



Handbook

ABDT-FC6000 Intelligent Flow Totalizer

Weifang AOBO Instrument Technology Development Co.,Ltd

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I. Product Overview

As a general flow totalizer with 32-bit single chip computer as the core and intelligent Chinese/English menu configuration, FC6000 intelligent flow totalizer can carry out the steam, gas and liquid measurement with faster computing speed, lower power consumption and more reliable performance. It can make real-time online fluid temperature and pressure compensation. It can receive flow, temperature, pressure and other signals at the same time. The signal can be frequency, current, differential pressure, resistance and other types. The technology based on adjustable parts without switch contact and potentiometer is adopted for signal processing, in order to provide more accurate and reliable flow measurement.

The totalizer adopts Watchdog technology, effectively preventing the totalizer breakdown in the industrial fields.

With the non-volatile technology, the totalizer data can be saved for more than 10 years after power failure.

The 24-digit ADC conversion chip and 12-digit DAC chip are adopted to provide the faster conversion speed and higher precision.

With MODBUS communication technology with RS232/485 interface, the totalizer can be networked with various networks or industrial buses to realize remote meter reading.

II. Technical Index

1.Flow input signal

Frequency signals, such as vortex flowmeter and turbine flowmeter;

(4~20)mA current signals, such as electromagnetic flowmeter and ultrasonic flowmeter;

Differential pressure signals, such as orifice flowmeter and V-cone flowmeter.

Notes: (1) standard of frequency signal: voltage pulse, $V_{Min} \leq 1V$, $V_{Max} \geq 5V$; received frequency range: (0~5000)Hz; (2) (4~20)mA current received for the differential pressure signal (linear signal).

2.Pressure input signal

(4-20) mA current signal, which can be set in Pa/KPa/MPa.

3. Temperature input signal

Pt100 platinum resistance (measurement range of $-50^{\circ}\text{C} \sim 500^{\circ}\text{C}$);

Temperature transmitter signal for (4~20)mA current output (measurement range of 0-upper temperature limit).

4. The IAPWS-IF97 formula, developed by International Formulation Committee (IFC) for calculating the thermal properties of water and steam, is adopted for the temperature and pressure compensation for the steam.

5. Accuracy: grade 0.2

6. Dual communication Interface (equipped according to the customer requirements):

Support dual-channel communication output at the same time, RS232 or RS485 interface, RS232 interface for AOBO protocol by default, and RS485 interface for standard Modbus protocol.

7. Display function

Flow, pressure, temperature, accumulative flow, frequency, current, differential pressure, density, power-off times, the last power-off time, date, total power-off time, instantaneous heat, accumulative heat and enthalpy value.

Instantaneous flow display range: $0 \sim 99999.9999$; accumulative flow display range: 99999999.9 .

Temperature display range: $-50.0 \sim 999.9$; pressure display range: $0 \sim 999.999$.

Instantaneous heat display range: $0 \sim 999999.99$; accumulative heat display range: $0 \sim 999999.99$.

8. Automatic compensation function

Three compensation modes are available for steam measurement, namely, temperature compensation, pressure compensation, and temperature and pressure automation compensation. When the temperature and pressure automation compensation mode is selected, the compensation shall be carried out according to the working mode of the saturated steam, if the field temperature is lower than the saturated steam temperature

corresponding to the pressure; on the contrary, the compensation shall be carried out according to the superheated steam working mode. In the pressure compensation mode, the maximum pressure compensation for saturated steam is 10MPa. In the temperature compensation mode, the maximum temperature compensation is 315 degrees. In the temperature and pressure automation compensation mode, the maximum pressure compensation for the superheated steam is 10MPa, and the maximum temperature compensation is 500 degrees.

9. Small signal removal function

In the environment with slight vibration or disturbance, removing the interference signal improves the measurement stability of the totalizer.

10. Power-off protection function

The results of the operation and the data set by the user will not be lost during power off and it will be saved for more than 10 years.

11. Working power supply

AC(110V~220V) $\pm$ 15%, power dissipation<5W, or DC12V $\pm$ 5%.

12. Output power supply

There are two groups. One is 12V/30mA and another is 24V/200mA.

13. Work environment

Temperature: (-20-55) $^{\circ}$ C, humidity: (5-85)%RH

14. Installation method: horizontal installation

15. Opening size

(152 $\pm$ 0.5) $\times$ (76 $\pm$ 0.5) (W $\times$ H, unit mm)

16. Outline size

160 $\times$ 80 $\times$ 120 (W $\times$ H $\times$ D, unit mm)

III. Wiring Diagram

1. AC220V Wiring diagram

Interface 1.

12V+	FIN	12V-	GND	24V	24V	H	P	T	GND	Pt-	Pt+
Pulse Input				mA Input					Temp. Input		
AC220V Input			DC12V Input		4~20mA Output		RS485		RS232		
L	N	FG	12IN	GND	AO-	AO+	A	B	GND	Tx	Rx

2. AC110V Wiring diagram

Interface 1-1.

