



# SMARTLINK® METER Quick Start Guide

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## SMARTLINK Meter – Quick Start Guide

### 1. Purpose

This document provides directions for making flow measurements and is intended to get you up and running as quickly as possible. It does not provide a detailed description of product specifications, available models and sizes, installation, piping, operating, and maintenance procedures.

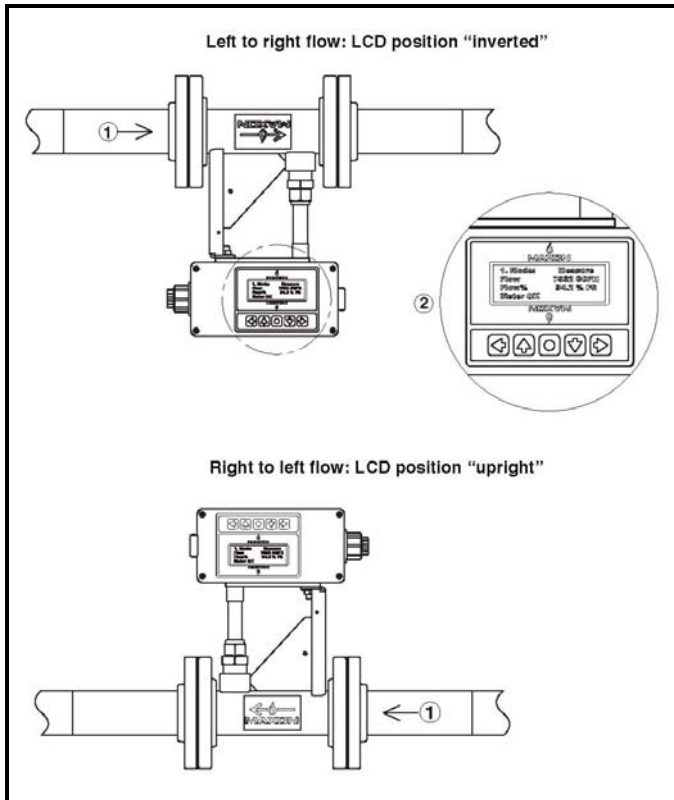
### 2. Product verification

On the flow sensor assembly and flow body product labels, locate the two fields, "Gcal" and "Fcal" that indicate the two important meter calibration parameters: fluid (or gas) type and the maximum flow range, respectively. Verify the process gas (or fluid) and the calibrated flow range shown on both labels are the same. This ensures the flow sensor assembly is inserted in the proper flow body.

### 3. Mechanical installation

3.1.1. Piping: For most applications, 5 diameters upstream (or 12 inches, whichever is greater) and 3 diameters downstream (or 12 inches, whichever is greater) are the minimum required straight, unobstructed pipe requirements. More straight diameters are recommended. Gas meter installations should include an upstream drip leg, Y-strainer (with 100 mesh stainless steel screen), and a high-turndown regulator (such as a Sensus 243-RPC, 441-57S with "V-wing" option). Proper sizing of the regulator, using upstream/downstream pressures and min/max flow requirements, is essential for preventing low flow regulator "chatter" which can affect meter performance. Follow all regulator installation requirements for location of the downstream sense line. Air meter installations with a process or combustion fan should include an inlet filter to minimize the collection of debris on the removable flow conditioning screens. If air flow control is performed using a valve, a surge-less fan should be specified to eliminate flow pulsations.

3.1.2. Flow body and LCD orientation: The flow body must always be mounted with the flow conditioning screens and sensor bracket upstream of the stainless probe assembly. The flow body can be mounted in any vertical or horizontal orientation. However, to access, view, and navigate the user display, the flow body and LCD can be inverted as shown in the figures below. If the LCD orientation needs to be changed after shipment, turn power off to the unit and open the flow sensor enclosure. With a small Phillips screwdriver, remove the four screws that retain the LCD electronics module to the standoffs. Unplug the module by lifting it straight out from the main electronics board. Rotate the module 180° and plug it back into the main board, making certain all pins are properly seated in the connector. Reinstall and tighten the four screws.

