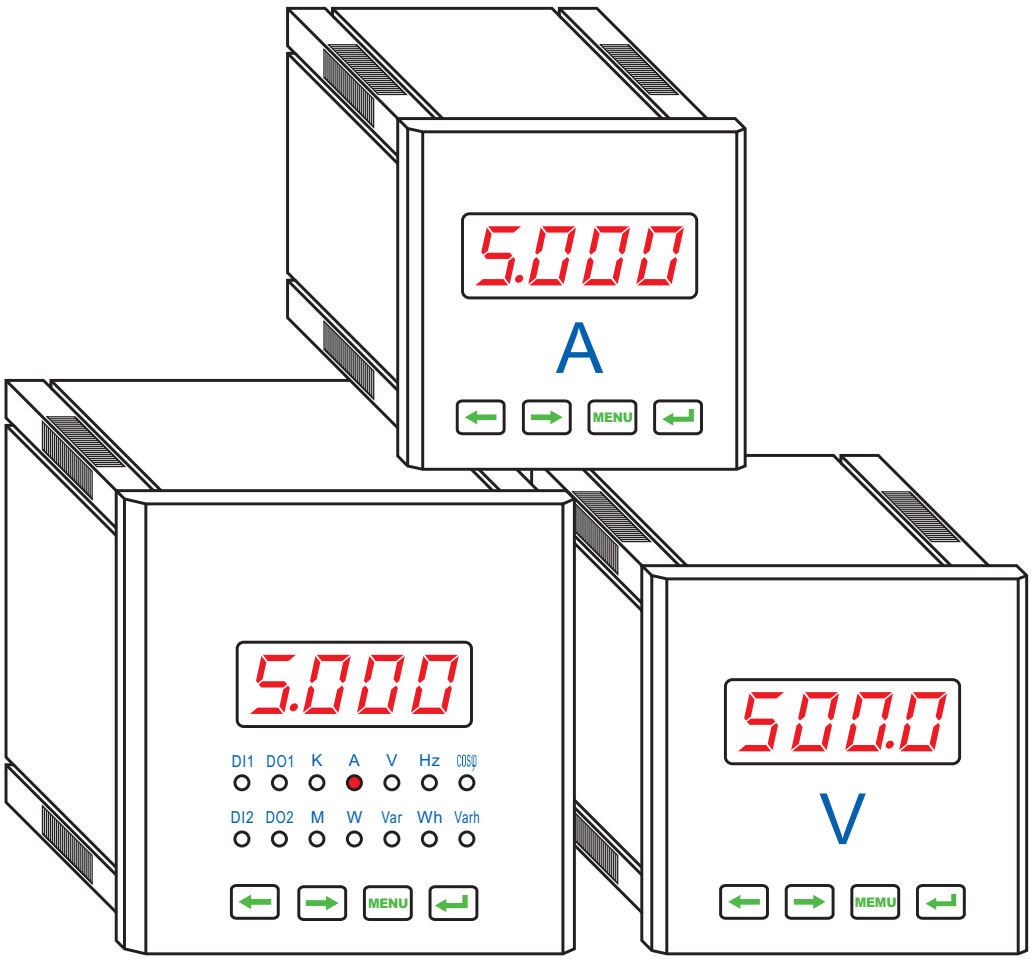
Multifunctional Power Instrument

Extended Function Series Meter



Operational Instruction Manual

Multifunctional Power Instrument
Extended Function Series Meter

Please read through the manual before installment and operation

Chapter 1. General Introduction

Multifunctional power instrument (instrument for short below) is specifically designed and made for the electrical monitoring requirement of power distribution system. It is with high-precision measurement all of the common electrical parameters including of single-phase voltage, current, active power, reactive power, frequency, power factor and energy etc;Long-life LED display the instrument measuring parameters ; RS485 communication interface, applying MODBUS_RTU communication protocol; with four programmable keys on the instrument panel,convenient switch, programmable setting of instrument parameters with great flexibility.

Many kinds of extended function modules for choosing: one-channel analog quantity (0~20mA/4~20mA)output can realize the transmitting output function of electrical quantity; two-channel switching value input and two-channel switching value output to realize the local or long-range switch signal monitoring and control output function (function of“ remote signaling” and “ remote control”).The instrument can directly replace conventional power transmitter, measuring indicating instrument, electric energy measuring instrument and the related auxiliary unit. With modular structural design, users can choose the most economical functional configuration according to the actual requirement, which is highly cost-effective.

