MAGNETROL® LEVEL MATTERS

ABLE

Installation & Maintenance Instructions

THERMATEL®

Enhanced Model TA2 Thermal Mass Flow Meter

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Thermatel®
Enhanced Model TA2

FOUNDATION Fieldbus™ Digital Output
Software v2.x

Installation and Operating Manual

Thermal

Dispersion

Mass Flow

Transmitter

FOUNDATION

MAGNETROL®

Read this Manual Before Installing

This manual provides information on the TA2 Thermal Dispersion Mass Flow Transmitter. It is important that all instructions are read carefully and followed in sequence. Detailed instructions are included in the Installation section of this manual.

Conventions Used in this Manual

Certain conventions are used in this manual to convey specific types of information. General technical material, support data, and safety information are presented in narrative form. The following styles are used for notes, cautions, and warnings.

NOTES

Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions. They follow the procedural steps to which they refer.

Cautions

Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician to unsafe practices or the need for special protective equipment or specific materials. In this manual, a caution box indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

WARNINGS

Warnings identify potentially dangerous situations or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, could result in serious injury or death.

Safety Messages

Follow all standard industry procedures for servicing electrical equipment when working with or around high voltage. Always shut off the power supply before touching any components.

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

Low Voltage Directive

For use in Installation Category II, Pollution Degree 2. If equipment is used in a manner not specified by manufacturer, protection provided by equipment may be impaired.

Notice of Trademark, Copyright, and Limitations

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Performance specifications are effective with date of issue and are subject to change without notice. Magnetrol® reserves the right to make changes to the product described in this manual at any time without notice. MAGNETROL makes no warranty with respect to the accuracy of the information in this manual.

Warranty

All MAGNETROL 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.

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 will repair or replace the control at no cost to the purchaser (or owner) other than transportation.

MAGNETROL 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 products.

Quality Assurance

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

The MAGNETROL Corporate 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.

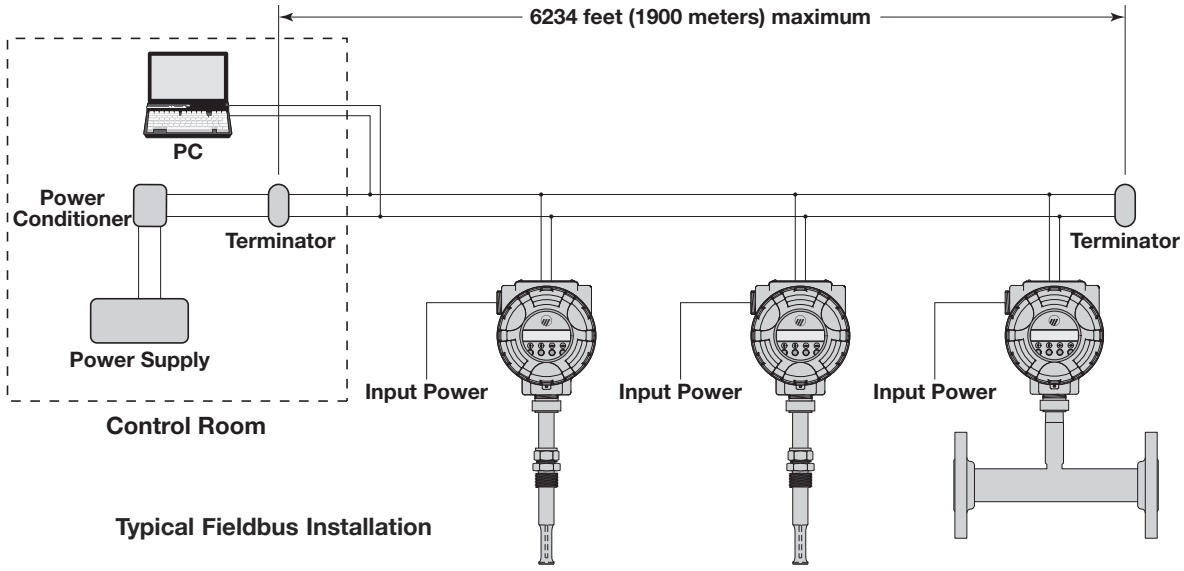
Thermatel® Enhanced Model TA2 Transmitter

Table of Contents

1.0 FOUNDATION fieldbus™ Overview

1.1 Description

FOUNDATION fieldbus™ is a digital communication system that serially interconnects devices in the field across a network. Fieldbus devices are smart and can maintain control over the system. The network can carry many process variables as well as other operational/maintenance information.



Typical Fieldbus Installation

The Enhanced Model TA2 transmitter is a FOUNDATION fieldbus™ registered device that communicates with the H1 FOUNDATION fieldbus™ protocol operating at 31.25 kbits/sec. The H1 physical layer is an approved IEC 61158 standard.

An IEC 61158 shielded twisted pair wire segment can be as long as 6234 feet (1900 meters) without a repeater. Up to four repeaters per segment can be used to extend the distance. The maximum number of devices allowed on a Fieldbus segment is 32.

Details regarding cable specifications, grounding, termination, and other network information can be found in IEC 61158 or the wiring installation application guide AG-140 at **www.fieldbus.org**.

NOTE: The Model TA2 FF Flow Meter is designed as a "Four-Wire" Transmitter. Since power is required for the operation, the TA2 FF requires supplemental power which can be either 15 to 30 VDC or 100–264 VAC. The TA2 connection to the host computer can be installed using a single pair of wires in multi-drop configuration.

1.2 Device Configuration

The function of a FOUNDATION fieldbus™ device is determined by the arrangement of a system of blocks defined by the Fieldbus Foundation. The types of blocks used in a typical User Application are described as follows:

Resource Block describes the characteristics of the FOUNDATION fieldbus™ device such as the device name, manufacturer, and serial number.

Transducer Blocks contain information such as calibration parameters and sensor type. They are used to connect the sensor to the input function blocks.

Function Blocks are built into the FOUNDATION fieldbus™ devices as needed to provide the desired control system behavior. The input and output parameters of function blocks can be linked over the Fieldbus. There can be numerous function blocks in a single User Application.

PID Blocks are key to many control schemes and contain the logic necessary to perform Proportional/Integral/Derivative control.

Analog Input (AI) Blocks use values from the Transducer Block and make available to other function blocks.

Integrator Blocks accumulate the flow or mass value from the AI Block to provide the value of the Totalized Flow.

Device Descriptions

An important requirement of Fieldbus devices is the inter-operability concept mentioned earlier. Device Description (DD) technology is used to achieve this interoperability. The DD provides extended descriptions for each object and provides pertinent information needed by the host system.

Any Fieldbus host system can operate with a device if it has the proper DD and Common File Format (CFF) for that device.

The most recent DD and CFF files can be found on the FOUNDATION fieldbus™ web site at **www.fieldbus.org**.

NOTE: Please consult your host system vendor for any host-specific files that may be needed.

1.2.1 FOUNDATION fieldbus™ Revision Table

Model TA2 2.x

FOUNDATION fieldbus™ Version	FOUNDATION fieldbus™ Release Date	Compatible with TA2 Software
Dev V1 DD V1	October 2011	Version 2.0A and later

1.3 Link Active Scheduler (LAS)

The default operating class of the Enhanced Model TA2 with FOUNDATION fieldbus™ is a basic device. However, it is capable of being a Link Active Scheduler (LAS). The LAS controls all communication on a FOUNDATION fieldbus™ segment. It maintains the "Live List" of all devices on a segment, coordinates both the cyclic and acyclic timing and, at any given time, controls which device publishes data via Compel data (CD) and Pass Token (PT).

The primary LAS is usually maintained in the host system, but in the event of a failure, all associated control can be transferred to a backup LAS in a field device such as the Enhanced Model TA2. The operating class can be changed from basic to LAS using a FOUNDATION fieldbus™ configuration tool.

NOTE: The Enhanced Model TA2 is shipped from the factory with Device Class set to Basic.

2.0 Quick Start Installation

The TA2 is calibrated and configured with the information supplied to MAGNETROL with the order. The instrument can be installed, wired, and placed directly into operation.

2.1 Probe Installation

Insert the probe into the pipe or duct at the appropriate location. It is recommended that the sensor be located on the center line of the pipe and that the flow arrow be positioned in the direction of flow.

See Appendix B for recommended straight run and flow conditioning plate installation details (if applicable).

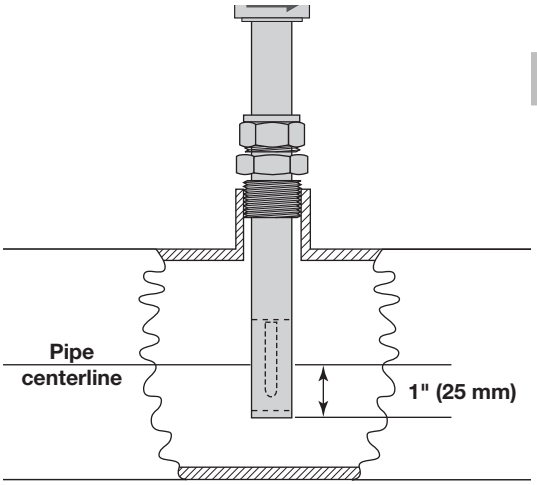


Figure 1

Probe Installation into Pipe or Duct Using a Compression Fitting

2.2 Wiring

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

NOTE: Make sure the electrical wiring to the TA2 is complete and in compliance with all regulations and codes. For a maximum ambient temperature of 80 °C use wiring rated up to 264 VAC and 105 °C. For a maximum ambient temperature of 70 °C use wiring rated up to 264 VAC and 95 °C.

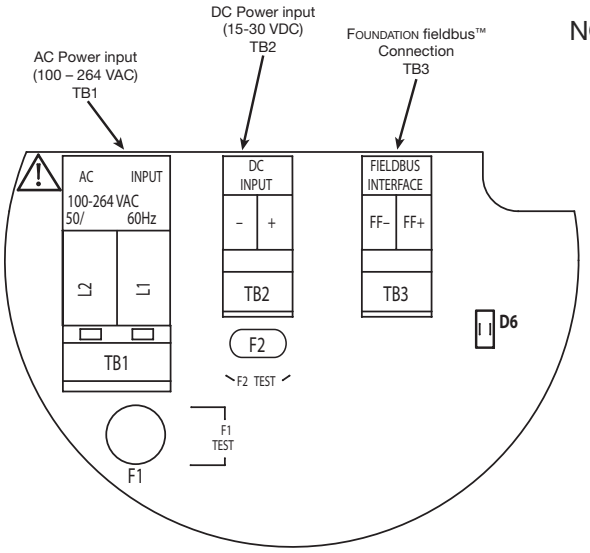


Figure 2

Enhanced TA2

FOUNDATION fieldbus™ Wiring Board

NOTE: The AC power terminal blocks accept 12-22 AWG wire and the DC power terminal blocks accept 14-30 AWG wire. Select wire size consistent with power requirements.

1. Remove the cover of the rear compartment.
2. Pull power supply and control wiring through conduit connection.
3. Connect power leads to proper terminals.
   a. 100 to 264 VAC – Make connections to TB1. Connect the "hot" wire to L1 and the second wire to L2.
   b. 15 to 30 VDC – Make the connections to TB2. Connect the Positive wire to (+) and the negative lead to (–).
4. Connect Foundation fieldbus leads to terminal TB3. Connect the positive wire to FF+ and the negative wire to FF-. Fieldbus voltage range is 9-32 VDC.

NOTE: Ensure that the correct wiring is made to the appropriate terminals. Connecting the DC power to the AC terminals will cause the unit not to operate. Connecting the AC power to the DC terminals will blow the fuse and potentially cause damage to the electronics boards.

NOTE: The green ground screw in the rear of the housing should be used for earth ground.

NOTE: Shielded cable is required for the DC wiring. Connect the shield wire to the green ground screw in the rear of the housing.

2.3 Configuration

The TA2 is pre-configured using the information supplied with the order. If desired, the user can view or change any of the configuration data. See *Configuring the Transmitter, Section 3.5*

3.0 Installation

3.1 Unpacking

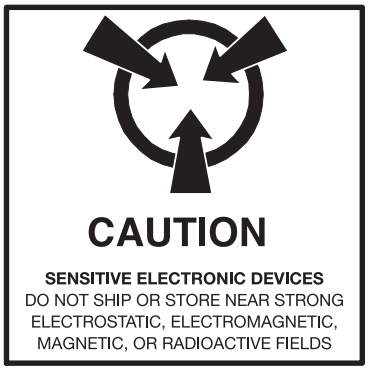
Unpack the instrument carefully making sure all components have been removed from the packing material. Inspect all components for damage. Report any concealed damage to the carrier within 24 hours. Check the contents of the carton making sure they correspond with the packing slip and purchase order. Save the Calibration Certificate containing the calibration and configuration data for future reference.

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. Record the serial number for future reference when ordering parts.

Model Number

Serial Number

3.2 Electrostatic Discharge (ESD) Handling Procedure



MAGNETROL 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 secure and none are partial or floating. Ground all equipment to a good earth ground.

NOTE: The instrument is rated per IEC 61010-1 for use in Installation Category II, Pollution Degree 2.

3.3 Installation

3.3.1 Electronics

The instrument is rated for use in Class I, Division 1 and Class I, Division 2 areas. The enclosure is also rated NEMA 4X. Remote electronics (optional) should be installed in an easy to access location within 500 feet (150 meters) of the sensor. The electronics should not be installed in areas where ambient temperature exceeds +175 °F (+80 °C). If ambient temperature is between -22 to -65 °F (-30 to -54 °C), the unit will operate but the display will not be readable.

Provide watertight seals for all wiring entrances in the enclosure to maintain the NEMA 4X rating. Use appropriate NEC section when installing the instrument.

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

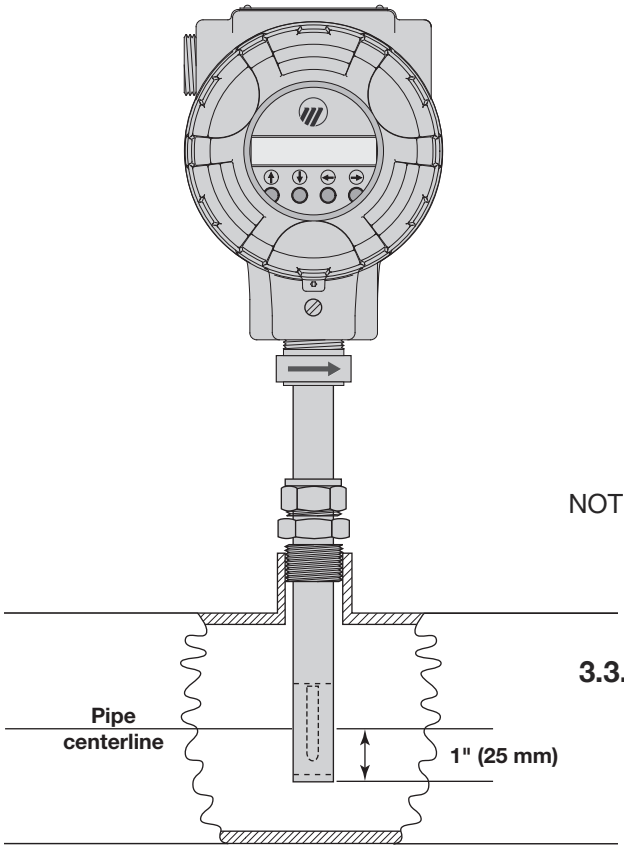


Figure 3

Probe Installation into Pipe or Duct Using a Compression Fitting

3.3.2 Probe/Flow Body

Proper installation of the probe in the pipe or duct is essential for accurate air or gas flow measurement. Normal procedures for installing any type of flow element should be followed. See Appendix B for additional information on probe location.

A flow arrow is 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 arrow is aligned in the direction of flow. The instrument is unable to recognize flow direction if inserted with the flow arrow in the wrong direction.

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. 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 3.

It may be necessary to rotate the head of the instrument to view the display while maintaining the proper flow orientation. This is accomplished by loosening the set screw on the bottom of the housing, rotating the enclosure to the desired position and re-tightening the set screw. The second set screw is a stop to prevent over rotating the enclosure. See figure 4.

Figure 4

Pressure ratings of the compression fitting:

Stainless steel ferrules:
1500 psig at +70 °F (103 bar at +20 °C)
1375 psig at +400 °F (95 bar at +200 °C)

Teflon® ferrules:
100 psig (7 bar)

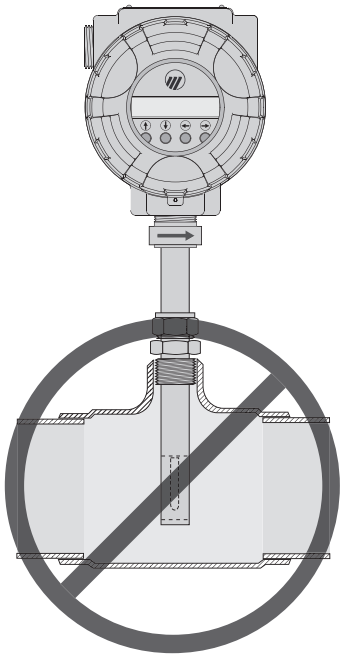


Figure 5
Probe Installation into a Tee Fitting is Not Recommended

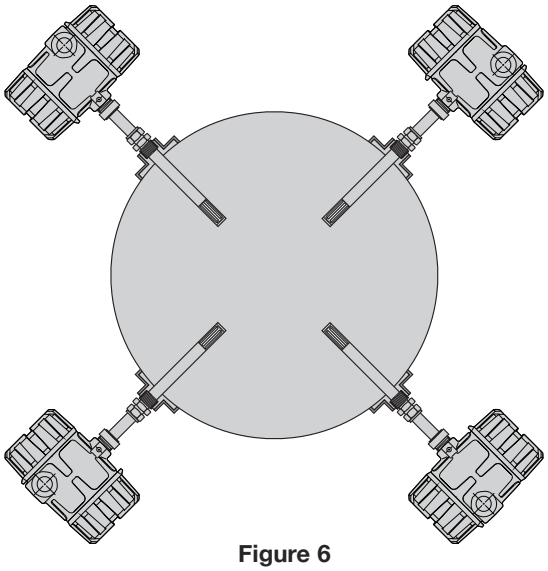


Figure 6
Install the TA2 at an Angle where Condensed Moisture may be Present

Various methods of mounting the probe include compression fittings, threads, 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 with ¾" or 1" NPT connection for ¾" outside diameter tube is recommended.

The use of Teflon® ferrules should be considered if repeated reposition of the sensor is considered. The stainless steel ferule can only be tightened once as it makes a permanent indentation on the probe. If using a compression fitting with stainless steel ferrules, ensure that the probe is in the desired location before tightening.

NOTE: The TA2 flow measurement is based on a fully developed turbulent flow profile in a pipe with the specified inner diameter. Accuracy will be affected if these conditions are not obtained. Installing the probe in a tee is not recommended as the flow profile and the flow area are distorted (See figure 5).

For applications where it is desirable to install or remove the probe without having to shut down the process, The MAGNETROL Retractable Probe Assembly (RPA) can be utilized. See the Model TA2 Product Catalog (MAGNETROL bulletin 54-140) for more information.

WARNING ***To avoid potential damage or injury, never loosen a compression fitting while sensor is under pressure.***

NOTE: Remote electronics is recommended for operating temperatures greater than +250 °F (+120 °C) or in locations where the temperature of the electronics will exceed +175 °F (+80 °C). Optionally, an insertion probe with extended probe length to provide at least four inches (100 mm) between the electronics and the compression fitting can be utilized.

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. Consider mounting the probe at a 45° angle from top, from the side or bottom of the pipe to minimize possibility of condensed moisture running down the probe and contacting the sensor (see Figure 6). In extreme cases, it may be necessary to insulate or even heat trace the pipe to prevent the condensation of moisture.

The TA2 with an insertion probe provides a point measurement and assumes that a fully developed profile exists. See Appendix B. The user has the ability to compensate the flow measurements based upon flow profile considerations under the Advanced Configuration section of the software. See Section 3.5.9.

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

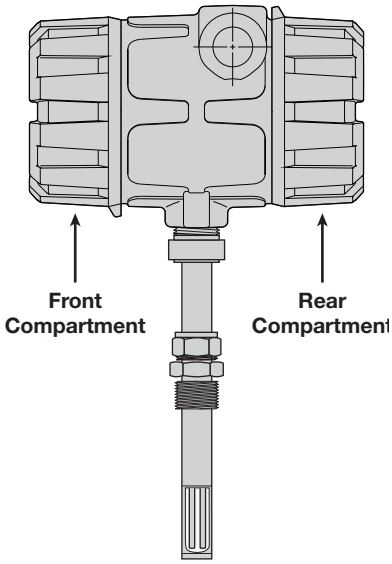


Figure 7

Wiring Housing Cover

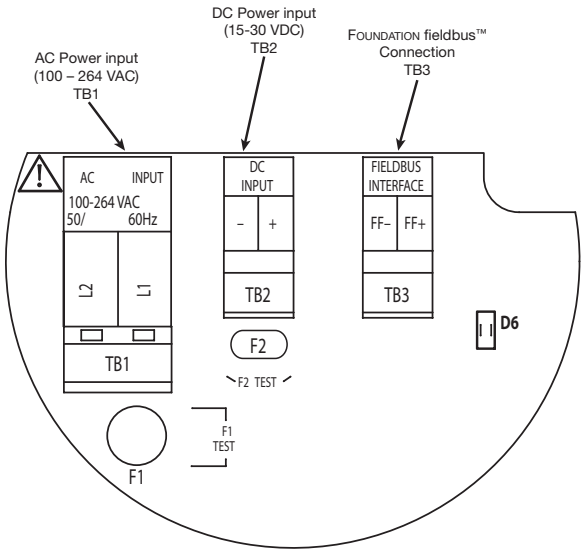


Figure 8

Enhanced TA2

FOUNDATION fieldbus™ Wiring Board

3.4 Wiring

There are two connections in the electronics enclosure for ¾" NPT or M20 connections. These are generally used as one connection for input power and one for output signal.

3.4.1 Power and Signal Connection

The instrument has separate wiring connections for AC (100 to 264 VAC) and DC (15 to 30 VDC). AC power wiring connections are made to terminal block TB1. DC Connec-tions are made to terminal block TB2. Refer to Figure 8.

NOTE: The AC power terminal blocks accept 12-22 AWG wire and the DC power terminal blocks accept 14-30 AWG wire. Select wire size consistent with power requirements.

For a maximum ambient temperature of 80 °C use wiring rated up to 264 VAC and 105 °C. For a maximum ambient of 70 °C use wire rated up to 264 VAC and 95 °C.

Caution: OBSERVE ALL APPLICABLE ELECTRICAL CODES AND PROPER WIRING PROCEDURES.

1. Make sure the power source is turned off.
2. Unscrew and remove housing cover of rear compartment. Refer to Figure 7.
3. Pull power supply and control wires through conduit connection.
4. Connect power leads to proper terminals. Refer to Figure 8.
   a. VAC (100 to 264 VAC) Make connections to TB1. Connect hot wire to terminal marked L1 and the second wire to the terminal marked L2.
   b. DC (15 to 30 VDC)–Make connections to TB2. Connect wires to terminals (+) and (-) on the terminal block.
   c. Connect Foundation fieldbus leads to terminal TB3. Fieldbus voltage range is 9-32 VDC.

NOTE: The green screw in the rear of the housing should be used for earth ground.

NOTE: Shielded cable is required for the DC wiring. Connect the shield wire to the green ground screw in the rear of the housing.

5. Replace housing cover. Installation is complete.

Caution: In hazardous areas, do not apply power to the unit until the conduit is sealed and the enclosure cover is screwed down securely.

NOTE: Install using Teflon® tape at all conduit entries (maximum 2 turns).

3.4.2 Ground Connection

The instrument must be grounded in accordance with Article 250 of the National Electric Code.

