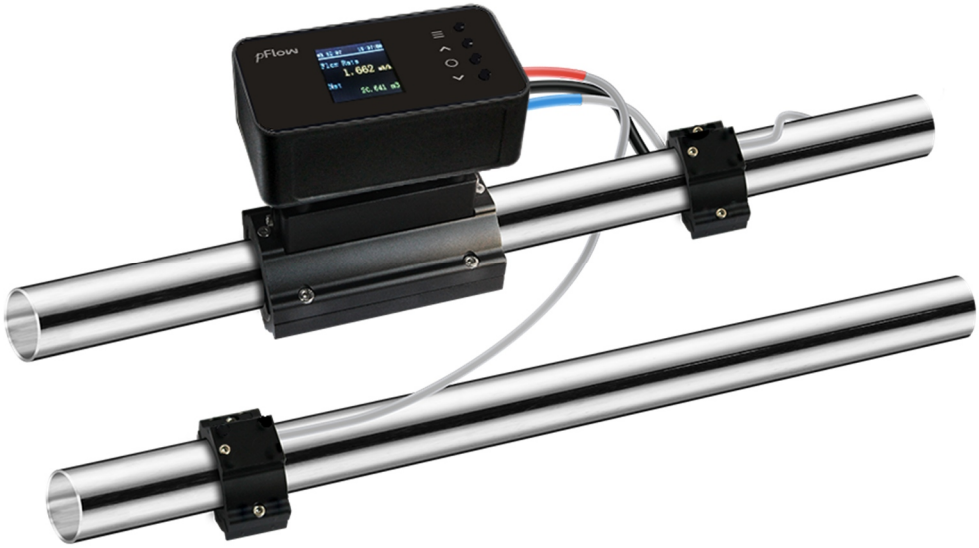
Clip-on Ultrasonic Thermal Energy/BTU Flow Meter Instruction Manual

Model: E3CL\E3RO



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Contents

Update Information：

1 Overview

Gentos quick measure Ultrasonic Thermal Energy/BTU Flow Meter E3CL\E3RO adopts the ultrasonic transit time measurement principle,combined with Gentos patented flow algorithm technology, it realizes accurate measurement of the fluid flow in the pipe.The product is an all-in-one and clip-on structure design, which is simple and convenient to install. Only four steps are needed all along. The installation process requires no contact with fluid media and no need to shut down.

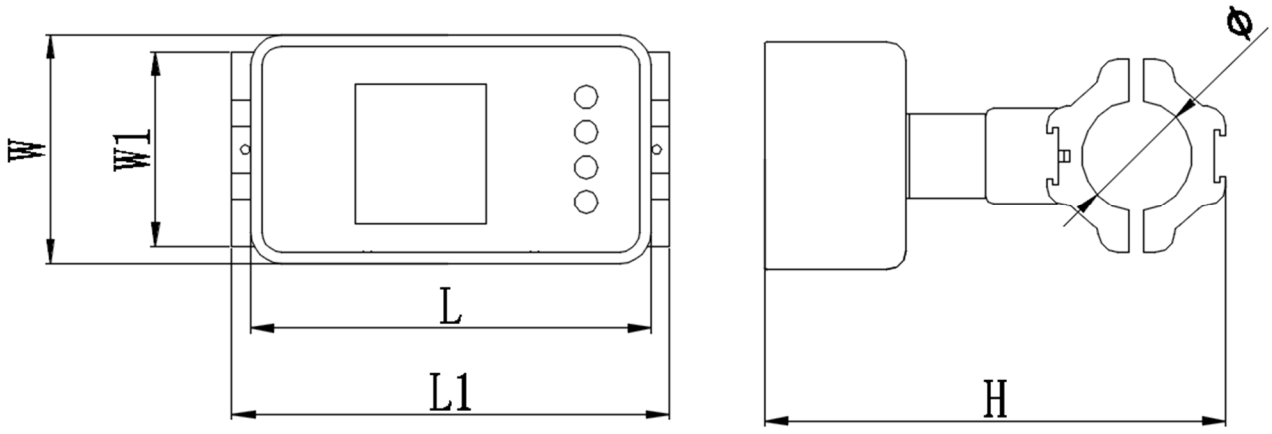
2 Product Features

- Easy installation, No pipe rework or damage
- No adjustment, Clip on to measure
- LCD colorful display screen
- 360° rotation adjustable display screen

3 Technical Parameter

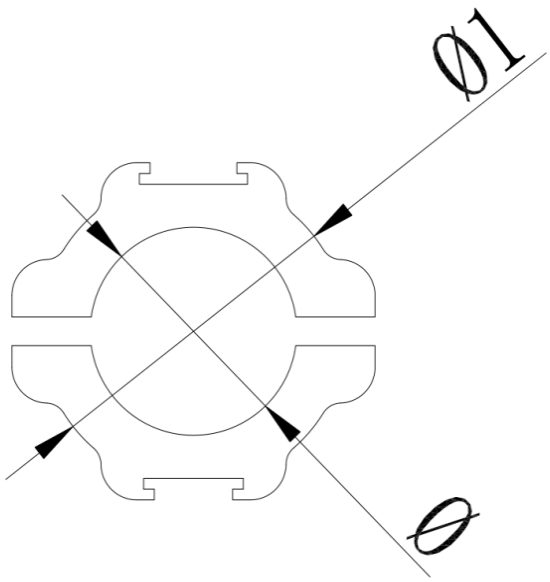
3.1 Dimension

3.1.1 Transmitter dimension



Pipe Size Comparison Table							Unit: mm
Model	Nominal Bore Diameter	W	W1	L	L1	H	Ø
E3CL E3RO	DN20	60	51	105	118	121	29
	DN25	60	56	105	118	128	36
	DN32	60	63	105	118	135	43
	DN40	60	74	105	118	146	54
	DN50	60	89	105	153	159	67
	DN65	60	102	105	153	172	80
	DN80	60	113	105	153	183	91