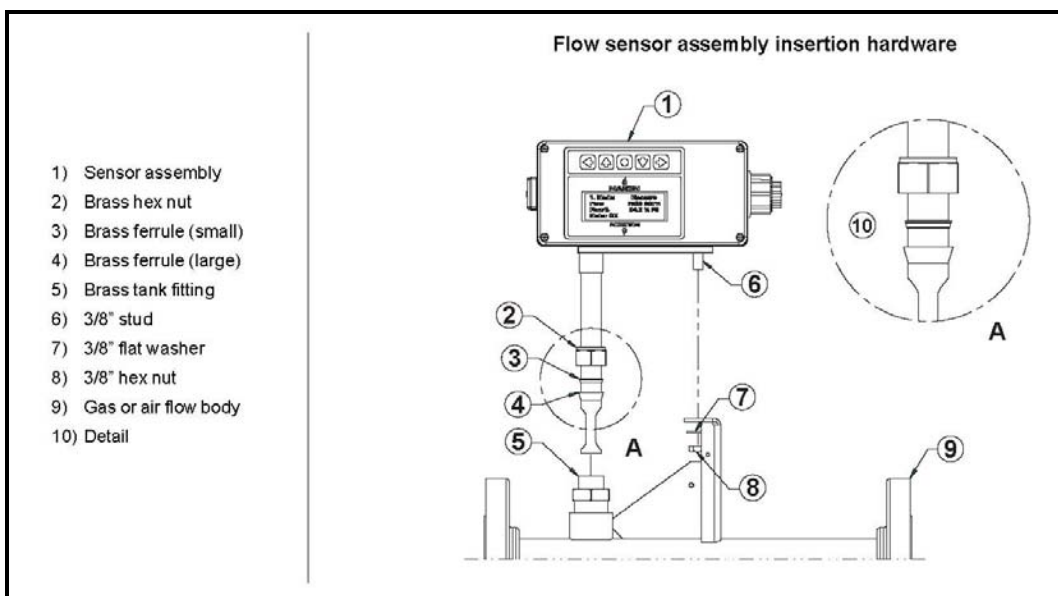


3.1.3. Flow sensor insertion: If the flow sensor assembly is provided separately or removed during flow body installation, the following procedure should be followed when re-inserting the sensor into the flow body:

Verify the Swagelok compression brass nut, small ferrule, and large ferrule are positioned in the correct order as shown in the drawing below. Remove the 3/8"-24 hex nut and flat washer from the threaded stud. (If installed, remove the compression plug fitting from the flow body and the plastic protective cap from the sensor probe.)

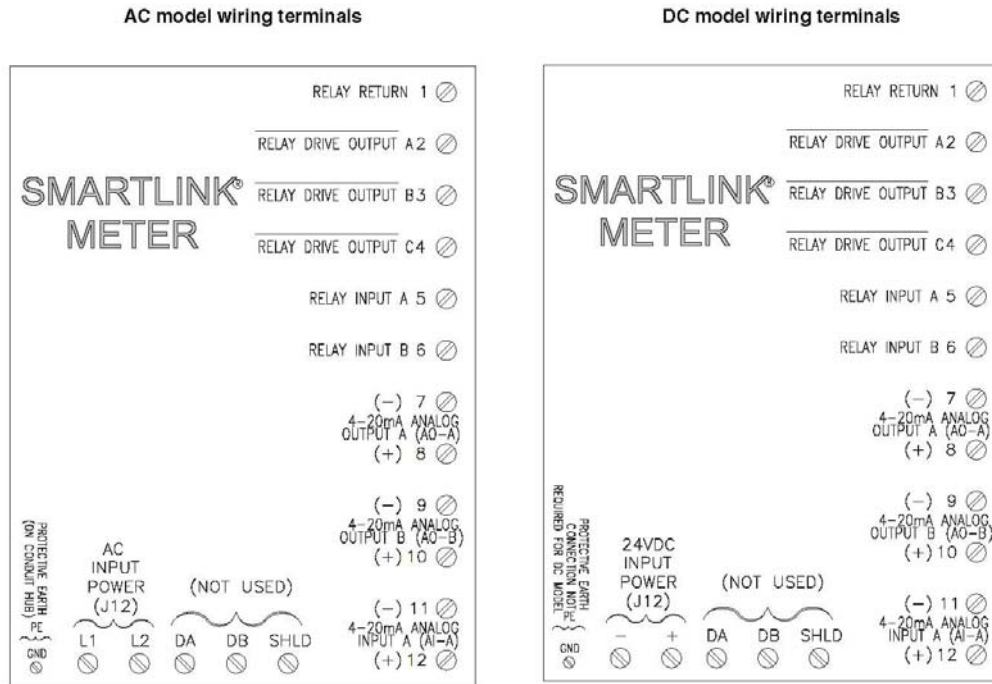
Verify the threaded stud engages the hole in the flow body mounting bracket and that the bottom of the bar with the threaded stud is seated flush with the top of the bracket.

Verify the tank fitting ferrules are properly seated, thread the tank fitting nut onto the body and hand tighten. Tighten the fitting nut with a 1-1/8" wrench by turning the nut 2 turns. Bolt the threaded stud in place using a 3/8"-24 hex jam nut and flat washer.



#### 4. Electrical installation

4.1.1. Wiring terminals: The two diagrams below (for the AC and DC model) show all wiring terminals. Read the following electrical sections before connecting the meter to any external wiring.



