Linear LinK™

Installation, Operation and Maintenance Manual

TM-100562, Rev T

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TM-100562 REVISIONS

DATE	REVISION	ECO NUMBER	APPROVAL
3/13/2013	H	22521	J. Blasius
4/15/2013	J	22566	J. Blasius
6/27/13	K	22660	R. Mann
9/4/13	L	22762	R. Mann
3/3/14	M	22907	J. Blasius
12/15/14	N	23522	R. Mann
8/9/16	P	24403	R. Mann
3/20/17	R	24681	R. Mann
3/24/17	S	24688	R. Mann
8/4/17	T	24842	R. Mann

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PUBLISHED BY FLOW TECHNOLOGY, INC. – March, 2017

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1 INTRODUCTION

1.1 Scope

This manual provides information and guidance for personnel responsible for the installation, operation, and maintenance of the Linear LinK™ manufactured by Flow Technology, Inc.

This manual covers model numbers beginning with "LA" only. For model numbers beginning with "LN", see technical manual TM-61546.

1.2 Purpose

The contents of this manual are for general information and to describe the operational characteristics of the Linear LinK™ flow computer. This manual does not include instructions for special application or factory repair.

1.3 Description

The Linear LinK™ series offers linearization, signal conditioning, selectable outputs, and a wide input power voltage range. The frequency measurement can be averaged over several pulses (up to 99) to "smooth" variations caused by pulsating flow or dimensional variations in the flow meter. The Linear LinK™ can be configured to output either volumetric or mass flow.

The Linear LinK™ reduces the installation cost; 1) by including a flow meter signal conditioner and eliminating the need for an external conditioner, 2) by producing a flow rate output and eliminating the need for separate instruments and 3) with compact packaging.

The Linear LinK™ system is complemented by a Windows® configuration program, Visual LinK™. The user-friendly Visual LinK™ configuration software is used to configure the system and also to recall data from the system that was configured previously. The Visual LinK™ software allows the user to input, edit, and screen plot calibration data and fluid property data for easy visual data verification.

The Linear LinK is approved for use in the European community under the CE certification program. A declaration of conformity is shown in Appendix C.

The Linear LinK™ is available in seven standard enclosure options and also available without an enclosure. See Appendix A for a model number breakdown. Examples of the enclosure options are shown in Figure 1 through Figure 7.

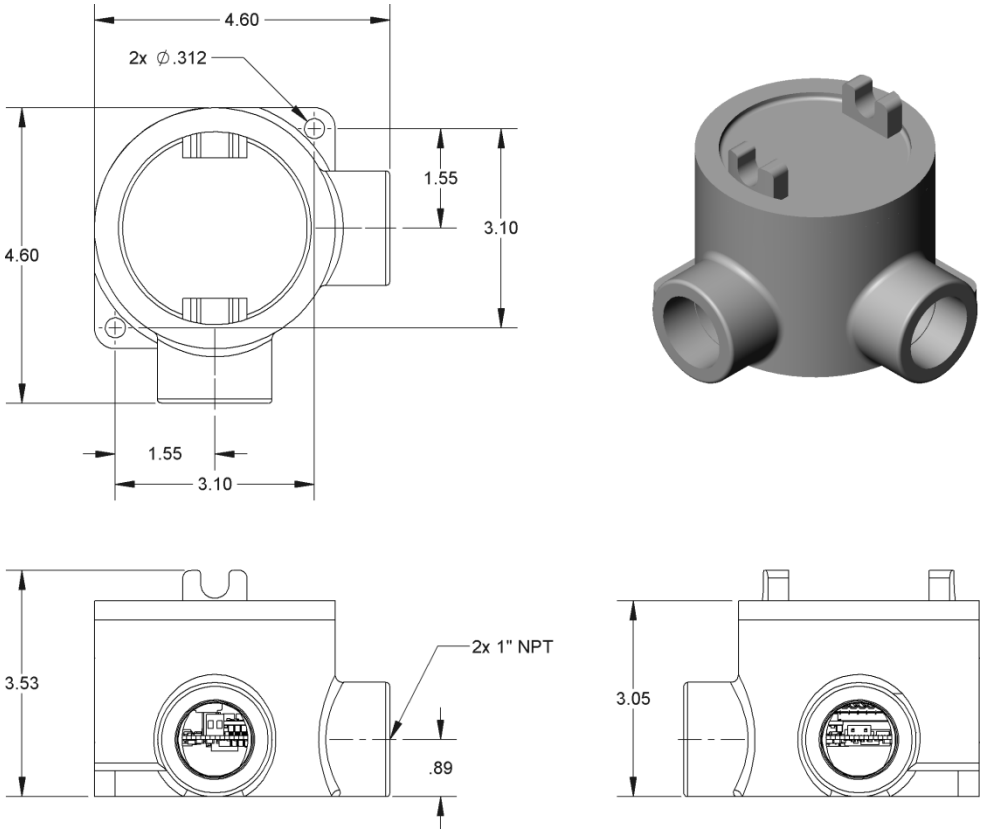


Figure 1 - Linear LinK™ Explosion Proof Enclosure (-9 option)

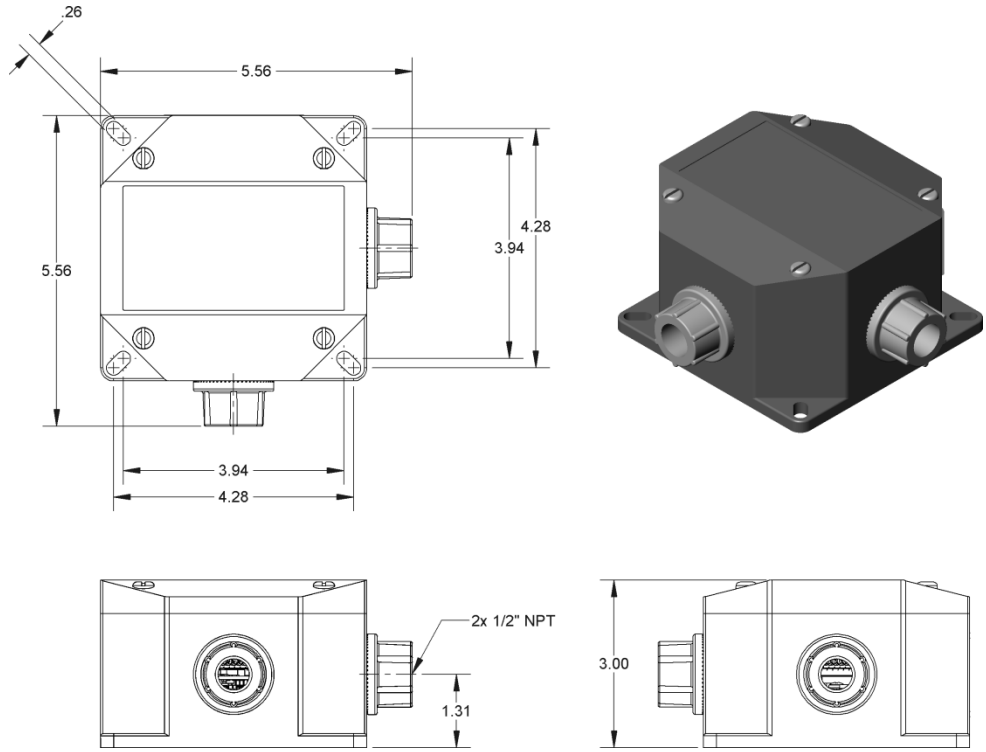


Figure 2 - Linear LinK™ NEMA 4X with Conduit Hubs (B6 option)

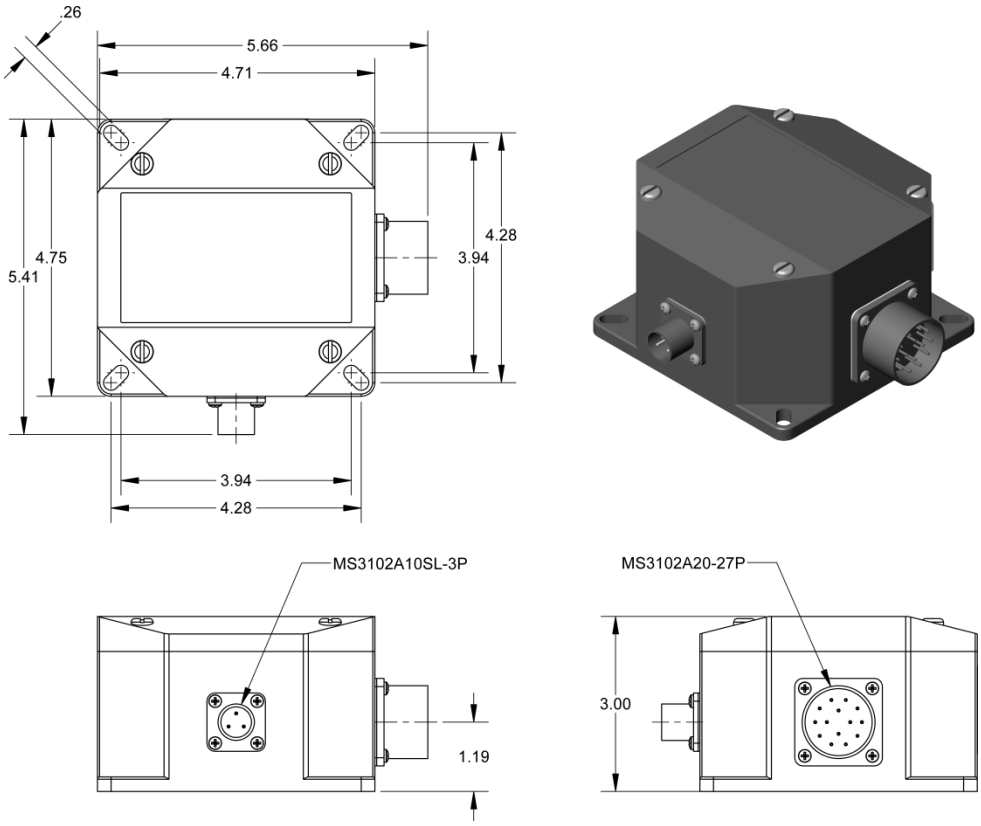


Figure 3 - Linear LinK™ NEMA 4X with MS Connectors (B7 option)