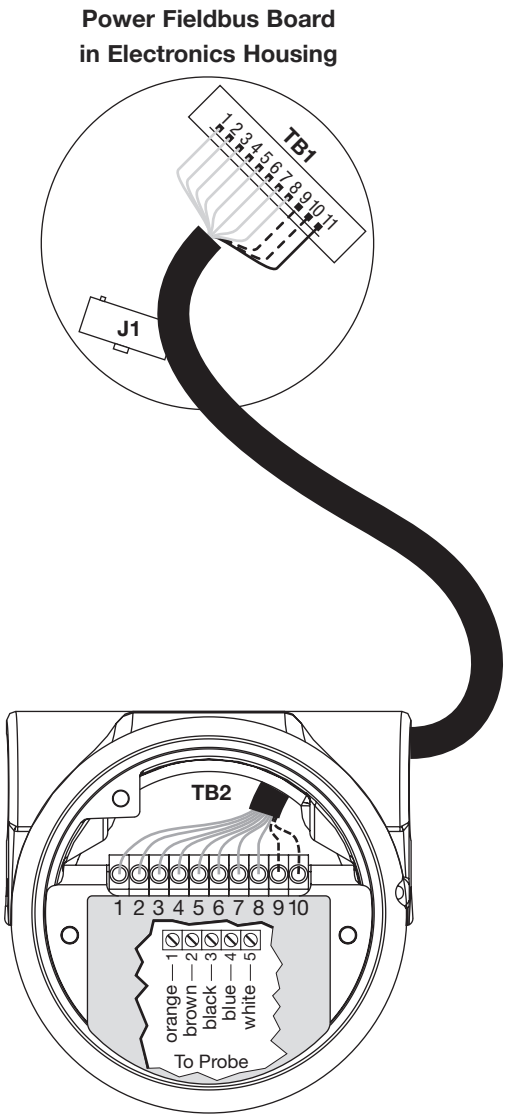


Figure 9

Probe Housing

REMOTE WIRING CABLE CONNECTIONS

Belden 8104 Max 200 Feet (60 meters) Wire Color	Belden 8305 Max 500 Feet (150 meters) Wire Number	TB2 connection Probe Housing	TB1 connection at Circuit Board in Electronics
Green/White	1	1	1
White/Green	2	2	2
Blue/White	3	3	3
White/Blue	4	4	4
Brown/White	5	5	5
White/Brown	6	6	6
Orange/White	7	7	7
White/Orange	8	8	8
	9	9	9
	10	10	10
Shield	Shield	Not used	11

3.4.3 Remote Electronics

If the electronics are remote from the probe, a remote board with terminal blocks is provided in the housing on the probe. For cable lengths up to 150 feet, the connection between the probe and electronics should be an 8-conductor shielded cable (Belden 8104). For cable lengths up to 500 feet, a 10-conductor shielded cable (Belden 8305) is used. This cable length can be adjusted in the field. If cable other than the recommended Belden cable is used, following are the maximum resistances which should be utilized:

8 Conductor–maximum resistance of 5.4 ohms

10 Conductor–maximum resistance of 10.0 ohms

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 nameplate; verify that they are the same.

3.4.3.1 Probe Wiring

The probe housing contains a remote board with terminal blocks for ease of wiring between the probe and the electronics. An 8-wire (Belden 8104) or 10-wire (Belden 8305) shielded interconnecting cable from the probe housing to the instrument is required. Refer to Figure 9 for wiring connections inside the probe housing and for remote cable wiring from the probe housing to the electronics housing.

1. Remove electrical power to the instrument.
2. Remove and unplug the display module if provided.
3. Remove the two hex head fasteners using a ¼" socket. This will remove a module consisting of the processor circuit board and the power fieldbus circuit board.
4. Unplug the electrical connections at J1 of the power fieldbus board.
5. Probe wiring connections are made to TB1 on the same side of the power fieldbus circuit board. Refer to Figure 9.
6. Reattach the electrical connections to J1.
7. Reassemble the circuit boards in the enclosure. Make sure that the probe wiring does not get pinched between the standoffs on the circuit board and the attachment lugs in the housing.
8. Reinstall the display module if provided.
9. Apply power to the instrument.

3.5 Configuring the Transmitter

The TA2 electronics are easy to set up and configure to the user's specifications. When specified with the order, the configuration settings are programmed 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 eight main groups:

Measured Values	View Selected Values
Basic Config	Configuration of essential programming information
I/O Config	Configure all input/output functions
Advanced Config	Additional configuration which affects the unit operation
Device Info	Provides information on the instrument
Diagnostics	Test operation of instrument
Factory Configuration	Factory calibration information
Run Mode	Normal operating mode

All necessary information can be input using the 4-button keypad located on the display module.

NOTE: The Display Module can be rotated in 90-degree increments. Remove cover, remove the two screws holding the display module, rotate to desired location and reattach display module. See Figure 10.

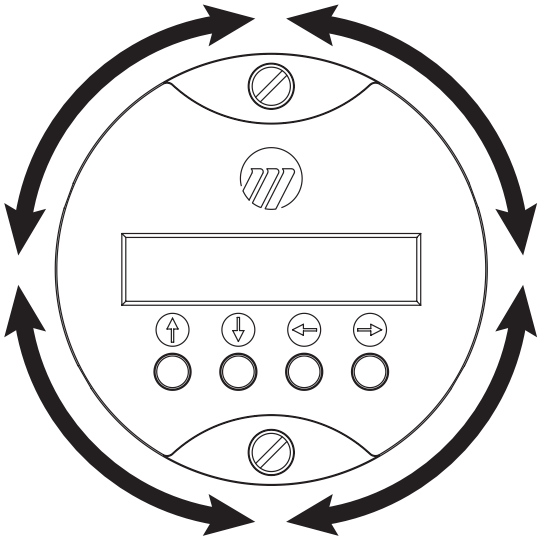


Figure 10
Display Module can be Rotated

3.5.1 Initialization

When power is first applied to the TA2 there is an initialization period for the sensor to reach stabilization. During this time the TA2 display (if provided) will read "Initializing."

Only after the sensor has stabilized and a valid flow measurement is obtained will the display show a flow measurement. The output signal will be active and the totalizer will begin counting.

3.5.2 Operator Keypad

The TA2 has a local user interface using a 2-line × 16-character liquid crystal (LCD) and 4-push-button keypad. All measurement data and configuration information is shown in the LCD.

The TA2 is configured via a "tree" type menu structure where it is easy to access branches of the tree to configure the various parameters. The four push buttons have different functions for various operating modes in the menu structure.

3.5.2.1 Menu Traversal Mode

Push Button		Keystroke Action
↑	Up	Moves to the previous menu
↓	Down	Moves to the next menu
←	Back	Moves back one level to the previous higher branch
→	Enter	Enters into the lower level branch

3.5.2.2 Item List Selection

Data is selected from a pre-specified list of entries. When Enter → key is depressed on a menu item the following modes are available. The symbol (↕) is shown on the right most character of the 2nd line to indicate that various selections are available.

Push Button		Keystroke Action
↑	Up	Moves to the previous selection in the list
↓	Down	Moves to the next selection in the list
←	Back	Returns to the previous mode without changing selection
→	Enter	Accepts the selection and returns to the menu traversal mode

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

3.5.2.3 Numeric Entry

The Numeric Entry Mode is used to enter numeric values. This mode is accessed when the Enter Key is pressed on a menu item that requires entry of a numeric value. Data is entered at the cursor position:

Push Button		Keystroke Action
	Up	Moves to the next digit (0,1,2,3…9). If held down the digits scroll until the push button is released.
	Down	Moves to the next digit (9,8,7,6…0). If held down the digits scroll until the push button is released.
	Back	Moves the cursor to the left and deletes the digit. If the cursor is located at the leftmost position the entire value is deleted and the previous saved value is displayed.
	Enter	Moves the cursor to the right. If the cursor is located at a blank position, the new value is saved and the display returns to the previous menu.

NOTE: In numeric entry mode, the leftmost position will show "+" if a negative value can be entered. To enter a negative value, move the cursor to left with the back button and toggle between "+" and "–" using the and arrows. If only positive values are valid, first digit is entered at leftmost position with no sign indicated. A decimal point can be entered after the first digit is entered.

3.5.2.4 Character Data Entry Mode

This mode is most commonly used when entering a new local tag line into the TA2. The local tag as shipped from the factory is "MAGNETROL TA2" and can be changed to permit the user to identify the instrument with a the actual tag line of the instrument or the service. When this mode is entered, a cursor marks the leftmost character on the 2nd line.

Push button		Keystroke Action
	Up	Moves to the next character (Z, Y, X, W, …). If held down the characters scroll until the push button is released.
	Down	Moves to the previous character (A, B, C, D, …). If held down the characters scroll until the push button is released.
	Back	Moves the cursor to the left. If the cursor is located at the leftmost position the screen is exited without changing the original characters.
	Enter	Moves the cursor to the right. If the cursor is located at the rightmost position the new value is saved and the display returns to the previous menu.

3.5.2.5 Increment/Decrement Digit Mode

The Increment/Decrement digit entry mode is used with some screens for changing numeric values.

Push button		Keystroke Action
	Up	Increases the displayed value. If held down the digits scroll until the push button is released. Depending upon what screen is being revised, the increment amount may change by a factor of 10 after the value has been increased 10 times.
	Down	Decreases the displayed value. If held down the digits scroll until the push button is released. Depending upon what screen is being revised, the decrement amount may change by a factor of 10 after the value has been decreased 10 times
	Back	Return to the previous menu without changing the original value which is immediately redisplayed.
	Enter	Accepts the displayed value and returns to the previous menu.

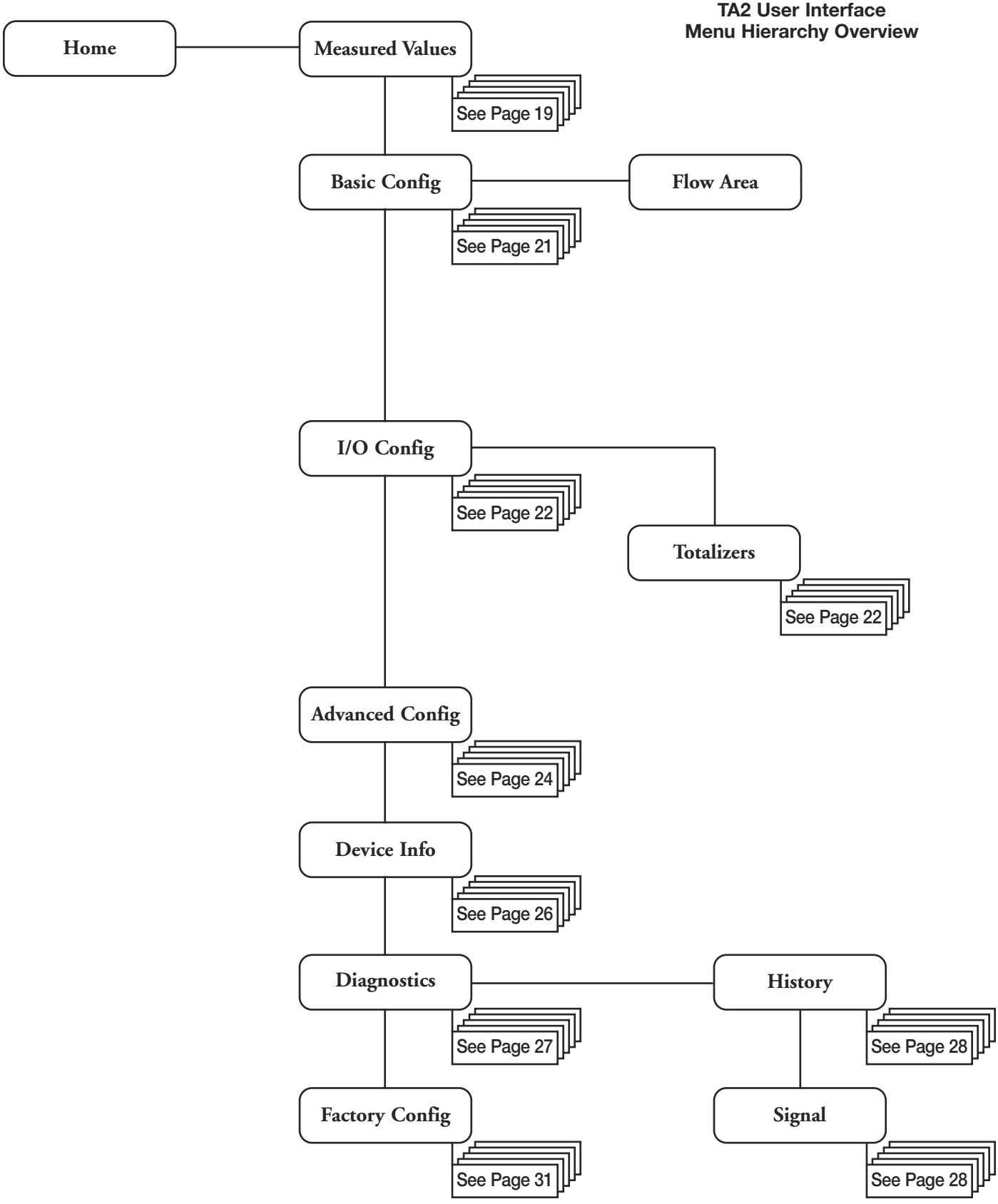
3.5.3 Password

A password protection system restricts access to portions of the user interface menu which affect the unit's operation and configuration. The default user password is 0.

If desired, a new user password can be entered in the Advanced Configuration in the New Password screen. The password can be changed to any numerical value up to 255.

Per revised password policy, user authority is no longer granted from the Fieldbus interface if the user password has been set to a non-zero value. It will be necessary to enter the user password to access user parameters from the Host system.

TA2 User Interface
Menu Hierarchy Overview



3.5.4 Run Mode

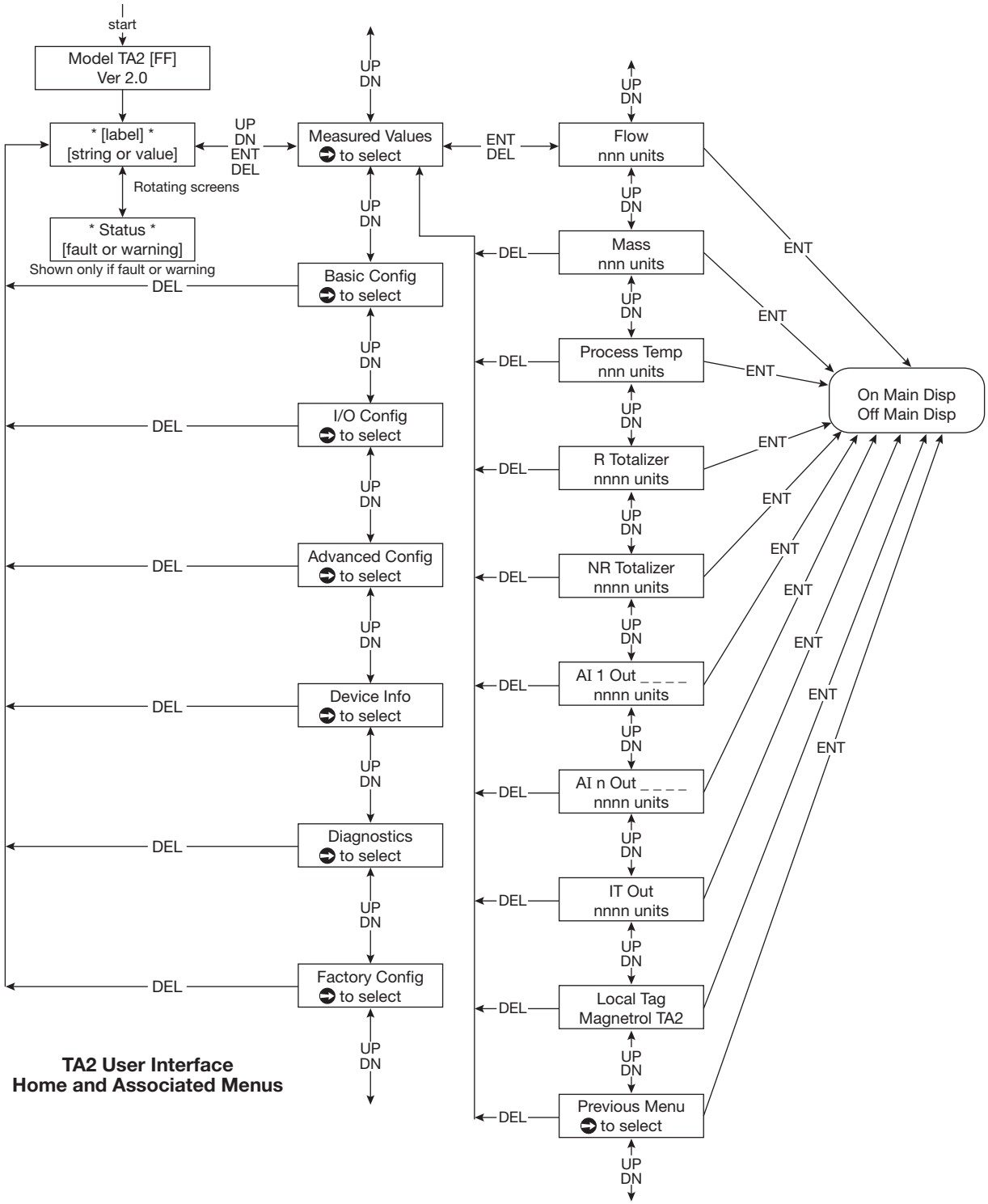
The Run Mode is the normal display for the TA2. The user has the option of selecting displayed values such as Flow, Mass, Process Temperature, Totalized Flow, AI output, IT output values and local tag. These values will rotate at 2-second intervals on the display during operation. AI output and IT output values will be blank until configured by the corresponding block. Run Mode appears on power-up or after a 5-minute period with no keypad activity.

The main menu is used to access the various parameters and sub-menus. From the Run mode, press any key to enter the Main Menu. The following describes the various selections available.

3.5.5 Measured Values

The Measured Values menu is used to display the current values measured by the TA2 and determine which parameters will be shown on the display during run mode. Enter this section by pressing → when Measured Values is displayed from the Main Menu.

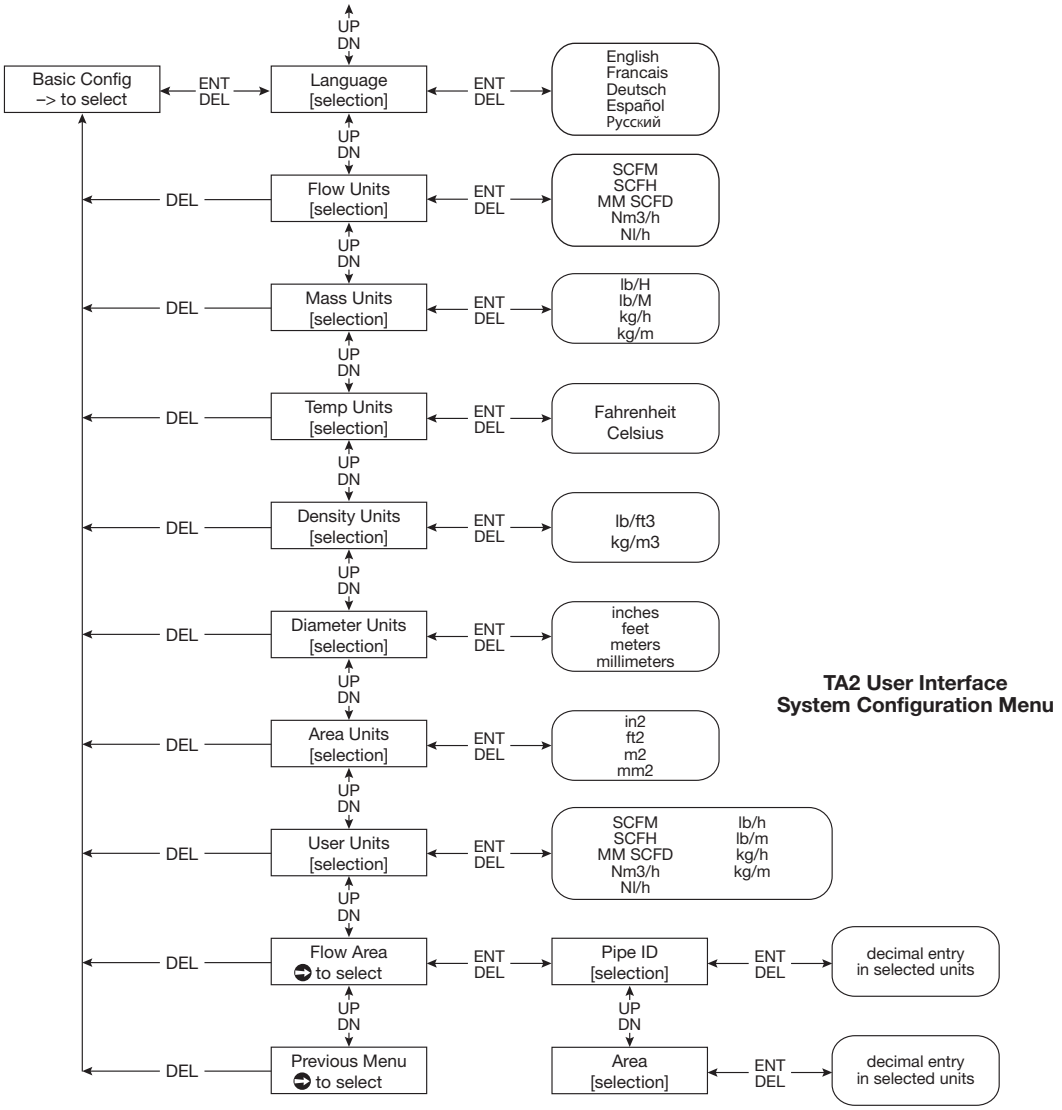
From the factory, the Home Menu will show the tag line and the flow value. To add or remove parameters from the Home Menu press the → key. Use the ↑ or ↓ keys to add (On Main Disp) or remove (Off Main Disp) variables. To return to the rotating Home Menu, simply press the ← key twice.



TA2 User Interface
Home and Associated Menus

3.5.6 Basic Configuration Menu

The Basic Configuration menu is used to select the display units and enter specific information for the application. Access this section by pressing Enter when Basic Config is displayed from the Main Menu. To calculate the flow or mass, it is necessary to accurately enter the inside area of the pipe or duct. If the pipe or duct is circular, simply enter the inside 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.

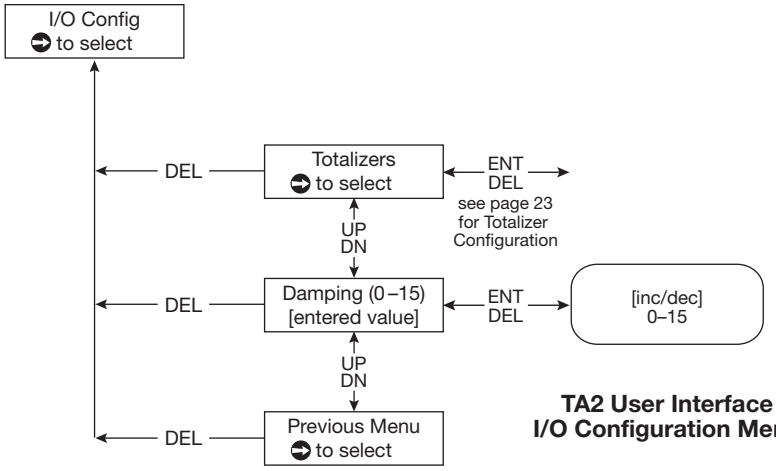


TA2 User Interface
System Configuration Menu

Configuration Parameter	Explanation
Language	The TA2 can be configured in English (default value), French, German, Spanish or Russian
Flow Units	Selection of SCFM, SCFH, MM SCFD, Nm^3/h, Nl/h
Mass Units	Selection of lb/h, lb/min, kg/h, kg/min
Temperature Units	Selection of Fahrenheit, Celsius
Density Units	lb/ft^3, kg/m^3
Diameter Units	Selection of inches, feet, meters, millimeters
Area Units	in^2 (square inches), ft^2 (square feet), m^2 (square meters), mm^2 (square mm)
User Units	SCFM, SCFH, MM SCFD, Nm3/h, Nl/h, lb/h, lb/min, kg/h, kg/min. Units used with install factors. See Advance Configuration Menu.
Flow Area	The TA2 requires entry of the pipe size or flow area to properly calculate the flow rate. This can either be entered by specifying the ID of the pipe or the flow body or by entering the flow area. Units of measurement are specified above.

3.5.7 I/O Configuration Menu

The configuration menu for the Totalizers is shown on page 23.



