PN 16, DIN 2527, Form B
34	1 1/2" 300# ANSI raised face flange	DB	DN50 PN 25/40, DIN 2527, Form B

- ① Not available with Hastelloy C construction
- ② Customer supplied or purchased separately (see page 24 for part numbers)

PROBE LENGTH

2.6 to 99.9 inches (example: 8.5" = 085) Minimum lengths: 2.6" (026) with threaded process connection 2.8" (028) with flanged process connection 4.5" (045) with compression fitting process connection
7 to 253 centimeters (example: 18 cm = 018) Minimum lengths: 7 cm (007) with threaded or flanged process connection 11 cm (011) with compression fitting process connection

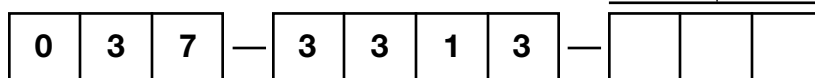


MODEL NUMBER

CONNECTING CABLE

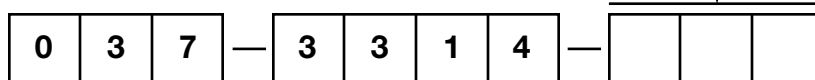
CABLE LENGTH IN FEET

10 feet minimum, 250 feet maximum length
 Example: 50 feet = 050



CABLE LENGTH IN METERS

3 meters minimum, 75 meters maximum length
 Example: 8 meters = 008



MODEL NUMBER

REMOTE TRANSMITTER WITH FLOW BODY

INPUT VOLTAGE

0	120 VAC
1	240 VAC
2	24 VDC
3	120 VAC with heater
4	240 VAC with heater

NUMBER OF RELAYS

0	None
2	Two
4	Four

CALIBRATION

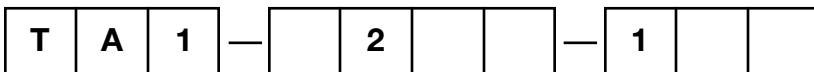
Actual Gas Calibration	
A	Special
B	Air
C	Nitrogen or Oxygen
D	Hydrogen
E	Natural Gas
F	Methane
G	Digester Gas
H	Propane
Air Equivalency Calibration	
K	Air Equivalency

PROBE HOUSING

1	FM/CSA approved
D	ATEX approved

CONDUIT CONNECTION

0	3/4" NPT
1	M20



MODEL NUMBER

FLOW BODY

MATERIALS OF CONSTRUCTION

A	All stainless steel
1	Carbon steel body with stainless steel sensor

SIZE

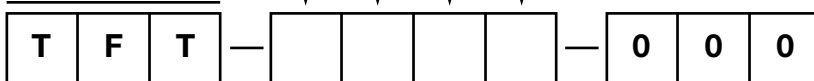
0	½ inch
1	¾ inch
2	1 inch
3	1½ inch
4	2 inch
5	3 inch
6	4 inch

PROCESS CONNECTION TYPE

1	NPT Threads (only when Digit 5 = 0, 1, 2, 3, or 4)
3	150# Flange

FLOW CONDITIONER (stainless steel)

0	Not provided
1	Provided (only when Digit 5 = 3, 4, 5, or 6)

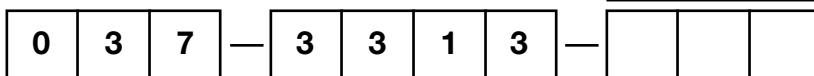


MODEL NUMBER

CONNECTING CABLE

CABLE LENGTH IN FEET

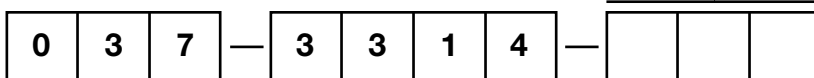
10 feet minimum, 250 feet maximum length
 Example: 50 feet = 050



Longer cable lengths possible.
 Consult Magnetrol with application details.

CABLE LENGTH IN METERS

3 meters minimum, 75 meters maximum length
 Example: 8 meters = 008



Longer cable lengths possible.
 Consult Magnetrol with application details.

REPLACEMENT PARTS

No.	Description	Part Number	
1	NEMA 4X enclosure	Consult Factory	
2	Enclosure gasket	012-1606-001	
3	Keypad overlay	Consult Factory	
4	Relay PC board	120 VAC, 0 relays	Z30-2218-001
		120 VAC, 2 relays	Z30-2218-002
		120 VAC, 4 relays	Z30-2218-003
		240 VAC, 0 relays	Z30-2218-004
		240 VAC, 2 relays	Z30-2218-005
		240 VAC, 4 relays	Z30-2218-006
		24 VDC, 0 relays	Z30-2218-007
		24 VDC, 2 relays	Z30-2218-008
		24 VDC, 4 relays	Z30-2218-009
5	Heater assembly	120 VAC	036-2202-003
		240 VAC	036-2202-004
6	Remote housing base $\frac{3}{4}$ " NPT conduit connection	004-9104-001	
7	Remote housing cover	004-9105-001	
8	Remote housing O-ring	012-2101-345	
9	Probe replacement kit	*	

* Probe and board are matched set. Consult factory for information.