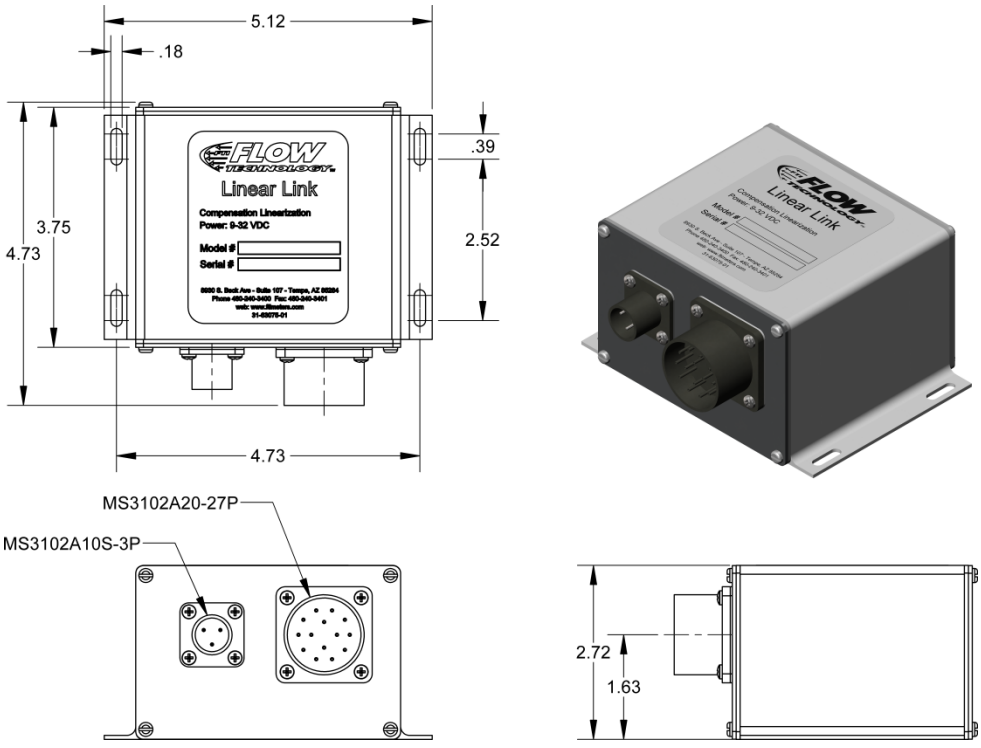


Figure 4 - Linear LinK™ Dust-tight Aluminum with MS Connectors (A7 option)

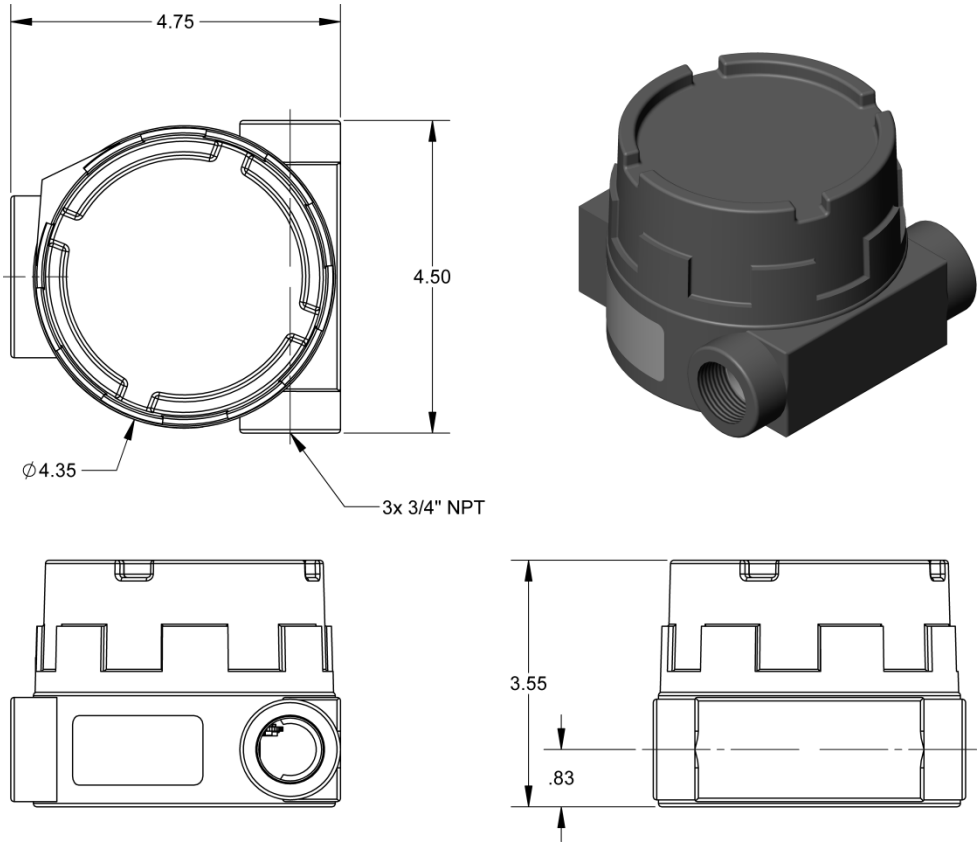


Figure 5- Linear LinK™ Flameproof Enclosure (-F option)

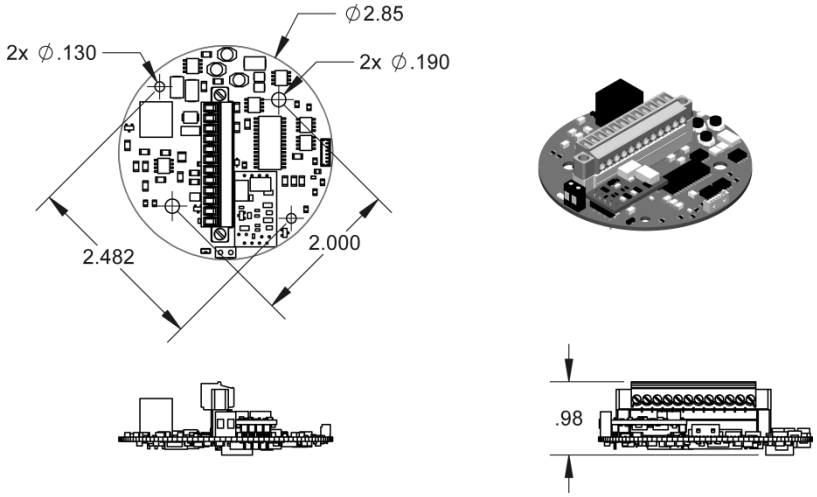


Figure 6 - Linear LinK™ No Enclosure (-0 option)

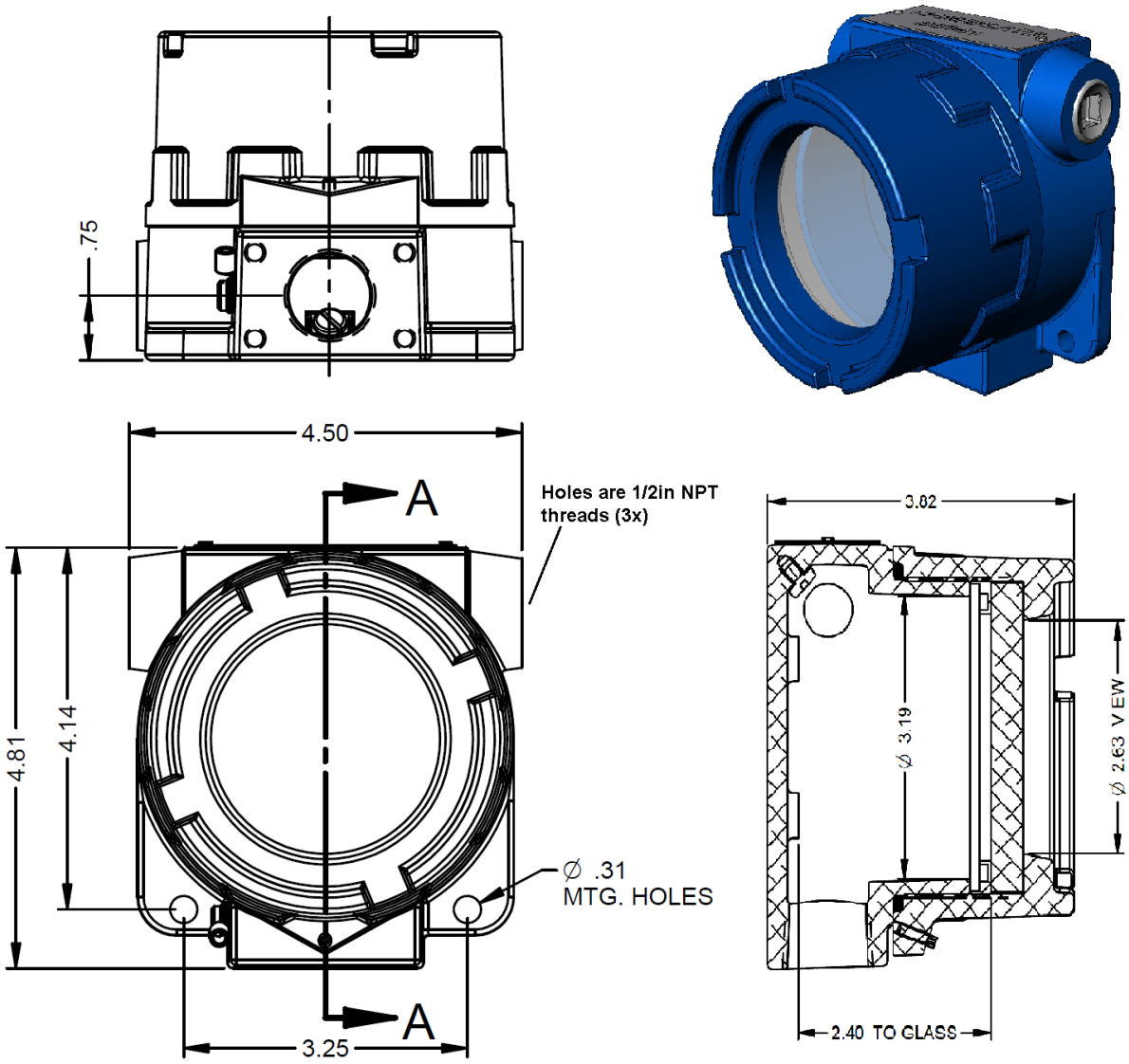


Figure 7 - Linear LinK™ with Industrial Display (F1 option)

2 INSTALLATION

2.1 Inspection

Your Linear LinK™ has been tested, calibrated, and programmed to linearize the output of its mated flow meter prior to shipment. The equipment is ready for immediate installation upon receipt. Please check the unit to assure that no damage has occurred during shipment. Verify that the model number of the unit received matches the equipment ordered.

2.2 Mechanical Installation of the Linear LinK™ to the Flow meter

2.2.1 Linear LinK™ mounted on flow meter pickoff.

If the Linear LinK™ is intended for direct mounting on the flow meter pickoff, it will be pre-mounted and pre-wired at the factory. No mechanical adjustments are required. You may proceed to Section 2.3.

In the event that you loosen the locknut on the flow meter pickoff, loosen the pickoff, and/or remove the pickoff, refer to the flow meter manual for proper reinstallation of the pickoff. Improper installation of the pickoff may result in erroneously low or zero output.