3.1.2 Temperature Transducer Clamp Dimension



Pipe Size	Ø Pipe clamp inner diameter（mm）	Ø1 Pipe clamp outer diameter（mm）
DN20	29	43
DN25	36	48
DN32	43	55
DN40	54	66
DN50	67	81
DN65	80	94
DN80	91	105

3.2 E3 Series Model Comparison Table

Model	**Port Configuration**	
E3CL	RS485	4~20mA
E3RO	RS485	OCT & Relay

Note: according to the needs of customers, E3RO can provide three port configuration methods, namely RS485+OCT，RS485+relay and OCT+relay.

3.3 Technical Index

Performance Index	
Flow Velocity	0.03~5.0m/s
Nominal diameter	DN20~DN80
Accuracy level	±2%
Temperature range	4~95℃
Temperature difference range	3~75K
Temperature resolution	0.01℃
Measuring medium	Water
Pipe Material	Carbon Steel, Stainless Steel, Copper, PVC (According to the user's selection requirements, it has been selected at the factory, and the details are subject to the instrument display.)
Functional Index	
Input interface	2*PT1000 Clamp-on temperature sensor 32～212℉（0~100℃）
Communication Interface	RS485(standard); Support FUJI Protocol and MODBUS Protocol
Output	4-20mA (for E3CL), OCT&Relay (for E3RO)
Power Supply	10～36VDC/500mA
Keyboard	4 touch keys
Display Screen	1.44 " LCD colorful screen, resolution 128 * 128
Temperature	Transmitter installation ambient temperature: 14 °F to 122 °F (–10℃ ~ 50℃) Transducer measures medium temperature: 32 °F to 140 °F (0℃ ~ 60℃).

Humidity	Relative humidity 0~99%, No condensation
IP	IP54
Physical Characteristics	
Transmitter	Integrated
Transducer	Clamp on
Cable	Ø 5 six core cable, standard length: 2m

- The accuracy obtained by Gentos flow standard device may cause errors due to the type of pipeline, fluid type, temperature, etc. used by the customer.

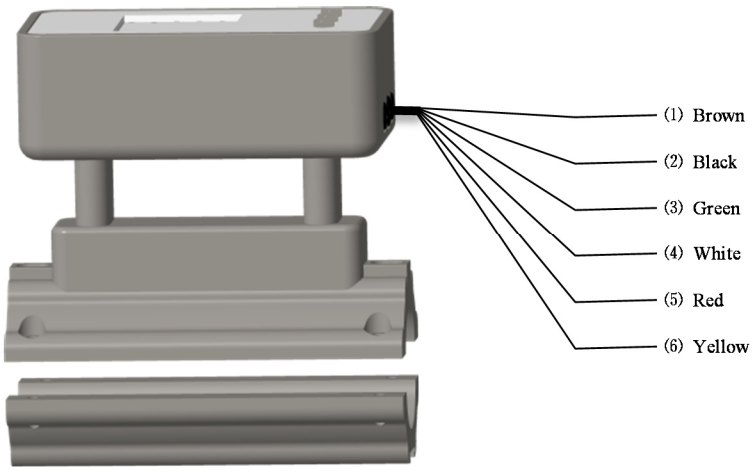
4 Installation and Wiring

4.1 Installation Description

1. Carefully read "Section 7. Choose Measurement Point". After the designated location is selected, the area outside the pipe to be installed must be cleaned, and the dense part of the pipe must be selected for installation.。
2. The special coupling sticker is pasted on the center of the sensor, which will be squeezed during installation to ensure that the sensor and the pipe wall are closely fitted without bubbles.
3. The direction of the arrow on the nameplate of the instrument shall be consistent with the direction of the fluid in the pipeline.

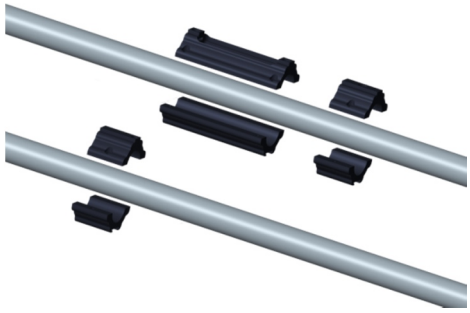
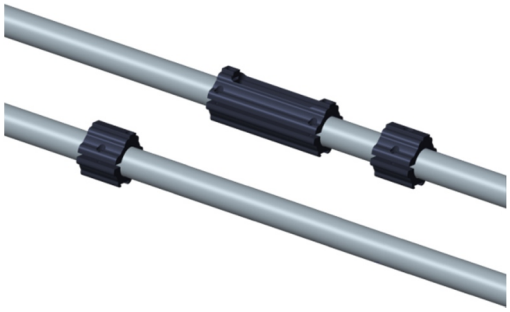
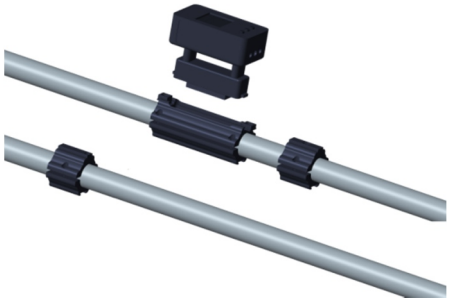
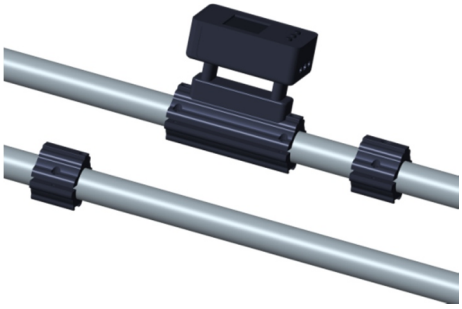
4.2 Meter Wiring

