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BLFT Turbine Flow Meter

Operation Manual



Version Number: E930000 Ver.E+001

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1. GENERAL INFORMATION

This manual will assist you in installing, using and maintaining Liquid Turbine Flowmeters. It is your responsibility to make sure that all operators have access to adequate instructions about safe operating and maintenance procedure.



Warning

For your safety, review the major warnings and cautions below before operating this equipment.

1. Use only fluids that are compatible with the housing material and wetted components of your Liquid turbine flow meter.
2. When handling hazardous liquids, always exercise appropriate safety precautions.
3. When measuring flammable liquids, observe precautions against fire or explosion.
4. When working in hazardous environments, always exercise appropriate safety precautions.
5. Handle the sensor carefully. Even small scratches or nicks can affect accuracy.
6. For best results, calibrate the meter at least once per year.
7. Do not purge the flow meter with compressed air.
8. During Liquid Turbine Flowmeter removal, liquid may spill. Follow the manufacturer's safety precautions for clean up of any minor spills

Product Description

Operating Principle

Liquid flows through the turbine housing causing an internal rotor to spin. As the rotor spins, an electrical signal is generated in the pickup coil. This signal is converted into engineering units (liters, cubic meters, gallons etc.) on the local display where applicable. Optional accessory modules can be used to transmit the signal to other equipment.

Upon receipt, examine your meter for visible damage. The turbine is a precision measuring instrument and should be handled carefully. Remove the protective plugs and caps for a thorough inspection. If any items are damaged or missing, contact us.

Make sure the turbine flow model meets your specific needs. For your future reference, it might be useful to record the information on the nameplate in the manual, in case it becomes unreadable on the turbine. Refer to the nameplate for your customized product's specification.

2. TECHNICAL DATA

Measuring System

Application Range	Liquid: Water; Diesel; Gasoline, Chemicals
	(1) Filtered, without solids, sand, debris
	(2) Low Viscosity
Measured Value	
Primary Measured Value	Flow Rate
Secondary Measured Value	Volume Flow

Design

Features	
Modular Construction	The measurement system consists of a flow sensor and a signal converter. It is available as compact and as separate remote mount version
Compact Version Converter	N1: No display; pulse output only
	N2: No display; Exd(not Europe) See EEx ia ATEX option
	A: No display; 2 wire 4-20mA output only
	E: Local display; 4~20mA/ pulse output; RS485 Modbus as an option.
Connection	Threaded: DN4-DN50
	Flange: DN4-DN200 (DIN, ANSI, JIS)
	Wafer: DN4-DN200
	Tri-Clamp: DN4-DN100
Measurement Ratio	Standard -10:1; Optional - 20:1

Process Connections

Flange	
EN 1092-1	DN4...200 in PN 6...40
ASME	1/2 " ...8 " in 150 lb RF
JIS	1/2 " ...8 " in 10...20K
Design of Gasket Surface	RF (Raised Face)
Other Sizes or Pressure Ratings on Request	
Thread	DN4...DN50 BSP or NPT, PN63

Measurable Flow Range

Diameter	Standard Flow Range	Extended Flow Range
(mm)	(m ³ /h)	(m ³ /h)
4	0.04 to 0.25	0.04 to 0.4
6	0.1 to 0.6	0.06 to 0.6
10	0.2 to 1.2	0.15 to 1.5
15	0.6 to 3.6	0.5 to 5
20	0.8 to 8	0.45 to 9
25	1 to 10	0.5 to 10
32	1.5 to 15	0.8 to 15
40	2 to 20	1 to 20
50	4 to 40	2 to 40
65	7 to 70	4 to 70
80	10 to 100	5 to 100
100	20 to 200	10 to 200
125	25 to 250	13 to 250
150	30 to 300	15 to 300
200	80 to 800	40 to 800

Note: The flow range above is for reference only. Consult the factory if you have a special requirement. Refer to the nameplate or certificate for actual calibrated flow range.

