



TEK-FLUX 1400B

Insertion Electromagnetic Flowmeter

Instruction Manual

Document Number: IM-1400B



www.tek-trol.com

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

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Important handling and storage instruction

Handling

Observe the following handling instructions.

- Do not lift the Flowmeter by the top-mounted Transmitter in case of an Integral Type Flowmeter.
- Do not put Sensor on surface without covering the Electrodes

Storage

When the Flowmeter is not in use

- Plug the cable glands of Transmitter
- Fasten the display side and terminals side covers of the Transmitter
- Fasten the cover of the Junction Box (Remote variant) adequately

This will prevent ingress of moisture or water that could either lower the performance or damage the internal electronics.

When Flowmeter is not in use for extended period, remove the Sensor from Ball Valve Assembly and close the valve.

1 Introduction

1.1 Tek-Flux 1400B Series

Tek-Flux 1400B Electromagnetic Flowmeters are used to measure the flow rate of a variety of conductive liquids. It functions according to the fundamental principle of Faraday's law of Electromagnetic Induction, which describes the relationship between an electrical conductor and the voltage it generates when moving within a magnetic field.

1.2 Principle of operation

In an Electromagnetic Flowmeter, a magnetic field is generated by a pair of diametrically placed electrical coils mounted external to the flow tube. As the conductive liquid passes through this Electromagnetic field, an electrical voltage is induced in the liquid, which is directly proportional to its velocity. This induced voltage is perpendicular to the directions of both - the liquid flow and the Electromagnetic field.

A pair of diametrically placed electrodes mounted along the inner wall of the flow tube and in the direction of the induced voltage, sense this induced voltage. The sensed voltage is further processed by the Transmitter to indicate the flow rate and generate a standard output signal proportional to the measured flow rate.

1.3 Flow Computation Basics

The flux density of the Electromagnetic field and the distance between the Electrodes are constant for a given Flowmeter. The induced voltage is therefore only a function of the liquid velocity.

$$E = K.B.V.D$$

Where -

E = Induced voltage

B = Magnetic field strength

K = Flow tube (meter) constant

v = Mean flow velocity

D = Distance between the electrodes

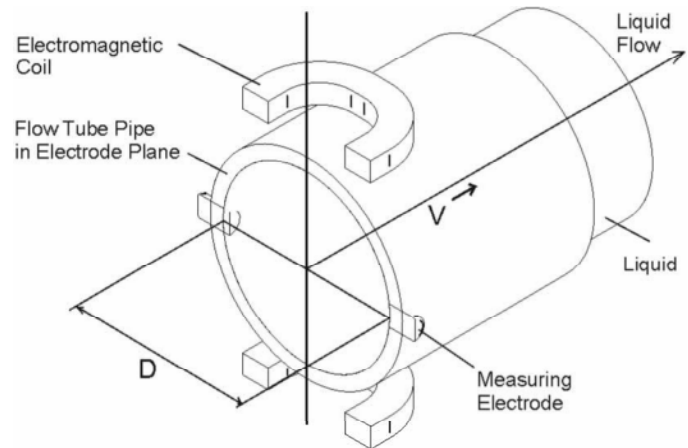
And the volumetric flow is calculated as –

$$qv = (\pi \times D^2/4) \times v$$

Therefore,

$$qv = (\pi \times E \times D) / 4 K B$$

The induced voltage is not affected by the physical properties of the liquid like temperature, viscosity, pressure, density and conductivity, as long as the conductivity of the measured liquid is above a minimum threshold.



2 Application Areas

Tek-Flux 1400B can be successfully deployed in a wide range of industrial liquid flow measurement applications. The major industry sectors include, but not limited to:

- Chemical and Process Industries
- Pharmaceutical Industries
- Sugar and Beverage Industries
- Mining and Dredging Industries
- Water and Waste Water Management

3 Preinstallation Check

- a. Re-confirm the compatibility of the process liquid with the materials of the Flow Sensor liner and the electrodes as ordered by you.
 - If the process liquid is a mixture of different components, confirm the compatibility of all the components.
 - Make sure that the electrical conductivity of the liquid is greater than 10 μ Siem.
 - Many process liquids are designated by generic names. But these may contain certain contaminants in traces. These traces may also be harmful to the Flowmeter. Therefore, check the compatibility of such traces as well.
 - Note that the severity of corrosion of materials depends upon the temperature and the concentration of the process liquid.
 - The corrosion due to service liquid will reduce the life of the Flowmeter.
- b. Confirm that the available supply voltage and its frequency (for AC supply) are in accordance with the specifications of the Flowmeter.
- c. Ensure that the selected Flowmeter size is suitable for the flow rate to be measured. Note that the velocity under normal conditions should be between 0.65ft/s and 39.37ft/s.
- d. Confirm that an appropriate Earth pit is available for proper Grounding.

4 Product Description

4.1 Specification

Nominal Diameter *	4" to 60"	
Working Process Pressure	248 psi	
Electrode Material*	Hastelloy C	
Electrode Cap Material	PTFE	
Measuring Tube Material*	316 SS	
Flow Sensor Rating	IP66	
Minimum Liquid Conductivity	10μ siemens	
Accuracy of Measured Value	±1% of span	
Repeatability	±0.2% of Span	
Measuring Range	0.65 to 39.37 ft/sec Bi-directional	
Display Version*	Integral	
Display Type	16 characters x 2 row LCD, 5 Digit Flow rate and 8 Digit Totalizer	
Units	Flow Rate	Totalizer
	LPS, LPM, LPH, LPD	L, MI, m ³
	MIps, MIpm, MIph, MIpd	MI
	cc/s, cc/m, cc/h, cc/d	L, MI, cc, m ³
	m3/s, m3/m, m3/h, m3/d	L, MI, m ³
	kg/s, kg/m, kg/h, kg/d	kg, t
	t/s, t/m, t/h, t/d	T
	gps, gpm, gph, gpd	G, ft ³
	Mgps, Mgpm, Mgph, Mgpd	Mg
	lgps, lgpm, lgph, lgpd	lg, ft ³
	IMgps, IMgpm, IMgph, IMgpd	IMg
	ft3/s, ft3/m, ft3/h, ft3/d	g, lg, ft ³
	lb/s, lb/m, lb/h, lb/d	lb
Current Output*	4 to 20 mA or Pulse	
Digital Output*	Modbus, RS485 or HART	
Power supply*	18 to 60 VDC or 80 to 300 VAC/VDC	
Terminal connectors	16 to 22 AWG	
Operating temperature	-20°F - 248°F (-28°C - 120°C)	

*Option as specified at the time of ordering

4.2 Model Chart

Example	Tek-Flux 1400B	1	H	HC	1	1	T	Tek-Flux 1400B-1-H-HC-1-1-T
Series	Tek-Flux 1400B							Insertion Electromagnetic Flowmeter
Transmitter		1						Direct Mount
Output			S H					4-20mA, Pulse, Modbus RS485 4-20mA, Pulse, HART
Electrodes				HC				Hastelloy
Insertion Length					1			20" Probe
Power Supply						1 2		18 - 28 VDC 80 - 300 VAC/VDC
Electrode Cap							T	PTFE

4.3 Popular Model

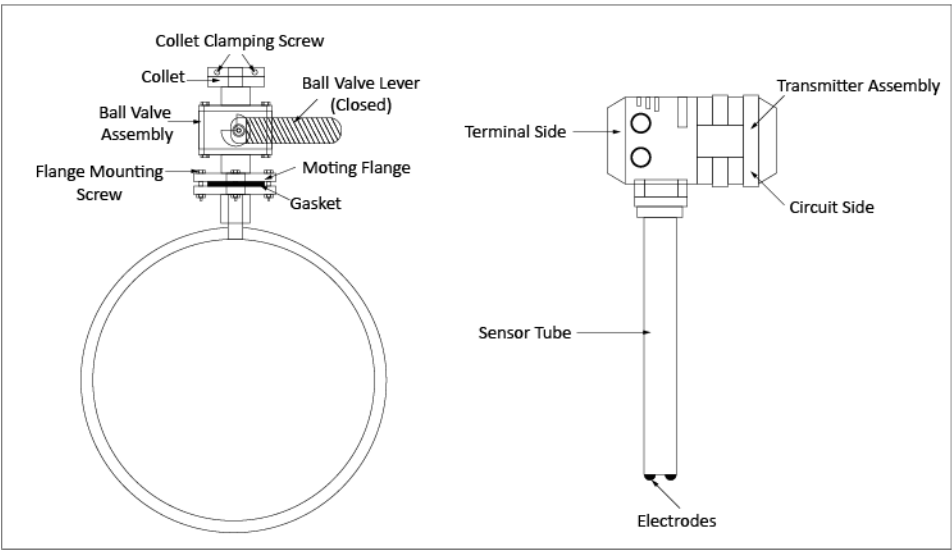
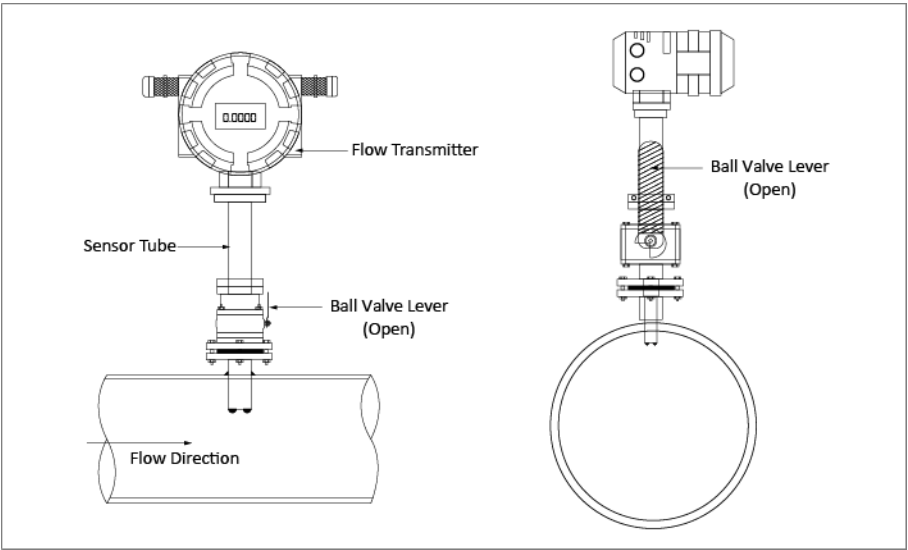
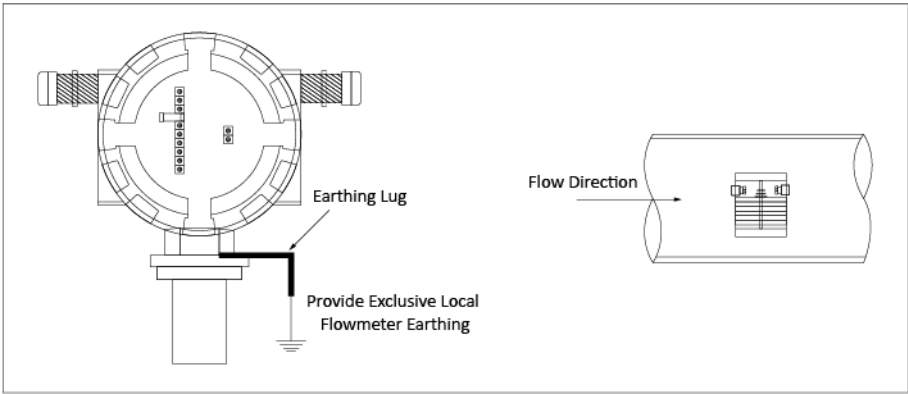
Model	Description
1400B-1-H-HC-1-1-T	Insertion Electromagnetic Flow Meter, 20" Probe

