Sierra Series 620S Boiler-Trak™
Insertion Mass Flow Meter

Instruction Manual

Part Number IM-62 BT
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Warnings and Cautions

Warning! All wiring procedures must be performed with the power Off.

Warning! To avoid potential electric shock, follow National Electric Code safety practices or your local regulations when wiring this unit to a power source and to peripheral devices. Failure to do so could result in injury or death.

Warning! Do not power the flow meter with the sensor jumper wires disconnected. This could cause over-heating of the sensors and/or damage to the electronics.

Warning! Always remove main power before disassembling any part of the mass flow meter.

Caution! Before making adjustments to the Smart electronics device, verify the flow meter is not actively monitoring or reporting to any master control system. Adjustments to the electronics will cause direct changes to flow control settings.

Caution! All flow meter connections and fittings for pipe tapping must have the same or higher pressure rating as the main pipeline.

Caution! To avoid serious injury, DO NOT loosen a compression fitting under pressure.

Catuion! Before attempting any flow meter repair, verify that the line is de-pressurized.

Caution! Printed circuit boards are sensitive to electrostatic discharge. To avoid damaging the board, follow these precautions to minimize the risk of damage:

- before handling the assembly, discharge your body by touching a grounded, metal object
- handle all cards by their edges unless otherwise required
- when possible, use grounded electrostatic discharge wrist straps when handling sensitive components

Chapter 1 Introduction

620S Boiler-Trak™ Mass Flow Meters

Sierra's 620S Boiler-Trak™ provides a reliable solution for natural gas, methane, or propane gas flow measurement applications. Low-flow sensitivity, fast response and outstanding rangeability have made this model the instrument of choice for many critical gas flow applications.

The Boiler-Trak™ microprocessor-based transmitter integrates the functions of flow-range adjustment, meter validation and diagnostics in a probe-mounted or remote NEMA 4X (IP65) housing. Mass flow rate and totalized flow, as well as other configuration variables can be displayed on the meter's optional 2 x 12 backlit LCD panel. The meter provides an optical/galvanic isolated flow output, two alarm outputs and one contact input for range or gas selection. The programmable transmitter is easily configured via RS-232 and Sierra's Smart Interface software or through three push buttons built into the device.

Depending on the probe length, the 620S Boiler-Trak™ is suitable for pipes or ducts from 1 inch up to 24 inches (DN25 up to DN600) . The 620S Boiler-Trak's simple installation combines with an easy-to-use interface that provides quick set up, long term reliability and accurate mass flow measurement over a wide range of conditions. Modbus communication is standard.

Using This Manual

This manual provides the information you need to install and operate the 620S Boiler-Trak™. The four chapters of this manual cover these areas:
- Chapter 1 includes the introduction and product description
- Chapter 2 provides installation and wiring instructions
- Chapter 3 describes system operation and programming
- Chapter 4 covers troubleshooting and repair

The product specifications and dimensional drawings are found in Appendix A. Dimensional drawings of the Packing Gland for the Hot Tap are in Appendix B. Modbus details are in Appendix C.

Note and Safety Information

We use note, caution and warning statements throughout this book to draw your attention to important information.

Warning!	**Caution!**	**Note**
This statement appears with information that is important to protect people and equipment from damage. Pay very close attention to all warnings that apply to your application.	This statement appears with information that is important for protecting your equipment and performance. Read and follow all cautions that apply to your application.	This statement appears with a short message to alert you to an important detail.

Receipt of System Components

When receiving a Sierra mass flow meter, carefully check the outside packing carton for damage incurred in shipment. If the carton is damaged, notify the local carrier and submit a report to the factory or distributor. Remove the packing slip and check that all ordered components are present. Make sure any spare parts or accessories are not discarded with the packing material. Do not return any equipment to the factory without a Return Material Authorization (RMA, see Chapter 4).

Technical Assistance

If you encounter a problem with your flow meter, review the configuration information for each step of the installation, operation and setup procedures. Verify that your settings and adjustments are consistent with factory recommendations. Refer to Chapter 4, Troubleshooting, for specific information and recommendations.

If the problem persists after following the troubleshooting procedures outlined in Chapter 4, contact Sierra Instruments by fax or by E-mail (service@sierrainstruments.com). For phone support you may call (800) 866-0200 or (831) 373-0200 between 8:00 a.m.
and 5:00 p.m. PST. In Europe contact Sierra Instruments b.v. at +31 20 6145810. When contacting Technical Support, make sure to include this information:

- the flow range, serial number and Sierra order number and model number (all marked on the meter nameplate)
- if possible, the firmware version (visible at start up on the meter display)
- the problem you are encountering and any corrective action taken
- application information (gas, pressure, temperature, piping configuration)

The 620S Boiler-Trak™ Flow Sensing Principle

Sierra's unique 620S Boiler-Trak™ sensor probe is responsible for the unsurpassed accuracy and reliability of Sierra mass flow meters. The sensor consists of two sensing elements–a velocity sensor and a temperature sensor which automatically corrects for changes in gas temperature. When power is applied to the flow meter, the transducer electronics heats the velocity sensor to a constant temperature differential above the gas temperature and measures the cooling effect of the gas flow. The electrical power required to maintain a constant temperature differential is directly proportional to the gas mass flow rate. The meter electronics measure this power and convert it into a linear 0-5 VDC (0-10 VDC optional) and 4-20 mA output signal.

The Boiler-Trak™ sensors are reference-grade platinum resistance temperature detectors (RTD) encapsulated in glass. The platinum RTD wire is wound on a rugged ceramic mandrel for strength and stability. The sensor is located at the tip of a 0.375 inch (3/8") diameter, 304 stainless steel probe which is inserted in the gas stream. The Boiler-Trak electronics are packaged in a weather-proof NEMA 4X (IP65) enclosure mounted either directly on the sensing probe or remotely up to 100 feet (60 meters) away.
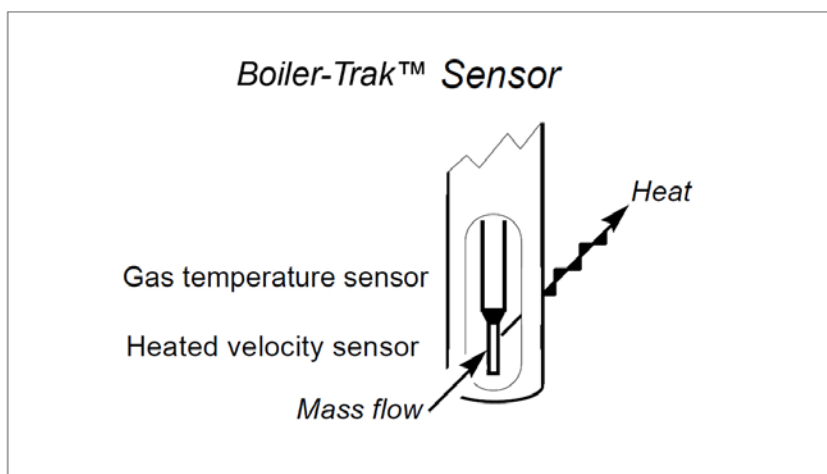

Figure 1-1. 620S Boiler-Trak™ Sensor Assembly

Boiler-Trak™ Electronics Features

Instrument Validation

Two simple tests offer full "field-validation" of your Boiler-Trak™ mass flow meter. The first test checks the system electronics, linearization and microprocessor functionality. This is performed by injecting a known input value and confirming that the flow meter outputs the expected value. The second test verifies that the instrument's primary sensing elements have not drifted or shifted from their original calibration. This is accomplished by measuring the resistance of the velocity and temperature sensors and comparing the results to the NIST-traceable calibration data provided with the flow meter. Together, these tests confirm that your meter is working correctly and the calibration variables did not drift, shift or change values.

Dual Range or Dual Gas Calibration (Optional)

Select one of two factory calibrated flow ranges using a simple external customer-supplied single contact closure.

User Full Scale Flow Rate

Field-configure from 50% to 100% of the factory full scale setting (factory full scale is normally set to 125% of the user-specified maximum flow rate). This adjustment can be made for each flow range.

Alarms

Program high and low or window alarm limits independently for each flow range. The solid state contacts are isolated with one common.

K-Factor Correction

Change the calibration correction factor to compensate for flow profile disturbances or specific application conditions. The K-factor is a multiplication factor applied to the linearized flow signal. You may set the K-factor individually for each flow range.

Dual Output Signals

Boiler-Trak™ offer two separate linear output signals proportional to flow, 0-5 VDC (0-10 VDC optional) and 4-20 mA. The 4-20 mA output can be field-configured as an active loop powered by the flow meter or an optically isolated passive loop requiring an external power supply.

Totalizer

With the optional LCD display, actual mass flow appears on line 1 and the totalized flow on line 2 both in the user-specified engineering units. The totalizer counts only the selected range and when ranges are switched, the value of the non-selected range is stored in memory. You may reset the totalizer using the 3 function buttons mounted on the PCA or by using a hand-held magnet.

Zero and Span Outputs

Validate and adjust the settings to ensure output circuits are correct.

Time Response Delay

Select from a low response for faster tracking to a high response for a smoother output.

Enclosure Options

Flow meter electronics are available mounted directly to the flow body, or remotely mounted up to 100 feet (60 meters) away. The electronics housing may be used indoors or outdoors.

Display options include a 2 x 12 character LCD display of mass flow rate including totalized mass, or a single-digit LED located on the device printed circuit board. Local operation and reconfiguration is accomplished using the three push buttons operated via finger touch. Boiler-Trak™ electronics include nonvolatile memory that stores all configuration information. The memory allows the flow meter to function immediately upon power up, or after an interruption in power.

Smart Interface™ Software

Sierra's Smart Interface Windows™-based software is available for connecting your PC directly to the Boiler-Trak™. An RS-232 serial cable along with CD-ROM containing the program and system files are available from the factory. See the Smart Interface User Guide included with the software for operating instructions.

Chapter 2 Installation

Installation Overview

The 620S Boiler-Trak™ flow meter is factory calibrated to the specific pipe size shown on the meter's Certificate of Calibration. The factory calibration eliminates the task of calculating the average flow across the pipe to determine the correct insertion depth. Simply insert the flow meter sensor to the centerline position of the pipe. (If the pipe size differs from the meter's calibrated size, return the meter to the factory for re-calibration.)

When selecting an installation site, make sure that:

1. Line pressure and temperature will not exceed the flow meter rating. Temperature should not vary more than 120°F (50°C) from the calibration temperature. Line pressure should not vary more than 50 psi (3.4 bar) around the calibrated pressure.

2. The location meets the required minimum number of pipe diameters upstream and downstream of the sensor head (see Figure 2-1).

3. Safe and convenient access with adequate clearance. Also, verify the meter is located where the gas is clean and dry and the meter is calibrated for the gas to be measured.

4. For remote installations, verify the supplied cable length is sufficient to connect the flow meter sensor to the remote electronics. (Do not extend or shorten the supplied cable between the probe and the electronics.)