Refer to the following diagram for meter wiring

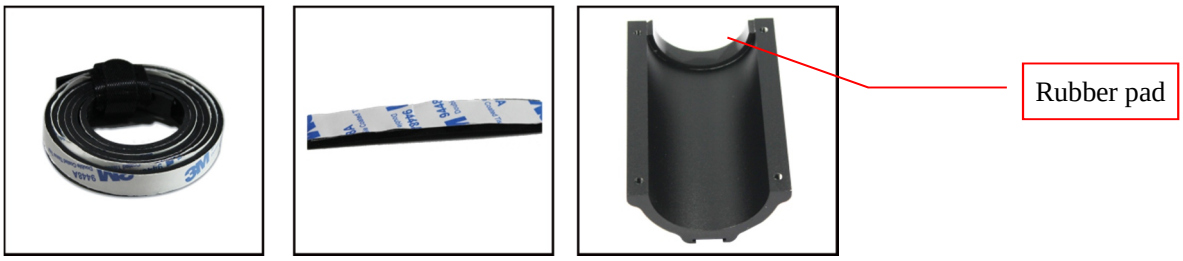


Function	Identifier	Color
Power Supply （10~36VDC）	+	Brown
	-	Black
RS485	A	Green
	B	White
Optional （4-20mA\OCT&Relay）	+	Red
	-	Yellow
For specific models and port configurations, please check section 3.2 E3 Series Model Comparison Table		

4.3 The quick installation steps of E3CL\E3RO

Step 1 Take out this device from the package and clip the upper and base bracket on the selected position of the pipe.	
Step 2 Tighten the screws.	
Step 3 Install the transmitter part into the slot of the upper pipe clamp and tighten the screws.	
Step 4 Power on and start measurement, user can set the actual pipe outer diameter, wall thickness and other parameters through the "Pipe Parameter Setting" menu to make the measurement more accurate.	
Step 5 Add pipe insulation. Users can add thermal insulation to reduce pipe heat dissipation.	

- If the brackets is still loose after locking, the black rubber pad (2mm thick) attached to the accessory bag can be pasted on both sides of the inner wall of the brackets.



4.4 Installation of temperature sensors

4.4.1 Clip-on temperature sensor

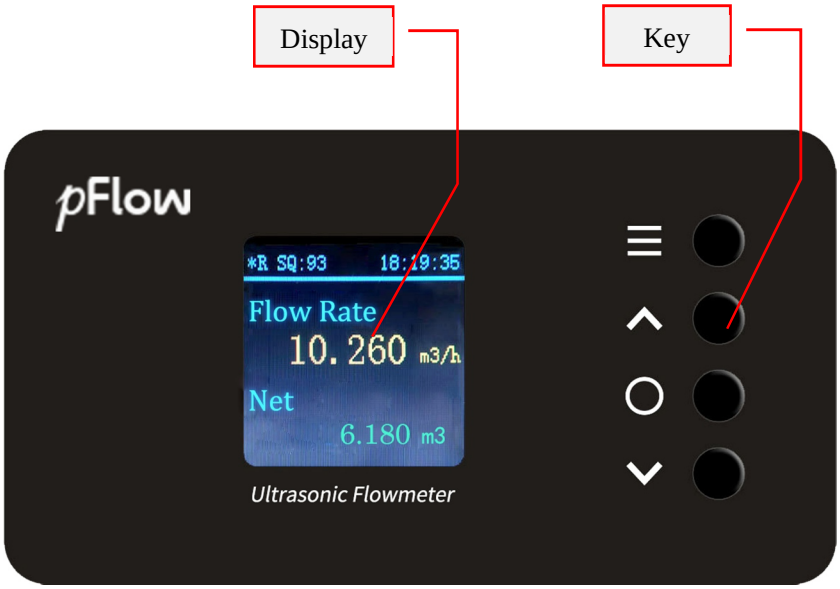
1. The temperature sensor include upper bracket and base bracket. The clip-on type temperature sensor is embedded in the groove of the inner wall of the upper bracket. Fix the brackets to the pipe with the screws.

2. Before the clamp-on temperature sensor is installed, it is necessary to clean up the area where the pipeline is to be installed, and remove rust and paint, etc.
3. Temperature sensors with red and blue markings are installed in the influent and effluent pipe sections respectively.

5 Display and Setting

5.1 Display Description

Upper part of the display area	*R	Indicates the measurement status (*R indicates normal measurement, *I indicates no signal, *G indicates searching for signal)
	SQ	93 indicates signal quality. It is consistent with Section 6.1 "Display Interface five ".
	18:19:35	The display is the current time, which is consistent with Section 6.1 "Display Interface three ".
Lower middle of display area	/	See Section 6.1 "Display Interface one~ Display Interface nine" for details.



5.2 Key Description

The Clip-on Thermal Energy/BTU Flow Meter consists of 4 buttons, and the operation instructions are as follows

Button	Menu button	Up Key	Down key	Confirm key
	≡Key	∧Key	∨Key	○Key
Function	1. Switch between display interface and menu interface; 2. Exit to the main interface	1. Used to select menu items; 2. When inputting a value, press the∧ key to increase the number, and the∨ key to move the cursor to the right		1. Used to confirm menu items; 2. Data input confirmation and exit

6 Menu Window Description

6.1 Display Interface

Press the ≡ key on the instrument panel to switch between the display interface and the menu interface. After switching to the display interface, press the ∧ key and the ∨ key to display interface one ~ interface nine in sequence.