Measuring Conditions

Reference Conditions	Flow conditions similar to EN 29104
	Medium: water/ Diesel/Alcohol
	Temperature: +10...+50°C/ +50...+86°F
	Straight lengths of pipe before & after: > 10 DN
Flow Meter Accuracy	Test operating pressure: 1 bar/14.5 psig
	Standard: ±1.0% of rate Optional: ±0.5% of rate

Installation Conditions

Installation Flow	Take Notice that the flow sensor is always fully flooded
	For detailed information see chapter "Cautions for Installation"
Direction	Forward
	Arrow on flow sensor indicates flow direction
Inlet Pipe Run	> 10 DN upstream straight lengths required
Outlet Pipe Run	>5 DN downstream straight lengths required

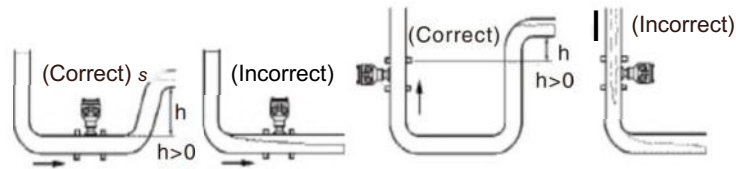
Materials

Sensor Housing	SS304		
	Other materials on request		
Flanges	SS304		
	Other materials on request		
Rotor			
Standard: 2Cr13	EN10088-3	1.4021	X20Cr13
	ANSI	420	
	BS	420S37	
	JIS	SUS410J1	
Optional: CD4MCU	DN15...DN80		
Bearing and Shaft	Tungsten Carbide		
Converter Housing	Standard: Polyurethane coated die-cast aluminum		

3. CAUTIONS FOR INSTALLATION

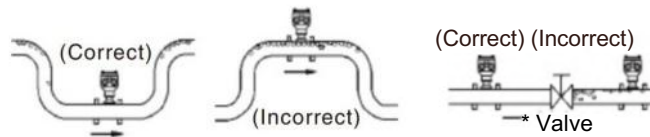
3.1 Mounting Positions

- Pipes must be fully filled with liquid. It is essential that pipes remain fully flooded at all times, otherwise flow rate indication may be affected and measurement errors may be caused.



Mounting Positions

- Avoid Air Bubbles. If air bubbles enter a measurement pipe, flow rate accuracy and operation may be affected and measurement errors may be caused.



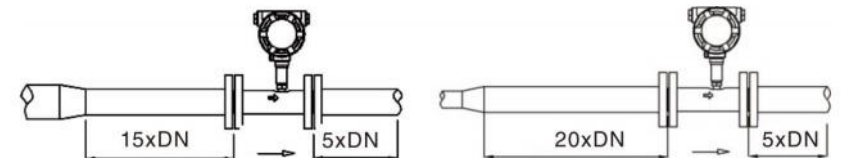
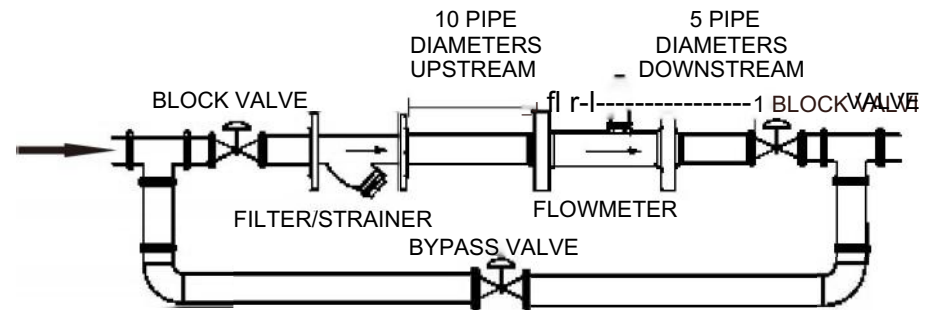
Avoiding Air Bubbles

- Avoid all pipe locations where the flow is pulsating, such as the outlet side of piston or diaphragm pumps
- Avoid locations near equipment producing electrical interference such as electric motors, transformers, variable frequency drives, etc.
- Install the meter with enough room for future access for maintenance purposes

 **Warning:** Precaution for direct sunshine and rain when the meter is installed outside.

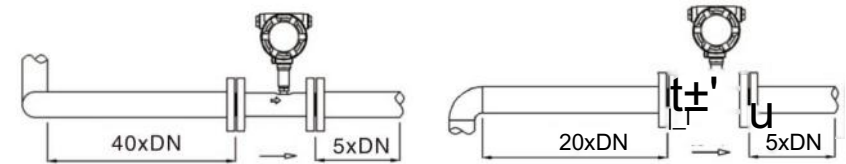
3.2 Required Lengths of Straight Pipe

Flow profile altering device such as elbows, valves and reducers can affect accuracy. See diagram below for typical flow meter system installation.