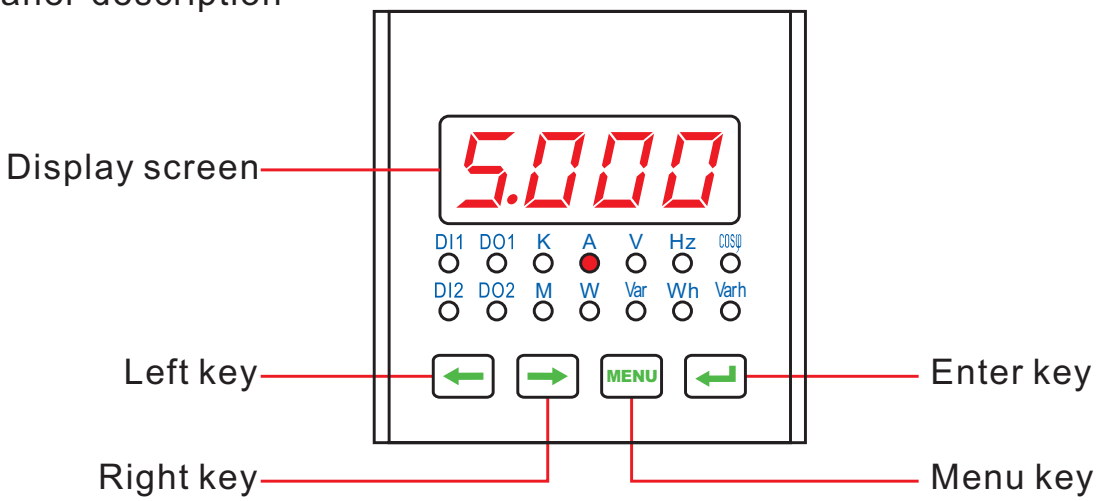
Chapter 2. Technical Parameters

Technical parameters			Index
Input	Net work		Single phase
	Voltage	Rated value	AC 0~500V
		Over load	Consistent:1.2 times instantaneous:2 times /30s
		Comsumption	<0.5VA(each phase)
		Impedance	>500kΩ
	Current	Rated value	AC 1A, 5A
		Over load	Consistent:1.2 times instantaneous:2 times /1s
		Impedance	<2mΩ
	Frequency		45~65Hz

Output	Communication	Output mode	RS485
		Protocol	MODBUS_RTU
		Baud rate	1200,2400,4800, 9600
	Analog quantity	Channel quantity	1 channels
		Output mode	0~20mA, 4~20mA
		Load ability	≤400Ω
	Switching value	Channel quantity	2 channels
		Output mode	Normally open relay contact output
		Contact capability	AC 250V/5A, DC 30V/5A
	Switching value input		2 channels
	Display mode		LED(Red)
Measuring accuracy	Voltage, current		±(0.5%FS+one digit)
	Active power, reactive power		±(0.5%FS+one digit)
	Frequency		±0.1Hz
	Power factor		±0.01PF
	Active energy		±0.5%(only for reference, not for meterage)
	Reactive energy		±1.0%(only for reference, not for meterage)
Sourse	Scope		AC 220V,50/60Hz
	Consumption		<5VA
Safety	Withstand voltage	Input and sourse	>2kv50Hz/1min
		Input and output	>1kv50Hz/1min
		Output and sourse	>2kv50Hz/1min
	Insulating resistance		Any two of input, output, source, casing>20MΩ
Environment	Temperature		Operation : -10~50°C
			Storage : -25~70°C
	Humidity		≤85%RH，free of wet and corrosive gas
	Elevation		≤3000m

Chapter 3. Program and usage

3.1 Panel description



3. 2 Description of key function

Left key: Under the programming mode. it is used for progressive decrease of parameter value or inter the previous menu. Under the measuring display mode, it is used to enter the previous display mode.

Right key:Under the programming mode.it is used for degressive increase of parameter value or inter the next menu.Under the measuring display mode,it is used to enter the next display mode.

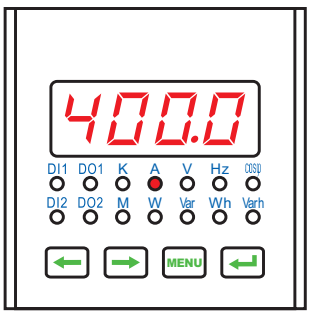
MENU Menu key:under the measuring display status,press this key to enter the program mode.After input the correct password(factory password: 0001)"Code" prompted by the instrument,it is capable of programming and setting.Under the programming mode,it is used to return to previous menu with storing parameters.

Enter key:Under the programming mode,it is used to return to the previous menu when choosing the menu items.The instrumen willing display"SAVE" when it return to the measuring display mode from the programming mode,then press the Enter key to save and qiut.

3.3 Description of display mode

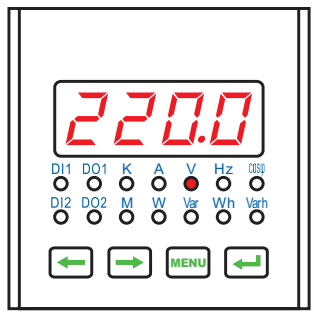
Through programming on the “diSP”parameters of the menu, it can choose one of the eight display modes and also can manually switch the display modes by “Right key” or “Left key”. “diSP” value display mode: 1: current; 2: voltage;

3：frequencyr；4：power factor；5：active power；6：reactive power；7：active electric energy, 8：reactive electric energy；0：automatically cyclic display.