TA2 User Interface
I/O Configuration Menu

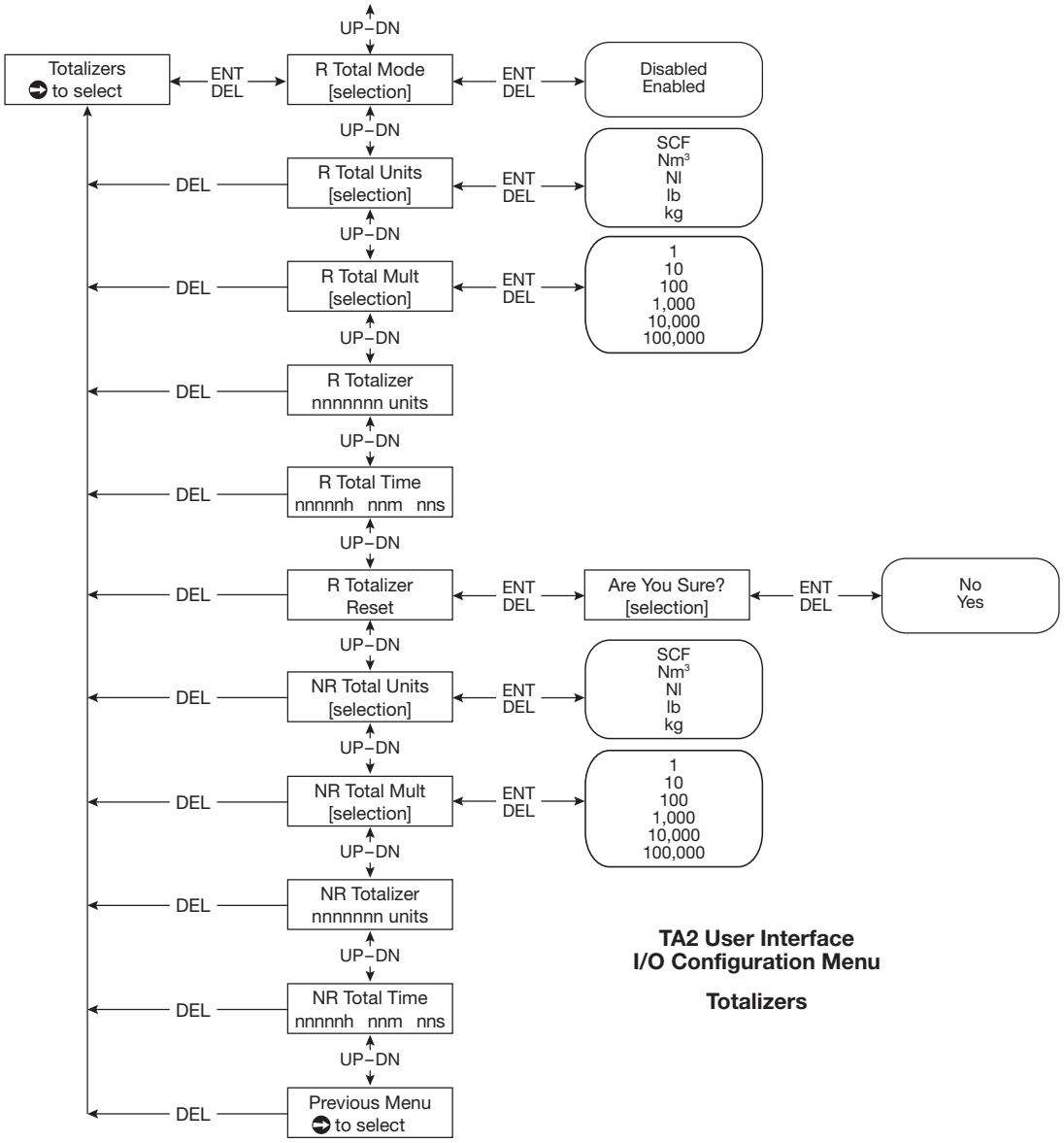
Configuration Parameter	Explanation
Totalizer	The TA2 provides both a resettable and a non-resettable totalizer. Configuration information on the totalizers is found on page 23.
Damping	Increasing the Damping will smooth the TA2 display of the measured values. This may be used in cases when turbulence is causing fluctuations in the measurement. The damping value is expressed in time constants. A one-second time constant means that with a step change in flow, the measured flow value will reach approximately 63% of the new value in one second and approximately 99% of the new value in five seconds. The lower limit is 0 which means no damping (other than the inherent response time of the sensor); the upper limit is 15 seconds.

3.5.8 Totalizer

The totalizer provides seven digits of resolution. In the event of a fault indication, the totalizer will not accumulate. When the value in the totalizer exceeds 9,999,999, the totalizer will rollover. The Total Time will keep counting.

Both the Resettable and Non-Resettable totalizers have individual multiplier factors which can be used to prevent too frequent rollover and potential loss of data.

The Totalizer data is stored in nonvolatile memory, eliminating the need of backup batteries. Data is written hourly.



TA2 User Interface
I/O Configuration Menu

Totalizers

Configuration Parameter	Explanation
R Total Units	The R Totalizer Units permits selection of the units for the resettable totalizer. Select SCF (Standard Cubic Feet), Nm^3 (Normal Cubic Meters), Nl (Normal Liters), lb (Pounds), or kg (Kilograms).
R Total Mode	R Total Mode allows the user to enable or disable the Resettable totalizer. The default mode is Enabled.
R Total Mult	The R Total Mult permits selection of the multiplier to be used for the resettable totalizer. The function of the totalizer multiplier is such that if the units are SCF and the multiplier is set to 100, then the totalizer will increment for each 100 SCF. The default value is 1.
R Totalizer	This is a read-only screen that displays the present value of the resettable totalizer.
R Total Time	This is a read-only screen that displays the time that has elapsed since the resettable totalizer was last reset.
R Totalizer Reset	The R Totalizer Reset screen allows the user to reset the total flow and elapsed time of the resettable totalizer to zero. Since this action will permanently lose this data, a second chance is provided with an “Are you sure” selection.
NR Total Mult	The NR Total Mult permits selection of the multiplier to be used for the Non-resettable totalizer. The function of the totalizer multiplier is such that if the units are SCF and the multiplier is set to 100, then the totalizer will increment for each 100 SCF. The default value is 1000.
NR Total Units	The NR Totalizer Units permits selection of the units for the non-resettable totalizer. Select SCF (Standard Cubic Feet), Nm3 (Normal Cubic Meters), Nl (Normal Liters), lb (Pounds), or kg (Kilograms).
NR Totalizer	This is a read-only screen that displays the value of the Non-resettable totalizer.
NR Total Time	This is a read-only screen that displays the time that corresponds to the value of the NR Totalizer.

3.5.9 Advanced Configuration Menu

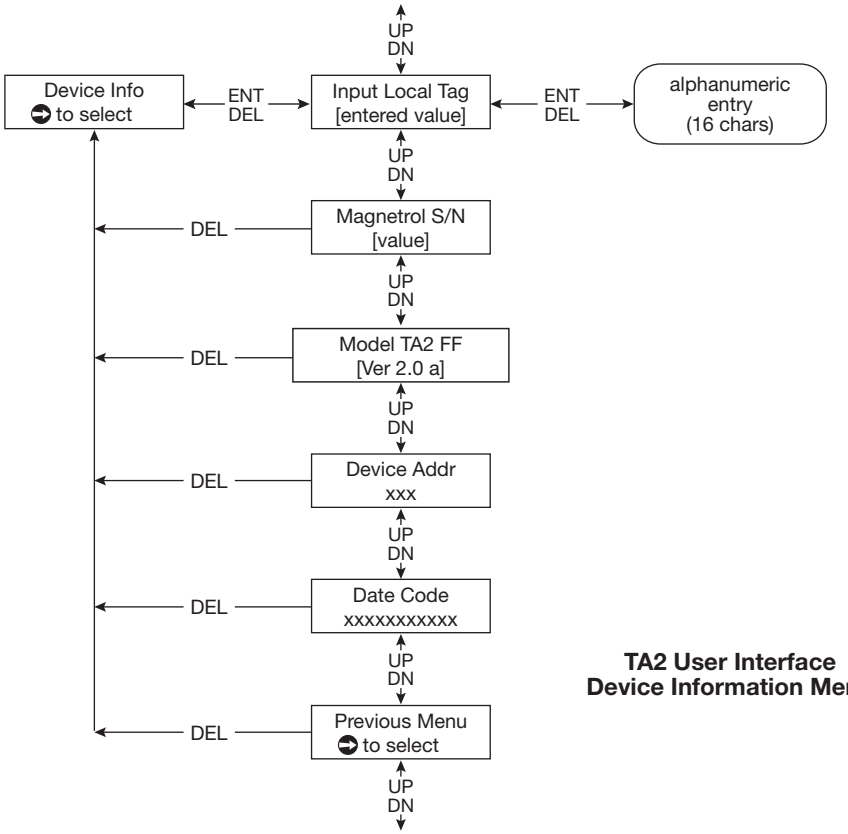
The Advanced Configuration menu sets advanced parameters that may occasionally be required for proper operation of the TA2.

TA2 User Interface
Advanced Configuration Menu

Configuration Parameter	Explanation
New Password	The default password is 0. If desired, a different password can be entered in the *New Password* screen. The password can be changed to any numeric value up to 255. The display will show an encrypted value. Contact MAGNETROL Technical Support with this value to determine the actual password which was last entered.
Install Factors	Permits the user to enter field adjustment factors to make adjustments to the flow measurement. These might be due to flow profiles considerations. The formula is a second order polynomial equation where adjusted flow = $a + bx + cx^2$ where x is in units selected in the Transducer Block under "USER_UNIT." Linear adjustments (changing the B factor) are the simplest. Ensure that units of measurement are finalized before Install Factors are determined. Changing units of measurement after Install Factors are calculated can result in reset of the Install Factors and a warning message.
Gas Cal Table A/B	Permits the user to select calibration for two different gases. If specifically ordered with calibration for two different gases, then each gas table will represent the calibration data for each gas. If calibrated for a gas other than air, the "A" table will represent the calibration data for the specified gas and the "B" table will represent the calibration data for air within a selected calibration range. The two gas tables can also be used for different ranges of the same gas.
Auto Switching	Allow automatic switching between a low flow Table A and a high flow Table B. It is necessary to have a dual calibration and distinct flow rate differences between tables in order to perform switching function. With Foundation Fieldbus version, it is only possible to Enable from the display.
STP Conditions	Permits the user to select STP (Standard Temperature and Pressure) conditions. Also referred to as Standard Conditions or Normal Conditions. Any value for temperature can be entered. Pressure can be selected to be 1 Atmosphere or 1 Bar. Adjustment of the STP conditions will affect the flow calculations.

3.5.10 Device Information

This section is used to display information about the device. Also in this section is the ability for the user to enter a local tag describing the location of the instrument.

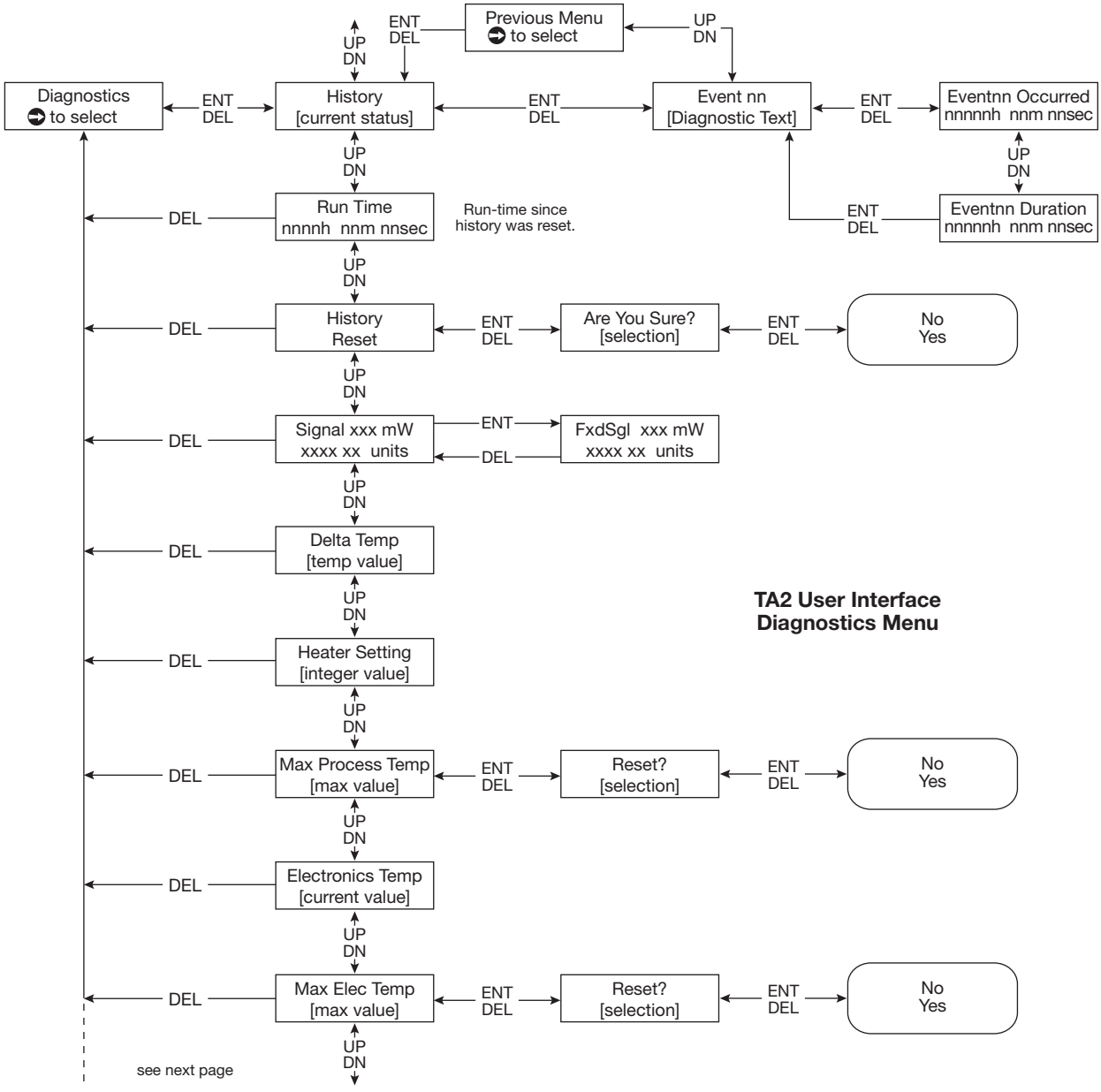


TA2 User Interface
Device Information Menu

Configuration Parameter	Explanation
Input Local Tag	From the factory this tag is shown as “MAGNETROL TA2” but this can be changed to describe the application or the flow transmitter number. The tag can contain a maximum of 16 characters. All upper and lower case letters, numbers and other characters are provided for the tag. See section 3.5.2.4 for details on entering characters.
MAGNETROL S/N	Displays the MAGNETROL serial number of the instrument. This is needed if information on the specific instrument is desired in the future.
Model TA2 FF	Provides information on the firmware used in this version of the TA2.
Device Addr	Address assigned to the instrument by the host. Default is 248.
Date Code	Factory Parameter to provide unique identification.

3.5.11 Diagnostics Menu

The Diagnostics Menu contains both informational items and diagnostic screens that can assist in obtaining information on the operation of the unit and troubleshooting if faults or warnings occur.

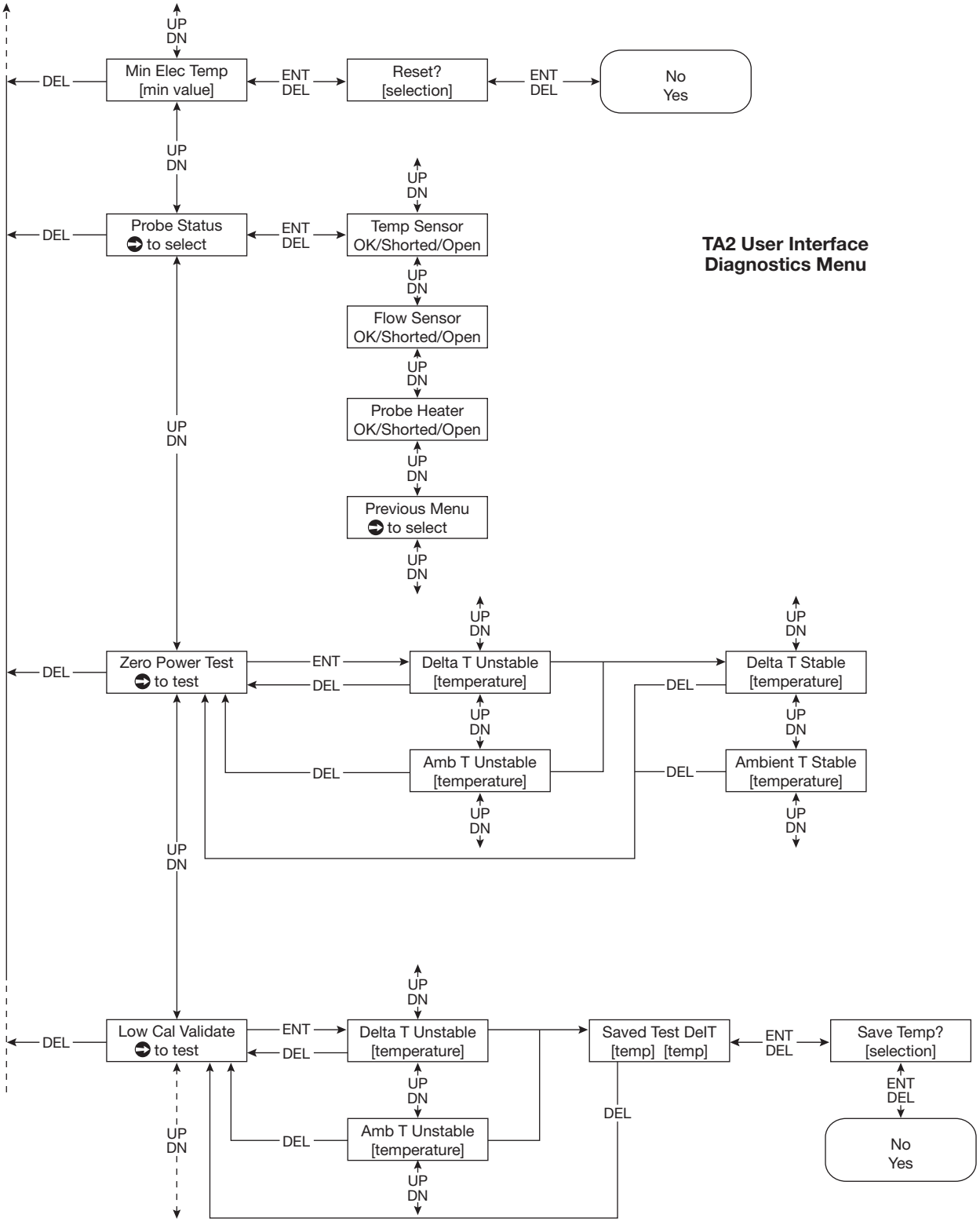


TA2 User Interface Diagnostics Menu

3.5.11 Diagnostics Menu (cont.)

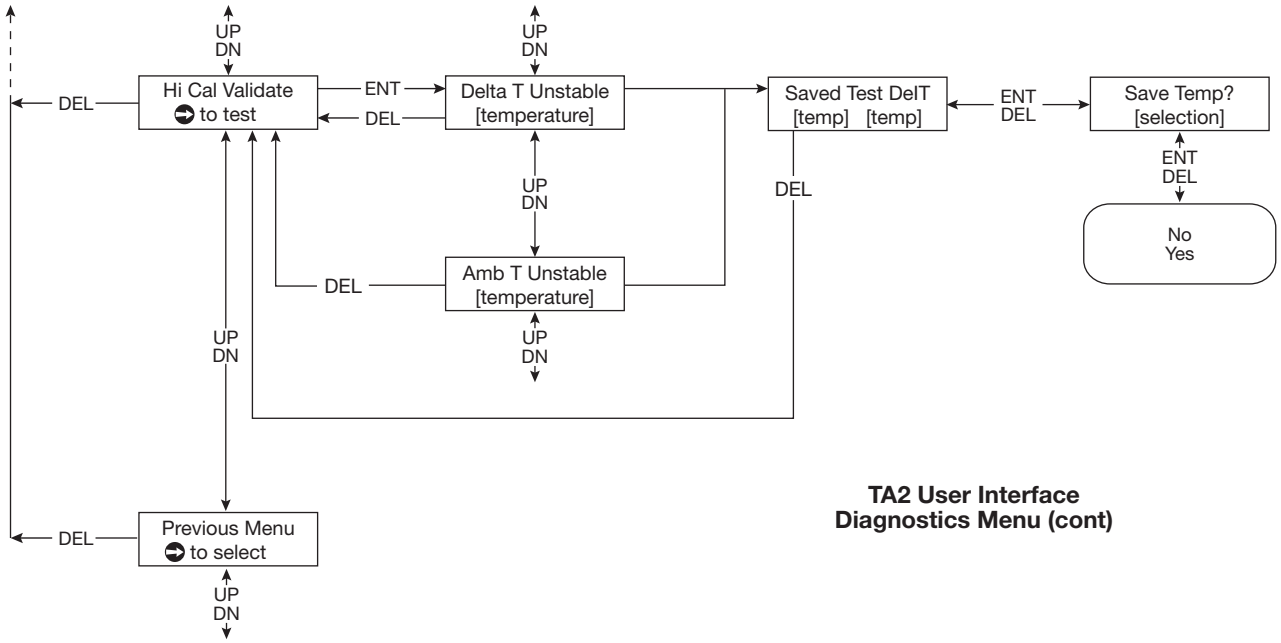
Configuration Parameter	Explanation
History	Displays the present status and the sequence in which any diagnostic events may have occurred. The second line of the menu shows the present status. If there are no present diagnostic events, this screen will have *History* on the top line and **OK** on the bottom line. Pressing ➔ descends to a lower menu level to view diagnostics events that have been logged in *History*. Each "event" is indicated by the event number label. The first event number label presented corresponds to the most recent diagnostic event. This event number also indicates the number of diagnostic events currently in the *History* submenu. Pressing the ↑ or ↓ will cycle between the relative time of the occurrence and the duration of the event.
Run Time	Displays the total time that the device has been powered. The run time is reset to zero when the History is reset.
History Reset	Provides a means to clear all of the diagnostic events that are stored in the *History* log.
Signal	Provides a live signal of the mW reading from the sensor. Also shown on the second line is the calculated flow rate. This is based on the units selected in the Transducer Block under "USER_UNIT." This data can be compared against the original calibration document to determine if there has been any change in the configuration. Pressing ➔ enters the **Fixed Signal Mode**. When in this mode, pressing the ↑ or ↓ permits the user to change the signal; the TA2 then calculates the flow which corresponds with this signal. Press ← to return to the main menu. NOTE: During fixed signal mode the Totalizers will stop operation and the display will show the "In Test Mode" message. The Transducer Block will be taken Out of Service (OOS).
Delta Temp	Displays the temperature difference between the two RTDs.
Heater Settings	Displays the current value sent to the heater. This can be compared against an actual reading which can be obtained from connections on the circuit board. See section 5.3.1.
Maximum Process Temp	Displays the maximum temperature which the sensor has recorded.
Electronic Temp	Displays the current temperature in the electronics enclosure.
Max Elect Temp	Displays the maximum temperature which the electronics have recorded.

3.5.11 Diagnostics Menu (cont.)



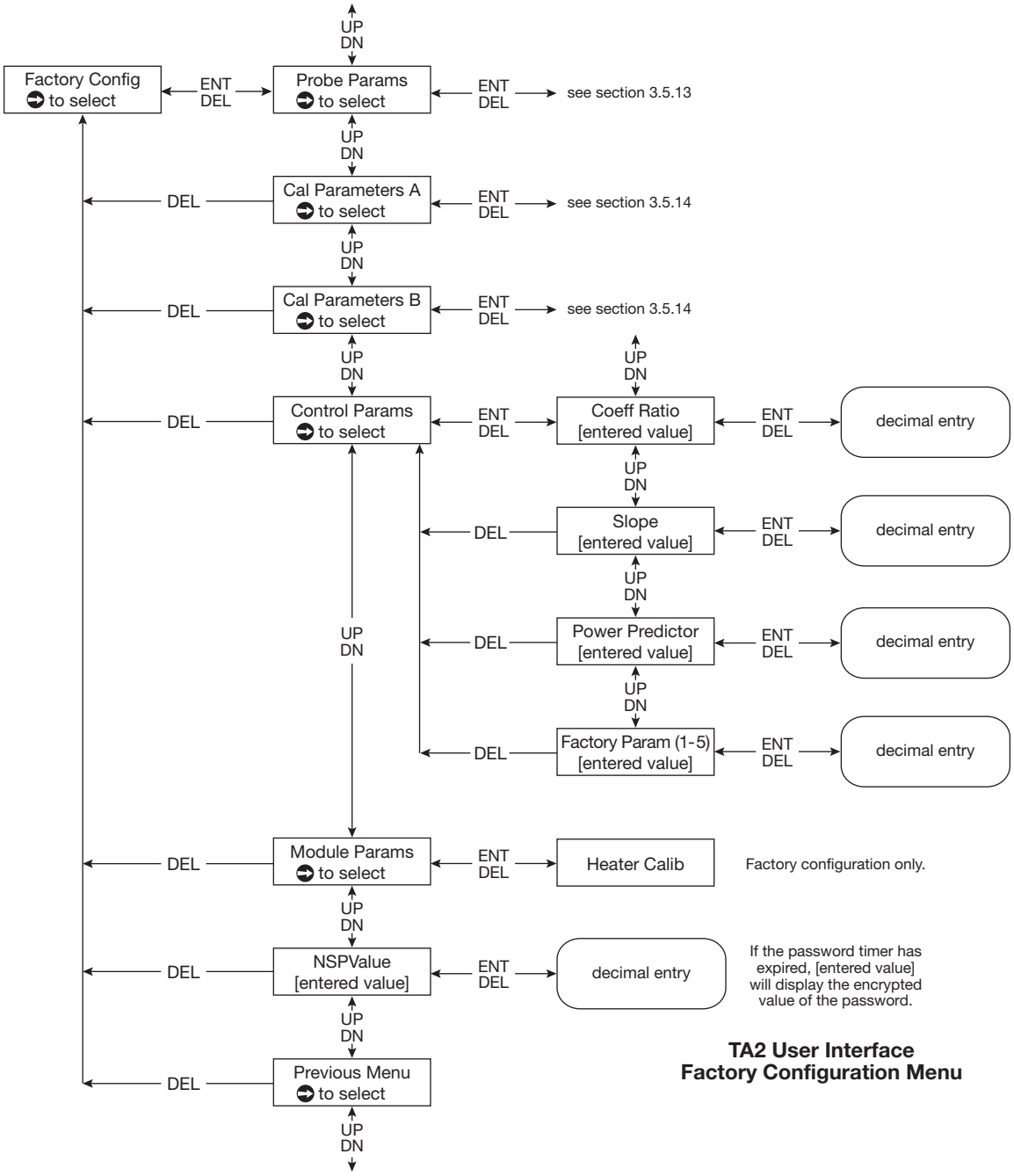
3.5.11 Diagnostics Menu (cont.)