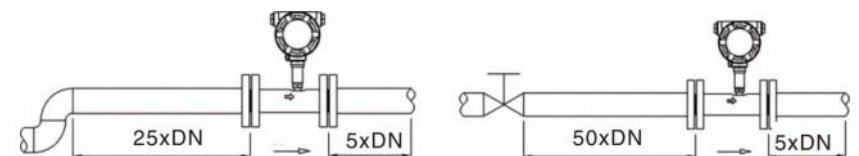
Concentric Contraction Fully Open Valve

Concentric Expansion Valve



Two 90 Degree Bends on Different Levels

One 90 Degree Bend



Two 90 Degree Bends on One Level

Half Open Valve

The recommended guidelines are given to enhance accuracy and maximize performance. Distance given here are minimum requirements; double them for ideal straight pipe lengths.

- Upstream: allow a minimum straight pipe length at least 10 times the internal diameter of the pipe . For example , with 50mm pipe , there should be 500 mm of straight pipe immediately upstream. Desired downstream straight pipe length is 1000mm.
- Downstream: allow a minimum straight pipe length at least 5 times the internal diameter of the pipe . For example , with 50mm pipe , there should be 250 mm of straight pipe immediately upstream. Desired downstream straight pipe length is 500mm.

3.3 Anti-Cavitation

Cavitation can be caused by entrained air. An amount higher than about 100 mg/l of entrained air or gas can produce error. In addition, cavitation can be caused by too little backpressure on the flow meter. For our turbine flow meters, you should provide a backpressure (downstream pressure) of at least 1.25 times the vapor pressure, plus 2 times the pressure drop through the flow meter. See formula 1.

$$\text{Formula 1: } P_b \geq 1.25 \times P_v + 2 \times (P_{in} - P_{out})$$

In formula 1: (P_b: Back pressure; P_v: Vapor Pressure; P_{in}: Inlet Pressure; P_{out}: Outlet Pressure) Create backpressure by installing a control valve on the downstream side of the meter at the proper distance detailed above.

Special Notice

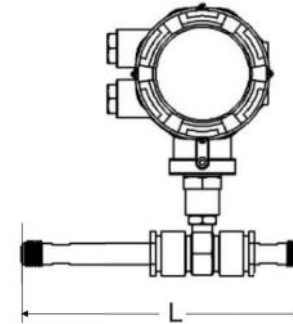
- Debris in the liquid being measured can clog the meter's rotor and adversely affect accuracy. If this problem is anticipated or experienced, install screens to filter impurities from measured liquids.
- To ensure accurate measurement, drain all air from the system before use.
- When the meter contains removable coverplates. Leave the coverplate installed unless accessory modules specify removal. Don't remove the coverplates when the meter is powered, or electrical shock and explosion hazard can be caused.

3.4 Connections

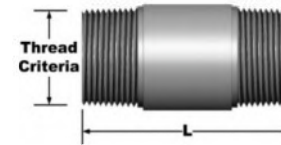
3.4.1 Thread Connection

Note: Default Thread is G Male (BSPM) Thread, other threads are available on request. For example: BSP, NPT Male/ Female Thread; Consult us for more information

DN4...DN10: Straight pipe adaptors and filter are included for DN4 to DN10 , as standard; DN15...DN50: Straight pipe adaptors are optional on request



DN4to DN10

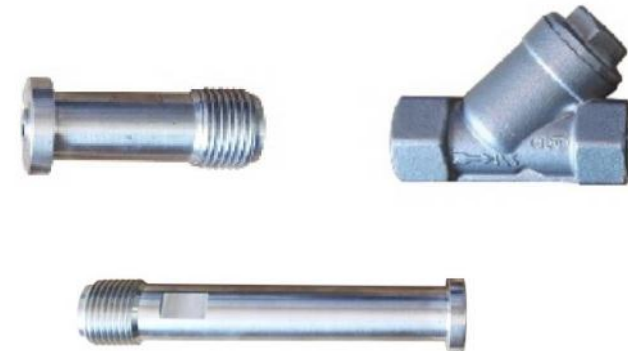


DN15to DN50

Diameter(mm)	L(mm)	Thread Criteria
4	225	G 1/2"
6	225	G 1/2"
10	345	G 1/2"
15	75	G 1"
20	80	G 1"
25	100	G 1-1/4"
32	140	G 2"
40	140	G 2"
50	150	G 2-1/2"