Display Category	Display Content	Description
Display interface One	Flow rate Net.	Display flow rate and net flow totalizer When the flow totalizer reaches 99999999m3, it will be automatically cleared.
Display interface Two	Flow velocity Net	Display flow velocity and net flow totalizer When the flow totalizer reaches 99999999m3, it will be automatically cleared.
Display interface Three	Date Time	Display current date and time
Display interface Four	ESN SWV	Display the instrument factory serial number and software version number
Display interface Five	Signal Quality Status	Display measurement status: *R: normal measurement; *G: searching signal; * I: no signal Display signal quality: The signal quality is represented by numbers from 00 to 99. 00 represents the worst and 99 represents the best. The signal quality is greater than 60 in normal working condition.
Display interface Six	InTemp. DeltaTemp	Display the temperature of the water inlet port, the unit is ℃; the temperature difference between the inlet and outlet water, the unit is K
Display interface Seven	OutTemp. DeltaTemp	Display the temperature of the water outlet port, the unit is ℃; the temperature difference between the inlet and outlet water, the unit is K
Display interface Eight	EFR ENT	When the accumulated amount reaches 99999999 (KWh/kcal/GJ), it will be automatically cleared.
Display interface Nine	EFR EPT	When the accumulated amount reaches 99999999 (KWh/kcal/GJ), it will be automatically cleared.

6.2 Menu interface

Press the ≡ key on the instrument panel to switch between the display interface and the menu interface. After switching to the menu interface, press the ∧ key and the ∨key to display 5 items in the level-1 menu in sequence. Press the ○ key again to enter the corresponding level-2 menu to display or set related parameters. Select Back to exit after the setup is complete. Or press the ≡ key to exit to the display interface with one key.

When inputting a value, press the ∧ key to increase the number, press the∨ key to move the cursor to the right, and press the○ key to confirm the data input and exit.

A menu	B menu	Function Instruction	Remark
1.Pipe parameter	1.Pipe Diameter	Enter the Pipe OD	20mm≤Pipe OD≤99.99mm
	2.Wall Thickness	Enter the pipe wall thickness	1.0mm≤Pipe wall thickness≤ 9.99mm
	3.Pipe Material	Select the pipe material, which has been selected at the factory according to the user's selection requirements.	Carbon steel, stainless steel, copper, PVC are optional. The details are subject to the instrument display.
	4.Back		
2.Energy setting	1.In Res of RTD	Used to offset the error caused by the resistance of the water inlet cable	0-99.99Ω (factory default 0Ω)
	2.Out Res of RTD	Used to offset the error caused by the resistance of the water outlet cable	0-99.99Ω (factory default 0Ω)
	3.TEMP Delicacy	Energy can be output only when the temperature difference is greater than the set temperature sensitivity value	0-10.00℃ (factory 0.20℃)
	4.In TEMP Limit	Only when the inlet water temperature is lower than this value can output temperature and energy	0-100.00℃ (factory default 100.00℃)
	5.Out TEMP Limit	Only when the outlet water temperature is lower than this value can output temperature and energy	0-100.00℃ (factory default 100.00℃)
	6. Energy Unit	Select energy unit and time unit for instantaneous energy	Optional energy unit: GJ, Kcal, KWh Optional time unit: h, m
	7. Back		

A menu	B menu	Function Instruction	Remark
3.Output settings (for E3RO)	1.OCT Mode	Current OCT Mode Freq Output Net Int Pulse	Select Net Int Pulse: 1 pulse is output when each flow unit of yield is accumulated. Options of the flow unit: m3, L, Gal.
	2.OCT Freq Range	Set OCT frequency range	0~9999
	3.Lowest Flow	Set flow rate in the lowest frequency range	0~9999 m3/h
	4.Highest Flow	Set flow rate at highest frequency range	0~9999 m3/h
	5.Relay Mode	Relay switch	On: the relay acts once when each accumulated flow unit of yield is accumulated. The flow unit can be m3, L, Cal。 Off: Do not perform any action
	6.Return		
3.Output Settings (for E3CL)	1.Curr Loop Mode	Select flow mode or flow rate mode	
	2.Curr Loop 4mA	After selecting the current loop mode, set the corresponding flow or flow rate of 4mA	Flow mode :0~14400m3/h Flow rate mode :0~5m/s
	3.Curr Loop 20mA	After selecting the current loop mode, set the flow or flow rate corresponding to 20mA	Flow mode :0~14400m3/h Flow rate mode :0~5m/s
	4.Curr Loop Check	Check the actual current of 0, 4, 8 and 16mA through the ammeter	
	5.Curr Loop Value	Current current loop value	
	6.Back		
4.Communication	1.RS485 Protocol	Choose MODBUS or FUJI	
	2.RS485 Baud Rate	There are 7 baud rates to choose from	4800、9600、38400、50400、57600、76800、115200
	3. Network IDN	The network identification address code is 1~247	
	4. Back		
5.System setting	1.System Unit	Select metric and imperial units	Metric unit, imperial unit