Also, before installation check your flow system for anomalies such as:
- leaks
- valves or restrictions in the flow path that could create disturbances in the flow profile that might cause unexpected flow rate indications
- heaters that might cause rapid excursions in the measured temperature

Unobstructed Flow Requirements

Select an installation site that will minimize possible distortion in the flow profile. Valves, elbows, control valves and other piping components may cause flow disturbances. Check your specific piping condition against the examples shown below. In order to achieve accurate and repeatable performance install the flow meter using the recommended number of straight run pipe diameters upstream and downstream of the sensor.
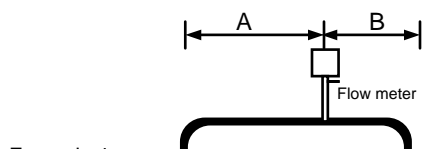
Example 1.
One 90° elbow before meter
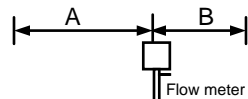
Example 2.
Two 90° elbows before meter in one plane
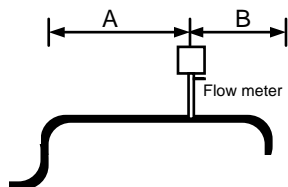
Example 3.
Two 90° elbows before meter out of plane (if three 90° bends present, double recommended length)
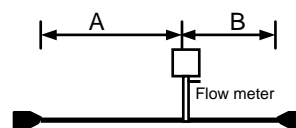
Example 4.
Reduction before meter
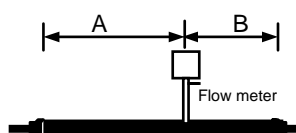
Example 5.
Expansion before meter
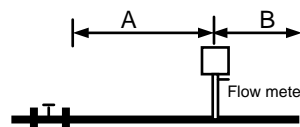
Example 6.
Regulator or valve partially closed before meter (If valve is alway wide open, base length requirements on fitting directly preceding

Example	A Upstream[1] Requirements	B Downstream[2] Requirements
1	10 D	5 D
2	15 D	5 D
3	25 D	10 D
4	10 D	5 D
5	20 D	5 D
6	25 D	10 D
(1) Number of diameters (D) of straight pipe required between upstream disturbance and the flow meter.		
(2) Number of diameters (D) of straight pipe required downstream of the flow meter.		

Figure 2-1. Recommended Pipe Length Requirements for Installation

Installation

Use the following data as a guide to prepare the pipe for flow meter in-sertion. Refer to a standard code for all pipe tapping operations. The following instructions are general in nature and intended for guideline purposes only.

1. Turn off the flow of process gas. Verify that the line is not pressu-rized.

2. Confirm that the installation site meets the minimum upstream and downstream pipe diameter requirements. See Figure 2-1.

3. Use a cutting torch or sharp cutting tool to tap into the pipe. The pipe opening must be at least .375 inches in diameter. (Do not at-tempt to insert the sensor probe through a smaller hole.)

4. Remove all burrs from the tap. Rough edges may cause flow profile distortions that could affect flow meter accuracy. Also, obstructions could damage the sensor assembly when inserting into the pipe.

Caution!
All flow meter connec-tions and fittings must have the same or higher pressure rating as the main pipeline.

5. Mount the 3/8 inch compression fitting on the pipe. Make sure this connection is within ± 5° perpendicular to the pipe centerline.

6. When installed, cap the fitting. Run a static pressure check on the connection. If pressure loss or leaks are detected, repair the connec-tion and re-test.

7. Insert the sensor probe through the compression fitting into the pipe. The correct insertion depth places the larger hole in the probe at the pipe's centerline. Do not force into the pipe.

8. Align the sensor head using the flow direction indicator. Adjust the indicator parallel to the pipe and pointing downstream in the direction of flow.

Caution!
To avoid serious in-jury, DO NOT loo-sen the compres-sion fitting under pressure.

9. Tighten the compression fitting to lock the flow meter in position. When the compression fitting is tightened, the position is permanent (unless using Teflon ferrules).

10. Units may be hot-tapped. A suitable packing gland is required (See Appendix B).
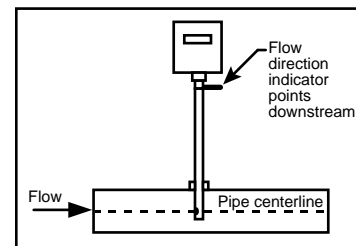
Wiring Connections

Warning!
All wiring procedures must be performed with the power Off.

The NEMA 4X enclosure contains an integral wiring compartment with one dual strip terminal block for power and signal connections and one dual strip terminal block for sensor connections. The enclosure has one 1/2 inch female NPT conduit entry. The terminal designations are labeled inside the enclosure cover.
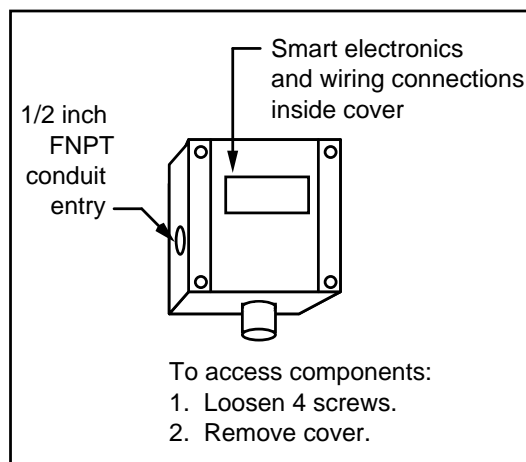
Figure 2-2. Wiring Access

Input Power Wiring

Warning!
To avoid potential electric shock, follow National Electric Code safety practices or your local code when wiring this unit to a power source and to peripheral devices. Failure to do so could result in injury or death.

Note!
The Boiler-Trak™ input power is a Sierra exclusive at 15 to 18 VDC.

Depending on the flow meter configuration, connect 15 to 18 VDC (625 mA load, maximum) as shown below. Confirm power configuration **before** applying power. See the flow meter nameplate for input power rating.
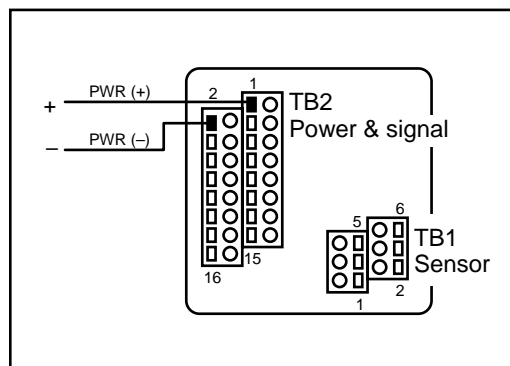
Figure 2-3. Input Power Connections

Output Signal Wiring

All flow meters are equipped with either a calibrated 0-5 VDC (0-10 VDC optional) or a calibrated 4-20 mA output signal. These linear output signals represent 0-100% of the flow meter user full scale.

DC Output Wiring

The 0-5 VDC (0-10 VDC optional) signal can drive a load of 1000 Ohms. The optional 0-10 VDC output signal is not available for power sources below 15 VDC. Connect as shown below.
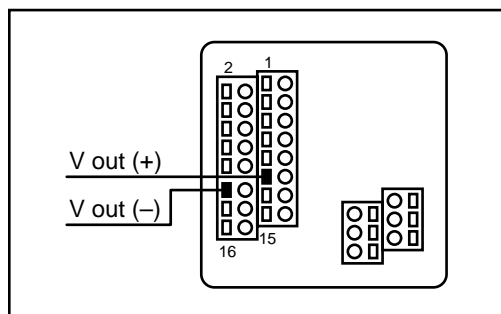
Figure 2-4. VDC Output Wiring Connections

4-20 mA Output Wiring

The 4-20 mA current loop output can be self-powered by the flow meter's power supply (non-isolated) or externally powered (isolated) requiring a separate 15 to 18 VDC power supply.

R_{load} is the total resistance in the loop, including the wiring resistance. To calculate R_{max}, the maximum R_{load} for the loop, use the maximum loop current, 20 mA. The voltage drop in the loop due to resistance is 20 mA times R_{load} and this drop is subtracted from the input voltage. Thus:

$$R_{max} \text{ the maximum load resistance} = 50 * (V_{supply} - 7.5V)$$

To use an external power supply for an isolated 4-20 mA output, connect as shown in Figure 2-5. For an internally powered non-isolated 4-20 mA output, connect as shown in Figure 2-6.

Figure 2-5. Isolated 4-20 mA Current Loop Connections
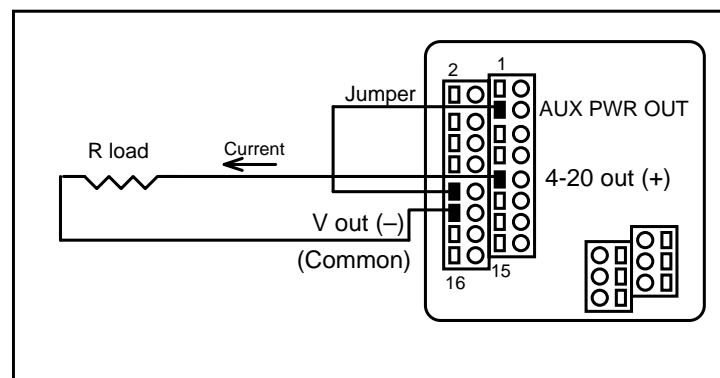
Figure 2-6. Non-isolated 4-20 mA Current Loop Connections

Alarm Output Wiring

Two alarm outputs (Low Alarm and High Alarm) are included on the flow meter terminal block. The alarm outputs relays are normally-open single-pole relays with one common connection.

There are two connection options for alarm outputs–the first with a separate power supply (isolated) and the second using the flow meter power supply (non-isolated). Use a separate power supply if a specific voltage is needed for the alarm output. Use the second (non-isolated) configuration if the voltage at the flow meter's power supply is an acceptable driver voltage for the load connected. (Take into account that the current used by your alarm loads have to come from the flow meter's power supply.) In either case, the voltage of the alarm output is the same as the voltage supplied to the circuit.

To use an external power supply for an isolated alarm output, connect as shown in Figure 2-7. To use the internally powered, non-isolated alarm output connect as shown in Figure 2-8. For a window alarm connect both outputs together.
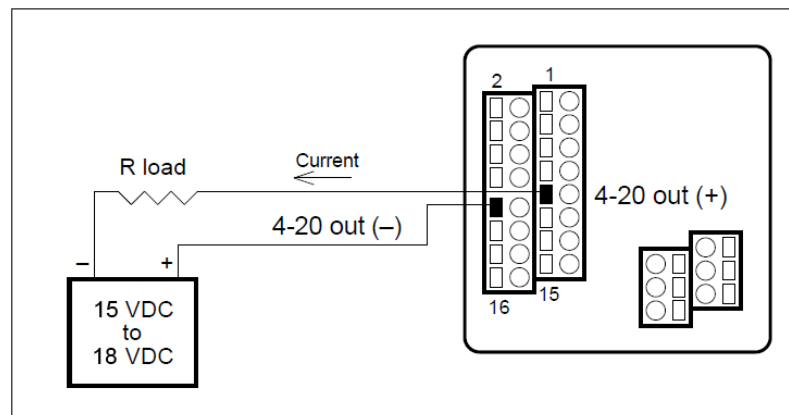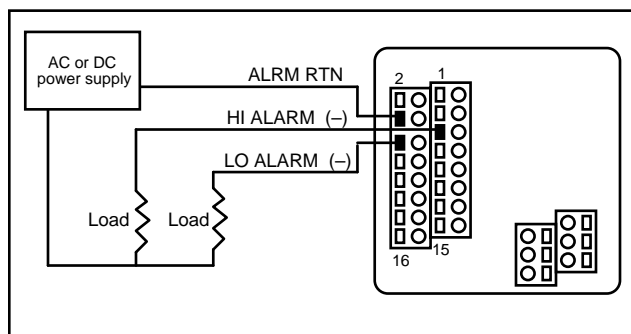

Figure 2-7. Isolated Alarm Output Connections
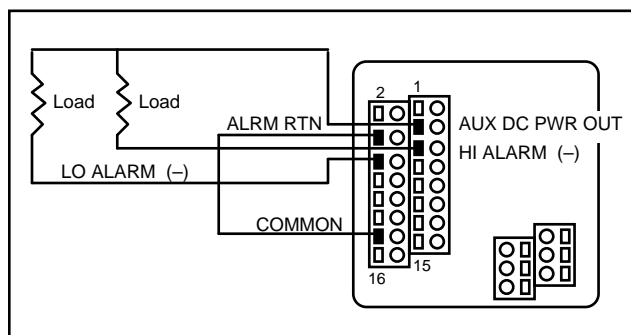
Figure 2-8. Non-isolated Alarm Output Connections

Remote Sensor Probe Wiring

Use only factory supplied cables when connecting the sensor probe to
a remotely mounted flow meter enclosure. The electronics, sensors
and interconnecting cables supplied by Sierra Instruments are cali-
brated as a complete precision mass flow circuit.

