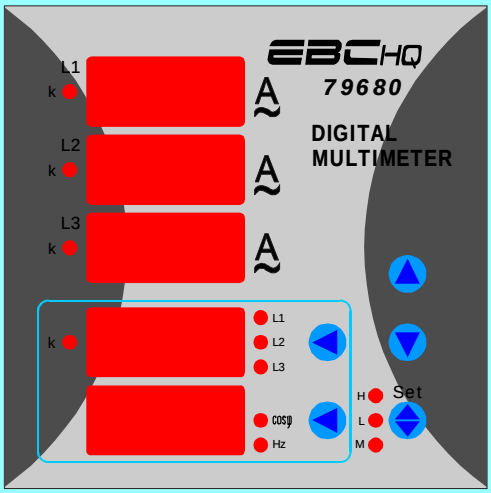
79680 series

Multifunctional Combined Electrical Instrument

OPERATIONAL INSTRUCTION MANUAL



Please read through the manual before installment and operation
Please keep the manual for future use

Chapter 3. Technical parameters

Table 2

Technical parameters			Index
Input	Voltage	Rated value	AC 57.7V、100V、220V、380V
		Overload	Consistent: 1.2 times instantaneous: 2 times /30s
		Consumption	< 1VA(each phase)
		Impedance	> 500kΩ
	Current	Rated value	AC 1A、5A
		Overload	Consistent: 1.2 times instantaneous: 20 times /1s
		Impedance	< 20mΩ (each phase)
	Frequency		45 ~ 65Hz
Output	Communication	Output mode	Rs485
		Protocol	MODBUS_RTU
		Baud rate	1200、2400、4800、9600
	Analog quantity	Channel quantity	Four channels
		Output mode	0 ~ 20mA、4 ~ 20mA programmable
		Load ability	≤400Ω
	Switching value	Channel quantity	Four channels (or one channel)
		Output mode	Normally open relay contact output
		Contact capability	AC 240V/1A
Measuring accuracy	Voltage,current		± (0.5%FS+one digit)
	Frequency		± 0.1Hz
	Power factor		± 0.01PF
Source	Scope		AC/DC 85 ~ 264V
	Consumption		< 5VA
Safety	Withstand voltage	Input and Source	> 2kV50Hz/1min
		Input and Output	> 1kV50Hz/1min
		Output and Source	> 2kV50Hz/1min
	Insulating resistance		Any two of input, output, source, casing > 20MΩ
Environment	Temperature		Operation: -10 ~ 50℃ Storage: -25 ~ 70℃
	Humidity		≤85%RH, free of wet and gas corruption
	Elevation		≤3000m

Chapter 1. General introduction

79680 multifunctional combined electrical instrument (instrument for short below) is the electronic measuring instrument developed for measuring several parameters of the electric network. The measured parameters display on the five displays. It can measure and manage more than 10 electrical parameters at the same time and can add functions according to actual demand.

It supplies maximum and minimum of voltage and current and demand value of current view functions. Multiplying power of CT and PT are programmable. At the same time of real-time measuring display, it can be added four switching value output channels or four analog transmitting output channels. It can instead the common electrical transmitter, measuring indicating instrument and other relative accessory unit instruments.

Chapter 2. Product specifications

Table 1

Instrument type	Shape	Maximum, minimum demand value	Four-channel switching value output	RS485 communication	Four-channel transmitting output	Measuring function
79680	96 × 96	YES	NO	NO	NO	Three-phase current phase voltage(L-N) line voltage(L-L) frequency power factor
79680A	96 × 96	YES	YES	NO	NO	
79680B	96 × 96	YES	NO	NO	YES	
79680C	96 × 96	YES	NO	YES	NO	
79680D	96 × 96	YES	YES	YES	NO	
79680E	96 × 96	YES	NO	YES	YES	

Chapter 4 Installment and connection

4.1 Shape and cutout hole dimension

Table 3

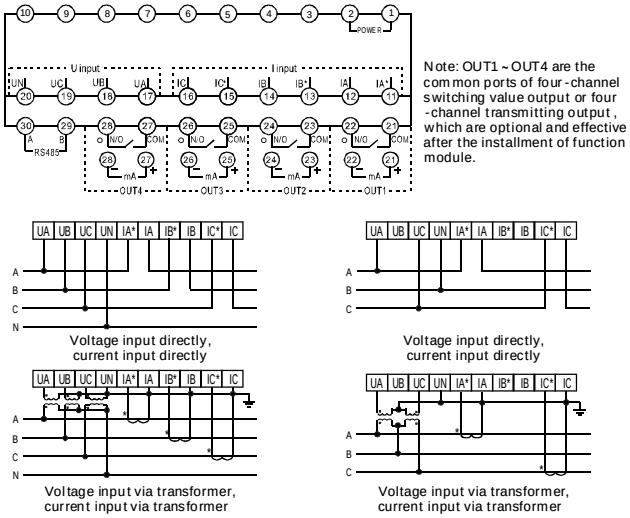
Instrument shape	Panel dimension		Case dimension			Cutout hole dimension	
	W	H	W	H	D	W	H
96 × 96	96	96	91	91	100	92	92