Configuration Parameter	Explanation
Min Elect Temp	Displays the minimum temperature which the electronics have recorded.
Probe Status	Press → to select and then the ↑ or ↓ arrows to scroll between the Temp Sensor, Flow Sensor, and Probe Heater. If the probe is operational, the display will show "OK". If there is a problem with the probe, then the diagnostics will show either "Shorted" or "Open." Press ← to return to the main menu.
Zero Power Test	Diagnostic test. During this test the heater is turned off and the sensor is given time for the sensors to stabilize. The temperature difference between the sensors is displayed. See section 5.3.2 for more information on this test.
Low Cal Validate Hi Cal Validate	The Low Cal Validate and the Hi Cal Validate test will verify that the heat transfer characteristics of the sensor have not changed. This test will verify that the unit is still within calibration. The tests are performed when off-line with the TA2 in air and in a water bath. See section 5.3.3 for more information on this test.



TA2 User Interface
Diagnostics Menu (cont)

3.5.12 Factory Configuration

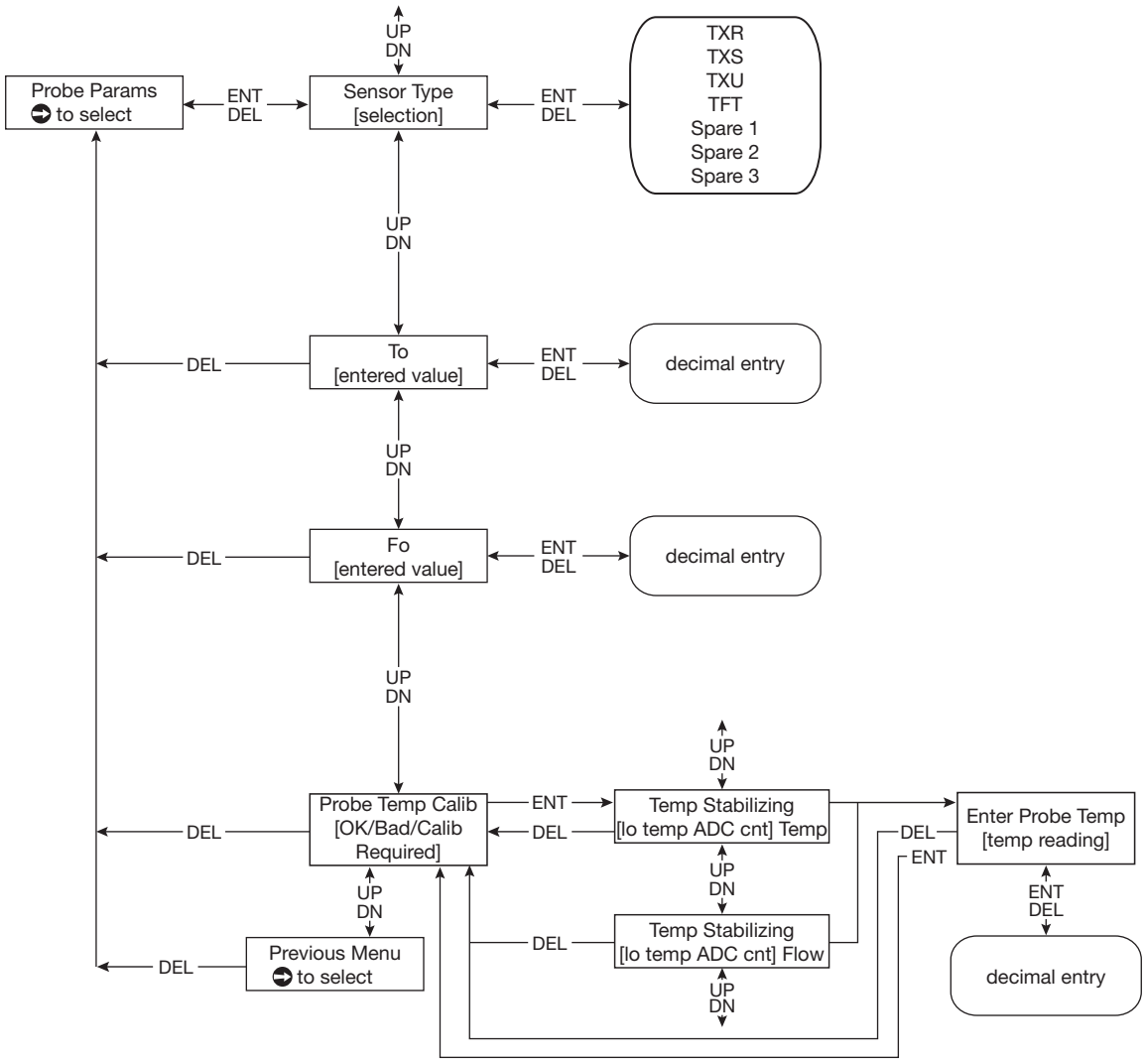


TA2 User Interface
Factory Configuration Menu

Configuration Parameter	Explanation
Probe Params	Provides the probe calibration parameters—see separate section 3.5.13.
Cal Parameters A	Provides the calibration parameters for Gas A—see separate section 3.5.14.
Cal Parameters B	Provides the calibration parameters for Gas B (if specified)—see separate section 3.5.14.
Control Parameters	Factory set parameters which should only be changed under direction of MAGNETROL
Module Params	Module Parameters—Factory set parameters

3.5.13 Probe Parameters

These parameters are specific characteristics defining the operation of the probe.



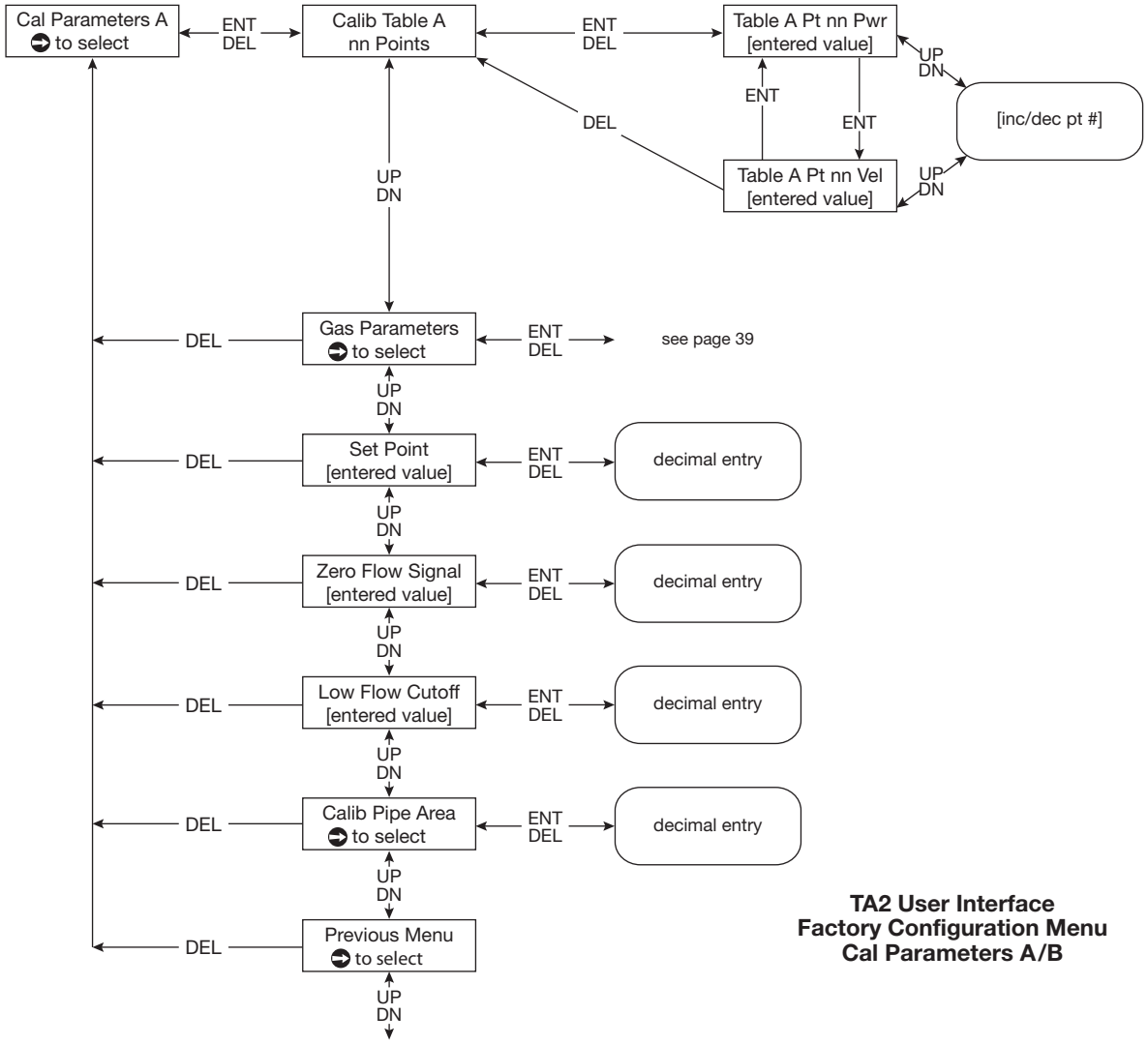
TA2 User Interface
Factory Configuration Menu
Probe Parameters

Configuration Parameter	Explanation
Sensor Type	Selects the type of sensor used with the TA2. Various sensors have different methods of calculating the flow rate.
To	Calibration parameter determined when calibrating the RTDs.
Fo	Calibration parameter determined when calibrating the RTDs.
Probe Temp Calib	Used during calibration of the RTDs. See section 6.3.

3.5.14 Calibration Parameters

There are two separate menus for Calibration Parameters titled Cal Parameters A and Cal Parameters B. These two different sets of Calibration Parameters are used when the TA2 is calibrated on two gases or for two different ranges. If the unit is calibrated for air, then only Calibration Parameter A is used. If the TA2 is calibrated for a different gas, then the calibration parameters for the specified gas is contained in Cal Parameters A, and the air calibration parameters are contained in Calibration Parameters B.

There is an identical menu structure for Cal Parameters B.

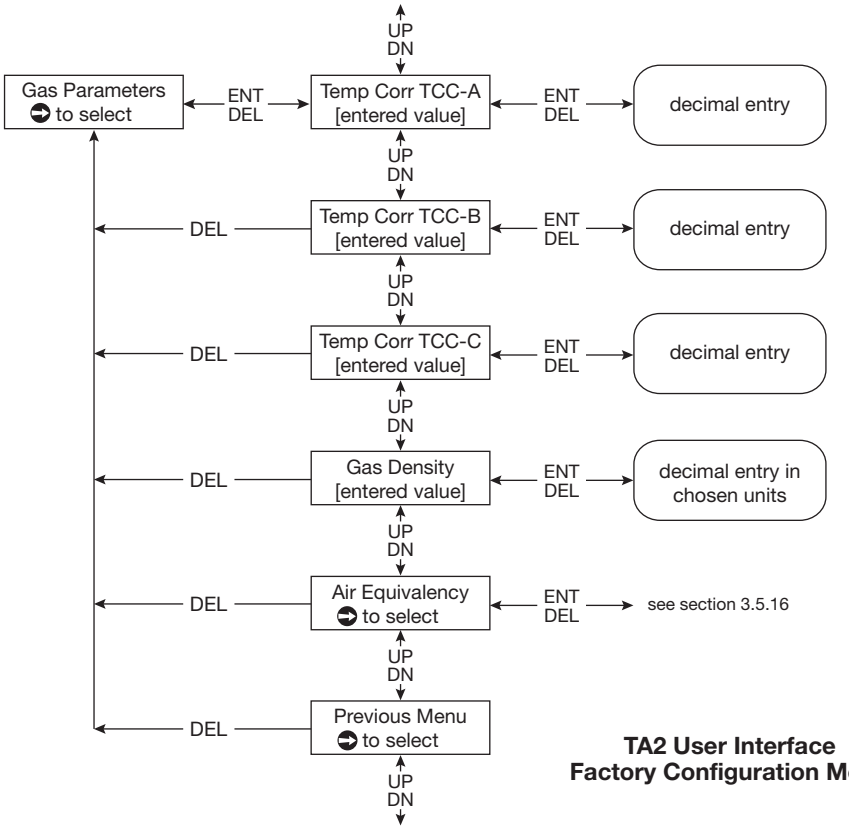


TA2 User Interface
Factory Configuration Menu
Cal Parameters A/B

Configuration Parameter	Explanation
Calib Table A nn Points	Provides actual calibration data points obtained during the calibration.
Gas Parameters	See Section 3.5.15.
Set Point	Indicates the temperature difference which the TA2 is attempting to maintain. This parameter should only be changed under direction of MAGNETROL.
Zero Flow Signal	Used to adjust the zero flow data point, if necessary, for application-specific related issues. See Troubleshooting Section 5.2.
Low Flow Cutoff	The TA2 will ignore flow rates below this value. This can be changed for application-specific issues. See Troubleshooting Section 5.2.
Calibration Pipe Area	See Recalibration Section 6.4.

3.5.15 Gas Parameters

Contains specific information on the gas which are used in the TA2 calculations.



TA2 User Interface
Factory Configuration Menu

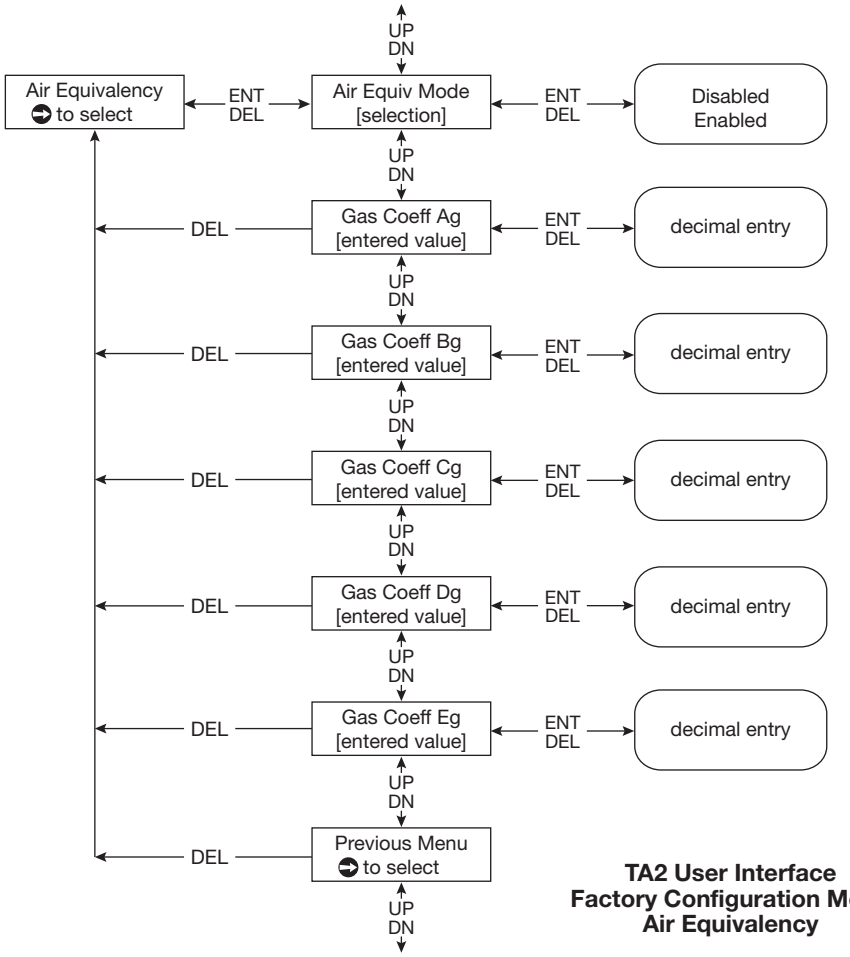
Gas Parameters menu exists for both Gas A and Gas B

Configuration Parameter	Explanation
TCC-A, TCC-B TCC-C	Gas-specific factors used for temperature compensation. This parameter should only be changed under direction of MAGNETROL.
Gas Density	Provides the density of the gas at the specified STP (Standard Temperature and Pressure) conditions.
Air Equivalency	Contains factors for equation which relates the gas flow to the flow of air. Contact MAGNETROL for factors specific to different gases.

3.5.16 Air Equivalency Calibration

The Air Equivalency calibrations permits the use of an air calibration and then, using the MAGNETROL historic data base, relate the flow of air to the flow of gas. The equations use a polynomial curve fit. A fault will occur if the curve fit becomes non-monotonic (signal decreases with increasing flow) which can occur if operating outside the data range. Consult MAGNETROL regarding proper sizing with Air Equivalency calibrations. The user may contact MAGNETROL to obtain air equivalency factors for various gases. These values should only be used when the TA2 was calibrated on air. If the calibration data in the Calibration Table is for a different gas, the results are invalid.

Configuration Parameter	Explanation
Enable/Disable	Enables or Disables the Air Equivalency calculations
Ag - Eg	Factors in a polynomial equation in the form of $A + Bv + Cv^2 + Dv^3 + Ev^4$ where v is the mass velocity. Contact MAGNETROL for factors.



TA2 User Interface
Factory Configuration Menu
Air Equivalency

Air Equivalency menu exists for both Gas A and Gas B

4.0 Function Blocks

4.1 Overview

The Model TA2 is a Thermal Mass Flow Meter with nine FOUNDATION fieldbus™ Function Blocks (one Resource Block, one Transducer Block, five Analog Input Blocks, one PID Block, and one Integrator Block). The idea of Function Blocks, which a user can customize for a particular application, is a key concept of Fieldbus topology. Function Blocks consist of an algorithm, inputs and outputs, and a user-defined name.

The RESOURCE Block contains specific information on the Enhanced TA2 and firmware.

The TRANSDUCER Block output is available to the network through the ANALOG INPUT blocks.

The ANALOG INPUT Blocks (AI) take the TRANSDUCER Block measured values and makes them available as an analog value to other function blocks. The AI blocks have scaling conversion, filtering, and alarm functions.

The INTEGRATOR Block will accumulate the flow or mass over time providing a value of the Totalized Flow.

The PID Block provides logic for Proportional/Integral/Derivative control.

4.1.1 Universal FOUNDATION fieldbus™ Block Parameters

The following are general descriptions of the parameters common to all blocks. Additional information for a given parameter is described later in that specific block section.

ST_REV (static data revision): a read only parameter that gives the revision level of the static data associated with the block. This parameter will be incremented each time a static parameter attribute value is written and is a vehicle for tracking changes in static parameter attributes.

TAG_DESC (tag descriptor): a user assigned parameter that describes the intended application of any given block.

STRATEGY: a user assigned parameter that identifies groupings of blocks associated with a given network connection or control scheme.

ALERT_KEY: a user assigned parameter which may be used in sorting alarms or events generated by a block.

MODE_BLK: a structured parameter composed of the actual mode, the target mode, the permitted mode(s), and the normal mode of operation of a block.

- The actual mode is set by the block during its execution to reflect the mode used during execution.
- The target mode may be set and monitored through the mode parameter.

- The permitted modes are listed for each block.
- The block must be in an automatic mode for normal operation.

NOTE: The MODE_BLK target parameter must be OOS (out of service) to change configuration and calibration parameters in that function block (when in OOS, the normal algorithm is no longer executed and any outstanding alarms are cleared).

All blocks must be in an operating mode for the device to operate. This requires the Resource Block to be in "AUTO" and the Transducer Block to be in "AUTO" before the Function Blocks can be placed in a mode other than OOS (out of service).

BLOCK_ERR: a parameter that reflects the error status of hardware or software components associated with, and directly affecting, the correct operation of a block.

NOTE: A BLOCK_ERR of "Simulation Active" in the Resource Block does not mean simulation is active—it merely indicates that the simulation (hardware) enabling jumper is present.

See section 4.2.2 and 5.1 for further information on the simulation mode.

4.2 Resource Block

The RESOURCE Block contains data specific to the Enhanced Model TA2 transmitter, along with some information about the firmware.

NOTE: The Resource Block has no control function.

MODE_BLK: Must be in AUTO in order for the remaining blocks in the transmitter to operate.

NOTE: A Resource Block in "out of service" mode will stop all function block execution in the transmitter.

RS_STATE (Resource State): identifies the state of the RESOURCE Block state machine. Under normal operating conditions, it should be "On-Line."

TEST_RW: Read/Write test parameter used for conformance testing.

DD_RESOURCE: a string identifying the tag of the resource that contains the Device Description for this device.

MANUFAC_ID: contains the MAGNETROL INTERNATIONAL FOUNDATION fieldbus™ manufacturer's ID number, which is 0x000156.

DEV_TYPE: the model number of the THERMATEL Enhanced Model TA2 transmitter (0x0004). It is used by interface devices to locate the Device Descriptor (DD) file for this product.

DEV_REV: contains the device revision of the THERMATEL Enhanced Model TA2 transmitter. It is used by interface devices to correctly select the associated DD.

DD_REV: contains the revision of the DD associated with the version of firmware in the THERMATEL Enhanced Model TA2 transmitter. It is used by interface devices to correctly select the associated DD.

GRANT_DENY: Options for access to parameters by DCS.

HARD_TYPES: Types of hardware available as channels.

RESTART: Default and Processor selections are available. Default will reset the Model TA2 to the established block configuration.

NOTE: As RESTART DEFAULT will set **most** block configuration parameters to their default values. Devices need to be reconfigured following activation of this function.

FEATURES: a list of the features available in the transmitter. The Model TA2 features include Reports, and Soft Write Lock.

FEATURES_SEL: allows the user to turn Features on or off.

CYCLE_TYPE: identifies the block execution methods that are available.

CYCLE_SEL: allows the user to select the block execution method.

MIN_CYCLE_T: the time duration of the shortest cycle interval. It puts a lower limit on the scheduling of the resource.

MEMORY_SIZE: Size of available memory in K bytes.

NV_CYCLE_T: the minimum time interval between copies of non-volatile (NV) parameters to NV memory. NV memory is only updated if there has been a significant change in the dynamic value and the last value saved will be available for the restart procedure. A value of "0" means it will never be automatically copied. Entries made by human interface devices to NV parameters are copied to non-volatile memory at the time of entry.

NOTE: After completing a large copy, allow several seconds before removing power from the THERMATEL Enhanced Model TA2 transmitter to ensure that all data has been saved.

FREE_SPACE: shows the amount of available memory for further configuration. The value is zero percent in a preconfigured device.

FREE_TIME: the amount of the block processing time that is free to process additional blocks.

SHED_RCAS: the time duration at which to give up computer writes to function block RCas locations. Shed from RCas will never happen when SHED_RCAS = 0.

SHED_ROUT: the time duration at which to give up computer writes to function block ROut locations. Shed from ROut will never happen when SHED_ROUT = 0.

FAULT_STATE, SET_FSTATE, CLR_FSTATE: these only apply to output function blocks. (The Model TA2 has no output function blocks).

MAX_NOTIFY: the maximum number of alert reports that the transmitter can send without getting a confirmation.

The user can set the number low, to control alert flooding, by adjusting the LIM_NOTIFY parameter value.

LIM_NOTIFY: the maximum numbers of unconfirmed alert notify messages allowed. No alerts are reported if set to zero.

CONFIRM_TIME: the time that the transmitter will wait for confirmation of receipt of a report before trying again. Retry will not occur if CONFIRM_TIME = 0.

WRITE_LOCK: When set to LOCKED, will prevent any external change to the static or non-volatile data base in the Function Block Application of the transmitter. Block connections and calculation results will proceed normally, but the configuration will be locked.

UPDATE_EVT (Update Event): is an alert generated by a write to the static data in the block.

BLOCK_ALM (Block Alarm): is used for configuration, hardware, connection, or system problems in the block. The cause of any specific alert is entered in the subcode field. The first alert to become active will set the Active status in the Status attribute. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed.

ALARM_SUM (Alarm Summary): contains the current alert status, the unacknowledged states, the unreported states, and the disabled states of the alarms associated with the block.

ACK_OPTION (Acknowledge Option): selects whether alarms associated with the block will be automatically acknowledged.

WRITE_PRI (Write Priority): the priority of the alarm generated by clearing the write lock.

WRITE ALM (Write Alarm): the alert generated if the write lock parameter is cleared.

ITK_VER (ITK Version): contains the version of the Interoperability Test Kit (ITK) used by the Fieldbus Foundation during their interoperability testing.

4.2.1 Additional Resource Block Parameters

Field Diagnostic Parameters

FD_VER: Major version of the Field Diagnostic specification to which this device conforms.

FD_FAIL_ACTIVE: For error conditions that have been selected for the FAIL alarm category, this parameter reflects those that have been detected as active.

FD_OFFSPEC_ACTIVE: For error conditions that have been selected for the OFFSPEC alarm category, this parameter reflects those that have been detected as active.

FD_MAINT_ACTIVE: For error conditions that have been selected for the MAINT alarm category, this parameter reflects those that have been detected as active.

FD_CHECK_ACTIVE: For error conditions that have been selected for the CHECK alarm category, this parameter reflects those that have been detected as active.

