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Handbook

Clamp-on/Plug-in Ultrasonic Flowmeter

ABDT-LCT-C/ ABDT-LCT-W

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CONTENTS

I. Overview

LCT series ultrasonic flowmeter is a general time difference ultrasonic liquid flowmeter designed by using VLSI and low-voltage wide pulse emission technology. It is suitable for continuous measurement of homogeneous liquid without high concentration suspended particles or gas in industrial environment.

1.1 Function characteristics

1) Hardware modular design, easy production and maintenance operation;

2) Built in 4M byte data recorder and record 200000 lines of timing output or real-time printing data;

3) Electrical isolation RS485 interface, including more than 10 kinds of communication protocols such as MODBUS, M-BUS and FUJI;

4) Electrical isolation 0~20mA or 4~20mA current loop output, optional loop power supply mode (two-wire system);

5) Optional HART Protocol;

6) Heat measurement function in accordance with CJ128 national heat meter standard;

7) 8~36VDC,220VAC power supply mode is optional;

8) It has the functions of manual accumulator and batch controller;

9) The cumulative recording function of month, year and day; and record the cumulative flow, cumulative heat and other data in the first 512 days (every day) and the first 128 months (every month);

10) Record and review the power-off time and other data of the previous 32 times;

11) The interval can be set from 1 second to 24 hours. There are up to 22 outputs;

12) Three analog inputs with accuracy of 0.1%.

Please know the working power supply and model of the product before use to prevent abnormal operation or damage caused by disconnection.

1.2 Technical parameters

Accuracy:better than 1%.

Power supply:AC(85~264)V or isolation DC(8-36)V.

Power consumption: Operating current 50mA (with no keyboard connected and buzzer silent.

Signal output(optional) :

One channel standard isolation RS485 output;

One channel isolation 4-20mA or 0-20mA active output,hart protocol(optional);

Two channel isolation OCT output (programmed between the pulse width(6-1000ms), default before leaving factory (200ms);

One channel isolation relay output,with positive, negative, net accumulation pulses and different alarm signals.

One channel bidirectional universal serial interface can directly connect multiple external devices(such as 4-20mA analog output boards, frequency signal output boards, thermal printers, and data loggers)in a daisy-chain configuration.

Signal input(optional):

Two channel three wire system PT100 platinum resistor input loop,to make heat meter has the function of displaying heat quantity.

Three channel 4-20mA input

Display:2*20 backlight LCD(English version)

Operating:4*4 tactile keypad

Other functions:automatic memory the positive,negative,net totalizer flow rate and heat quantity of the last 512 days,128 months,10years.

Automatic memory the time of power on/ off and flow rate of the last 30 times, realize to replenish by hand or automatically, read the datas through MODBUS communication protocol.

Transducer:clamp-on type; Insertion type.

II. Operation and Display

The product adopts window software design. All input parameters, instrument settings

and display measurement results are uniformly subdivided into more than 100 independent windows. Users can enter parameters, modify settings or display measurement results by "visiting" a specific window. Windows are numbered with two digits (including + sign), from 00 to 99, followed by + 0, + 1, etc. Window number, or window address code, indicates a specific meaning.

There are three main types of windows:

(1) Data type, such as M11 and M12;

(2) Select item type, such as M14;

(3) Pure display type, such as M01, M00.

Access the data window to view the corresponding parameters. If you want to modify the value, you can directly type the value key and press “ENT” key;You can also type the “ENT” key, then type the digit key, and then type the “ENT” key to confirm.

Access the selection window to view the corresponding selection. If you want to modify, you must first type the “ENT” key, and then ">" and flashing cursor will appear on the left side of the screen, indicating that you have entered the modifiable selection state. Users can use "►/+”key and "▼/-”key to move out the desired selection item, type "ENT" key for confirmation, or directly output the selection item corresponding to the number and type "ENT" key to confirm. The display window is only displayed for users to browse and cannot be modified.

For example :to use 16 keys keyboard.

0 – 9 and • are used to input digits or Menu number.

◄ key is used to left backspace or delete left character.

▲/+ and ▼/- are used to enter upper and lower Menu.

when inputting digits,it equals to plus or minus key.

MENU Key (Abbreviated as the M key) is used to visit Menu,firstly press this key and then press two digits keys to enter related Menu.for example,if you input outside pipe diameter,press MENU 1 1 .

ENT Key is the Enter key, also known as Confirm key. It is used to ensure the input digit or chosen content. The other function is to press this key to enter “modify” status

before inputing parameters.Refer to "Quick Input of Pipe Parameters" for detailed operations.

■ detailed information of Menu

Flow rate/Flow totalizer display	00	Display instant flow rate/net totalizer,adjust the units in M30-M32
	01	Display instant flow rate/instant flow velocity, adjust the units in M30-M32
	02	Display instant flow rate/positive totalizer, adjust the units in M30-M32
	03	Display instant flow rate/negative totalizer, adjust the units in M30-M32
	04	Display instant flow rate/date/time
	05	Display heat flow rate/total heat quantity,adjust the units in M84 ,M88.
	06	Display temperature input T1,T2
	07	Display analogue input AI3,AI4
	08	Display system error code
Initial setup	09	Display today net totalizer
	10	Input outside perimeter of pipe
	*11	Input pipe outer diameter,data range:0-18000mm
	*12	Input pipe wall thickness
	*13	Input pipe inner diameter
	*14	Choose the kinds of pipe materials
	15	Input sound velocity of pipe material
	16	Choose kinds of liner
	17	Input the sound velocity of liner
	18	Input the thickness of liner
	19	Input inner pipe wall absolute degree of roughness
	*20	Choose kinds of fluids
	21	Input fluid velocity
	22	Input fluid viscosity
	*23	Choose the types of transducers,including more than 20 types to choose
	*24	Choose transducer installation method

	*25	Display transducer installation space
	*26	Parameter solidifying and setup
	27	Store and read installation parameters on installation point
	28	When signal set turning poor,keep last datas
	29	Input signal strength when the pipe flow is set to be empty. Received signal strength below this set value is considered zero.
Flow unit setup	30	Choose metric or imperial unit
	31	Choose instantaneous flow unit
	32	Choose cumulative flow unit
	33	Choose the accumulator multiplication factor. This serves to amplify the accumulated value range.
	34	Net accumulator switch
	35	Positive accumulator switch
	36	Negative accumulator switch
	37	Restore parameters setup before leaving factory and reset accumulator
	38	Manual accumulator (for calibration), display cumulative flow, time, and instantaneous flow
	39	Choose operating language,including 8 kinds of different languages for international users to use
	3•	Setup the LCD display method,inputting 0 or 1 means fixed displaying content.
Choosing setup	*40	Damping coefficient
	*41	Input low flow velocity cutoff value
	42	Setup static zero point
	43	Clear zero point setup and manually setup zero point,restore default before leaving factory.
	44	Set up zero point deviant by hand
	45	Meter coefficient,rectification coefficient
	46	Input Network address identification number(meter communication address)
	47	Password protecting operation,after the meter was setup with password,only browse menus without any modification.
	48	Input degree of linearity broken line rectification data.at most there is 12 segments broken line
	49	Network communication tester,on this window to visit the datas transferred from upper computer.

