FDM-96C Multifunctional Power Meter

User's Manual

Ver1.0

CAUTION

This meter must be installed by professionals.
Cut off the power supply before installing or removing the meter.
Always use voltage detection equipment of the correct rating.

FICO HITECH (PVT) LIMITED

1.Summary

FDM-96C multi-function power meter (hereinafter referred to as meter) is a new generation of high precision and economic power meter, which integrates measurement, energy measurement, power quality analysis and communication. It can support dual power source metering (DI trigger); Dual relay output. This series of meters have friendly HMI, easy to operate and use, variable ratio settable, and support Modbus-RTU communication protocol. They are mainly used in low voltage distribution systems such as power plants and substations.

With this meter, the power quality can be analyzed while the basic power data is measured, which provides diagnostic basis for the operation of the power network and guides customers to carry out preventive maintenance of power facilities, so as to improve the availability and reliability of electrical systems and equipment, reduce power consumption and significantly improve economic benefits.

2.Features

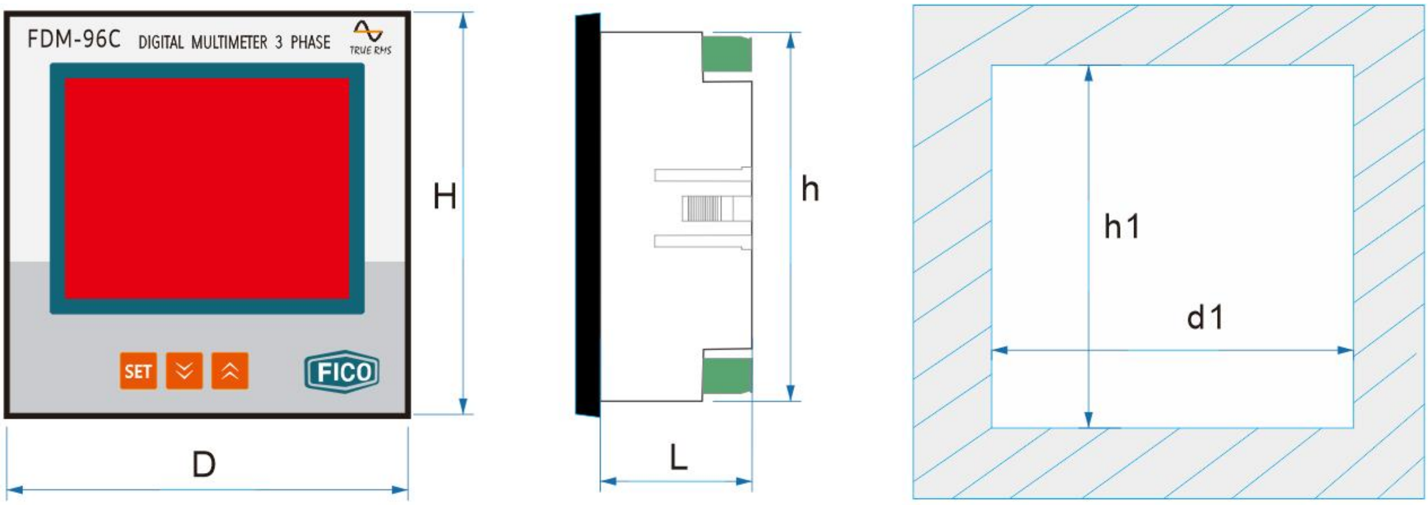
- Class 0.2 high precision, True RMS measurement, This meter can accurately measure distortion waveform.
- Three rows of 4-digit full-view LED digital screen display is adopted, which combines the advantages of LCD displayable characters and long life of LED display.
- It can measure voltage, current, active power, reactive power, apparent power, power factor, frequency and other electrical parameters in the power network.
- Maximum demand can be recorded.
- It can measure four-quadrant electric energy.
- It can measure the 2-31 harmonic content, total harmonic distortion rate (THD), odd total harmonic distortion rate (TOHD), even total harmonic distortion rate (TEHD), and total harmonic factor (THF) of voltage and current in the power network, and can display the total harmonic distortion rate of voltage and current.
- It can measure the voltage crest factor and current K factor in the power network.
- It can measure the positive sequence, negative sequence, zero sequence, unbalance degree and other power network quality parameters of voltage and current in the power network.
- Expandable 1 channel DI input for dual source power metering.
- Optional 2-way relay dry contact output (DO) module can be used for alarm signal output or remote control function.
- Extensible RS-485 communication interface, Modbus-RTU communication protocol, baud rate of 1.2k~19.2k can be set (19.2kbps by default), used to transmit real-time power parameters.
- Ultra-thin shell is adopted, and the shell depth is only 39mm, saving cabinet space.
- Adopt screw-free clamping parts, and the installation method is firm, simple and reliable.

3.Main technical performances and parameters

Technical Parameter		Data
Accuracy class		Voltage, current, frequency, power factor, active power: class 0.2; active power: class 0.2; apparent power: class 0.2; reactive power class 2.0; active energy: class 0.2; harmonic: class A
Display mode		3-row 4-tube LED screen
Auxiliary power supply		AC / DC85V～264V
Voltage input	Rated value（Un）	415V (phase-phase)
	Working range	0V～500V（phase-phase）
	Power dissipation	<5VA
Current input	Rated value（In）	AC`5A
	Overload	Continuous: 1.2 times, instantaneous: 10 times / 5s

	Power dissipation	<0.5VA (each phase)
	Impedance	<20mΩ (each phase)
Frequency	45Hz～65Hz	
Output	Switch output	The upper and lower limit alarms are output by the same relay, with contact capacity of AC250V / 2A and DC30V / 2A
	Analog output	DC0-10mA, 0-20mA, 4mA-20mA, Output load ≤ 500 Ω, can be customized voltage output
	Communication	RS-485 communication interface, Modbus RTU communication protocol, baud rate 1200, 2400, 4800, 9600, 19200 can be set.
	energy pulse output	Pulse constant：10000imp/kwh Output mode: optocoupler isolated collector open circuit output Requirements for pulse acquisition interface：VCC≤5V Iz≤50mA
Security	Withstand voltage	Power supply to input terminal or output terminal ＞AC 2kV 50Hz/1min，input terminal to output terminal＞AC2kV 50Hz/1min
	Insulation resistance	>100MΩ
	Heat and flame resistance	Terminal block：960℃、Shell：650℃、Action time：30s
EMC	ESD	±8kV
	EFT	±1kV
	HFEF	80MHz～1000MHz,10V/m
Environment	Temperature	Operating temperature: -10～70℃, storage temperature: -25～70℃
	Humidity	≤95%RH, no condensation and corrosive gas
	Altitude	≤2500m

4.Contour and installation size



Front size		Enclosure size			Mounting hole size	
Width (D)	Height (H)	Width (d)	Height (h)	Depth (L)	Width (d1)	Height (h1)
96mm	96mm	90mm	90mm	39mm	91mm	91mm