FD_FAIL_MAP: maps conditions to be detected as active for the FAIL alarm category.

FD_OFFSPEC_MAP: maps conditions to be detected as active for the OFFSPEC alarm category.

FD_MAINT_MAP: maps conditions to be detected as active for the MAINT alarm category.

FD_CHECK_MAP: maps conditions to be detected as active for the CHECK alarm category.

FD_FAIL_MASK: used to suppress an alarm from being broadcast for single or multiple conditions that are active in the FAIL alarm category.

FD_OFFSPEC_MASK: used to suppress an alarm from being broadcast for single or multiple conditions that are active in the OFFSPEC alarm category.

FD_MAINT_MASK: used to suppress an alarm from being broadcast for single or multiple conditions that are active in the MAINT alarm category.

FD_CHECK_MASK: used to suppress an alarm from being broadcast for single or multiple conditions that are active in the CHECK alarm category.

FD_FAIL_ALM: used to broadcast a change in the associated active conditions, which are not masked, for the FAIL alarm category.

FD_OFFSPEC_ALM: used to broadcast a change in the associated active conditions, which are not masked, for the OFFSPEC alarm category.

FD_MAINT_ALM: used to broadcast a change in the associated active conditions, which are not masked, for the MAINT alarm category.

FD_CHECK_ALM: used to broadcast a change in the associated active conditions, which are not masked, for the CHECK alarm category.

FD_FAIL_PRI: specifies the priority of the FAIL alarm category.

FD_OFFSPEC_PRI: specifies the priority of the OFF-SPEC alarm category.

FD_MAINT_PRI: specifies the priority of the MAINT alarm category.

FD_CHECK_PRI: specifies the priority of the CHECK alarm category.

FD_SIMULATE: Diagnostic conditions can be manually supplied when simulation is enabled.

FD_RECOMMEN_ACT: Describes what actions can be taken to address an active diagnostic condition.

4.2.2 Manufacturer-Specific Parameters

SOFT_SIMULATION_DISABLE: if set to yes, enabling the simulation is disallowed regardless of the presence of the simulation jumper, and the "simulation" indicator will be cleared in the Block Error parameter. If set to no, simulation can only be enabled if the simulation jumper is present which also sets the "simulation" indicator in the Block Error parameter.

See section 5.1 for further information on the simulation feature.

FIRMWARE_VERSION: read-only parameter that corresponds to "Firmware Version" in the Transducer Block.

SERIAL_NUMBER: read-only parameter that corresponds to "MAGNETROL Serial Number" in the Transducer Block.

RB_LOCAL_TAG: read-only parameter that corresponds to "Local Tag" in the Transducer Block.

4.3 Transducer Block

The TRANSDUCER Block is a custom block containing parameters that support the Model TA2 Thermal Mass Flow Meter. It contains the TA2 transmitter configuration, diagnostics, and calibration data. Output from the Transducer Block is process variables and status information.

The TRANSDUCER Block parameters are grouped in a useful configuration. There are both read-only parameters and read-write parameters within the TRANSDUCER Block.

- The read-only parameters report the block status and operation modes.
- The read-write parameters affect the function block basic operation, transmitter operation, and calibration.

The Transducer Block will automatically be changed to "Out of Service" when the local interface (keypad) is used to change a parameter online. The Transducer Block must be placed back in service from the Host system.

4.3.1 Transducer Block Parameters

The first six parameters in the TRANSDUCER Block are the universal parameters discussed in section 4.1.1. After the universal parameters, six additional parameters are required for Transducer Blocks. The most notable of these parameters are **UPDATE_EVT** and **BLOCK_ALM**. It should be noted that these six additional parameters must exist but do not have to be implemented.

An important device-specific parameter found later in the TRANSDUCER Block list is **DEVICE_STATUS**, which displays the status of the device. If more than one message exists, then the messages are displayed in priority order.

If **DEVICE_STATUS** indicates a problem, refer to Section 5.2, Troubleshooting.

For a complete list of Transducer Block Parameters, refer to table in the Appendix A - Transducer Block Parameters.

4.4 Analog Input Block

The ANALOG INPUT (AI) Block takes the THERMATEL Model TA2 input data, selected by channel number, and makes it available to other function blocks at its output:

Channel	Process Value
1	Flow
2	Mass
3	Process Temperature
4	R. Totalizer
5	NR. Totalizer

4.4.1 AI Block Parameters

PV: The primary measurement value for use in executing the function.

OUT: The primary value calculated as a result of executing the function block.

SIMULATE: Allows the transducer analog input or output to the block to be manually supplied when simulate is enabled. When simulate is disabled, the simulate value and status track the actual value and status

XD_SCALE: The high and low scale values, engineering units code, and number of digits to the right of the decimal point used with the value obtained from the transducer for a specified channel.

OUT_SCALE: The high and low scale values, engineering units code, and number of digits to the right of the decimal point to be used in displaying the OUT parameter.

GRANT_DENY: Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block.

IO_OPTS: Option which the user may select to alter input and output block processing.

STATUS_OPTS: Options which the user may select in the block processing of status.

CHANNEL: The number of the logical hardware channel that is connected to this I/O block. This information defines the transducer to be used going to or from the physical world.

L_TYPE: Determines if the values passed by the Transducer Block to the AI block may be used directly (Direct) or if the value is in different units and must be converted linearly (Indirect), or with square root (Ind Sqr Root), using the input range defined for the transducer and the associated output range.

LOW_CUT: Limit used in square root processing.

PV_FTIME: Time constant of a single exponential filter for the PV, in seconds.

FIELD_VAL: Raw value of the field device in % of PV range, with a status reflecting the Transducer condition, before signal characterization (L_TYPE) or filtering (PV_FTIME).

UPDATE_EVT: This alert is generated by any change to the static data.

BLOCK_ALM: The block alarm is used for all configuration, hardware, connection failure or system problems in the block.

ALARM_SUM: The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block.

ACK_OPTION: Selection of whether alarms associated with the function block will be automatically acknowledged.

ALARM_HYS: Amount the PV must return within the alarm limits before the alarm condition clears. Alarm hysteresis expressed as a percent of the span of the PV.

HI_HI_PRI: Priority of the high high alarm.

HI_HI_LIM: The setting for high high alarm in engineering units.

HI_PRI: Priority of the high alarm.

HI_LIM: The setting for high alarm in engineering units

LO_PRI: Priority of the low alarm.

LO_LIM: The setting for low alarm in engineering units.

LO_LO_PRI: Priority of the low low alarm.

LO_LO_LIM: The setting for low low alarm in engineering units.

HI_HI_ALM: The status for high high alarm and its associated time stamp.

HI_ALM: Status for high alarm and associated time stamp.

LO_ALM: Status for low alarm and associated time stamp.

LO_LO_ALM: The status for low low alarm and its associated time stamp.

The TRANSDUCER and AI Block's MODE_BLK parameter must be set to AUTO to pass the PV Value through the AI to the network.

Transducer scaling, called XD_SCALE, is applied to the PV from the CHANNEL to produce the FIELD_VAL in percent. Selection of valid XD_SCALE engineering units is limited to predefined units of measurement which is dependent on what channel is selected in the AI Block. Options include SCFM, SCFH, MMSCFD, Nm^3/h, Nl/h, lb/h, lb/min, kg/h, kg/min, °F, °C, SCF, kg, lb, Nm3, and Nl.

The AI blocks can have a BLOCK_ERR when:

1. Channel is not set correctly.
2. XD_SCALE does not have suitable engineering units or has range incompatibility.
3. SIMULATE parameter is active
4. AI Block MODE is O/S (out of service).

NOTE: This can be caused by the Resource Block being OOS or the AI Block not scheduled for execution.

5. L-TYPE not set or set to Direct with improper OUT_SCALE.

The AI Block uses the STATUS_OPTS setting and the TRANSDUCER PV LIMIT value to modify the AI PV and OUT QUALITY.

Damping Filter is a feature of the AI Block. The PV_FTIME parameter is a time constant of a single exponential filter for the PV, in seconds. This parameter can be used to dampen out fluctuation.

The AI Block has multiple ALARM functions that monitor the OUT parameter for out of bound conditions.

4.5 PID Block

The PID Function Block contains the logic necessary to perform Proportional/Integral/Derivative (PID) control. The block provides filtering, set point limits and rate limits, feedforward support, output limits, error alarms, and mode shedding.

Although most other function blocks perform functions specific to the associated device, the PID Block may reside in any device on the network. This includes a valve, a transmitter, or the host itself.

The Enhanced Model TA2 PID Block implementation follows the specifications documented by the Fieldbus Foundation.

4.5.1 PID Block Parameters

ACK_OPTION: Used to set auto acknowledgement of alarms.

ALARM_HYS: The amount the alarm value must return to before the associated active alarm condition clears.

ALARM_SUM: The summary alarm is used for all process alarms in the block.

ALERT_KEY: The identification number of the plant unit.

BAL_TIME: The specified time for the internal working value of bias to return to the operator set bias.

BKCAL_HYS: The amount the output must change away from its output limit before the limit status is turned off, expressed as a percent of the span of the output.

BKCAL_IN: The analog input value and status for another blocks BKCAL_OUT output.

BKCAL_OUT: The value and status required by the BKCAL_IN input for another block.

BLOCK_ALM: Used for all configuration, hardware, connection failure, or system problems in the block.

BLOCK_ERR: Reflects the error status associated with the hardware or software components associated with a block.

BYPASS: Used to override the calculation of the block.

CAS_IN: The remote setpoint value from another block.

CONTROL_OPTS: Allows one to specify control strategy options.

DV_HI_ALM: The DV HI alarm data.

DV_HI_LIM: The setting for the alarm limit used to detect the deviation high alarm condition.

DV_HI_PRI: The priority of the deviation high alarm.

DV_LO_ALM: The DV LO alarm data.

DV_LO_LIM: The setting for the alarm limit used to detect the deviation low alarm condition.

DV_LO_PRI: The priority of the deviation low alarm.

FF_GAIN: The feedforward gain value.

FF_SCALE: The high and low scale values associated with FF_VAL.

FF_VAL: The feedforward control input value and status.

GAIN: The proportional gain value. This value cannot equal zero.

GRANT_DENY: Options for controlling access of host computers to alarm parameters of the block.

HI_ALM: The HI alarm data.

HI_HI_ALM: The HI HI alarm data.

4.5.1 PID Block Parameters (cont.)

HI_HI_LIM: The setting for the alarm limit used to detect the HI HI alarm condition.

HI_HI_PRI: The priority of the HI HI Alarm.

HI_LIM: The setting for the alarm limit used to detect the HI alarm condition.

HI_PRI: The priority of the HI alarm.

IN: The connection for the PV input from another block.

LO_ALM: The LO alarm data.

LO_LIM: The setting for the alarm limit used t detect the LO alarm condition.

LO_LO_ALM: The LO LO alarm data.

LO_LO_LIM: The setting for the alarm limit used to detect the LO LO alarm condition.

LO_LO_PRI: The priority of the LO LO alarm.

LO_PRI: The priority of the LO alarm.

MODE_BLK: The actual, target, permitted, and normal modes of the block.

OUT: The output value of the PID block.

OUT_HI_LIM: The maximum output value allowed.

OUT_LO_LIM: The minimum output value allowed.

OUT_SCALE: The high and low scale values associated with OUT.

PV: The process variable use in block execution.

PV_FTIME: The time constant of the first order PV filter.

PV_SCALE: The high and low scale values associated with PV.

RATE: The derivative action time constant.

RCAS_IN: Target setpoint and status that is provided by a supervisory host.

RCAS_OUT: Block setpoint and status that is provided to a supervisory host.

RESET: The integral action time constant.

ROUT_IN: Block output that is provided by a supervisory host.

ROUT_OUT: Block output that is provided to a supervisory host.

SHED_OPT: Defines action to be taken on remote control device timeout.

SP: The target block setpoint value.

SP_HI_LIM: The highest SP value allowed.

SP_LO_LIM: The lowest SP value allowed.

SP_RATE_DN: Ramp rate for downward SP changes.

SP_RATE_UP: Ramp rate for upward SP changes.

4.5.1 PID Block Parameters (cont.)

STATUS_OPTS: Allows one to select options for status handling and processing.

STRATEGY: Can be used to identify grouping of blocks.

ST_REV: The revision level of the static data associated with the function block.

TAG_DESC: The user description of the intended application of the block.

TRK_IN_D: Discrete input that initiates external tracking.

TRK_SCALE: The high and low scale values associated with TRK_VAL.

TRK_VAL: The value applied to OUT in LO mode.

UPDATE_EVT: This alert is generated by any changes to the static data.

4.6 Integrator Block

The Integrator Function Block integrates an analog value as a function of the time. The block may be used as a totalizer that counts up until reset, or as a batch totalizer that has a setpoint. When used as a batch totalizer, the integrated value is compared to pre-trip and trip settings to generate discrete signals when these settings are reached. The Integrator Block has two inputs, and can only get an input value from another function block, typically an Analog Input Block. It cannot get an input value directly from the Transducer Block.

The Integrator Block and internal totalizer are independent and may have different values. The difference can occur due to different sample times or different reset times.

A simple configuration for the Fieldbus Model TA2 might be as follows:

- AI Block is configured with channel set to Flow. XD_SCALE, OUT_SCALE, and L_TYPE parameters are set appropriately so that the AI Out value is flow in SCFM.
- IT Block is configured as follows:
    - Set Units Index in OUTPUT_RANGE to SCF.
    - Select “minutes” for TIME_UNIT1 which corresponds to the rate time unit of the AI Out value.
    - Select “Demand” for INTEG_TYPE (Count up and is reset on demand; totalizer set point and trip outputs are not used).
    - Select “Flow forward” for INTEG_OPT.
    - GOOD_LIM set to 90%.
    - UNCERT_LIM set to 75%.

- Using a Configuration Tool, the OUT value from the AI Block is connected to IN_1 of the Integrator Block, and both function blocks are then scheduled for execution.
- If successful, the function blocks can go into service if the Resource Block is in service.

Note that the Totalized value in the Integrator Block is saved in non-volatile memory every 60 seconds. In the event that the power is lost, the maximum totalized value lost would correspond to one minute of flow. Also, the IT Out value will be available for display on the local user interface similar to the AI Out Values.

4.6.1 Integrator Block Parameters

BLOCK_ALM: Used for all configuration, hardware, connection failure, or system problems in the block.

CLOCK_PER: Establishes the period for periodic reset in seconds.

GOOD_LIM: Sets the good limit for PCT_INCL; i.e. if PCT_INCL ≥ GOOD_LIM, the status of OUT is set to good.

GRANT_DENY: Options for controlling access of host computer and local control panels to operating, tuning, and alarm parameters of the block.

IN_1: Input 1 value to the block.

IN_2: Input 2 value to the block.

INTEG_OPTS: Used to configure the type of input (rate or accum.) used in each input, the flow direction to be considered in the totalization, the status to be considered in TOTAL, and if the totalization residual value beyond the trip value shall be carried over to the next batch for INTEG_TYPE = UP_AUTO or DN_AUTO.

INTEG_TYPE: Defines the type of counting (up or down) and the type of resetting (demand or periodic).

N_RESET: Counts the number of resets.

OP_CMD_INT: Operator Command to reset the totalizer.

OUT: The output (TOTAL) value of the Integrator Block.

OUT_PTRIP: Second discrete output.

OUT_RANGE: The display scaling for the corresponding output. It has no effect on the block.

OUT_TRIP: First discrete output.

OUTAGE_LIM: The maximum tolerated duration for power failure.

PCT_INCL: Indicates the percentage of inputs with "good" status compared to the ones with "bad" status, or "bad" and "uncertain" status.

PRE_TRIP: Sets the value that should set OUT_PTRIP; i.e. OUT_PTRIP is set when the integration reaches (TOTAL_SP - PRE-TRIP) when counting up, or the integration reaches PRE-TRIP when counting down.

PULSE_VAL1: Determines the mass, volume, or energy per pulse on Input 1 (used when accumulating the counts from a Pulse Input Block).

PULSE_VAL2: Determines the mass, volume, or energy per pulse on Input 2 (used when accumulating the counts from a Pulse Input Block).

RESET_CONFIRM: Momentary discrete value which can be written by a host to enable further resets, if the option Confirm Reset is selected in INTEG_OPTS.

RESET_IN: Input to function block to reset the totalizers.

REV_FLOW1: Input to function block indicates reverse flow on Input 1 when true.

REV_FLOW2: Input to function block indicates reverse flow on Input 2 when true.

RTOTAL: Indicates the totalization of inputs with "bad" status, or "bad" and "uncertain" status, according to INTEG_OPTS.

SRTOTAL: A copy of RTOTAL just before a reset.

SSP: A copy of TOTAL_SP.

STATUS_OPTS: Options which the user may select in block processing of status.

STOTAL: A copy of OUT just before a reset.

TIME_UNIT1: The rate time unit of Input 1 for conversion to rate per second.

TIME_UNIT2: The rate time unit of Input 2 for conversion to rate per second.

TOTAL_SP: Set point for batch totalization.

UNCERT_LIM: Sets the uncertain limit for PCT_INCL; i.e. if PCT_INCL ≥ UNCERT_LIM, the status of OUT is set to uncertain.

UNIT_CONV: Factor to convert the engineering units of Input 2 into the engineering units of input 1 when integrating two inputs.

UPDATE_EVT: This alert is generated by any changes to the static data.

4.7 Local Display of Function Block Values

The LCD and keypad on the Model TA2 Foundation Fieldbus transmitter provides access to read or change the Transducer Block parameters. In addition the TA2 permits the display of the devices Analog Input [AI] Block and the Integrator [IT] Block output values on the local LCD under Measured Values. These values can be displayed on the rotating display—see section 3.5.5.

A list of the Analog Input Block Process values is shown in section 4.4.

Typical display of the Analog Output values is shown in figure 11.

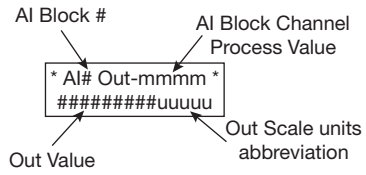


Figure 11

The screens will be formatted as shown, where # in the title is the number of the AI Block (1, 2, 3, 4, or 5) and mmmm is one of: “Flow”, “Mass”, “Temp”, “NRTot”, “RTot”, “----” depending on the value of the associated AI Block’s Channel parameter.

- For example, “AI1 Out-Flow” will probably be the most commonly used AI Out screen
- “AI2 Out----” would be displayed when the channel value is 0 [uninitialized] for AI Block 2.

Additional representative examples are shown in figure 12.

Figure 12

There may be differences in the AI value in the Analog Input Block and the IT value in the Integrator Block compared to the values shown on the TA2 display. Primary reason for this difference is the time when the data was acquired.

In order to provide indication that the Function Block is not executing and/or to avoid displaying a possibly stale value, the second row will be blank if the Block Error parameter in a configured Function Block is indicating Out Of Service, a block configuration error, or input failure. The second row on an AI Out screen or IT Out will also be blank if the unit has not been assigned a permanent address, or if the associated Function Block has not been configured and scheduled for execution.

The Out Scale units abbreviations will be displayed only when the Output Scale Units Abbreviation is “%” or one of the flow, mass, temperature, or totalizer units supported for local display.

5.0 Diagnostic Parameters

The Model TA2 measurement engine runs through a series of self-tests and will detect and report faulty operation. The TRANSDUCER BLOCK displays these faults in the DEVICE_STATUS parameter. Refer to Section 5.2.1.4 for more information on specific faults and warnings.

BLOCK_ERROR is not used except for indicating Out of Service (OOS).

When the Model TA2 is initially powered on, the measurement engine does not have enough valid measurement cycles to make a decision about the output value. For the first few seconds after power is applied, the FLOW_STATUS/QUALITY is "Uncertain," the SUB_STATUS is "Initial value," and the LIMIT attribute is "Constant."

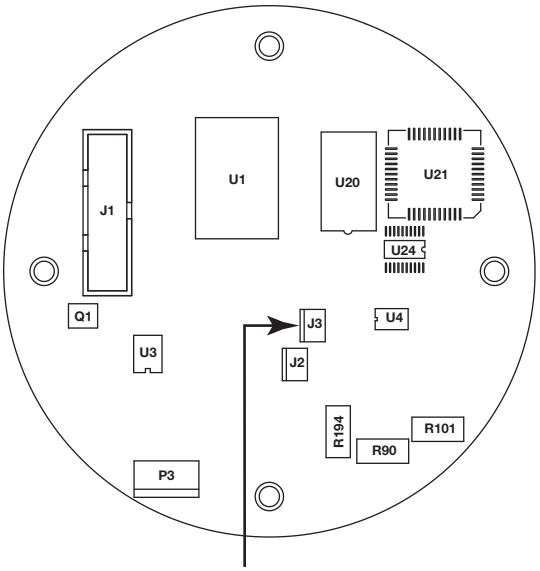
When the Model TA2 is operating properly, the FLOW_STATUS/QUALITY is shown as "GOOD," and the SUB_STATUS is "Non-Specific."

While changing the transmitter operational parameters using the local display or through the system configuration tool (with the MODE_BLK in OOS), the output might be inaccurate because of the changing parameters. When the device is set to OOS, the TRANSDUCER BLOCK will still output flow but the QUALITY will be shown as "Bad" and the SUB_STATUS is "Out of Service."

When the Enhanced Model TA2 measurement cycle fails to find a valid output value, the transmitter maintains the last good value as the output and flags the failure. The LIMIT attribute is the same as the last good measurement.

If the Model TA2 fails to find a measurable signal, the TRANSDUCER BLOCK maintains the last good value as the output and flags the failure. The QUALITY is "Bad," the SUB_STATUS is "Sensor failure" for no flow (or "Device failure."

Refer to Section 5.2.1.4 for additional information.



J3 Simulation Jumper

Figure 13

5.1 Simulation Feature

The THERMATEL Model TA2 with FOUNDATION fieldbus™ supports the Simulate feature in the Analog Input Block. The Simulate feature is typically used to exercise the operation of an AI block by simulating a TRANSDUCER block input.

This feature cannot be activated without the placement of a hardware jumper. Normally, the THERMATEL Model TA2 will ship with the hardware jumper placed so that the Simulation Feature is disabled. See section 5.1.1 for instructions about accessing the Simulation jumper.

5.1.1 Accessing the Simulation Jumper

To access the simulation jumper:

1. Remove the cover to the electronics display.
2. Remove the display module by removing the two retaining screws.
3. To enable simulation, place jumper at J3 across the two pins.To disable simulation, place jumper at J3 on one pin only.

NOTE: Do not remove the jumper at position J2. The J2 jumper is used in a diagnostic test; see section 5.3.1.

4. Reassemble the display module and cover.

NOTE: A BLOCK_ERR of “Simulation Active” in the Resource Block does not mean simulation is active—it merely indicates that the simulation (hardware) jumper is placed to enable simulation. See section 4.2.2 for instructions to mask this block error.

5.2 Troubleshooting

The TA2 Thermal Mass Flow Meter is designed for ease of use and trouble-free operation. The TA2 is shipped pre-calibrated and pre-configured based on information provided at time of order.

The following lists possible problems and solutions to investigate.

WARNING! *Explosion hazard. Do not remove the TA2 housing cover unless power has been switched off or the area is known to be non-hazardous.*

5.2 Troubleshooting (cont.)

Symptom	Problem	Solution
No Output signal No Display	No input power	Verify that LED D6 on the input wiring board is on. If not, check wiring connections. Check F1 test and F2 test to check fuses protecting input wiring. See Figure 8.
Totalizer not operating	Totalizer is Disabled	Ensure that the totalizer operation is enabled. See section 3.5.8.
Flow is measured under a no flow condition	Increased heat transfer. This can occur under no flow with increased pressure.	Increase the low flow cutoff to a value greater than the displayed flow rate. The TA2 will ignore readings lower than this value. Optionally, increase the zero flow signal to match the value indicated under Signal Value. See section 3.5.14.
Flow Rate too high or too low	Instrument configuration does not match actual application	Check values entered for Flow Area under Basic Configuration. Check if Install Factors are entered under Advanced Configuration. Check STP conditions under Advanced Configuration.
	Buildup on sensor	Depending on type and size of buildup, flow readings may either increase or decrease. Clean sensor.
Flow Rate too high	Flow Profile Considerations	The TA2 assumes a specific fully developed flow profile. User can correct for variations in flow profile using the Install Factors found under Advanced Configuration section 3.5.9.
Flow Rate too high, output spiking	Moisture in the Gas	Condensed moisture will cool the sensor more than gas flow. This will temporarily indicate a higher than expected flow rate.

5.2.1 Error Messages

The TA2 Mass Flow Meter utilizes a 3-level hierarchy for reporting diagnostics information: FAULTS, WARNINGS, and INFORMATION. Faults and Warnings can be reviewed on the rotating screen in the Home menu. These screens capture only current conditions. Historic diagnostic information can be viewed in the HISTORY screen of the Diagnostics Menu.

FAULT: The highest level in the hierarchy of diagnostics. A Fault indicates a defect or failure in the circuitry or software, or a calibration condition that makes reliable measurement impossible. Further error information can be obtained by reviewing the Diagnostic Menu screens.