5 Sensor Installation

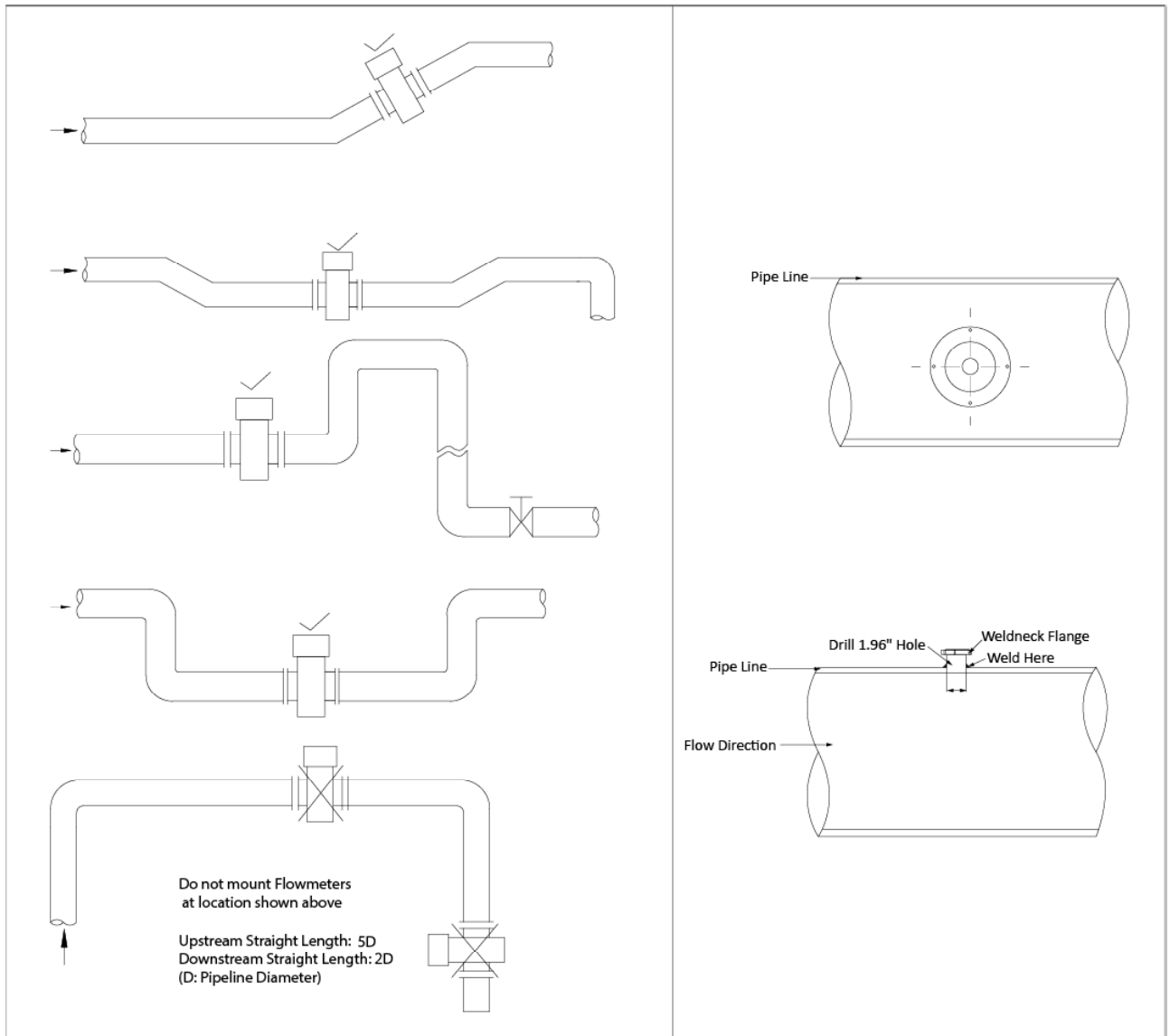
The Flowmeter can be installed at any arbitrary location in the pipeline as long as the installation requirements are satisfied. At the same time, care should be exercised when selecting the installation site to assure that moisture cannot enter into the connection area.

- A ball valve assembly with Weld Neck Flange will be supplied in advance.
- A hole of 1.96" diameter is to be made on the pipe line. The Weld Neck Flange is to be welded into the Pipe Line for Flowmeter installation.
- Put a gasket between Weld neck Flange and Ball Valve Assembly.
- Mount Ball Valve Assembly on the Weld Neck Flange by aligning Weld Neck Flange and Ball Valve Assembly Bottom Flange. Ensure Ball Valve Lever Alignment is with respected to the Flow direction as shown in the figure.
- The Ball Valve Assembly Mounting Bolts are provided (M 10 X 3.93") The mounting bolts are to be tightened. Follow diametrically opposite tightening Sequence.
- Loosen the Collet Clamping Screws provided on the periphery of collect at the Top of Ball Valve Assembly.
- According to the theory of velocity profiles for fully developed turbulent flow in the pipe line, the average velocity point is located at a distance of $1/8 D$ from the pipe wall where D is the internal pipe diameter.
- We insert up to 10% of Pipe Diameter.
- Before Sensor is inserted, the insertion length is marked on the Sensor.
 - a) Measure the length of Assembly from Pipe Surface to Collet Top. (Say X)
 - b) Say Insertion Length is Y.
 - c) Say Pipe Thickness is Z.
 - d) Now mark the length of $X + Y + Z$ starting from Electrodes and up.
- Now open Ball Valve lever fully. Slowly insert the Flow meter's Sensor, passing through the hole.
- Up to the length marked on the Sensor. The Flow Transmitter direction should be as per the drawing.
- Once, the Insertion Length is achieved, tighten the Collet Clamping Screws.
- For the Flowmeter installation in a pit, for proper installation, commissioning and maintenance of the Flowmeter, the pit dimensions have to be at least 6.5ft X 6.5ft.
- Kindly ensure that the pit is covered with the protective cover. The pit should be waterproof so that in rainy season it should not get flooded or submerged in water.

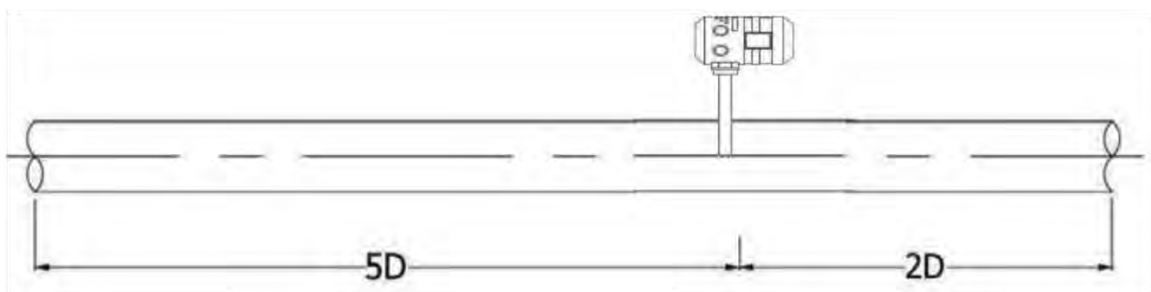
5.1 Typical Line mounting arrangement



5.2 Selection of Mounting Location



At flowmeter upstream, there should be straight pipe no less than 5D and no less than 2D at flowmeter downstream. (D is the inner diameter of the flowmeter)



5.3 Flow Sensor Local Earthing / Grounding

- a. A proper grounding of the Primary Head is very important to ensure proper functioning and accurate measurement by the Flowmeter.
- b. This ground is the reference ground for measurement and should not introduce any interference into the signal to be measured.
- c. Use 0.098 inch² or higher conductor diameter cable for Earthing.
- d. To prevent any electrical interferences do not connect the ground of any other heavy electrical equipment, to this ground.
- e. This ground also functions as the safety ground.

5.4 Checking for sealing

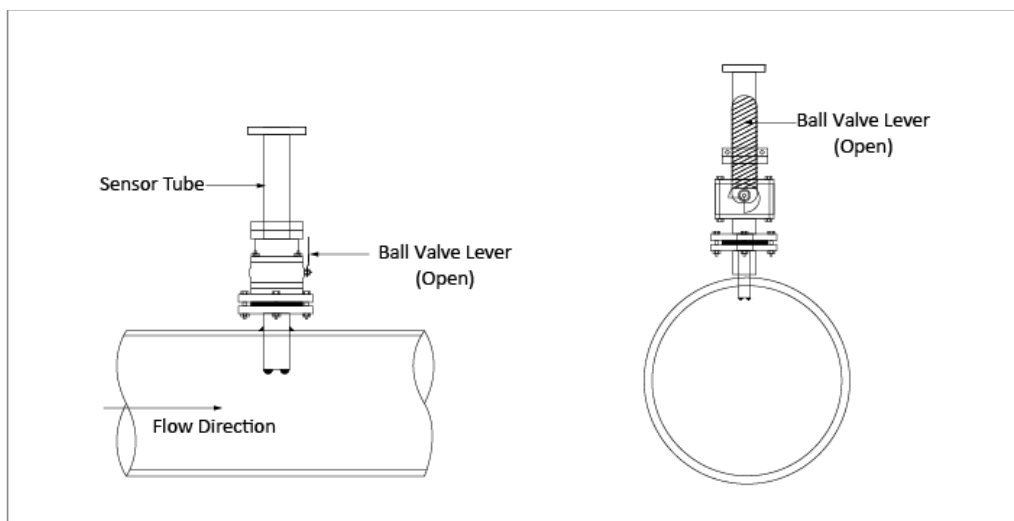
Once the Flow Sensor has been mounted, fill the pipeline gradually (preferably) with water instead of process liquid and confirm that the entire mounting is leak-free.

If even minor leaks are noticed, check the axial alignment of the Flow Sensor with the upstream and downstream pipe lengths, cleanliness of gasket, the rating of gasket material and proper tightening of the bolts. After eliminating the leakages, allow the process liquid to pass through the pipeline.

6 Transmitter Installation

6.1 Integral Type Transmitter

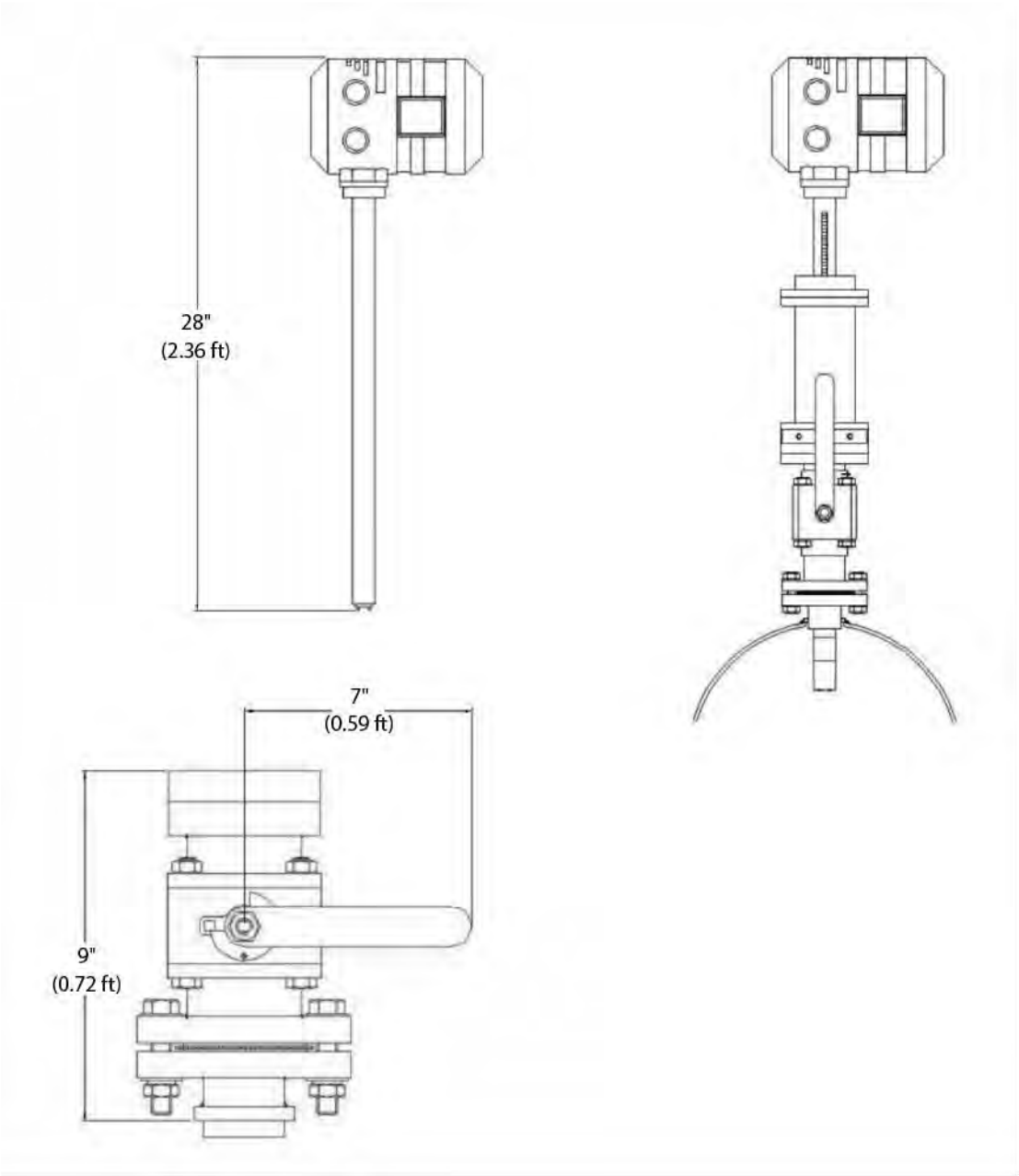
- In case of an Integral Type Flowmeter, the Transmitter comes pre-mounted atop the Flow Sensor and therefore gets physically installed along with the Flow Sensor/sensor.
- The images below show the Integral Type Transmitter mounted on the Flow Sensor.