A menu	B menu	Function Instruction	Remark
	2.Flow Unit	Select the flow unit and time unit of instantaneous flow	Optional flow unit: m3、L、Gal Optional time unit: h、m
	3.Totalizer Unit	Select cumulative flow unit	Optional flow unit: m3、L、Gal
	4.System Time	Set the current time	Year-Month-Day, Hour-Minute-Second
	5.Screen Mode	Set rotation display direction	Optional 0 °, 90 °, 180 °, 270 °
	6.Reset	Clear all setting parameters and restore to the original factory default values	Select "Yes", this operation will clear all the user's data and change it to the factory default value. Please be cautious.
	7.Clear Totalizer	Clear cumulation flow	Select “Yes” to clear Cumulation Flow.
	8.Language	Chinese and English optional	
	9.Upgrade	Upgrade the software version through Ethernet. Ensure that the network is in good condition.	Select "Yes" to upgrade the firmware
	10.Back		
6.select settings	1.Damping	Input the damping coefficient, it’s used for smoothing the displayed data.	The damping coefficient ranges from 0 to 99 seconds
	2.Low Flow Cutoff	Cut off the low flow. To enable the system to display the "0" value when the flow is low, so as to avoid invalid accumulation.	Cut off value ≤ 0.25m/s, factory default is 0.03m/s
	3.Set zero	When the fluid is static, the indication of the instrument is called "zero". When the "zero point" of the flowmeter is not zero, the zero point will be superimposed on the true value of the flow at any time, so that there is a deviation in the measurement of the flowmeter, which must be removed.	Select "Yes" to wait for the process to complete.
	4.Reset zero	Reset the set zero point	Select "Yes" to clear the "zero point" set by the user.

A menu	B menu	Function Instruction	Remark
	5.Manual Zero	Set zero shift	An offset superimposed on the measured value can be entered.
	6.Back		
7. Calibration （for E3RO）	1.Scale factor	Also known as the instrument K-factor, it is used to correct the flow measurement results.	Calibrated at the factory
	2.In Temp Min	Calibrate the inlet water temperature to the minimum value (0 degrees Celsius)	Short press for fine adjustment, long press for coarse adjustment, note: the cable resistance compensation needs to be set to zero during calibration (it has been calibrated at the factory, please operate with caution)
	3.In Temp Max	Calibrate the inlet water temperature to the maximum value (100 degrees Celsius)	Short press for fine adjustment, long press for coarse adjustment, note: the cable resistance compensation needs to be set to zero during calibration (it has been calibrated at the factory, please operate with caution)
	4.Out Temp Min	Calibrate the outlet water temperature to the minimum value (0 degrees Celsius)	Short press for fine adjustment, long press for coarse adjustment, note: the cable resistance compensation needs to be set to zero during calibration (it has been calibrated at the factory, please operate with caution)
	5. Out Temp Max	Calibrate the outlet water temperature to the maximum value (100 degrees Celsius)	Short press for fine adjustment, long press for coarse adjustment, note: the cable resistance compensation needs to be set to zero during calibration (it has been calibrated at the factory, please operate with caution)
	6. Back		
7. Calibration （for E3CL）	1.Meter factor	Also known as the meter K-factor, it is used to correct flow measurement results.	factory calibrated
	2.In Temp Min	Calibrate the inlet water temperature to the minimum value (0 degrees Celsius)	Short press for fine adjustment, long press for coarse adjustment, note: the cable resistance compensation needs to be set to zero during calibration (it has been calibrated at the factory, please operate with caution)

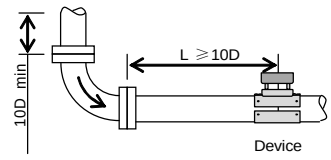
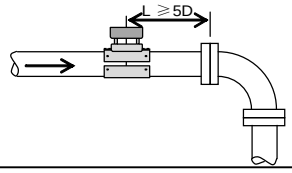
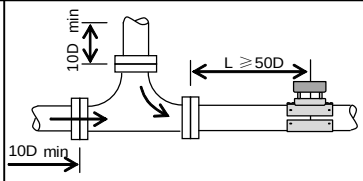
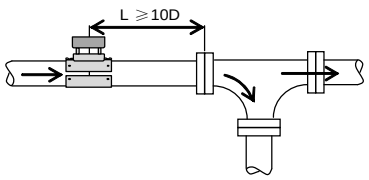
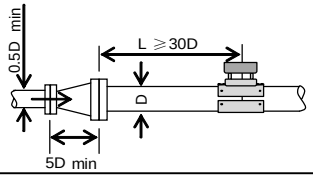
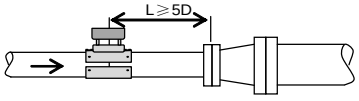
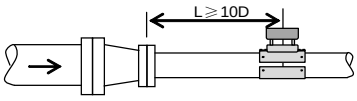
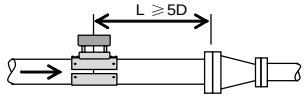
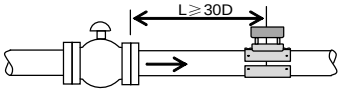
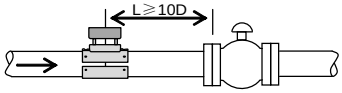
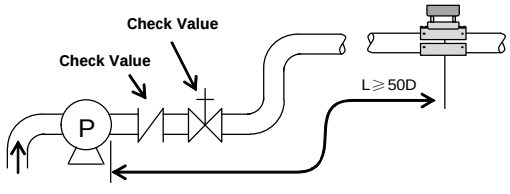
A menu	B menu	Function Instruction	Remark
	3.In Temp Max	Calibrate the inlet water temperature to the maximum value (100 degrees Celsius)	Short press for fine adjustment, long press for coarse adjustment, note: the cable resistance compensation needs to be set to zero during calibration (it has been calibrated at the factory, please operate with caution)
	4.Out Temp Min	Calibrate the outlet water temperature to the minimum value (0 degrees Celsius)	Short press for fine adjustment, long press for coarse adjustment, note: the cable resistance compensation needs to be set to zero during calibration (it has been calibrated at the factory, please operate with caution)
	5. Out Temp Max	Calibrate the outlet water temperature to the maximum value (100 degrees Celsius)	Short press for fine adjustment, long press for coarse adjustment, note: the cable resistance compensation needs to be set to zero during calibration (it has been calibrated at the factory, please operate with caution)
	6.Current Loop 4mA	Adjust the output current with the ∧ keys and ∨ key	Connect an external precision ammeter to the current output terminal of E3CL clip-on flowmeter (red+, yellow -)
	7.Current Loop 20mA	Adjust the output current with the ∧ keys and ∨ key	
	8. Back		