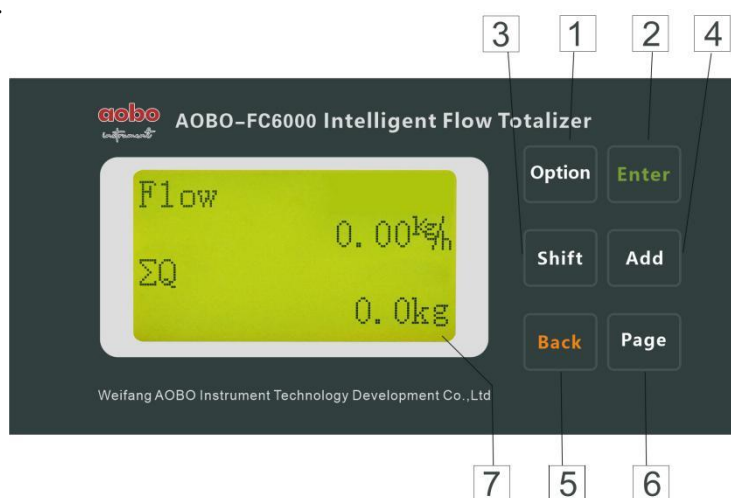
12V+	FIN	12V-	GND	24V	24V	H	P	T	GND	Pt-	Pt+
Pulse Input				mA Input					Temp. Input		
AC110V Input			DC12V Input		4~20mA Output		RS485		RS232		
L	N	FG	12IN	GND	AO-	AO+	A	B	GND	Tx	Rx

IV. Structure

Standard insert type

V. Display Function

Totalizer panel:



Interface 2.

Panel description:

Table 1

No.	Name	Content
1	Option key	Option key for parameter setting.
2	Enter key	Enter totalizer parameter setting; Confirm the set value changed; To enter the current item in changing the set value.
3	Shift key	Set the cursor position when changing the set value.
4	Add key	Increase number when changing the number; Select the current setting item when changing the set value.
5	Back key	Exit the current setting item when changing the set value.
6	Page key	Call the display picture when the working conditions are displayed; Change the current setting item when changing the set value.
7	Display screen	Display the real-time measured value (fixed display or cycle display); Display the setting parameter(s) in the state of parameter setting.

Working condition display interface:

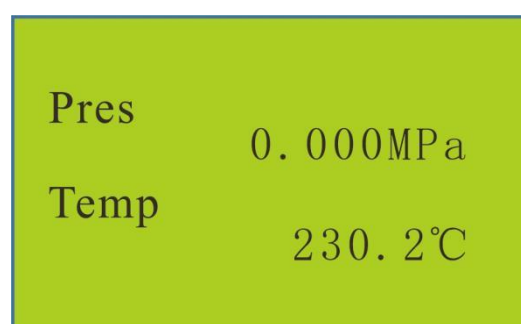
Press the "Page " key to display the desired content. All display pictures can be displayed by the panel keyboard at any time, and which also can be displayed circularly or fixedly through programming. The display pictures of working conditions are as follows:



Interface 3.

Instantaneous Flow and Cumulative Flow

Combined Interface



Interface 4.

Pressure and Temperature Interface

Freq	0.0Hz
Den	0.00000kg/m ³
Enth	0.0kj/kg
Alarm	

Interface 5.

Frequency, Density, Enthalpy and
Alarm Information Interface

PWR	0.00kW
Energy	138.28kWh

Interface 6.

Instantaneous Heat and Cumulative Heat
Combined Interface (Measuring Steam Heat
Available)

Flow	kg/h
	0.0000

Interface 7.

Instantaneous Flow Interface

ΣQ	kg
	17638.5

Interface 8.

Cumulative Flow Interface

PWR	kW
	0.00

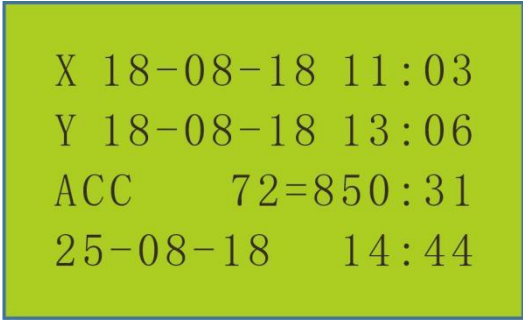
Interface 9.

Instantaneous Heat Interface

Energy	kWh
	14038.28

Interface 10.

Cumulative Heat Interface



```
X 18-08-18 11:03
Y 18-08-18 13:06
ACC      72=850:31
25-08-18  14:44
```

Interface 11.

Power Off, Power On Time, Power Off Count, Total Power Off Duration,
Current Calendar Time Interface

VI. Programming Method of Totalizer

This totalizer is a multifunctional programmable intelligent totalizer. Therefore, before using the totalizer, the user must carry out programming operation for the totalizer, in order to determine the flow sensor type to be used, the output signal type for the sensor selected, and the ranges, measurement ranges and meter coefficients of all measurement sensors.