To connect the sensor probe to a remotely mounted electronics enclo-
sure, see Figure 2-9. To make wiring connections from a sensor probe
junction box to a remotely mounted enclosure, see Figure 2-10.
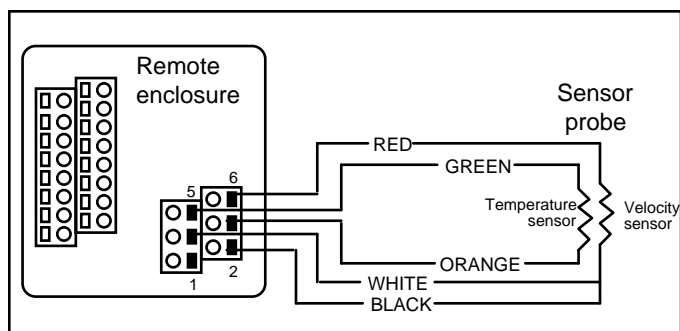
Figure 2-9. Remote Electronics Enclosure to Sensor Connections
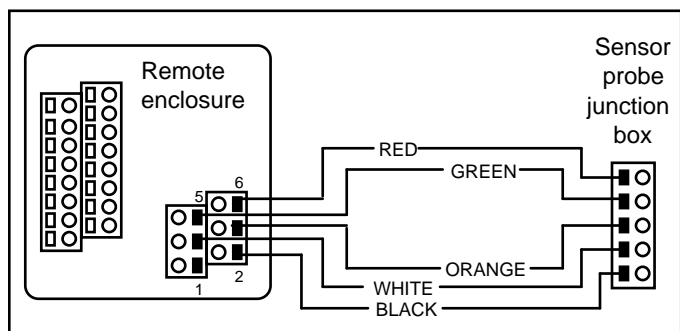
Figure 2-10. Sensor Junction Box to Remote Enclosure Connections

Range Selection Wiring

If your meter is equipped with an optional second range calibration, connect a contact switch as shown below. When the switch is closed the device changes to Range 2. Open the switch to return to Range 1.
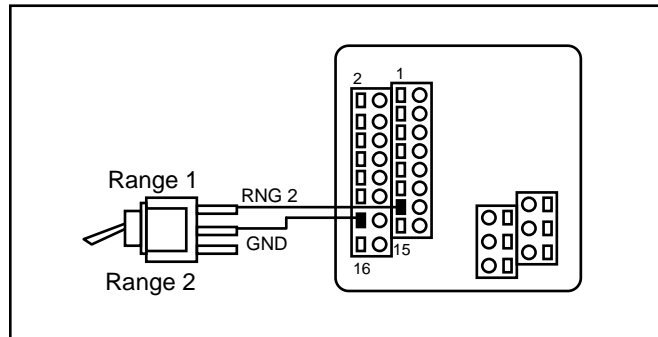
Figure 2-11. Range Selection Wiring

Chapter 3 Operation

Using the Boiler-Trak™ Electronics Basic Features

⚠

Caution!
Before making any adjustment to the Boiler-Trak™ electronics device, verify the flow meter is not actively monitoring or reporting to any master control system. Any adjustment to the electronics will cause direct changes to flow control settings.

Three push buttons allow selection and adjustment of the basic user functions. Use the push buttons to enter:

- alarm parameters
- change the user full scale
- adjust the K-factor
- adjust the time response speed
- reset the totalizer

You may view parameters using the optional LCD front panel display or by selecting functions on the single-digit LED and viewing the meter's 0-5 VDC output with a digital voltmeter (DVM).

Before making changes or adjustments:

For meters with the optional LCD display, remove the enclosure cover to access the Boiler-Trak™ electronics. Press the FUNCTION key to view and record the factory settings. When pressing FUNCTION the optional LCD display prompts for a password, press FUNCTION again to skip the password and review the current settings. (To make changes, at the password prompt press the UP arrow until 11 is displayed, press FUNCTION to continue.)

For flow meters without the display, remove the enclosure cover to access the Boiler-Trak™ electronics. Connect the DVM as described on the following pages and record the factory-set parameters.

After 12 seconds of non-activity during programming, the meter returns to the Run Mode with any new settings immediately in effect. For units without a LCD front panel display: if the unit "times-out" when entering a new parameter, press the FUNCTION button *only* to resume adjustments.
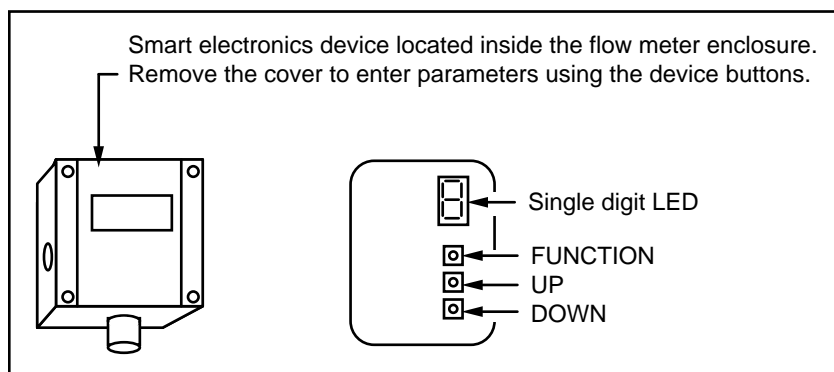
Figure 3-1. Display/Keypad Commands

Flow Meter Start Up

When applying power to a flow meter equipped with the optional LCD display you will see the product name, the software version, unit serial number, the range number, the user full scale (UFS), the current flow rate and the totalized flow. Any active alarm will flash on the screen every few seconds. For meters without the optional display, when power is applied the on-board single-digit LED flashes the revision number of the software in a series of 3 digits, followed by the range number; the range number continues to flash every 3 seconds thereafter.

Using the Single-Digit LED for Programming

Run Mode

Software version
shown in series
of 3 digits

Version

Range in use

Range
No.

Press
FUNCTION

**FUNCTION
Assignments**

| 1 | Voltage Zero |

| 2 | Voltage Span |

| 3 | Current Zero |

| 4 | Current Span |

| 5 | High Alarm |

| 6 | Low Alarm |

| 7 | K-Factor |

| 8 | User Full Scale |

| 9 | Time Response Delay |

Press FUNCTION to view or change settings.

Use the UP or DOWN button to enter new parameters. Press FUNCTION to continue.

After 12 seconds of non-activity, the settings are saved and the meter returns to the Run Mode.

Using the LCD Display for Programming

**Start Up
Screens**

Flow meter model — [Sierra Flow Meter]

Software version
Meter serial number — [Version Serial No.]

Run Mode

Current flow rate
Totalized flow — [Flow Total Flow]

Current range in use
User full scale — [Range No. UFS]

Current flow rate
If an alarm is active
(will flash) — [Flow Alarm]

Press FUNCTION

**LCD Display
FUNCTIONS**

[Password]
↓
[Zero Volts]
↓
[Span Volts]
↓
[Zero mA]
↓
[Span mA]
↓
[High Alarm]
↓
[Low Alarm]
↓
[K-Factor]
↓
[User FS]
↓
[Time Resp.]
↓
[Total Reset?]

For units with the optional front panel LCD display, you must correctly enter the password to change parameters.

To **view** settings, press FUNCTION twice, skipping the password. To **change** settings, press FUNCTION, enter the password, 11, press FUNCTION to continue.

Use the UP or DOWN button to enter new parameters. Press FUNCTION to continue.

After 12 seconds of non-activity, the settings are saved and the meter returns to the Run Mode.

Entering Alarm Parameters

⚠️ **Caution!**
The flow meter must not be reporting or measuring gas flow during adjustments.

Use the High Alarm and Low Alarm function to set or adjust alarm trip points. The alarms have a minimum hysteresis of 3% to avoid "chattering." When setting a window alarm, the alarm setpoints must be at least twice the hysteresis value apart. We suggest at least a 10% separation between window alarm setpoints. If you choose not to use the high alarm for a specific alarm function, Sierra recommends that you set the high alarm at 100% of the user full scale setting which creates an "over-range" indicator. Your flow meter will continue to indicate flow and generate a signal if the flow is over the maximum range, but will not operate within the specified accuracy.

Entering Alarms with the LCD Display

Enter alarms setpoints directly in engineering units.

1. Select the desired range. Press FUNCTION, enter the password. Press FUNCTION until *High Alarm* or *Low Alarm* appears on the display.

2. Use the UP or DOWN arrow keys to enter the high or low alarm setpoint value in engineering units.

3. Press FUNCTION to advance to the next option, or after 12 seconds of non-activity the meter returns to the Run Mode and the new parameters are in effect.

Entering Alarms without the LCD Display

When using a DVM to set alarms, the setpoint is a percentage of the flow meter's user full scale.

VOLTS = (ALARM PERCENT x 5.0)

If you want to alarm at 25% of user full scale, used in Step 3 below, press the UP or DOWN button until 1.25 VDC is present on the DVM. If you want to alarm at 75% of user full scale, press the UP or DOWN button until 3.75 VDC is present on the DVM.

1. Set the DVM to voltage mode and connect between Vout+ and Vout– on the flow meter terminal block.

2. Select the desired range. Press the FUNCTION button until a solid "5" (high alarm) or solid "6" (low alarm) appears on the LED.

3. Adjust the UP or DOWN button until the DVM indicates the desired setpoint voltage as described above.

4. Press FUNCTION again to advance to the next option, or after 12 seconds of non-activity the meter returns to the Run Mode and the new alarm parameters are in effect.

K-Factor Adjustment

⚠️
Caution!
The flow meter must not be reporting or measuring gas flow during adjustments.

Entering a K-factor adjusts the meter's output signal without affecting the factory calibration curve. Use the K-factor calibration offset for *additional* flow profile compensation (the factory includes an initial flow profile correction in the calibration curve of the unit).

Entering a K-factor with the LCD Display

A K-factor value of 1.000 means the output value is not affected and is the factory default setting. You may enter any number from 0.500 to 5.000.

1. Select the desired range. Press FUNCTION, enter the password. Press FUNCTION until *K-factor* appears on the display.

2. Use the UP or DOWN arrow keys to enter the desired K-factor value in engineering units.

3. Press FUNCTION to advance to the next option, or after 12 seconds of non-activity the meter returns to the Run Mode and the new K-factor is in effect.