7 Choose Measurement Point

The Thermal Energy/BTU Flow Meter is simple and convenient to install. As long as a suitable measuring point is selected, Clamp the product sensor surface on the pipe section directly and fix the pipe clamp, and then the power is turned on, the flow measurement can be realized.

When selecting measuring points, it is required to select pipe sections with uniform fluid flow field distribution to ensure measurement accuracy. The following principles shall be followed during installation:

- Select a pipe segment that is filled with fluid, such as the vertical part of the pipe line (the fluid is better to flow upward) or the horizontal pipe segment that is filled with fluid.
- The measuring point should be on a uniform straight pipe section with 10 times the diameter (10D) from the upstream and 5 times the diameter (5D) from the downstream. There are no valves, elbows, reducers and other devices interfering with the flow field within this range. The length of the straight pipe section is recommended to use the values shown in the following table.
- Ensure that the temperature at the measuring point is within the working range.
- Fully consider the scaling condition on the inner wall of the pipe, try to select the pipe section without scaling for measurement, and select the pipe section of uniform and dense pipes so as to make ultrasonic transmission easier.

Name	Straight length of Upstream piping	Straight length of Downstream piping
90°bend		
Tee		
Diffuser		
Reducer		
Value	 **Flow controlled upstream**	 **Flow controlled downstream**
Pump		

8 Communication protocol

The hot (cold) meter adopts the reply communication method, and th host computer sends “ command”, requires sub-hot (cold) scale responses. The baud rate of asynchronous communication (Primary station, computer system, hot (cold) meter is generally 9600bps. A single byte data format (10bits): one start bit, one stop bit and eight data bits. Check bit:: NONE.

8.1 FUJI protocol

The FUJI protocol of the meter adopts the mode of reply communication, and the upper system requests the meter to reply by issuing "commands". The baud rate of asynchronous communication (main workstation, computer system, secondary workstation, ultrasonic flowmeter) is usually 9600bps. Single byte data format (10 bits): 1 starting bits, 1 stop bits and 8 data bits. Check bit: NONE.

The basic command collection is represented by a data symbol string, and the command binding representedby a carriage return and line feed symbol is special in that the data length is arbitrary. Commonly used commands are shown in the following table:

Communication command

Command	Command meaning	Data Format
DQD(cr)(lf)	Return daily instantaneous flow	±d.dddddE±dd(cr)*1
DQH(cr)(lf)	Return hourly instantaneous flow	±d.dddddE±dd(cr)
DQM(cr) (lf)	Return instantaneous flow per minute	±d.dddddE±dd(cr)
DQS(cr) (lf)	Return instantaneous flow per second	±d.dddddE±dd(cr)
DV(cr) (lf)	Return instantaneous velocity	±d.dddddE±dd(cr)
DI+(cr) (lf)	Return positive accumulative flow	±ddddddE±d(cr)*2
DI-(cr) (lf)	Return negative accumulative flow	±ddddddE±d(cr)
DIN(cr) (lf)	Return net accumulative flow	±ddddddE±d(cr)
DID(cr) (lf)	Return identification code of instrument (address code)	ddddd(cr)5 bits in length
DL(cr) (lf)	Return signal intensity	UP:dd.dd，DN:dd.dd，Q=dd(cr)
ESN(cr) (lf)	Return electronic serial number	ddddddddcr)(lf) *3
W	Networking command prefix of numeric string address	*4
P	Prefix of return command with check	
&	Function sign of command “add”	
e+(cr)	Instantaneous amount of heat	
e-(cr)	Instantaneous cooling capacity	

die+(cr)	Heat accumulation	
die-(cr)	Cumulative amount of cooling capacity	

Note:

1. （cr）expresses carriage return. Its ASCII values is 0DH. (if)expresses line feed. Its ASCII value is 0AH.
2. “d” expresses 0-9 number. 0 value is expressed as +0.000000E+00.
   “d” expresses 0-9 number. There is no decimal point in integral part belore “ E”.
3. Eight “ddddddddd” expresses the electronic serial number of the machine. “t” expresses the type of machine.
4. If there are multiple flowmeters in a data network then the basic commands cannot be used alone. The prefix W must be added. Otherwise, multiple flowmeters will answer simultaneously, which will cause chaos in the system.

（1）P prefix

Character P can be added before each basic command to indicate that the returned data has CRC verification.The check sum is obtained by binary addition.

For example: If the return data of the command DI+ (CR) (LF) (The corresponding binary data are 44H, 49H, 2BH, 0DH, 0AH) is+1234567E+0m3 (CR) (LF) (The corresponding binary data are 2BH, 31H, 32H, 33H, 34H, 35H, 36H, 37H, 45H, 2BH, 30H, 6DH, 33H, 20H, 0DH, 0AH), the return data of the command PDI+ (CR) is +1234567E+0m3 !F7 (CR). "!" indicates that it is the sum character in the front, and the checksum of two bytes is in the back (2BH+31H+32H+33H+34H+35H+36H+37H+45H+2BH+30H+6DH+33H+20H= (2) F7H).