6.2 Protecting the Transmitter

Provide a weather-shade/ canopy to protect the Transmitter from direct exposure to sunlight, rain or any other dropping fluids. This will help enhance the useful life of the Transmitter.

6.3 Dimension



7 Electrical Connection

7.1 Instructions for connecting cables

- a. Always use cables of the following specifications.
 - Power: 3 core, 0.039 inch², PVC/ PTFE sheathed cable
 - Current Output: 2 core, 0.039 inch², PVC/PTFE sheathed cable
 - Coil and Electrodes (in case of Remote Type Flowmeter): as supplied with Flow Sensor



CAUTION

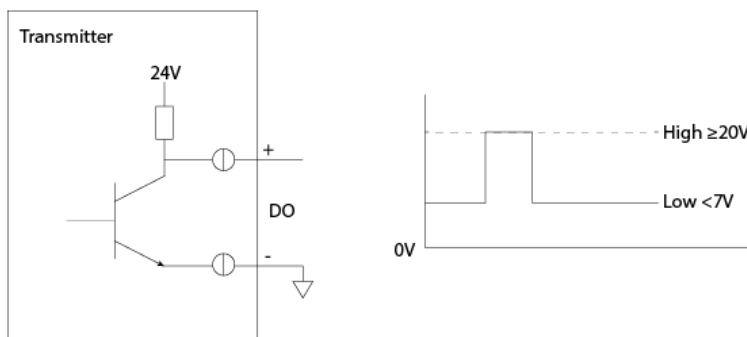
Never extend the Coil and Electrodes cable by joining another cable

- b. Use ferrules for each wire and crimp the ends of the conductors with appropriate cable lugs.
- c. Disassemble the cable gland nut and pull out the rubber sleeves.
- d. Run the required cable through the nut and rubber sleeve which fits snugly over the cable.
- e. Then pass it through the cable gland and terminate it onto the appropriate terminals.
- f. Press-in the rubber sleeve into the gland cone and then tighten the cable gland nut.
- g. Ensure that the cable is tightly clamped.
- h. Run the following sets of cables through physically separated cable trays and trenches.

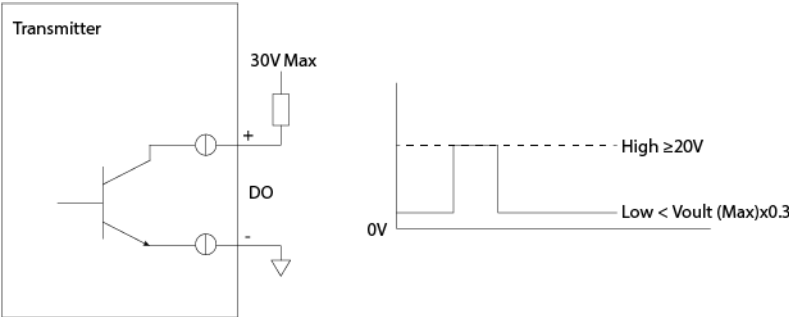
Set 1	Set 2	Set 3
Power	Coils	Current output
Relay Output	Electrodes	Digital input
		Digital output
		RS485

- i. Before making the various Input-Output connections, understand the manner in which these connections are to be done.

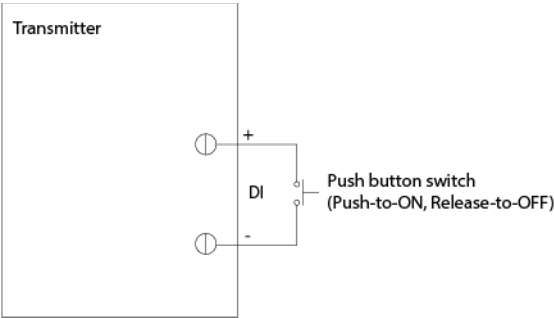
DO1, DO2 Active output



DO1, DO2 Open Collector output



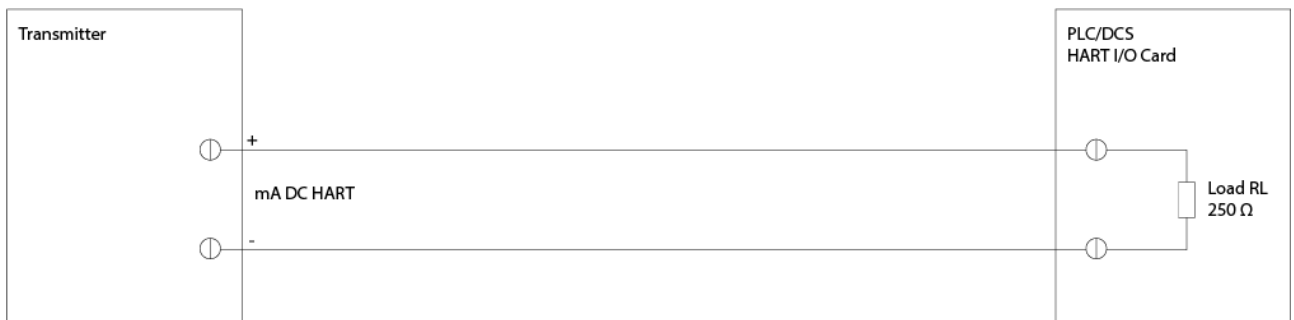
DI Digital Input



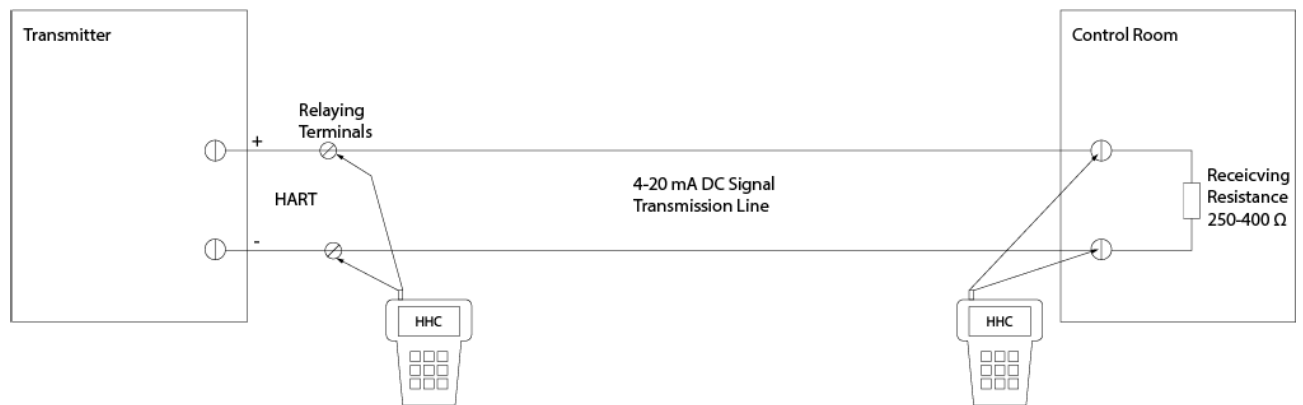
Current Output



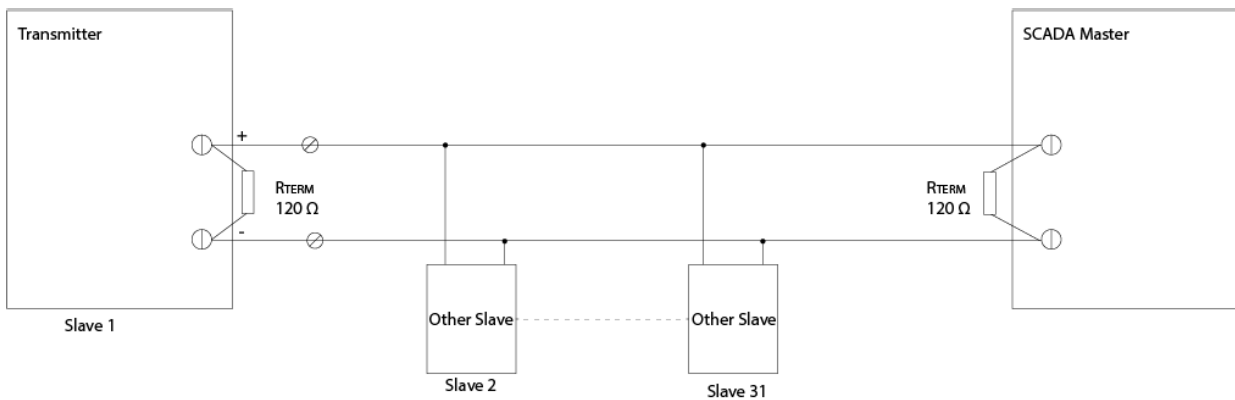
Current Output



Current Output HART with HHC



Modbus RS 485



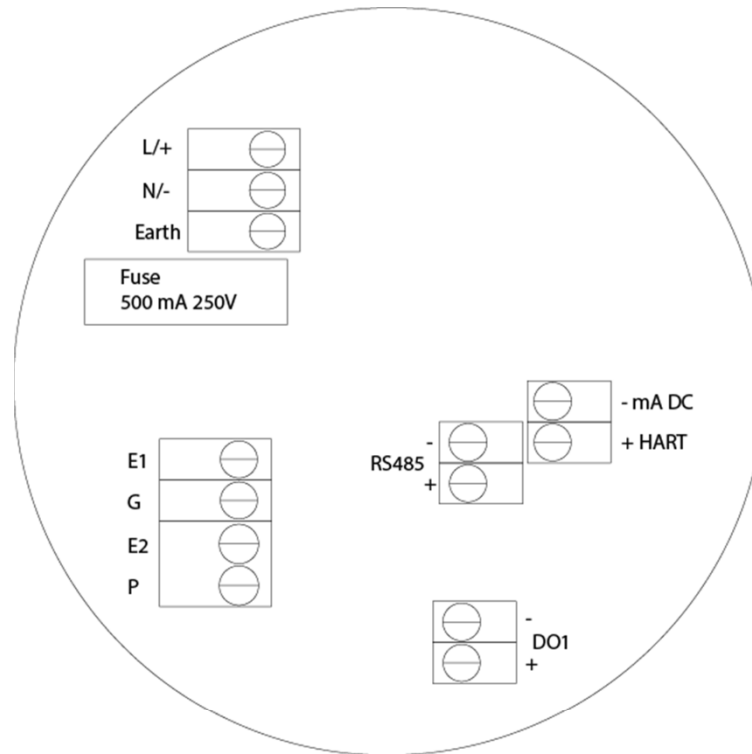
7.2 Integral Transmitter terminals

- Unscrew the rear cover of the Transmitter. Read the operating Power Supply voltage indicated on the tag plate, and confirm that the available power supply matches the Transmitter's requirement.
- Make the field connections to the terminals as indicated in the following image



CAUTION

Note that the Coils and Electrodes are internally pre-wired.



- c. Refer to the following table for a description of the terminals.