Scheduled time output	50	Optional setup of datas output at scheduled time,choose output content at scheduled time to print,more than 20 to select	
	51	Setup output time at scheduled time	
	52	Printing data flow direction control.by default printing data will flow directly to the thermal printer hanged inside bus.setup printing data output to outside serial port(RS485 port)	
	53	Display analogue input AI5(Battery-Powered Main board) – This window displays the battery voltage	
Input and output setup	54	Setup of OCT totalizer pulse output,pulse width,range:6 ms-1000ms.	
	55	Choose current loop output mode	
	56	Corresponding data to output of current loop 4mA or 0mA	
	57	Corresponding data to output of current loop 20mA	
	58	Verification of current loop output. It is applied to check whether current loop is normal or not.	
	59	Present output of current loop	
	60	Date/time and setup	
	61	Software version information and Electronic Serial Number (ESN)	
	62	Setup serial port parameter	
	63	Communication protocol choosing(including compatible protocol choosing),two options.	
	64	Analogue input AI3	By inputting measuring range ,the flow meter will turn current signal into data range users needed ,so display related analogue input that corresponding to physical parameter data.
	65	Analogue input AI4	
	66	Analogue input AI5	
	67	Setup frequency range of frequency output signal	
	68	Setup lower limit flow of frequency signal output	
	69	Setup upper limit flow of frequency signal output	
	70	LCD backlight control	
	71	LCD contrast ratio control	
	72	Work timer,logging work time of the meter by unit of second.it can reset.	
	73	Set #1 Alarm lower limit flow value	By setting the upper and lower limits of the alarm, an alarm signal will be triggered when the measured flow exceeds the set range. The alarm signal can be output externally via a configured OCT (Open Collector Transistor) or relay
	74	Set #1 Alarm higher limit flow value	
	75	Set #2 Alarm lower limit flow value	
	76	Set #2 Alarm higher limit flow value	

	77	Beeper setup options
	78	Setup Open Collector Transistor output(OCT) output options
	79	Setup relay(OCT2) output options
Heat quantity measuring	80	Choose input signal of batch controller
	81	Batch controller
	82	Day/month/year totalizer,check the flow rate and heat quantity of the totalizers
	83	Automatically replenish flow switch during the period of power off,default status:off.
	84	Choosing heat quantity unit, GJ, Kcal, KW/h, BTU
	85	Choose temperature signal origin
	86	Heat capacity. Default: GB-CJ128 enthalpy difference method. The temperature difference method can also be used.
	87	Heat quantity totalizer switch
	88	Heat quantity multiplier factor.
	89	Display present temperature difference and setup temperature difference sensitivity.
	8•	Options of installation of heat meter on supply water pipe or return water pipe
Diagnosis	*90	Display the signal strength and signal quality
	*91	Display the transit time ratio
	92	Display the calculated fluid sound velocity .
	93	Display the total transit time and the delta time
	94	Display the Reynolds number and the pipe coefficient
	95	Display positive,negative heat quantity totalizer, start cycle display function.

III. Troubleshooting

LCT series converter designed perfect self-diagnosis function. The errors are displayed on the upper right corner of the menu window via identification code in a timely order. Display orderly all the existing errors on M08.

Hardware self-diagnosis is conducted every time when power is on. Some errors can even be detected during normal operation.For those errors undetectable due to incorrect settings or improper testing conditions, the flow meter will also display useful information to

help the user to quickly debug the error and solve the problems according to following listed methods.

Displayed errors have two kinds:one is circuit hardware errors information,arising possible problems and solve method can refer to table 1.if finding problems when power is on,and in the state of measuring,it will display "* F"on the upper left corner of screen.power on again,check the displayed information,adopts measures according to following table.if the problems still exist,contact manufacturer. The other is error information about measurement.refer to table 1 and table 2.

Table 1. Hardware self-diagnosis errors and solutions after power on

LCD display information	**Causes**	**Solution**
ROM verification Error	* ROM operation illegal / error	* Contact the manufacturer.
Data storage error	* Invalid memory parameters	*Press ENTER to restore factory settings.
System logger error	* System stored data area has error	*Power on again/contact manufacturer.
Measuring circuit hardware error	* Sub-CPU circuit errors	*Power on again/contact manufacturer.
CPU or clock speed error	* System timer has errors	*Power on again/contact manufacturer.
Hardware clock failure	Internal RTC (Real-Time Clock) malfunction	*Check coin cell battery/contact manufacturer
CPU or interrupt error - retrying		*Power on again
Host system resetting repeatedly		*Contact manufacturer.
Date time error	* System date and time are wrong	* Reset date and time
No Display. Erratic or Abnormal Operation	* Problem with wiring	*Check wiring connections.
No response to key pressing	Keypad is locked	* Input password to unlock keyboard

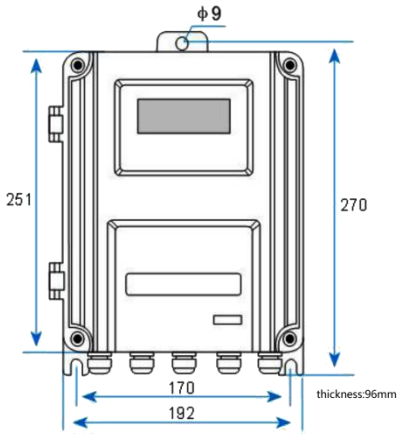
Table2. Working status errors code causes and solutions