4.1.2. Input power and grounding: The two-position power input connector on the main electronics board is labeled to indicate the power input option. For the AC model, connect two wires, hot and neutral, from the mains supply to the power connector, labeled "L1 L2", respectively. The wires connected to the meter L1 and L2 terminals should correspond to the same connections of the AC source. (Product configuration is NOT required to select between 115VAC and 230VAC operation.) Connect an earth ground wire to the conduit hub terminal that is labeled with the protective earth symbol. For the 24VDC model, connect two wires from a 24VDC supply (with  $\pm 5\%$  voltage regulation) to the power connector, labeled "+24V -". The polarity of each wire from the DC power source must match the meter's connection polarity. No protective earth ground wire is required for the DC model.

4.1.3. Loop power: The power source associated with any 4-20 mA (or current loop) is referred to as "loop power". A loop power selection switch is provided in the field wiring compartment below the power input connector. For all field applications, it is recommended that external, 24VDC (max) loop power is provided for the two 4-20mA output circuits. Therefore, the loop power switch should remain in the (factory default) "EXT. 24V MAX." position. (Only for local meter diagnostics when no output wiring is connected or for meter demonstration with a volt meter or calibrator connected should the internal 24VDC loop power be selected.)

4.1.4. Flow Output (Analog Output A): The 4-20mA current loop that represents the measured flow is connected to Terminals #7 (-) and #8 (+). Before connecting these terminals to any external wiring, verify that the loop power switch described above is in the correct position, EXT. 24V MAX. The following wiring convention is recommended:

| Terminal    | Device          | Name & Destination   |
|-------------|-----------------|--|
| #7: AO-A(-) | Flow Meter      | Analog Output A (-): Connect to (+) terminal of external 24VDC loop power supply   |
| #8: AO-A(+) | Flow Meter      | Analog Output A (+): Connect to (+) terminal of external 4-20mA measurement device |
| (-) 24VDC   | External Supply | Negative (-) 24VDC: Connect to (-) terminal of external 4-20mA measurement device  |

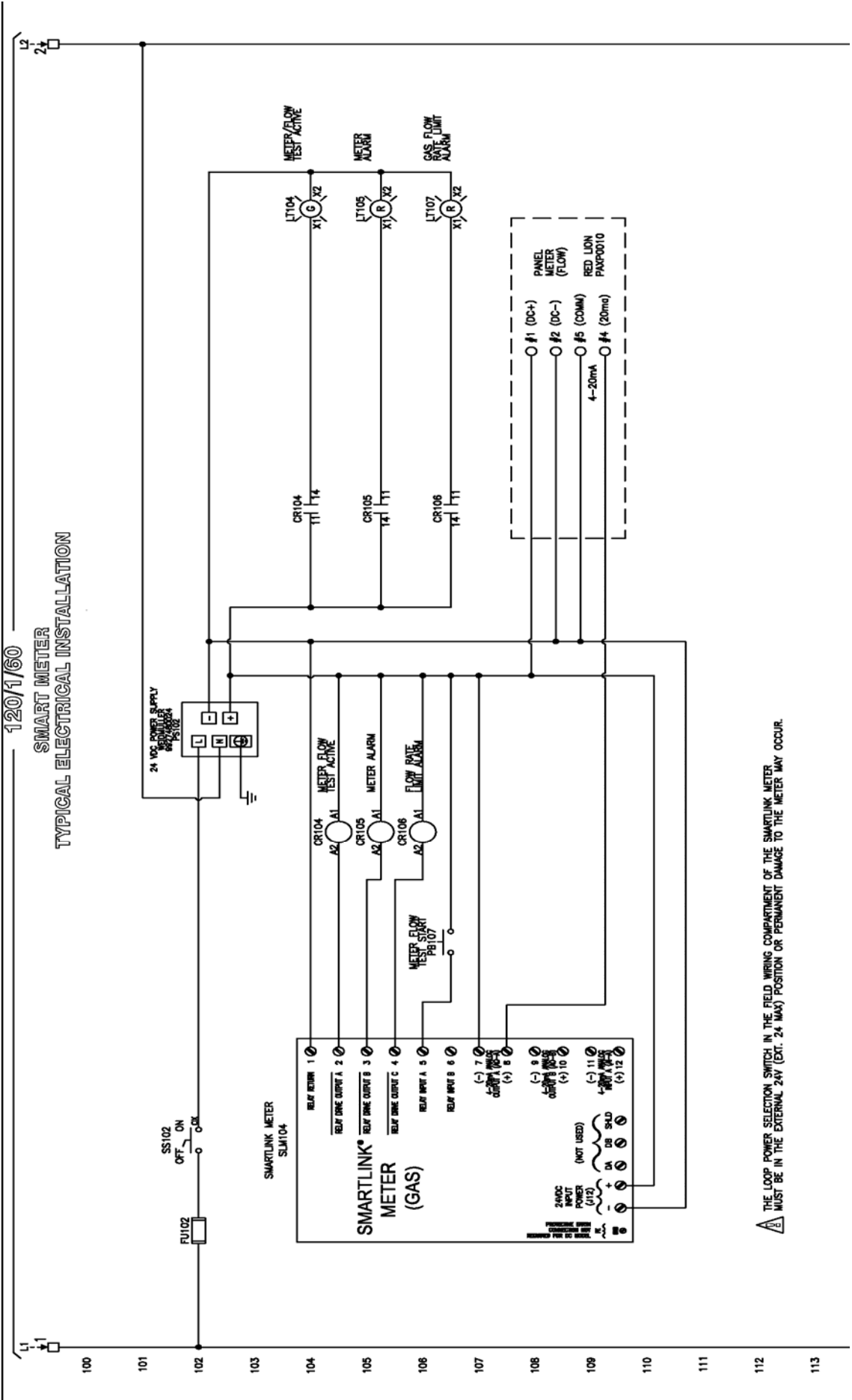
Belden P/N 82760, a shielded, twisted pair, instrumentation cable is recommended for these connections. The shield wire should be connected on the external equipment end.