Marking	Description	
L / +	110/ 230VAC	24 VDC
N / -	Neutral	0 VDC
E	Earth	
RS485 +	Modbus	
RS485 -		
DO1 +	Pulse Output	
DO1 -		
mA DC +	Current output	
mA DC -		

7.3 After Making all the Connections

- a. Inspect and confirm that the O-ring of the rear cover is appropriately seated and is not damaged. Then align its threads properly against those of the Transmitter. Engage the threads, rotate and fix the cover by screwing it completely till the O-ring is effectively compressed. This will prevent any ingress of moisture or water into the Transmitter enclosure.
- b. Inspect and confirm that the Gasket of the Junction Box cover is appropriately seated and is not damaged. Then align its sealing surface with that of the Junction Box base. Engage the screw threads, rotate and fix the cover by screwing it completely till the Gasket is effectively compressed. This will prevent any ingress of moisture or water into the Junction Box.

8 Powering Up the Flowmeter

Confirm that installation has been done and completed as described in this manual. Then, the Flowmeter is ready for operational use.

Switch-on the mains power to the Transmitter. The Transmitter is delivered duly calibrated and configured for the range of flow rate measurement, as ordered by you.

Allow the process liquid to start flowing through the Flow Sensor. Ensure that flow rate is within the specified limits for the Flowmeter. Excess flow rate could damage the Flow Sensor lining.

The Flowmeter will start indicating the flow rate and driving the current output proportional to the flow rate.

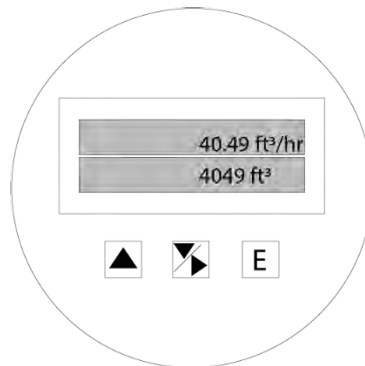
9 User Interface

The user interface comprises of backlit LCD readout in a configuration 2 rows of 16 characters each, and a set of three tactile keys. The Flowmeter has different modes, and the LCD displays information relevant to each of the four modes – Run, Program, Info and Clear respectively. The tactile keys in conjunction with the LCD, enable switching between different modes, reading static information and runtime values, setting and programming new values and selecting between certain functional options. This process of navigation takes you through different Screens - each Screen being a collection of information relevant to that particular Screen. The Screens are part of an internal Menu structure.



CAUTION

To help you navigate through the above Menu, it is useful to understand the nature of the actions of the three tactile switches.



UP key

- Move to the next option within a Menu level
- Increment the value of the digit by one
- Move to the next value of a parameter



DOWN/ RIGHT key

- Move to the previous option within a Menu level
- Decrement the value of the digit by one
- Move to the previous value of a parameter



DOWN/ RIGHT key

- Move to the right digit
- Move from the rightmost digit to the leftmost



ENTER key

- Select the option presently being displayed
- Select the parameter presently being displayed for viewing and/or editing
- Set the value presently being displayed

10 Understanding the Value Operation



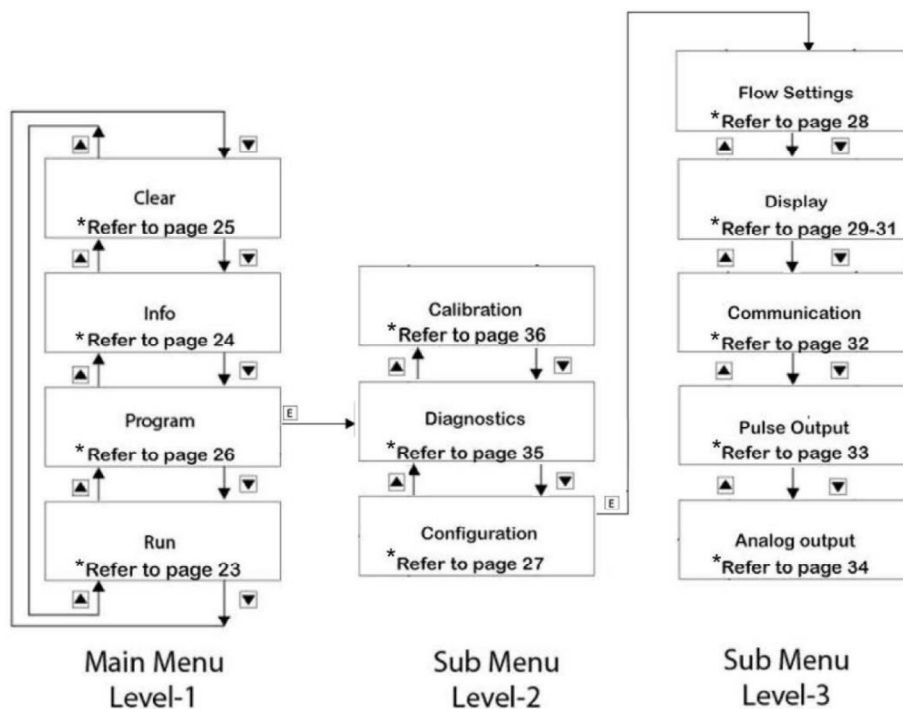
CAUTION

Please read this section before trying to operate the tactile switches to navigate through Menu. The 1400B Menu has the following structure. At power ON, the Transmitter LCD momentarily indicates.

- The Flowmeter Model, then
- The Software Version number, then
- The RUN mode indicating the Flow rate, Totalized flow and Flow velocity depending on which parameters have been configured to be displayed.

Hit the ENTER key first to access the 4 main functions using the UP and DOWN keys: Run/ Program/ Info and Clear

Simple Explanation of How to Navigate



* See corresponding page in manual

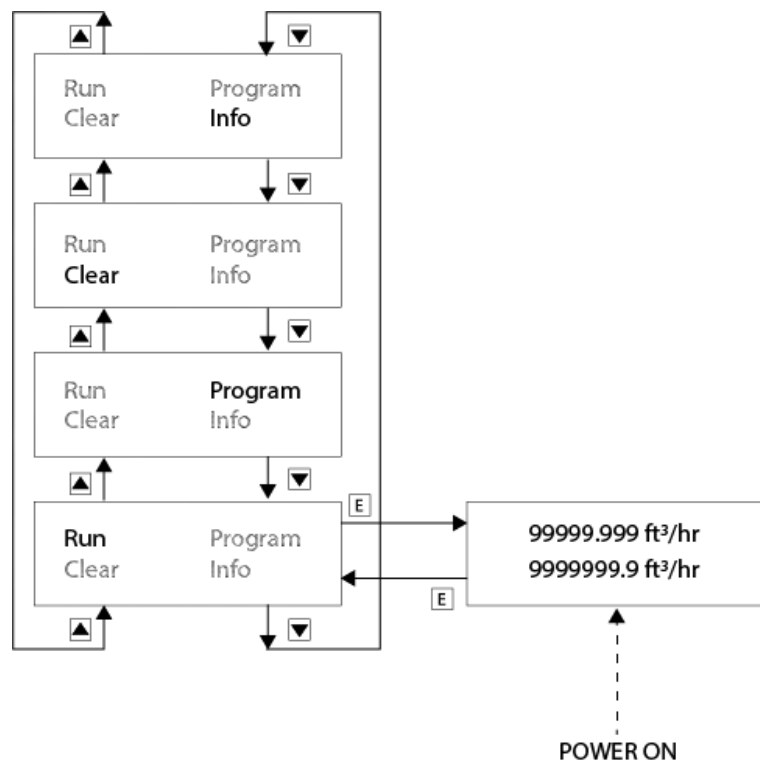
Main function of the keys (tactileSwitches):

Use key to move up within a Menu Level
 Use key to move down within a Menu Level
 Use key to move to next Menu Level
 Use key to Exit to previous Menu Level