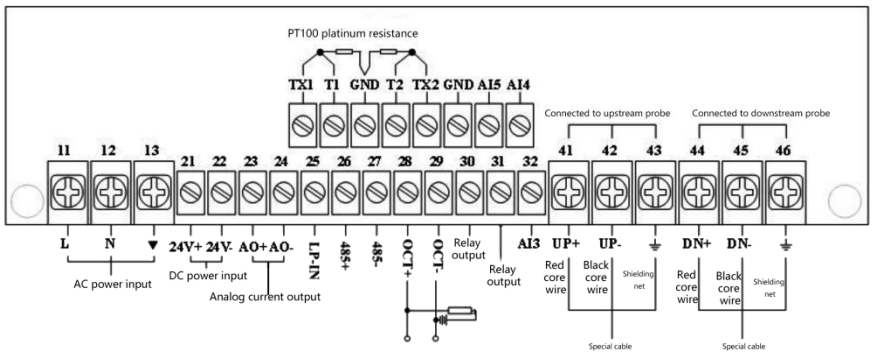
Code	M08 displaying	Causes	Solutions
*R	System work normally	* Normal system	

*J	Circuit Hardware Error	* Hardware problem	* Contact the manufacturer
*I or *H	No Signal	*Parameter input error *Loosen contact or not enough coupling agent between transducer and pipe surface. *Transducers installed improperly *Scaling on inner pipe wall is too thick.	* Enter correct pipeline parameters * Ensure pipe surface is clean *Achieve full sensor-pipe coupling. *Carefully review "Sensor Installation" in manual * Relocate mounting point or replace sensor
*K	As shown in Table 1	*Problem during power-on self-test *Permanent hardware failure	*After power again, if issue persists, please contact manufacturer
*G	Gain adjustment in progress > S1 Gain adjustment in progress > S2 Gain adjustment in progress > S3 Gain adjustment in progress>S4(Displayed in M00, M01, M02, M03 windows)	*These four stages indicate the machine is performing gain adjustment to prepare for normal measurement. *If the system stalls at S1/S2 or oscillates between them, this indicates either insufficient signal strength or poor waveform quality.	*After power again, if issue persists, please contact manufacturer
*K	*Empty Pipe Detected - Configure via M29 Menu	*No fluid in pipeline OR configuration error	If fluid is confirmed present in pipeline, enter '0' in M29 menu to disable empty pipe detection

Attention:the codes of *Q,*E displayed do not affect measurement,only means current loop and frequency output have problems.

IV. Overall Dimension and Wiring Diagram





V. Transducers Installation

5.1 Overall

The mounting of temperature sensors is relatively straightforward - simply install them on both the supply and return pipelines respectively. This section will not focus on this process, as the chapter primarily details flow sensor installation procedures.

The following steps are generally followed for installing the flow sensor:

(1)Choosing measurement point;

(2)Select the appropriate installation method according to the site conditions or the type of sensor purchased;

Type selection of insertion type flow sensor: insertion type B; Installation method: Z method.

External clamp flow sensor: the sensor type has been set before delivery, and other parameters such as "outer diameter, wall thickness and installation mode" are set according to the site conditions.

(3)Enter the pipe parameters and calculate the installation distance between the two flow sensors;

(4)Field mounted sensors;

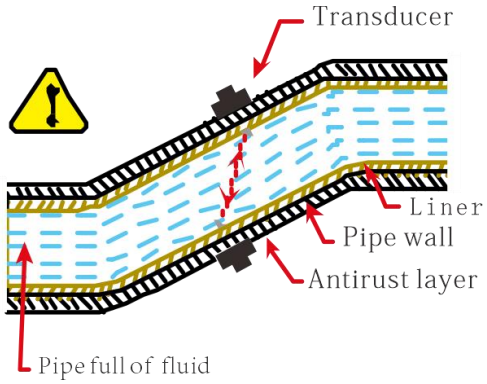
(5)Signal check(Verify installation compliance through Windows 90, 91, and 92).

5.2 Choosing measurement point

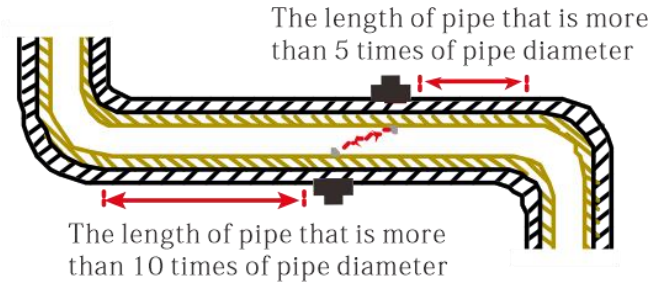
To ensure measurement accuracy and stability,the installation point of transducers should be on the straight pipe full of well distributed fluid(when installing,the pipe must be full of liquid).

Following principle:

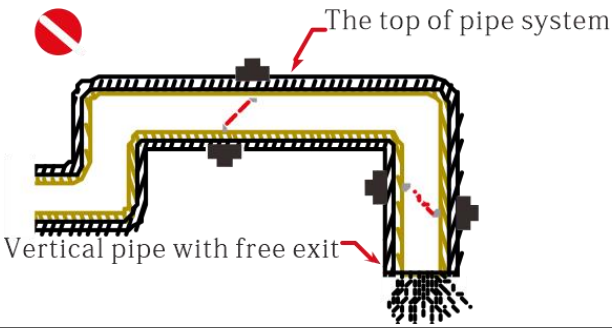
1. Pipe must be full of liquid that is uniform and easy to travel the ultrasonic beam(vertical pipe or horizontal pipe)



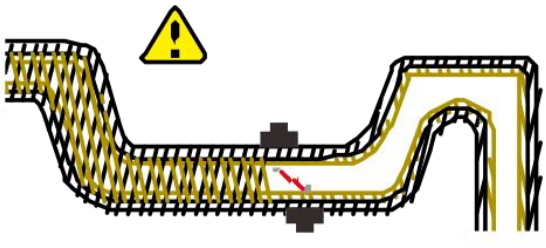
2. Upstream transducer should be installed at the place where the upstream length of the straight pipe is at least 10D and the downstream length is at least 5D where install the downstream transducer,so the pipe length should be straight without any valve,pump,angle head, D stands for pipe outside diameter. The installation point should stay away from valves,pump,high pressure current,transformers interference source etc.



3. Avoid to install on the highest point of pipe system or vertical pipe with free exit(flow down).



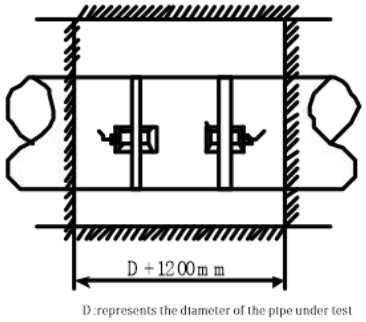
4. For the opened pipe or half full pipe,the transducers should be installed on U type pipe.