WARNING: This is the second level in the hierarchy of diagnostics. A Warning indicates conditions that are not fatal but may affect the measurement. A message will appear on the Home (rotating) screen when a Warning is detected but will not affect the output current. Further error information can be obtained by reviewing the Diagnostic Menu screens.

INFORMATION: This is the lowest level in the hierarchy of diagnostics. Information messages are for conditions that provide operational factors that are not critical to the measurement. Further error information can be obtained by reviewing the Diagnostics Menu.

5.2.1.1 Fault Messages

Diagnostic	Fault Description/Corrective Action	LCD Message
Non-Volatile Memory corruption	Partial corruption of the Non-Volatile memory stored in the EEPROM. Data may revert to Default conditions. Re-verify that all calibration and configuration factors in the TA2 match the calibration certificate.	Default Params
No signal from Probe	There is no signal from the sensor. Check the wiring between the probe and the electronics.	No Probe Signals
Temperature Sensor Failure	A short has occured in the RTD measuring the process temperature or in the interconnecting wiring (if remote electronics). Check wiring to the probe.	TempSnsr Shorted
Temperature Sensor Failure	There is an open circuit in the RTD measuring the process temperature or in the interconnecting wiring (if remote electronics). Check wiring to the probe.	Temp Sensor Open
Flow Sensor Failure	A short has occured in the RTD measuring the heated sensor or in the interconnecting wiring (if remote electronics). Check wiring to the probe.	FlowSnsr Shorted
Flow Sensor Failure	There is an open circuit in the RTDs measuring the heated sensor or in the interconnecting wiring (if remote electronics). Check wiring to the probe.	Flow Sensor Open
RTDs Reversed	The wiring connecting the RTDs is reversed. Check probe wiring or interconnecting cable (if remote electronics)	RTDs Reversed
Heater Shorted	The heater has developed a short either in the probe or in the interconnecting cable (if remote electronics). Check probe wiring.	Heater Shorted
Heater Open	There is an open circuit in the wiring going to the heater. Check wiring. Also, check if the two-pin jumper is missing. See section 5.3.1.	Heater Open
Zero Flow Signal is too high	Zero Flow Signal (power) is greater than second data point in the Calibration Table. Check value entered under Factory Config/Cal Parameters/Zero Flow Signal.	ZFS Too High
Too Few Calibration Points	The calibration table does not contain sufficient number of data points for the flow range. Minimum of ten points is required.	Too Few Cal Pts
Air Equivalency Coefficients incorrect	The Air Equivalency factors used result in a non-monotonically increasing curve over the operating range. Check factors.	Air Equiv Coeffs
Install Factors incorrect	Install factors entered under Advanced Configuration result in a non-monotonically increasing curve. Check factors.	User Coeffs
Module Failure	No readings received from the ADCs, or the values out of range. Indicates failure of Analog to Digital converters. Requires replacement of processor board or return of unit to factory.	Module Failure
Velocity is greater than the Upper Sensor Limit	The velocity is greater than established values. Contact MAGNETROL.	Vel > UprSnsrLmt

5.2.1.2 Warning Messages

Diagnostic	Warning Description	LCD Message
Initializing	Initialization in progress. The TA2 will begin making flow readings at completion of cycle.	Initializing
TA2 is running diagnostics test	The operator has put the TA2 into one of several diagnostics tests.	In Test Mode
Velocity too high	The Flow rate exceeds the calibration range of the instrument. Instrument will continue to operate. Accuracy is uncertain; flow measurements will be repeatable.	Vel > Upr Cal Pt
RTD drift	The RTD drive circuit current has drifted since last calibration. The drift is outside expected range. The TA2 has compensated for the drift, continued drift may affect accuracy. Repeatability will remain.	RTD Drive Ckt
Totalizer Error	There is an error in the Totalizer operation—the Totalizer and Elapsed Time indicator are reset to 0.	Dflt Totalizer
Temperature Limit Exceeded	The temperature measured by the sensor exceeds the rated temperature. Continued operation will damage sensor.	Process Temp Hi
Install Factor Error	Check and recalculate the install factors. This message may occur if the units of measurement were changed after install factors were entered.	Check Inst Factors
Electronic Temperature Exceeded	The temperature of the microprocessor board is above +176° F (+80° C) or below –40° F (–40° C)	Elec Temp Hi
		Elec Temp Lo

5.2.1.3 Information Message

Diagnostic	Information Description	LCD Message
System Warning	Non-fatal firmware exception. Advise MAGNETROL with system code number.	System Code

5.2.1.4 Device Status Parameter in the Transducer Block

The following table lists the conditions indicated in the Device Status parameter. It also shows how the conditions affect PV Quality, Sub-Status and Limit. XD ERROR and BLOCK ALARM are not affected by these conditions directly.

Device Status				Process Variable Status		
Type	**Label**	**Bit #**	**Value**	**Quality**	**PV Sub Status**	**Limit**
Mode	Config Changed	6	0x00000040	Bad	OOS	Not Limited
Fault	Default Params	31	0x80000000	Bad	Configuration Error	Not Limited
Fault	No Probe Signals	29	0x20000000	Bad	Sensor Failure	Constant Limited
Fault	Temp Sensor Shorted	28	0x10000000	Bad	Sensor Failure	Constant Limited
Fault	Temp Sensor Open	27	0x08000000	Bad	Sensor Failure	Constant Limited
Fault	Flow Sensor Shorted	26	0x04000000	Bad	Sensor Failure	Constant Limited
Fault	Flow Sensor Open	25	0x02000000	Bad	Sensor Failure	Constant Limited
Fault	RTDS Reversed	24	0x01000000	Bad	Sensor Failure	Constant Limited
Fault	Heater Shorted	23	0x00800000	Bad	Sensor Failure	Constant Limited
Fault	Heater Open	22	0x00400000	Bad	Sensor Failure	Constant Limited
Fault	ZFS Too High	21	0x00200000	Bad	Configuration Error	Not Limited
Fault	Too Few Cal Pts	20	0x00100000	Bad	Configuration Error	Not Limited
Fault	Air Equiv Coeffs	19	0x00080000	Bad	Configuration Error	Not Limited
Fault	User Coeffs	18	0x00040000	Bad	Configuration Error	Not Limited
Fault	Module Failure	17	0x00020000	Bad	Device Failure	Constant Limited
Fault	Vel > UprSnsrLmt	16	0x00010000	Bad	Non-Specific	High Limited
Warning	Initializing	15	0x00008000	Uncertain	Initial Value	Constant Limited
Warning	In Test Mode	13	0x00002000	Bad	OOS	Not Limited
Warning	Vel > UprCalPt	12	0x00001000	Good	Non-Specific	Not Limited
Warning	Vel < LowFlowLmt	11	0x00000800	Good	Non-Specific	Low Limited
Warning	RTD Drive Circuit	10	0x00000400	Good	Non-Specific	Not Limited
Warning	Default Totalizer	9	0x00000200	Bad①	Configuration Error	Not Limited
Warning	Process Temp High	4	0x00000010	Good	Non-Specific	Not Limited
Warning	Check Install Factors	3	0x00000008	Bad	Configuration Error	Not Limited
Warning	Elec Temp High	2	0x00000004	Good	Non-Specific	Not Limited
Warning	Elec Temp Low	1	0x00000002	Good	Non-Specific	Not Limited

① For the Default Totalizer Warning, PV Status is bad only if the PV is R Totalizer or NR Totalizer. If the PV is Flow, Mass, or Temperature, then PV status is "Good, Non-Specific, Not limited"

If everything is running normally and there are no Faults or Warnings, then status is not shown on the rotating menu on the local display and 0x00000000 will be displayed for the Device Status parameter in the Transducer Block from the Fieldbus interface. If a static parameter is changed from the local display, the Transducer Block is taken Out of Service if it is not already, and the "Config Changed" mode condition is set in Device Status. This will indicate to the operator that the configuration has been changed from the local display. No indication is given on the Fieldbus network if someone is only viewing parameters on the local display.

For the Default Totalizer Warning, PV Status is bad only if the PV is R Totalizer or NR Totalizer. If the PV is Flow, Mass, or Temperature, PV Status is "Good, Non-specific, Not Limited".

5.3 Diagnostics Test

The TA2 has several diagnostics tests which may be routinely performed. When conducting these tests, the Transducer Block is taken Out of Service (OOS).

5.3.1 Heater Setting

The amount of current flowing to the heater is displayed under Diagnostics/Heater Setting. This value can be verified by connecting a multi-meter across the Heater Bypass terminals (J2) shown in figure 13. This board can be accessed by opening the cover and removing the display module. See Figure 14.

The measured value should match the value shown on the display. Any difference between the two values indicates that the heater calibration is incorrect. If the heater circuit is open, a nominal current value will be displayed, but the measured current will be zero.

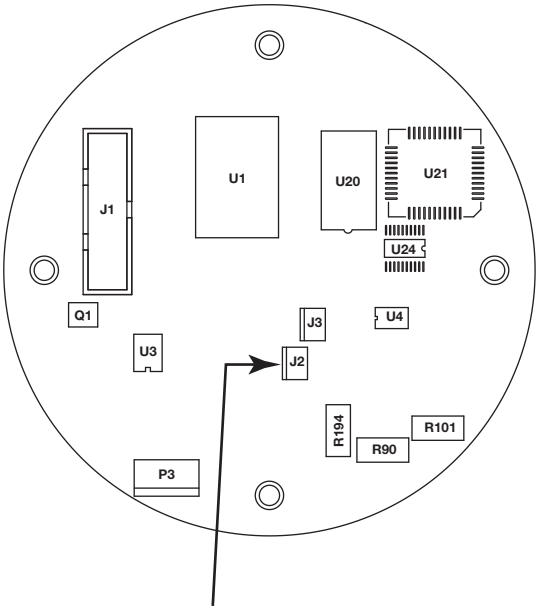


Figure 14

5.3.2 Zero Power Test

This test checks that the resistances of the RTDs have not changed. The heater is turned off and the temperature difference between the two sensors is compared. The test should be performed in a water bath (preferred) or under flowing conditions. Conducting this test in still air will cause the test to time out and provide inconclusive results.

The temperature difference between the two sensors is displayed. Typical values will match within 0.15° C. Temperature difference may be as high as 0.5° C depending upon test conditions. If greater than this value, contact the factory as drift in the RTDs may have occurred.

5.3.3 Calibration Verification Procedure

The TA2 measures heat transfer. These procedures are designed to permit the user to verify the calibration by checking the heat transfer characteristics of the sensor. If the heat transfer characteristics are approximately the same when the test is conducted compared with when the same data was collected at the factory during the initial calibration, the unit remains in calibration.

The procedure is performed under two different sets of conditions. Both tests should be conducted at "room temperature," approximately +70° to +85° F (+21° to +30° C).

Low Flow Validate—Simulates a low flow condition.

i. Cover sensor tips to isolate from air currents. During the test, the heater power is set and the Delta T (temperature difference) between the two RTDs is measured.

ii. After completion of the test, the value of the temperature difference measured during the test is compared against the previously stored value. (This value can also be compared with the initial calibration found on the original calibration certificate.)

iii. The value from the test should compare with the stored (or original calibration value) within 1.5° C. This variation in part due to potential variations of the ambient temperature during the test and differences in test methods.

Figure 15

High Flow Validate—Simulates a high flow condition.

i. Support the TA2 vertically in a water bath. See Figure 15. During the test, the heater power is set and the Delta T (temperature difference) between the two RTDs is measured.

ii. After completion of the test, the value of the temperature difference measured during the test is compared against the stored value. (This value can also be compared with the initial calibration found on the original calibration certificate.)

iii. The value from the test should compare with the stored (or original calibration value) within 1.5° C This variation in part due to potential variations of the ambient temperature during the test and differences in test methods.

If the temperature difference measured during the test is greater than the recommended temperature difference indicated above in item "iii", then the overall accuracy of the TA2 may be affected. Contact MAGNETROL Technical support.

6.0 Maintenance

6.1 Circuit Board Replacement

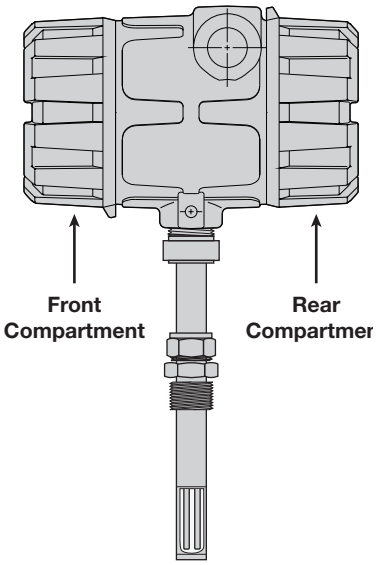


Figure 16

The input wiring board and display module can be replaced without any effect on the performance and operation of the TA2. The processor board contains the calibration information and is matched with the probe. If this circuit board is replaced, re-entry of all the original calibration data and configuration information is required. This information is contained on the calibration certificate which can be supplied by MAGNETROL.

1. Make sure the power source is turned off.
2. The input wiring board is contained in the rear compartment where the input voltage wiring comes into. The display module, power fieldbus board and processor board are contained in the front compartment.
3. Remove cover—refer to Figure 16.
4. If removing boards in the front compartment:
    a. Remove and unplug the display module if provided.
    b. Remove the two hex head fasteners using a ¼" socket. This will remove the electronics module containing the processor board and the power fieldbus board.
    c. Unplug the electrical connection at J1 of the power fieldbus board.
    d. Probe wiring connections are made to TB1 on the same side of the power fieldbus circuit board.
    e. Connect the probe wires as indicated:

Integral Electronics

Wire Color	Connection on TB1
Orange	8
Brown	7
Black	3
Blue	2
White	1

Remote Electronics—see Figure 9 on Page 13.

    f. Reattach the electrical connection to J1.
    g. Reassemble the circuit boards in the enclosure. Make sure that the probe wiring does not get pinched between the standoffs on the circuit board and the attachment lugs in the housing.
    h. Reinstall the display module if provided.
5. If replacing the input wiring board, loosen screws, and remove the electrical connection to J1 on the rear of the circuit board.
    i. Attach electrical connections to J1 on new circuit board and reassemble.
6. Re-install the cover.
7. Apply power to the instrument.
8. Proceed to section 6.3

6.2 Probe Replacement

The probe and processor board are calibrated together to form a matched set. If a probe needs to be replaced, MAGNETROL will provide a new calibration certificate. The user will be required to re-enter the data from this certificate into the instrument. A new serial number will be designated to the replacement probe.

Integral Electronics

1. Make sure the power source is off.
2. Access the power fieldbus circuit board following procedure in section 6.1.4.
3. Disconnect wiring to the probe.
4. Loosen the two set screws at the base of the housing. One serves as a rotational lock, the other secures the head into place.
5. Unthread the probe.
6. Thread in a new probe.
7. Connect the probe wires to the power fieldbus board as indicated in section 6.1.4., step "e"
8. Reassemble the electronics following 6.1.4.
9. Align the enclosure with the desired probe position, making sure that the flow arrow indicates the direction of flow.
10. Retighten the two set screws.
11. Reapply power.
12. Proceed to section 6.3.

Remote Electronics

1. Make sure the power source is off.
2. Remove cover of remote electronics housing.
3. Remove bezel.
4. Disconnect the wires from the probe at terminal TB1.
5. Loosen the two set screws at the base of the housing. One serves as a rotational lock, the other secures the head into place.
6. Unthread the probe.
7. Thread in a new probe.
8. Connect the probe wires to Terminal TB1 as shown in figure 10.
9. Retighten the two set screws.

Wire Color	Terminal Connection on TB1
White	1
Blue	2
Black	3
Brown	4
Orange	5

10. Re-assemble the bezel and install cover.
11. Reapply power.
12. Proceed to section 6.3.

6.3 Replacement Calibration

6.3.1 RTD Calibration

If either the probe or the processor board is replaced in the field, calibration of the RTDs in the probe will return the TA2 to like-new performance.

NOTE: If this procedure is not followed, the accuracy will be affected; however, very repeatable flow measurements will be obtained.

Locate the sensor vertically in a water bath with an accurate temperature sensor directly adjacent to the probe tips. It is preferable that the water is stirred during the calibration to ensure the TA2 pins and temperature probe are at the same temperature. Using the keypad and display, select "Factory Config\Probe Params\Probe Temp Calib" and then press the Enter key. The device will dynamically display the To/Fo readings over a period of time. After 3 minutes, and if the readings are stable enough, the display automatically changes to request entry of a password (126) followed by the ambient water temperature. After the temperature is entered, the device will display if the calibration is OK. The device then automatically resets itself for normal operation.

6.3.2 Set Point Adjustment

A new set point must be calculated to complete the reconfiguration.

1. Place the probe in ambient temperature air where there is no flow across the sensor. This can be accomplished by wrapping the sensor tip with a piece of paper.
2. Go into Diagnostics → Signal. Allow time for the signal to stabilize to within ±1 mW and record the new signal.
3. Calculate a new set point by using the following formula:

New set point = set point x (zero flow signal ÷ new signal)

If replacing the probe, use the set point and zero flow signal (ZFS) shown on the new calibration certificate that came with the probe.

If replacing the processor board, use the set point and ZFS on the original calibration certificate. If the original calibration certificate is not available, contact MAGNETROL with the serial number of the unit found on the nameplate.

New signal is the value measured under step 2.

NOTE: If the TA2 is calibrated for a gas other than air, there are two ZFS values on the certificate. One is for air and the other is for the particular gas. Use the ZFS for air when making the adjustment in air.

4. Enter this new set point into the TA2 instead of the value on the calibration certificate under Factory Config → Cal Parameters A → Set Point.

5. Return to the signal screen, similar to step 2, ensuring there is no flow over the sensor. The signal value should now agree with the original ZFS within 1%. If desired, steps 2 through 5 can be repeated.

6.4 Flow Recalibration

Calibration of the TA2 requires a flow bench or other method for determining the flow rate. Using this procedure, the user can re-calibrate the unit himself or use a local flow calibration facility rather than returning the unit to the factory for recalibration. With an insertion probe, it is not necessary to calibrate in the same size pipe as the unit is installed in. The TA2 has internal scale-up factors which adjusts the data from the calibration pipe size to the installation pipe size.

Calibration requires the TA2 sensor to be positioned in a test section; the test section should have a sufficient upstream and downstream straight run to ensure the formation of a fully developed flow profile. Calibration should be performed using the same gas which the unit is calibrated for. Optionally, an air equivalency calibration can be performed. In this case, calibrate in air and contact the factory for air equivalency factors and equivalent air calibration rate.

Recalibration Procedure:

1. Select the set point; this is the temperature in degrees Celsius which the TA2 maintains between the two sensors. If the unit is re-calibrated for the same application, then it is probably not necessary to change the original value. If it becomes necessary to change the set point due to change in the calibration velocity or the type of gas:
    a. Record the set point under Factory Configuration/ Cal Parameters (A or B)/Set Point.
    b. Determine the maximum velocity in SFPM which the unit will operate (SFPM equals the SCFM divided by the flow area of the test section in square feet).
    c. Install the probe in the test section and flow gas that is equivalent to the maximum velocity in the calibration range.
    d. Using the display, obtain the signal value in mW from the Diagnostics menu.
    e. Calculate a new set point using the formula:

    New set point = old set point * (800/measured signal (mW)). 800 mW is the desired maximum power rating for the TA2.
    f. Enter new /set point in TA2 under Factory Configuration/Cal Parameters (A or B) Set Point.
2. Convert the flow rate in the application to the flow rate in the test section using the formula:

    Flow in test section = application flow * (flow area of test section/flow area of application)

a. Allow a flow of a known amount of gas through the test section, recording flow rate and TA2 signal (mW). A minimum of 10 and a maximum of 30 data points including a zero flow value should be obtained. One data point should be taken at a flow rate approximately 20% greater than the expected operating range. The higher the number of data points, the better the overall accuracy of the instrument.

b. Convert the flow rate in the test section to mass velocity in SFPM (Standard Feet Per Minute). This is equivalent to the flow rate in SCFM divided by the flow area in square feet. Convert from other units of measurement as necessary. Use MAGNETROL STP conditions of 70 °F and 1 Atmosphere (14.69 psia).

c. Enter the Power and the corresponding Mass Velocity into the TA2 using the display and keypad or using the Fieldbus interface. These values should be entered in increasing order to ensure a monotonically increasing curve.

   Note password of 126 is required for entry of calibration data. (Contact MAGNETROL if issues using this password.)

d. After completion of entry of the calibration data, check the display for the number of points accepted (or table length). If this number is less than the actual number of data points entered, then there is an error in the entry of the calibration data. Ensure that the data is entered so the curve is monotonically increasing. The values of mass velocity and power should always be increasing over the calibration range.

e. A Fault message will occur if there are fewer than 10 calibration data points in the calibration table.

3. Enter the flow area of the calibration test section. Units of measurement are the same as selected under Basic Config menu. This value is used in calculating the scale-up factor between the calibration test section and the installation.

7.0 Reference Information

7.1 Description

The THERMATEL Model TA2 Thermal Mass Flow Meter provides a mass flow measurement of air and other gases. The TA2 consists of a probe or flow body with electronics either integrally mounted on the probe or remotely located.

The electronics are rated for use in explosion proof service. The unit will accept 15 to 30 VDC power or 100 to 260 VAC input power.

The optional plug-in display module with four-button keypad permits the user to easily make changes in the configuration of the TA2 for application-specific conditions. The display provides an indication of the mass flow, temperature and totalized flow, plus other selectable information.

Each instrument is calibrated and configured by MAGNETROL for the type of gas, pipe size, flow area and flow rate. Calibration is performed in a NIST traceable flow bench.

The TA2 provides real-time temperature compensation which adjusts the flow measurement due to changing gas properties caused by process temperature changes.

7.2 Theory of Operation

The flow element of the TA2 Thermal Mass Flow Meter utilizes a heater and two resistance 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 variable power is provided to the heater. The active RTD measures the temperature of the heated sensor in a feedback loop to the electronics. The electronics vary the power to the heater to maintain a constant temperature difference between the active and reference RTDs. As the mass flow rate increases there is a cooling effect on the heated sensor. The power to the heated sensor is controlled to maintain a constant temperature difference between the two sensors. The amount of power required to maintain this temperature difference provides a measurement of the mass flow.

There is an inherent non-linear relationship between heater power and the mass flow rate. The microprocessor based electronics convert the heater power to provide a linear measurement of the mass flow rate. The electronics also provide real time temperature compensation which automatically adjusts the flow measurement for changes in process temperature over the entire operating range of the instrument.

The temperature measured by the reference RTD and the totalized flow can be viewed on the display, and is also available from the Fieldbus interface.

7.3 Display Module

The Enhanced model TA2 has a back-lit, plug-in, rotatable display module. The display module consists of a 2-line × 16-character Liquid Crystal Display with four-push-button keypad for configuring the instrument, or for diagnostics.

The display can be rotated in 90-degree increments to permit viewing from various orientations. To rotate the display, remove the two screws on the front of the display module, rotate to the desired position, and reattach.

7.4 Agency Approvals

AGENCY	APPROVED MODEL	PROTECTION METHOD	AREA CLASSIFICATION
UNITED STATES & CANADA 	TA2-AXXX-X3X TA2-AXXX-X4X with TXR-XXXX-XXX (probe) TFT-XXXX-000 (flow body)	Explosion Proof	Class I, Div 1, Groups B, C, D T6 Ta = -40° C to +70° C, T5 Ta = -40° C to +80° C
		Dust Ignition Proof	Class II, III, Div 1, Groups E, F, G T6 Ta = -40° C to +70° C, T5 Ta = -40° C to +80° C
		Non-Incendive	Class I, Div 2, Groups A, B, C, D T4 Ta = -40° C to +80° C
		Suitable for	Class II, Div 2, Groups E, F, G Class III, Div 1 T4 Ta= -40° C to +80° C Type 4X, IP 66
ATEX 	TA2-AXXX-X3X TA2-AXXX-X4X with TXR-XXXX-XXX (probe) TFT-XXXX-000 (flow body)	Explosion proof EN60079-0: 2009 EN60079-1: 2007	II 2 G Ex d IIC T6 Gb, Tamb -40° C to +55° C
IEC	TA2-AXXX-X3X TA2-AXXX-X4X with TXR-XXXX-XXX (probe) TFT-XXXX-000 (flow body)	Explosion Proof IEC 60079-0: 2007-10 IEC 60079-1: 2007-04	Ex d IIC T6 Gb when T amb= -40° C to +70° C and T medium= -40° C to +55° C
EAC	TA2-AXXX-X3X TA2-AXXX-X4X	Russian Authorization Standards - Consult MAGNETROL for Details	
BRAZIL  **INMETRO TÜV**	TA2-AXXX-X3X TA2-AXXX-X4X com TXR-XXXX-XXX (probe) TFT-XXXX-000 (flow body)	Explosion proof ABNT NBR IEC 60079-0:2008 ABNT NBR IEC 60079-1:2009 ABNT NBR IEC 60529:2005	Ex d IIc T6 Gb IP66W -40° C < Ta < +55° C TÜV 11.0027 X

Note: Maximum surface temperature is +4° C (+7.2° F) above process temperature.

CE These units have been tested to EN 61326 and are in compliance with the EMC Directive 2004/108/EC.

7.5 Replacement Parts

NOTE: Replacement of the processor circuit board or the probe requires entry of calibration and configuration data from the Calibration Certificate.