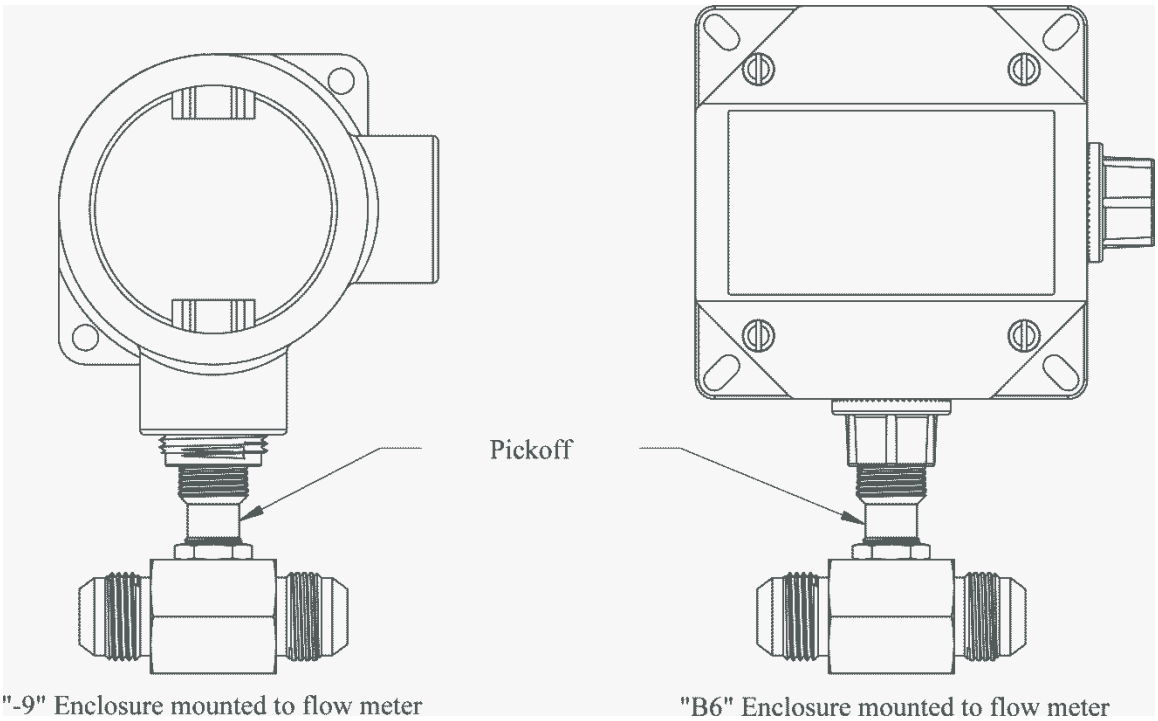


Figure 8 - Linear LinK™ Mounted on Flow Meter

2.2.2 Linear LinK™ mounted remotely from the flow meter

If the Linear LinK™ is intended for remote mounting no mechanical adjustments are required. The enclosure may be mounted using the conduit hubs (where applicable), or the mounting holes. You may proceed to Section 2.3.

For RF input versions of the Linear LinK™ locate the enclosure no more than 10 feet from the flow meter pickoff and use a twisted shielded cable. When multiple RF input versions are installed, use separate twisted shielded cables between the flow meter and enclosure and do not run the cables in a common conduit. In some applications, placing the pickoffs, cables, or enclosures too close together may cause cross-talk between the units. Grounding the fluid piping may reduce the cross-talk between the units.

In the event that you loosen the locknut on the flow meter pickoff, loosen the pickoff, and/or remove the pickoff, refer to the flow meter manual for proper reinstallation of the pickoff. Improper installation of the pickoff may result in erroneously low or zero output.

2.3 Electrical Installation

This section provides the professional installer with information for connecting the Linear LinK™ to the user's system.

WARNING:

Verify that the power is off before connecting or servicing!

NOTE: Pickoff connections from a remote flow meter should be made using double shielded cable. The shielding should be of both foil and braid type.

2.3.1 Pickoff Wiring

Wiring diagrams for the standard FTI pickoffs are shown below.

Figure 9 – MS Connector Pickoff Wiring: Pickoff codes -1 (RF) and -2 (MAG)

Figure 10 – Flying Leads Pickoff Wiring: Pickoff codes -3 (MAG) and -5 (RF)

Figure 11 – Explosion Proof, Flying Leads Pickoff Wiring

Pickoff codes –X3 (Explosion Proof MAG) and –X5 (Explosion Proof RF)

2.3.2 Codes “A7”, and “B7” (MS Connectors)

Table 1 lists each signal available on the 3-pin and 14-pin connectors. All cables going to or from the Linear LinK™ must be shielded. The shield should be grounded at the customer’s interface and not at the Linear LinK™ for the 14 pin connector. The RF Shield should be connected to “C” of the 3-pin connector and that side will be grounded through the enclosure side.

Table 1 - Electrical Connections For A7, and B7 Enclosures

Linear LinK™ Function		**MS Connector**	
Signal Designation	**Description**	**3 Pin Input**	**14 Pin Output**
- XDCR	Pick-off lead, Non-polar	A (yel/wht)	
+ XDCR	Pick-off lead, Non-polar	B (org/wht)	
Tx	Program transmit		K (yel)
Rx	Program receive		J (brn)
F_Lin	Flow 0-5V square wave, processed pulse		C (gry)
Tx_ Data	Transmit data		D (brn/wht)
DGND	Digital Ground		M (blu/blk)
F_Raw	Flow 0-5V square wave, raw pulse		L (org)
RF Shield	Shield Ground	C (blk)	
AGND	Analog Ground		N (blk/wht)
FIOut	Flow current out		F (blu/wht)
FVOut	Flow voltage out		E (blu)
PWR_RET	Power Ground		B (blk)
PWR	12 to 32 VDC, Vout, 19 to 32 VDC, Iout		A (red)

2.3.3 Codes “-F”, “-9”, “-0”, and “B6” (No MS Connectors)

Table 2 lists each signal available on the circuit board. All cables going to or from the Linear LinK™ must be shielded. The shield should be grounded at the customer’s interface and not at the Linear LinK™, except for the RF Shield which should be connected to PC Board Terminal “P2,1”and that side will be grounded through the enclosure side.

The PC board terminals are shown below in Figure 12.

Table 2 - Electrical Connections for –F, -9, -0, and B6 Enclosures

Linear LinK™ Function		PC Board Terminal
Signal Designation	**Description**	
- XDCR	Pick-off lead, Non-polar	P1, (-)
+ XDCR	Pick-off lead, Non-polar	P1, (+)
Tx	Program transmit	P3, 1
Rx	Program receive	P3, 2
F_Lin	Flow 0-5V square wave, processed pulse	P2, 10
Tx_ Data	Transmit data	P2, 11
DGND	Digital Ground	P2, 3
F_Raw	Flow 0-5V square wave, raw pulse	P2, 9
RF Shield	Shield Ground	P2,1
AGND	Analog Ground	P2, 12
FIOut	Flow current out	P2, 7
FVOut	Flow voltage out	P2, 8
PWR_RET	Power Ground	P2, 1
PWR	12 to 32 VDC, Vout, 19 to 32 VDC, Iout	P2, 2

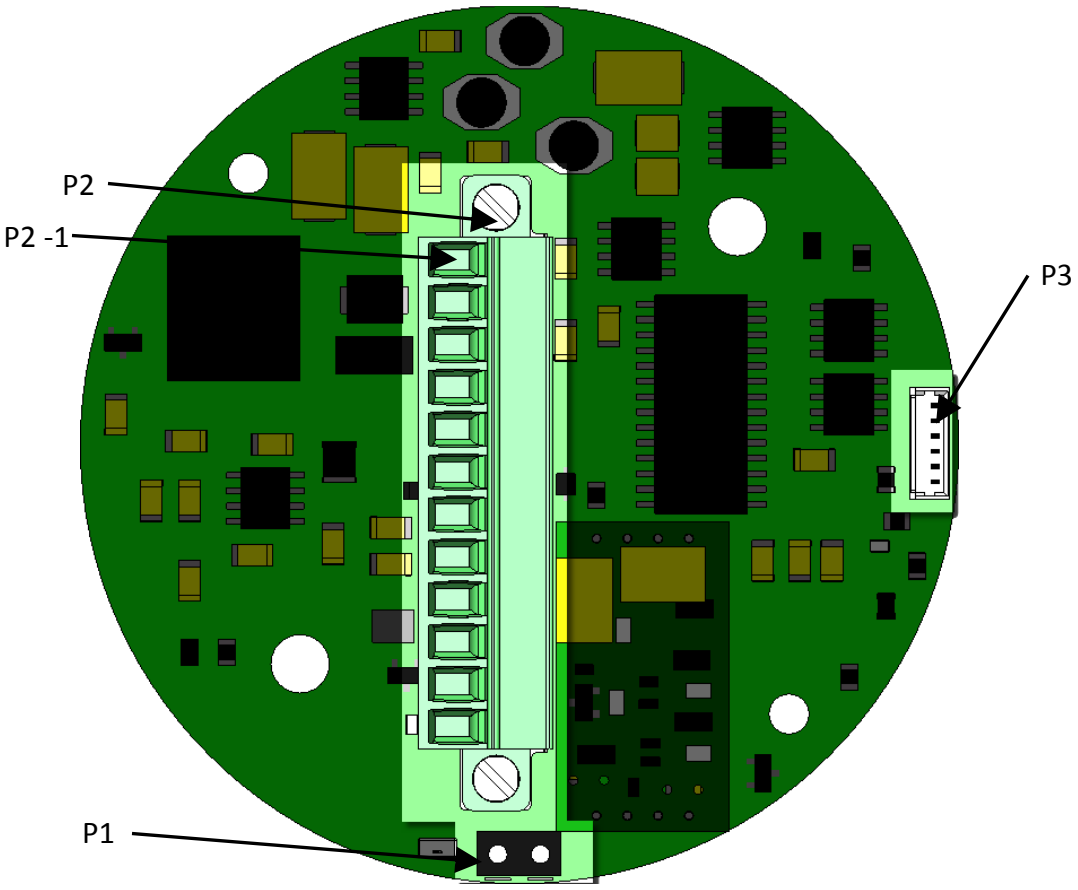


Figure 12 - PCBA with P1, P2, and P3 Connectors

2.3.4 Programming and/or Calibration using Visual LinK™

A programming cable is required for programming. The cable may be purchased from Flow Technology, Inc. or the user can create their own. If purchasing the cable, specify cable part number 19-62627-104 for models without a MS connector or 19-62627-106 for models with a MS connector. A cable drawing is shown in Appendix D.

The switch on the DB9 connector is used to toggle between operate and program mode. To program using Visual LinK™, the switch must be set to “P”. To monitor the serial data, set the switch to “O”.

To connect the programming cable, the enclosure must be opened for access to the programming connector. Plug the cable in to the connector identified as P3 on the circuit board.

2.3.5 Code “-F1” (Industrial Display)

Table 3 lists each signal available on the circuit board. All cables going to or from the Linear LinK™ must be shielded. The shield should be grounded at the customer’s interface and not at the Linear LinK™, except for the RF Shield which should be connected to PC Board Terminal “P2,14”and that side will be grounded through the enclosure side. P1 is used to supply power and signals to the Display PCBA.