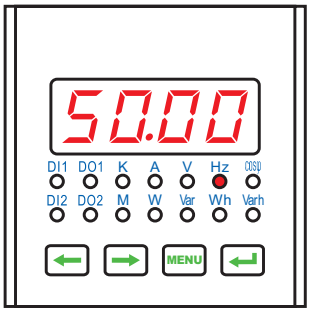
diSP=1

The left picture shows:
Current：400.0A



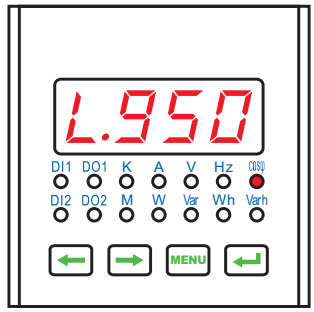
diSP=2

The left picture shows:
Voltage：220. 0V



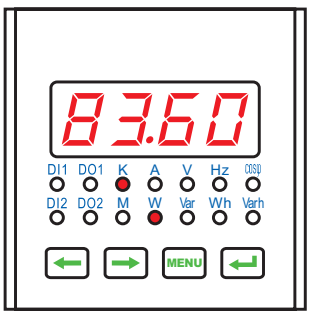
diSP=3

The left picture shows:
Frequency：50.00Hz



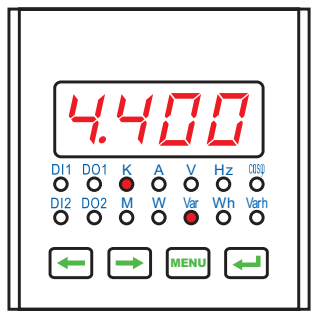
diSP=4

The left picture shows:
Power factor：0.950



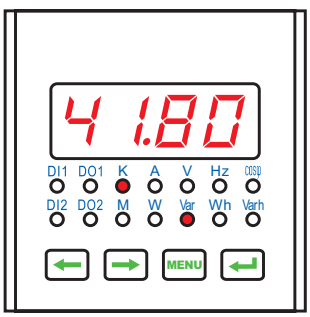
diSP=5

The left picture shows:
Active power：83.60KW



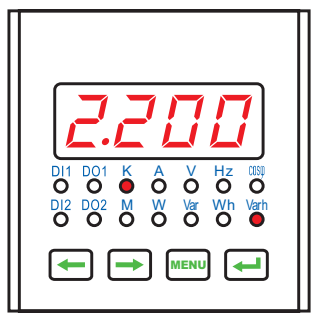
diSP=6

The left picture shows:
Reactive power：4.400KVar



diSP=7

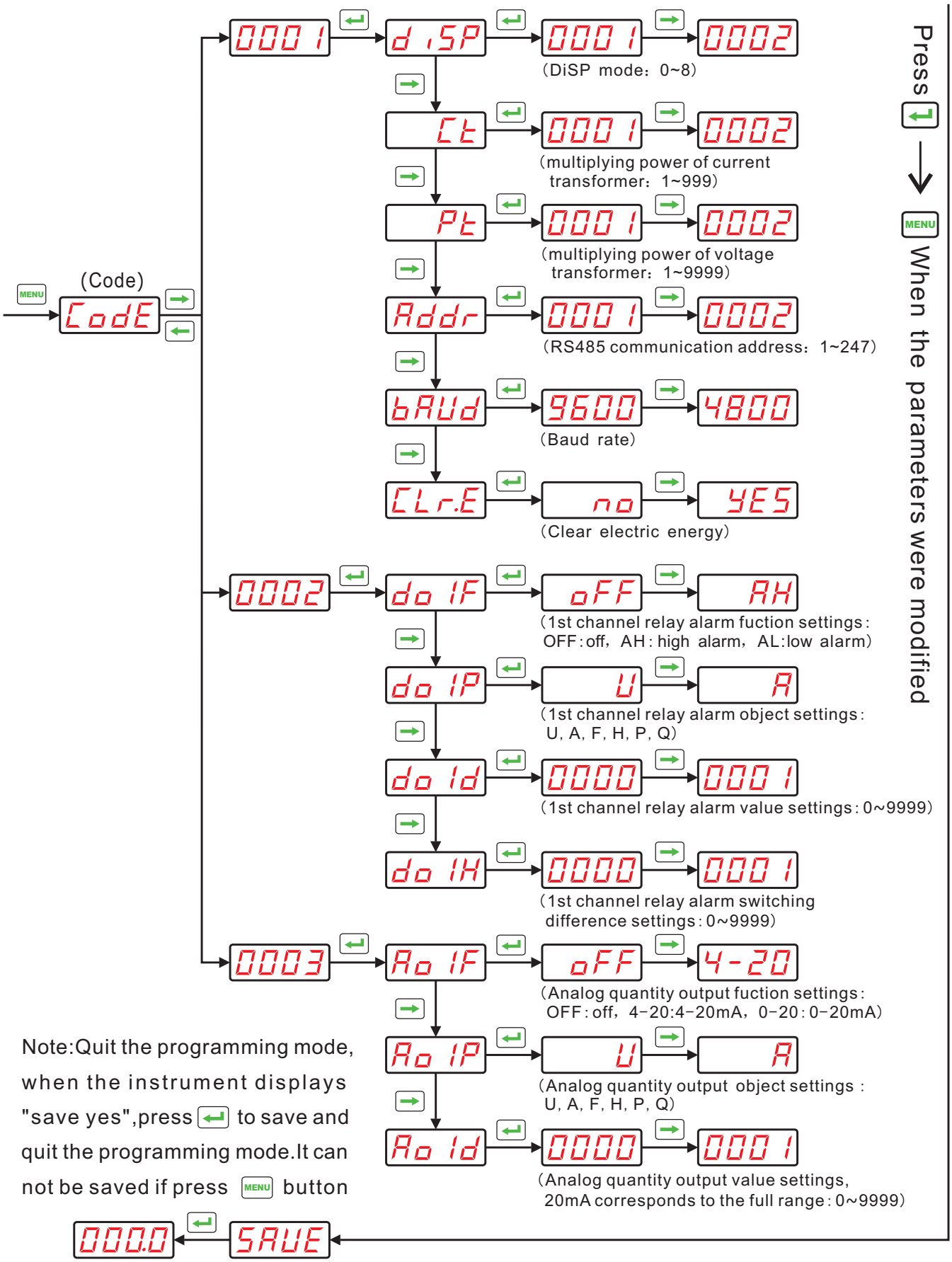
The left picture shows:
Active energy：41.80MWh