5.Installation and instruction

5.1 Installation

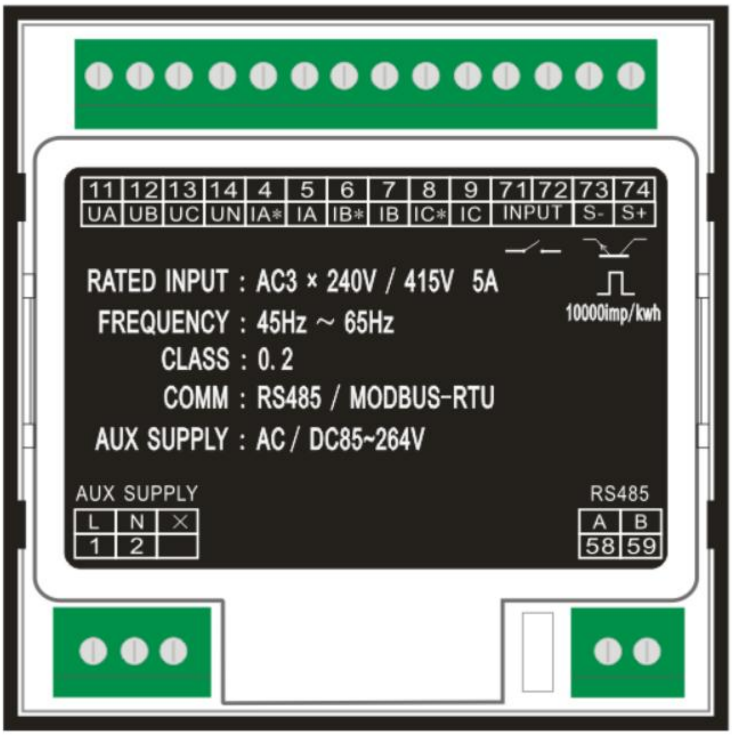
According to the requirements of meter appearance and installation size, make holes on the installation screen, install the meter into the installation hole, clip the two clamping pieces into the slots on both sides of the meter from the back of the screen, and then push them tight by hand.

5.2 Wiring mode

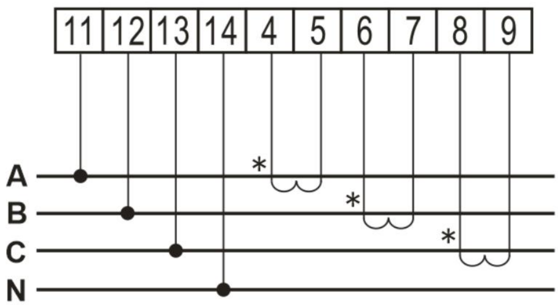
Before power-on, check whether the meter wiring is correct. If the diagram is inconsistent with the wiring diagram on the meter housing, the wiring diagram on the meter housing shall prevail.

5.2.1 Back terminal distribution diagram

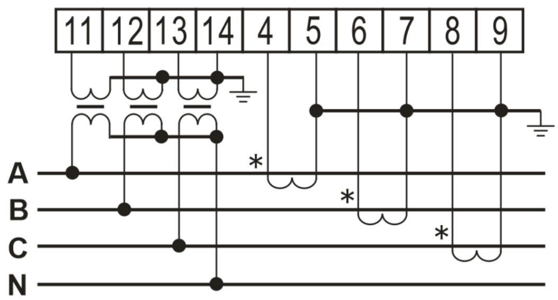
Terminals 11 to 14 are three-phase voltage input; Terminals 4 to 9 are three-phase current input; Terminals 71 and 72 are DI inputs for switching the power metering source; Terminals 73 and 74 are electric energy pulse output; Terminal 1 and 2 are auxiliary power supply; Terminals 58 and 59 are RS485 communication;



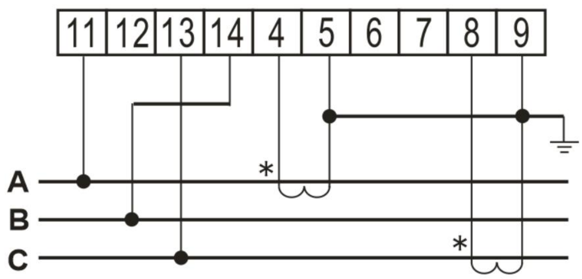
5.2.2 Wiring diagram:



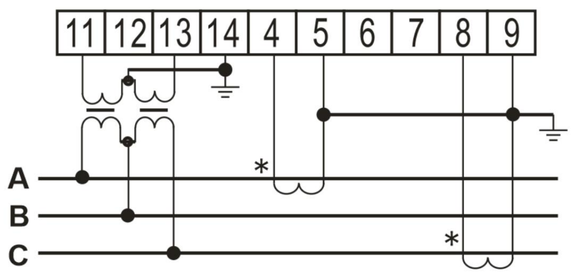
3P4W with CT with out PT



3P4W with CT and PT



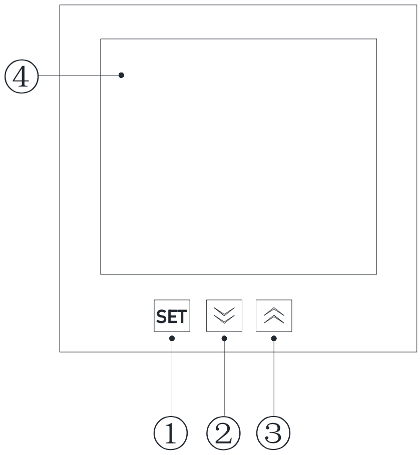
3P3W with CT with out PT



3P3W with CT and PT

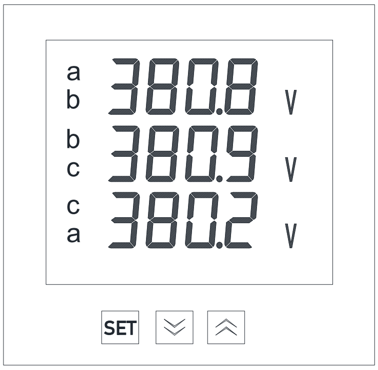
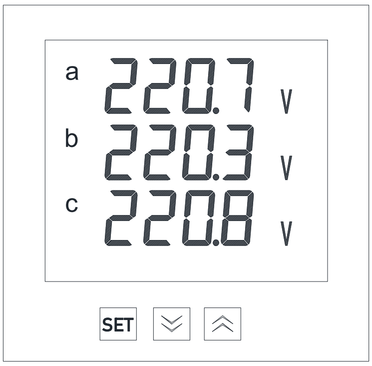
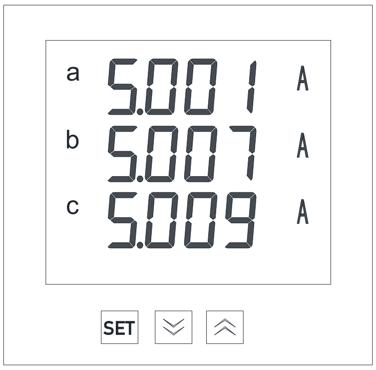
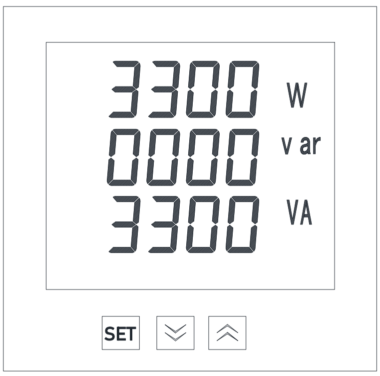
5.3 Wiring instruction