6.1 User programming

In Interface 3, press "Enter" key to enter programming process. Programming work will be carried out with the help of Chinese/English prompts. Firstly, enter the programming password 000000 at the factory (Figure 1). Press "Shift" key and "Add"key to enter the numbers. After correctly entering the password, press "Enter" key to enter the main menu (Figure 2,Figure2-1).



```
Program      0001
Password     *****
SN: 20250146Ver23
```

Figure 1

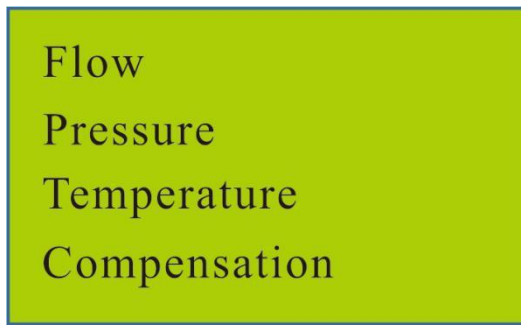


Figure 2

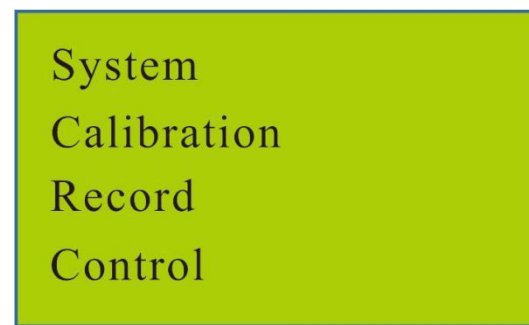


Figure 2-1

Select "Flow" in the main menu with help of the "Option"key, and press "Enter" key to enter the sub-menu "Flow Setting" (Figure 3); press "Back" key to exit the current page and return to the previous menu; press "Page" key to enter the next sub-menu.

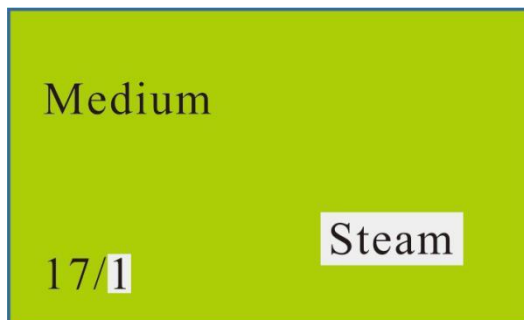


Figure 3



Figure 3-1

6.2 Flow setting

Steam, gas and liquid are optional for "Fluid Medium" setting(Figure 3). The "Add"key is used for item selection, and the "Enter" key is used to save the item selected.

Frequency, differential pressure current(Short for ΔP current),differential pressure voltage(Short for ΔP voltage), flow current and flow voltage are optional for "Flow Signal" setting. The "Add"key is used for item selection, and the "Enter" key is used to save the item selected (Figure 3-1) (differential pressure voltage and flow voltage are optional functions).



Figure 3-2

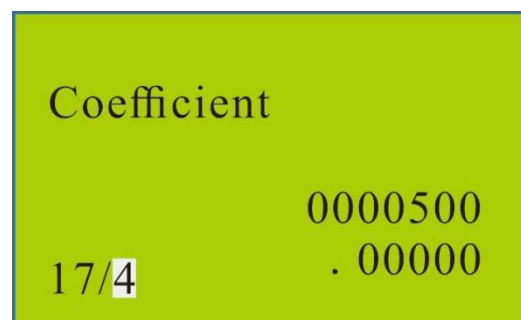


Figure 3-3

Kg, t, m³, L, Nm³ are optional for "Measurement Unit" setting. Kg and t are selected for mass flow measurement, and m³, L and Nm³ are selected for volume flow measurement. The "Add" key is used for item selection, and the "Enter" key is used to save the item selected (Figure 3-2).

In "Meter Coefficients" setting, press "Shift" key to select the data bit, press "Add" key to enter the number(s), and press "Enter" key to save the number entered (Figure 3-3). Note: when the differential pressure current is selected, the differential pressure range, the design density of differential pressure and the maximum flow of differential pressure must be entered, and the meter coefficient can be automatically calculated with no factor changes.



Figure 3-4

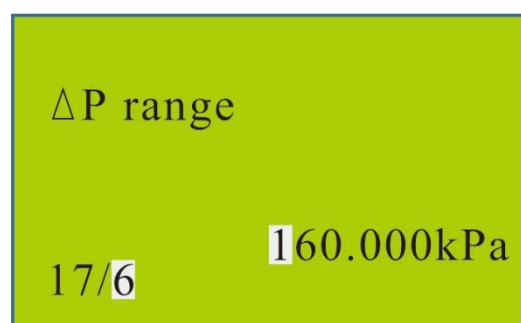


Figure 3-5

"Flow Range" setting is necessary for the current signal. In "Flow Range" setting, press "Shift" key to select the data bit, press "Add" key to enter the number(s), and press "Enter" key to save the number entered (Figure 3-4).

"Differential Pressure Range" (Short for ΔP range) setting is necessary for the differential pressure signal. In "Differential Pressure Range" setting, press "Shift" key to select the data bit, press "Add" key to enter the number(s), and press "Enter" key to save the

number entered (Figure 3-5).