Use key to encrement a digit
 Use key to shift to right digit

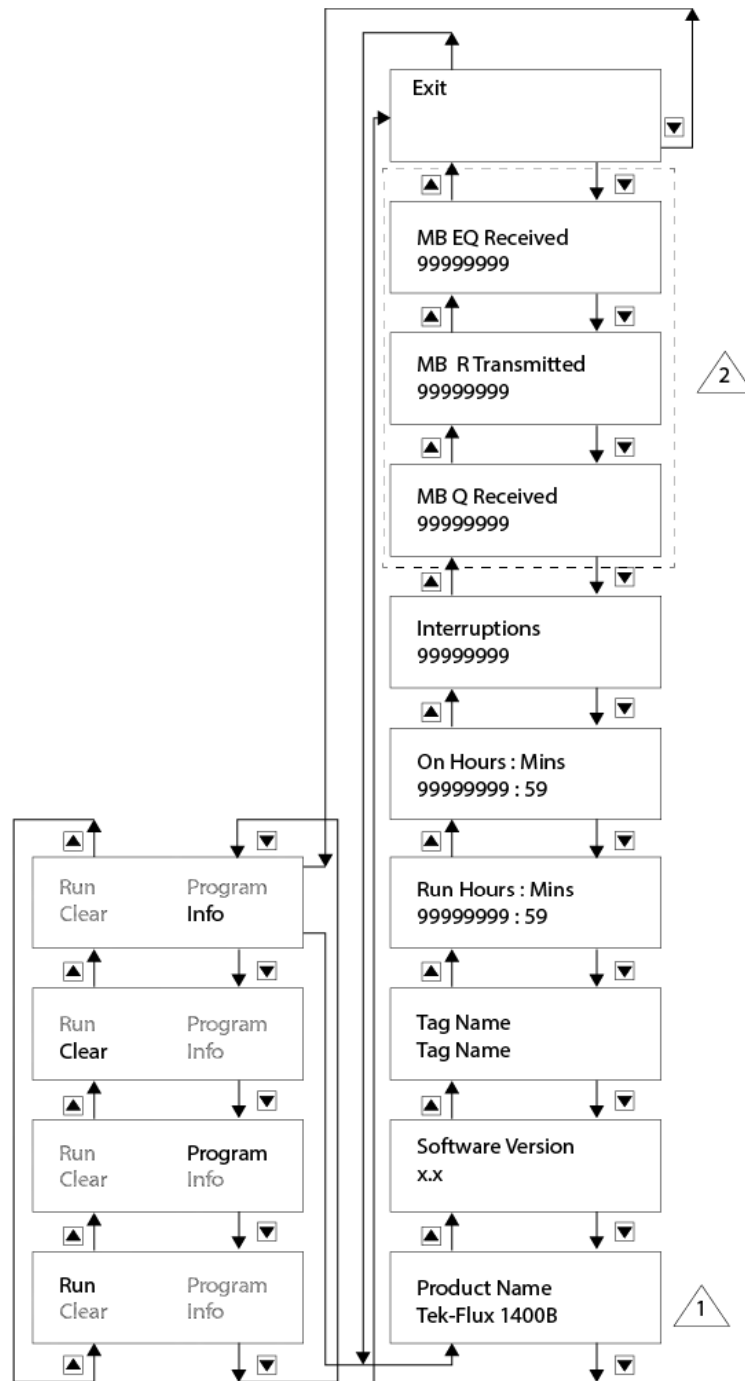
11 Menu and Modes of Operation

11.1 Run Mode



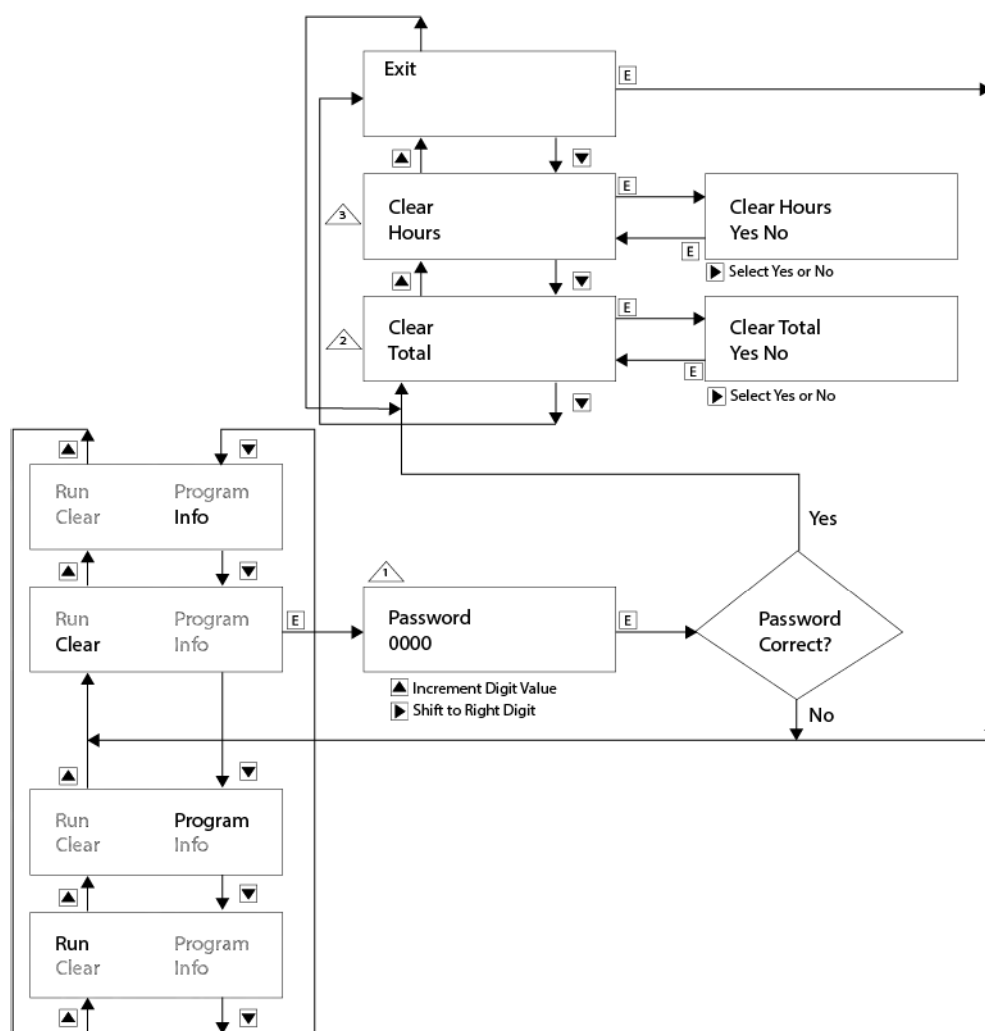
- △¹ Polarity indication only for Bidirectional flow setting
- △² Diagnostic messages in place of flow rate and velocity value-
 - a. Empty pipe
 - b. High Flow (> 39 ft/s)

11.2 Info Mode



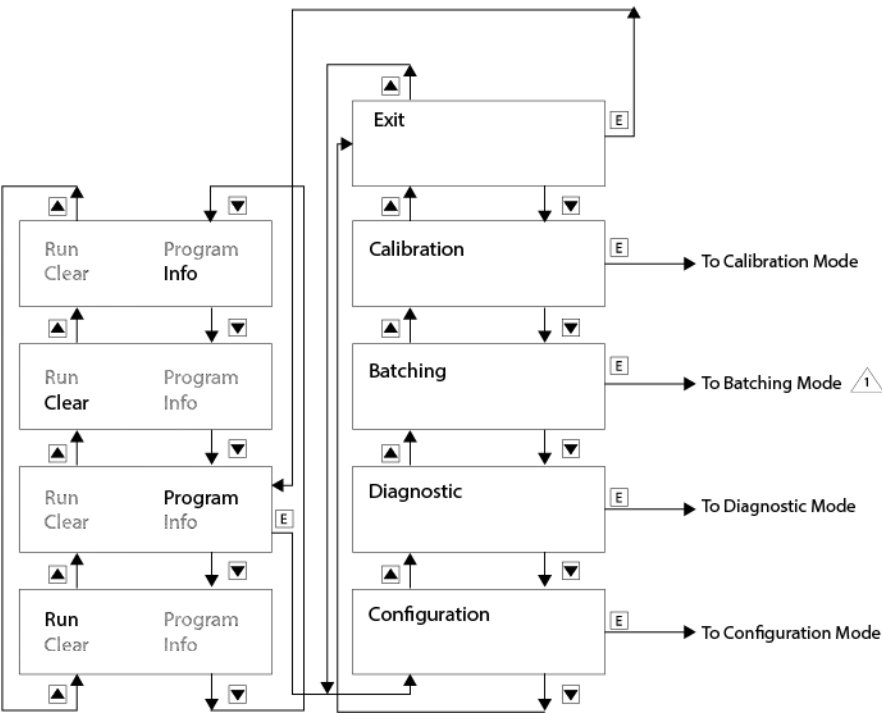
- △ 1 'Tek-Flux 1400B' displayed in case of model Tek-Flux 1400B
△ 2 Applicable when communication is enabled

11.3 Clear Mode



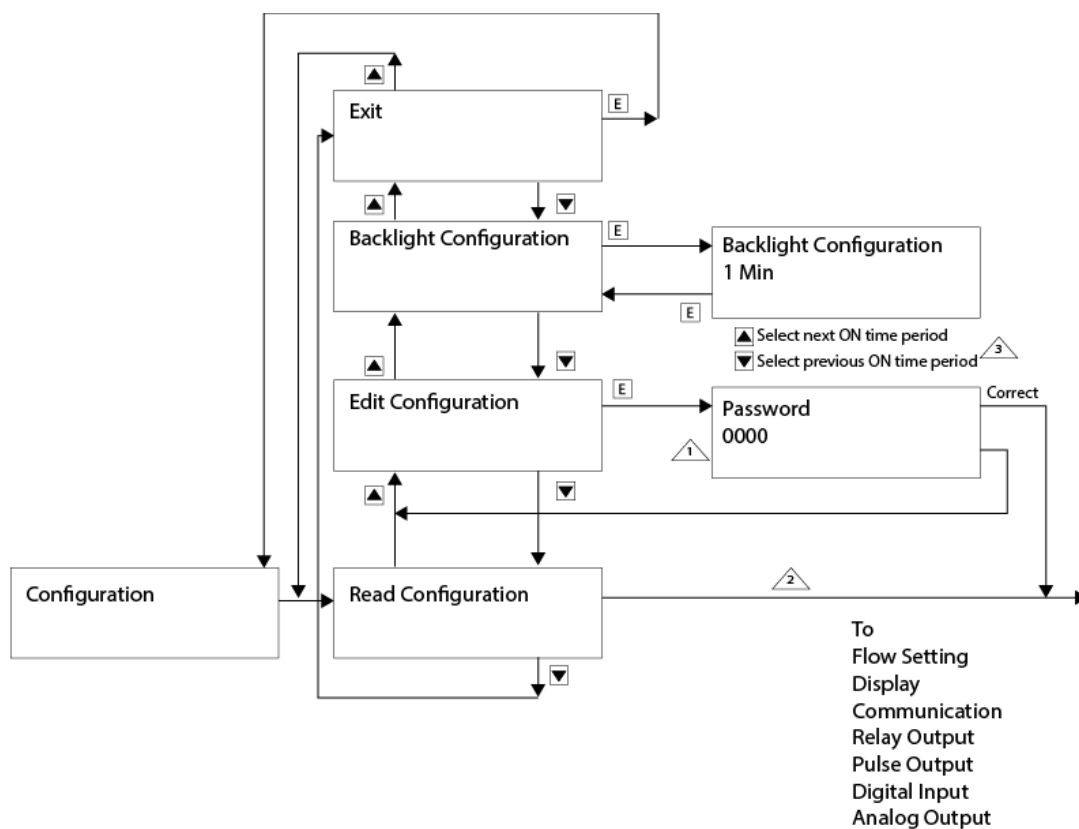
- △1 Password = 0741
- △2 Totalizer value can be cleared
- △3 ON and RUN hours, and power interruption count can be cleared

11.4 Program Mode



 If batching is enabled

11.5 Configuration Mode



- 1 Password = 4321
- 2 In Read Mode, no parameter setting permitted
- 3 Periods = Always ON 1/5/10/30/60/120 MIN

11.6 Flow Setting

(for DN Size, Flow & Totaliser Unit options refer to the Specification chapter)

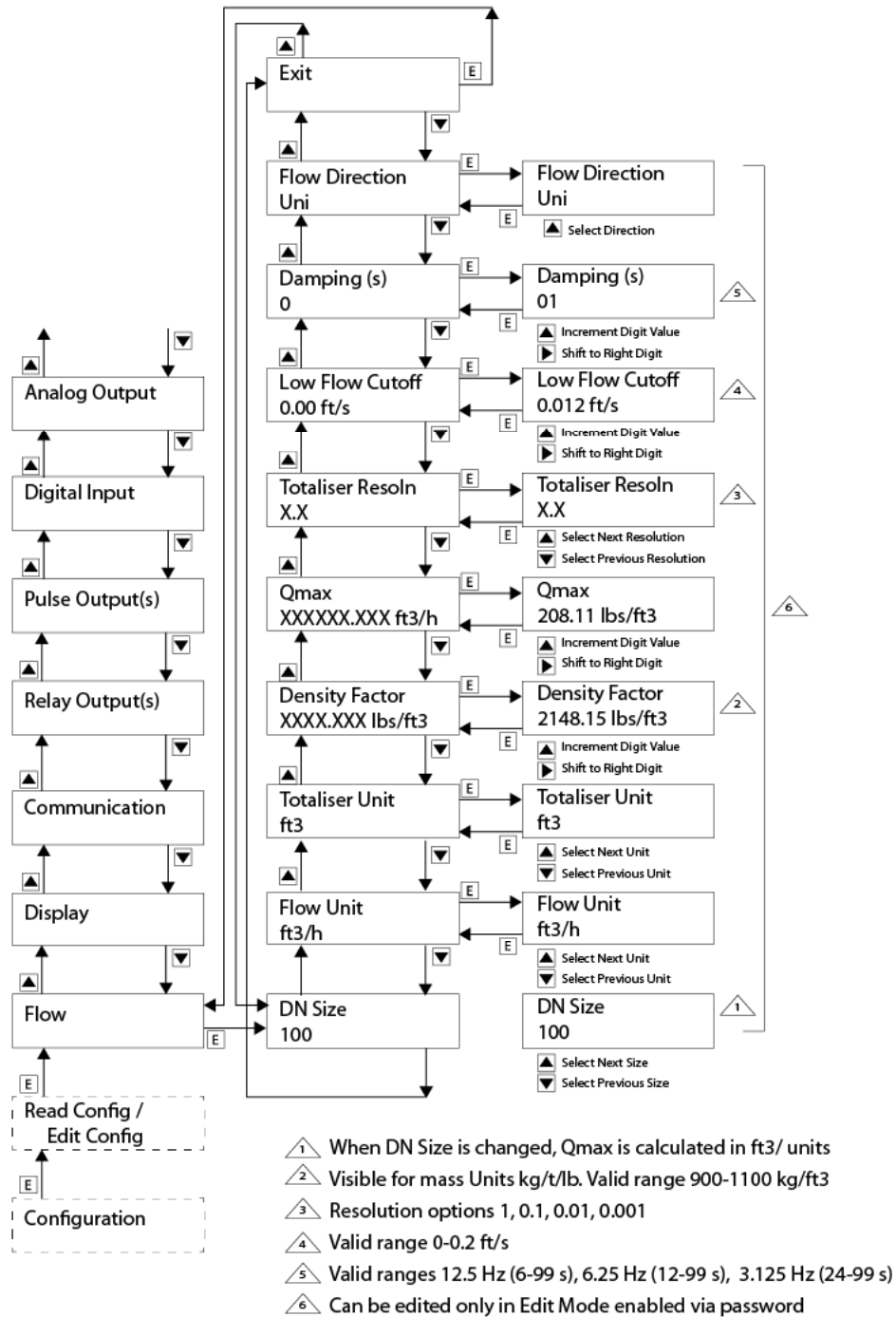


Figure 1 is a detailed state transition diagram for the 'Flow Rate' system. The diagram shows a sequence of states: Flow, Display, Communication, Totaliser Enabled, Velocity Enabled, Scroll Time (s) 5, and Exit. Transitions are labeled with '▲' (select next) and '▼' (select previous). A legend on the right explains the scroll time values: 5/10/15/20/25/30/35/40/45/50/60 sec.