Table 3 - Electrical Connections for the –F1 Enclosure

Linear LinK™ Function		**PC Board**
Signal Designation	**Description**	**Terminal**
- XDCR	Pick-off lead, Non-polar	P2, 15
+ XDCR	Pick-off lead, Non-polar	P2, 16
Tx	Program transmit	P3, 1
Rx	Program receive	P3, 2
F_Lin	Flow 0-5V squ wave, processed pulse	P2, 11
Tx_ Data	Transmit data	P2, 12
DGND	Digital Ground	P2, 4
F_Raw	Flow 0-5V squ wave, raw pulse	P2, 10
RF Shield		P2,14
AGND	Analog Ground	P2, 13
FIOut	Flow current out	P2, 8
FVOut	Flow voltage out	P2, 9
PWR_RET	Power Ground	P2, 14
PWR	15 to 32 VDC, Vout 23 to 32 VDC, Iout	P2, 3
R_RST +	Remote Reset +	P2, 2
R_RST -	Remote Reset -	P2 ,1

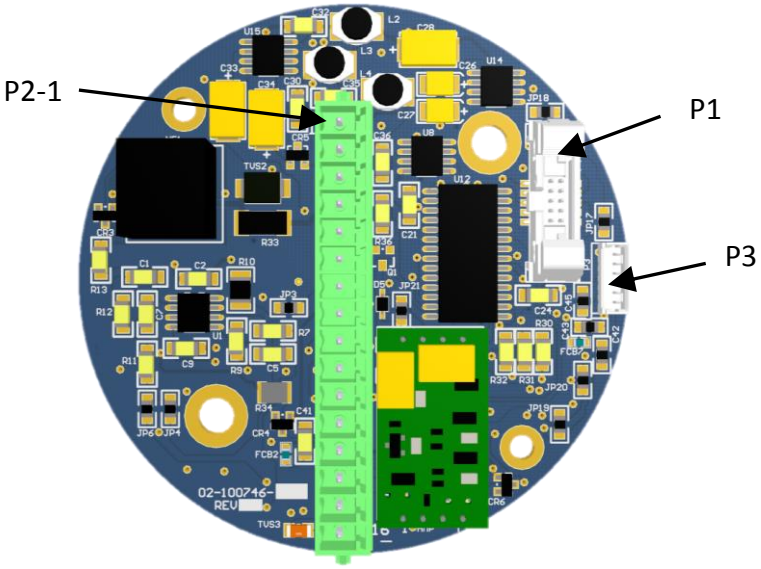


Figure 13 - PCBA with P1, P2 and P3 Connectors

3 THEORY OF OPERATION

3.1 Variable Definitions

Table 4 lists the variables references in this section. Note that K-Factor, volume rate, mass rate, temperature, and density all have user-defined units. An example unit is listed in the table for clarity.

Table 4 - Variable Definitions

Variable	Description
f	Meter frequency (Hz)
FI_{Out}	Analog current output for flow rate (mA)
f_{Max}	User-defined maximum frequency (Hz)
f_{OUT}	Scaled frequency output for flow rate (Hz)
FV_{Out}	Analog voltage output for flow rate (VDC)
I_{Range}	Range of analog current output, default = 16 (mA)
K_0	Reference K-Factor (pulse/gallon)
K_D	Desired K-Factor (pulse/gallon)
M_A	Actual mass flow rate (lb/min)
M_{Max}	Maximum mass flow rate (lb/min)
Q_A	Actual volumetric flow rate (gallon/minute)
Q_{Max}	User-defined maximum flow rate (gallon/minute)
TI_{Out}	Analog current output for flow rate (mA)
TV_{Out}	Analog voltage output for flow rate (VDC)
TimeBase	Number of seconds in the user-defined time scale (sec)
V_{Max}	User-defined maximum voltage output (VDC)
ρ	Fluid density (lb/gal)

3.2 Overview

Fluid traveling through a turbine flow meter causes the rotor to spin with a velocity proportional to the volumetric flow rate. The pickoff coil is sensitive to the ferric content of the stainless steel rotor blades. Each blade of the spinning rotor generates a pulse while passing through the electromagnetic field surrounding the pickoff coil. These pulses, when viewed over time *(pulses per second, or hertz)*, produce a frequency that is directly proportional to the flow rate.

The Linear LinK™ is available in either a MAG pickoff version or an RF pickoff version. The MAG version generates a magnetic field with a small magnet. The RF version uses a signal conditioner to generate a carrier wave. Generally the MAG version can operate through thicker flow meter walls than the RF, but also introduces magnetic drag on the rotor. The RF version introduces no drag, and is preferred for smaller meters, especially when operating in the lower extended flow ranges.

The relationship between the volumetric flow rate and the frequency output of a flow meter is known as the K-Factor (pulses per unit volume; i.e. pulses per gallon).

$$K - Factor = \frac{Frequency}{FlowRate} * TimeBase$$

Turbine flow meters are noted for their fast response times, repeatability and good linearity. Unfortunately, the relationship between K-Factor and flow rate becomes increasingly non-linear for turbine flow meters operating at the low end of their flow ranges where viscosity, bearing, and magnetic pickoff drag have significant effects on rotor performance.

The Linear LinK™ compensates for the deviation of a turbine meter from the ideal performance and generates a pulse signal that is linear to within ±0.1% of reading. The linearized K-Factor is generated by using the actual K-Factor as a reference.

The Linear LinK™ linearizes the K-Factor curve of a turbine flow meter by providing up to 100 points of correction. The microprocessor compensates for the non-linearity of each segment of the curve between the points. With the simple programming provided by Visual LinK™, every flow meter equipped with a Linear LinK™ can be given an identical K-Factor. This allows for direct interchangeability without the need to re-program displays or batching controllers.

The Linear LinK™ product requires calibration data for the flow meter and fluid property data, before it can be used to calculate the flow rate as a function of meter frequency, compensate for measurement errors, and output the scaled units of volume or mass. The Linear LinK™ will output compensated and scaled frequency, analog voltage, or analog current for the flow rate.

3.3 Operating Functions

3.3.1 Period Measurement with Averaging

The Linear LinK™ uses a period measurement method to measure the frequency. This can be configured to average the frequency of 1 period or up to 99 periods. This allows the user to optimize the system for the specific application. One period can be selected to minimize response time (less than 20 milliseconds). This will update the frequency based on every period, such as each pulse from a turbine meter. Alternately, the frequency can be averaged over several periods. This function can be used to smooth the output in a pulsating flow. The averaging feature uses a running averaging that is updated every period with the least current frequency discarded as the most current frequency is acquired. This allows a continuous update of the frequency output.

3.3.2 Flow Linearization

The Linear LinK™ contains linearization tables for the flow meter frequency. Up to 30 points can be entered to linearize the flow meter frequency signal. The user enters the table values with Visual LinK™. Visual LinK™ allows the user to view a graph of the data and edit the data to produce the best characterization of the flow meter.

The Linear LinK™ includes a raw flow meter frequency output that allows the user to output the unprocessed flow rate frequency along with a the processed output. The unprocessed signal can be used to verify the processed signal during operation. In addition, the raw frequency output will accept a 0 to 5VDC pulse signal from a frequency generator that can be used to setup or verify the processed pulse prior to installation.

All of the data is entered and configured using Visual LinK™. The calibration data, configuration data and comments are stored in the Linear LinK™. This data can be recalled and viewed with Visual LinK™. This allows the user to have a record of the previous calibration along with a history of the instrument.

3.3.3 Mass Flow Rate Output

Fluid property data uses a fixed density. The fixed density data is used to determine mass flow rate.

The mass flow rate is calculated from the flow meter. The Linear LinK™ performs all of the calculations and produces a linearized frequency output and/or analog output related to the mass flow rate.

3.3.4 Visual LinK™ Configuration Software

When purchased with a flow meter, the Linear LinK™ flow computer will be shipped fully programmed and should not require any input from the user prior to installation. Should the Linear LinK™ require re-programming or modification in the field, Visual LinK™ can be downloaded from the Flow Technology, Inc. website (www.ftimeters.com). Visual LinK™ is Windows® software that allows the user to enter calibration data, enter fluid property data, configure the input signals and configure the output signals.

The Linear LinK™ is connected to a PC computer or a notebook computer with Windows® installed and an available serial port, using a standard RS-232 cable. When Visual LinK™ is first connected to the Linear LinK™, a check is performed to verify that communication is properly established and to verify that the memory, digital bus and digital Outputs are operating properly. The status of each test is displayed and acknowledged upon completion.

The Linear LinK™ is then configured by reading in or entering calibration data or and fluid property data. The software will directly read the Flow Technology flow meter calibration data electronic file. Alternately, the data can be entered manually. The data is displayed on a graph that allows the user to verify the data easily and avoid errors. The data can be edited, as required, to provide the best characterization of the sensor.

All calibration data and configuration data is saved in a job file in the PC computer and is also saved in the Linear LinK™. In addition, the date of the most recent calibration, the date of the next calibration and comments can be stored.

When the configuration is complete, Visual LinK™ will download the data into the Linear LinK™.

3.4 Linear LinK™ Outputs

The Linear LinK™ is configured for a flow rate frequency pulse and analog flow output. A serial output is also provided for volumetric or mass flow rate.
The raw flow rate frequency is output with all configurations. The raw flow rate frequency output can also be used as a frequency input to inject a frequency (0 to 5V square wave) during setup or troubleshooting.

3.4.1 Designators

The signal designations are explained below:

F_LIN: Linearized frequency pulse output (5 V amplitude), square wave pulse.

F_RAW: Unscaled pulse output (5 VDC amplitude). This signal is the amplified input frequency of the flow meter before linearization. This is useful for monitoring the raw frequency generated by the flow meter. It can also be used to inject a pulse for verifying calibrations.

FVOUT: Provides a scaled voltage (0-10VDC or 0-5VDC) output signal that corresponds to the flow rate.

FIOUT: Provides a scaled current (4 - 20 mA) output signal that corresponds to the flow rate. This line connects to the current grounding path.

Tx: Serial programming transmits data line.

Rx: Serial programming receives data line.

Tx_Data: Serial transmit data line for streaming output

3.4.2 Flow Meter Analog Output

The Linear LinK™ produces an analog output signal for flow rate. The analog output channel is configured using the Visual LinK™ software. As with all other configuration data, the analog output configuration is stored with the Linear LinK™ and can be recalled with the Visual LinK™ interface software. The analog signal is available as a 0 to 5VDC, 0 to 10VDC, and 4 to 20mA respectively. The analog output is accomplished digitally with the microprocessor. The processor sets a digital word equal to a precise analog value in the digital to analog converter. This provides a fast response, eliminates the possibility of drift and provides protection against tampering. The excitation voltage for the 4 to 20mA output is provided by the Linear LinK™ to drive a passive load. The following equation can be used to define the load resistance;

$$\text{Maximum Value for RL}$$

$$RL = \frac{(\text{supply voltage} - 4)}{0.02}$$

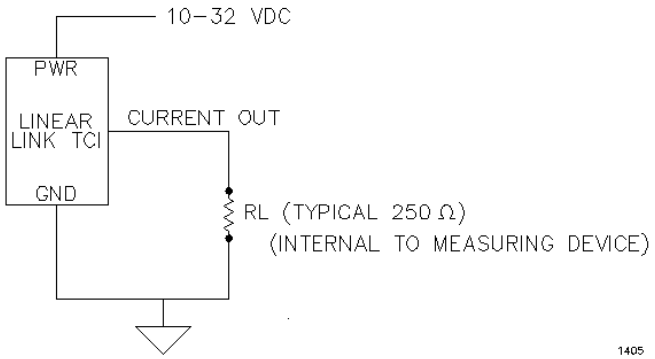


Figure 14 - Analog Current Output

The analog flow rate signal is linearized to provide the best accuracy. This simplifies the connection to a data acquisition system since all of the counter/timer logic and flow meter correction factors are completed by the Linear LinK™. The user simply connects the analog signal to the A/D input of the data acquisition system.