Figure 3-6

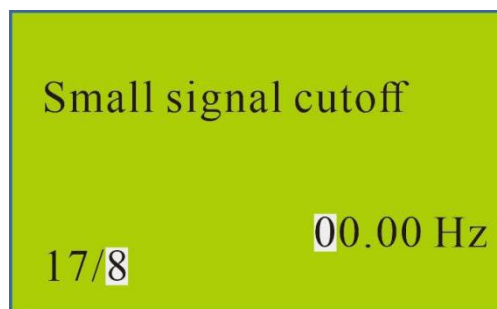


Figure 3-7

"Damping Time" refers to the time for smooth software digital filtering, and which can be any of the numbers from 0 to 99. The set value by default is 10. In "Damping Time" setting, press "Add"key to enter the number(s), and press "Enter" key to save the number entered (Figure 3-6).

"Small Signal Cutoff" setting is necessary for the small flow removal signal. In "Small Signal Cutoff" setting, press "Shift" key to select the data bit, press "Add"key to enter the number(s), and press "Enter" key to save the number entered (Figure 3-7).

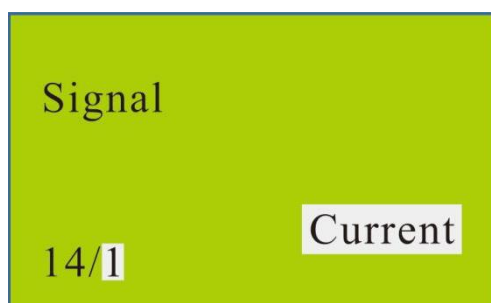


Figure 4

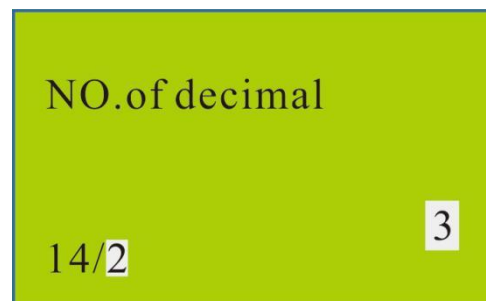


Figure 4-1

6.3 Pressure setting

Select "Pressure" in the main menu with help of the "Option"key, and press "Enter" key to enter the sub-menu "Pressure Setting" (Figure 4); press "Back" key to exit the current page and return to the previous menu; press "Page" key to enter the next sub-menu.

In "Pressure Signal" setting, press "Add"key to select "Current", "Voltage" and "Setting", and press "Enter" key to save the item selected. Note:Voltage is an optional function.

In "NO. Of Decimal Places" setting, display 3places (Figure 4-1).

In "Upper/Lower Limit of Pressure" setting, press "Shift" key to select the data bit, press "Add"key to enter the number(s), and press "Enter" key to save the number entered (Figure 4-2, Figure 4-2-1).

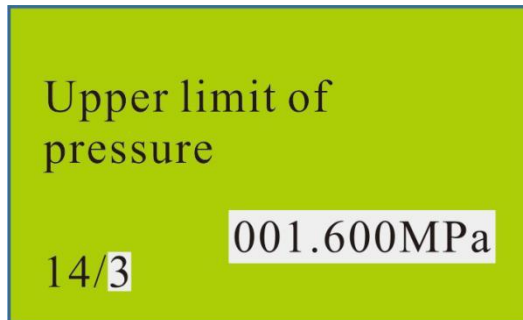


Figure 4-2

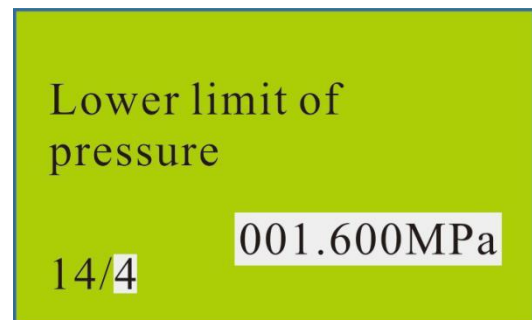


Figure 4-2-1

In "Measurement Unit" setting, press "Add"key to select Pa, KPa or MPa, and press "Enter" key to save the item selected (Figure 4-3).

"Damping Time" refers to the time for smooth digital filtering, and which can be any of the numbers from 0 to 99. The set value by default is 10. In "Damping Time" setting, press "Add"key to enter the number(s), and press "Enter" key to save the number entered (Figure 4-4).

"Pressure Setting " setting is necessary for the pressure signal selected. In "Pressure Setting " setting, press "Shift" key to select the data bit, press "Add"key to enter the number(s), and press "Enter" key to save the number entered (Figure 4-5).