4.1.5. Ratio Output (Analog Output B): The 4-20mA current loop that represents ratio is connected to Terminals #9 (-) and #10 (+). Follow the same wiring conventions as for the flow output described above. This output will be active only if a 2<sup>nd</sup> meter's flow output is connected to Analog Input A, Terminals #11 (-) and #12 (+). This output can also be configured to represent fluid temperature.

- 4.1.6. Flow Input (Analog Input A): If "standalone" (i.e. no PLC or DCS) ratio monitoring is required by the application, a 2<sup>nd</sup> external, 4-20mA flow output will require connection to the input 4-20mA current loop for "local" meter measurement of the second flow. Analog Input A and Analog Output A of the 2<sup>nd</sup> external meter should be connected as follows:

| Terminal      | Meter    | Name & Destination  |
|---------------|----------|---|
| #11: AI-A (-) | Local    | Analog Input A (-): Connect to Terminal #7, Analog Output (-) of 2 <sup>nd</sup> external meter |
| #12: AI-A (+) | Local    | Analog Input A (+): Connect to (+) terminal of 24VDC external loop power                        |
| #8: AO-A (+)  | External | Analog Output A (+): Connect to (-) terminal of 24 VDC external loop power                      |

- 4.1.7. Relay (drive) Outputs: Three, solid-state, open collector outputs are provided for flow meter monitoring – 1.) Meter/Flow Test Active (Terminal #2), Meter Alarm (Terminal #3), and Flow/Ratio Limit (Terminal #4). Each output used by the application should be connected to an external 24VDC relay coil with transient suppression and a maximum ON current of 100mA. The Relay (drive) Return, Terminal #1, must also be connected to the common or negative (-) terminal of the external 24VDC used to power the relay coils described previously.
- 4.1.8. Relay Input A: This digital input is used to initiate a Meter/Flow Test remotely. If required by the application, connect Terminal #5 to the switched side of an electromechanical relay contact with DC voltage ONLY, when closed. The Relay (drive) Return, Terminal #1, must also be connected to the common or negative (-) of the 24VDC supply that is "switched" in by the relay. If a relay output and input are both required, the same DC supply must be used due to the meter's single Relay Return terminal for both functions. The Meter/Flow Test is initiated by a 24VDC pulse, ½ second or longer.
- 4.1.9. Typical electrical installation: The following schematic shows a SMARTLINK Meter (24VDC model) wired to a 24VDC supply for meter and current loop power, panel meter for remote display of flow, 3 24VDC relays for status annunciation, and 1 momentary pushbutton to initiate a Meter/Flow Test.



⚠ THE LOOP POWER SELECTION SWITCH IN THE FIELD WIRING COMPARTMENT OF THE SMARTLINK METER MUST BE IN THE EXTERNAL 24V (EXT. 24 MAX) POSITION OR PERMANENT DAMAGE TO THE METER MAY OCCUR.



## 5. Operational Overview

5.1.1. General: After the electrical wiring has been completed as described previously, verify the Loop Power selector switch is in the rightmost “EXT. 24V MAX.” factory default position. (The switch is located on the left side of the field wiring compartment below the power connector.) Apply power to the unit. After a 30-second startup period, check for LCD illumination, a ‘0’ flow reading, and a “Meter OK” message on Menu #1.

5.1.2. Meter 100% full-scale flow output: All meters are shipped with the 20mA Flow Output set to represent 100% Full Scale which is equal to the Calibrated Max Flow Rate (on sensor label) + 5%. The 5% "buffer" permits most closed-loop control applications to properly operate at the maximum calibrated flow rate used for product selection. Although the 4-20mA flow output can be "scaled" to represent lower 20mA flow rates, the 100% Full Scale flow rate of the meter cannot be exceeded or changed and the maximum application flow must be less than (or equal to) the calibrated maximum flow rate on the product label.