3.5 Operating Sequence

The Linear LinK™ uses the following sequence to read the inputs, process the data and produce outputs. Detailed information is provided below.

1. Read flow meter frequency.
2. Use the K-Factor to calculate the linearized compensated flow rate.
3. Calculate the mass flow rate.
4. Calculate and output the scaled frequency from the flow rate.
5. Calculate the analog output values from the flow rate.

3.5.1 Flow Meter Frequency Input

The flow meter frequency is determined by the microprocessor using a period measurement method. The number of periods can be set between 1 and 99 via Visual LinK™. When the period is set to 1, the flow meter frequency is measured between successive turbine blades. A 20-megahertz clock (divided by 4) is used as the time base for the frequency measurement. This provides exceptional accuracy throughout the frequency range with especially high precision at low frequencies. The period method also allows minimum response time to produce the fastest response.

The meter input frequency is used to lookup the K-Factor obtained during the flow meter calibration. The K-Factor versus frequency data is stored in a table in the microprocessor. The frequency parameter is used to index the table to determine the K-Factor. Up to 100 points can be stored in the table. The table can be edited by the user to best characterize the flow meter. Linear interpolation is used between table entries.

$$Q_A = \frac{f}{K_A} * TimeBase$$

The value for *TimeBase* is equal to the number of seconds in the user-defined time unit. For example, if the flow rate units are gallons per minute, then *TimeBase* equals 60. If the units are liters per second, then *TimeBase* equals one.

3.5.2 Calculated the volumetric flow rate

Once the actual K-Factor is known, the actual volumetric flow rate can be calculated. Flow rate is calculated as;

3.5.3 Fluid density

The device uses the fixed density defined in Visual LinK™ during device programming.

3.5.4 Mass flow rate

The actual mass flow rate can be calculated by multiplying the volumetric flow rate by the fluid density.

$$M_A = Q_A \rho$$

3.5.5 Frequency output

The output frequency is generated to correspond to the constant K-Factor desired by the user. The output frequency is calculated from the ratio of the desired K-Factor and the actual K-Factor determined from the calibration data. The desired K-Factor is calculated from the maximum frequency output and the corresponding maximum flow rate. The max frequency and max flow rate are defined by the user with Visual LinK™. The equation to determine the desired K-Factor is as follows;

$$K_D = \frac{f_{MAX}}{Q_{MAX}}$$

To determine the output frequency, the following equation is used for volume rates:

$$f_{Out} = K_D Q_A$$

or, for mass rates

$$f_{Out} = K_D M_A$$

3.5.6 Analog output

The scaled analog outputs are calculated in a similar manner to the scaled frequency output. The following equations are used to calculate the voltage and current output for volumetric flow rates.

$FV_{Out} = Q_A \frac{FV_{Max}}{Q_{Max}}$ for voltage output, or $FI_{Out} = Q_A \frac{FI_{Range}}{Q_{Max}} + 4$ for current output.

For mass flow rates, the following equations are used:

$FV_{Out} = M_A \frac{FV_{Max}}{M_{Max}}$ for voltage output, or $FI_{Out} = M_A \frac{FI_{Range}}{M_{Max}} + 4$ for current output.

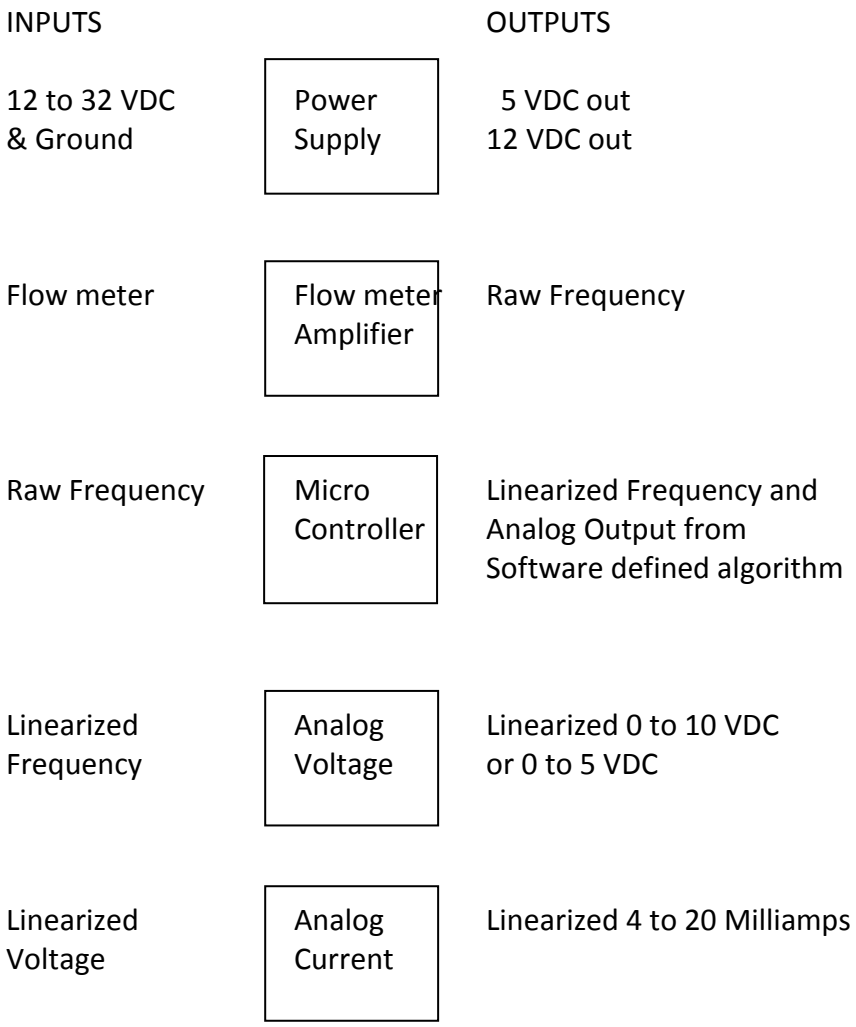
Note that these equations assume a zero-based scaling; that is 0VDC equals zero flow or 4mA equals zero flow. The value for V_{Max} is either 5VDC or 10VDC and the value for I_{Range} is 16mA (20 – 4). The value for M_{Max} is calculated as:

$$M_{Max} = \rho_{Max} Q_{Max}$$

3.6 Over and Under Range

The Linear LinK™ will continue to provide a corrected output for over-speed and under-speed conditions up to 125% above the maximum calibrated frequencies of the mating flow meter and down to the point when the rotor stops. The Linear LinK™ output during over and under range conditions are an extrapolation and are neither traceable nor guaranteed to be accurate.

3.7 Block Diagram



3.8 Industrial Display (-F1 Option)

3.8.1 Menu Navigation

Figure 15 is a hierarchy of the menu structure. This will be referenced throughout the rest of the manual. Note: the "Run Screen" is the main screen that displays flow rate and total.

Run Screen

- **Main Menu**
  - **Units Displayed**
    - Set Units
    - Set Time base
  - **Set Decimal Place**
    - Set Flow Rate
    - Set Total
  - **Input Scaling**
    - Volume/Mass
    - Units
    - Time base
    - Max Flow
    - Max Hz
    - Min Hz
  - **Passcode**
    - Set New Passcode
    - Lock/Unlock Device
  - **Screen Settings**
    - Brightness
    - Contrast
    - Backlight Settings
  - **About**
    - FTI Contact Info & Software Version

Figure 15 - Menu Structure

3.8.2 Display/Buttons

The Industrial Display is equipped with 2 sets of interface buttons (See Figure 16) mechanical pushbuttons and optical infrared buttons. Pushbuttons are designed to be used when the enclosure lid is removed. The infrared buttons are designed to be used with the lid installed. Each set of buttons perform the same task and can be used interchangeably,

Notes on infrared button operation:

- They are disabled for 60 sec once a pushbutton is pressed.
- It is best to install with the screen facing away from direct sunlight or other sources of infrared light.
- Keep the glass clean
- Keep the "Top Lid" screwed down tight

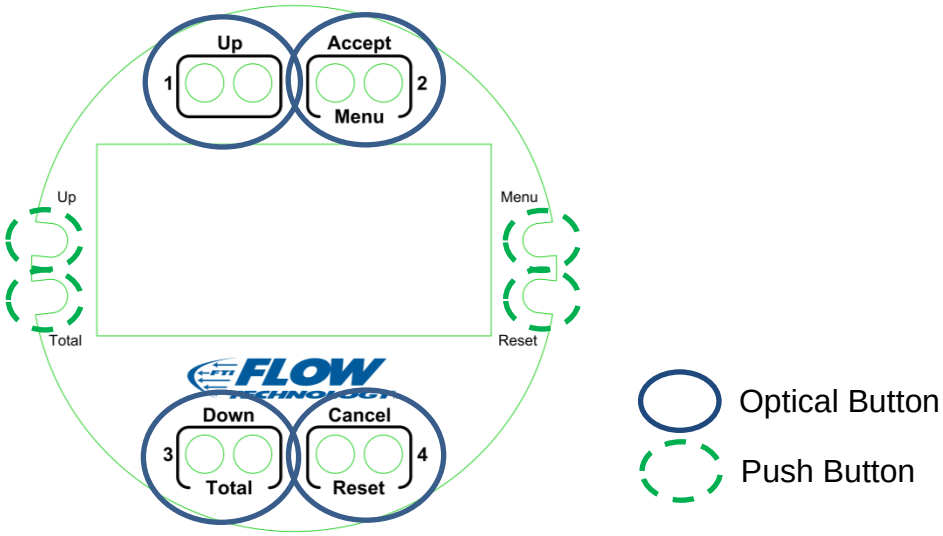


Figure 16 - Button layout

Because each button performs multiple functions, in this manual they will be referred to by their function.

Below is a description of each button function.

3.8.2.1 "Up"

Run Screen – No Function
Menu – Up
Pass Code – 1

3.8.2.2 "Menu"

Run Screen – Switches to the Menu
Menu – Accept/Enter
Pass Code – 2

3.8.2.3 "Total"

Run Screen – Toggles between the Sub Total (T1) and Grand Total (T2)
Menu – Down
Pass Code – 3

3.8.2.4 "Reset"

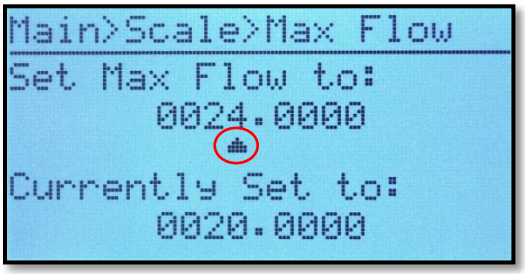
Run Screen – Activates the Sub Total Reset
Menu – Cancel/Esc
Pass Code – 4

3.8.3 How to Change a Setting

Select the setting you want to change. The screen will change to a list of options for that setting (shown below). The “check mark" indicates which option is currently selected. Pressing “Accept” will move the “check mark” to whatever setting the arrow is pointing to. For example: in the screen below, the setting “Backlight” is currently set to “Always ON”. If “Accept” was pressed, it would set “Backlight” to “Always OFF” because that is where the arrow is pointing. Once a setting is set, pressing “Cancel” will back out to the menu.