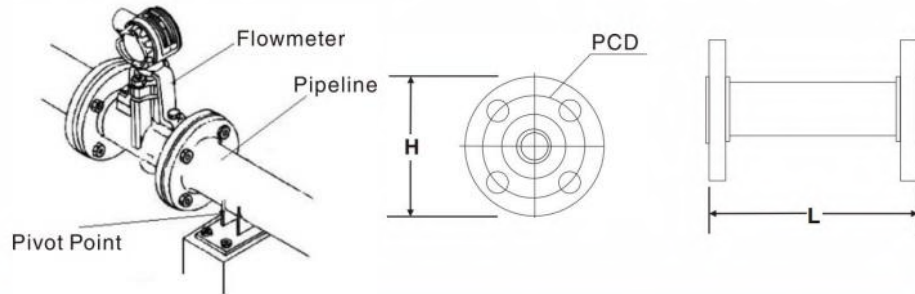


Filter and Straight Pipe



3.4.2 Flange Connection

Flange	
EN 1092-1	DN4...200 in PN 6...40
ASME	1/2"...8" in 150 lb RF
JIS	1/2"...8" in 10 ...20k
Design of Gasket Surface	RF (Raised face)
	Other sizes or pressure ratings on request



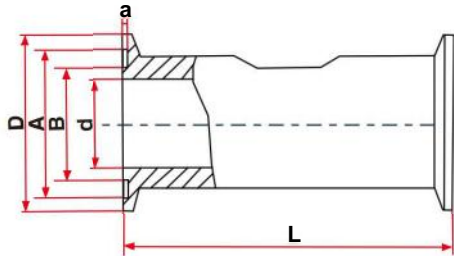
ANSI150# Flange Dimensions							
Size Code		L(mm)	ANSI Flange Rating Class	Flange Diameter (H)	Bolt Hole Diameter	Bolt Circle Diameter (PCD)	Bolt Hole Quantity
(Inch)	(mm)						
1/2"	15	75	150#	89	16	60	4
3/4"	20	80	150#	99	16	70	4
1"	25	100	150#	108	16	79	4
1-1/4"	32	140	150#	115	16	89	4
1-1/2"	40	140	150#	127	16	99	4
2"	50	150	150#	152	19	121	4
2-1/2"	65	170	150#	180	19	140	4
3"	80	200	150#	191	19	152	4
4"	100	220	150#	229	19	191	8
5"	125	250	150#	255	22	216	8
6"	150	300	150#	279	22	241	8
8"	200	360	150#	343	22	298	8

DIN PN16 Flange Dimensions							
Size Code		L	DIN Flange Rating Class	Flange Diameter (H)	Bolt Hole Diameter	Bolt Circle Diameter (PCD)	Bolt Hole Quantity
(Inch)	(mm)						
1/2"	15	75	1.6	95	14	65	4
3/4"	20	80	1.6	105	14	75	4
1"	25	100	1.6	115	14	85	4
1-1/4"	32	140	1.6	140	14	100	4
1-1/2"	40	140	1.6	150	18	110	4
2"	50	150	1.6	165	18	125	4
2-1/2"	65	170	1.6	185	18	145	4
3"	80	200	1.6	200	18	160	8
4"	100	220	1.6	220	18	180	8
5"	125	250	1.6	250	18	210	8
6"	150	300	1.6	285	22	240	8
8"	200	360	1.6	340	22	295	12

Notice: Please contact manufacturer for JIS Flange Connection Dimensions.

3.4.3 Tri-Clamp Sanitary Connections (Max. Pressure: 10bar)

a	DN4-DN40	1 mm
	DN50-DN80	1.5mm
	DN100	2mm



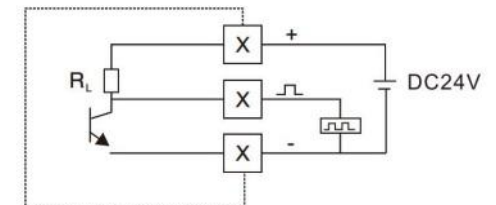
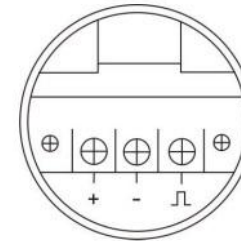
Diameter (mm)	D (mm)	A (mm)	B (mm)	d (mm)	L (mm)
DN 4	50.5	46	40.5	4	100
DN 6				6	
DN10				10	
DN15				15	
DN20				20	
DN25				25	
DN32	64	59	54	32	120
DN40				40	140
DN50				50	150
DN65	91	86	80.5	65	170
DN80	106	94	94	80	200
DN100	119	106	106	100	220

4. ELECTRICAL WIRING

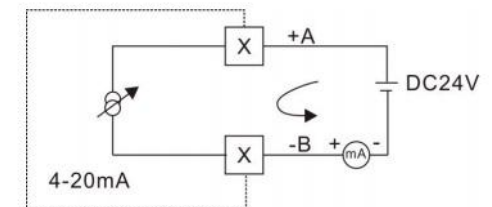
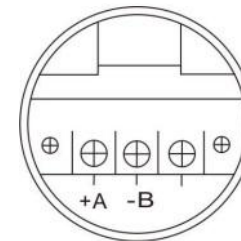
4.1 N1 Type (Pulse)