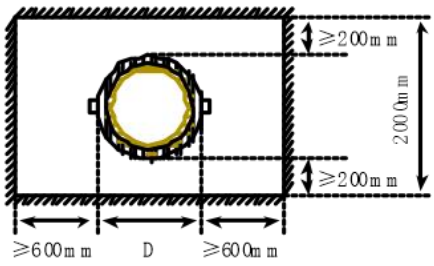


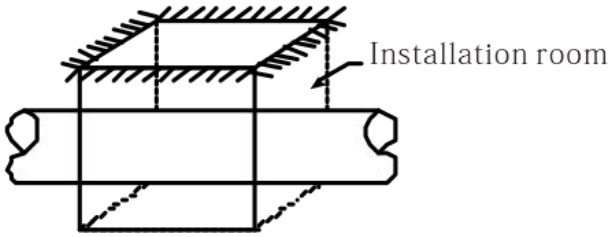
5. The two transducers must be installed in horizontal direction to pipe axis plane,within ±45° of axis line horizontal plane, to prevent bubbles or not full in upper pipe or sediment in down side of pipe to influence transducer measurement normally.If there is space limit of installation that could not install horizontal symmetry,then install the transducers vertically or dip angle under the condition of no bubbles in upper parts of pipe.

5.3 Instrument well construction requirements

If need to install transducers in instrument well,there must be enough installation room,convenient for people to stand up to work,distance between pipe wall and well wall is at least above 550mm,width is more than (D+550*2)mm,cement pipe width is more than (D+700*2)mm,instrument well axial width L is more than D+1200mm.







Attention:

(1)Do best to install transducers in the range of +/-45° of horizontal position of axis .

(2)Connect the mainframe enclosure with ground.

(3)Avoid the installation place of flange,welding line,pipe reducer.

(4)Enough installation room,convenient for people to stand up to work

5.4 Quickly input pipe parameter steps

(1)Press key [MENU] [1] [1] to enter M11 window to input the digits for the pipe outer diameter, and then press [ENT] key.

(2) Press [▼/-] key to enter M12 window to input the digits for the pipe wall thickness and then press [ENT] key.

(3)Press [▼/-] key to enter M14 window and choose the pipe material by [▲/+] and [▼/-] key and then press [ENT] key.

(4)Press [▼/-] key to enter M20 window and choose the fluid type by [▲/+] and [▼/-] key, and then press [ENT] key.

(5)Press [▼/-] key to enter M23 window and choose the sensor type by [▲/+] and [▼/-] key，and then press [ENT] key.

(6)Press [▼/-] key to enter M24 window and choose the installation mode by [▲/+] and [▼/-] key，and then press [ENT] key.

(7)Press [▼/-] key to enter M25 window, and then install according to the installation distance and the chosen installation mode.

(8)Press key [MENU] [2] [6] to enter M26 window and choose "1Solidify (or Fix) the parameters and apply them consistently by [▲/+] and [▼/-] key and then press [ENT] key. (This operation is very important. For applications requiring long-term online operation, after configuring parameters, use this feature to permanently store the parameter data block from RAM into FLASH.)

(9)Press key [MENU] [9] [0] to enter M90 window, check signal strength and signal quality, higher values are better.

(10)Press key [MENU] [9] [1] to enter M91 window, check signal transmission time

ratio (within 100±3).

(11)Press key MENU 0 8 to enter M08 window,check operational status;display *R is normal.

(12)Press key MENU 0 1 to enter M01 window and display measurement results.

5.5 Clamp on type transducer installation method

First, clean the area where the sensor is to be installed (preferably using an angle grinder), removing rust and anti-rust coatings. Apply an ample amount of coupling agent to the pipe wall surface where the sensor will be installed. Then, firmly press the sensor against the surface and secure it in place, ensuring there are no air bubbles or sand particles between the sensor and the pipe wall.

1. Installation space

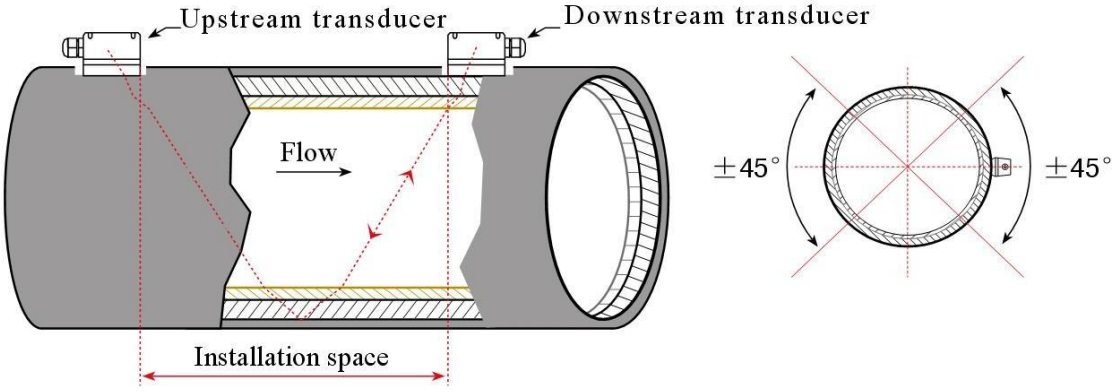
Installation space of clamp on type transducer is inner edge distance of the two transducers(face to face),after inputting the required parameters in Menu,check the display on M25,that is the installation space.

2. Installation method

The method of the clamp-on sensor has 4 kinds: V method,Z method，N method and W methods.

V method(suitable to the pipe diameters within the range DN15-DN200mm)

Normally, V method is standard installation method, convenient to use with precise measurement,when installation,the two transducers horizontally align,its centre line is horizontal with pipe axis line.