Entering a K-factor without the LCD Display

A K-factor value of 1.000 VDC means the output value is not affected and is the factory default setting. You may enter any value from 0.500 to 5.000 VDC in Step 3 below. If the device indicated output is 3.0 VDC and you know it should be 3.8 VDC then you could "force" the output to the desired 3.8 VDC by adjusting the K-factor to indicate 1.27 VDC (1.27 = 3.8/3.0). Use this formula to determine the desired K-factor voltage:

VOLTS = DESIRED/ INDICATED

1. Set the DVM to voltage mode and connect between Vout+ and Vout– on the flow meter terminal block.

2. Select the desired range. Press the FUNCTION button until a solid "7" appears on the LED.

3. Adjust the UP or DOWN button until the DVM indicates the desired K-factor value as described above.

4. Press FUNCTION to advance to the next option, or after 12 seconds of non-activity the meter returns to the Run Mode and the new K-factor is in effect.

User Full Scale Adjustment

Caution!
The flow meter must not be reporting or measuring gas flow during adjustments.

The user full scale (UFS) feature adjusts the flow meter output range anywhere within 50% to 100% of the factory full scale (FFS). This feature allows you to re-range the voltage or current output of the meter to accommodate different flow rates. When entering a new user full scale setting for Range 2, it cannot be less than 10% of the Range 1 user full scale setting.

Changing the User Full Scale with the LCD Display

The factory full scale is shown on the flow meter label. If you want a UFS equal to the FFS, adjust the display to match the FFS. If you want to use 50% of FFS, adjust the display to read 50% of the FFS.

1. Select the desired range. Press FUNCTION, enter the password. Press FUNCTION until *User Full Scale* appears on the display.

2. Use the UP or DOWN arrow keys to enter the desired UFS value in engineering units.

3. Press FUNCTION to advance to the next option, or after 12 seconds of non-activity the meter returns to the Run Mode and the new UFS is in effect.

Changing the User Full Scale without the LCD Display

If the FFS is set to 11,000 sfpm and UFS is set to output 5.0 VDC, or 100%, the flow meter will indicate 5.0 VDC when 11,000 sfpm is present on the probe. If you want 6,000 sfpm for UFS, used in Step 3 below, adjust the UFS to 6000/11000 or 54.55% of factory full scale. Adjust the voltage to 2.73 VDC (2.73 = 5 x .5455). Use this formula to determine the desired UFS voltage:

$$VOLTS = 5 \times (\text{User Full Scale} / \text{Factory Full Scale})$$

1. Set the DVM to voltage mode and connect between Vout+ and Vout– on the flow meter terminal block.

2. Select the desired range. Press the FUNCTION button until a solid "8" appears on the LED.

3. Adjust the UP or DOWN button until the DVM indicates the desired user full scale as described above.

4. Press FUNCTION to advance to the next option, or after 12 seconds of non-activity the meter returns to the Run Mode and the new UFS is in effect.

Time Response Delay Adjustment

Changing the Time Response Delay with the LCD Display

1. Press FUNCTION, enter the password. Press FUNCTION until *Time Response* appears on the display.

2. Use the UP or DOWN button to adjust the time response delay from 0.10 to 7.2 seconds.

3. Press FUNCTION again to advance to the next option, or after 12 seconds of non-activity the meter returns to the Run Mode and the new time response setting is in effect.

Changing the Time Response Delay without the LCD Display

1. Set the DVM to voltage mode and connect between Vout+ and Vout– on the flow meter terminal block. Select the desired range. Press the FUNCTION button until a solid "9" appears on the LED.

2. Adjust the UP or DOWN button until the DVM indicates the desired voltage (as shown in the following table).

Volts Indicated on DVM	Time Response (Seconds)	Volts Indicated on DVM	Time Response (Seconds)	Volts Indicated on DVM	Time Response (Seconds)	Volts Indicated on DVM	Time Response (Seconds)
0.5	0.1	1.0	0.3	1.5	0.5	2.0	0.7
2.5	1.2	3.0	1.8	3.5	2.4	4.0	3.6
4.5	4.8	5.0	7.2				

3. Press FUNCTION to advance to the next option, or after 12 seconds of non-activity the meter returns to the Run Mode and the new time response delay setting is in effect.

Totalizer Reset

If your device is equipped with the optional LCD display, reset the totalizer using the keypad. If you are unable to open the flow meter enclosure, use a magnet to reset the totalizer as shown below.

1. Select the desired range. Enter the password. Press FUNCTION until *Total Reset?* appears on the display.

2. Press the UP button and then the DOWN button until the display reads "Resetting Totalizer."

Hold magnet here for reset
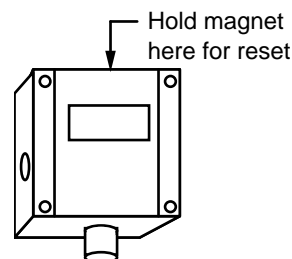
Using the Boiler-Trak Advanced Features

⚠️

Caution!
Adjusting zero or span
will affect meter cali-
bration.

Zero and span (Function 1 through 4) can be used to validate system operation and calibrate the digital to analog signals on the Boiler-Trak™. Additionally, these functions can compensate for resistance in long signal   cables connected to your data collection or in-dicating system.

You must use a certified digital voltmeter to adjust zero and span as the voltmeter acts as a standard. We recommend recording the current val-ues as shown on the LCD display or DVM before making any changes to the zero and span settings. <u>Note:</u> when adjusting zero the voltage signal will be driven to 0 VDC and when adjusting span the voltage signal will be driven to 5 VDC (or 10 VDC).

Voltage Zero Adjustment

If needed, use Zero Volts (Function 1) to adjust the 0-5 VDC output to 0.0 VDC, or optional 0-10 VDC to 0.0 VDC.

1. Set the DVM to voltage mode and connect between Vout+ and Vout–.

2. Press FUNCTION, enter the password (if so equipped). Press FUNCTION until *Zero Volts* appears on the LCD display or a solid "1" appears on the LED. Adjust the UP or DOWN button until the DVM in-dicates between 0 and .01 VDC (no less than 0.005). The Boiler-Trak™ electronics device cannot drive negative values.

3. After 12 seconds of non-activity, the meter returns to the Run Mode and the new parameter is in effect.

Voltage Span Adjustment

If needed, use Span Volts (Function 2) to adjust the 0-5 VDC output to 5.0 VDC, or optional 0-10 VDC to 10 VDC.

1. Set the DVM to voltage mode and connect between Vout+ and Vout–.

2. Press FUNCTION, enter the password (if so equipped). Press FUNCTION until *Span Volts* appears on the LCD display or a solid "2" appears on the LED. Adjust the UP or DOWN button until the DVM, indicates between 4.99 and 5.01 VDC. (For 0-10 VDC devices, the target value is 9.99 to 10.01.)

3. After 12 seconds of non-activity, the meter returns to the Run Mode and the new parameter is in effect.

Note: when adjusting zero the current signal will be driven to 4 mA and when adjusting span the current signal will be driven to 20 mA. We recommend recording the current values before making any changes to the current zero or span settings.

Current Zero Adjustment

If needed, use Zero mA (Function 3) to adjust the 4-20 mA output to 4.0 mA.

Caution!
Adjusting zero or span will affect meter calibration.

1. Disconnect the 4-20 mA (+) loop wire. Set the DVM to current mode and connect the positive lead to the wire you just disconnected. Connect the negative lead to the 4-20 mA (–) on the flow meter terminal block.

2. Press FUNCTION, enter the password (if so equipped). Press FUNCTION until *Zero mA* appears on the LCD display or a solid "3" appears on the LED. Adjust the UP or DOWN button until the DVM indicates between 3.95 and 4.05 mA. Set DVM back to voltage mode when adjustment is complete.

3. After 12 seconds of non-activity, the meter returns to the Run Mode and the new parameter is in effect.

Current Span Adjustment

If needed, use Span mA (Function 4) to adjust the 4-20 mA output to 20.0 mA.

1. Disconnect the 4-20 mA (+) loop wire. Set the DVM to current mode and connect the positive lead to the wire you just disconnected. Connect the negative lead to 4-20 (–) on the flow meter terminal block.

2. Press FUNCTION, enter the password (if so equipped). Press FUNCTION until *Span mA* appears on the LCD display or a solid "4" appears on the LED. Adjust the UP or DOWN button until the DVM indicates between 19.95 and 20.05 mA. Set DVM back to voltage mode when adjustment is complete.

3. After 12 seconds of non-activity, the meter returns to the Run Mode and the new parameter is in effect.

Instrument Validation

System electronics are verified by injecting a known input value and confirming that the flow meter outputs the expected value. This test confirms that the microprocessor, analog to digital and digital to analog converters, the linearizer and the display are working properly. Sensor validation is accomplished by measuring the resistance of the velocity and temperature sensors and comparing the results to the NIST-traceable calibration data provided with the flow meter. These tests confirm that your meter is working correctly and the calibration variables did not drift, shift or change values.

To perform the instrument validation procedures you will need these items:

- certified digital multimeter with minimum 4 character resolution, accuracy of at least ± 0.1% of range
- Calibration Certificate supplied with the flow meter
- small pot adjusting tool (screwdriver)

Before beginning the validation procedures, review Figure 3-2 and Figure 3-3 to familiarize yourself with the component locations.
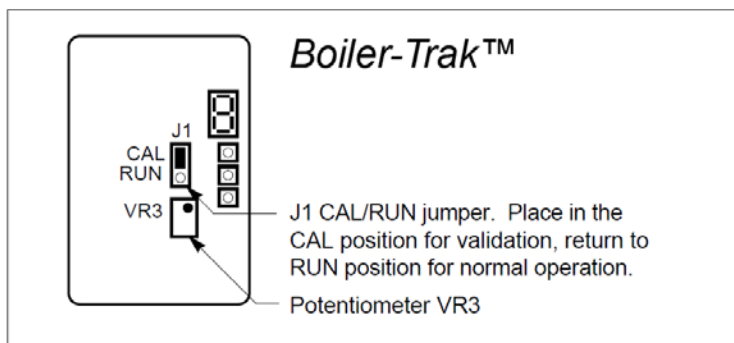

Figure 3-2. Electronics Validation Component Locations

Electronics Validation Procedure

Caution!
Before beginning this procedure, make sure the flow meter is not actively monitoring or reporting to any master control system. Any adjustment to the electronics will cause direct changes to flow control settings.

1. Verify the flow meter is off line from any remote communications. Make sure the meter's user full scale setting is the same as the factory full scale setting. If not, adjust the user full scale value as needed.

2. Locate the Calibration Certificate supplied with the flow meter. Record in Table 3-1 the five bridge voltage values, the output (VDC or mA) values and the indicated flow values.

3. Remove power from the flow meter. Remove the cover(s) of the flow meter enclosure to access the wiring terminal block and the Boiler-Trak™ electronics.

4. Set the multimeter to the 20 volt range. Connect to BV(+) and BV(−) terminals on the flow meter terminal block.

5. Move the J1 Cal/Run jumper on the Boiler-Trak™ electronics to the CAL position. Locate potentiometer VR3 on the Boiler-Trak™ electronics. Turn on power to the flow meter.

6. Adjust potentiometer VR3 until the multimeter matches the first bridge voltage point (the value must be ± 0.002 VDC of the bridge voltage point).

7. Record the resulting flow shown on the optional LCD display in Table 3-1. If not using a display or if you prefer to validate one of the analog output signals, move the multimeter + connection to Vout (+). Record the resulting output voltage in Table 3-1. If using a 4-20 mA calibrated meter, set the multimeter to read current and connect the meter to read the mA signal in your connected loop. Record the resulting current output in Table 3-1.

8. Repeat Step 6 and Step 7 to record the results of the remaining four bridge voltage validation points in Table 1. Compare the values recorded in Table 3-1. Indicated values must be within the flow meter's stated accuracy shown on the Calibration Certificate.

9. When data collection is complete, turn off power to the flow meter. Disconnect the multimeter from the flow meter terminal block.