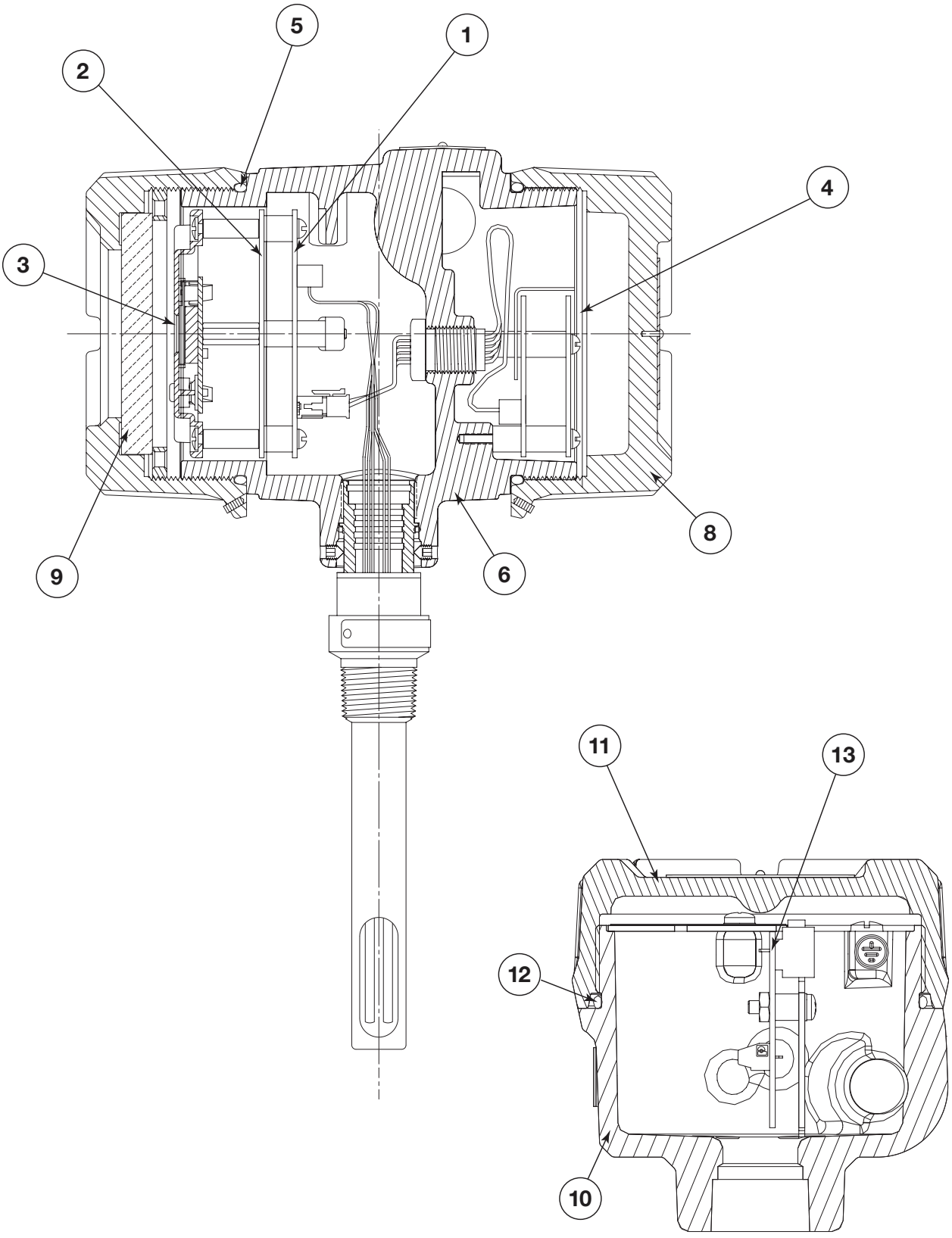
WARNING: EXPLOSION HAZARD
Substitution of components may impair suitability for Class I, Division 2

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

Item	Description		Part Number
1	Power Fieldbus Board		Z30-3618-001
2	Processor Board		Z30-3617-001
	Electronics Module with Processor Board, Power Fieldbus Board with mounting hardware		089-7263-001
3	Display Module		Z30-3614-001
4	Input Wiring Module		089-7262-001
5	Enclosure O-ring		012-2201-240
6	Enclosure Base		004-9207-XXX
7	Short Enclosure Cover *		004-9197-007
8	Wiring Enclosure Cover		004-9206-010
9	Enclosure Cover with Window **		036-4411-001
10	Remote Probe Housing Base		004-9212-XXX
11	Remote Probe Housing Cover		004-9193-002
12	Remote Probe Housing O-ring		012-2101-237
13	Remote PC Board		030-3616-001
14	Probe/Flow Body		See Probe/Flow Body

* Short enclosure cover used with units that do not include display

** Enclosure cover with window is used with units that do include display


5
1
2
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13
12
10

7.6 Specifications

7.6.1 Performance

Flow range maximum	10–54,000 SFPM (0.05–275 Nm/s) air reference to standard conditions
	Contact MAGNETROL for other gases
Accuracy flow	±1% of reading +0.5% of calibrated full scale
Accuracy temperature	±2 °F (1 °C)
Repeatability	±0.5% of reading
Linearity	Included in flow accuracy
Turn down	100:1 typical (depending on calibrated flow range)
Calibration	NIST traceable
Span	Minimum 0–100 SFPM
Response time	1 to 3 second time constant typical
Cable length	500 feet (150 m); (see section 3.4.3 for cable specifications)

7.6.2 Transmitter

Display	Two-line alphanumeric LCD, 16-characters per line
Keypad	Four push button
Menu Language	English, French, German, Spanish, Russian
Supply voltage	100–264 VAC, 50–60 Hz
	15-30 VDC (lower VDC possible - Consult Factory)
Power consumption	DC = 9 W maximum, AC = 20 VA maximum
Ambient temperature	-40 to +176 °F (-40 to +80 °C); display not readable below -22 °F (-30 °C)
Temperature effect	Approximately ±0.04% of reading per °C
Humidity	99% Non-condensing
Housing Material	Aluminum A356 (<0.2% copper); 316 stainless steel
Shock/Vibration	ANSI/ISA-S71.03 table 2, level SA1 (Shock), ANSI/ISA-S71.03 table 1, level VC2 (Vibration)

7.6.3 Probe

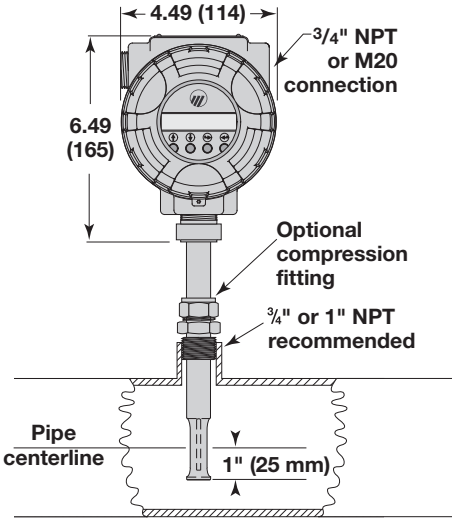
Materials	316/316L stainless steel all welded
	Hastelloy® C-276/C-22
Process connections	Refer to model number, hot tap optional
Pressure rating	1500 psig @ +70 °F (103 bar @ +20 °C), 1375 psig @ +400 °F (95 bar @ +200 °C)
Temperature rating	-50° to +400° F (-45° to +200° C)①

7.6.4 Flow Body

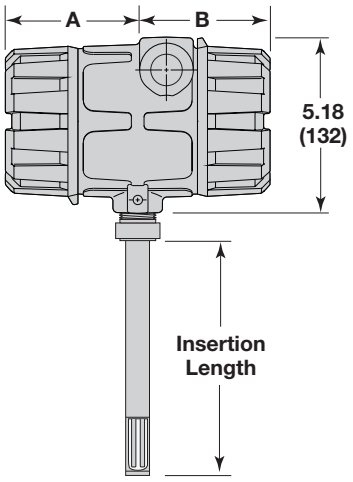
Materials	316/316L stainless steel all welded
	Carbon steel with stainless steel sensor
Process connections	NPT or 150 pound flange – Refer to model number
Pressure rating	1500 psig @ +70 °F (103 bar @ +20 °C), 1100 psig @ +400 °F (76 bar @ +200 °C)
Temperature rating	-50 to +400 °F (-45 to +200 °C)①

① For operating temperatures between +250 and +400 °F (+120 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.

7.6.5 Physical – inches (mm)



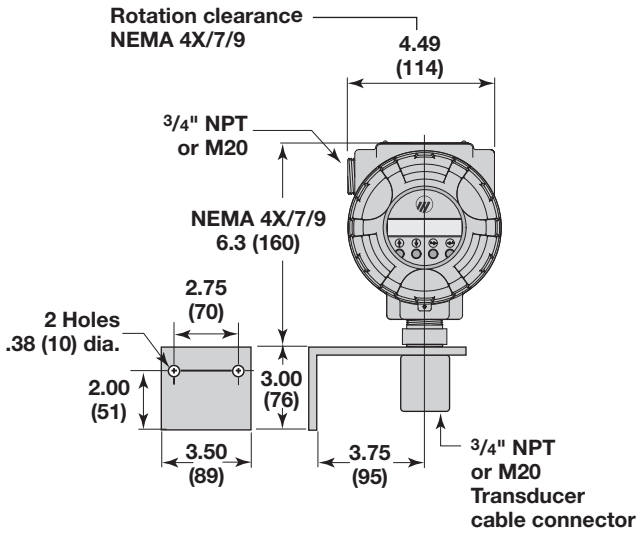
Front View



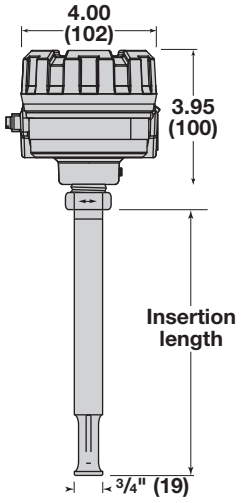
Dimension A:
3.33 (85) without display
3.88 (99) with display

Dimension B:
3.88 (99)

Side View

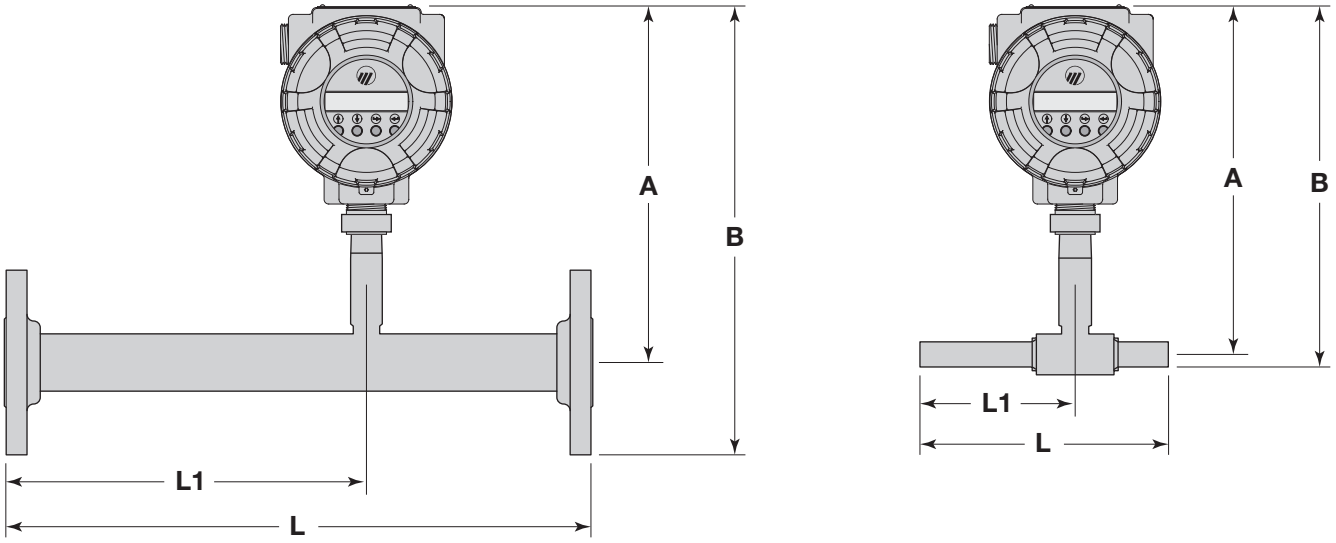


Main Electronics



Remote Probe with Housing

7.6.5 Physical – inches (mm)

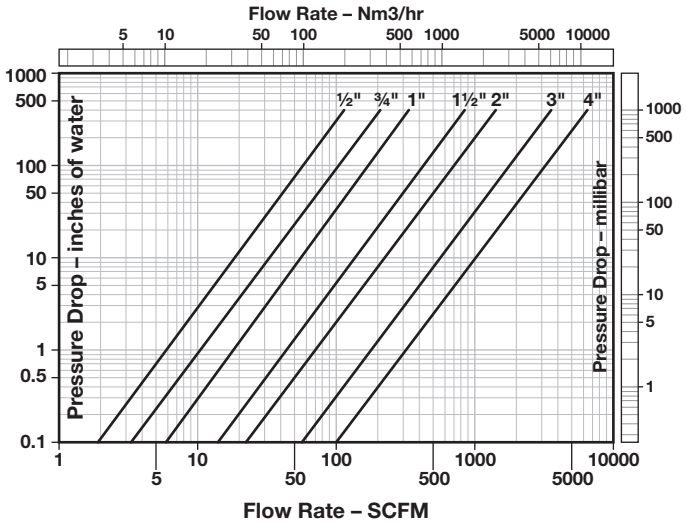


Code	Size	Length (L)		L1		Height to Centerline (A)	Overall Height (B)	
		With Flow Conditioning	Without Flow Conditioning	With Flow Conditioning	Without Flow Conditioning		NPT	Flange
0	½"	8 (203)	—	5 (127)	—	8.0 (203)	8.4 (213)	9.7 (246)
1	¾"	11.25 (285)	—	7.5 (190)	—	8.0 (203)	8.5 (216)	9.9 (251)
2	1"	15 (381)	—	10 (254)	—	8.0 (203)	8.6 (218)	10.1 (257)
3	1½"	19.5 (495)	7.5 (191)	12 (305)	3.75 (95)	8.3 (210)	9.2 (234)	10.8 (274)
4	2"	26 (660)	7.5 (191)	16 (406)	3.75 (95)	9.5 (241)	10.7 (272)	12.5 (318)
5	3"	39 (991)	10 (254)	24 (610)	5 (127)	9.5 (241)	N/A	13.3 (338)
6	4"	52 (1321)	12 (305)	36 (914)	6 (152)	9.5 (241)	N/A	14.0 (356)

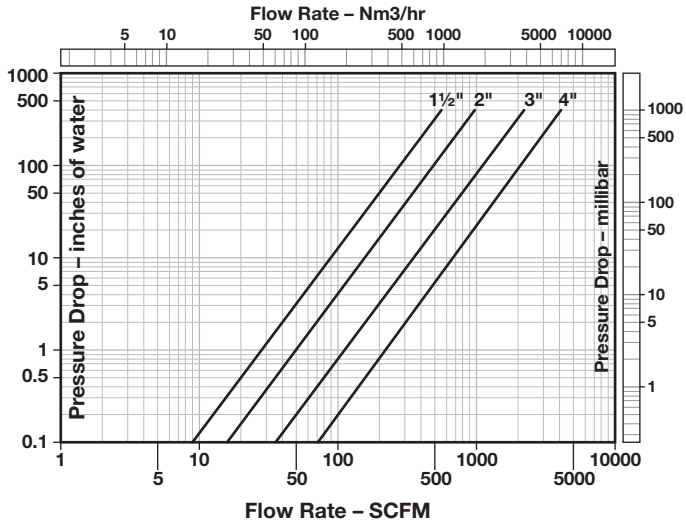
Flow conditioning on ½" to 1" is provided due to length of flow body and sensor design.

Optional flow conditioning plate and straight run is available on flow bodies 1½" and larger.

Pressure Drop



Pressure Drop with Flow Conditioning Plate



Pressure drop is based on air at +70 °F and 1 atmosphere (density = 0.075 lb/ft³). For other gases, pressure or temperatures, estimate pressure drop by multiplying value from chart by actual density (at operating conditions) divided by 0.075.

7.7 Model Numbers

7.7.1 Transmitter

SIGNAL OUTPUT

0	4-20 mA
1	4-20 mA with HART
2	FOUNDATION fieldbus
4	4-20 mA with HART, Pulse/Alarm, second mA Output

DISPLAY

0	None
B	Plug-in display with keypad (with window)

CALIBRATION–INSERTION PROBE

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

CALIBRATION–FLOW BODY

Actual Gas Calibration	
A	Special ①
B	Air
C	Nitrogen
D	Hydrogen
E	Natural Gas
G	Digester Gas
H	Propane
J	Oxygen
Air Equivalency / Correlation	
F	Gas Correlation ①
K	Air Equivalency

① Consult factory for approval

HOUSING LOCATION / AGENCY APPROVAL

3	Integral, general purpose, non-incendive, & explosion proof FM/FMc/ATEX Ex d/IEC
4	Remote, general purpose, non-incendive, & explosion proof FM/FMc/ATEX Ex d/IEC
E	Integral, general purpose, ATEX, Ex d+ ib (Zone 0)
F	Remote, general purpose, ATEX, Ex d+ ib (Zone 0)

ENCLOSURE TYPE

0	Aluminum, ¾" NPT
1	Aluminum, M20
2	Stainless Steel, ¾" NPT
3	Stainless Steel, M20

T	A	2	—	A			0	—			

7.7.2 Insertion Probe

THERMATEL PROBE

T E	Probe length in inches
T M	Probe length in centimeters

PROBE TYPE

R	¾" diameter probe

MATERIALS OF CONSTRUCTION

A	316/316L Stainless Steel
B	Hastelloy C

PROCESS CONNECTION SIZE

00	Compression Fitting Utilized (customer supplied)
03	¾" NPT SS compression fitting with Teflon Ferrules
04	¾" NPT SS compression fitting with Stainless Steel Ferrules
05	1" NPT SS compression fitting with Teflon Ferrules
06	1" NPT SS compression fitting with Stainless Steel Ferrules
11	Threaded ¾" NPT
21	Threaded 1" NPT
22	Threaded G1 (1" BSP)

ANSI FLANGES

23	1" 150# ANSI raised face flange
24	1" 300# ANSI raised face flange
33	1½" 150# ANSI raised face flange
34	1½" 300# ANSI raised face flange
43	2" 150# ANSI raised face flange
44	2" 300# ANSI raised face flange

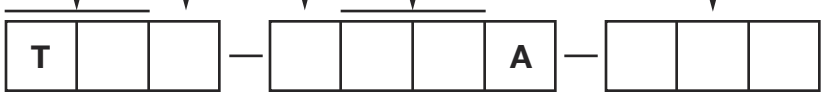
DIN FLANGES

BB	DN 25	PN 16/25/40	EN 1092-1, Type A
CB	DN 40	PN 16/25/40	EN 1092-1, Type A
DA	DN 50	PN 16	EN 1092-1, Type A
DB	DN 50	PN 25/40	EN 1092-1, Type A

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 proces 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



7.7.4 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

① Only when digit 5 = 0, 1, 2, 3, or 4

FLOW CONDITIONING PLATE (stainless steel)

A	Not provided
B	Provided (only when Digit 5 = 3, 4, 5, or 6)

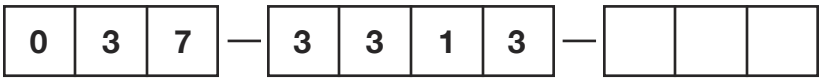
② Only when Digit 5 = 3, 4, 5, or 6. Flow conditioning on 1/2" to 1" is already provided due to length of flow body and sensor design. Optional flow conditioning is available on flow bodies larger than 1" which includes additional straight run and conditioning plate.

7.7.5 Connecting Cable

FOR CABLE LENGTHS UP TO 150 FEET

037-3313-XXX (Cable length in feet)—10 feet minimum, 150 feet maximum length

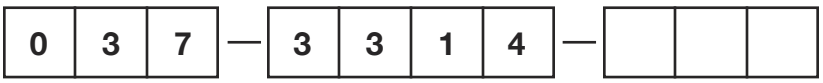
Example: 50 feet = 050



FOR CABLE LENGTHS UP TO 45 METERS

037-3314-XXX (Cable length in meters)—3 meters minimum, 45 meters maximum length

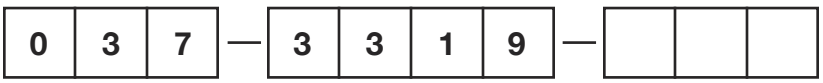
Example: 8 meters = 008



FOR CABLE LENGTHS BETWEEN 150 AND 500 FEET

037-3319-XXX (Cable length in feet)— 500 feet maximum length

Example: 300 feet = 300



FOR CABLE LENGTHS BETWEEN 45 AND 150 METERS

037-3320-XXX (Cable length in meters)—150 meters maximum length

Example: 80 meters = 080

7.8 References

1. FOUNDATION fieldbus™: A Pocket Guide, Ian Verhappen, Augusto Pereira
2. FOUNDATION fieldbus™—System Engineering Guidelines, AG–181

Appendix A – Transducer Block Parameters

ITEM	PARAMETER NAME	PARAMETER LABEL
0	BLOCK_STRUCTURE	BLOCK STRUCT
1	ST_REV	ST REV
2	TAG_DESC	TAG DESC
3	STRATEGY	STRATEGY
4	ALERT_KEY	ALERT KEY
5	MODE_BLK	MODE BLK
6	BLOCK_ERR	BLOCK ERR
7	UPDATE_EVT	UPDATE EVT
8	BLOCK_ALM	BLOCK ALM
9	TRANSDUCER_DIRECTORY	XD DIRECTORY
10	TRANSDUCER_TYPE	XD TYPE
11	XD_ERROR	XD ERROR
12	COLLECTION_DIRECTORY	COLLECT DIR
13	VOLUME_FLOW	Flow
14	VOLUME_FLOW_UNIT	Flow Unit
15	MASS_FLOW	Mass
16	MASS_FLOW_UNIT	Mass Unit
17	PROCESS_TEMP	Process Temp
18	TEMPERATURE_UNIT	Temperature Unit
19	DENSITY_UNIT	Density Unit
20	INSIDE_DIAMETER	Inside Diameter
21	DIAMETER_UNIT	Diameter Unit
22	FLOW_AREA	Flow Area
23	AREA_UNIT	Area Unit
24	USER_UNIT	User Unit
25	DAMPING	Damping
26	R_TOTALIZER_MODE	R Totalizer Mode
27	R_TOTALIZER_MULTIPLIER	R Totalizer Multiplier
28	R_TOTALIZER_FLOW	R Totalizer Flow
29	R_TOTALIZER_UNIT	R Totalizer Unit
30	R_TOTALIZER_TIME	R Totalizer Time
31	RESET_TOTALIZER	Reset R Totalizer
32	NR_TOTALIZER_MULTIPLIER	NR Totalizer Multiplier
33	NR_TOTALIZER_FLOW	NR Totalizer Flow
34	NR_TOTALIZER_UNIT	NR Totalizer Unit
35	NR_TOTALIZER_TIME	NR Totalizer Time
36	INSTALL_FACTOR_A	Install Factor A
37	INSTALL_FACTOR_B	Install Factor B
38	INSTALL_FACTOR_C	Install Factor C
39	STP_TEMPERATURE	STP Temperature
40	STP_PRESSURE	STP Pressure
41	GAS_CAL_TABLE	Gas Cal Table
42	UPPER_FLOW_LIMIT	Upper Flow Limit
43	UPPER_CAL_POINT	Upper Cal Point
44	TA2_SENSOR_TYPE	Sensor Type
45	TZERO_FACTOR	TZero
46	FZERO_FACTOR	FZero
47	COEFFICIENT_RATIO	Coefficient Ratio
48	SLOPE	Slope
49	POWER_PREDICTOR	Power Predictor
50	FACTORY_PARAMETER_1	Factory Parameter 1
51	FACTORY_PARAMETER_2	Factory Parameter 2
52	FACTORY_PARAMETER_3	Factory Parameter 3
53	FACTORY_PARAMETER_4	Factory Parameter 4
54	FACTORY_PARAMETER_5	Factory Parameter 5
55	GAS_A_TEMP_CORR_A	Gas A TCC-A
56	GAS_A_TEMP_CORR_B	Gas A TCC-B
57	GAS_A_TEMP_CORR_C	Gas A TCC-C
58	GAS_A_DENSITY	Gas A Density
59	GAS_A_AIR_EQUIV_MODE	Gas A Air Equiv Mode
60	GAS_A_COEFF_A	Gas A Coeff Ag
61	GAS_A_COEFF_B	Gas A Coeff Bg
62	GAS_A_COEFF_C	Gas A Coeff Cg
63	GAS_A_COEFF_D	Gas A Coeff Dg
64	GAS_A_COEFF_E	Gas A Coeff Eg
65	GAS_A_SET_POINT	Gas A Set Point
66	GAS_A_ZERO_FLOW_SIGNAL	Gas A Zero Flow Signal
67	GAS_A_LOW_FLOW_CUTOFF	Gas A Low Flow Cutoff
68	GAS_A_CALIB_PIPE_AREA	Gas A Calib Pipe Area
69	GAS_B_TEMP_CORR_A	Gas B TCC-A
70	GAS_B_TEMP_CORR_B	Gas B TCC-B
71	GAS_B_TEMP_CORR_C	Gas B TCC-C
72	GAS_B_DENSITY	Gas B Density
73	GAS_B_AIR_EQUIV_MODE	Gas B Air Equiv Mode
74	GAS_B_COEFF_A	Gas B Coeff Ag
75	GAS_B_COEFF_B	Gas B Coeff Bg
76	GAS_B_COEFF_C	Gas B Coeff Cg
77	GAS_B_COEFF_D	Gas B Coeff Dg
78	GAS_B_COEFF_E	Gas B Coeff Eg
79	GAS_B_SET_POINT	Gas B Set Point
80	GAS_B_ZERO_FLOW_SIGNAL	Gas B Zero Flow Signal
81	GAS_B_LOW_FLOW_CUTOFF	Gas B Low Flow Cutoff
82	GAS_B_CALIB_PIPE_AREA	Gas B Calib Pipe Area
83	CAL_TABLE_A_LENGTH	Cal Table A Length
84	TABLE_A_POINT_01	Table A Pt 01
85	TABLE_A_POINT_02	Table A Pt 02
86	TABLE_A_POINT_03	Table A Pt 03
87	TABLE_A_POINT_04	Table A Pt 04
88	TABLE_A_POINT_05	Table A Pt 05
89	TABLE_A_POINT_06	Table A Pt 06
90	TABLE_A_POINT_07	Table A Pt 07
91	TABLE_A_POINT_08	Table A Pt 08
92	TABLE_A_POINT_09	Table A Pt 09
93	TABLE_A_POINT_10	Table A Pt 10
94	TABLE_A_POINT_11	Table A Pt 11
95	TABLE_A_POINT_12	Table A Pt 12
96	TABLE_A_POINT_13	Table A Pt 13
97	TABLE_A_POINT_14	Table A Pt 14
98	TABLE_A_POINT_15	Table A Pt 15
99	TABLE_A_POINT_16	Table A Pt 16
100	TABLE_A_POINT_17	Table A Pt 17