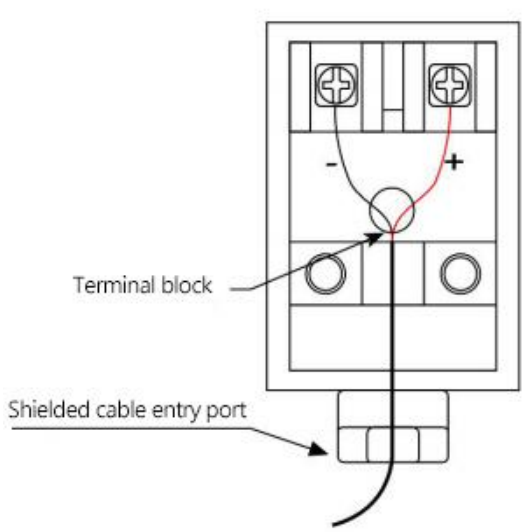
Z method (Applicable for pipes with DN ⩾ 200mm or when the V-method fails to detect a signal or the signal quality is poor)

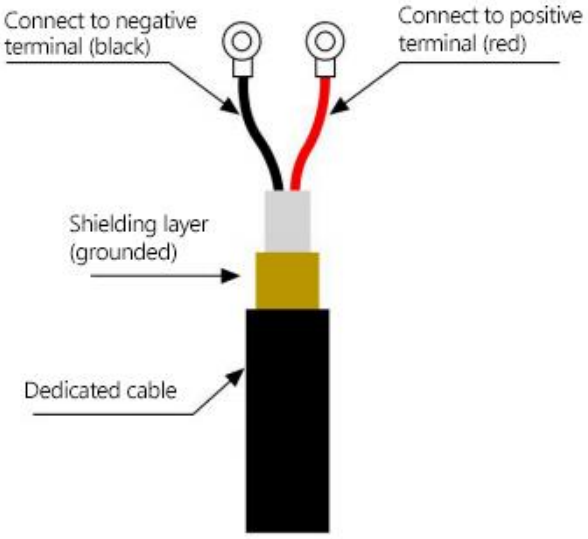
The characteristic of the Z-method is that ultrasonic waves propagate directly through the pipeline without reflection (referred to as a single pass), resulting in minimal signal attenuation.

Installation Steps

(1) Wiring (as shown in the diagram)

The shield wire of the signal cable can be left unconnected (floating). Ensure it does not short-circuit with the positive (red) or negative (black) wires.





(2) Sensor Installation

Install the sensors by following these steps:

Firstly use an angle grinder to polish the installation area, removing any rust, paint, or anti-corrosion layers. Wipe off oil and dust with a clean cloth; Then apply an adequate amount of coupling agent around the center of the sensor installation area on the pipe wall. Finally firmly press the sensor against the pipe wall and secure it in place;Fasten the fixture (stainless steel band) at the center of the sensor to ensure even force distribution. Ensure no air bubbles or grit are trapped between the sensor and the pipe wall.

5.6 Insertion type transducer installation method

Installation method: Z method, applicable to above DN80

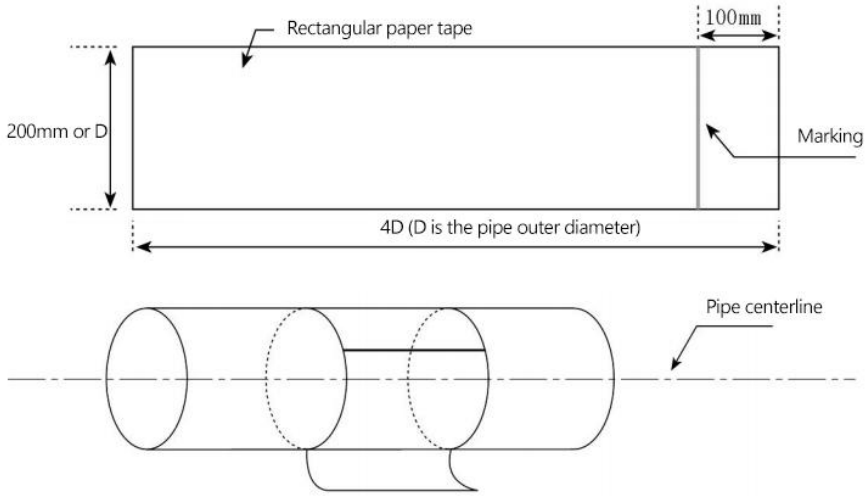
Sensor type: insert type B

Installation tools: special opening tools provided by the company, 400W electric hand drill (preferably adjustable speed), wrench, etc.

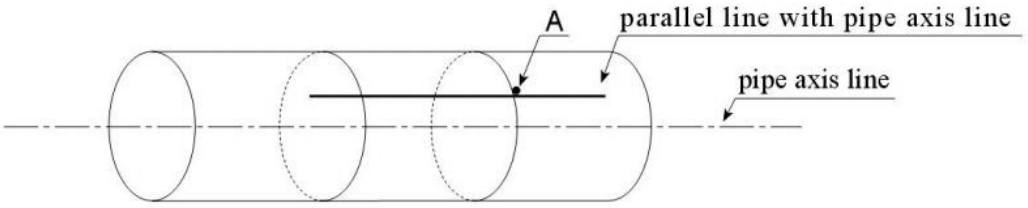
Installation distance L: the distance of the sensor along the pipe axis (see M25), or L = inner diameter -9.113mm

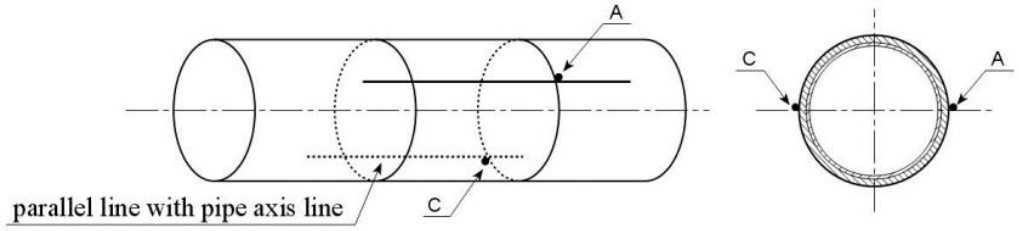
1.Locate the installation point

A.Making a fixed position paper:take a 4D(D refers to the pipe inner diameter) long and 200mm (or D) wide rectangular paper (according to actual situation on spot, the paper tape can also be replaced by moisture-and-corrosion resistant materials), and draw a line about 100mm from the edge; Wrap the fixed position paper on the cleaned surface of the pipe, making sure that the two paper sides are overlapping and aligned and thus the line drawn may be parallel with the pipe axis.