3.8.4 How to Change a Number

Select the number you want to change. The screen now displays two numbers. The top number is the number you are changing. The bottom number is what the setting is currently set to. This is used only as a reference. To change the number, press “Down” to shift the digit indicator to the right by one digit. Pressing “Up” will increment the digit that the digit indicator (highlighted below) is pointing to. Both operations will cycle back around, so if you pressed “Up” or “Down” one too many times, keep pressing it until it cycles back around to the number or digit you want. Once you have entered the number you need, press “Menu” to save it. Press “Cancel” to back out. (Note that the bottom number will change to the same as the top number once it’s saved)



3.8.5 Settings Description

While in the menu, the top line will always display where you are in the menu structure (Note: some items are abbreviated). The text in italics to the right of each item in this section will show what the top line of the display will show while in this setting.

3.8.5.1 Units Displayed - Main>UnitsDisp

To change the units of the flow rate and total displayed in the Run Screen, navigate to “Main>UnitsDisp” and change either the Units or Timebase to the desired setting.

NOTE: The “Display” portion of the Industrial Display cannot convert between volume and mass units, therefore the options in the Units menu are determined by what the Volume/Mass setting is set to in “Main>Scale>Vol/Mass”. If mass is selected, only mass units will appear, if volume is selected; only volumetric units will appear.

3.8.5.2 Units – Main>UnitsDisp>Units

Selects which units you want displayed in the Run Screen. Note, this controls the units for both flow rate and total, they cannot be separated.

3.8.5.3 Time base – Main>UnitsDisp>TimeB

Selects the time base to display in the Run Screen. Note- Time base only applies to the flow rate, not the totalizer.

3.8.5.4 Set Decimal Place – Main>Dec Place

The Industrial Display provides a 5 digit flow rate display and an 8 digit Totalizer display. The Decimal Place setting allows the user to set how many decimal places are displayed to the right of the decimal point. See examples below.

Flow Rate options
0 = XXXXX.
1 = XXXX.X
2 = XXX.XX
3 = XX.XXX

Totalizer options
0 = XXXXXXXX.
1 = XXXXXXX.X
2 = XXXXXX.XX

3.8.5.5 Set Flow Rate – Main>Dec Place>Rate

Selects the decimal place precision for the Flow Rate.

3.8.5.6 Set Total – Main>Dec Place>Total

Selects the decimal place precision for the Totalizer

3.8.5.7 Input Scaling – Main>Scaling

The Input Scaling section is where you program the pulse input conversion factor to convert from frequency pulses to flow rate. The current settings are displayed in the column to the right so that all the settings are viewable at a glance.

NOTE: If the Industrial Display was purchased with a flow meter, the Input Scaling has already been set for you from the factory and this section can be skipped. However, if the Industrial Display is ever used with a different flow meter, the Input Scaling will need reprogrammed.

To set the input scaling, you will need to know the frequency output scaling of the Linear LinK™ PCBA. This can be found in the device datasheet

Volume/Mass	=	Is the flow rate in Volumetric or Mass units
Units	=	Units portion of the flow rate
Time base	=	Time base portion of the flow rate
Max Flow	=	Set to max flow rate of scaling
Max Hz	=	Set to max frequency of scaling (Cannot enter tenths of Hz, round to nearest 1Hz)
Min Hz	=	Set to Min frequency of scaling (For Industrial Display, this will always be 0)

An example frequency scaling is 0 – 2000Hz where:
2 kHz = 10 GPM
0Hz = 0 GPM

From the example above the following settings should be set to:
Volume/Mass = Volume
Units = Gallons
Time base = Minute

Max Flow = 10.0
Max Hz = 2000 (cannot enter tenths of Hz, round to nearest 1Hz)
Min Hz = 0

NOTE: A Min Flow setting is not needed as it will always be set to 0.

NOTE: Because the Industrial Display cannot convert between Mass and Volumetric units, switching this setting between Mass and Volume will force both totalizers (T1 & T2) to be reset to 0.

3.8.5.8 Volume/Mass – Main>Scale>Vol/Mass

Should be set to volume or mass depending on what unit the incoming pulse scaling is in.

3.8.5.9 Units – Main>Scaling>In-Units

Set to whatever unit the incoming pulse scaling is in.

3.8.5.10 Time base – Main>Scl>In-Time base

Set to whatever time base the incoming pulse scaling is in.

3.8.5.11 Max Flow – Main>Scale>Max Flow

Set to the max flow rate associated with the top calibration point.

3.8.5.12 Max Hz – Main>Scaling>Max Hz

Set to the max frequency (Hz) associated with top calibration point.

3.8.5.13 Min Hz – Main>Scaling>Min Hz

Set to the min frequency (Hz) associated with bottom calibration point.

3.8.5.14 Passcode – Main>Passcode

To avoid unauthorized personnel tampering with the Industrial Display, a passcode can be set to only allow authorized personnel to make changes to the device.

<u>To Lock the Industrial Display:</u>
Navigate to the Passcode menu and select “Set New Passcode”. You will be asked to enter a 4 digit code. The 4 input buttons will now enter numbers (shown below). Enter any 4 digit code consisting of the numbers 1,2,3 or 4. Once the last digit is entered, it will display the code you typed and asked to either “Save and Lock Device” or “Exit w/o save”. Choose “Save and Lock Device”, the device will lock and switch to the “Run Screen”.

If the 4 digit code was not entered correctly or the menu was entered by mistake, choose “Exit w/o save”

Once a passcode is set:

- The device will automatically be locked and switch to the “Run Screen”
- A “Lock” symbol will appear in the “Run Screen”
- The correct passcode is required to reset the sub total (T1) from the screen
- The correct passcode is required to enter the menu.
- Once in the menu, the user has full access to everything in the menu including unlocking the device or changing the passcode

NOTE: When activated, the remote reset feature will always reset the sub total (T1) to 0 regardless if the device is locked or not. It is assumed the user will secure the physical remote reset switch as needed.

<u>To Unlock the Industrial Display:</u>
Enter the menu (type correct passcode) then navigate to the “Passcode” menu and choose “Lock/unlock device”, then select “unlock device”. This will clear the passcode and unlock the device.

NOTE: If a locked device is left unattended while still in the menu, it is fully accessible by anyone until it times out after 60 seconds and goes back to the Run Screen. Therefore, it is always a good practice to exit to the Run Screen before leaving a locked device thus re-securing it.

3.8.5.15 Set New Passcode – Main>Passcode>Set PC

Allows a new passcode to be entered

NOTE: Because all 4 buttons are used for passcode input numbers, it is not possible to “cancel/esc” out of this menu. If entered by mistake, enter any passcode and a screen will come up asking to confirm the passcode. Select “Exit w/o Saving”

3.8.5.16 Lock/Unlock Device – Main>Passcode>Lock

Allows you to lock or unlock the display.

NOTE: If no passcode has been entered and "Lock Device" is selected, you will be taken to the "Set New Passcode" screen to enter one.

3.8.5.17 Screen Settings – Main>Screen Settings

A list of settings specific to the display screen.

3.8.5.18 Brightness – Main>Screen>Bright

Allows the brightness of the backlight to be adjusted by pressing "Up" or "Down" to adjust, then "Cancel" to back out.

3.8.5.19 Contrast– Main>Screen>Contrast

Allows the contrast of the screen to be adjusted by pressing "Up" or "Down" to adjust, then "Cancel" to back out.

3.8.5.20 Backlight Settings – Main>Scn>Backlight

Use to set the backlight "Always ON", Always OFF" or "Auto" which turns on with any button press and turns off after 60 secs of no button presses.

3.8.5.21 About – Main>About

Displays contact info for Flow Technology Inc. as well as the Software Version.

3.8.6 Operation

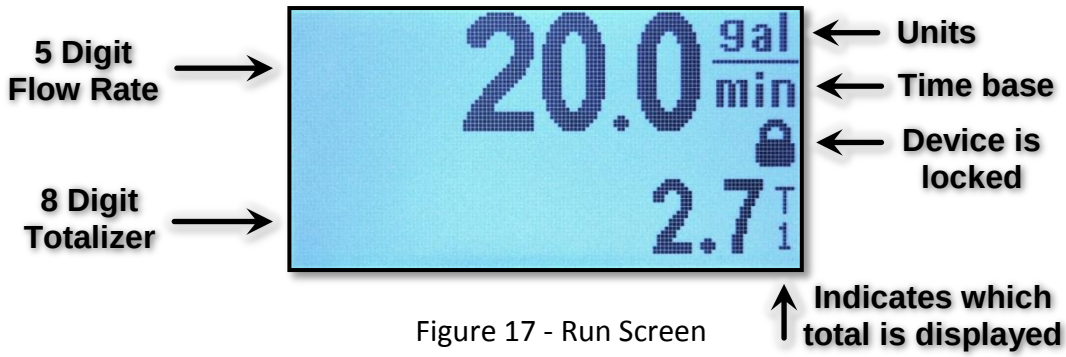


Figure 17 - Run Screen

The Industrial Display provides a visual indication of flow rate and total flow (subtotal and grand total) from the output of the Linear LinK™.

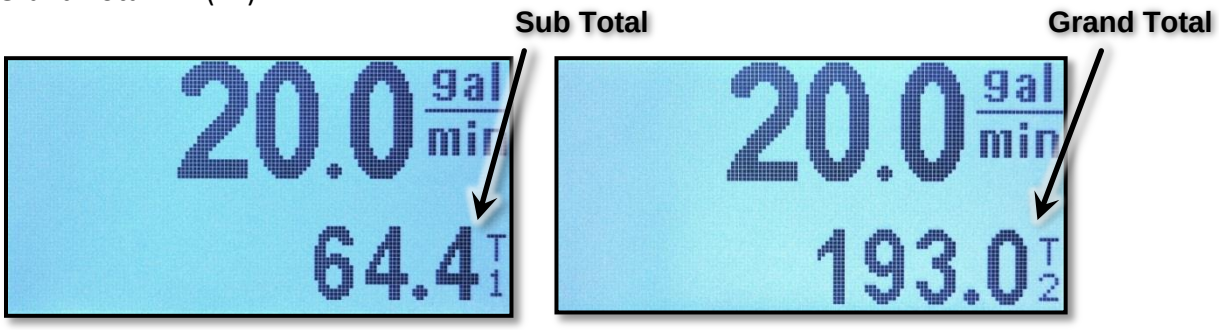
If the Linear LinK™ w/Industrial Display was purchased with a flow meter, it will ship from the factory programmed for that flow meter

Once wired properly, the Industrial Display will operate automatically.

The flow rate and totalizer will update once a second. If no input counts are received for 2 seconds (0.5Hz) it will display a flow rate of 0.

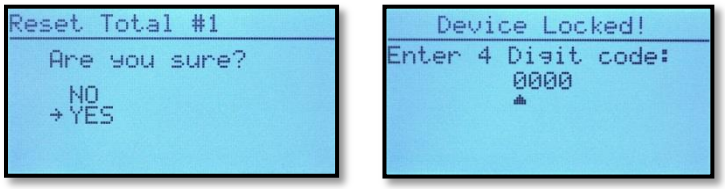
There are 2 totalizers that can be toggled between by pressing "Total".