diSP=8

The left picture shows:
Reactive energy：2.200MVarh

3.4 Menu framework



Note:Quit the programming mode, when the instrument displays "save yes",press ↵ to save and quit the programming mode.It can not be saved if press MENU button

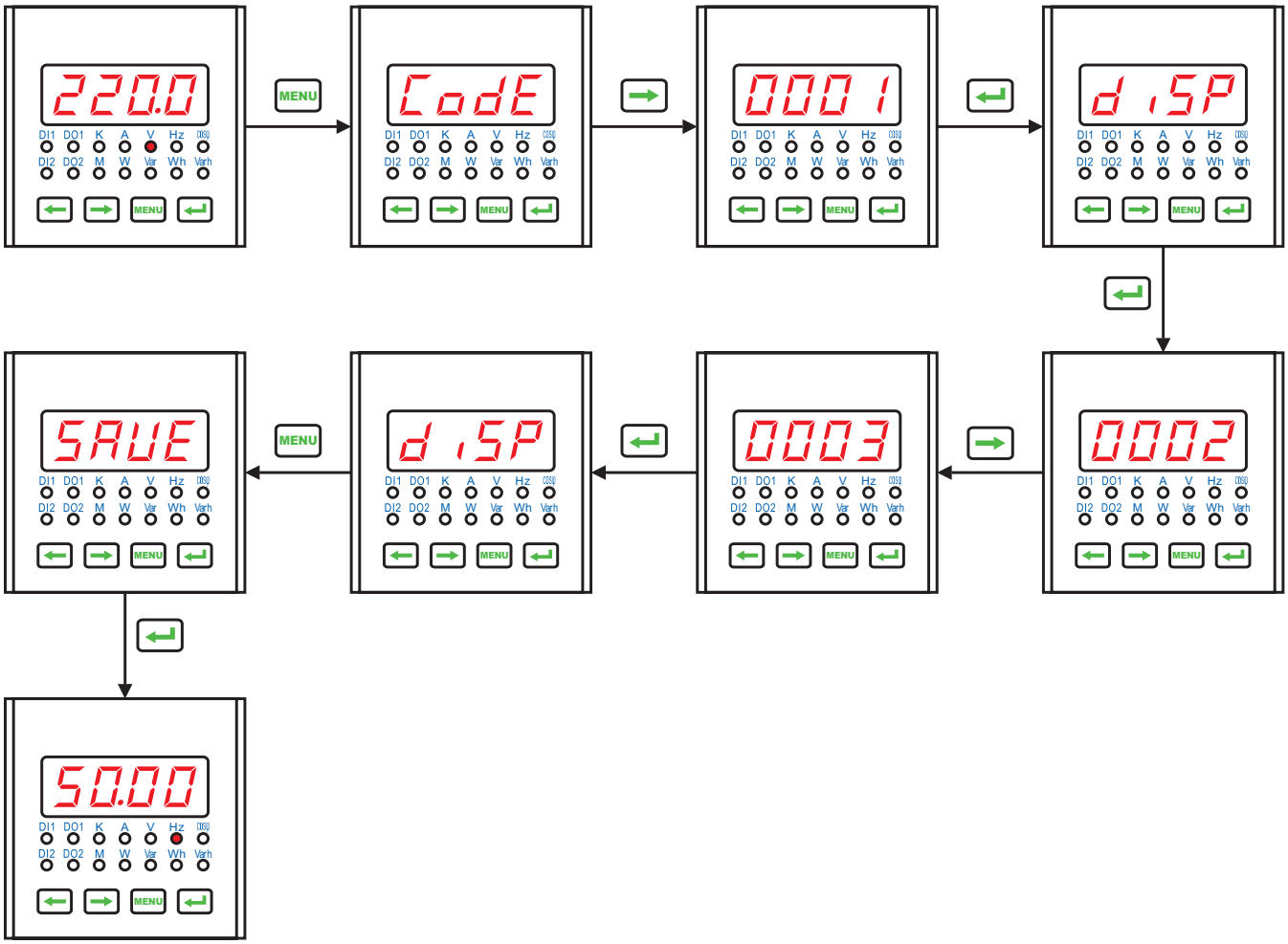
3.5 Menu significations

Menu	Parameter	Description
CodE	0001 0002 0003	Signal input and Communication code:**0001**; Switching value output code:**0002**;Annlog quantity output:**0003**.
d.SP	0~8	Select display mode “diSP”
Ct	1~9999	Set multiplying power of current transformer (Primary value/second value of current transformer)
Pt	1~9999	Set multiplying power of voltage transformer (Primary value/second value of voltage transformer)
Addr	1~247	Set RS485 communication address “Addr”
bAUd	1200,2400 4800,9600	Select communication baud rate“bAud”:1200,2400,4800 or 9600
CLr.E	YES/NO	Pressing“ Enter key”to clear the electric energy data
do 1F	OFF AH AL	1st channel relay alarmt fuction settings: OFF:off，AH:high alarm，AL:low alarm
do 1P	U, A, F, H, P, Q	1st channel relay alarm object settings:U:voltage, A:current, F:frequency, H:power factor, P:active power, Q:reactive power
do 1d	0~9999	1st channel relay alarm value setting:0~9999