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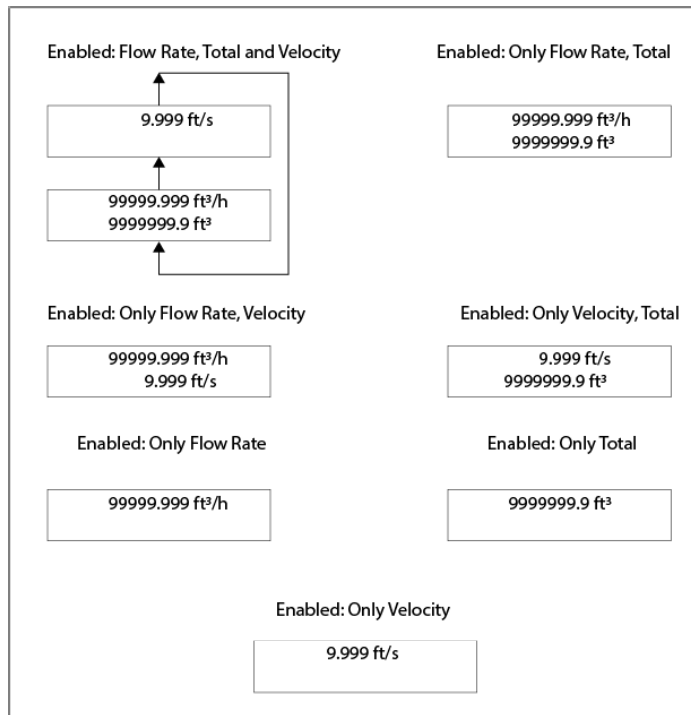
graph TD
    Flow[Flow] --▲--> Display[Display]
    Display --▲--> Communication[Communication]
    Display --▼--> FR_Enabled[Flow Rate Enabled]
    Display --E--> Exit[Exit]
    Communication --▲--> FR_Enabled
    Communication --▼--> FR_Enabled
    FR_Enabled --▲--> Totaliser_Enabled[Totaliser Enabled]
    FR_Enabled --▼--> Totaliser_Enabled
    FR_Enabled --E--> Exit
    Totaliser_Enabled --▲--> Velocity_Enabled[Velocity Enabled]
    Totaliser_Enabled --▼--> Velocity_Enabled
    Totaliser_Enabled --E--> Exit
    Velocity_Enabled --▲--> Scroll_Time[Scroll Time (s) 5]
    Velocity_Enabled --▼--> Scroll_Time
    Velocity_Enabled --E--> Exit
    Scroll_Time --▲--> Exit
    Scroll_Time --▼--> Exit
    Scroll_Time --E--> Exit
    Exit --▲--> Flow
    Exit --▼--> Flow
    Exit --E--> Flow
  
```

Legend:

- ▲ Select Next Value
- ▼ Select Previous Value
- E Select Enabled/Disabled

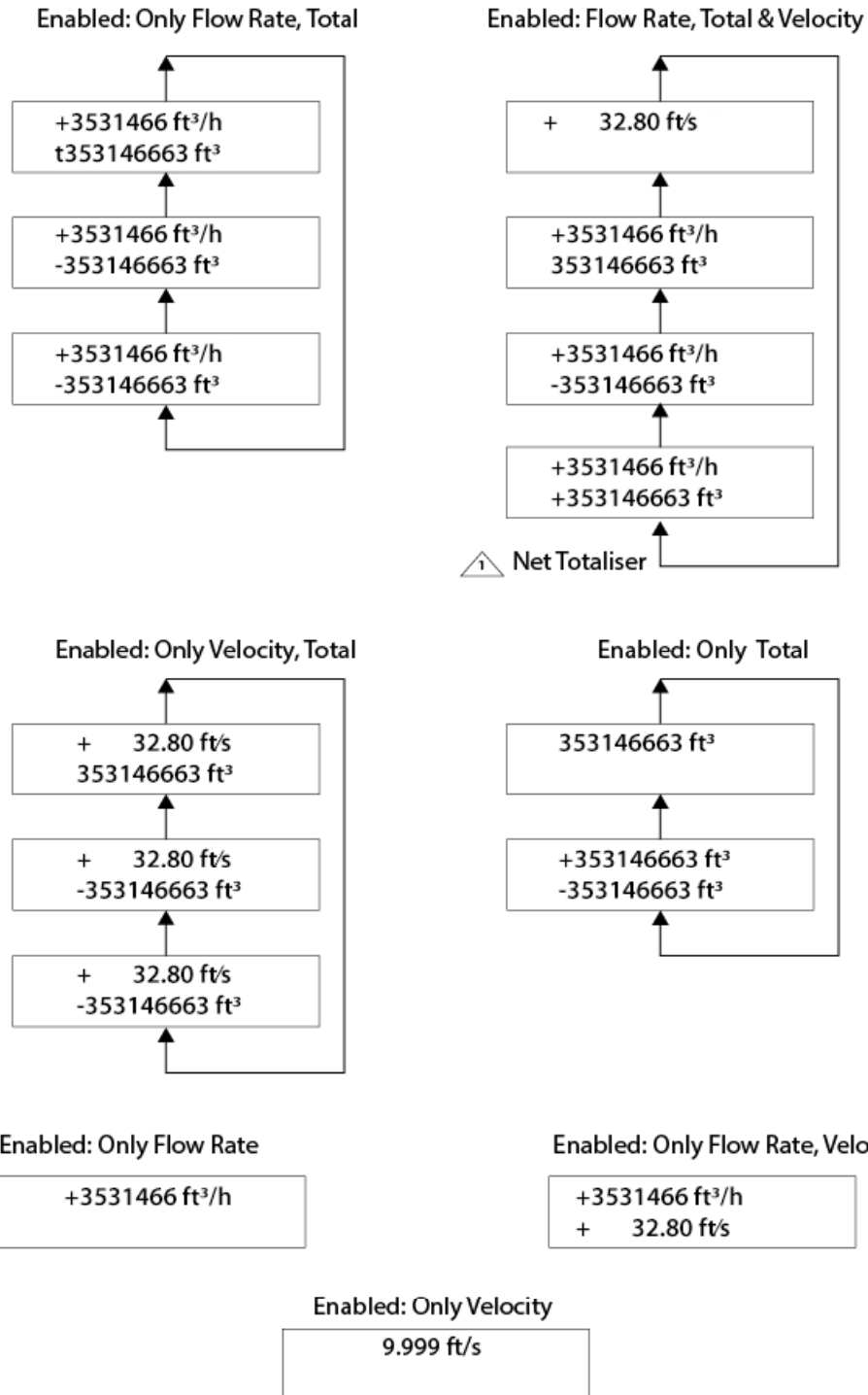
Scroll Time 5/10/15/20/25/30/35/40/45/50/60 sec

In case more than 2 parameters are programmed to be displayed, these will be displayed across multiple Screens. Each Screen will remain visible for the duration of the programmed Scroll Time. After that, the next Screen will be displayed.



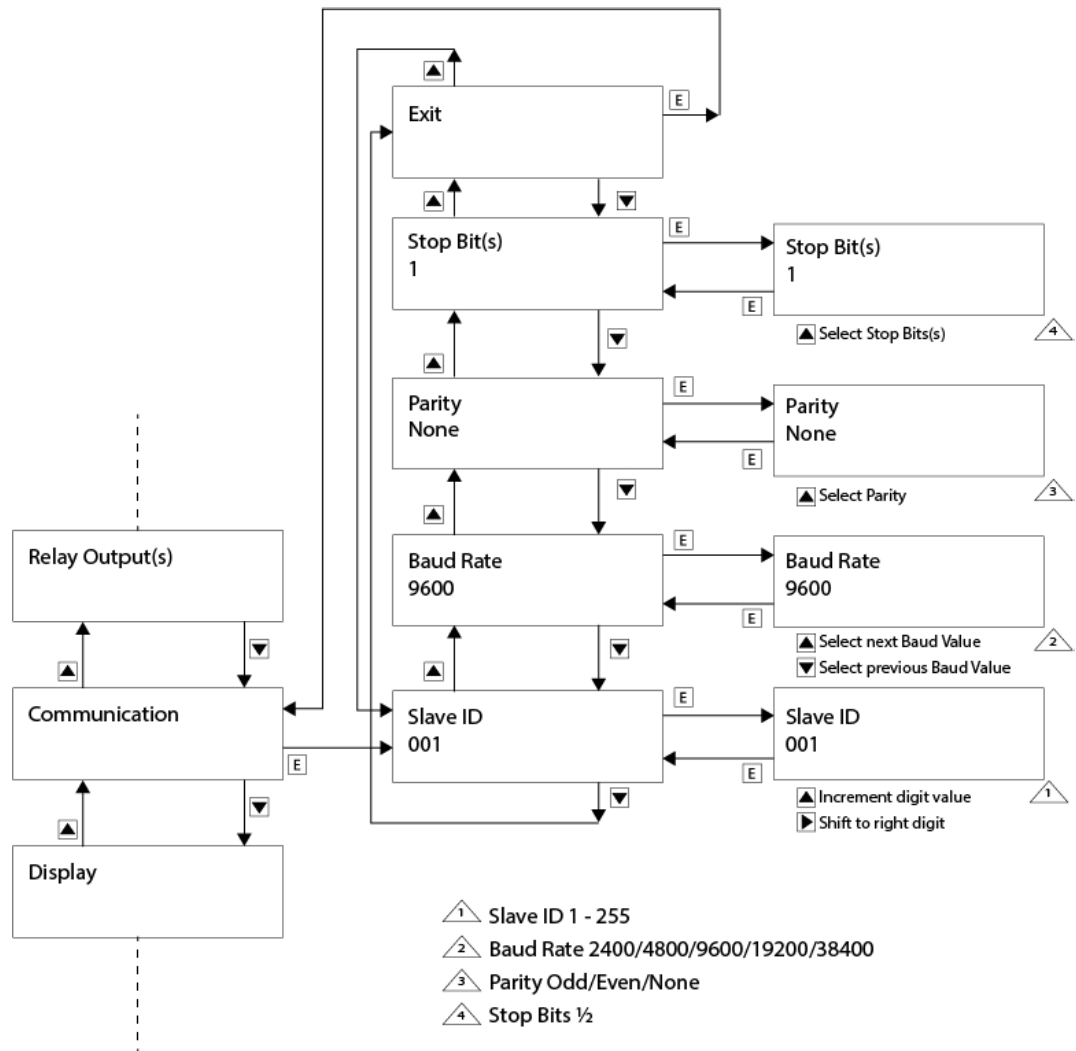
11.9 Display Screens: Bidirectional Flow

In case more than 2 parameters are programmed to be displayed, these will be displayed across multiple Screens. Each Screen will remain visible for the duration of the programmed Scroll Time. After that, the next Screen will be displayed.

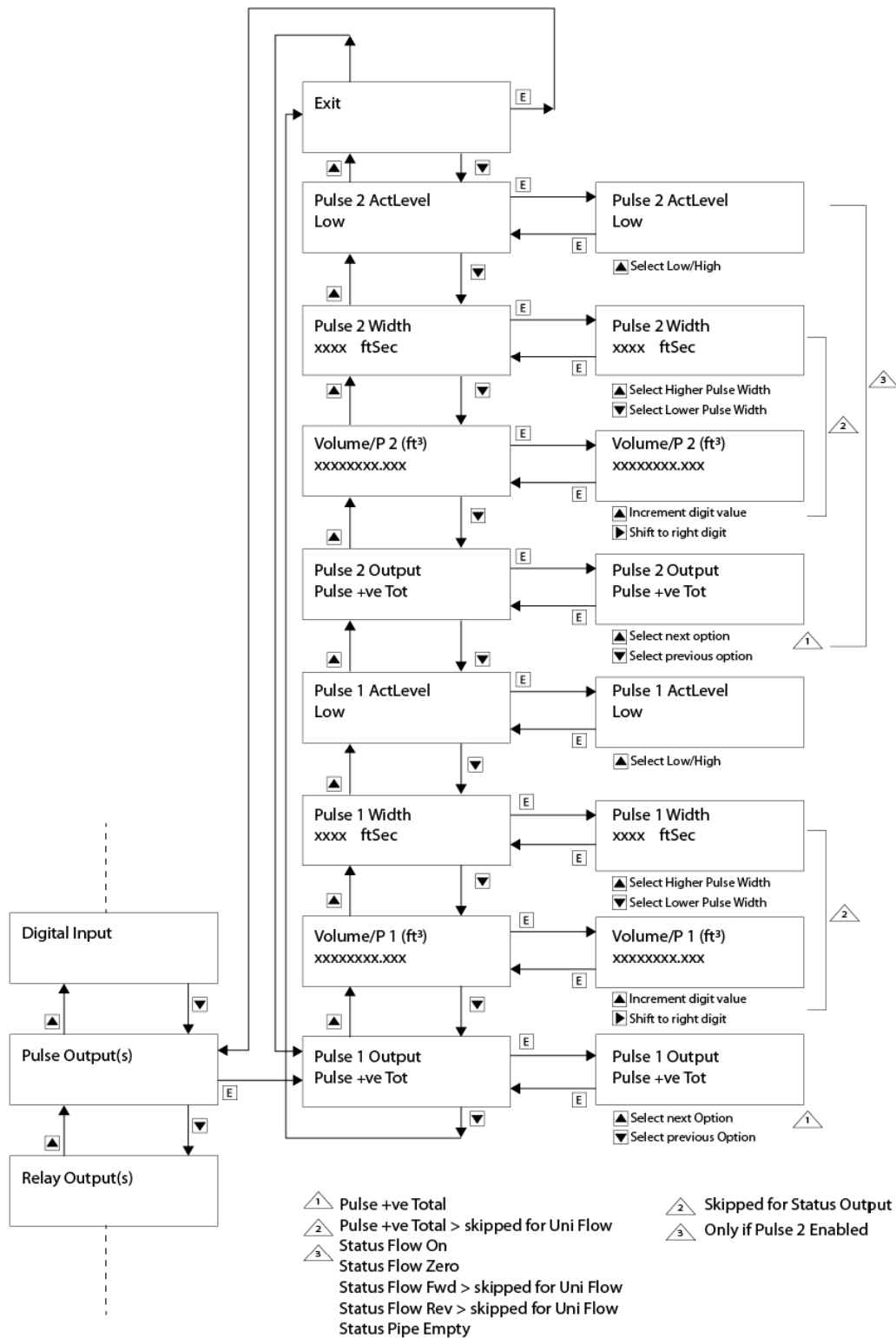


Note: Indicated polarity of Flow Rate and Velocity depends on actual flow direction

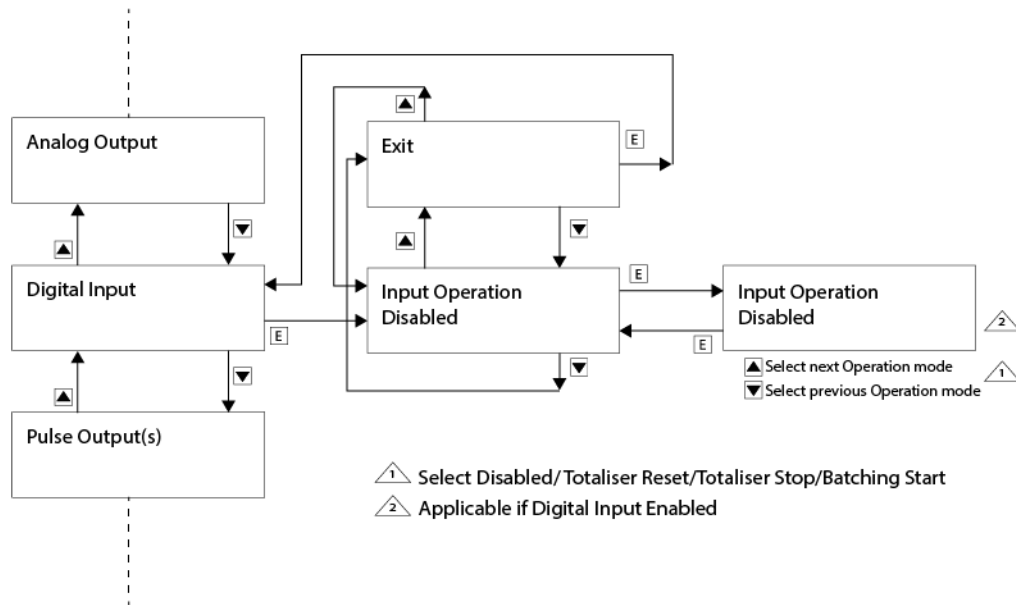
11.10 Communication Settings



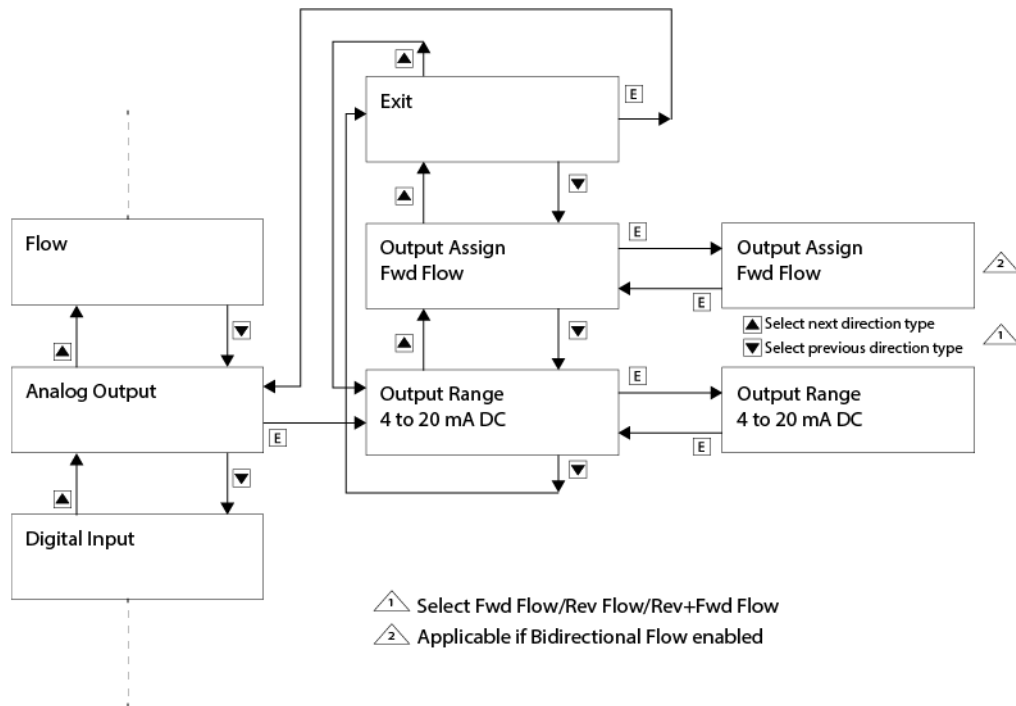
11.11 Pulse Output Settings



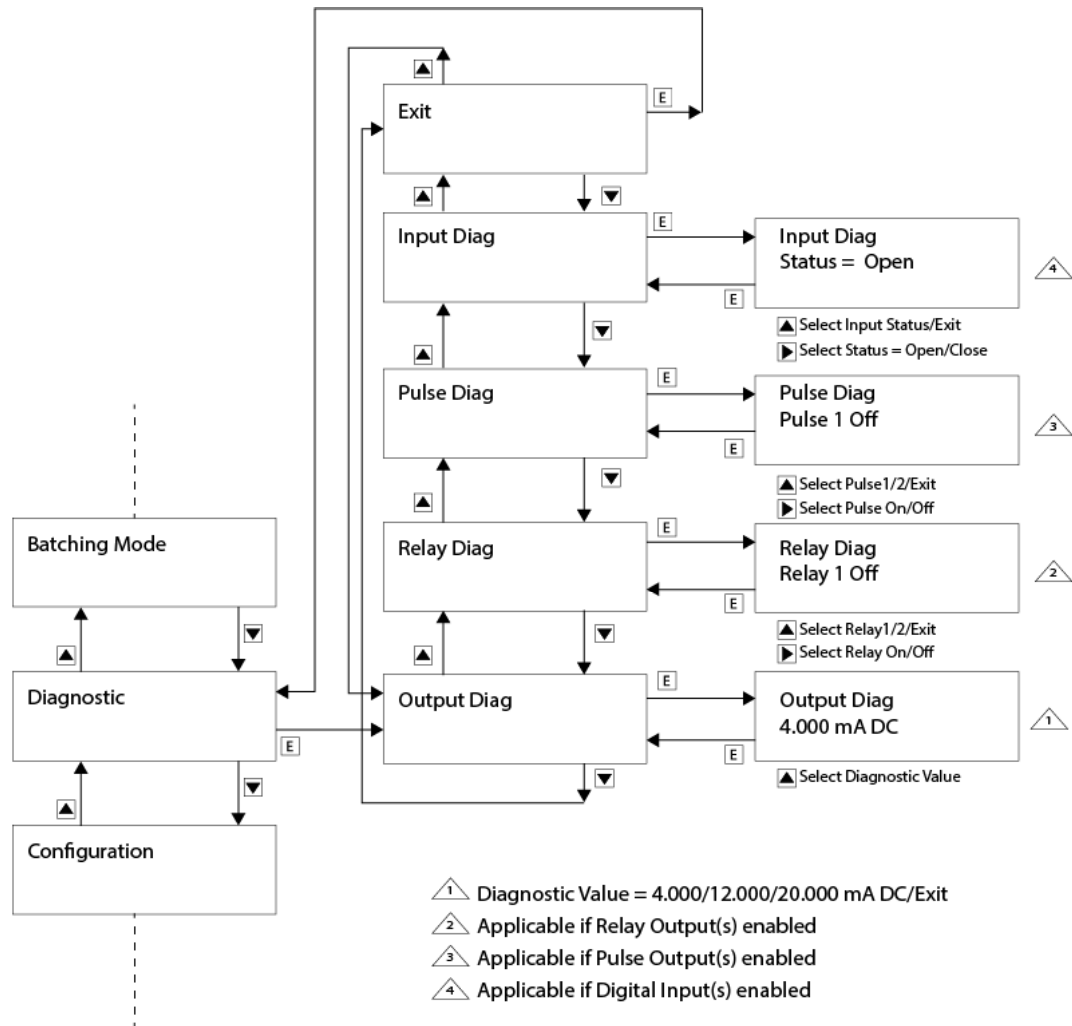
11.12 Digital Input Settings



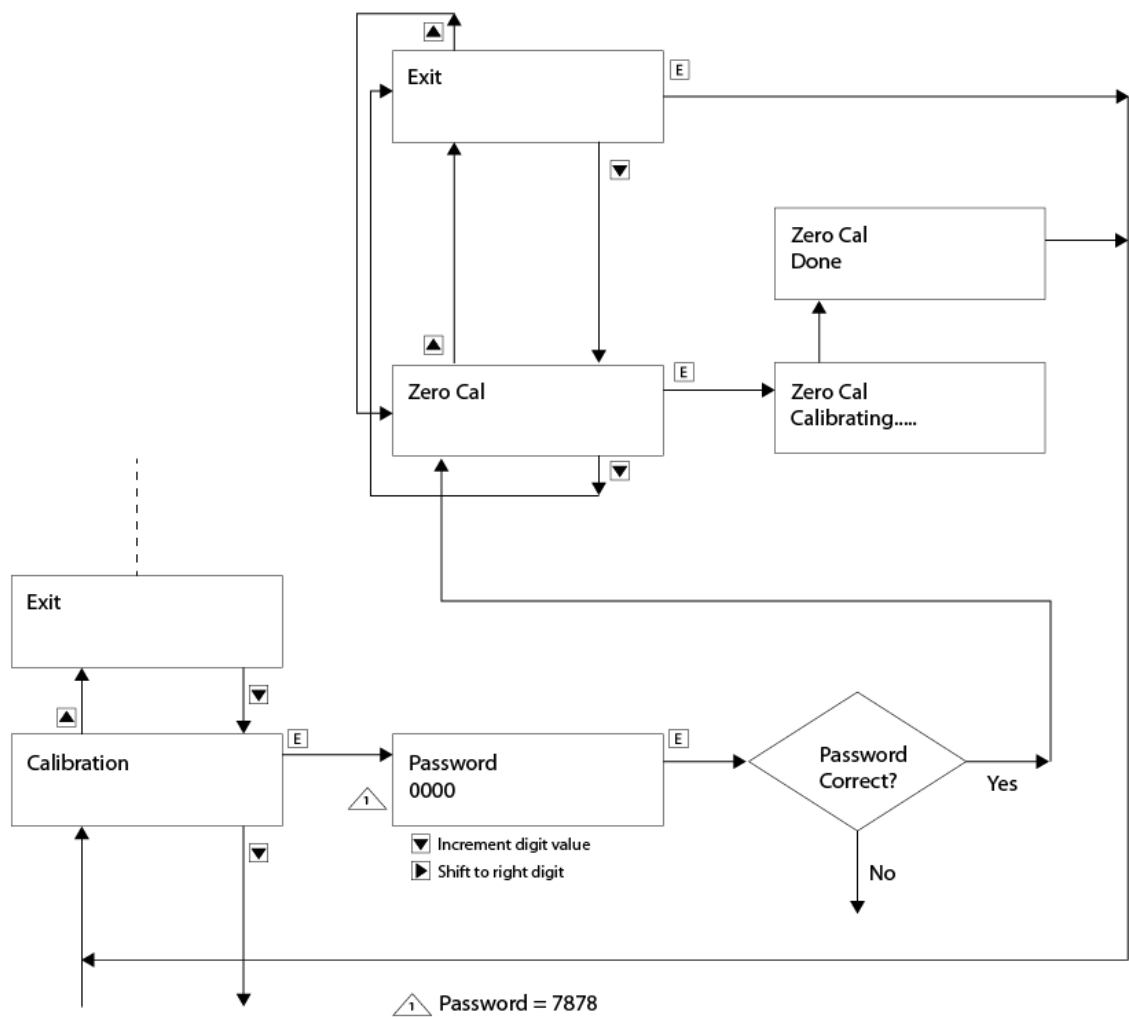