Sub Total - (T1) (Resettable)
Grand Total - (T2)

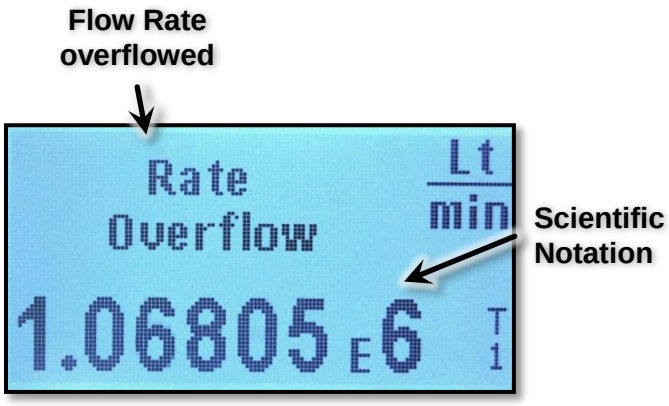


The Sub Total can be reset using the on-screen buttons or by contact closure between the “remote reset+” and “remote reset-“terminals.

To reset the Sub Total using the on screen buttons, press “Reset”. A screen will appear asking to confirm the reset. Press “Down” to move the cursor to “Yes” then press “Accept” to accept and reset. Note: if Locked, the display will prompt for the passcode before you can accept the reset.



<u>Overflow</u>
If the flow rate overflows, the screen will blink “Rate Overflow”. To mitigate, change the “Decimal Place” setting for flow rate to a lower number, or change the “Units Displayed” to a larger unit of measure or to a shorter time base.



If the totalizer overflows it will switch to displaying the total in scientific notation.
To mitigate, change the “Decimal Place” setting for total to a lower number, or change the “Units Displayed” to a larger unit of measure.

4 CALIBRATING THE LINEAR LINK™

4.1 General

When purchased as a mate to a specific turbine flow meter, the Linear LinK™ is fully programmed to the mating meter calibration with the units and scaling as requested in your order. Likewise, subsequent Flow Technology, Inc. calibrations will re-program the Linear LinK™ during the mating meter re-calibration.

4.2 Equipment and Tools Required

- Visual LinK™ 5.0 or greater software
- Visual LinK™ Software Manual. FTI P/N TM-100654
- Computer
  - 2.33 GHz CPU
  - 40GB Hard Drive
  - 2 GB RAM
  - Supported Operating Systems:
    - Windows XP (SP3 or later)
    - Windows 7
  - One available serial port
- Serial Cable FTI P/N 19-62627-104 for models without a MS connector
- Serial Cable FTI P/N 19-62627-106 for models with a MS connector
- Printer (optional): Windows® compatible for hardcopy reports
- DMM: Fluke Model 45 or equivalent
- Oscilloscope: Tektronix 2235 or equivalent
- Function Generator: HP 33120A or equivalent
- Frequency Counter: Fluke 7260A or equivalent
- 24 VDC regulated power source

4.3 Electrical Connection

Connect the Linear LinK™ as per the instructions and tables shown in “2.3 Electrical Installation”. The Serial Cables will connect directly to the P3 connector on the printed circuit board assembly.

4.4 Calibration

Refer to the Visual Link Software Manual for complete instructions on how to load the calibration files, and calibrate and scale the Analog Outputs.

Note: Refer to the sections specific to the Linear LinK™ , the LA version of the product has the same programming and calibration as the LN version, however, the LA version only has a single Analog Output.

Appendix A Model Number Break Down

LA-*5-a-bbcc-xxx*

a Flow meter Input
- A = MAG
- B = PULSE
- C = RF
- D = OTHER RF

bb Outputs
- V1 = 0 to 10 VDC analog and Pulse
- V2 = 0 to 5 VDC analog and Pulse
- MA = 4 to 20 mA analog and Pulse

cc Enclosures
- -0 = No Enclosure
- -F - Adalet XIHFCX3
- B6 = NEMA 4X
- B7 = NEMA 4X with MS connectors
- -9 = CLASS 1, DIV 1, GROUP A, B, C, & D
- A7 = Dust tight Aluminum /w MS connectors
- F1 = Adalet XIHFGCX-2L (Industrial Display)

xxx Specials (Factory assigned three digit code)

EXP: CE Conformed (see Appendix C and E for details)
Only available with enclosure types “-F”, “F1”, & “-9”.

CFP: CE Conformed (see Appendix C continued, page 43, for details)
Only available with enclosure type “-F”.

Assembly, installation, and adjustment for both -EXP & -CFP versions is the same as the standard Linear Link described in this manual.

If desired, it is possible to bypass the transducer (flow meter & pickoff) by disconnecting ±XDCR leads and injecting a 0-5 VDC square wave in on pin labeled F_Raw. The output impedance of the pulse source must be 50 ohms or less. If this is not possible, adjust amplitude of frequency source (while connected to F_Raw pin of the Linear LinK™) until amplitude of 0-5 VDC is achieved, not to exceed 0-10 VDC.

NOTE: Frequency source common should be connected to Linear LinK™ digital ground (DGND) common when injecting square wave pulse input.

Appendix B Linear LinK™ Specifications

Input Power	Model Number Code	Specifications
24 VDC nominal	3	12 - 32 VDC: no display and unloaded voltage output 110mA max 15 - 32 VDC: with display and unloaded voltage output 160mA max 19 – 32 VDC: no display and current output 135mA max 23 – 32 VDC: with display and current output 200mA max

Flow Meter Input Type	Model Number Code	Specifications	
Magnetic	A	Frequency range: Impedance: Sensitivity:	1 Hz to 4 kHz Greater than 5 k ohms 20 mV p-p
Pulse Schmitt Trigger Buffer	B	Frequency range: Impedance: Voltage (STB): Input max.	1 Hz to 4 kHz 5.8 k ohms to +5 VDC Low 0 to 1.0 VDC High 4.0 to 5 VDC 0 to 10 VDC 1 Hz to 4 kHz
RF	C	Frequency range: Inductance: Oscillator frequency:	5 to 3500 Hz 1 mH 45 - 55 kHz
Other RF	D	Frequency range: Inductance: Oscillator frequency:	5 to 3500 Hz 350 μH 45 - 55 kHz

Linearization		Specifications
Flow meter K-Factor	Number of Points: Interpolation Method:	2 to 30 Linear
Density	Number of Points:	Fixed

Outputs		Specifications
Frequency (Flow rate)	Raw Frequency:	0 to 5 V pulse
	Linearized Frequency:	0 to 5 V pulse (1 to 4000 Hz)
	Impedance:	2.2 K ohms
	Transmission Distance:	250 ft maximum
Analog Voltage (Flow rate)	0 to 10VDC or 0 to 5VDC (factory settable), Linearized, Scaled	
	Zero offset:	less than 10 mV
Analog Current (Flow rate)	4 to 20 mA, Linearized, Scaled	
	Maximum load:	R_{load} = (supply voltage-4)/0.02
RS-232 (Vol/Mass Flow)	Baud rate:	19200
	Update rate:	0.5/sec, 1.0/sec, or 2.0/sec
	8 Data Bits	
	1 Stop Bit	
	No Parity	
-F1 option (Industrial Display)		
Displayed Flow rate		
	Digit Accuracy	5 Digits
	Segment Height	0.425in
	Decimal Place Precision	3 places (1/1000th)
Displayed Total		Sub and Grand Total
	Digit Accuracy	8 Digits
	Segment Height	0.275in
	Decimal Place Precision	2 places (1/1000th)

Units

Volume	Mass	Time
Gallon	Pound	Day
Liter	Kilogram	Hour
Milliliter	Gram	Minute
Cubic Inch	Ounce	Second
Cubic Feet		
Cubic Meters		
Cubic Centimeter		

Performance		Specifications	
Accuracy		Linearized Frequency: Linearized Analog:	0.1% of reading or better 0.1% of full scale or better
Linearization Latency	N = 1	9ms to 12ms + period of input	
N = Periods Averaged	N = 2-99	$\frac{N}{inputHZ} + 9\ to\ 12\ mSec$	

Environment	Specifications
Temperature	Operating: -40° to +85°C Storage: -55° to +125°C
–F1 option (Industrial Display)	Operating: 0° to +50°C Storage: -10° to +60°C
Humidity	0 to 85% RH non-condensing
Enclosure	NEMA 4X (option) Class 1, Div 1, Group A, B, C & D (option)

Communications	Specifications
Interface	RS-232, serial USART connection to personal computer (with serial cable)
Baud	19200 – Output 19.2K – Programming 8 Data Bits 1 Stop Bit No Parity

Approvals	Specifications
CE	EN 61000-6-2:2005, EN 61000-6-4:2006
Hazardous area	Enclosure options “-F” and “F1” Class 1, Division 1, Groups B, C, D T6/T5 Class 1, Zone 1, AEx d IIC T6/T5 Class 1 Zone 1, Ex d IIC T6/T5 NEMA 4X / IP-66

Approvals	Specifications
Hazardous area	Enclosure option “-9” Class 1, Division 1, Groups A, B, C, D T6/T5

Connectors	Specifications
3 pin MS Mate	15-89515-102 (MS3106A10SL-3S)
14 pin MS Mate	15-89515-105 (MS3106A20-27S,)
12 pin plug for PCB	15-94994-01 (Phoenix Contact p/n 1847220)
6 pin plug for PCB	15-94736-206 (connector) (Molex p/n 51021-0600), 6x 15-94736-800 (pins) (Molex p/n 50079-8000)
–F1 option (Industrial Display)	
16 pin plug for PCB	15-93915-03 (Phoenix Contact p/n 1840502)
10 pin IDC for PCB	19-95021-01 (Samtec p/n , FFSD-05-D-04.50-01-N)

Enclosure / Display Module	Model Number Code	Specifications	
Adalet XIHFGCX-2L	F1	Holes	Qty 3 - 1/2NPT

Appendix C DECLARATION OF CONFORMITY

8930 S. Beck Avenue, Suite 107, Tempe, Arizona 85284

Phone: (480) 240-3400 **Fax:** (480) 240-3401 **e-mail:** ftimarket@ftimeters.com **website:** www.ftimeters.com

CE - DECLARATION OF CONFORMITY

Manufacture Name: FTI Flow Technology Inc.

Manufacturer Address: 8930 South Beck Avenue, Suite 107, Tempe, AZ 85284 USA

Type of Equipment: Linearizing Flow Measuring Transmitter

Application of Council Directive: 2014/30/EU

Standards to which Conformity is Declared:

EN 61000-6-2:2005 – Generic standards – Immunity standard for Industrial Environments

EN 61000-6-4:2007 – Generic standards – Emission standard for Industrial Environments

Test Report: p1140011, p1230005, d0950009, EB-69789 and EB-100512

Application of Council Directive: 2011/65/EU

Flow Technology Inc. equipment is designed, and intended for use in industrial applications. Installations are in "large-scale stationary industrial tools" or "large-scale fixed installations". The equipment is intended for long term operation, and is installed and decommissioned by professional operators. For this reason FTI products are exempt/compliant from/with Directive 2011/65/EU per Article 2, Item 4 of that directive.