Cable Color	Terminal Symbols	Description
Red Wire	24V (+)	Power Supply: +24V
Blue Wire	Pulse	Pulse Signal Output
Black Wire	24V (-)	Power Supply: -24V

4.2 N2Type (Pulse)



4.3 AType (4-20mA)



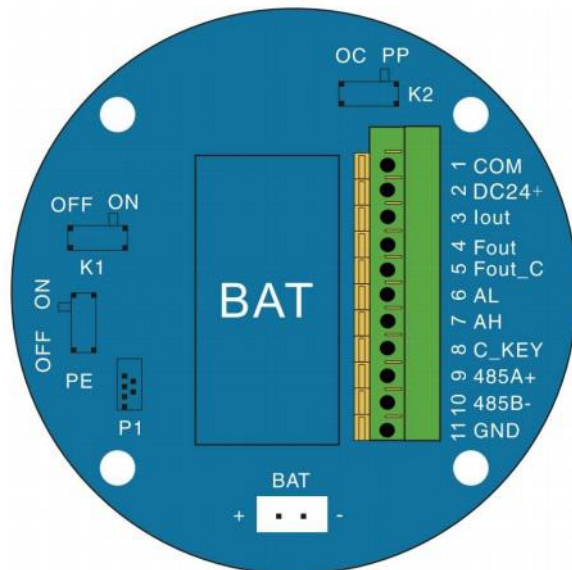
4.4 E Type (Pulse/ 4-20mA/ModbusRS485)

Power supply	Display	Output								
		Pulse	Scaled Pulse	Current					RS485	HART
				2wires 4-20mA	3wires 4-20mA	3wires 0-20mA				
Battery	•									
DC24V	•	•	•	•	•		•			
BAT+ DC24V	•	•	•	•	•		•			
DC24V	•	•	•			•	•			
BAT+ DC24V	•	•	•			•	•			
DC24V	•			•					•	
Symbol	Standard •			Option ○						

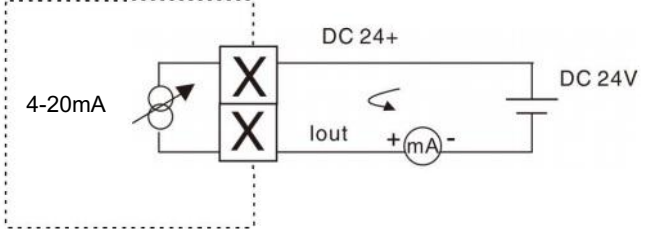
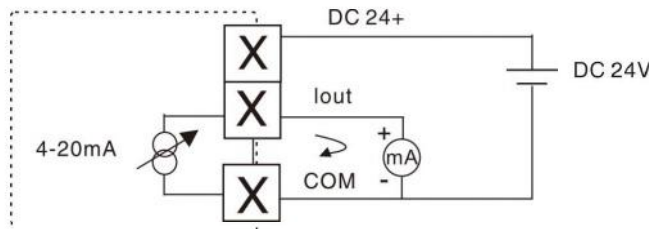
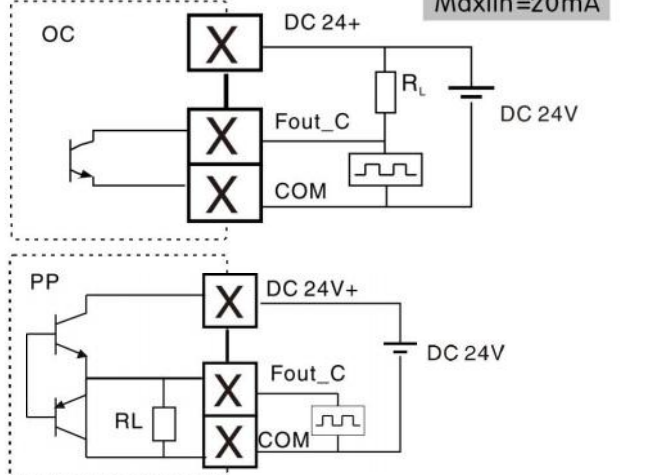
(1)Terminal Description