5.1.3. Modes of operation: Startup, measurement, flow/meter test, and input/output test are the 4 distinct meter operating modes.

Startup mode is entered after the meter is powered ON. During this period, the electronics are initialized and power is applied to the RTD probe assembly. This mode is displayed as "Startup" on Menu #1 and is active for about 10 seconds after power is applied.

Measurement mode is entered after startup initialization is complete. In the first ½ minute of this mode (and during the 10-second startup period), the flow output may be non-zero while the RTD assembly stabilizes in temperature. This mode is displayed as "Measure" on Menu #1 and is active if the meter is powered ON and no Input/Output or Flow Test command is being executed.

Measurement mode is automatically re-entered after a Flow Meter Test cycle is completed or when any Input/Output Test command is turned OFF.

Flow/meter test mode is user-initiated by a user command or when a digital input is turned ON. This mode is displayed as "Flo-Test" on Menu #1 and provides a complete "self-check" of the meter electronics and RTD sensor assembly.

Input/output test mode is user-initiated by display commands for checkout of the electrical connections, I/O hardware, and external equipment after meter installation. This mode is displayed as "I/O Test" on Menu #1.

5.1.4. Menu Navigation and Command Execution: As shown in the table below, user display menus are all numbered and divided into 3 categories.

| Meter Status         | User Commands       | User Configuration   |
|----------------------|---------------------|----------------------|
| 1. Mode: Measure     | 2. Totalizer Reset  | 3. Flow Units        |
| 1.1 Flow Totalizer   | 2.1 Meter/Flow Test | 3.1 Temp Units       |
| 1.2 Meter Status     | 2.2 Output ON Test  | 3.2 Output-B Setup   |
| 1.3 Ratio Status     | 2.3 Output OFF Test | 3.3 FlowIN X-Factor  |
| 1.4 Output A: Flow   | 2.4 Setup Reset     | 3.4 20mA Ratio AO-B  |
| 1.5 Output B: Ratio  | 2.5 Reset Event Log | 3.5 AC Filter        |
| 1.6 Input A: Flow    | 2.6 All Tests OFF   | 3.6 21.5mA Alarm     |
| 1.7 Relay Outputs    |                     | 3.7 Flow Filter      |
| 1.8 Event Log        |                     | 3.8 Flow Bias        |
| 1.9 Passcode Entry   |                     | 3.9 Flow Cutoff      |
| 1.10 Unit Mfg Data A |                     | 3.10 LO Limit A-Flow |
| 1.11 Unit Mfg Data B |                     | 3.11 HI Limit A-Flow |
| 1.12 Calibration     |                     | 3.12 LO Limit B      |
|                      |                     | 3.13 HI Limit B      |
|                      |                     | 3.14 20mA Flow       |
|                      |                     | 3.15 20mA OutB       |
|                      |                     | 3.16 Passcode        |

The four arrow keys are used to select the desired menu display as summarized in the table below. When the LCD is installed in the inverted position, the arrow keys automatically change function. Pressing the LEFT and RIGHT arrow keys simultaneously forces the first item in the column to be displayed. If both keys are held down longer, Menu #1 is selected and the LCD is reinitialized. All user commands (Menu #2.-2.6) are executed by pressing the ENTER [•] key.

| Key       | Function  |
|-----------|---|
| → (RIGHT) | Selects the first display in the “next” menu column (or category). If Menu #1.4, Output A: Flow is displayed and the RIGHT arrow key is pressed, Menu #2.Totalizer Reset is displayed. When any Menu #3.x item is selected and the RIGHT arrow key is pressed, the display will “wrap” to menu #1. Mode |

|          |  |
|----------|--|
| ← (LEFT) | Selects the first display in the “previous” menu column (or category). If Menu #2.1 Meter/Flow Test is displayed and the LEFT arrow key is pressed, Menu #1. Mode is displayed. When any Menu #1.x item is selected and the LEFT arrow key is pressed, the display will “wrap” to Menu #3. Flow Units. |
| ↑ (UP)   | Used to move “up” the menu column to a lower item number. When the first item in a column is selected and the UP arrow is pressed, the display will “wrap” to the last item in the column.   |
| ↓ (DOWN) | Used to move “down” the menu column to a higher item number. When the last item in a column is selected and the DOWN arrow is pressed, the display will “wrap” to the first item in the column.  |

5.1.5. Changing Entering Data: As described in the following procedure, all five keys are used to modify specific meter configuration parameters in Menu #3.3, #3.4, and #3.8 through #3.16. Changing user configuration data is only permitted if the meter is “unlocked”, i.e. not passcode protected.