10. Place the J1 Cal/Run jumper in the RUN position. Make sure the jumper is securely in place before resuming flow meter operation. Replace the flow meter cover(s).

Calibration Certificate Values				Validation Test Results			
Sam-ple Point	Bridge Voltage	Indicated Flow	Output (V or mA)	Indicated Flow (LCD)	Flow Meter Stated Accura-cy	Output (V or mA)	Flow Meter Stated Accuracy
0%							
25%							
50%							
75%							
100%							

Table 3-1. Electronics Validation Results

Sensor Validation Procedure

Warning!
Do not power the flow meter with the sensor jumper disconnected. This could cause over-heating of the sensors and/or damage to the electronics.

1. Locate the Ro temperature (measured resistance at 0°C) value and the Alpha value shown on the Calibration Certificate supplied with the flow meter.

2. **Turn off power to the flow meter. Allow a 6 minute cool-down before continuing.**

3. Remove the cover of the flow meter enclosure to access the sensor connection points. Remove the four-position jumper from J5, J6, J7 and J8 as shown below.
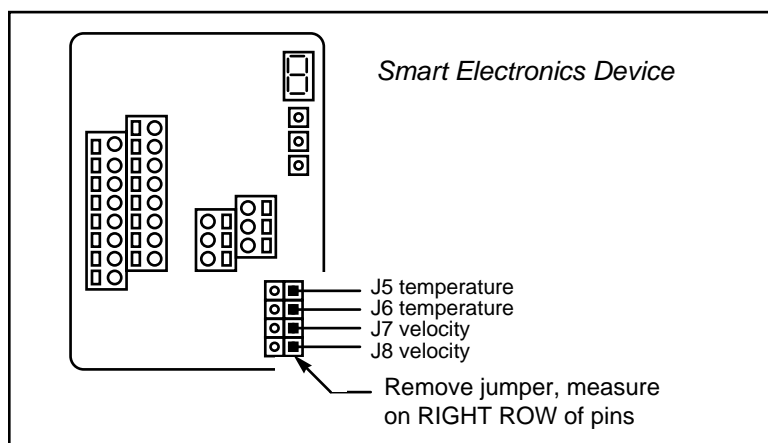

Smart Electronics Device

J5 temperature
J6 temperature
J7 velocity
J8 velocity

Remove jumper, measure on RIGHT ROW of pins

Figure 3-3. Sensor Validation Component Location

4. Set the multimeter to read Ohms in the 2K range. Connect the multimeter to terminals J5 and J6 (temperature sensor). Measure the resistance between J5 and J6 and record the temperature sensor resistance (in Ohms) in Table 3-2.

5. Set the multimeter to read in the 200 Ohm range. Connect the multimeter to terminals J7 and J8 (velocity sensor). Measure the resistance between J7 and J8 and record the velocity sensor resistance (in Ohms) in Table 3-2.

6. Use the measured resistance values and the Ro and Alpha values from the Calibration Certificate to calculate the temperature for each sensor as follows:

$$T = \frac{R - R_0}{Alpha \ x \ R_0}$$

Where

  T   = degrees Celsius
  R   = measured sensor resistance
  R_0 = resistance at 0° C (from the Calibration Certificate)
  Alpha = value unique to each sensor (from the Calibration Certificate)

7. Compare the results recorded in Table 3-2. The sensors are validated if they are within 10 degrees Celsius of each other.

8. Disconnect the multimeter and replace the four-position jumper on the sensor terminals. **Make sure the jumper is securely in place before applying power.** Replace cover.

Temperature Sensor Resistance	T (from equation)
Velocity Sensor Resistance	**T (from equation)**

Table 3-2. Sensor Validation Results

Chapter 4 Troubleshooting and Repair

Troubleshooting the Flow Meter

Begin hardware troubleshooting by verifying the following facilities issues are correct. These areas impact system operation and must be corrected prior to performing any flow meter inspections.

Warning!
Always remove main power before disassembling any part of the mass flow meter.

Caution!
Before attempting any flow meter repair, verify that the line is not pressurized.

1. Verify the incoming power to the flow meter is present and of the correct voltage and polarity.

2. Check the flow meter wiring for correct connections as described in Chapter 2.

3. Verify the flow meter is installed with the correct number of upstream and downstream pipe diameters as shown on page 2-2.

4. Verify the flow direction indicator is correctly aligned pointing downstream of flow.

5. Make sure there are no leaks in the line being measured.

After verifying the factors above, follow the troubleshooting procedures outlined on the next page. If you need to return the flow meter to the factory, see the page 4-3 for Return Material Authorization (RMA) and shipping instructions.

Flow Meter Calibration

Sierra Instruments maintains fully equipped, quality controlled Flow Calibration Metrology Laboratories for re-calibration. These laboratories have ISO 9001 certification. If the flow body or electronics have been damaged or if you simply want to have the flow meter re-calibrated, contact the factory for shipping instructions. Calibration must be performed by qualified personnel using NIST-traceable equipment.

Problem	Possible Cause	Solution
Velocity measurement is erratic or fluctuating	Very erratic or non-uniform flow	Follow installation requirements given in Chapter 2
	Flow meter installed with less than required pipe diameters upstream and downstream of the sensor	Follow installation requirements shown in Chapter 2
	Insertion sensor probe not mounted securely	Sensor probe must be mounted securely without vibration
	Sensor component broken	Return to factory for replacement
	Malfunction in system electronics	Return to factory for evaluation
	Ground loop	Check wiring, see Chapter 2
	Moisture present in the gas flow	Install a water trap or filter upstream of the flow sensor
Velocity measurement seems too high or low	Sensor assembly not aligned correctly to flow	Correct alignment with the flow indicator pointing downstream
	Sensor probe not inserted to the proper depth	Verify sensing point is located on the centerline of the pipe
	Boiler-Trak™ electronics programming is incorrect	Check all settings, see Chapter 3
	Flow profile influences	Correct with K-factor adjustment or find another mounting location
	Flow has exceeded the maximum range of the flow meter	Reduce flow below the maximum range shown on the meter's nameplate or contact the factory for re-calibration advice
	Extremely turbulent flow	Do not place the meter near a ventilator, static mixer or valve
No response to flow from sensor assembly	No power	Turn on power to the flow meter
	Low flow cutoff too high	Correct low flow cutoff programming using Sierra's Smart Interface software
	Flow rate below meter's minimum flow rating	Contact factory for instructions
	Microprocessor locked	Switch off power, wait 10 seconds, restore power
	Sensor failure	Return to factory for evaluation
	Printed circuit assembly defective	Return to factory for evaluation

Obtaining a Return Material Authorization

If you encounter any problem with your instrument, review the configuration information for each step of the installation, operation, and set up procedures as explained in this manual. Verify that your settings and adjustments are consistent with factory recommendations.

If the problem persists, Sierra is eager to help you. You may contact us at any of the following Technical Support Centers listed below. It may also help to call your Sierra Sales Agent, who is also well trained in the operation of the product.

IMPORTANT: When contacting Technical Support, make sure you have included the following information:

- The flow range, serial number, Sierra order number and model number (all marked on the instrument data label).
- The problem you are encountering and any corrective action taken.
- Application information (gas, pressure, temperature, pipe and fitting configuration).

Customer Service and Support Information:

Email Technical Support: service@sierrainstruments.com
Email Sales: sales@sierrainstruments.com

FACTORY USA
TOLL FREE: 800-866-0200
PHONE: +1-831-373-0200
FAX: +1-831-373-4402
EMAIL: service@sierrainstruments.com

European Sales & Service Center:
PHONE: +31 72 5071400
FAX: +31 72 5071401
EMAIL: service@sierra-instruments.nl

Asia Sales & Service Center:
PHONE: + 8221 5879 8521
FAX: +8621 5879 8586
EMAIL: www.sierra-asia.com

Returning Equipment to the Factory

Factory Calibration—All Models

Sierra Instruments maintains a fully-equipped calibration laboratory. All measuring and test equipment used in the calibration of Sierra transducers are traceable to NIST Standards. Sierra is ISO-9001 registered and conforms to the requirements of ANSI/NCSL-Z540 and ISO/IEC Guide 25.

Instructions for Returning Your Instrument for Service

The following information will help you return your instrument to Sierra Instruments' Factory Service Center and will ensure that your order is processed promptly. Prices may vary depending on the flow range, type of gas and operating pressure of your unit. To request detailed pricing, contact your local Sierra Instruments distributor or contact one of our offices directly. Our expedite fees are: three-day turnaround 25%, two-day turnaround 40%.

Please follow these easy steps to return your instrument for factory service:

1. Obtain a Return Materials Authorization (RMA) number from Sierra Instruments. You may obtain an RMA number by three different methods.

    1. Go to **http://www.sierrainstruments.net/rma.aspx** and fill in the form. Hit Submit and print a copy of the RMA (that now includes RMA #) send a copy of the RMA form along with your meter back to the factory.

    2. Call Sierra at 800-866-0200 or +1-831-373-0200 Monday through Friday between 7:00 a.m. and 5:00 p.m.

    3. Email Customer Service for an RMA number at service@sierrainstruments.com

2. If you require service beyond calibration, but do not know which service(s) will be required, describe the symptoms as accurately as possible on the RMA form.

3. Pack your instrument carefully. Use the original packaging and foam or bubble wrap (packing peanuts NOT recommended) and include a copy of the RMA form (complete with Sierra supplied RMA number) with the unit(s).   This is particularly important when shipping the medium and high flow versions. Due to their weight, they can be damaged in transit if not packed properly.

4. Ship the unit(s) to the following address:

Sierra Instruments, Inc.
Attention: Factory Service Center
5 Harris Court, Building L
Monterey, CA 93940 USA
RE: RMA# (your number)

Appendix A   Product Specifications

Operating Specifications

Gases	Natural Gas, Propane, Methane
Mass Flow Rates	0 to 200 sfpm (0 to 1 nmps) minimum, 0 to 8,000 sfpm (0 to 40 nmps) maximum for CH_4 and Natural Gas (6600 sfpm (33 nmps) for propane)
Dual Calibration	User-selectable dual ranges or two different gases (the user full scale for Range 2 two cannot be less than 10% of the full scale for Range 1)
Gas Pressure	0-120 psig (0-8 barg)
Pressure Drop	Negligible
Gas & Ambient Temperature	Gas .... -40°F to 176°F (–40°C to 80°C) Ambient.......................... -40°F to 120°F (-40°C to 50°C)
Power Requirements	15 to 18 VDC (regulated), 625 mA
Output Signal	Linear 0-5 VDC (0-10 VDC optional) proportional to point mass flow rate or velocity, 1000 Ohms minimum load resistance, and linear 4-20 mA proportional to point mass flow rate or velocity, 700 Ohms maximum resistance (power supply dependent), optically isolated (isolation is an input-to-output isolation of 1500 VAC for 1 minute)
Alarms	User-adjustable low, high or window alarms Deadband adjustable with Smart Interface™ software Relay rating.................... Maximum 42 VAC or 42 VDC, 140 mA, 27 Ohm maximum on-resistance, optically isolated (isolation is an input-to-output isolation of 1500 VAC for 1 minute)

Display	Alphanumeric 2 x 12 digit backlit LCD
	Adjustable variables via on-board membrane buttons or with Smart Interface software
	Adjustable variables .... Full scale adjustment (50 to 100%)
	    Time delay response (0.1 to 7.2 seconds)
	    Correction factor setting (0.5 to 5)
	    Zero and span adjustments