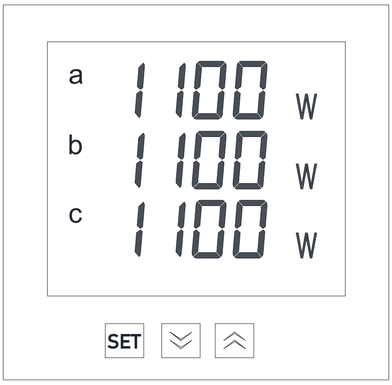
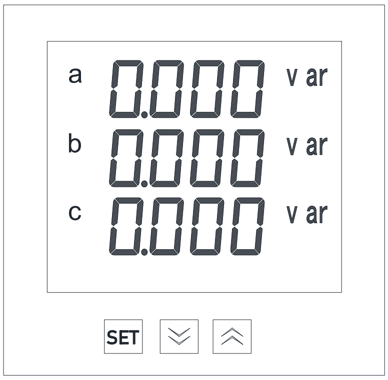
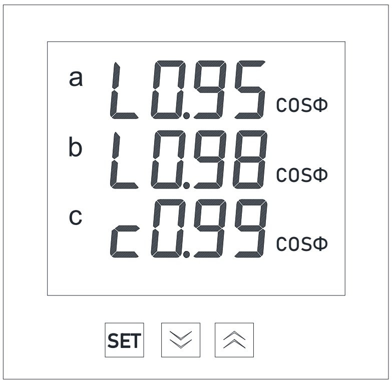
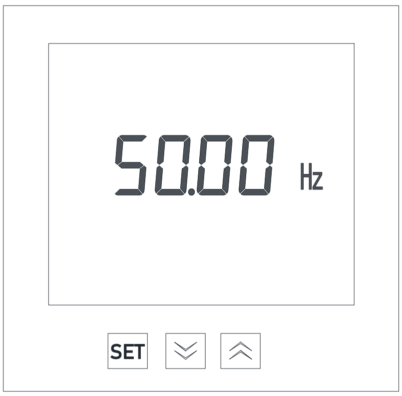
5.3.1 Make sure the rated input voltage cannot be higher than the rated input voltage of the product, or else, the user can consider to use the PT, which secondary side should be ground connection. For convenient maintenance, we suggest to use the line bank, and install a fuse in the voltage input end.
5.3.2 Make sure the rated input current cannot be higher than the rated input current of the product, or else, the user can consider to use the CT, which secondary side should be ground connection. For convenient maintenance, we suggest to use the line bank.
5.3.3 Current connector which has * identification is the high end of secondary side current, and the connection should be in strict accordance with A, B, C phase sequence showed on the label and distinguish the high end and low end of current, or else, it will cause the meter cannot measure correctly.
5.3.4 The meter is 3P4W wiring by default. If the 3P3W mode is needed, set the nEt parameter in the menu to 1. 3P3W mode is two-element measurement, and some functions will not be supported, such as three-unbalance measurement, B-phase harmonic, B-phase power factor, etc. And the unbalanced load will affect the measurement accuracy. Users must fully understand that this is the inherent defect of two-element measurement, and any three-phase meter with two-element measurement principle cannot be avoided. Therefore, the 3P3W mode is only applicable to the balanced load without zero line. If it is used to measure the uncertain unbalanced load, it will bring unpredictable measurement error.
5.4 Panel operation instruction

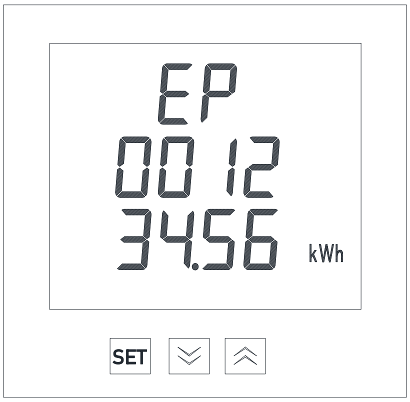
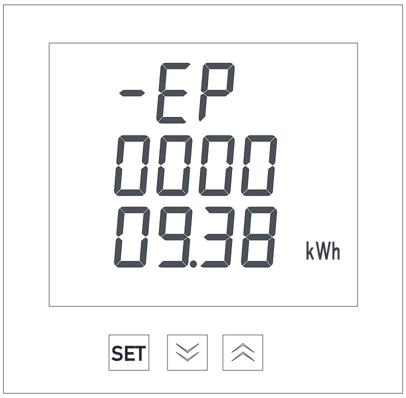


①: **SET key. Used to enter the menu and move the cursor.**
In the measurement mode, press and hold for 3 seconds to enter the menu.
In the programming mode, click to enter the sub-menu, and press and hold for 3s to return to the parent-menu.
In the parameter editing mode, click the cursor to move, and press and hold few second to return to the parent-menu.
②: **Decrease key.**
In the measurement mode, page up.
In the menu mode, select the previous parameter.
In the parameter editing mode. Used to reduce the data.
③: **Add key.**
In the measurement mode, page down.
In menu mode, select the next parameter.
In the parameter editing mode. Used to increase the data.
④: **Screen display area.**
5.5 Description of display interface

The measurement display interface has 10 pages (in programming operation, setting parameter 'Disp' can control the time of automatic cycle display, default value is 0, that is fixed display). You can use decrease and increase key to switch pages.

Page index	Show contents	Description
Page1		This page is used to display the L-L voltage of the power grid; The left figure shows the line voltages Uab, Ubc and Uca , with the unit of "V". The left figure shows Uab=380.8V, Ubc=380.9V and Uca=380.2V
Page2		This page is used to display the L-N phase voltage of the power grid; The left figure shows the three-phase voltages Ua, Ub and Uc , with the unit of "V". The left figure shows Ua=220.7V, Ub=220.3V and Uc=220.8V
Page3		This page is used to display the phase-splitting current of the power grid. The left figure shows three-phase current Ia, Ib, Ic in units of "A". The left figure shows Ia=5.001A, Ib=5.007A, Ic=5.009A.
Page4		This page is used to display the combined active power, reactive power and apparent power of the power grid. The left figure shows the combined active power, the combined reactive power and the combined apparent power in W, var, VA respectively. The left figure shows Pt=3300W, Qt=0var, St=3300VA