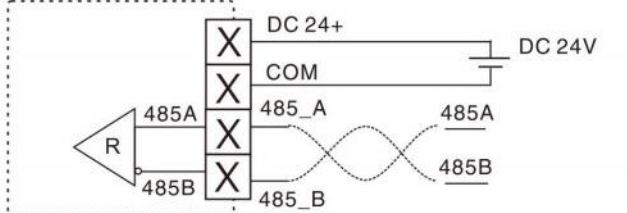
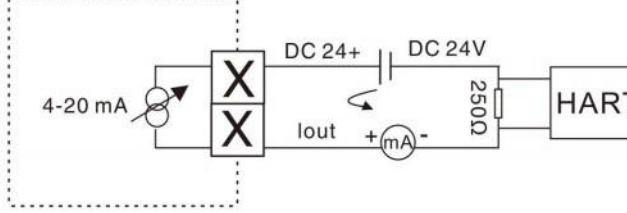
Terminal No.	Terminal Symbol	Terminal Description	Note
1	COM	-24V	
2	DC24V+	-24V	
3	Iout	Current output	
4	Fout	Pulse output	
5	Fout_C	Pulse or scaled pulse output	
6	AL	Low limit alarm	
7	AH	High limit alarm	
8	C_KEY	External button positive terminal	Use along with GND
9	485_A	RS485 terminal A	
10	485_B	RS485 terminal B	
11	GND	External button negative terminal	Use along with C_KEY

4.4.1 PCB Diagram



(2) Wiring

<p>4-20mA Output (2 wires)</p>  <p><i>Notice: Current load resistances 5000</i></p>	
<p>4-20mA Output (3 wires)</p>  <p><i>Notice: Current load resistances 500Q.</i></p>	
<p>Pulse Output(3 wires)</p> <p>Maxlin=20mA</p>  <p><i>Notice: High level amplitude > 22V, low level amplitude < 0.8V, pulse frequency < 3000Hz</i></p>	

<p>RS485 Output</p>  <p><i>Notice: Communication protocol format is MODBUS-RTU</i></p>	
<p>HART Output</p> 	



(3) Pulse Output Description

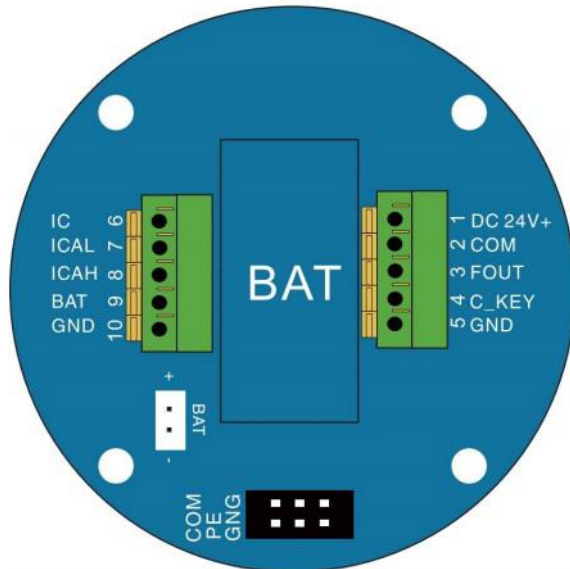
K2 is the switch for the PP and OC scaled pulse output, the terminal is Fout_C.

Code	Symbol	Description
K2	PP	Push-pull Output ($1 \leq 20\text{mA}$)
	OC	Open collector ($1 \leq 20\text{mA} / \leq 24\text{V}$)

The terminal of Fout is only used for calibration, and it will output the original frequency.

Code	Symbol	Description
K1	ON	Power by battery
	OFF	Power by DC 24V

4.4.2 Battery-supply Diagram



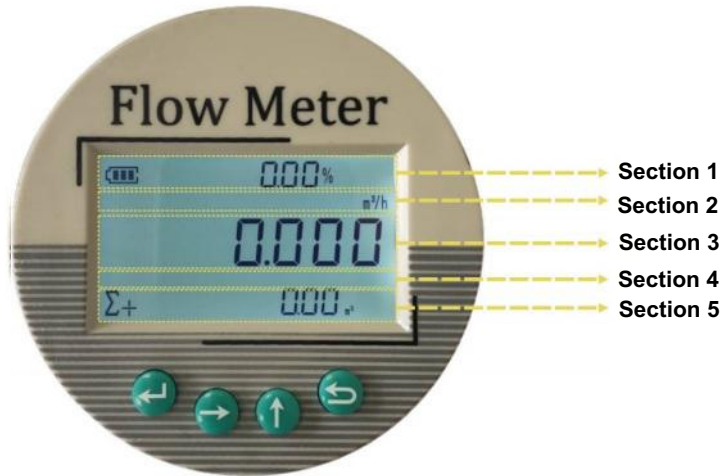
(1) Terminal Description

Terminal No.	Terminal Symbol	Terminal Description	Note
1	DC24V+	24V+	Only for calibration
2	COM	24V-	
3	FOUT	Pulse output	
4	C_KEY	External button positive terminal	
5	GND	External button Negative terminal	Use along with C_KEY
6	IC		Reserved
7	ICAL		Reserved
8	ICAH		Reserved
9	BAT		Reserved
10	GND	External button negative terminal	Use along with C_KEY

5. E Type Display and Buttons

Note: all menus are present in all signal converter versions, but some parameter settings are ONLY valid for specified models.