do 1H	0~9999	1st channel relay alarm switching difference setting:0~9999（Set the alarm switchingdifference to avoid the continuous action of alarm output when the meter is at the critical status of alarm）
do2F	OFF AH AL	2nd channel relay alarmt fuction settings: OFF:off，AH:high alarm，AL:low alarm
do2P	U, A, F, H, P, Q	2nd channel relay alarm object settings:U:voltage, A:current, F:frequency, H:power factor, P:active power, Q:reactive power
do2d	0~9999	2nd channel relay alarm value setting:0~9999
do2H	0~9999	2nd channel relay alarm switching difference setting:0~9999（Set the alarm switchingdifference to avoid the continuous action of alarm output when the meter is at the critical status of alarm）
Ao 1F	OFF 4~20mA 0~20mA	Analog quantity output fuction settings: OFF:off，4-20:4-20mA，0-20:0-20m
Ao 1P	U, A, F, H, P, Q	Analog quantity output object settings :U:voltage, A:current, F:frequency, H:power factor, P:active power, Q:reactive power
Ao 1d	0~9999	Analog quantity output value settings, 20mA corresponds to the full range:0~9999

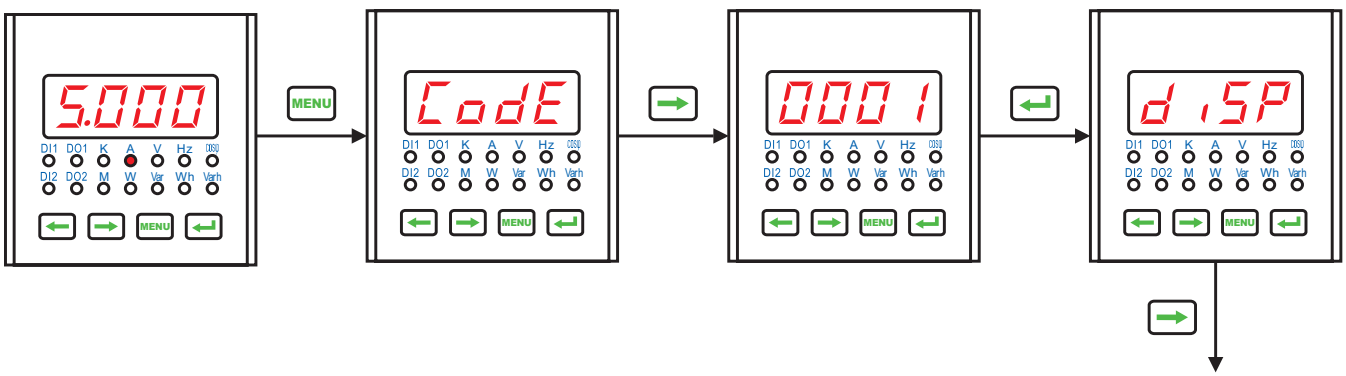
3.6 Programming operation examples

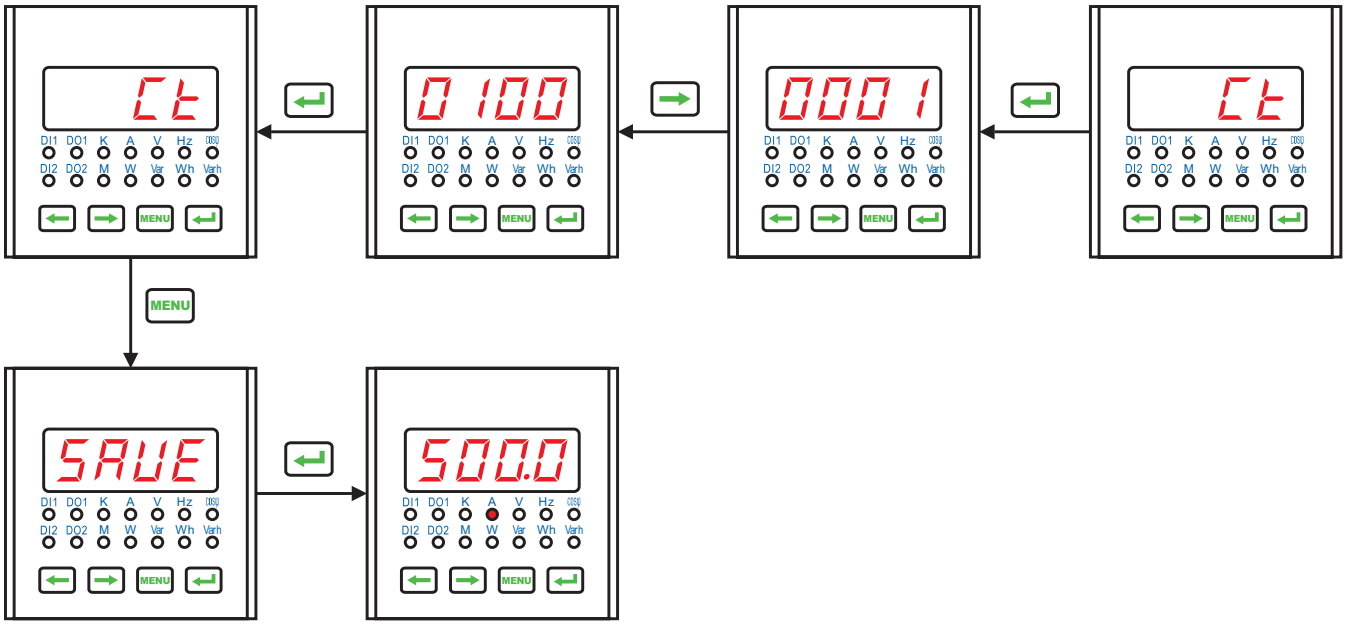
The measuring range of instruments has been set as the same parameters provided by users at the factory. Users should check if the input network and measuring range are consistent with the actual input again before use.