Page5		This page is used to display the split-phase active power of the grid; The left figure shows the three-phase active power Pa, Pb and Pc, with the unit of "W", and the left figure shows Pa=1100W, Pb=1100W, Pc=1100W
Page6		This page is used to display the split-phase reactive power of the grid; The left figure shows the three-phase reactive power Qa, Qb, Qc, in "var", and the left figure shows Qa=0var, Qb=0var, Qc=0var
Page7		This page is used to display the split-phase power factor; The left figure shows three-phase power factors PFa, PFb and PFc respectively. The first symbol L represents inductive and C represents capacitive. The left figure shows PFa=L0.95, PFb=L0.98 and PFc=C0.99
Page8		This page is used to display the frequency; The left figure shows the grid frequency of 50.00Hz

Page9		This page is used to display three-phase positive active electric energy, represented by the character EP. DI can switch the electric energy metering source. When DI is connected, the character EPr represents another metering source; The left figure shows that the current positive active electric energy is 001234.56kwh
Page10		This page is used to display three-phase reverse active electric energy, represented by the character - EP. DI can switch the electric energy metering source. When DI is connected, the character - EPr represents another metering source; The left figure shows that the current reverse active electric energy is 00009.56kwh

5.6 Meter setting

5.6.1 Enter menu

To set the meter parameters, press the SET key for 3 seconds in the measurement mode, enter the correct password at the cursor, and press the SET key again to enter the setting interface. (The default password is 0. If the password is incorrect, press the SET key only as the cursor shift function in the data area)

If no operation is performed within 60 seconds after entering the menu, the meter will timeout and automatically return to the basic electricity measurement mode. If it timeout or press the SET key for 3 seconds to exit, the set parameters will be saved. In case of unexpected power cut in the menu interface, the set parameters will not be saved.

5.6.2 Menu list

First level menu	Secondary menu	Set range	Description
SYS (System parameters)	dI SP	0～30s	Rotation display counter: set to 0, no rotation display, automatic rotation display within 30s can be set
	USPn	57.7～400.0	Voltage specification: 57.7V ~ 400.0V is optional. It is selected according to the rated voltage of PT secondary side. When the low-voltage circuit is directly connected, it is set as the rated voltage of power grid.
	I SPn	1.000～5.000	Current specification: 1.000A ~ 5.000A optional, selected according to the rated current of CT secondary side.

<table>
<tr><td rowspan="6"></td><td>FSPn</td><td>50.00～60.00</td><td>Frequency specification: 50.00Hz ~ 60.00Hz is optional, which is selected according to the actual rated frequency of the power grid.</td></tr>
<tr><td>UrAt</td><td>1～9999</td><td>Voltage ratio： Ratio of PT primary side voltage to secondary side voltage</td></tr>
<tr><td>IrAt</td><td>1～9999</td><td>Current ratio: Ratio of CT primary side current to secondary side current</td></tr>
<tr><td>nEt</td><td>3P4L/3P3L</td><td>Network of wiring: Set the wiring mode according to the actual wiring, and the setting must be consistent with the wiring</td></tr>
<tr><td>CLrE</td><td>0～1</td><td>Clear energy: Set to 1 to clear the energy value when exiting the menu</td></tr>
<tr><td>codE</td><td>0～9999</td><td>User password: set the password to enter the menu. The user can set the password to enter the menu by himself. The password must be correct to enter the menu. The default password is 0</td></tr>
<tr><td rowspan="3">Conn
(Communication parameters)</td><td>Addr</td><td>1～247</td><td>Address of Modbus: Set the address value as required. The address of the same network cannot be repeated</td></tr>
<tr><td>bAud</td><td>1200/2400/4800/9600/19200</td><td rowspan="2">Must be consistent with the host settings to communicate. The default baud rate is 19200bps, and the default stop bit is 1</td></tr>
<tr><td>Stb</td><td>1～2</td></tr>
<tr><td rowspan="6">ALnn
(For alarm parameters, only DO module is available, and there is no corresponding menu when DO module is not selected)</td><td>AL1P</td><td>0～25
26 optional objects in total
(see note 1</td><td>Alarm object 1:When ordering, it is declared that the alarm function (switch output) is required to be effective. If you do not indicate that you need this function, it is not available by default and the setting is invalid.The upper and lower limit value of alarm output is the percentage of output range, see note 1 for details.
Setting example: the meter voltage range is 220V, and the alarm channel 1 is used to monitor the voltage of phase A of the line. When the voltage is higher than 242v or lower than 176v, channel 1 will give an alarm. First, select the alarm object of channel 1 as UA, and then set the upper limit as 110.0%, and the lower limit as 80.0%. Calculation of alarm setting value: upper limit voltage alarm value: 220V * 110.0% = 242v; lower limit voltage alarm value: 220V * 80.0% = 176v;</td></tr>
<tr><td>AL1L</td><td>0.0%～100.0%</td><td>Alarm lower limit 1</td></tr>
<tr><td>AL1H</td><td>0.0%～150.0%</td><td>Alarm upper limit 1</td></tr>
<tr><td>AL2P</td><td>26 optional objects in total (see note 1)</td><td>Alarm object 2, The setting method is the same as AL1P</td></tr>
<tr><td>AL2L</td><td>0.0%～100.0%</td><td>Alarm lower limit 2</td></tr>
<tr><td>AL2H</td><td>0.0%～150.0%</td><td>Alarm upper limit 2</td></tr>
</table>

SEnd (AO parameter, only equipped with AO module is effective, when no AO module is selected, there is no corresponding menu)	Sdt	0～2	AO specification 0：4～20mA 1：0～20mA 2：0～10mA
	Sd1P	0～25 26 optional objects in total (see note 1)	AO object 1: When ordering, it is declared that the transfer function (analog output) is required to be effective. If you do not indicate that you need this function, it is not available by default and the setting is invalid. Setting example: the current range of the meter is 5A, the analog quantity signal is output by the transmission channel 1, the transmission object is phase current IA, the transmission type is 4-20mA, the upper limit is 100.0%, the lower limit is 0.0%, the calculation of the transmission output value: the upper limit value of the transmission is 5A * 100.0% = 5A; the lower limit value of the transmission is 5A * 0.0% = 0A; When Ia > = 5A, the full range value of output transformer is 20mA; when Ia = 0A, the minimum range value of output transformer is 4mA; when 0 < Ia < 5.0A, the corresponding output transformer value is: (IA * 100.0% - 5A * 0.0%) / (100.0% - 0.0% * 5A) * (20mA-4mA) + 4mA; linear output.
	Sd1L	0.0%～100.0%	AO lower limit 1
	Sd1H	0.0%～100.0%	AO upper limit 1
	Sd2P	26 optional objects in total (see note 1)	AO object 2, The setting method is the same as Sd1P
	Sd2L	0.0%～100.0%	AO lower limit 2
	Sd2H	0.0%～100.0%	AO upper limit 2

Note 1: meaning of DO and AO object setting value, see following table.