5.1 Screen Display



Section 1	Functional region which consists of battery situation, communication, current, frequency, flow percentage (Temperature could be available on request)
Section 2	Units section which consists of 10 units: m ³ /h, L/h, L/min, US Gal/min, UK Gal/min, US Gal/h, UK Gal/h, kg/h, t/h, ft ³ /h
Section 3	Flow rate (7 digital figure at max)
Section 4	Alarm sign which consists of SET prompt and alarm prompt
Section 5	Total flow (11 digital figure at mini) with two decimal places

5.2 Buttons with Function

Interface buttons (four keys)

Buttons		
Interface Buttons		Turn page/Save
		Move cursor
		Menu value increase/Turn page
		Exit

Notice : To hold for 5 seconds to turn off the back-light if the back-light is on and vice-versa.

Operation

Menu				
Main Menu	Go to sub-menu	x	x	x
Sub-menu	Go to password menu	x	x	Back to main menu
Password Menu	a. False or No password will go to the next menu b. Correct password: The parameter is settable	Move Cursor	Set parameter	Back to main menu
Setup Menu	Set/Save	Move Cursor	a. Setup status: Menu Value Increase or Revise number; b. Non-Setup status: Turn to previous menu.	Cancel the setting and back to main menu

5.3 Parameters Setting

5.3.1 Passwords

Type	Password	Note
User password	1234	To modify the P1-P14 parameters
Engineer password	1010	To modify the P16-P26 parameters
Total flow reset	5555	To reset the total flow

Note: It will display "0000" before inputting password. If the password is incorrect, it will go to P1 menu automatically in non-programming mode.

5.3.2 Menu Instruction

Password	Code	Function	Parameter	Note	
1234	P1	Unit	0- m ³ /h 5-USGal/h	Other parameters setting, the variables associated with units will be related automatically, according to the units of P1 to calculate, such as total flow, flow rate, scaled pulse and so on.	
			1- L/h 6-UKGal/h		
			2- L/min 7- kg/h		
			3- US Gal/min 8-t/h		
			4- UK Gal/min 9- ft ³ /h		
				10- US. bpd	
	P2	Damping Time	00-99S	To slow flow changes and prevent jump	
	P3	Maximum Flow Rate	Maximum Flow settings, the unit corresponds to the flow.	Exceed the maximum flow, showing the minimum flow	
	P4	Minimum Flow Rate	Minimum flow settings, the unit corresponds to the flow.	When the flow rate is lower than minimum flow rate, the flow rate will show "0"	
	P5	Input frequency cap setting	The upper limit setting of measuring frequency	When it exceeds the upper limit, it will display max value, accuracy is 0.1 Hz.	
P6	Medium Density	When the unit setting is mass unit, the density unit of medium requests to be set	The density unit is g/cm ³ .		
P7	Frequency Output Mode	0- No frequency output	Select Parameter		
		1- Corrected pulse output after linearization.			
		2- Scaled pulse output			
P8	Scaled-pulse Output	0.01:0.01 L/Pulse 0.1:0.1L/Pulse 1:1L/Pulse 10:10L/Pulse 100:100L/Pulse 1000:1000L/Pulse	Unit is in accordance with P1 menu		
P9	Pulse Width	1 ~ 2000 ms	The width setting of scaled pulse		
P10	COMM.	0: RS485 1: Hart			