Totalizer	Eight digits (99,999,999) in engineering units, resetable by user
Software	Smart Interface™ Windows™-based software, minimum 8 MB of RAM, preferred 16 MB of RAM, RS-232 communication

Performance Specifications

Accuracy	± 1% of full scale (actual gas) ± 1% of full scale plus 3% of reading (correlation)
Repeatability	± 0.24% of full scale
Temperature Coefficient	± 0.02% of reading per °F within ± 50°F of customer specified conditions ± 0.03% of reading per °F within ± 50°F to 100°F of customer specified conditions ±0.04% of reading per °C within ± 25°C of customer specified conditions ±0.06% of reading per °C within ± 25°C to 50°C of customer specified conditions
Pressure Coefficient	0.02% per psi
Response Time	200 milliseconds to 63% of final velocity value

## Physical Specifications

|	
Wetted Materials	Probe: 304SS, epoxy, ceramic, Viton
Enclosure	NEMA 4X (IP65) powder-coated cast aluminum enclosure
Mounting (optional)	3/8-inch tube compression fitting with 1/2-inch male NPT
Certifications	CE approved

Mounting Dimensions

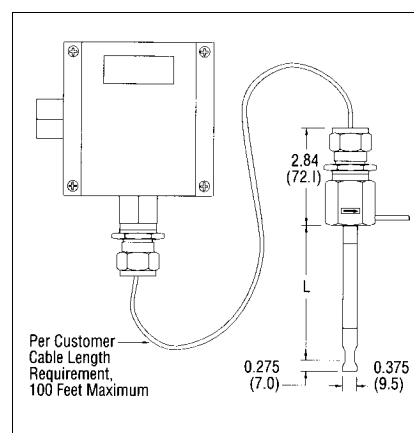| Length Chart for all Views	
Code	**L**
L04	4.0 (101.6)
L06	6.0 (152.4)
L09	9.0 (228.6)
L13	13.0 (330.2)
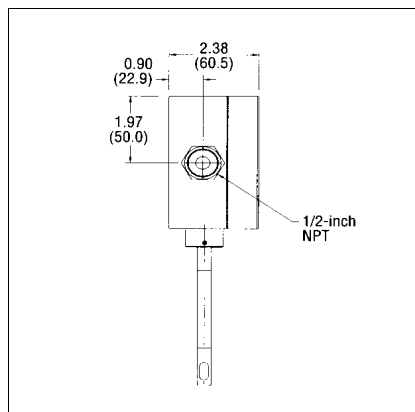
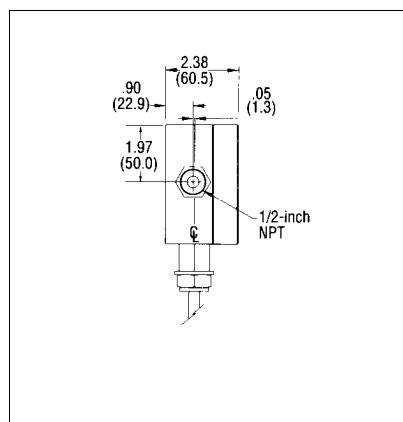*Standard Enclosure - Side View*
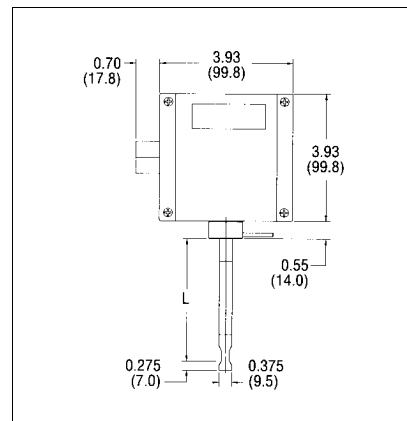
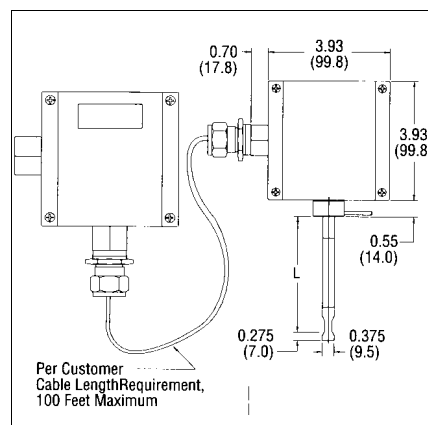*Standard Enclosure - Front View*
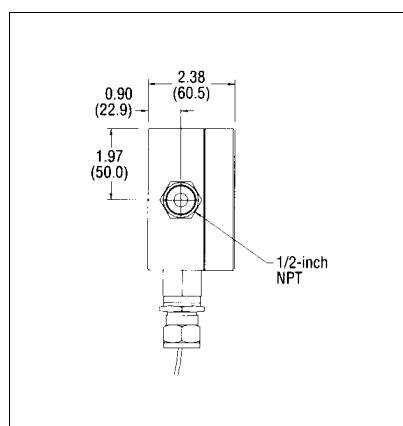
Remote Enclosure - Side View

Remote Enclosure - Front View

Enclosure-Junction Box - Side View

Enclosure-Junction Box - Front View

Appendix B 620S Boiler-Trak™ Packing Gland

Appendix C:
MOBI
MODBUS Interface for Boiler-Trak™

Instruction Manual
Part Number: IM-62 BT, Rev. A.1, February 2011

GLOBAL SUPPORT LOCATIONS: WE ARE HERE TO HELP!

CORPORATE HEADQUARTERS
5 Harris Court, Building L   Monterey, CA 93940
Phone (831) 373-0200   (800) 866-0200   Fax (831) 373-4402
www.sierrainstruments.com

EUROPE HEADQUARTERS
Bijlmansweid 2 1934RE Egmond aan den Hoef
The Netherlands
Phone +31 72 5071400   Fax +31 72 5071401

ASIA HEADQUARTERS
Rm. 618, Tomson Centre, Bldg A, 188 Zhang Yang Road
Pu Dong New District, Shanghai, P.R. China
Phone: + 8621 5879 8521   Fax: +8621 5879 8586

Table of Contents

Introduction

The need to be able to interact (or at the minimum collect data) with a flow meter from a remote location is becoming a very important issue. The already available dialup modem is for very remote locations. Most end users have PC's which are equipped with different interfaces. There are flow meters with are equipped with an RS232 interface. When using one flow meter, there isn't a problem. The user connects the flow meter to the PC and has access to information from the meter. The only problem is the distance between the PC and the flow meter.

It becomes a different story when the user has many flow meters. The RS232 interface only supports point to point communication. One could equip the PC with multiple RS232 interfaces but that would be costly and it will require tons of cables (each flow meter each own cable). Beside the maximum distance for RS232 is 20 meters.

An option would be RS485. This type of interface enables users to hook up 247 devices in parallel (the maximum numbers of devices will depend on the line conditions). There are ready made converters available which are able to convert RS232 into RS485. Two problems emerge:

1. RS232/485 converters are costly
2. Sierra flow meters equipped with an RS232 interface only support point to point communication.

There are many protocols available which can handle multiple devices sharing the same bus. A widely used protocol is MODBUS which has proven itself in the field. Unfortunate the Sierra flow meters only support one protocol and can't be modified.

MOBI

Sierra has developed an interface which acts as a gateway between two protocols. The MOBI (**MO**d**B**us **I**nterface) translates the Sierra protocol to MODBUS and visa versa. All available data from the Sierra units is stored in holding registers and can be accessed through MODBUS. Some registers can be modified.
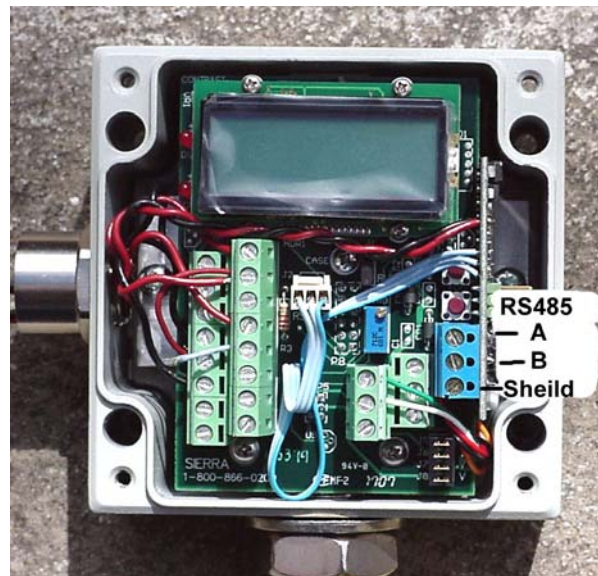
EN2 Connections (Boiler-Trak™)

Chapter 1 - The Interface Board

MOBI is build around a small PCB measuring 35 x 55 mm. Communication with the MODBUS network is done through an optical isolated RS485 driver.
Two LED's show the activities of the interface:

Red LED	Green LED	State
Off	Flashing	Processing data from the smart unit
Flashing	On	Processing MODBUS message
On	Off	Initializing
Slowly flashing	Off	Error has occurred

Board overview
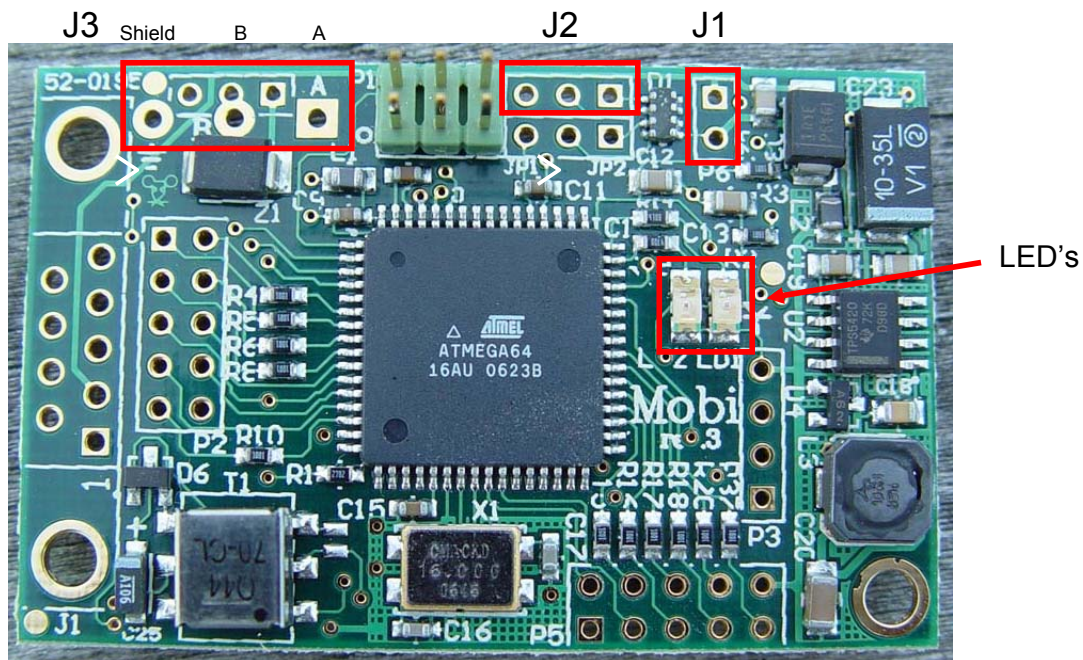
(Top view)

J1 – Power supply

Pin	Function
1☐	Power in (8 ~ 30 VDC)
2	Ground

J2 – RS232 port

Pin	Function
1☐	Receive (input)
2	Transmit (output)
3	Ground

Standard RS232 interface which connects to the flow meter or PC (when using the set up tool).