Please note that there is a space symbol before "!" .

（2）W prefix

The usage of W prefix: W + string address code (must be five digits) + basic command, the value range ofthe number string is 0~65535 except 13（0DH carriage return), 10（0AH switch lane),，42（2AH*），38（26H&）。Such as accessing the instantaneous flow rate of flow meter NO.12345，please issue command W012345DV（CR），and the corresponding binary code is 57H，31H，32H，33H，34H，35H，44H，56H，0DH。

（3）&Functional symbols

&the function symbol can add up to five basic commands (prefixed with P) to form a composite command and transmit it to the flowmeter, which responds at the same time.For example, requesting to send back flow meter No. 4321 at the same time. 1.Instantaneous flow；2.Instantaneous velocity；3.Positive accumulative energy；4.Negative accumulative energy；5.Accumulative cooling energy，with verification, and send the command as follows:

W04321PDQD&PDV&PDI+&PDI-&PDIN（CR）

The data returned at the same time may be as follows:

+0.000000E+00m3/d! AC（CR）

+0.000000E+00m/s! 88（CR）

+1234567E+0m3! F7（CR）

+0.000000E+0m3! DA（CR）

+0.000000E+0 m3! DA（CR）

8.2 MODBUS Protocol

This MODBUS Protocol uses RTU transmission made. The Verification Code uses CRC-16-IBM （polynomial is X16+X15+X2+1， shield character is 0xA001) which is gained by the cyclic redundancy algorithm method.

MODBUS RTU mode uses hexadecimals to transmit data.

8.2.1 MODBUS Protocol Function Code and Format

The flow meter protocol supports the following two-function codes of the MODBUS.

Function Code	Performance Data
0x03	Read register
0x06	Write single register

8.2.2 MODBUS PROTOCOL function code 0x03 usage.

The host sends out the read register informaton frame format:

Slave address	Function code	Register first address	Request number of registers	Verify Code
1 byte	1 byte	2 bytes	2 bytes	2 bytes
0x01~0xF7	0x03	0x0000~0xFFFF	0x0000~0x7D	CRC(Verify)

The slave returns the data frame format:

Slave address	Function code	Register first address	Request number of registers	Verify Code
1 byte	1byte	1byte	N*x2 bytes	2 bytes
0x01~0xF7	0x03	2xN*	N*x2	CRC (Verify)

N*＝ Number of registers for data.

The range of flow meter addresses 1~247（Hexadecimal：0x01～0xF7）， and can be checked in the Menu46.For example, decimal number “11” displayed on Menu 46 means the address of the flow meter in the MODBUS protocol is 0x0B。

The CRC Verify Code adopts CRC-16-IBM（polynomial is X16+X15+X2+1, shield character is 0xA001）whichisgained by the cyclic redundancy algorithm method. Low byte of the verify code is at the beginning while the hgih byte is at the end.

Example 1. In RTU mode, read the instantaneous flow (m3/h) in hours of the meter with address 1 (0 x01), that is read the data of registers 40005、40006，the read command is as follows:

0x01 0x03 0x00 0x04 0x00 0x02 0x85 0xCA

Meter address function Code register address register number CRC Verify code

The data returned by the meter is (assuming the current flow = 1.234567m3 / h):

0x01 0x03 0x04 0x06 0x51 0x3F 0x9E 0x3B 0x32

Meter address Function code Databytes Data(1.2345678） CRC Verify code

The four bytes of 3F 9E 06 51 are IEEE754 single precision floating-point format of 1.2345678.

Please notice the order in which the data is stored in the example above. When C programming language is used to interpret values, Pointers can be used to directly put the required data into the corresponding variable address. Generally, the sequence of storage is low bytes first. For example, in the above example of 1.2345678m/s, the sequence of storage of 3F 9E 06 51 data is 06 51 3F 9E.

Example 2. In RTU mode, read the positive cumulant (m3) of the meter with address 1 (0x01), that is, read the data of register addresses 0008, 0009 and 000A. The reading command is as follows:

0x01 0x03 0x00 0x08 0x00 0x03 0x84 0x09

Instrument address Function code Register first address Register amount CRC check code

The data returned by the meter is (assuming the current positive cumulant = 2.46m3) :

0x01 0x03 0x06 0x00 0xF6 0x00 0x00 0xFF 0xFE 0x29 0x10

Instrument address Function code Data Number of bytes data (246*10-2) CRC check code

The four bytes of 00 00 00 F6 are the hexadecimal number of 246, that is, the hexadecimal data is directly converted to decimal.

So FF FE is 10 to the minus 2. The following table:

MODBUS Data	**The corresponding unit of exponent**	
FFFD	x0.001(1E-3)	10^{-3}
FFFE	x0.01	10^{-2}
FFFF	x0.1	10^{-1}
0000	x1	10^{0}
0001	x10	10^{1}
0002	x100	10^{2}
0003	x1000	10^{3}
0004	x10000(1E+4)	10^{4}
Including positive, negative, net cumulant and energy cumulant.		

Example 3. Change the address of the meter at address 1 (0x01) to 2 (0x02) in RTU mode, that is, write the data of register 44100 of the hot (cold) meter to 0x02. Write the command as follows:

0x01 0x06 0x10 0x03 0x00 0x02 0xFC 0xCB

Instrument address Function code Register address Register data CRC check code

The data returned by the meter is:

0x01 0x06 0x10 0x03 0x00 0x02 0xFC 0xCB

Instrument address Function code Register address Register data CRC check code

8.2.3 Error Handling

This meter returns only one error code, 0x02, indicating an incorrect data start address.