11.13 Analog Output Settings



11.14 Diagnostics Mode



11.15 Calibration Mode



12 Operational Precautions

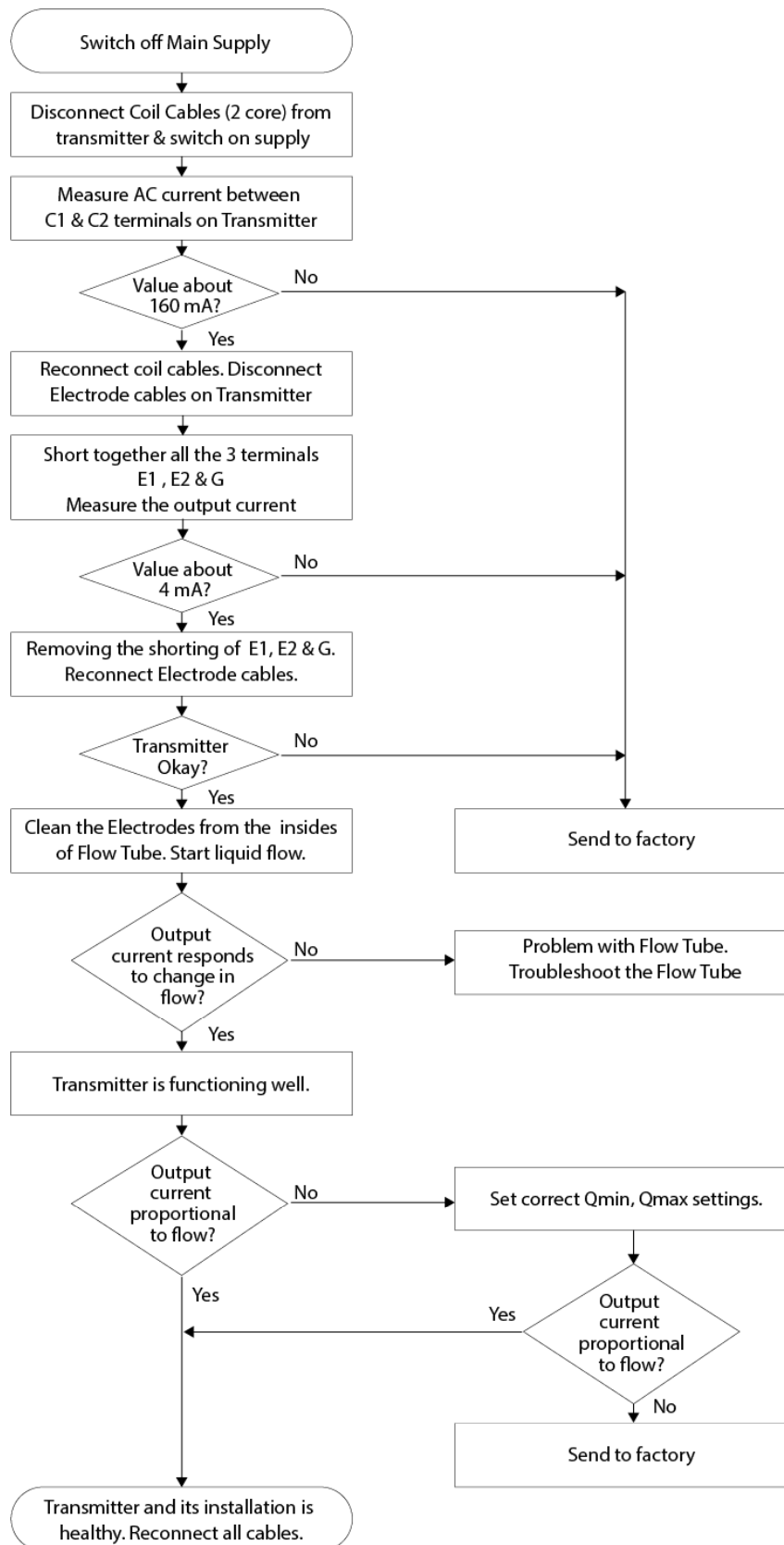
- a. The Junction Box of the Flow Sensor in case of a Remote Transmitter is designed for field applications and use. However, it is advisable to protect it from exposure to direct sunlight and rain, by installing a weather shade over it. Likewise, the Transmitter is designed for field applications and use. However, it is advisable to protect it from exposure to direct sunlight and rain, by installing a weather shade over it. This will help extend the useful life of the Flowmeter as a whole.
- b. Keep the covers of the Transmitter and that of the Junction Box well fastened, taking care that the O-rings and Gaskets are undamaged and properly seated for effective sealing.
- c. Keep the cable gland nuts tight and ensure that the cables are gripped uniformly around their circumference to prevent any ingress of moisture or water into the Transmitter and Terminal Box.
- d. Ensure that the Mains power supply is stable, without any surges & spikes and well within the specified range.
- e. Measure and ensure that there are no sources of strong magnetic field in the immediate vicinity of the Flow Sensor. Such magnetic fields can interfere and alter the output signal of the Flowmeter.
- f. Follow these steps to check that the zero flow condition is proper.
 - Stop the flow through the Flow Sensor by shutting off the valve which is immediately downstream of the Flow Sensor.
 - This way the Flow Sensor will remain filled with liquid.
 - Keep the Transmitter powered ON.
 - Measure the output signal using a calibrated 3½ digital multi meter.
 - The output must be within 4 ± 0.01 mA.
- g. If the output is not within above values, the possible causes can be-
 - Improper grounding.
 - Shifted zero. In this case follow the Calibration mode.
 - Contaminated electrodes.
- h. Note that the pulsed-DC technique of exciting the field coils ensures a stable zero or auto zeroing, provided all other requirements are satisfied.