DO / AO object		**Corresponding range value for each electric parameter U is voltage, I is current, Urat is voltage rate, Irat is current rate**	
Parameter editor value	**Related electric parameter**	**Upper and lower limit range under 3P4L mode**	**Upper and lower limit range under 3P3L mode**
0	UA	U×UrAt	/
1	UB	U×UrAt	/
2	UC	U×UrAt	/
3	Uab	U×UrAt×1.732	U×UrAt×1.732
4	Ubc	U×UrAt×1.732	/
5	Uca	U×UrAt×1.732	U×UrAt×1.732
6	Ia	I×UrAt	I×IrAt
7	Ib	I×UrAt	/
8	Ic	I×UrAt	I×IrAt
9	Pa	U×UrAt×I×IrAt	/

10	Pb	U×UrAt×I×IrAt	/
11	Pc	U×UrAt×I×IrAt	/
12	Pt	U×UrAt×I×IrAt×3	U×UrAt×I×IrAt×3
13	Qa	U×UrAt×I×IrAt	/
14	Qb	U×UrAt×I×IrAt	/
15	Qc	U×UrAt×I×IrAt	/
16	Qt	U×UrAt×I×IrAt×3	U×UrAt×I×IrAt×3
17	Sa	U×UrAt×I×IrAt	/
18	Sb	U×UrAt×I×IrAt	/
19	Sc	U×UrAt×I×IrAt	/
20	St	U×UrAt×I×IrAt×3	U×UrAt×I×IrAt×3
21	PFA	1	/
22	PFB	1	/
23	PFC	1	/
24	PFT	1	1
25	Hz	65Hz (upper limit of range)－45Hz (lower limit of range)＝20Hz	

The meter can support up to 2 channels DO or 2 channels of AO. Each output channel is set by the channel number menu.
For example, DO1 is set by AL1P, AL1L, and AL1H.

6.Instruction of communication parameter

6.1 This meter provides RS-485 communication interface and Modbus-RTU communication protocol. The parameter information that can be read or modified is as follows:

Address	Parameter name	Parameter description	Data type	Word length	Read-write properties
Menu parameters (actual value of parameter with (*) = communication parameter value × 0.1)					
0000H	rSt.d	The recorded values of demand and maximum and minimum values are reset, and the demand and maximum and minimum values are reset when writing 1	word	1	R/W
0001H	RESERVED	System reserved	word	1	R/W
0002H	Clr.E	Clear electric energy data when writing 1	word	1	R/W
0003H	Disp	0 is off, 1~30 is wheel display time (s)	word	1	R/W
0004H	RESERVED	System reserved	word	1	R/W
0005H	RESERVED	System reserved	word	1	R/W
0006H	Net	Wiring mode, 0 is 3P4L, 1 is 3P3L	word	1	R/W
0007H	Irat	CT ratio	word	1	R/W
0008H	Urat	PT ratio	word	1	R/W
0009H	AL1P	Alarm object 1	word	1	R/W
000AH	AL1L	Alarm lower limit 1	word	1	R/W

000BH	AL1H	Alarm upper limit 1	word	1	R/W
000CH	AL2P	Alarm object 2	word	1	R/W
000DH	AL2L	Alarm lower limit 2	word	1	R/W
000EH	AL2H	Alarm upper limit 2	word	1	R/W
000FH	AL3P	Alarm object 3	word	1	R/W
0010H	AL3L	Alarm lower limit 3	word	1	R/W
0011H	AL3H	Alarm upper limit 3	word	1	R/W
0012H	AL4P	Alarm object 4	word	1	R/W
0013H	AL4L	Alarm lower limit 4	word	1	R/W
0014H	AL4H	Alarm upper limit 4	word	1	R/W
0015H	Sdt	AO specification 0：4～20mA 1：0～20mA 2：0～10mA	word	1	R/W
0016H	Sd1P	AO object 1	word	1	R/W
0017H	Sd1L	AO lower limit 1	word	1	R/W
0018H	Sd1H	AO upper limit 1	word	1	R/W
0019H	Sd2P	AO object 2	word	1	R/W
001AH	Sd2L	AO lower limit 2	word	1	R/W
001BH	Sd2H	AO upper limit 2	word	1	R/W
001CH	Sd3P	AO object 3	word	1	R/W
001DH	Sd3L	AO lower limit 3	word	1	R/W
001EH	Sd3H	AO upper limit 3	word	1	R/W
001FH	Sd4P	AO object 4	word	1	R/W
0020H	Sd4L	AO lower limit 4	word	1	R/W
0021H	Sd4H	AO upper limit 4	word	1	R/W
0022H	Addr	Address 1~247	word	1	R/W
0023H	bAud	Baud rate 0: Choose 1200bps; 1: Choose 2400bps; 2: Choose 4800bps; 3: Choose 9600bps; 4: Choose 19200bps;	word	1	R/W
0024H	Stb	Stop bit 1: Choose 1 Stop bit; 2: Choose 2 Stop bit;	word	1	R/W
0025H～0038H	REV	System reserved	word	1	R/W
Running parameter					

0039H	DO	Switching quantity output state, detailed explanation refers to “6.2 alarming output state”	word	1	R/W
003AH	DI	Switching quantity input state, detailed explanation refers to “6.3 switching quantity input state”	word	1	R
Electric quantity data of secondary side (power factory, frequency and phase angle are same for primary side and secondary side)					
003BH	Ua	Phase A voltage data, unit V (no valide when three-phase three-wire)	word	1	R
003CH	Ub	Phase B voltage data, unit V (no valide when three-phase three-wire)	word	1	R
003DH	Uc	Phase C voltage data, unit V (no valide when three-phase three-wire)	word	1	R
003EH	Uab	Uab line voltage data, unit V	word	1	R
003FH	Ubc	Ubc line voltage data, unit V	word	1	R
0040H	Uca	Uca line voltage data, unit V	word	1	R
0041H	Ia	Ia current data, unit A	word	1	R
0042H	Ib	Ib current data, unit A (no valide when three-phase three-wire)	word	1	R
0043H	Ic	Ic current data, unit A	word	1	R
0044H	Pa	Phase A active power, unit W	word	1	R
0045H	Pb	Phase B active power, unit W (no valide when three-phase three-wire)	word	1	R
0046H	Pc	Phase C active power, unit W	word	1	R
0047H	Pt	Total active power, unit W	word	1	R
0048H	Qa	Phase A reactive power, unit var	word	1	R
0049H	Qb	Phase B reactive power, unit var (no valide when three-phase three-wire)	word	1	R
004AH	Qc	Phase C reactive power, unit var	word	1	R
004BH	Qt	Total reactive power, unit var	word	1	R
004CH	Sa	Phase A apparent power, unit VA	word	1	R
004DH	Sb	Phase B apparent power, unit VA (no valide when three-phase three-wire)	word	1	R
004EH	Sc	Phase C apparent power, unit VA	word	1	R
004FH	St	Total apparent power, unit VA	word	1	R
0050H	PFa	Phase A power factor (no valide when three-phase three-wire)	word	1	R
0051H	PFb	Phase B power factor (no valide when three-phase three-wire)	word	1	R
0052H	PFc	Phase C power factor (no valide when three-phase three-wire)	word	1	R
0053H	PFt	Total power factor	word	1	R
0054H	Freq	Frequency, unit Hz	word	1	R