3.6.1 Set display mode, change the display mode from voltage(diSP=2) to frequency(diSP=3).



3.6.2 set multiplying power of current transformer is 100(CT 500A/5A)





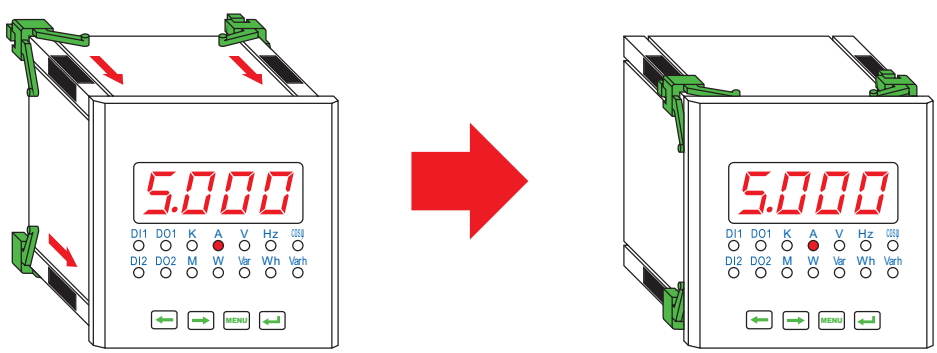
Chapter 4. Installment and wiring

4.1 Shape and cutout hole dimension(unit：mm)

Shape	Panel dimension		Case dimension			Cutout hole dimension	
	W	H	W	H	D	W	H
120×120Square	120	120	110	110	83	112	112
96×96Square	96	96	90	90	83	92	92
96×48Rectangular	96	48	90	44	83	92	45
80×80Square	80	80	74	74	83	76	76
72×72Square	72	72	66	66	83	68	68
48×48Square	48	48	44	44	73	45	45

4.2 Method of installation

Choose the corresponding hole cutout dimension from the table above , make a hole in the installation screen, insert the instruments into the hole, place the four clamping pieces into the clamping holder and push and tighten them by hand.



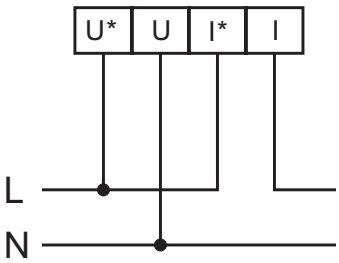
4.3 Wiring instructions

4.3.1 Terminal arrangement and function declaration of instrument(please accord to the one of instrument case)

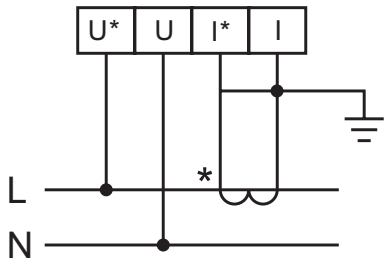
Auxiliary power supply (POWER): AC 220V,50/60Hz(Can customize other values)

Electrical quantity signal input : I* is current live wire. When the voltage is higher than the rated input voltage of the product,you should consider of using PT and installing fuse of 1A at the voltage input port; while the current is higher than rated input current of the product, you should consider of using the exterior CT

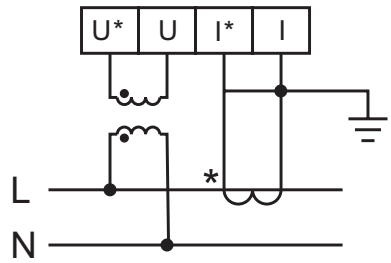
4.3.2 Typical connection



Voltage≤600V,input directly
Current≤5A,input directly



Voltage≤600V,input directly
Current>5A,input via CT



Voltage>600V,input via PT
Current>5A,input via CT

4.3.3 RS485 communication connection

The instrument supplies a RS485 communication interface and applies MODBUS_RTU communication protocol . Up to thirty-two instrument can be connected in one communication line at one time. Each instrument should have the only communication address in the circuitry. Communication connection should use the shielded twisted paired with copper mesh, whose diameter should be not less than 0.5mm. Communication line should be far away from the high-voltage cables or other highfield environment and the maximum transmission distance is 1200 m. The typical network connections are shown in the following figure and users can choose other suitable connect mode under specific conditions.