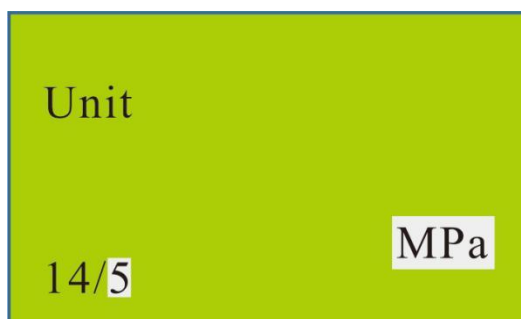


Figure 4-3



Figure 4-4

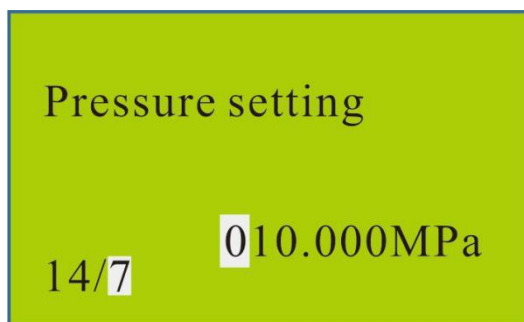


Figure 4-5



Figure 5

6.4 Temperature setting

Select "Temperature" in the main menu with help of the "Option" key, and press "Enter" key to enter the sub-menu "Temperature Setting" (Figure 5); press "Back" key to exit the current page and return to the previous menu; press "Page up/down" key to enter the next sub-menu.

"Resistance(Short for Pt), voltage, thermocouple, current and set" are optional for "Temperature Signal" setting. In "Temperature Signal" setting, the "Add" key is used for item selection, and the "Enter" key is used to save the item selected. Note: voltage is an optional function.

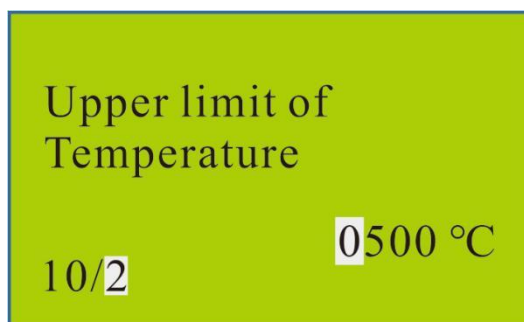


Figure 5-1

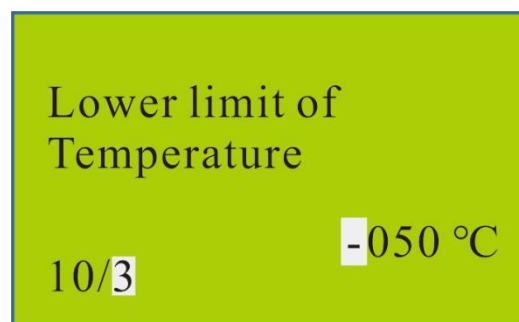


Figure 5-1-1

In "Temperature Range" setting, enter the range value when the current signal is selected for the temperature signal. Press "Shift" key to select the data bit, press "Add" key to enter the number(s), and press "Enter" key to save the number entered. In this way, respectively enter the upper limit of temperature and the lower limit of temperature (Figure 5-1, Figure 5-1-1).

"Damping Time" refers to the time for smooth software digital filtering, and which can be any of the numbers from 0 to 99. The set value by default is 10. In "Damping Time"

setting, press "Add"key to enter the number(s), and press "Enter" key to save the number entered (Figure 5-2).

"Temperature Setting" setting is necessary for the temperature signal. In "Temperature Setting" setting, press "Shift" key to select the data bit, press "Add"key to enter the number(s), and press "Enter" key to save the number entered (Figure 5-3).



Figure 5-2

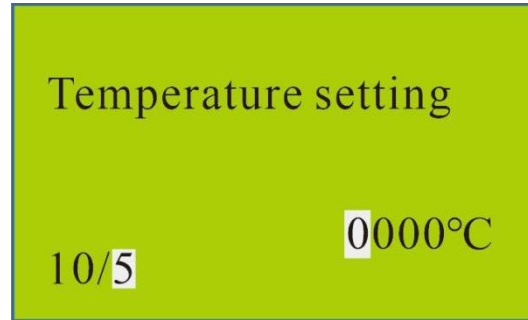


Figure 5-3

6.5 Compensation setting

Select "Compensation" in the main menu with help of the "Option"key, and press "Enter" key to enter the sub-menu "Compensation Setting" (Figure 6); press "Back" key to exit the current page and return to the previous menu; press "Page" key to enter the next sub-menu.

Temperature and pressure automation compensation(Short for P_T_Auto), pressure compensation(Short for Pressure), temperature compensation(Short for Temperature) and density set are optional for "Compensation Mode" setting. In "Compensation Mode" setting, the "Add"key is used for item selection, and the "Enter" key is used to save the item selected. The IAPWS-IF97 formula, developed by International Formulation Committee (IFC) for calculating the thermal properties of water and steam, is adopted for the temperature and pressure compensation.