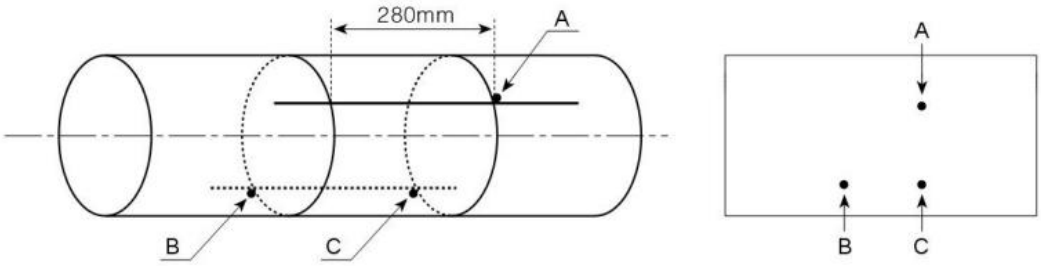


B.Extend the straight line on the fixed position paper, draw a straight line on the pipe, and the intersection point between the drawn straight line and an edge of the positioning paper is A; Starting from point A, measure 1 / 2 of the circumference of the pipe along the edge of the positioning paper. The parallel intersection is C. draw a straight line parallel to the pipe axis at point C (that is, parallel to the straight line on the positioning paper).





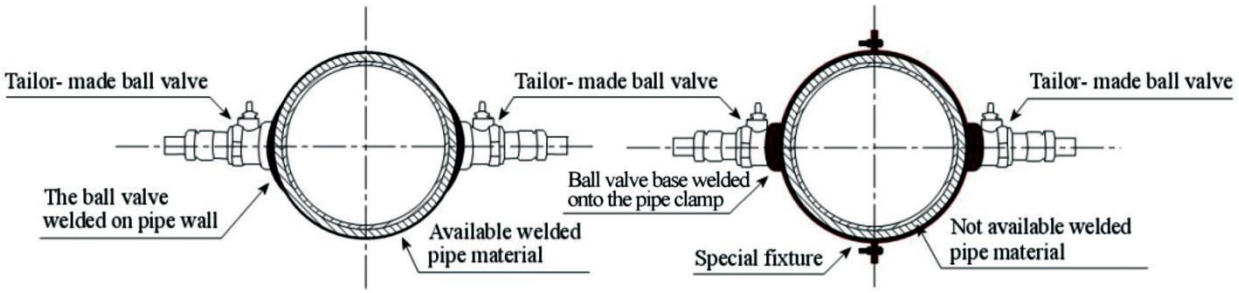
C.Removing the fixed position paper and starting from C, the installation space L should be measured along the line, draw on the pipe ,the point is B. Thus, A and B are the points where the transducers are to be installed. For example, L=280mm. Then two bases of ball valves should be welded respectively on A and B, making sure the centers of bases overlap A and B respectively.



2.Welding the base of the ball valves

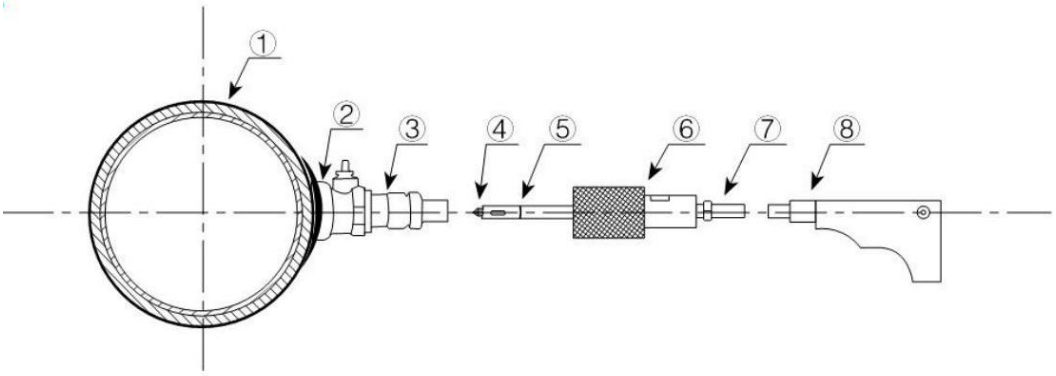
For pipes that can be welded (such as steel and stainless steel, etc.), just weld the base on the pipe (Stainless steel pipe should be welded to stainless base,please indicate in your order). Before welding, the rust and paint on the section where the sensors are to be installed shall be cleaned up by using an angle grinder, and the oil dirty and dust should be cleaned by using acetone or alcohol. to prevent water leakage,so the work of welding is very important, making sure the centers of bases overlap A and B respectively,no air bubbles.

For pipes which material cannot be welded directly (such as cast iron and cement, etc.), special hoops (with air-proof rubber pads) should be used. The bases of the ball valves have been welded on the hoops.These hoops are directly fixed on the pipe and make sure that the centers of the ball valves overlap A and B respectively. Finally, the ball valves should be closely fixed on the bases welded on the hoops to prevent water leakage.



3.Hole-drilling

Connect the sealed sheath of the hole-drilling machine and the outer screw thread of the tailor-made ball valves,screw tightly,open the ball valves,push the drill pipe to touch the outer surface of pipe; then the drill pipe shall be locked to the handle rotary drill before the drill is switched on. During drilling, the drill machine should work in a low speed to avoid sticking or even drill bit breaking.after drilling through pipe wall,pull back the drill pipe until the head of drill bit reach the ball valves spool,turn off the ball valves,take down hole-drilling machine.



①Pipe

②Ball valve base

③Tailor-made ball valve

④Locating drill pipe bit

⑤19 super hole cutter

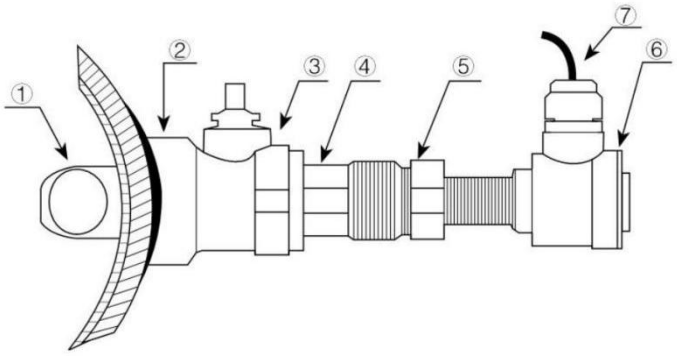
⑥Seal gland

⑦Drill pipe

⑧Hole-drilling machine

4. Inserting the transducers

Screw the screw mut to a position under the bottom of the transducer and screw the transducer through the ball valve to ball valve spool. Open the ball valve and continue to screw the transducer until the head of transducer passes the inner wall of the pipe. Before the wires are connected, the angle of the transducer should be adjusted to make sure that the head of two transducers can be in face to face position so as to send and receive the signals properly(the hole for line of two transducers should be upward or downward at same time).and then fix the screw mut,connect the wires,use silicon rubber to seal the connection place.