For example, in RTU mode, only 40002 register data of an instrument with address 1 (0x01) is read. The instrument considers that data integrity is damaged and sends the following command:

0x01 0x03 0x00 0x01 0x00 0x01 0xD5 0xCA

Instrument address Function code Register first address Register number CRC check code

The meter returns the error code:

0x01 0x83 0x02 0xC0 0xF1

Instrument address Error code Error extension code CRC check code

8.2.4 MODBUS Register Address List

The MODBUS register of this instrument consists of read-only register and single write register.

Read only register address list (read with 0x03 function code)

Register address	Register	Data description	Data type	Register number	Explanation
$0000	40001	Instantaneous flow per second - Low bytes	32 bits real	2	
$0001	40002	Instantaneous flow per second - High bytes			
$0002	40003	Instantaneous flow per minute - Low bytes	32 bits real	2	
$0003	40004	Instantaneous flow per minute - High bytes			
$0004	40005	Instantaneous flow per hour - Low bytes	32 bits real	2	
$0005	40006	Instantaneous flow per hour - High bytes			
$0006	40007	Flow rate - Low byte	32 bits real	2	
$0007	40008	Flow rate - High byte			
$0008	40009	Positive cumulant - Low bytes	32 bits int.	2	
$0009	40010	Positive cumulant - High bytes			
$000A	40011	Positive cumulant - exponential	16 bits int.	1	
$0016	40023	Upstream signal strength - Low bytes	32 bits real	2	0～99.9
$0017	40024	Upstream signal strength - High bytes			
$0018	40025	Downstream signal strength - Low bytes	32 bits real	2	0～99.9
$0019	40026	Downstream signal strength - High bytes			
$001A	40027	Signal quality	16 bits int.	1	0～99
$001B	40028	4~20mA output current value - Low bytes	32 bits real	2	The unit is mA
$001C	40029	4~20mA output current value - High bytes			
$001D	40030	Error code - character 1,2	String	3	Please refer to the "Fault Analysis" section for the specific meaning of the codes.
$001E	40031	Error code - character 3,4			
$001F	40032	Error code - character 5,6			

$003B	40060	Rate unit - Characters 1,2	String	2	
$003C	40061	Rate unit - Characters 3,4			
$003D	40062	Instantaneous traffic unit - Characters 1,2	String	2	Note 1
$003E	40063	Instantaneous traffic unit - Characters 3,4			
$003F	40064	Cumulant unit - Characters 1,2	String	1	
$0040	40065	Instantaneous unit of energy - characters 1,2	String	2	Note 2
$0041	40066	Instantaneous unit of energy - characters 3,4			
$0042	40067	Energy accumulation - Character 1,2	String	1	
$0049	40074	Water inlet temperature value - Low byte	32 bits real	2	
$004A	40075	Water inlet temperature value - High byte			
$004B	40076	Water outlet temperature value - Low byte	32 bits real	2	
$004C	40077	Water outlet temperature value - High byte			
$004D	40078	Heat energy accumulation - Low bytes	32 bits uint	2	
$004E	40079	Heat energy accumulation - High bytes			
$004F	40080	Heat energy accumulation - Index	16 bits int	1	
$0050	40081	Coolness accumulation - Low bytes	32 bits uint	2	
$0051	40082	Coolness accumulation - High bytes			
$0052	40083	Coolness accumulation - Index	16 bits int	1	
$0053	40084	Instantaneous heat - Low bytes	32 bits real	2	
$0054	40085	Instantaneous heat - High bytes			
$0055	40086	Instantaneous coolness - Low bytes	32 bits real	2	
$0056	40087	Instantaneous coolness - High bytes			

Note：

1. The units of cumulative quantity can be selected as follows:
   0. “m3” －Cubic meter
   1. “l” －Litre
   2. “gal” －Gallon
2. Energy units are available as follows:
   0. “GJ” －Gijoule
   1. “Kc” －Kilocalorie
   2. “kw” －Kilowatt-hour
3. When the meter address or communication baud rate is changed, the meter will work at the new address or communication baud rate immediately after returning the response with the original address or communication baud rate.
4. 16 bits int- Indicates a short integer, 32 bits int- indicates a long integer, 32 bits real- indicates a floating-point number, and String- indicates a string.

9 Appendix 1 - Flow meter pipe diameter comparison table

Model	Pipe Material	Nominal inside diameter of pipe	Pipe clamp adapts to pipe outside diameter range （mm）		Flow measurement range （0.03~5m/s） （m3/h）
			A grade	B grade	
E3 series	PVC Stainless Steel Carbon Steel	DN20	25~29	21~25	0.04~6
		DN25	32~36	28~32	0.05~9
		DN32	39~43	35~39	0.09~15
		DN40	50~54	46~50	0.13~23
		DN50	63~67	59~63	0.20~35
		DN65	76~80	72~76	0.35~60
		DN80	87~91	83~87	0.55~90
Note: Grade B requires attached rubber pads on both sides of the inner wall of the pipe clamp.					

Model	Pipe Material	Nominal inside diameter of pipe	Pipe clamp adapts to pipe outside diameter range （mm）		Flow measurement range （0.03~5m/s） （m3/h）
			A grade	B grade	
E3 series	Copper	DN20 DN25	25~29	21~25	0.04~6 0.05~9
		DN32	32~36	28~32	0.09~15
		DN40	39~43	35~39	0.13~23
		DN50	50~54	46~50	0.20~35
		DN65	63~67	59~63	0.35~60
		DN80	76~80	72~76	0.55~90
Note: Grade B requires attached rubber pads on both sides of the inner wall of the pipe clamp.					