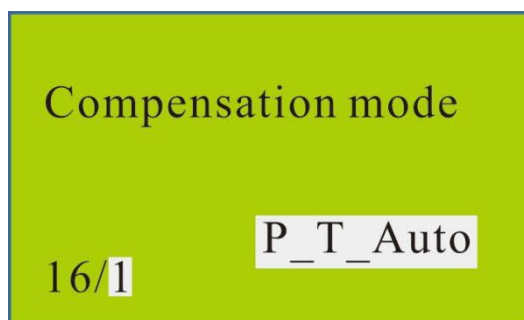


Figure 6

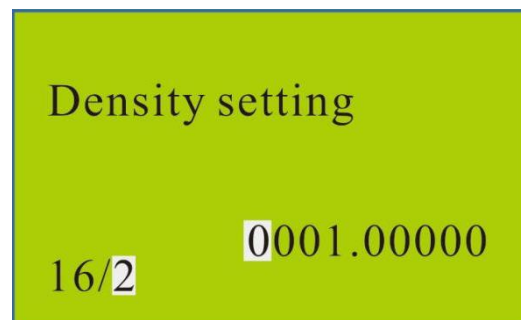


Figure 6-1

In "Compensation Mode" and "Density Setting" setting, press "Shift" key to select the data bit, press "Add" key to enter the number(s), and press "Enter" key to save the number entered (Figure 6, Figure 6-1).

"Energy Unit" setting is necessary for steam heat measurement. GJ, MWH, MJ and KWH are optional for the measurement unit. In "Energy Unit" setting, the "Add" key is used for item selection, and the "Enter" key is used to save the item selected (Figure 6-2).

"Output Range" refers to the maximum instantaneous flow/heat corresponding to 20mA current output. In "Output Range" setting, the "Add" key is used to enter the number, and the "Enter" key is used to save the number entered (Figure 6-3).

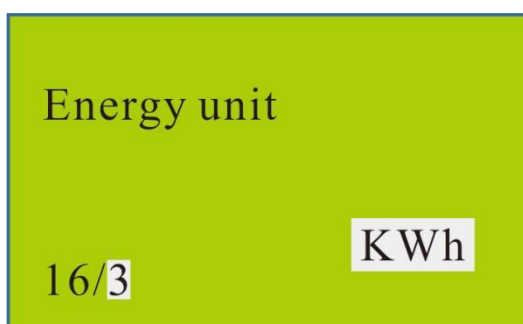


Figure 6-2

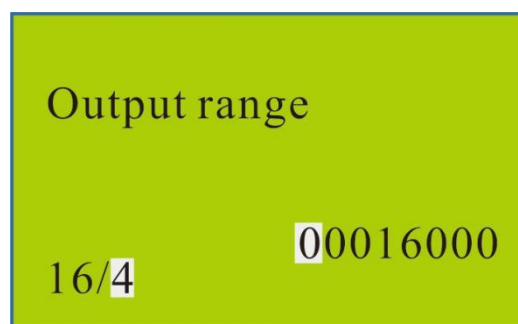


Figure 6-3

In "mA Current Output" setting, the current output represents the instantaneous flow when the instantaneous flow is selected; and the current output represents the instantaneous heat when the instantaneous heat is selected (Figure 6-4).

"Heat Calculation": Disable: heat calculation function off; Enable: heat calculation function on. In "Heat Calculation" setting, the "Add" key is used to enter the number, and the "Enter" key is used to save the number entered (Figure 6-5) (Steam heat measurement can be carried out when the switch is "Enable").

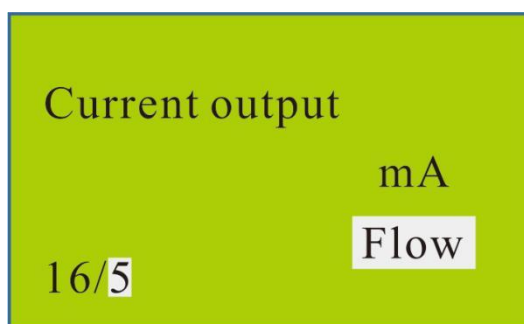


Figure 6-4

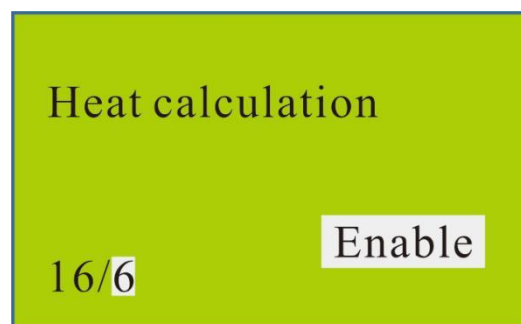


Figure 6-5

6.6 Communication setting

Select "System" in the main menu with help of the "Option" key to enter the sub-menu "Communication Setting" (Figure 7); press "Back" key to exit the current page and return to the previous menu; press "Page up/down" key to enter the next sub-menu.

"Address" refers to the communication address of the totalizer. "Address 1" refers to the totalizer communication address under the AOBO protocol, and "Address 2" refers to the totalizer communication address under the MODBUS protocol. In "Address 2" setting, press "Shift" key to select the data bit, press "Add" key to enter the number(s), and press "Enter" key to save the number entered (Figure 7-1).



Figure 7



Figure 7-1

AoBoZ, AoBoIC, MODBUS RTU and AoBo D are optional for "Protocol Type" selection. In "Protocol Type" setting, the "Add" key is used for type selection, and the "Enter" key is used to save the type selected (Figure 7-2).