Transmitter Model Number: LA-5-x-yzaa-bbb

x =	A: Magnetic pick-off input B: Square wave pulse input C: Modulated carrier pick-off input
yz =	MA: 4 – 20mA analog output V1: 0 – 10 VDC analog output V2: 0 – 5 VDC analog output
aa=	-9: Crouse-Hinds EABL36SA -F: Adalet XIHFCX3 A7: Aluminum enclosure with MS connectors B6: Nema 4X B7: Nema 4X with MS connectors F1: Rate and Total Display, Adalet XIHFGCX-2L Enclosure
bbb=	Factory assigned three digit code, self declared conformant based on previous test results and best engineering judgment.

Serial Number(s) All Year of First Manufacture 2012

Place Tempe, AZ, USA

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive and Standards, and this Declaration is supported by a Technical File located at the Factory

Ralph Duffill, General Manager
FTI Flow Technology, Inc.

AC-100529-01 Rev H per ECO 24688 Page 1 of 1

APPENDIX C DECLARATION OF CONFORMITY – CONTINUED

8930 S. Beck Avenue, Suite 107, Tempe, Arizona 85284

Phone: (480) 240-3400 **Fax:** (480) 240-3401 **e-mail:** ftimarket@ftimeters.com **website:** www.ftimeters.com

CE - DECLARATION OF CONFORMITY

Manufacture Name: FTI Flow Technology Inc.
Manufacturer Address: 8930 South Beck Avenue, Suite 107, Tempe, AZ 85284 USA

Type of Equipment: Linearizing Flow Measuring Transmitter

Application of Council Directive: 2014/30/EU

Standards to which Conformity is Declared:

EN 61000-6-2:2005 – Generic standards – Immunity standard for Industrial Environments

EN 61000-6-4:2007 – Generic standards – Emission standard for Industrial Environments

Test Report: p1140011, d0950009, EB-69789 and EB-100512

Application of Council Directive: ATEX Directive 2014/34/EU

Standards to which Conformity is Declared:
FTI declares compliance for Equipment Group II, Category 3, through Annex VIII "Internal Control of Production" to EN 60079-7:2015 Type Protection "ec". Ex ec IIC T5 (-40° C) ≤ Ta ≤ 50° C. Ex ec IIC T4 (-40° C) ≤ Ta ≤ 70° C
EN 60079-0:2012 General Requirements

Test Report: EN-101116

Application of Council Directive: 2011/65/EU
Flow Technology Inc. equipment is designed, and intended for use in industrial applications. Installations are in "large-scale stationary industrial tools" or "large-scale fixed installations". The equipment is intended for long term operation, and is installed and decommissioned by professional operators. For this reason FTI products are exempt/compliant from/with Directive 2011/65/EU per Article 2, Item 4 of that directive.

Transmitter Model Number: LA-5-x-yz-F-CFP

x = A: Magnetic pick-off input
C: Modulated carrier pick-off input

yz = MA: 4 – 20mA analog output
V1: 0 – 10 VDC analog output

Junction Box: 73-65658-101, 73-65658-102

Pick-off Part Number: 27-66503-102
27-66503-103
27-32400-102
27-32400-103

Serial Number(s) All Year of First Manufacture 2011
Place Tempe, AZ, USA

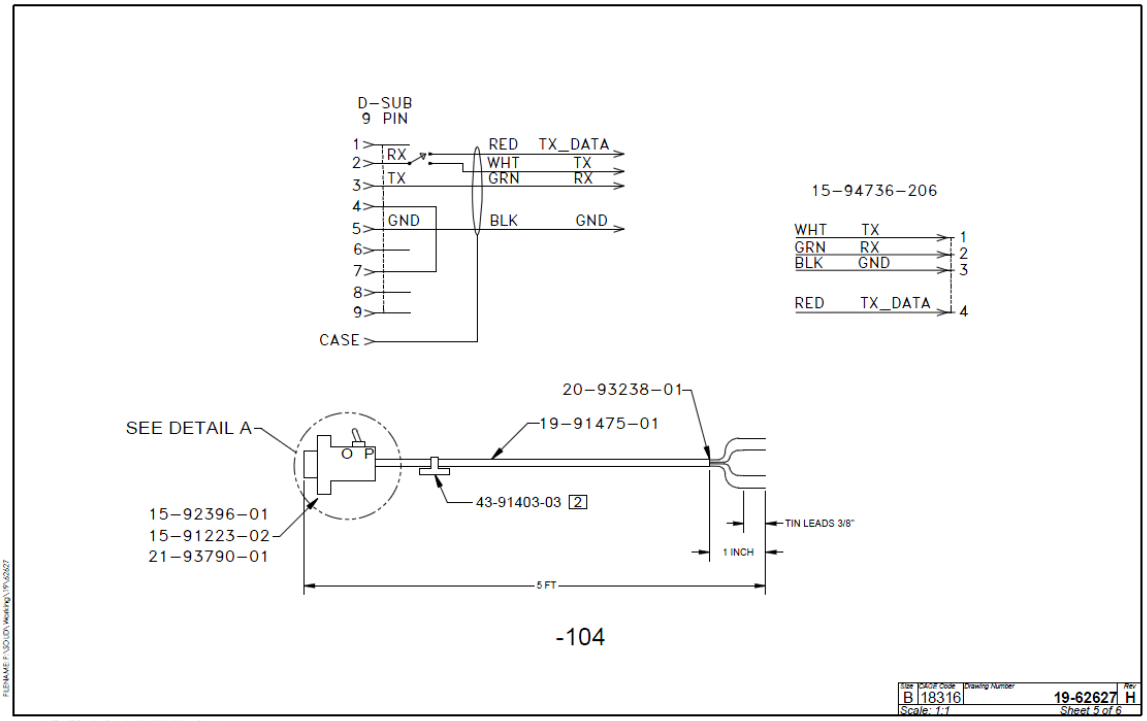
I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive and Standards, and this Declaration is supported by a Technical File located at the Factory.

Ralph Duffill, General Manager
FTI Flow Technology, Inc.

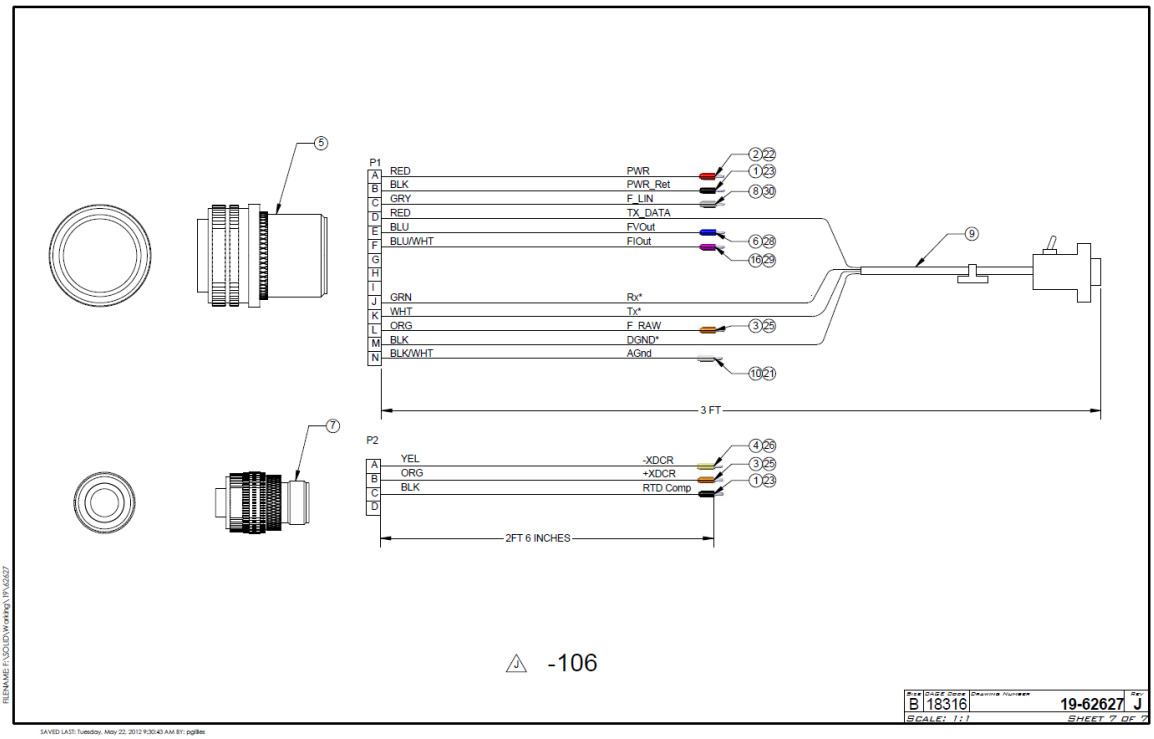
AC-100529-02 Rev K per ECO 24680

Appendix D PROGRAMMING CABLE DRAWING

For Non-MS connector versions



For MS connector versions



Appendix E CERTIFICATION OF COMPLIANCE

QPS Evaluation Services Inc
Testing, Certification and Field Evaluation Body
Accredited in Canada, the USA, and Internationally

File
LR 1275

CERTIFICATE OF COMPLIANCE
(ISO TYPE 3 CERTIFICATION SYSTEM)

Issued to	FTI Flow Technology Inc.
Address	8930 South Beck Ave. Suite 107 Tempe, AZ 85284 USA
Project Number	**LR 1275-1**
Product	Flow Meters (Transmitters with pickoff sensors)
Model Number	LA-*-*-***F-*** or LAT-*-**-***F-*** or ID-*-***-*** LA-*-*-**F1-*** or LAT-*-**-***F1-***
Ratings	Class I, Div 1, Group BCD, T6/T5 Ex d IIC T6/T5 Class I, Zone 1, AEx d IIC T6/T5 Tamb = -40°C to +70°C/+85°C V= 10 – 32 Vdc; Imax= 110 – 200 mA
Applicable Standards	CAN/CSA 60079-0: 2011, CAN/CSA 60079-1: 2011, CSA C22.2 No. 30: 1986, CSA C22.2 No. 142: 1987 UL 1203 4th ed., UL 508 17th ed., ISA/ANSI 60079-0: 2009, ISA/ANSI 60079-1: 2009
Model Number	LA-*-*-***9-*** or LAT-*-**-***9-***
Ratings	Class I, Div 1, Groups ABCD, T6/T5 Tamb = -40°C to +70°C/+85°C V= 10 – 32 Vdc; Imax= 110 – 200 mA
Applicable Standards	CSA C22.2 No. 30: 1986, CSA C22.2 No. 142: 1987 UL 1203 4th ed., UL 508 17th ed.
Factory/Manufacturing Location	Same as Above

Statement of Compliance: The products identified in this Certificate and described in the Report covered under the above referenced project number have been investigated and found to be in compliance with the relevant requirements of the above referenced standards. As such, they are eligible to bear the QPS Certification Mark shown below, in accordance with the provisions of QPS's Service Agreement.

CERTIFIED
ELECTRICAL SAFETY

Issued By: **Rob Kohuch, P. Eng.**
Senior Engineer, Hazardous Locations

Signature: Rob Kohuch Date: July 23, 2013

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QSD 34 Rev. 03 Issue Date: 7/05 Rev. Date: 9/11