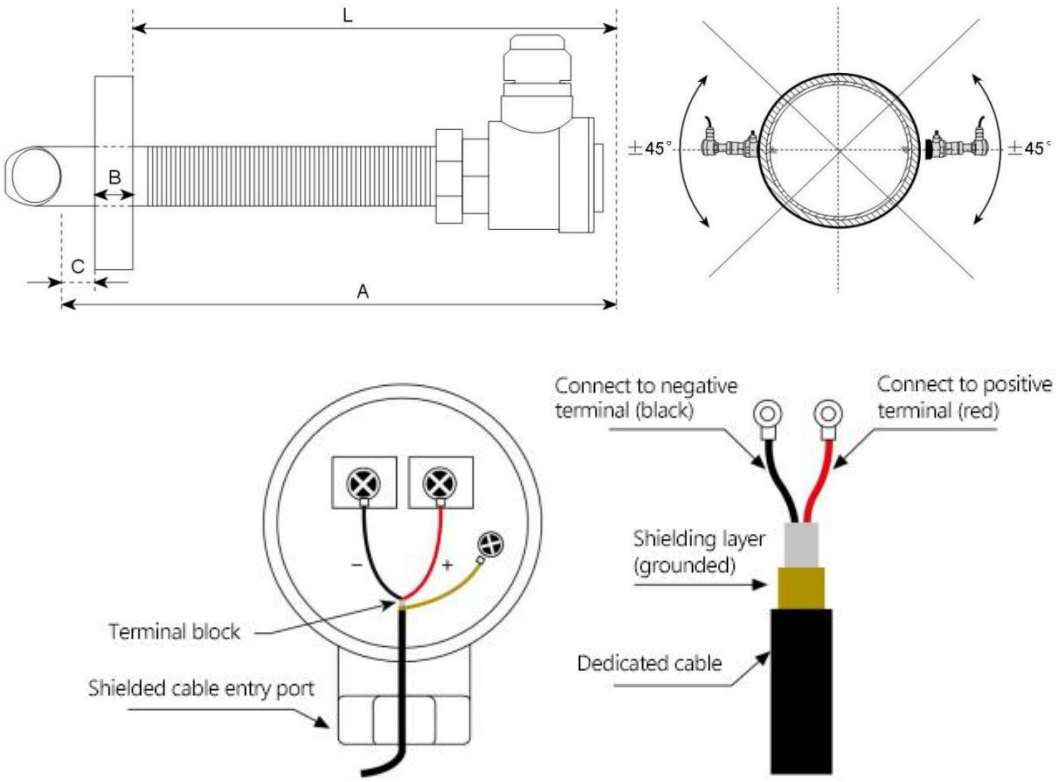


①transducer
②ball valve base
③tailor-made ball valve
④screw thread
⑤locknut
⑥connecting box
⑦signal cable

5. Length calculation of the part of transducer into the pipe inner wall

Insertion style transducer is made of stainless steel by casting. As the transducer's length A and the pipe wall's thickness B are known,and the length part of transducer left outside the pipe can be measured, the length of the inner part of the transducer can be calculated through the formula: L=A-B, C=0

Note:the length A of different types of transducers are:Standard insertion type B:A=170mm; Cement insertion type B:A=310mm.



After wiring is completed, tighten the cable gland nut (ensure the sealing gasket is not lost) and screw on the sealing cover to prevent water leakage. For maintenance, simply follow the reverse procedure of installation: remove the old sensor and replace it with a new one.

VI. Checking installation

The quality of installation directly determines the accuracy of flow measurements and the long-term reliable operation of the flowmeter. Therefore, the following inspections must be carried out to ensure optimal measurement performance and prolonged reliable service.

6.1 Signal strength

The signal strength (displayed in M90) refers to the intensity of the signals received by the sensors in both the upstream and downstream directions. It is represented numerically on a scale of 00.0 to 99.9 to indicate relative signal strength. For clamp-on sensors, the installation process should include careful adjustment of sensor positioning and verification of sufficient coupling agent application to ensure maximum signal strength is achieved. (The

system can operate normally only when the signal strength in both directions exceeds 60.0.)

6.2 Signal quality (Q value)

Signal quality, abbreviated as Q value (displayed in M90), indicates the integrity level of the received signal. A value above 60.0 is generally required, and higher values correspond to better performance.

6.3 Transit time ratio

The transit time ratio (displayed in M91) is used to verify the correctness of the sensor installation spacing. When properly installed, the ratio should be 100 ± 3. The transit time ratio can be viewed in M91 and should be adjusted to be as close to 100 as possible.

If the ratio exceeds the range of 100 ± 3, the following should be checked:

(a) Whether the entered parameters (pipe outer diameter, wall thickness, pipe material, liner, etc.) are correct;

(b)Whether the sensor installation distance matches the data displayed in M25;

(c)Whether the sensors are installed on the same axial plane of the pipe;

(d)Whether there is excessive scale buildup;

(e)Whether the pipe at the installation point is oval or deformed.

VII. Heat Measurement

The ABDT-LCT series ultrasonic heat/cooling meter is a device compliant with the European EN1434 standard for heat meters. It utilizes the ultrasonic time-difference principle for flow measurement and integrates a heat calculator to accurately measure both thermal energy and cooling consumption. Characterized by long-term measurement stability without degradation in accuracy, reliable operation, and robust functionality, the meter is available in both compact (integrated) and split-type configurations.

7.1 Operational principle

1. $Q = \int_{t_0}^{t_1} q_m \Delta h dt$

Q—heat released or absorbed (J or Wh)

q_m—mass flow of water flowing through the heat meter (kg/h)

△h—water enthalpy difference at the inlet and outlet temperature for heat exchange system (J/kg)

t——time (h)

2. When installed in the feed water inlet: instantaneous heat $q_{heat}=q_v\times \rho_{feed}\times(h_{feed}-h_{return})$

When installed in the return water outlet: instantaneous heat $q_{heat}=q_v\times \rho_{return}\times(h_{feed}-h_{return})$

Where,

q_v= instantaneous flow for volume

ρ_{feed}=water density at the feed water inlet temperature

ρ_{return}=water density at the return water outlet temperature

h_{feed}=heat enthalpy of water at the feed water inlet temperature

h_{return}=heat enthalpy of water at the return water outlet temperature

Under normal conditions, the temperature sensor with 3 wire PT100 platinum resistance is used for the heat (cold) meter with working power supply of AC220V, and the temperature sensor with 2 wire PT1000 platinum resistance is used for the heat (cold) meter with working power supply of 3.6V (lithium battery).