WARNING: EXPLOSION HAZARD

Substitution of components may impair suitability for Class I, Division 2.

WARNING: EXPLOSION HAZARD

Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

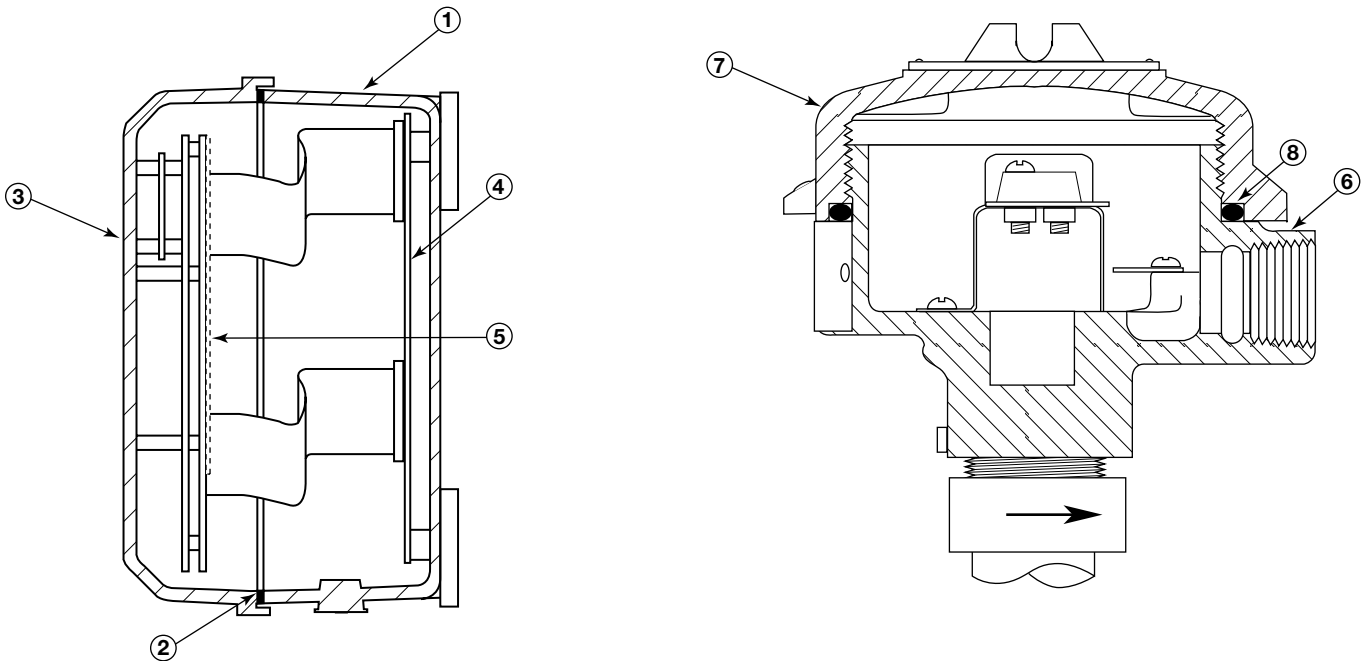


Figure 20

GLOSSARY

Atmospheric pressure: Average pressure at sea level. One atmosphere pressure is equal to 14.696 psia or 29.921 inches of mercury or 406.8 inches of water.

Bar: Unit of pressure measurement. One bar equals 14.504 pounds per square inch or 100 kilopascals.

Celsius (C): Unit of temperature measurement. At one atmosphere pressure: at zero degrees Celsius, water freezes; at 100 degrees Celsius, water boils. One degree Celsius is equal to 1.8 degrees Fahrenheit.

$$T_c = (T_f - 32) / 1.8$$

Fahrenheit (F): Unit of temperature measurement. At one atmosphere pressure: at 32 degrees Fahrenheit, water freezes; at 212 degrees Fahrenheit, water boils.

$$T_f = 1.8 \times T_c + 32$$

Kelvin: Unit of temperature measurement referenced to absolute conditions.

$$\text{Degrees Kelvin} = \text{Degrees Celsius} + 273.15$$

NCM/M (normal cubic meters per minute): Flow measurement at normal (standard) conditions (STP).

NM/M (normal meters per minute): Velocity of the gas referenced to standard (STP) conditions.