4.3.4 Switching value input(DI input):DI1~DI2 are 1~2 way dry contact input port, inside of the instrument there is power supply of +5V.

4.3.5 Switching output and ananlog transmitting output: can support two-channel switching value output and one-channel analog transmitting output.

Chapter 5. Communication protocol

5.1 This series instrument are provided with Rs485 communication interface and apply MODBUS_RTU communication protocol.

Start	Address code	Function code	Data sector	CRC code	End
Halt time more than three bytes	1byte	1byte	Nbyte	2byte	Halt time more than three bytes

5.2 Communication message transmitting process

When communication instructions transmit from master device to slave device, the slave device with corresponding address code receives communication orders and reads the massage according to functional code and relational requirements. After successful CRC verification without error, the corresponding operation will be conducted and the result (data), including address code, function code,data after execution and CRC verification code, is returned to the master device. In case of CRC verification failure, no message would be returned.

5.2.1 Address code:

Address code is the first byte (8 bits) of each communication message frame, from 1 to 247. Every slave device must have the only address code and only the slave device conforming to the address code can respond and return the message. When the slave device returns the message, all of the return data start with each address code. The address code sent by master device shows the receiving address of slave device, while the address code returned by slave device shows the returning slave address. The responding address code shows where the message comes from.

5.2.2 Function code

Function code is the second byte of each communication message frame. The master device sends and tells that what operation the slave device should carry out by means of function code. Then the slave device responds. The functional code returned by slave device is the same as the one sent by master device, which shows that slave device has responded the master device and carry out the relational operation. The instrument supports three function codes as following:

Function code	Definition	Operation
03H	Read register	Read data of one or multiple resigister

5.2.3 Data sector

Data sector are different following the different function code. These data could be numerical value, reference address and so on. For different slave device, the address and data information are different (There should be communication information table). The master device utilizes the communication order (Function code03H) to read and amend the data register of the slave device. The data length read out or written in should not exceed the effective range of the data register address once.

5.3 16-bit CRC verification code . Algorithm of CRC code:

5.3.1 Presetting a 16-bit register to hex FFFF (namely 1 for all bits in binary system). The register is called CRC register;

5.3.2 XORing the first 8-bit binary data (the first byte of the communication message frame) with the low 8-bit of 16-bit CRC register, then storing the result in CRC register;

5.3.3 Right-shifting the register data by one bit (towards lower bit) and filling the highest bit with 0, then verificationing the shift-out bit;

5.3.4 If the shift-out bit is 0, repeat step 3 (right-shifting one more bit);If the shift-out bit is1, XOR the CRC register data with polynomial A001 (1010 0000 0000 0001);

5.3.5 Repeating step 3 and step 4 until all of the 8-bit data have been processed after 8 right-shift operations

5.3.6 Repeating step 2 to step 5 to process the next byte of the communication message frame;

5.3.7 When calculation procedures of the first 5 bytes in the communication message frame are completed, the 16-bit CRC verification code will be generated in the 16-bit CRC register.

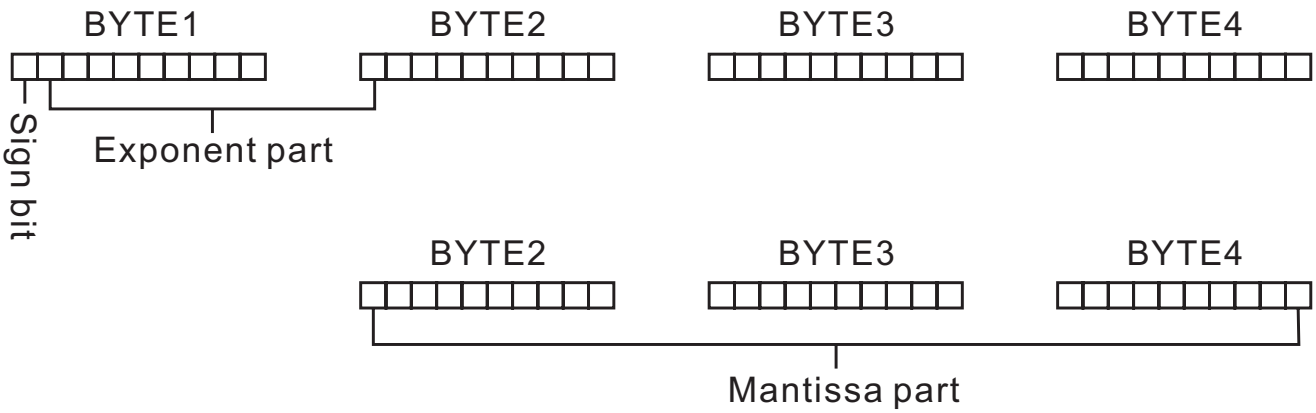
5.4 MODBUS_RTU address information form(the address is demonstrated with decimal system);