7.2 Wiring for PT100 platinum resistance

The power supply end and signal end of the feed water circuit platinum resistance shall be respectively connected with the above wiring terminals TX1 and T1; the power supply end and signal end of the return water circuit platinum resistance shall be respectively connected with the wiring terminals TX2 and T2. The other end of the platinum resistance shall be connected with the "GND" terminal of the circuit board, and common-grounding is realized for the two platinum resistances.

7.3 Wiring for PT1000 platinum resistance

Both ends of the feed/return water platinum resistance shall be connected with the two terminals corresponding to T1 and T2 respectively.

When extending the connection wire of temperature sensor, please use the wire with larger wire diameter as far as possible, and ensure that all the wires connected with the temperature sensor have the same size.

Please note that, common-grounding shall be provided for the temperature measurement circuit and the flow measurement circuit.

7.4 Common menu options for heat (cold) measurement

M84: select the unit used for temperature measurement;

M85: select the input source of temperature signal (T1 and T2, or AI3 and AI4) (T1 and T2 by default);

M86: select enthalpy difference method or temperature difference method (enthalpy difference method by default);

M87: heat accumulator switch;

M88: set the multiple factor of the accumulator during heat accumulation, that is, define the range of the accumulator;

M89: display the current temperature difference and set the temperature difference sensitivity during heat accumulation. By setting an appropriate temperature sensitivity value, the accumulator can not accumulate heat when the temperature difference is very low, so as to avoid the incorrect accumulation. The low temperature difference sensitivity is generally set to 0.1 ℃ when leaving the factory;

M8· : select the installation position of heat meter (feed water pipe or return water pipe);

M06: display the temperature values and the equivalent resistance values for the current two inputs, i.e., T1 and T2;

M95: display the contents of the current (positive/negative) heat accumulator;

M05: display heat flow / total heat;

Use 4-20mA current loop output (optional output by HART protocol);

Select the output mode in window M55, such as flow output or heat output;

Enter the flow value represented by 4mA in window M56;

Enter the flow value represented by 20mA in window M57.

For example, if the flow range of a pipeline is 0-1,000m^3/h, enter 0 in window M56, enter 1,000 in window M57, and enter window M26 to confirm the settings (no setting confirmation required for some models).

7.5 How to output integrated pulse

Integrated pulse can only be output by the hardware OCT or a relay. Therefore, the corresponding settings must be realized for the hardware OCT or the relay (see windows M78 and M79);

For example, if you want to use the relay to output positive integrated pulse, and each pulse corresponds to the flow of 0.1m3, the settings required are as follows:

1. Press MENU 3 2 , and select the integrated flow unit "Cubic meter (m^3)";
2. Press MENU 3 3 , and select the multiple factor "2.×0.1";
3. Press MENU 7 9 , and select "9. positive integrated pulse output".

Note: the suitable integrated pulse shall be selected. If the integrated pulse selected is too large, the output cycle will be too long; if the pulse is too small, the relay will act more frequently, affecting its service life. In addition, the frequent actions may cause the missing pulse. Therefore, it is recommended to use the rate of 1~60 pulse(s)/min.

How to output by the frequency signal

For example, if the flow range is 0~3,600m^3/s, it is required to output the corresponding frequency signal 0~1,000Hz. The settings required are as follows:

Press MENU 6 7 , and enter the lower limit frequency "0" and the upper limit frequency "1000";

Press MENU 6 8 , and enter 0;

Press MENU 6 9 , and enter 3,600;

Press MENU 7 8 , and select "24 frequency signal output";

At this time, the flow of 0 m^3/s corresponds to 0 pulse, and the flow of 3,600 m^3/s corresponds to 1,000 pulses. If 432 pulses are detected per second, you can know that the

instantaneous flow of the current flowmeter is "432*(3600/1000) = 1,555.2 m^3/s. In this example, the pulse equivalent = 3,600/1,000 = 3.6 m^3/pulse.

There is no special output circuit for the frequency signal, and its signal output must be realized by OCT.

VIII. Serial Port and Communication Protocol

The A0B0-LCT series products are equipped with an isolated RS485 interface, capable of simultaneously supporting multiple widely used communication protocols. These include the MODBUS protocol, M-BUS, FUJI extended protocol, and compatibility with communication protocols of Huizhong Corporation products. MODBUS protocol is a standard industrial automation protocol. Both RTU and ASCII formats of MODBUS are supported.

M-BUS: An internationally common protocol for heat meter metering. To use this protocol, select the "MODBUS ASCII" option in the M63 menu.

FUJI Extended Protocol: Developed as an extension based on the protocol of Japanese FUJI ultrasonic flow meters. It is compatible with both the original FUJI ultrasonic flow meter protocol and Version 7 ultrasonic flow meter protocol.

The compatible protocols support communication with our company's water meter protocols and Huizhong Corporation's product communication protocols. To facilitate the integration of ABDT-LCT series products into data acquisition systems developed for other domestic manufacturers' communication protocols, the device currently supports 8 compatible protocols.To use a compatible protocol, users must first select the "MODBUS ASCII" option in the M63 menu, and then choose any one of the available compatible protocols.

The ABDT-LCT series products can be seamlessly integrated into data acquisition systems using standard MODBUS drivers provided by various configuration software. Additionally, by employing a MODBUS-PROFIBUS converter, the device can be easily connected to PROFIBUS networks.

The ABDT-LCT series also functions as a compact RTU (Remote Terminal Unit). It

supports current loop and OCT output to control the opening of stepping or analog solenoid valves, while the OCT output can manage power switching for other devices. Its single analog input channel can accept signals from pressure or temperature sensors. In network environments, except for address code programming which requires a serial or parallel keyboard, all other parameters can be configured remotely from a host computer.

Data transmission follows a command-response model, where the host computer sends commands and the flow meter returns corresponding replies. For data acquisition, the company offers a universal flow/heat monitoring system specifically designed for the A0B0-LCT. This system leverages the unique hardware and software features of the flow meter, providing a cost-effective, straightforward, and highly reliable solution.

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