- i. The flowing liquid must be free of any gas bubbles as the presence of bubbles causes falsified output.

13 Troubleshooting

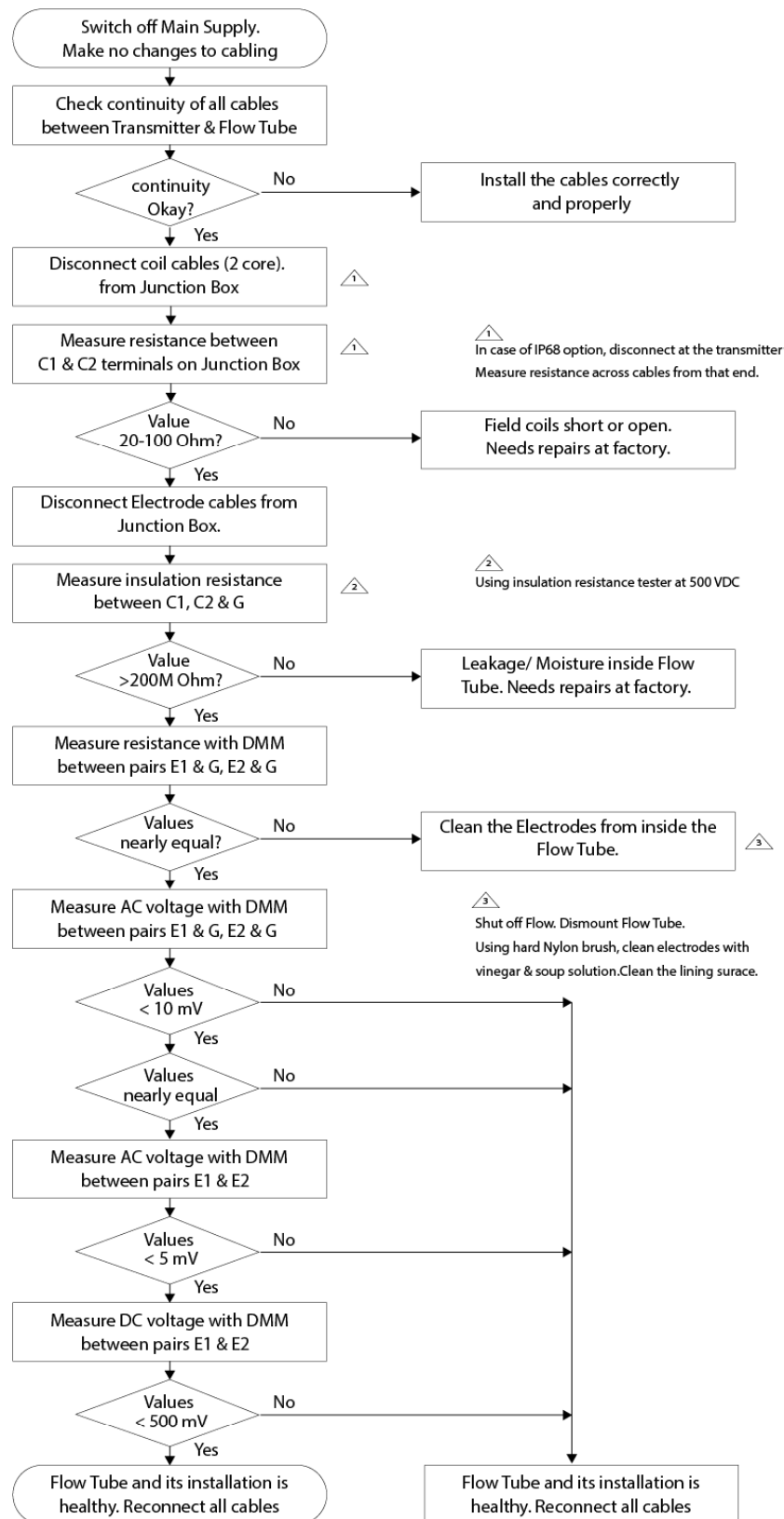
13.1 Quick Checks

No.	Problem Observed	Possible Cause	Corrective Action
1	Transmitter does not power up.	a. Fuse has blown. b. The mains power supply is not as specified.	a. Ensure that the mains power supply is within $\pm 15\%$ of the value specified on the Nameplate. b. Replace the fuse if found to be blown.
2	The output current is not 4 mA DC under zero flow condition.	a. The flow is not essentially zero. There exists a small amount of trickle flow. b. Grounding is not proper.	a. Force the flow to zero by completely shutting off the downside valve and check. b. Correct the grounding.
3	Output current is not steady.	a. Flow itself is not steady but pulsating or irregular. b. Gas or air bubbles are present in the flowing liquid. c. The flowing liquid has a varying conductivity.	a. Allow the flow to stabilize and then check. b. Identify and eliminate the cause of the air or gas bubbles or wait until liquid is free of bubbles. c. Allow to flowing liquid to attain a stable conductivity. d. Correct the grounding.
4	Output current not proportional to flow.	Qmax values may not be set properly.	Set the Qmax to values correctly corresponding to 20 mA.
5	Display alternates between High Flow and Empty pipe.	Grounding is not proper.	Correct the grounding.
6	Modbus communication issues	a. Wiring is not correct. b. Communication settings are incorrectly set.	a. Correct wiring as per diagram. b. Set correct communication parameters
7	Pulse is not available.	a. Pulse settings are not correct. b. Pulse type is not known.	a. Correct Pulse settings in respective DO section. b. Check your ordering for Active or Open Collector Output.

13.2 Troubleshooting the Transmitter Section



13.3 Troubleshooting the Flow Sensor Section





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