9600, 4800, 2400 and 1200 are optional for "Baud Rate" selection. In "Baud Rate" setting, the "Add" key is used for item selection, and the "Enter" key is used to save the item selected

(Figure 7-3).

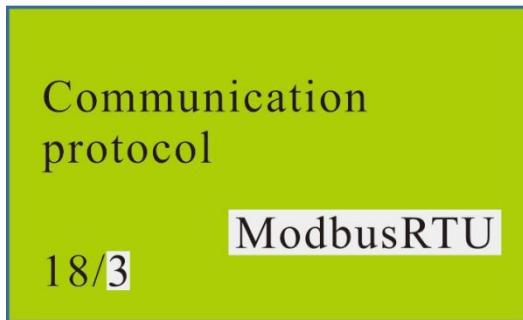


Figure 7-2

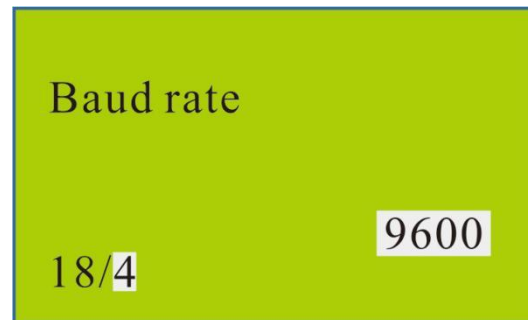


Figure 7-3

English and Chinese are optional for "Language" selection. In "Language" setting, the "Add" key is used for item selection, and the "Enter" key is used to save the item selected (Figure 7-4).

Fixed display (Short for Fixe) and cycle display (Short for Cycl) are optional for "Display Mode" selection. Fixed display means that the working conditions interface of the totalizer is displayed fixedly, and cycle display means that the working conditions interface of the totalizer is displayed circularly (Figure 7-5).

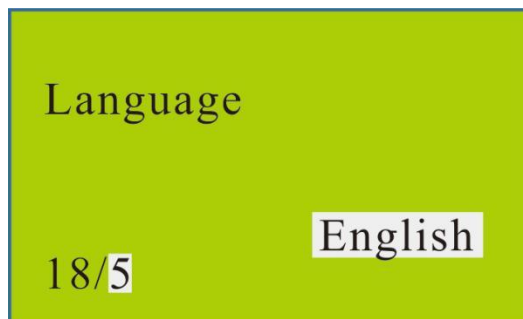


Figure 7-4



Figure 7-5

"Backlight Time" setting is to control the backlight working time of the LCD screen. In "Backlight Time" setting, press "Shift" key to select the data bit, press "Add" key to enter the number(s), and press "Enter" key to save the number entered (Figure 7-6).

"Clock Setting" is to show date and time on the controller. In "Clock Setting" setting, press "Shift" key to select the data bit, press "Add" key to enter the number(s), and press "Enter" key to save the number entered (Figure 7-7).

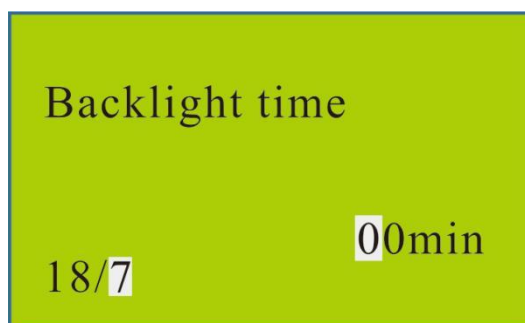


Figure 7-6

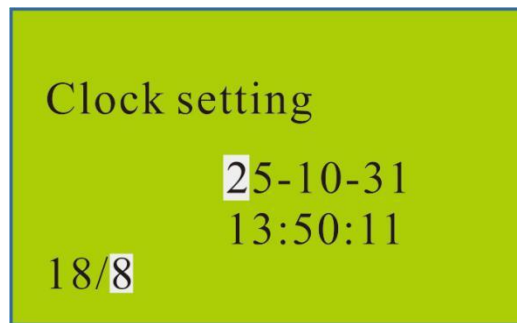


Figure 7-7

Note: totalizer calibration has been carried out in the factory, and non professional personnel do not operate the totalizer. Please return the totalizer to our factory for calibration if necessary!

6.7 Menu settings

Table 2

Programming item	Sub-item	Set text value and range	Function and significance	Remarks
Flow menu	Fluid media	Steam, gas, liquid		
	Flow signal	Frequency, current, differential pressure (optional)		
	Measurement unit	m ³ , L, kg, t, Nm ³	Unit selection for flow measurement	The mass measurement unit is kg by default, and the volume measurement unit is m ³ by default.
	Meter coefficient	0~9999999.99999		Two decimal places for the frequency signal, and four decimal places for the differential pressure signal.
	Flow range	0~99999999	Value corresponding to 20mA for the current signal	Setting necessary for the current signal
	Differential pressure range	0~999.999	Value corresponding to 20mA for the current signal	Setting necessary for the differential pressure signal