0055H	PGA	Phase angle between voltage and current of Phase A	word	1	R
0056H	PGB	Phase angle between voltage and current of Phase B	word	1	R
0057H	PGC	Phase angle between voltage and current of Phase C	word	1	R
0058H 0059H	+Ep	Positive active energy	float	2	R
005AH 005BH	-Ep	Reverse active energy	float	2	R
005CH 005DH	+Eq	Positive reactive energy	float	2	R
005EH 005FH	-Eq	Reverse reactive energy	float	2	R
Electric quantity data of primary side (the user can read directly without conversion) (for example, if the user reads R_Ua value is 220.12345, which means the primary voltage Ua is 220.12345V; if the user read R_Ia value is 800.256, which means the primary current Ia is 800.256A.If sets the corrent current ratio, the read data is the actual value of the primary side.)					
0060H 0061H	R_Ua	Phase A voltage data, unit V (no valide when three-phase three-wire)	float	2	R
0062H 0063H	R_Ub	Phase B voltage data, unit V (no valide when three-phase three-wire)	float	2	R
0064H 0065H	R_Uc	Phase C voltage data, unit V (no valide when three-phase three-wire)	float	2	R
0066H 0067H	R_Uab	Uab line voltage data, unit V	float	2	R
0068H 0069H	R_Ubc	Ubc line voltage data, unit V	float	2	R
006AH 006BH	R_Uca	Uca line voltage data, unit V	float	2	R
006CH 006DH	R_Ia	Phase A current data, unit A	float	2	R
006EH 006FH	R_Ib	Phase B current data, unit A (no valide when three-phase three-wire)	float	2	R
0070H 0071H	R_Ic	Phase C current data, unit A	float	2	R
0072H 0073H	R_Pa	Phase A active power, unit W	float	2	R
0074H 0075H	R_Pb	Phase B active power, unit W (no valide when three-phase three-wire)	float	2	R
0076H 0077H	R_Pc	Phase C active power, unit W	float	2	R

0078H 0079H	R_Pt	Total active power, unit W	float	2	R
007AH 007BH	R_Qa	Phase A reactive power, unit var	float	2	R
007CH 007DH	R_Qb	Phase B reactive power, unit var (no valide when three-phase three-wire)	float	2	R
007EH 007FH	R_Qc	Phase C reactive power, unit var	float	2	R
0080H 0081H	R_Qt	Total reactive power, unit var	float	2	R
0082H 0083H	R_Sa	Phase A apparent power, unit VA	float	2	R
0084H 0085H	R_Sb	Phase B apparent power, unit VA (no valide when three-phase three-wire)	float	2	R
0086H 0087H	R_Sc	Phase C apparent power, unit VA	float	2	R
0088H 0089H	R_St	Total apparent power, unit VA	float	2	R
008AH 008BH	R_+Ep	Primary side positive active electric energy	float	2	R
008CH 008DH	R_-Ep	Primary side reverse active electric energy	float	2	R
008EH 008FH	R_+Eq	Primary side positive reactive electric energy	float	2	R
0090H 0091H	R_-Eq	Primary side reverse reactive electric energy	float	2	R
Harmonic parameter (% symbol is percentage, for example, data 123 stands for 12.3%, keep a decimal precision)					
0092H~00AFH	Hua2~ Hua31	Phase A voltage 2~31 times harmonic containing rate (%)	word	1	R
00B0H~00CDH	Hub2~ Hub31	Phase B voltage 2~31 times harmonic containing rate (%)	word	1	R
00CEH~00EBH	Huc2~ Huc31	Phase C voltage 2~31 times harmonic containing rate (%)	word	1	R
00ECH~0109H	Hia2~ Hia31	Phase A current 2~31 times harmonic containing rate (%)	word	1	R
010AH~0127H	Hib2~ Hib31	Phase B current 2~31 times harmonic containing rate (%)	word	1	R
0128H~0145H	Hic2~ Hic31	Phase C current 2~31 times harmonic containing rate (%)	word	1	R
0146H	THDUa	Phase A voltage total harmonic containing rate (%)	word	1	R

0147H	THDUb	Phase B voltage total harmonic containing rate (%)	word	1	R
0148H	THDUc	Phase C voltage total harmonic containing rate (%)	word	1	R
0149H	THDIa	Phase A current total harmonic containing rate (%)	word	1	R
014AH	THDIb	Phase B current total harmonic containing rate (%)	word	1	R
014BH	THDIc	Phase C current total harmonic containing rate (%)	word	1	R
014CH	THFUa	Phase A voltage total harmonic factor (%)	word	1	R
014DH	THFUb	Phase B voltage total harmonic factor (%)	word	1	R
014EH	THFUc	Phase C voltage total harmonic factor (%)	word	1	R
014FH	THFIa	Phase A current total harmonic factor (%)	word	1	R
0150H	THFIb	Phase B current total harmonic factor (%)	word	1	R
0151H	THFIc	Phase C current total harmonic factor (%)	word	1	R
0152H	THDUa_odd	Phase A voltage total odd harmonic containing rate (%)	word	1	R
0153H	THDUa_even	Phase A voltage total even harmonic containing rate (%)	word	1	R
0154H	THDUb_odd	Phase B voltage total odd harmonic containing rate (%)	word	1	R
0155H	THDUb_even	Phase B voltage total even harmonic containing rate (%)	word	1	R
0156H	THDUc_odd	Phase C voltage total odd harmonic containing rate (%)	word	1	R
0157H	THDUc_even	Phase C voltage total even harmonic containing rate (%)	word	1	R
0158H	THDIa_odd	Phase A current total odd harmonic containing rate (%)	word	1	R
0159H	THDIa_even	Phase A current total even harmonic containing rate (%)	word	1	R
015AH	THDIb_odd	Phase B current total odd harmonic containing rate (%)	word	1	R
015BH	THDIb_even	Phase B current total even harmonic containing rate (%)	word	1	R
015CH	THDIc_odd	Phase C current total odd harmonic containing rate (%)	word	1	R
015DH	THDIc_even	Phase C current total even harmonic containing rate (%)	word	1	R
Voltage crest factor, current K factor (retain two decimals precision, for example, 141 stands for 1.41)					
015EH	CFua	Phase A voltage crest factor	word	1	R
015FH	CFub	Phase B voltage crest factor	word	1	R
0160H	CFuc	Phase C voltage crest factor	word	1	R