J3 – Isolated RS485

Pin	Function
1☐	A - Non-inverting output / input
2	B - Inverting output / input
3	Shield (Optional)

No external power is required for the RS485 interface. The shield can be connected to the ground/shielding of the network cable. Don't connect shield with ground when electrical isolation is required.

Note: Pin 1 on the PCA is identified by a square pad (☐)

Connecting the Board

RS232 connection

The board is connected with the flow meter using a special cable (or any cable suitable for the application). The picture below shows how the board can be connected with a model 640 flow meter:
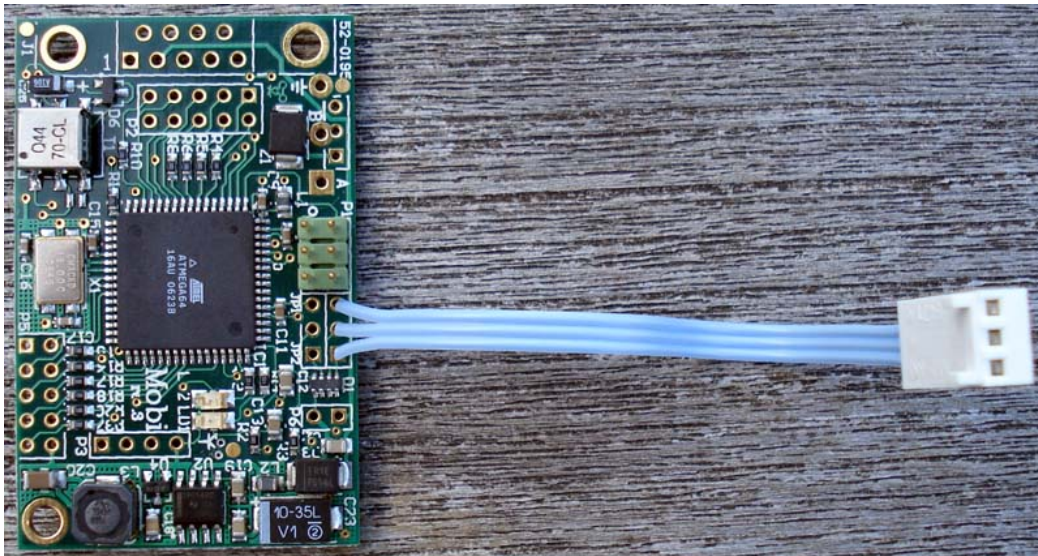
RS485 connection

The interface can only be connected to a 2 wire RS485 network as shown below:
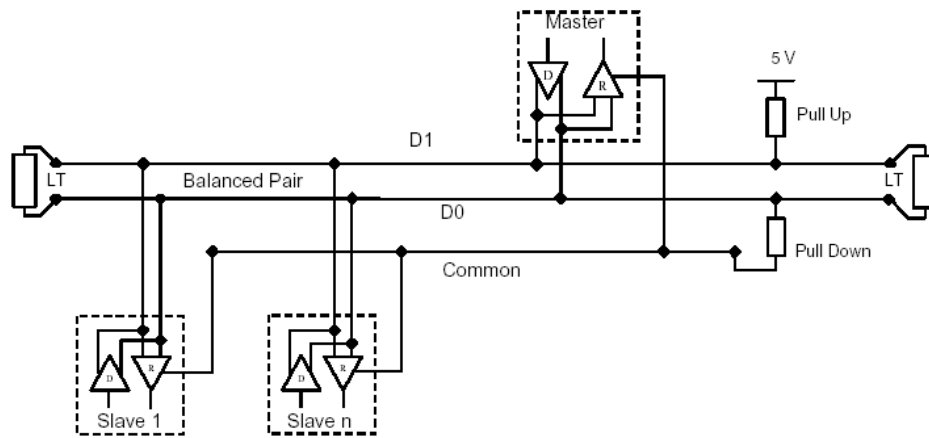
D0 = A   D1 = B   Common = shield

If the interface is the last device on the network then a terminator has to be connected between terminal A and B. The terminator consists of a resistor with a value of 150 ohm (0.5W)

Chapter 2 - Interface Setup

Mobi can be setup using the boot loader. The boot loader can be accessed using a terminal program. In order to setup Mobi a PC needs to be equipped with an RS485 interface or an external converter connected to the RS232 port.

In this example 'HyperTerminal' from Microsoft will be used.

Start HyperTerminal from windows and select the com port to which the RS485 interface is connected. Use the following settings:

Baud rate:	9600
Number of bits:	8
Parity:	N
Stop bits:	1

The boot loader will only be active during the first 2 seconds after a power-up or reset. During power-up (or reset) the green LED will blink twice before executing the application. To enter the boot loader, follow the next steps:

1.   Power up the unit
2.   In HyperTerminal press the enter key within 2 seconds of power up (any other key will terminate the boot loader and will start the application)

The following menu should be presented on the screen:

Boot 1.0
1)Load Firmware
2)Setup Firmware
3)Quit

>

Press the '2' key to select the 'Setup firmware'. The following item is presented:

Boot 1.0
1)Load Firmware
2)Setup Firmware
3)Quit

>2
Firmware:v1.0
ID (1-247)=255
(C)hange (N)ext

The current version of the firmware is shown as well as the first setting. Press the 'C' (or 'c') button to change the ID code or press 'N' (or 'n') to skip.

Depending on the firmware, several settings are presented which can be changed. After the last settings the menu will be presented again.

Now press the '3' key (Quit) to run the application or perform a power cycle to start the application.

Chapter 3 - MODBUS Commands

The implemented commands are all according to the MODBUS protocol as described in document "MODBUS Application Protocol Specification V1.1" available from the MODBUS organization (www.modbus.org). The commands can be tested using software tools like MODBUS Poll from Wittecom (www.wittecom.com).

Implemented commands

The following commands are implemented:

Function	Sub function	Description
0x03	N/A	Read holding registers
0x06	N/A	Write single holding register
0x08		Diagnostics
	0x00	Return query data
	0x01	Restart communications option
	0x04	Force listen only mode
	0x0A	Clear counters
	0x0B	Return bus message count
	0x0C	Return bus communication error count
	0x0D	Return bus exception error count
	0x0E	Return slave message count
	0x0F	Return slave no response count
	0x10	Return slave NAK count
	0x11	Return slave busy count
	0x12	Return bus character overrun count
	0x14	Clear overrun counter and flag

Holding Registers Overview Table

Register	Read	Write	Type	No. registers
40001	Actual flow - low word		32 bit float	2
40002	Actual flow - high word			
40003	Totalizer - low word		32 bits int	2
40004	Totalizer - high word			
40005	User full scale	User full scale	16 bits int	1
40006	Factory full scale		16 bits int	1
40007	K factor	K factor	16 bits int	1
40008	Dummy (reads $0001)	Reset totalizer	16 bits int	1
40009	Calibration - high word *		32 bits Int	2
40010	Calibration - low word *			
40011	Flow unit - char 1,2		String	3
40012	Flow unit - char 3,4			
40013	Flow unit - char 5,6			
40014	Totalizer unit- char 1,2		String	2
40015	Totalizer unit- char 3,4			
40016	Serial number – char 1,2		String	6
40017	Serial number – char 3,4			
40018	Serial number – char 5,6			
40019	Serial number – char 7,8			
40020	Serial number – char 9,10			
40021	Serial number – char 11,12			
40022	Tag number - char 1,2		String	5
40023	Tag number - char 3,4			
40024	Tag number - char 5,6			
40025	Tag number - char 7,8			
40026	Tag number - char 9,10			
40027	Decimal point – flow/totalizer		16 bits int	1
40028	Analog CH0 (10 bit res.)**		16 bits int	1
40029	Analog CH1 (10 bit res.)**		16 bits int	1
40030	Analog CH2 (10 bit res.)**		16 bits int	1
400341	Analog setup	Analog setup	16 bits int	1

* Format = mmddyyyy (decimal)
** Only available in special cases

Read Holding Register Overview

Each register holds a specific type of data. Sometimes more registers are required to obtain the desired information.

40001 – 40002: Actual flow

The actual flow as displayed on the LCD of the unit (if available). The flow is IEEE-754 encoded.

Example: $44C34599 = 1562.175

40003 - 40004: Totalizer value

The totalizer value as displayed on the LCD of the unit (if available). The value isn't scaled and might need correction. Read register 40027 to determine the location of the decimal point or scale the value in the OPC/HMI software

Example: $293F0D = 2703117

Reading register 40027 returns $0002 $\Rightarrow$ totalizer decimal point = $02 $\Rightarrow$ #.##
The value of the totalizer becomes: 27031.17

40005: User full scale

The returned word contains the full scale of the unit as set by the user.

Returned: User full scale hexadecimal encoded

Example: $4E20 = 20000

40006: Factory full scale

Returned word contains the full scale of the unit as set by the manufacturer.

Returned: Factory full scale hexadecimal encoded

Example: $5DC0 = 24000

40007: K factor

The returned word contains the K factor of the used gas as set by the user.

Returned: K factor hexadecimal encoded

Example: $03E8= 1000 $\Rightarrow$ the value needs to be divided by 1000 to get the correct factor $\Rightarrow$ 1.000

40008: Dummy

Reading this address will return fixed data ($0001).

40009 – 40010: Calibration date

The returned data contains the calibration date of the unit.

Returned: calibration date hexadecimal encoded

Example: Reading 0x8D2CA3 which equals 9252003 in decimal. This equals to
                9 25 2003 = September 25, 2003

40011 – 40013: Flow unit

Each register contains two characters of the flow unit. The returned word is encoded in ASCII.

Returned: Characters

Example: $534C $\Rightarrow$ "SL"

40014 - 40015: Totalizer unit

Each register contains two characters of the totalizer unit. The returned word is encoded in ASCII.

Returned: Characters

Example: $534C $\Rightarrow$ "SL"

40016 - 40021: Serial number

Each register contains two characters of the serial number. The returned word is encoded in ASCII.

Returned: Characters

Example: $5339 $\Rightarrow$ "S9"

The serial number is 12 characters long. It always starts with "SN:"

40022 – 40026: Tag number

Each register contains two characters of the tag number. The returned word is encoded in ASCII.

Returned: Characters

Example: $5330 $\Rightarrow$ "S0"

The tag number is set through the configuration software

40027: Decimal point of the flow/totalizer

Location of the decimal point in the actual flow/totalizer

Returned: 2 bytes (high byte = flow, low byte = totalizer)

Example: $0201 $\Rightarrow$ decimal point flow = $02, decimal point totalizer = $01

Data	Point location	Divide by
0	00000000	0
1	0000000.0	10
2	000000.00	100
3	00000.000	1000
Etc.		

40028 – 40030: Analog channel

Data from the analog input channels. The analog to digital converter has a resolution of 10 bits.

Write Holding Register Overview

40005: User Full scale

The sent word contains the full scale of the unit as set by the user.

Example: Writing $5DC0 will set the scale to 24000

40007: K factor

Set the K factor of the unit.

Example: Writing $4B0 will set the K factor to 1.2 (1200)

40008: Reset totalizer

Reset the totalizer by writing the value $0001.