| No. | Procedure Description  |
|-----|--|
| 1.) | Press ENTER to begin the change procedure. The first digit that can be changed is indicated by a flashing cursor.  |
| 2.) | The UP and DOWN arrow keys are used to select a digit (0-9), a decimal (for non-integer values), – minus sign (for negative values), and a blank character to delete digits in all but the first position. |
| 3.) | Use the RIGHT and LEFT arrow keys to select the digit to be changed or entered.  |
| 4.) | Press ENTER to save the modified data.   |
| 5.) | If NO data change is desired after beginning to edit, press the LEFT arrow key until the cursor stops blinking and the previous screen is displayed.   |

5.1.6. Changing Selections: As described in the following procedure, the four arrow keys are used to select from a list of configuration options in Menu #3.1, #3.2, #3.5 through 3.7.

| No. | Procedure Description   |
|-----|---|
| 1.) | Press ENTER and the cursor will flash indicating that a change can be made.   |
| 2.) | The UP and DOWN arrow keys are used to make a selection from a list of options.   |
| 3.) | Press ENTER to save the modified selection.   |
| 4.) | If NO selection change is desired after beginning to scroll the list of options, press the LEFT arrow key until the cursor stops blinking and the previous screen is displayed. |

5.1.7. Meter Configuration: SMARTLINK Meter is configured with factory default parameters allowing out-of-the-box operation for most applications. A short list is provided below of the most commonly changed configuration parameters along with setup procedures for ratio monitoring. (Configuration of the 4-20mA flow input is required if the meter’s standalone, ratio monitoring capability is utilized).

**Flow measurement and total units** - The meter’s mass flow rate out, 4-20mA input/output definitions, and calibration range, are displayed in one of the following “Standard” or “Normal” units as selected by the Menu #3 Flow Units configuration setting. For each flow rate unit, the flow total is displayed in the corresponding volumetric units. (Note the reference conditions and densities below for all SMARTLINK Meter flow rate units. These definitions vary widely across industries, manufacturers, and geographic regions.) The meter is shipped to display SCFH.

| Display Units     | Unit Description               | Display Total Units |
|-------------------|--------------------------------|---------------------|
| SCFH              | Standard Cubic Feet Per Hour   | SCF                 |
| SCFM              | Standard Cubic Feet Per Minute | SCF                 |
| SFPM              | Standard Feet Per Minute       | SCF                 |
| SFPS              | Standard Feet Per Second       | SCF                 |
| LB/H              | Pounds Per Hour                | LBS                 |
| LB/M              | Pounds Per Minute              | LBS                 |
| LB/S              | Pounds Per Second              | LBS                 |
| NM <sup>3</sup> H | Normal Cubic Meters Per Hour   | NM3                 |
| NM <sup>3</sup> M | Normal Cubic Meters Per Minute | NM3                 |
| NMPM              | Normal Meters Per Minute       | NM3                 |
| NMPS              | Normal Meters Per Second       | NM3                 |
| NLPH              | Normal Liters Per Hour         | NL                  |
| NLPM              | Normal Liters Per Minute       | NL                  |
| KG/H              | Kilograms Per Hour             | KG                  |
| KG/M              | Kilograms Per Minute           | KG                  |
| KG/S              | Kilograms Per Second           | KG                  |
| SMPM              | Standard Meters Per Minute     | SM3                 |
| SMPS              | Standard Meters Per Second     | SM3                 |

|                      |   |
|----------------------|---|
| Reference Conditions | Temperature and pressure conditions for flows displayed in “Standard” volumetric, “Standard” velocity, and all mass flow rate units: 60°F (15.6 C) and 14.73 PSIA (762 mm Hg / 1.02 barr) per ANSI/API MPMS, 14.3.1 |
| Reference Densities  | Temperature and pressure conditions for flows displayed in “Normal” volumetric and “Normal” velocity flow units: 32°F (0 C) and 14.70 PSIA (760mm Hg / 1.01 barr)   |



**Limit Output** - SMARTLINK Meter includes a fail-safe limit output that can be used to notify plant personnel or external PLC/DCS monitoring equipment of high and low levels of flow and ratio (or fluid temperature). To enable a High and/or Low Flow Limit condition, the following configuration parameters need to be set using the following formulas:

$$\text{HI Limit A-Flow \%FS (Menu \#3.11)} = 100\% \times \text{Required HI Threshold Flow Rate} \div 100\% \text{ Meter Full Scale Flow}$$

$$\text{LO Limit A-Flow \%FS (Menu \#3.10)} = 100\% \times \text{Required LO Threshold Flow Rate} \div 100\% \text{ Meter Full Scale Flow}$$

For an example, a SMARTLINK Meter for natural gas, Model SMN10, has a 100% meter full scale range of 8400 SCFH. If a limit output is required by the application to “trip” at 7000 SCFH or higher, then the HI Limit A-Flow %FS needs is calculated as follows:  $83.3\% = 100\% \times 7000 \text{ SCFH} \div 8400 \text{ SCFH}$ . The limit output is fail-safe and therefore is normally turned ON when the condition does NOT exist. A HI Limit Flow condition will be indicated on the user display (and relay output C\ will turn OFF) when the measured flow rate is equal to or greater than 7000 SCFH. To avoid chattering limit relays, a fixed hysteresis of 2% FS is applied to all limits. Therefore, the HI Flow Limit condition will remain active until the flow rate drops below 81.3% or 6832 SCFH. Both High and Low Flow Limits can be configured simultaneously.