0161H	KFIa	Phase A current K factor	word	1	R
0162H	KFIb	Phase B current K factor	word	1	R
0163H	KFIc	Phase C current K factor	word	1	R
Three-phase unbalance degree and sequence components (% symbol is percentage, for example, data 456 stands for 45.6%, keep a decimal precision; positive negative zero sequence voltage and current data conversion way is same as the way of *secondary electric quantity data*)					
0164H	εU2	Voltage negative sequence unbalance degree (%)	word	1	R
0165H	εI2	Current negative sequence unbalance degree (%)	word	1	R
0166H	εU0	Voltage zero sequence unbalance degree (%)	word	1	R
0167H	εI0	Current zero sequence unbalance degree (%)	word	1	R
0168H	Up	Positive sequence voltage	word	1	R
0169H	Un	Negative sequence voltage	word	1	R
016AH	Uz	Zero sequence voltage	word	1	R
016BH	Ip	Positive sequence current	word	1	R
016CH	In	Negative sequence current	word	1	R
016DH	Iz	Zero sequence current	word	1	R
Three-phase voltage current average value, three-phase current summation (data conversion way is same as the way of *secondary electric quantity data*)					
016EH	Uavg	Three-phase voltage average value	word	1	R
016FH	Iavg	Three-phase current average value	word	1	R
0170H	Isum	Three-phase current summation	word	1	R
Demand, maximum and minimum value (maximum demand cycle is 15 minutes, sliding time is 1 minute, data conversion way is same as the way of *secondary electric quantity data*)					
0171H	CDa	Phase A active current demand	word	1	R
0172H	CDb	Phase B active current demand	word	1	R
0173H	CDc	Phase C active current demand	word	1	R
0174H	CDt	Total active current demand	word	1	R
0175H	MDa	Phase A active maximum demand	word	1	R
0176H	MDb	Phase Bactive maximum demand	word	1	R
0177H	MDc	Phase C active maximum demand	word	1	R
0178H	MDt	Total active maximum demand	word	1	R
0179H	Ua-Max	Phase A voltage maximum value	word	1	R
017AH	Ua-Min	Phase A voltage minimum value	word	1	R
017BH	Ub-Max	Phase B voltage maximum value	word	1	R
017CH	Ub-Min	Phase B voltage minimum value	word	1	R
017DH	Uc-Max	Phase C voltage maximum value	word	1	R

017EH	Uc-Min	Phase C voltage minimum value	word	1	R
017FH	Ia-Max	Phase A current maximum value	word	1	R
0180H	`Ia-Min	Phase A current minimum value	word	1	R
0181H	Ib-Max	Phase B current maximum value	word	1	R
0182H	Ib-Min	Phase B current minimum value	word	1	R
0183H	Ic-Max	Phase C current maximum value	word	1	R
0184H	Ic-Min	Phase C current minimum value	word	1	R
0185H	Pt-Max	Total power maximum value	word	1	R
0186H	Pt-Min	Total power minimum value	word	1	R
0187H～0189H	REV	System reserved	word	1	R
System clock, standby energy metering, time-sharing energy metering, electric energy statistics of last month (The following categories are only supported when the corresponding functions are selected,) When the user opens the backup power metering enable menu and the external DI is short-circuited, the instrument will switch to the backup power metering, and the main power metering and time-sharing metering will stop. The following data are electric energy data at the primary side, without conversion.					
018AH	Year	Current year	word	1	R
018BH	Month	Current month	word	1	R
018CH	Day	Current day	word	1	R
018DH	Hour	Current hour	word	1	R
018EH	Minute	Current minute	word	1	R
018FH	Second	Current second	word	1	R
0190H	CoreTemp	Core temperature of meter	word	1	R
0191H	REV	System reserved	word	1	R
0192H	bkEP	Standby positive active energy	float	2	R
0193H					
0194H	-bkEP	Standby reverse active energy	float	2	R
0195H					
0196H	bkEQ	Standby positive reactive energy	float	2	R
0197H					
0198H	-bkEQ	Standby reverse reactive energy	float	2	R
0199H					
019AH	t1_EP	Active energy of tariff 1	float	2	R
019BH					
019CH	t2_EP	Active energy of tariff 2	float	2	R
019DH					
019EH	t3_EP	Active energy of tariff 3	float	2	R
019FH					
01A0H	t4_EP	Active energy of tariff 4	float	2	R
01A1H					
01A2H	LastMt1_EP	Active energy of tariff 1 last month	float	2	R
01A3H					
01A4H	LastMt2_EP	Active energy of tariff 1 last month	float	2	R
01A5H					
01A6H	LastMt3_EP	Active energy of tariff 1 last month	float	2	R

01A7H					
01A8H	LastMt4_EP	Active energy of tariff 1 last month	float	2	R
01A9H					
01AAH	LastM_EP	Active energy last month	float	2	R
01ABH					
Deviation value, load rate and phase angle (the frequency deviation value retains 2-bit accuracy, for example, 123 represents the deviation value of 1.23Hz, the% symbol is percentage data, and retains 1-bit accuracy, for example, - 23 represents the deviation value of -2.3%, and the phase angle retains 1-bit accuracy, for example, 1200 represents the angle of 120.0 degrees.)					
01ACH	dFrq	Frequency deviation value (Hz)	word	1	R
01ADH	dUa	UA deviation (%)	word	1	R
01AEH	dUb	UB deviation (%)	word	1	R
01AFH	dUc	UC deviation (%)	word	1	R
01B0H	dUab	UAB deviation (%)	word	1	R
01B1H	dUbc	UBC deviation (%)	word	1	R
01B2H	dUca	UCA deviation (%)	word	1	R
01B3H	LF	Load factor (%)	word	1	R
01B4H	PHUa	UA phase angle	word	1	R
01B5H	PHUb	UB phase angle	word	1	R
01B6H	PHUc	UC phase angle	word	1	R
01B7H	PHIa	IA phase angle	word	1	R
01B8H	PHIb	IB phase angle	word	1	R
01B9H	PHIc	IC phase angle	word	1	R

Note: 1. write 1 will clear the total energy

2. the product of voltage ratio and current ratio shall not exceed 100000, or else, it will cause part data display overflow
3. float stands for floating-point type of 4 bytes
4. the actual value of parameters with * mark = communication parameter value X 0.1
5. when use the remote control mode, the user should set ALxL as the minimum value 0, set ALxH as the maximum value 1500. At this time, the upper and lower limit alarm will not tripper the relay to operate. Then deliver the right of control to the upper computer, when the upper computer write 1 to the corresponding upper limit or lower limit of DO byte of meter, the related relay will close.

6.2 Alarming output state

DO high byte：

BIT15	BIT14	BIT13	BIT12	BIT11	BIT10	BIT9	BIT8
-	-	-	-	-	-	-	-

DO low byte:

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
DO4 upper alarm	DO4 lower alarm	DO3 upper alarm	DO3 lower alarm	DO2 upper alarm	DO2 lower alarm	DO1 upper alarm	DO1 lower alarm

Bits 0-7 respectively indicate the alarm status, output '0' indicates no alarm, and '1' indicates an alarm

6.4 Energy data conversion

Integer electric quantity ready by communication is secondary side data, negative number will be showed by complement code, specific conversion way refers to the following table.