Note: Sometimes it needs two write attempts to get the value written to the unit

40031: Analog settings

The analog inputs can be configured to perform the following functions:

Low byte bits	Function	CH0	CH1	CH2
0	Input multiplier, 0 = 1x, 1 = 0.5x	●		
1	Input mode, 0 = voltage, 1 = current	●		
2	Input multiplier, 0 = 1x, 1 = 0.5x		●	
3	Input mode, 0 = voltage, 1 = current		●	
4	Input multiplier, 0 = 1x, 1 = 0.5x			●
5	Input mode, 0 = voltage, 1 = current			●
6	-	-	-	-
7	Reference, 0 = 2.56V, 1 = 5V	●	●	●

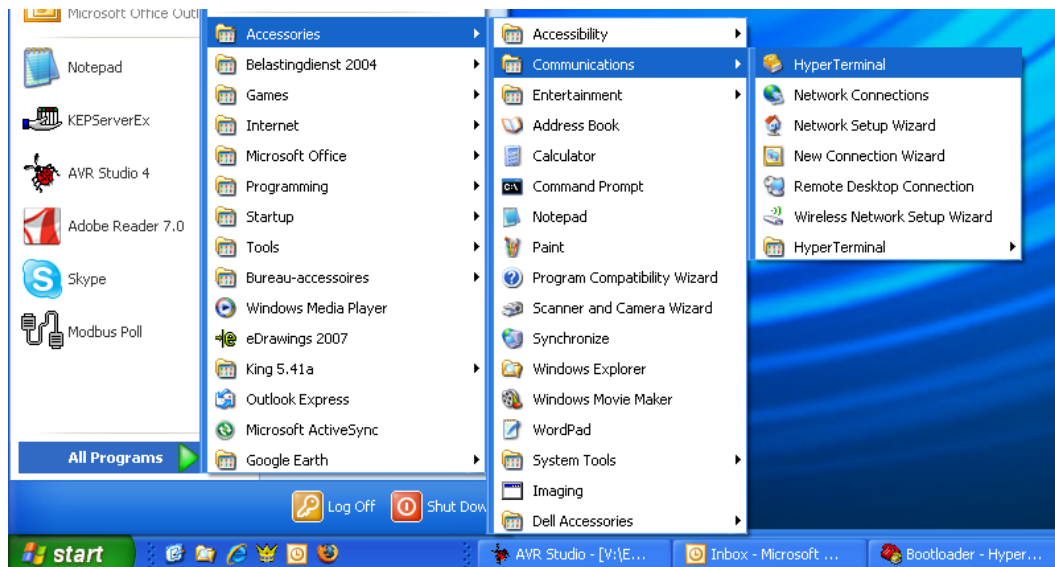*Note: maximum input range voltage: 5V*

Appendix A : MOBI - Boot Loader

Introduction

This section describes how the boot loader is used currently found on the new Mobi generation. The boot loader makes it possible to set up applications and download firmware using a simple terminal program and a serial connection.

Getting started

In order to set up Mobi, a PC is needed which is equipped with an RS485 interface or an external converter connected to the RS232 port.

Connect the RS485 interface of Mobi to the RS485 interface of the PC. On the PC start a simple terminal program like HyperTerminal.
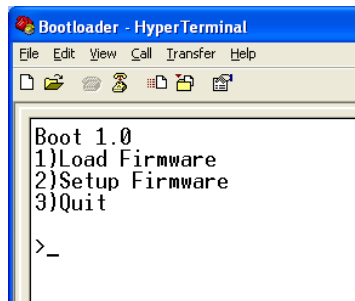
Start HyperTerminal from windows and select the com port to which the RS485 interface is connected. Use the following settings:

        Baud rate: 9600
        Number of bits: 8
        Parity: N
        Stop bits: 1

The boot loader will only be active during the first 2 seconds after a power-up or reset. During power-up (or reset) the green LED will blink twice before executing the application. To enter the boot loader, follow the next steps:

1.   Power up the unit
2.   In HyperTerminal press the enter key within 2 seconds of power up (any other key will terminate the boot loader and will start the application)

When the boot loader is activated successfully the green LED will stay on. The following menu will be presented on the screen:
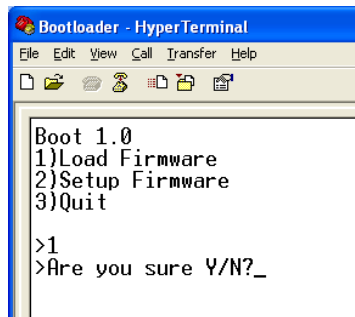

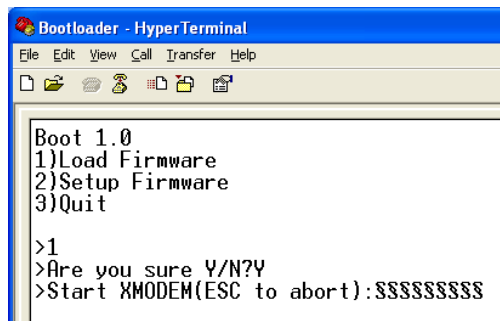The version of the boot loader is shown and three options. By pressing the "1", "2" or "3" key an option is selected.

Load Firmware

This option is used to download firmware to the unit. When pressing the "1" key the following screen will be presented:
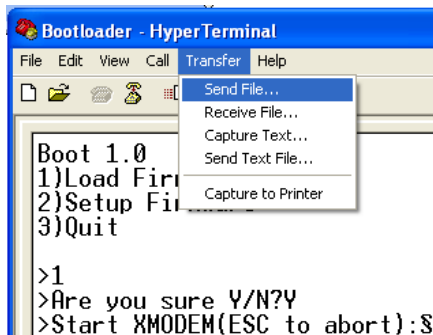

A question is presented asking to continue. Press the "Y" or "y" key to continue. Press "N" or "n" to abort. When continuing the following screen will be presented:
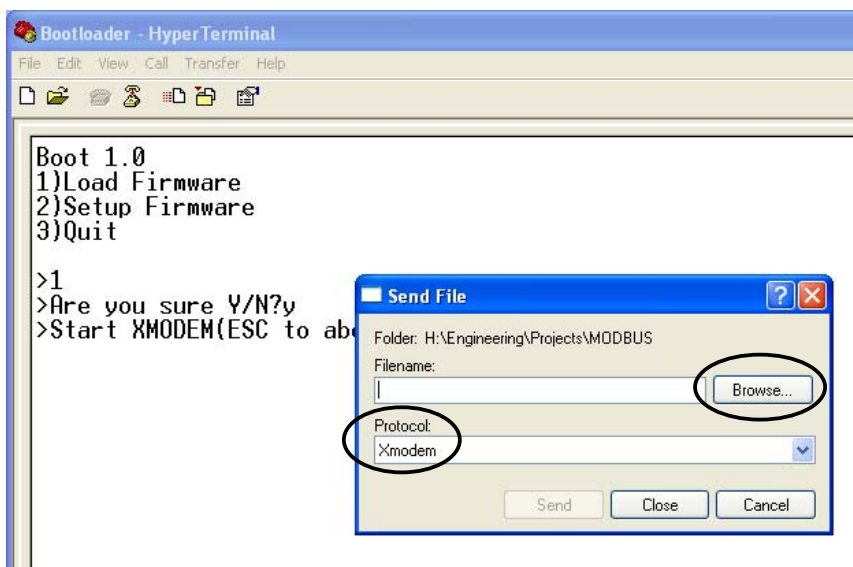

The screen will start to fill up with the "§" character indicating that the XMODEM transfer can be started. Press the "ESC" key to abort.

From the "Transfer" menu select "Send file"

A new screen will be presented asking for the file to be transferred:

Use the "Browse" button to select the file to download. Only files with the ".hex" extension can be downloaded to the unit. Also make sure that the "Xmodem" protocol is selected. When the file is selected, press the "Send" button. The transfer screen pops up and the file download status can be monitored. During the download the green LED will be off will the red LED will be on.

If the download needs to be cancelled then simple press the "Cancel" button and then press the "Esc" key to return to the boot menu.
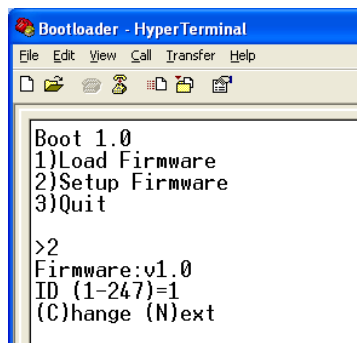
Note: Once the download has started it isn't possible to stop it. Doing so will result in losing the current application.
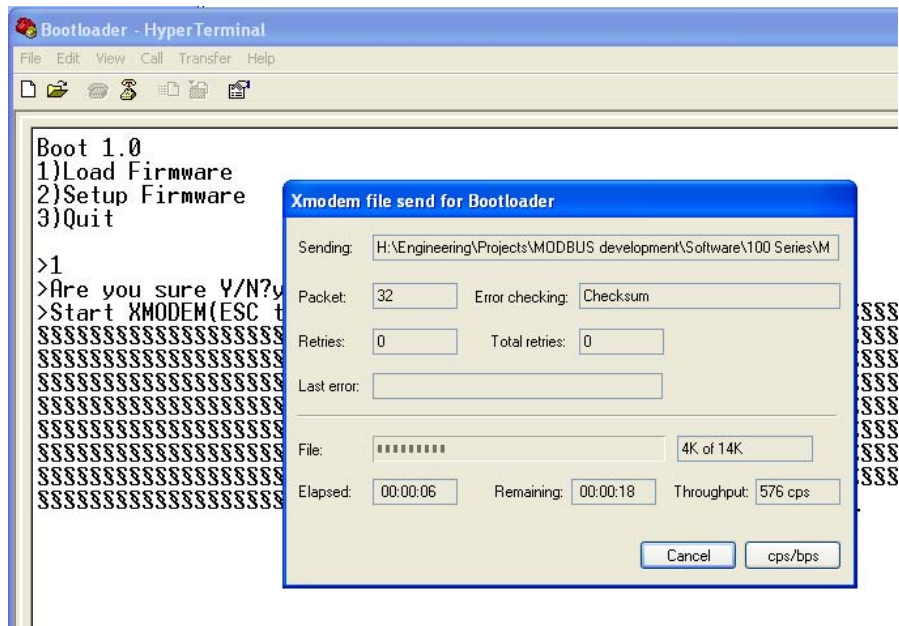
When the download is finished the start-up screen will be shown again presenting three options.

Setup Firmware

This option is used to set up the firmware in the unit. When pressing the "2" key the following screen will be presented:

The version of the firmware will be shown followed by the first option which can be set. It will show the current selected value as well which values can be entered.

In this above example, the ID code of the unit can be set between 1-247 and the current setting is 1.

Pressing the "C" or "c" key will prompt for a new value. Enter a new value and press the "Enter" key. The new value will be stored and the next option will be presented (if available). Data which can be entered must match the type presented. So in the above example only numbers can be entered. Characters will be ignored. Also the size of the entry will be limited depending on the maximum size allowed.

When all options have been viewed the default boot menu will be presented again. The options presented will depend on the firmware.

Hint: While entering a new value the "Backspace" key can be used to erase entered values

Note: It is advised to only enter values which are shown between the brackets. Other values may be entered but could result in the unit not functioning correctly.

Quit

This option will quit the boot loader and will start the application.

Trouble shooting

Problem	Solution
During the firmware transfer the download has halted and nothing is happening anymore (or an error message appears)	Reset the unit and try again. Make sure that only .hex files intended for the unit are selected
When trying the enter data the length is limited. No more data is excepted	For each option the data type and length are predefined. When data isn't accepted anymore then the maximum is reached. Also it's not possible to enter characters when numbers are expected (and visa-versa)
The characters on the screen are all messed up	Check the communication settings. They should be 9600,8,N,1
The unit doesn't enter the boot loader although the enter key is pressed within 2 seconds after start-up	Try swapping the "A" & "B" lines of the RS485 connection and try again