When Analog Output-B is setup for ratio, High and/or Low Ratio Limit configuration parameters can be set with the following formulas:

$$\text{HI Limit B \%FS (Menu \#3.13)} = 100\% \times \text{Required HI Threshold Ratio} \div 20\text{mA Ratio AO-B (Menu \#3.4)}$$

$$\text{LO Limit B \%FS (Menu \#3.12)} = 100\% \times \text{Required LO Threshold Ratio} \div 20\text{mA Ratio AO-B (Menu \#3.4)}$$

**Meter passcode protection** – The meter can be “Locked” to prevent tampering with the configuration and execution of all user commands. To enable the “Lock” function, change the parameter, “Passcode”, on Menu #3.16, to a non-zero, 1, 2, 3, or 4-digit number. This number should be remembered or written down for future reference. Once the passcode is changed, the unit will be in a “Locked” state even after cycling power.

To “Unlock” the unit when in a “Locked” state, go to Menu #1.9, Passcode Entry, and enter the passcode. The meter will automatically return to a locked state approximately 50 minutes after the last key is pressed or if the power is cycled.

If the passcode is forgotten, go to Menu #1.9 and enter the master passcode of 911. After the 911 passcode is entered, additional factory diagnostic information (Menu #4.1 to #4.9) is displayed.

To disable the “Lock” function, first enter the previously stored (valid) passcode on Menu #1.9 and then change the stored passcode back to 0 on Menu #3.16.

**Ratio monitor** - To configure SMARTLINK Meter as a “standalone” ratio monitor for combustion applications, the following procedure must be performed:

| No. | Ratio Monitor Configuration Procedure Description   |
|-----|---|
| 1.) | An external, second meter must be connected to the primary meter’s Analog Input-A (AO-A), a 4-20mA input that represents the flow measured by the external meter. Configure the flow measurement units of the second meter to be the same as the primary meter (configured for ratio monitoring). DO NOT select any velocity flow rate units for ratio monitoring. On the external meter, verify the 21.5MA Alarm function is disabled on Menu #3.6 and record the 20mA flow output definition on Menu #1.4 in the selected flow units.   |
| 2.) | On the primary meter, Analog Output-B (AO-B) must be configured for ratio output using Menu #3.2. The parameter, “Output-B Setup”, must be set to either “AI / AO” or “AO / AI”. The two configuration options are defined as follows:<br><b>a.) “AI/AO”=Flow rate of Analog Input-A (ext. 2<sup>nd</sup> meter) ÷ Flow rate of Analog Output-A</b><br>This is the factory default configuration and is used for an external air meter to calculate air/fuel ratio; for combustion systems, this is the process variable of interest.<br><b>b.) “AO/AI”=Flow rate of Analog Output-A ÷ Flow rate of Analog Input-A (ext. 2<sup>nd</sup> meter)</b><br>This configuration is used for an external gas meter to calculate air/fuel ratio. |

|     |   |
|-----|---|
| 3.) | For the primary meter to calculate ratio, the 4-20mA input current (AI-A) representing the flow of the 2 <sup>nd</sup> , external meter, must be properly configured. The configuration parameter, "FlowIN-X Factor" must be setup as follows:<br><b>"FlowIN-X Factor" = Meter 100% Full Scale Flow Rate ÷ External Meter 20mA Flow Rate</b><br>The meter 100% full scale flow rate is displayed as the "MAX" value on Menu #1.12 Calibration. Refer to the previous section for a complete discussion on full scale meter flow rate. The external meter's 20mA Flow Rate definition was recorded in Step #1, above. Calculate the parameter, "FlowIN-X Factor", using the equation above and enter this value in Menu #3.3 |
| 4.) | Verify the 20mA input flow rate (on Menu #1.6) now matches the 20mA output flow rate (on Menu #1.4 of the 2 <sup>nd</sup> , external meter). If the two flow rates are not the same, repeat Step #3   |
| 5.) | If the application ratio exceeds 20:1, change the configuration parameter, "20MA Ratio AO-B" on Menu #3.5 to a value equal to or greater than the largest ratio required for monitoring. Verify the configuration parameter, "20mA OutB" is set to 100 %FS and the desired ratio output at 20mA is displayed on Menu #1.5.  |
| 6.) | With both meters operational and reading a non-zero flow rate, verify the external meter flow rate matches the input flow rate on the primary meter.  |
| 7.) | Using either of the following formulas below, verify the ratio on Menu #1.3, Ratio Status, corresponds to the current output displayed on Menu #1.5, Output-B: Ratio and the calculated/displayed ratio in any external equipment interfaced to Analog Output-B:<br><b>Ratio Output (mA) = 4mA + 16mA x [Ratio ÷ 20mA Ratio]</b><br><b>Or</b><br><b>Ratio = (mA Ratio Output – 4mA) ÷ 16 mA x 20mA Ratio</b>  |
| 8.) | If any changes are made to the external meter's 20mA output definition, repeat Step #3, 4, 6, and 7.  |