Parameter name	Conversion formula	Unit	Object
Voltage	U = URMSx(x=a、b、c)×Urat×0.1	V	Ua,Ub,Uc,Uab,Ubc,Uca
Current	I = IRMSx(x=a、b、c)×Irat×0.001	A	Ia,Ib,Ic
Active power	P = Px(x=a、b、c)×Urat×Irat	W	Pa,Pb,Pc
Reactive power	Q = Qx(x=a、b、c)×Urat×Irat	var	Qa,Qb,Qc
Apparent power	S = Sx(x=a、b、c)×Urat×Irat	VA	Sa,Sb,Sc
Total active power	P = Pt×Urat×Irat	W	Pt
Total Reactive power	Q = Qt×Urat×Irat	var	Qt
Total Apparent power	S = St×UrAt×IrAt	VA	St
Power factor	PF = PFx(x=a、b、c、t)×0.001		PFa,PFb,PFc,PFt
frequency	F = Freq×0.01	Hz	F
Angle between voltage and current	φ= PGx(x=a、b、c)×0.1	°(degree)	PGA,PGB,PGC

To ensure the data precision under bigger current ratio, the meter has provided the electric quantity data of primary side, showed by IEEE754.32 digit floating-point number. Primary side data has already included the current ratio, so the user doesn't need to convert.

7.Precaution

7.1 before power on, please reconfirm whether the meter power supply, input signal are within the scope of use, and whether the wiring of each terminal is correct and reliable.

7.2 do not touch the terminal after the meter is powered on.

7.3 the meter shall not be knocked, collided and vibrated violently, and the use environment shall meet the technical requirements.

Appendix A communication protocol

A.1 Communication format

The information is transmitted asynchronously and in bytes. The communication information between the host and the slave is in 11 bit word format, including 1 start bit (0), 8 data bits and 2 stop bits (1).

Message frame format:

Table A.1

Start	Address code	Function code	Data area	CRC code	End
Pause time greater than 3.5 bytes	1 byte	1 byte	n byte	2 bytes	Pause time greater than 3.5 bytes

A.2 Communication information transmission process

When the communication command is sent from the host to the slave, the slave that matches the address code sent by the host receives the communication command. If the CRC check is correct, perform the corresponding operation, and then return the execution result (data) to the host. The returned information includes address code, function code, executed data and CRC check code. If there is an error in CRC verification, no information is returned.

A.2.1 Address code

The address code is the first byte of each communication information frame, from 1 to 247. Each slave must have a unique address code in the bus. Only the slave that matches the address code sent by the host can respond to the returned information. When the slave sends back information, the return data starts with their respective address codes. The address code sent by the host indicates the slave address to be sent, and the address code returned by the slave indicates the slave address to be returned. The corresponding address code indicates where the information comes from.

A.2.2 Function code

The second byte of each communication information frame. The host sends the function code to tell the slave what to do. The slave responds. The function code returned from the slave is the same as the function code sent from the host, indicating that the slave has responded to the host and performed relevant operations.

The meter supports the following two function codes:

Table A.2

Function code	Definition	Operation
03H	Read multiple register	Read data from one or more registers
10H	Write multiple registers	Write n 16 bit binary data to n continuous registers

A.2.3 Data area

Data area varies with function code. These data can be numeric values, reference addresses, etc. For different slave device, the address and data information are different, and the communication information table should be given.

The host can read and modify the slave data register at will by using the communication commands (function codes 03H and 10H). The length of data read or written at one time shall not exceed the valid range of data register address.

A.3 Function code introduction

A.3.1 Function code 03H：Read multiple register

For example, if the master wants to read two register data with slave address 01h and start register address 0ch, the master will send:

Table A.3

Host send		Messages sent
Address code		01H
Function code		03H
Start register address	High byte	00H
	Low byte	0CH
Number of registers	High byte	00H
	Low byte	02H
CRC code	Low byte	04H
	High byte	08H

If the data of the slave registers 0CH and 0DH are 0000H and 1388H, the slave returns:

Table A.4

Slave return		Information returned
Address code		01H
Function code		03H
Number of bytes		04H
Register 0CH data	High byte	00H
	Low byte	00H
Register 0DH data	High byte	13H
	Low byte	88H
CRC code	Low byte	F7H
	High byte	65H

A.3.2 Function code 10H: write multiple registers

For example, the host should save data 0002H, 1388H and 000AH to three registers with slave address 01H and start register address 00H.

Host send frame：

Table A.5

Host send		Messages sent
Address code		01H
Function code		10H
Start register address	High byte	00H
	Low byte	00H
Number of registers	High byte	00H
	Low byte	03H
Number of bytes		06H
00H register data to be written	High byte	00H
	Low byte	02H
01H register data to be written	High byte	13H
	Low byte	88H
02H register data to be written	High byte	00H
	Low byte	0AH
CRC code	Low byte	9BH
	High byte	E9H

Slave return frame：

Table A.6

Slave return		Information returned
Address code		01H
Function code		10H
Start register address	High byte	00H
	Low byte	00H
Number of registers	High byte	00H
	Low byte	03H
CRC code	Low byte	80H
	High byte	08H

A.4 16-bit CRC code

The host or slave can use the check code to judge whether the received information is correct. Due to electronic noise or some other interference, information may be wrong in the transmission process. The check code can check whether the communication information of the host or the slave is wrong.

The 16-bit CRC check code is calculated by the host and placed at the end of the transmitted information frame. The slave recalculates the CRC of the received information, and compares whether the calculated CRC is consistent with the received CRC. If not, it indicates an error. Only 8 data bits are used in CRC calculation, and neither start bit nor stop bit is involved in CRC calculation.

CRC code computing method

1) The preset 16 bit register is hexadecimal FFFF(i.e. all 1), which is called CRC register;

2) The first 8-bit binary data (the first byte of communication information frame) is different from the lower 8 bits of the 16 bit CRC register or the result is placed in the CRC register;

3) Move the contents of CRC register to the right one bit (towards the low position) and fill the highest position with 0, and check the shift out position after the right shift;

4) If the move out position is 0: repeat step 3) (move right again);

If the shift out bit is 1: the CRC register is XOR with the polynomial A001 (1010 0000 0000 0001);

5) Repeat steps 3) and 4) until it is shifted 8 times to the right, so that the whole 8-bit data is processed;

6) Repeat step 2) to step 5) to process the next byte of the communication information frame;

7) After all bytes of the communication information frame (excluding CRC check code) are calculated as per the above steps, the CRC register content obtained is: 16 bit CRC check code.

A.5 Error handling

When the meter detects any error other than CRC code error, it will send back information to the host. The highest position of the function code is 1, the function code returned from the slave to the host is based on the function code sent by the host plus 128. The format of the error message frame returned by the slave is as follows:

Table A.7

Address code	Function code（The highest bit is 1）	Error code	CRC code low byte	CRC code high byte
1 byte	1 byte	1 byte	1 byte	1 byte

The error code as follows：

Table A.8

01H	Illegal function code	Function code meter received does not support
02H	Illegal register address	The received register address is out of the register address range of the meter
03H	Illegal data value	The received data value is out of the data range of the corresponding address