Modbus address	Parameter code	Description	Explanation
Electrical quantity, Data of switch value, Power sign information			
0,1	U	Voltage	2 words(4 bytes) floating-point representation data, IEEE-754 data format standard.All data is primary data,then by the ratio of the value. The unit of voltage V, The unit of current A, active power unit KW,reactive power unit Kvar, apparent power unit KVA, the unit of frequency Hz.
2,3	A	Current	
4,5	F	Frequency	
6,7	H	Power Factor	
8,9	P	Active Power	
10,11	Q	Reactive Power	
12,13	Reserve		
14,15	WPP	Active Energy	
16,17	WQP	Reactive Energy	
18,19	Reserve		
20,21	Reserve		
22	DI	Switch value input	
23	DO	Switch value output	
24	SING	Power sign bit	
Parameter information setting			
25	diSP	Display mode	0~8
26	CT	Multiplying power of current	1~9999
27	PT	Multiplying power of voltage	1~9999
28	Addr	Communication address	1~247
29	BAUD	Communication buad rate	0~3
30	DO1F	1st channel relay alarm fuction settings	0~2
31	DO1P	1st channel relay alarm object settings	0~5
32	DO1D	1st channel relay alarm value settings	0~9999

33	DO1H	1st channel relay alarm switching difference settings	0~9999
34	DO2F	2nd channel relay alarm fuction settings	0~2
35	DO2P	2nd channel relay alarm object settings	0~5
36	DO2D	2nd channel relay alarm value settings	0~9999
37	DO2H	2nd channel relay alarm switching difference settings	0~9999
38	AO1F	Analog quantity output fuction settings	0~2
39	AO1P	Analog quantity output object settings	0~5
40	AO1D	Analog quantity output value settings,20mA corresponds to the full range	0~9999

Note：Description of data format

Data type “float” :four-byte floating data,apply IEEE-754 standard. The level code and mantissa express the magnitude of number.The description according to byte is as following:



Sign bit: SIGN=0 is poative, SIGN=1 is oppsite;

Exponent part: E=Exponent part-126;

Mantissa parts: M = mantissa parts make up the highest bit is 1;

Data results：$REAL=SIGN\times 2^{E}\times M/(256\times 65536)$.

For example: energy data which read from the address table to know electric energy (positive active absorption) is: (Byte mode, compatible with the old standard) 92 (005CH) length of 4 (0004H).

Master divice：01H 04H 00 5CH 00 04H 31 DBH

Slave divice：01 04H 04H 50 80 00 00H EBH 6CH

(50 80 00 00 is active energy, EBH, 6CH is low byte and high byte of CRC verification code)

Data representation: SIGN (sign bit = 0, positive), Exponent part: EX = A1H-126 = 35, Mantissa part: 08 00 00H

Electric energy：2^{35}×80.00 00H/100 00 00H=17179869184Wh=17179869KWh

Chapter 6. FAQ and Solutions

6.1 About the inaccuracy measuring for the U,I,P and so on

Firstly,the users have to be sure that the right volt and current signal have already reach to the instrument.The users may use the multimeter to test the volt signal,or if needed,use pincer like meter to test the current signal.Secondly,make sure the connecting of the signal line is correct,for example the leading-in interface for the current signal;check each phase sequence is right.The instrument can view the power display,only if the reverse electricity input,the active power will be in minus while the active power symbol will be plus if the instrument used normally. If the active power symbol is minus,it may means the wrong connecting for current leading-in line or the wrong connecting of the phase sequency.Another thing should be noted that the electricity value the instrument displayed is primary Grid values. If the set for the PT and CT rate of the instrument is different from the actual used rate,the instrument may also display the wrong electricity value.

6.2 About the inaccuracy energy read,energy data not saved

The energy accumulated value of the instrument is based on the power me asuring.Check firstly whether the instrument's power value is conforming to the actual load.The instrument support the bidirectional energy computation.With the wrong connecting and minus total active power,the energy will accumulate to the reverse active energy and the positive active energy not.The problem appearing most is the wrong connecting for the CT leading-in line and leading-out line.If the energy data fails to be saved,please check whether there is any load for the instrument.Counting the load,the instrument will keep accumulating.

6.3 The instrument isn't lighting

Make sure suitable auxiliary power (AC 220V, 50/60Hz) has already added to the instrument's auxiliary power interface.The volt exceeding the auxiliary power may damage the instrument and can not be recovered.The users can use the multimeter to test the volt value of the auxiliary power.If the power volt tests fine and there is nothing displayed on the screen of the instrument,the users may consider about cutting off the electricity and connecting it again.If the instrument still doesn't display normally,please contact with our technical department.

6.4 About RS 485 communication,there is no returning data from the instrument

Firstly,make sure the instrument's communicating setting information,such as the slave device's address,baud rate,checking ways is confirming to the core device.If there is more than one instrument that doesn't have the data returned, please check the connecting of main communicating line is right and also the RS 485 converter works fine.If there is only one instrument or few instrument communicate exceptionally,the users should also check the relevant communicating lines.Excluding or confirm the core device software problem with the way to modify the exception situation and slave device address.Or excluding or confirm the instrument problems with the way of testing the exception and instrument installation address.