5.1.8. Meter Status and Event Log: Meter alarm and limit conditions are shown on the fourth line of the LCD on Menu #1 and Menu #1.2. When no alarm or limit condition exists, "Meter OK" will be displayed. Alarm conditions are intended to indicate a meter hardware failure, software fault, or an over-temperature condition. Each alarm condition and its associated display message are listed below:

|                             |                         |
|-----------------------------|-------------------------|
| Meter/Flow Test Alarm:      | "ALARM: Meter Flo-Test" |
| Meter Flow mA Test Alarm:   | "ALARM: Meter Flow-mA"  |
| Meter Flow Hardware:        | "ALARM: Meter H/W-Flow" |
| Meter Temperature Hardware: | "ALARM: Meter H/W-Temp" |
| Housing (Over) Temperature: | "ALARM: Temp Housing"   |
| Fluid (Over) Temperature    | "ALARM: Temp Fluid"     |
| Meter Voltage Hardware:     | "ALARM: Meter H/W-VDC"  |
| Meter Software/Math:        | "ALARM: Meter S/W-Math" |
| Meter Resistance Hardware:  | "ALARM: Meter H/W-Ohms" |
| Meter Watchdog Reset:       | "ALARM: Meter Reset"    |

Each high and low limit condition and its associated display message are listed below:

|                                    |                       |
|------------------------------------|-----------------------|
| High Flow Limit, Analog Output-A:  | "LIMIT:HI OutA-Flow"  |
| Low Flow Limit, Analog Output-A:   | "LIMIT:LO OutA-Flow"  |
| High Ratio Limit, Analog Output-B: | "LIMIT:HI OutB-Ratio" |
| Low Ratio Limit, Analog Output-B:  | "LIMIT:LO OutB-Ratio" |
| High Fluid Limit, Analog Output-B: | "LIMIT:HI OutB-Fluid" |
| Low Fluid Limit, Analog Output-B:  | "LIMIT:LO OutB-Fluid" |

The meter includes an event log of all alarm and limit conditions. The log holds the number of occurrences or "counts" for each event and is cleared when power is applied or by executing an event log reset command, using Menu #2.5.

5.1.9. User Commands: The user commands found are Menu #2 through #2.6. The two that require some explanation include:

**Meter/Flow test** – The Meter/Flow Test command can be initiated by the user display (on Menu #2.1) or a hardware input momentary ON pulse (i.e. 1 second, minimum ON duration). The test is a complete "self-check" of the meter electronics and RTD probe assembly that can be performed while the unit is measuring flow. The meter operating mode displayed during the test is shown as "Flo-Test" on Menu #1 and is active for 40 seconds to 2.5 minutes. During this mode, flow measurement and the 4-20mA output remain active, however, the fluid temperature is assumed to be the same value throughout the test. **Because the ambient temperature sensing RTD is used as a velocity sensing RTD, the test should be performed only when the gas temperature and flow rate is steady and greater than 20% of full scale.** In addition, all control loops that utilize the flow output should be disabled during the test. After the test completes, the meter will remain in the "Flo-Test" operating mode until the fluid temperature RTD has stabilized and this can take up to approximately 2 minutes depending on flow rate. While observing the display after command execution, a test failure is indicated by a "Flow Alarm" count of 1 or more. If the test

fails or the error percentage is greater than 1.5% just before being reset to 0%, refer to the maintenance instructions below on how to properly clean the RTD elements and when to send the flow sensor back for re-calibration. The Flow Alarm count can be reset using the “Reset Event Log” command on Menu #2.5.

**Input/output tests** – Two input/output test commands are provided on the user display for checkout of the electrical connections, I/O hardware, and external equipment after meter installation. These commands should only be executed when the outputs are not being used for monitoring and control purposes since normal operating output states are overridden. The “Output ON Test”, on Menu #2.2, turns on all relay drive outputs and sets both 4-20mA signals to 20mA. Conversely, the “Output OFF Test”, on Menu #2.3, turns off all relay drive outputs and sets both 4-20mA signals to 4mA. Each command can be “toggled” off as prompted on the display. In addition, the command, “All Tests OFF”, on Menu #2.6, will turn either input/output command off as well as the meter/flow test.