ITEM	PARAMETER NAME	PARAMETER LABEL
101	TABLE_A_POINT_18	Table A Pt 18
102	TABLE_A_POINT_19	Table A Pt 19
103	TABLE_A_POINT_20	Table A Pt 20
104	TABLE_A_POINT_21	Table A Pt 21
105	TABLE_A_POINT_22	Table A Pt 22
106	TABLE_A_POINT_23	Table A Pt 23
107	TABLE_A_POINT_24	Table A Pt 24
108	TABLE_A_POINT_25	Table A Pt 25
109	TABLE_A_POINT_26	Table A Pt 26
110	TABLE_A_POINT_27	Table A Pt 27
111	TABLE_A_POINT_28	Table A Pt 28
112	TABLE_A_POINT_29	Table A Pt 29
113	TABLE_A_POINT_30	Table A Pt 30
114	CAL_TABLE_B_LENGTH	Cal Table B Length
115	TABLE_B_POINT_01	Table B Pt 01
116	TABLE_B_POINT_02	Table B Pt 02
117	TABLE_B_POINT_03	Table B Pt 03
118	TABLE_B_POINT_04	Table B Pt 04
119	TABLE_B_POINT_05	Table B Pt 05
120	TABLE_B_POINT_06	Table B Pt 06
121	TABLE_B_POINT_07	Table B Pt 07
122	TABLE_B_POINT_08	Table B Pt 08
123	TABLE_B_POINT_09	Table B Pt 09
124	TABLE_B_POINT_10	Table B Pt 10
125	TABLE_B_POINT_11	Table B Pt 11
126	TABLE_B_POINT_12	Table B Pt 12
127	TABLE_B_POINT_13	Table B Pt 13
128	TABLE_B_POINT_14	Table B Pt 14
129	TABLE_B_POINT_15	Table B Pt 15
130	TABLE_B_POINT_16	Table B Pt 16
131	TABLE_B_POINT_17	Table B Pt 17
132	TABLE_B_POINT_18	Table B Pt 18
133	TABLE_B_POINT_19	Table B Pt 19
134	TABLE_B_POINT_20	Table B Pt 20
135	TABLE_B_POINT_21	Table B Pt 21
136	TABLE_B_POINT_22	Table B Pt 22
137	TABLE_B_POINT_23	Table B Pt 23
138	TABLE_B_POINT_24	Table B Pt 24
139	TABLE_B_POINT_25	Table B Pt 25
140	TABLE_B_POINT_26	Table B Pt 26
141	TABLE_B_POINT_27	Table B Pt 27
142	TABLE_B_POINT_28	Table B Pt 28
143	TABLE_B_POINT_29	Table B Pt 29
144	TABLE_B_POINT_30	Table B Pt 30
145	ENTER_PASSWORD	Enter Password
146	USER_PASSWORD	New User Password

ITEM	PARAMETER NAME	PARAMETER LABEL
147	DEVICE_STATUS	Device Status
148	RUN_TIME	Run Time
149	SIGNAL	Signal
150	FIXED_SIGNAL_MODE	Fixed Signal Mode
151	FIXED_SIGNAL_VALUE	Fixed Signal Value
152	DELTA_TEMP	Delta Temp
153	HEATER_SETTING	Heater Setting
154	MAX_PROCESS_TEMP	Max Process Temp
155	RESET_MAX_PROCESS_TEMP	Reset Max Process Temp
156	ELECTRONICS_TEMPERATURE	Electronics Temp
157	MAX_ELECTRONICS_TEMP	Max Elec Temp
158	MIN_ELECTRONICS_TEMP	Min Elec Temp
159	RESET_ELECTRONICS_TEMPS	Reset Electronics Temps
160	NSP_VALUE	NSP Value
161	LOCAL_DISPLAY_SELECT	Local Display Select
162	LOCAL_TAG	Local Tag
163	DATE_CODE	Date Code
164	MAGNETROL_SERIAL_NUMBER	MAGNETROL S/N
165	FIRMWARE_VERSION	Firmware Version
166	CALIB_LOCATION	Calibration Location
167	CALIB_DATE	Calibration Date
168	CALIB_WHO	Calibration Who
169	PROBE_TEMP_DATA	Probe Temp Data
170	RTD_CAL_RESULT	RTD Cal Result
171	HEATER_CAL_RESULT	Heater Cal Result
172	PROC_DATA_STATE	Proc Data State
173	CAL_TEMP	Cal Temp
174	CURRENT_SETTING	Current Setting
175	PWM_SETTING	PWM Setting
176	LOW_CAL_VALIDATE	Low Cal Delta T
177	HI_CAL_VALIDATE	High Cal Delta T
178	HISTORY_CONTROL	History Control
179	HISTORY_CAPTURE_TIME	History Capture Time
180	NUM_OF_HIST_EVENTS	Number of Events
181	HIST_ENTRY_1	History Entry 1
182	HIST_ENTRY_2	History Entry 2
183	HIST_ENTRY_3	History Entry 3
184	HIST_ENTRY_4	History Entry 4
185	HIST_ENTRY_5	History Entry 5
186	HIST_ENTRY_6	History Entry 6
187	HIST_ENTRY_7	History Entry 7
188	HIST_ENTRY_8	History Entry 8
189	HIST_ENTRY_9	History Entry 9
190	HIST_ENTRY_10	History Entry 10
191	RESET_HISTORY	Reset History

Appendix B

The flow measurement of the TA2 assumes that the end of the probe is one inch past the centerline and the presence of a fully developed flow profile. See Figure A.

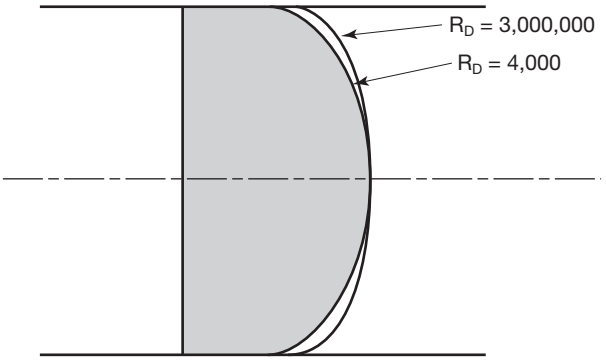


Figure A

Turbulent Flow Profile

As gas flows in a pipe or duct, the flow profile will change with obstructions and changes in flow direction. As the gas flows around an elbow, the momentum causes the gas velocity on the outside of the elbow to increase and the velocity on the inside to decrease. See figure B.

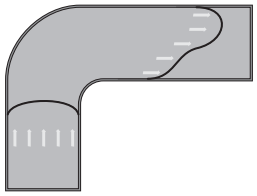
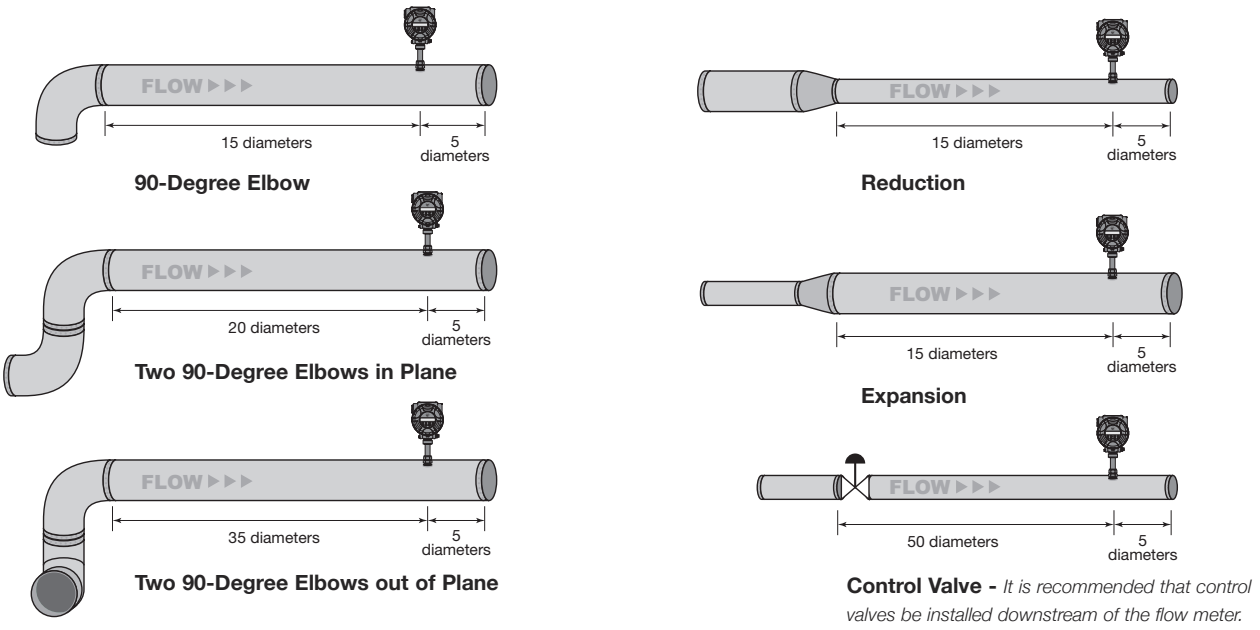


Figure B

Flow Profile Following Single Elbow

Figure C, below, indicates the minimum recommended straight-run distances required to obtain the desired fully developed flow profile. If these straight-run distances are not available, the overall accuracy of the flow measurement will be affected; however, the repeatability of the measurement will be maintained.

The user has the ability to enter correction factors to compensate for non-ideal flow profile conditions.



Control Valve - *It is recommended that control valves be installed downstream of the flow meter.*

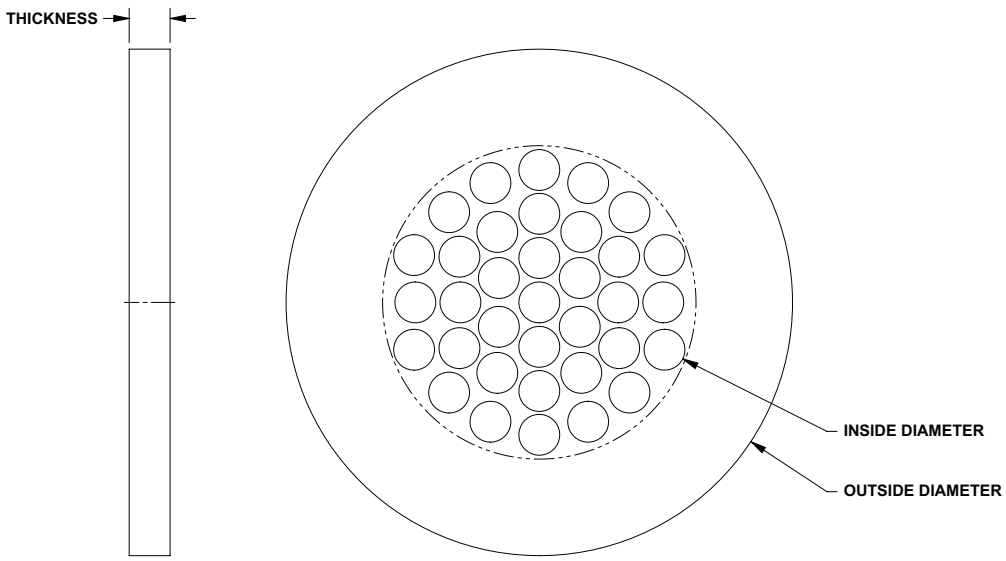
Figure C – Probe Installations

Conditioning Plates

Flow conditioning plates may be provided in applications where limited straight run is available. Plates are available in flow body type sensor designs (TFT) from 1.5" to 4" pipes. Plates may be purchased separately for pipe sizes 4" to 12" when using insertion probes (TXR).

The plate should be installed 2-5 diameters downstream of the nearest obstruction, change in pipe inside diameter or change in flow direction. For TXR designs, the insertion probe can be installed 8 pipe diameters downstream of the plate with 5 diameters required downstream of the TXR. For TFT designs with the plate at the entrance, the downstream is provided in the length of the TFT.

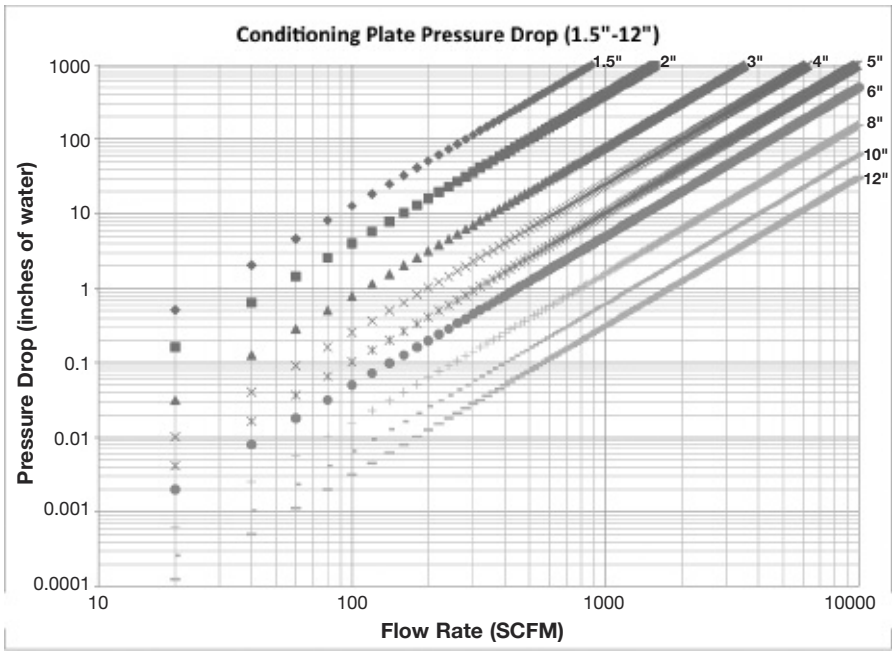
Plates are to be fitted with gaskets (customer supplied) in between flanges. If plates are not included and recommended straight run is not adhered to, the TA2 will provide repeatable measurement and the installation factors can be utilized.

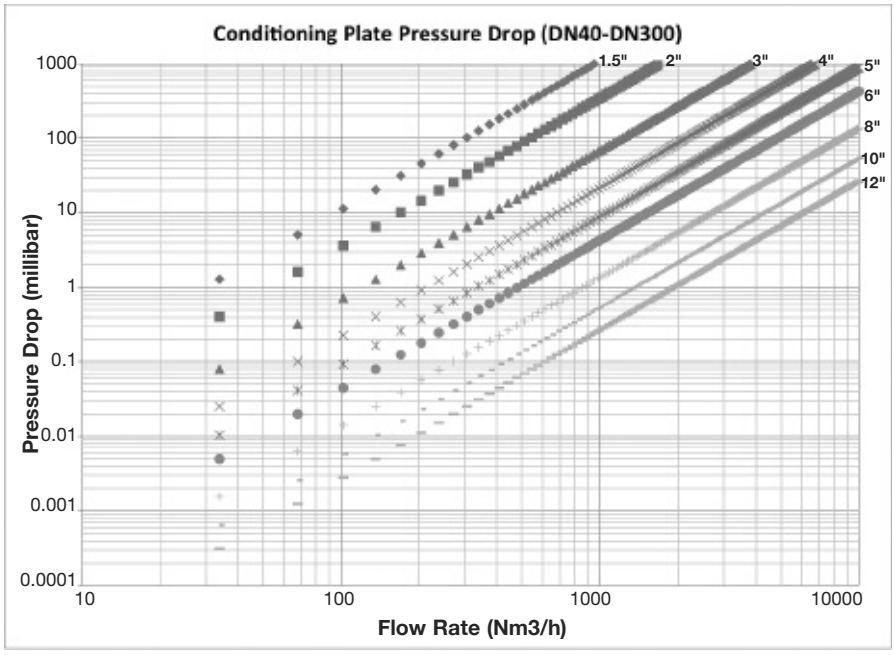


Part Number	Description	OD in (mm)	ID in (mm)	Thickness in (mm)
004-8986-001	4" 316 Stainless Steel	6.19 (157.2)	3.83 (97.3)	0.50 (12.7)
004-8986-002	4" Carbon Steel	6.19 (157.2)	3.83 (97.3)	0.50 (12.7)
004-8986-003	4" PVC	6.19 (157.2)	3.83 (97.3)	0.50 (12.7)
004-8986-004	5" 316 Stainless Steel	7.31 (185.7)	4.81 (122.2)	0.63 (16)
004-8986-005	5" Carbon Steel	7.31 (185.7)	4.81 (122.2)	0.63 (16)
004-8986-006	5" PVC	7.31 (185.7)	4.81 (122.2)	0.63 (16)
004-8986-007	6" 316 Stainless Steel	8.50 (215.9)	5.76 (146.3)	0.75 (19.1)
004-8986-008	6" Carbon Steel	8.50 (215.9)	5.76 (146.3)	0.75 (19.1)
004-8986-009	6" PVC	8.50 (215.9)	5.76 (146.3)	0.75 (19.1)
004-8986-010	8" 316 Stainless Steel	10.62 (269.7)	7.63 (193.7)	1.00 (25.4)
004-8986-011	8" Carbon Steel	10.62 (269.7)	7.63 (193.7)	1.00 (25.4)
004-8986-012	8" PVC	10.62 (269.7)	7.63 (193.7)	1.00 (25.4)
004-8986-013	10" 316 Stainless Steel	12.75 (323.9)	9.56 (242.9)	1.25 (31.8)
004-8986-014	10" Carbon Steel	12.75 (323.9)	9.56 (242.9)	1.25 (31.8)
004-8986-015	10" PVC	12.75 (323.9)	9.56 (242.9)	1.25 (31.8)
004-8986-016	12" 316 Stainless Steel	15.00 (381)	11.37 (288.9)	1.50 (38.1)
004-8986-017	12" Carbon Steel	15.00 (381)	11.37 (288.9)	1.50 (38.1)
004-8986-018	12" PVC	15.00 (381)	11.37 (288.9)	1.50 (38.1)

Appendix B (continued)

Pressure Drop Charts





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.

$$Tc = (T_f - 32) \div 1.8$$

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

$$Tf = 1.8 \times Tc + 32$$

Kelvin: Unit of temperature measurement referenced to absolute conditions.

$$Kelvin = Degrees\ Celsius + 273.15$$

NIST: National Institute of Science and Technology

Nm3/h (Normal cubic meters per hour): Flow measurement at normal (standard) conditions (STP).

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

1 atmosphere pressure = 14.696 psia

PSIA = PSIG + 14.696

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

Rankine: Unit of temperature measurement referenced to absolute conditions.

Degrees Rankine = Degrees Fahrenheit + 459.67

SCFH (standard cubic feet per hour): Flow measurement at standard (STP) conditions.

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.

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

Install Factors: The TA2 assumes a fully developed flow profile at the sensor location. Differences in flow profile or other installation issues can affect the measurement of the TA2. Advanced users have the ability to adjust the TA2 measurement using a polynomial relationship in the form of:

$$Corrected\ flow = A + Bx + Cx^2$$

The default is B = 1 and A and C factors = 0. The units for "x" are the units of measurement selected in the Transducer Block under "USER_UNIT." The most common adjustment is the linear "B" factor.

Once determined, the Install Factors can be entered into the TA2 under the Advanced Configuration menu. See section 3.5.9.

Mass flow: Measured in various units, typically LB/Hr or Kg/h. An input of the flow area of the pipe or duct and density 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 TA2 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.

Flow: Measured in various units, typically SCFM (standard cubic feet per minute), SCFH (standard cubic feet per hour), MMSCFD (million standard Cubic Feet per Day), or Nm^3/h (normal cubic meters per hour), referenced to standard conditions. An input of the flow area of the pipe or duct is required to obtain this value.

Tag line: Tag lines are programmable for both Display (16-character Local Tag)

Initially the local tag line on the display reads "MAGNETROL TA2". This can be changed from the advanced configuration section of the software. See Device Information Section 3.5.10.

MAGNETROL®

Flow Application Questionnaire

Thermatel Model TA2

(Please fill out in detail.)

BULLETIN: 54-350.7

REFERENCE INFORMATION

Customer/Company: _____ Date: _____

Contact/Title: _____ Phone: _____ Fax: _____

Submitted by: _____

FOR OFFICE USE:

INSTRUMENT

Model Number: Electronics _____ Probe/Flow Body: _____

Remote Cable: _____ Compression Fitting/RPA: _____ Quantity: _____

PROCESS DATA

Application: _____

Gas composition (vol%): _____

Condensed Moisture in Gas? ☐ No ☐ Yes Dust Buildup? ☐ None ☐ Light ☐ Heavy Type of Dust: _____

	Maximum	Normal	Minimum	Units
Flow Rate				
Temperature				
Pressure				

STP Conditions

Specify Standard Temperature and Pressure conditions (If not specified Magnetrol uses 70° F and 1 Atmosphere)

Temperature: _____ Pressure: ☐ 1 Atmosphere ☐ 1 Bar

PIPE DIMENSIONS

Pipe Diameter: _____ inch Schedule _____

or Pipe ID: _____ units _____

or Metric Pipe: _____ mm OD _____ mm wall thickness

DUCT INTERNAL DIMENSIONS

Diameter _____ units _____

Rectangular dimensions _____ units _____

FACTORY CONFIGURATION (Check one)

☐ SCFM* ☐ Nm³/min ☐ lbs/min*

☐ SCFH* ☐ Nm³/h* ☐ lbs/h*

☐ SCFD ☐ Nm³/d ☐ lbs/d

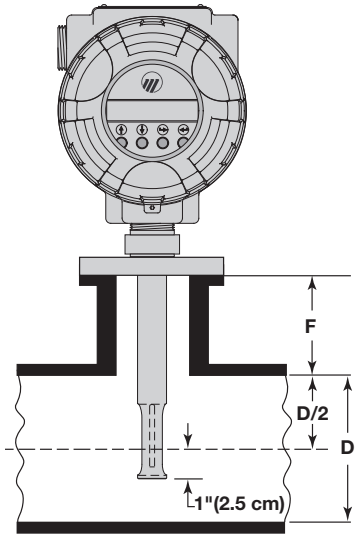
☐ MSCFD ☐ Nl/min ☐ kg/min*

☐ MMSCFD* ☐ Nl/h* ☐ kg/h*

☐ Nl/d ☐ kg/d

	4 mA value (0%)	20 mA value (100%)
Flow		
Temperature (TA2-A4)		

* Indicates which units are available for FOUNDATION™ fieldbus option



Probe length = $F + \frac{D}{2} + 1"\ (2.5\ cm)$

PROBE LENGTH CALCULATIONS

The probe can be ordered in 0.1 inch or 1 cm increments. This is most important when used with a flange or threaded connection to ensure that the sensor is located on the centerline of the pipe. The active portion of the sensor is located 1" (2.5 cm) from the end of the probe. Refer to illustration at right.

REMARKS

Service Policy

Owners of MAGNETROL may request the return of a 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 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.

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 a MAGNETROL 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.

MAGNETROL®

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BULLETIN: 54-650.0
EFFECTIVE: January 2015