	Damping time	0~99	Base for one flow calculation	
	Removal signal	0~99.99	In the case of frequency signal, measurement is not necessary if the frequency is smaller than the set value; in the case of current or differential pressure signal, measurement is not necessary if the current is smaller than the set value.	
Pressure menu	Pressure signal	Set, current and voltage		
	Decimal place(s)	0~3		
	Pressure range	0~999.999	Maximum pressure corresponding to 20mA input	
	Measurement unit	Pa, KPa, MPa		
	Damping time	0~99	Base for one pressure calculation	
	Set pressure	0~999.999	The value is valid when pressure signal setting is selected.	
Temperature menu	Temperature signal	PT, current, set, voltage		
	Temperature range	0~9999	Temperature corresponding to 20mA for the current signal	
	Damping time	0~99	Base for one temperature calculation	
	Set temperature	0~9999	The value is valid when temperature signal setting is selected.	
Compensation menu	Compensation mode	Temperature and pressure automation, pressure compensation, temperature compensation, density setting	When steam is selected as the measured media, different compensation modes shall be selected for mass flow calculation.	
	Set density	0~9999.99999	The value is valid when setting density is selected.	
	Energy unit	MWH, GJ, KWH, MJ	Heat measurement unit selection	
	Output range	0~999999999	Maximum instantaneous value corresponding to 20mA output	

VII. Programming Examples

Example 1:

Measured media: superheated steam

Matched instruments:

Vortex sensor DN100 for pulse output with the meter coefficient of 1198.6 and the lower removal frequency limit of 5Hz.

Pressure transmitter with the range of 0~1.6MPa, the output current of 4~20mA and the Pt100 platinum resistance.

Analog output of secondary instrument: (4~20) mA corresponding to the upper flow limit of 7500kg/h.

According to the above conditions, the parameters are set as follows:

Table 3

Item	Content	Set value
Flow	Fluid media	Steam
	Flow signal	Frequency
	Measurement unit	Kg
	Meter coefficient	1198.6
	Removal signal	05.00
	Output range	7500
Pressure	Pressure signal	Current
	Pressure range	1.60
Temperature	Temperature signal	Pt
Compensation	Compensation mode	Temperature and pressure automation compensation

Example 2:

Measured media: compressed carbon dioxide gas

Matched instruments:

Vortex sensor DN80 for pulse output with the meter factor of 2300.5 and the lower removal frequency limit of 7Hz.

Pressure transmitter with the range of 0~2.5MPa and the output current of 4~20mA.

Temperature transmitter with the range of (0~100) °C and the output current of (4~20)mA.

Note: carbon dioxide density of 1.829kg/m³.

According to the above conditions, the parameters are set as follows:

Table 4

Item	Content	Set value
Flow	Fluid media	Gas
	Flow signal	Frequency
	Measurement unit	Kg
	Meter coefficient	2300.5
	Removal signal	07.00
Pressure	Pressure signal	Current
	Pressure range	2.5
Temperature	Temperature signal	Current
	Temperature range	100
Compensation	Compensation mode	Temperature and pressure automation compensation

VIII. Communication Function

Standard MODBUSRTU protocol and RS485 or RS232 communication interface are available for this totalizer for data communication. GPRS transmission or bus mode transmission can be selected for data transmission. When bus mode transmission is selected, an individual instrument number and a proper baud rate are necessary for each instrument. Instrument number and baud rate shall be set in the set menu.

IX. Totalizer Calibration

1. No frequency adjustment is required for the totalizer, and which is defined by the crystal oscillator.

2. Each analog quantity acquisition channel has been calibrated in the factory. Non professional personnel do not carry out totalizer calibration, otherwise incorrect measurement results may be caused.

Note: in addition, the company also can supply UPS power and rechargeable battery, and which shall be packed in a box with the totalizer.

X. Totalizer Computation Model

1. Equipped with frequency sensor

$$Q = 3600 \times \frac{F \cdot d}{k}$$

2. Equipped with current sensor

$$Q = \frac{(I - 4)}{16} \times Q_{\max} \cdot d$$

3. Equipped with differential pressure sensor

- 3.1 Mass flow

$$Q = U\sqrt{\Delta P \times d}$$

- 3.2 Volume flow

$$Q = U\sqrt{\Delta P \div d}$$

4. Differential pressure value calculation

$$\Delta P = \frac{(I - 4)}{16} \times \Delta P_{\max}$$

5. Density calculation

- 5.1 Steam density: temperature and pressure automation compensation

- 5.2 Gas density:

$$\text{Volume density under standard conditions} = \frac{(\text{Pressure} + 0.101325) \times 293.15}{0.101325 \times (\text{Temperature} + 273.15)}$$

Mass density under standard conditions = Volume density under standard conditions × set density

Where:

F: Sensor output frequency, unit: Hz

Q: Instantaneous mass flow

D: Medium density, unit: kg / m^3

I: Actual current unit: mA

K: Instrument coefficient, unit: N / m^3

U: Orifice coefficient

Q_{max} : Maximum value of instrument setting, unit: m^3 / h

ΔP : Differential pressure value, unit: KPa

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