Password	Code	Function	Parameter	Note	
1234	P11	Communication Parameter	Address	1-255	
			Baud Rate	1200, 2400, 4800, 9600, 19200	
			Verification	N, O, E	No verify, Odd verify, Even verify
			Data Length	7, 8	
			Stop Bits Length	1,2	
		HART	Address	Editable	
	P12	Upper limit alarm setting	YES/NO		
			1%-100%: Setting the flow percentage of the upper limit		
	P13	Lower limit alarm setting	YES/NO		
			1 %-100%: Setting the flow percentage of the upper limit		
P14	Backlight	0- Off mode			
		1- Automatic mode			
		2- On mode (available for 3 wires)			
****	P15	Total Flow	Modifying total flow value		
1010	P-16 F-1	Linearization of the Flowcurve: point 1	First Row: Frequency (P1) Second Row: K-Factor (P1)	Input Value, Factory ONLY	
	P-17 F-2	Linearization of the Flowcurve: point2	First Row: Frequency (P2) Second Row: K-Factor (P2)	Input Value, Factory ONLY	
	P-18 F-3	Linearization of the Flowcurve: point3	First Row: Frequency (P3) Second Row: K-Factor (P3)	Input Value, Factory ONLY	
	P-19 F-4	Linearization of the Flowcurve: point4	First Row: Frequency (P4) Second Row: K-Factor (P4)	Input Value, Factory ONLY	
	P-20 F-5	Linearization of the Flowcurve: point5	First Row: Frequency (P5) Second Row: K-Factor (P5)	Input Value, Factory ONLY	
	P-21 F-6	Linearization of the Flowcurve: point6	First Row: Frequency (P6) Second Row: K-Factor (P6)	Input Value, Factory ONLY	

Password	Code	Function	Parameter	Note
1010	P-22 F-7	Linearization of the Flowcurve: point 7	First Row: Frequency (P7) Second Row: K- Factor (P7)	InputValue, Factory ONLY
	P-23 F-8	Linearization of the Flowcurve: point 8	First Row: Frequency (P8) Second Row: K- Factor (P8)	Input Value, Factory ONLY
	P-24 F	K- Factor	1 st Row: Corrected Frequency 2sec Row: Factor(p26)	Input Value, Factory ONLY
	P-25	Reserved menu	Reserved Menu	
	P-26	K-Factor unit	0:P/L 1:P/m ³	

Note: To turn on/ off the back light by longer pressing 5 seconds.

5.3.3 ERR Analysis

Display	Description	Solutions
ErrD	Data storage in error	A new PC board need to be replaced
Err I	Low battery percentage	Change Batteries
Err E	Data stored in error and low battery	Change Batteries, if the error is still shown, the PC board may need replacing.

6. Modbus Communication Protocol

6.1 EType Communication Protocol Description

The data format defaults to n, 8, 1 (1 start bit, 8 data bits, no parity, 1 stop bit), supports parity check, 2 stop bits, etc

The default baud rate is 9600, and five options are available: 1200, 2400, 4800, 9600, 19200
Meter address is decimal "01- 255", "0" address is used for broadcasting, this protocol does not support broadcasting.

This instrument uses the 0*03 instruction in the MODBUS protocol.

Command 03 (HEX)	Read single or multiple registers
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The data in the protocol:

Float: the format is IEEE754, from high to low.

Double: the format is IEEE754, from high to low.

Unsigned int: 0-65535.

Command 3 format is as follows.

6.2 MODBUS Request

Meter Address	1 BYTE	01-F7
Function Code	1 BYTE	03
Start Address	2 BYTE	0000-FFFF
Number of Reads	2 BYTE	N(01-7D)
CRC Low Bit	1 BYTE	
CRC High Bit	1 BYTE	

6.3 MODBUS Response

MODBUS Response	1 BYTE	01-F7
Function Code	1 BYTE	03
Byte Count	1 BYTE	N*2
Input Status	N*2 BYTE	
CRC Low Bit	1 BYTE	
CRC High Bit	1 BYTE	

6.4 Error Response

Meter Address	1 BYTE	01-FF
Function Code	1 BYTE	83
ERROCode	1 BYTE	01,02, 03 (See Note 1)
CRC Low Bit	1 BYTE	
CRC High Bit	1 BYTE	

Note:

- 01: Register address error;
- 02: Register length error;
- 03: CRC error.

6.5 Data Definition

Characteristic	Item	Address (Hex)	Register Length(word)	Data Type	Description
Read Only	Total flow	0000	4	Double float	
Read Only	Total flow	0004	2	Float	
Read Only	Instantaneous flow	0006	2	Float	
Read Only	Instantaneous Flow Unit	0008	1	Unsigned int	0:m³/h 1 :L/h 2:L/min 3:US Gal/min 4:UK Gal/min 5:USGal/h 6:UK Gal/h 7:kg/h 8:t/h 9:ft³/h
Read Only	Battery Voltage	0009	2	Float	Unit: V

Read Command	01 03 0004 0004 05C8	CRC low bit first, read cumulative flow and instantaneous flow at the same time
Return Data	01 03 08 42 84 00 00 (cumulative flow=66) 00 00 00 00 (instantaneous flow=0) D4 36	Floating point high bit first, CRC low bit first