PSIA: Absolute pressure in pounds per square inch. Zero psia is an absolute vacuum.

$$1 \text{ atmosphere pressure} = 14.696 \text{ psia}$$

$$\text{PSIA} = \text{PSIG} + 14.696$$

PSIG: Gauge pressure in pounds per square inch above atmospheric pressure.

Rankine: Unit of temperature measurement referenced to absolute conditions.

$$\text{Degrees Rankine} = \text{Degrees Fahrenheit} + 459.67$$

SCFM (standard cubic feet per minute): Flow measurement at standard (STP) conditions.

SFPM (standard feet per minute): Velocity of gas flowing in the pipe or duct referenced to standard (STP) conditions.

Standard Conditions: Typical is 70° F and one atmosphere pressure (14.7 psia) or 0° C and one bar pressure (14.5 psia).

STP (standard pressure and temperature): Also referred to as standard conditions.

Velocity: Measured in SF/M (standard feet per minute) or NM/M (normal meters per minute). This is the mass velocity directly measured by the instrument referenced to the appropriate standard conditions.

IMPORTANT

PRODUCT WARRANTY

All Magnetrol/STI electronic level and flow controls are warranted free of defects in materials or workmanship for one full year from the date of original factory shipment. Repair parts are warranted free of defects in materials and workmanship for one year from the date of shipment. Materials, specifications, and contents are subject to change without prior written notice.

If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, Magnetrol/STI will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

Magnetrol/STI shall not be liable for misapplication, labor claims, direct or consequential damage or expense arising from the installation or use of equipment. There are no other warranties expressed or implied, except special written warranties covering some Magnetrol/STI products.

QUALITY ASSURANCE

The quality assurance system in place at Magnetrol/STI guarantees the highest level of quality throughout the company. Magnetrol/STI is committed to providing full customer satisfaction both in quality products and quality service.



Magnetrol's quality assurance system is registered to ISO 9001 affirming its commitment to known international quality standards providing the strongest assurance of product/service quality available.

ASSURED QUALITY & SERVICE COST LESS

SERVICE POLICY

Owners of Magnetrol/STI controls may request the return of a control or any part of a control for complete rebuilding or replacement. They will be rebuilt or replaced promptly. Controls returned under our service policy must be returned by Prepaid transportation. Magnetrol/STI will repair or replace the control at no cost to the purchaser (or owner) other than transportation if:

1. Returned within the warranty period; and
2. The factory inspection finds the cause of the claim to be covered under the warranty.

If the trouble is the result of conditions beyond our control; or, is NOT covered by the warranty, there will be charges for labor and the parts required to rebuild or replace the equipment.

In some cases it may be expedient to ship replacement parts; or, in extreme cases a complete new control, to replace the original equipment before it is returned. If this is desired, notify the factory of both the model and serial numbers of the control to be replaced. In such cases, credit for the materials returned will be determined on the basis of the applicability of our warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

LOW VOLTAGE DIRECTIVE

For use in Category II installations. If equipment is used in a manner not specified by the manufacturer, protection provided by equipment may be impaired.

RETURN MATERIAL PROCEDURE

So that we may efficiently process any materials that are returned, it is essential that a "Return Material Authorization" (RMA) number be obtained from the factory, prior to the material's return. This is available through Magnetrol/STI's local representative or by contacting the factory. Please supply the following information:

1. Company Name
2. Description of Material
3. Serial Number
4. Reason for Return
5. Application

Any unit that was used in a process must be properly cleaned in accordance with OSHA standards, before it is returned to the factory.

A Material Safety Data Sheet (MSDS) must accompany material that was used in any media.

All shipments returned to the factory must be by prepaid transportation.

All replacements will be shipped F.O.B. factory.

NOTE: See Electrostatic Discharge Handling Procedure on page 4.



5300 Belmont Road • Downers Grove, Illinois 60515-4499 • 630-969-4000 • Fax 630-969-9489 • www.magnetrol.com
145 Jardin Drive, Units 1 & 2 • Concord, Ontario Canada L4K 1X7 • 905-738-9600 • Fax 905-738-1306
Heikensstraat 6 • B 9240 Zele, Belgium • 052 45.11.11 • Fax 052 45.09.93
Regent Business Ctr., Jubilee Rd. • Burgess Hill, Sussex RH15 9TL U.K. • 01444-871313 • Fax 01444-871317



5300 Belmont Road • Downers Grove, Illinois 60515-4499 • 630-969-4028 • Fax 630-969-9489 • www.sticontrols.com

Copyright © 2006 Magnetrol International, Incorporated. All rights reserved. Printed in the USA.

Magnetrol and Magnetrol logotype are registered trademarks of Magnetrol International.
STI and STI logotype are registered trademarks of Magnetrol International.

Performance specifications are effective with date of issue and are subject to change without notice.

BULLETIN: 54-620.5

EFFECTIVE: March 2006

SUPERSEDES: February 2003