4.2 Method of installation

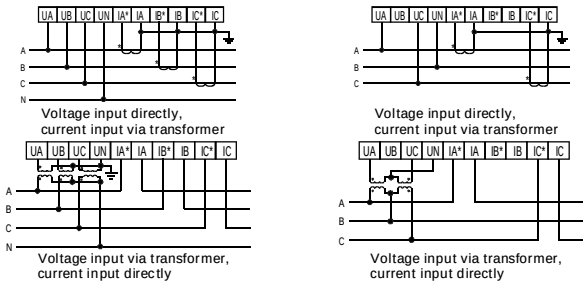
Choose the corresponding hole cutout dimension from the table above, make a hole in the installation screen, insert the instruments into the hole, place the two clamping pieces into the clamping holder and push and tighten them by hand.

4.3 Terminal arrangement and function declaration of instrument

(Note: If it is not the same with the wiring schema of the instrument case, please accord to the one of instrument case).



Note: OUT1 ~ OUT4 are the common ports of four-channel switching value output or four-channel transmitting output, which are optional and effective after the installment of function module.



4.3.1 Auxiliary power supply (POWER) : The voltage range of operational power supply is AC/DC 85～264V. It is suggested to install a fuse of 1A beside of the live wire when using the AC power supply to prevent damaging the instrument. In the areas with poor power quality, the surge suppressor and quick pulse group suppressor should be installed in the power supply circuit.

4.3.2 Electrical quantity signal input(I input and U input) : I input is A, B and C three-phase AC current signal input port, U input is A, B and C three-phase AC voltage signal input port and I* is current inlet wire.. When connection, please ensure the phase sequence and polarity of input signal respond with the terminals to avoid indicating value error. 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.

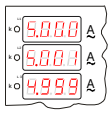
4.3.5 Switching output or analog transmitting output (OUT1～OUT4) : Can support four-channel switching value output or four-channel analog transmitting output (It needs to add the corresponding modules), but only one of the two. When installing the four switching value output modules, OUT1～OUT4 respectively correspond the alarm or switching value output 1～4. When it is applied in switching value output, the output status is controlled by the PC and the corresponding alarm output object should be set as oFF. When it is applied in the alarm output, the output status is controlled by the instrument. When installing the four analog quantity transmitting output modules, OUT1～OUT4 respectively correspond the transmitting output 1～4.

4.3.6 RS485 communication connection

The instrument supplies a RS485 communication interface and adopts MODBUS_RTU communication protocol (see the appendix). 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 high field 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.

5.3 Display mode description

5.3.1 Current display：under measuring display status, the first row, second row, third row display window respectively display A,B and C-phase current, as the following picture shows:



The left picture shows:
A-phase current IA=5.000A;
B-phase current IB=5.001A;
C-phase current IC=4.999A;

5.3.2 Voltage display：under measuring display status, the indicating value of the fourth row display window is current phase voltage or voltage measuring value. Switch the display object among UA, UB, UC, UAB, UBC and UCA by pressing the voltage view key, the display mode is respectively as following：

The left picture shows:
L1 phase voltage
UA=220.0V

The left picture shows:
L2 phase voltage
UB=220.1V

The left picture shows:
L3 phase voltage
UC=220.0V

The left picture shows:
L1-L2 line voltage
UAB=380.1V

The left picture shows:
L2-L3 line voltage
UBC=380.2V

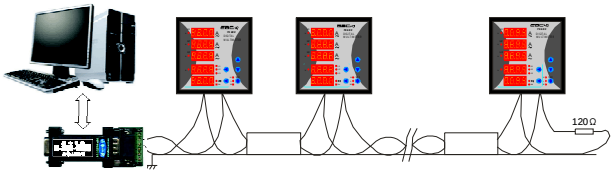
The left picture shows:
L1-L3 line voltage
UCA=380.3V

5.3.3 Frequency and power factor display：under measuring display status, switch the display object between frequency and power factor in the fifth row display window by pressing the frequency view key, the display mode is respectively as following：

The left picture shows:
Frequency value
FREQ=50.00Hz

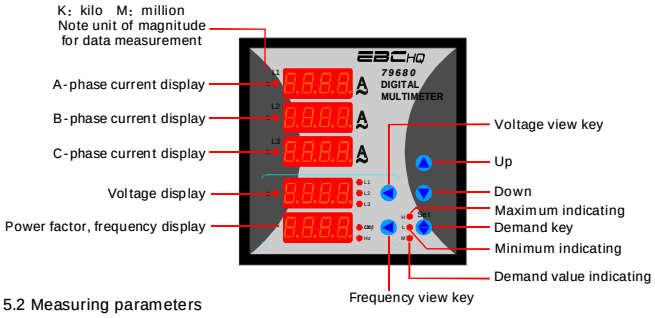
The left picture shows:
Power factor value
PFt=1.000

5.3.4 Maximum and minimum display：under measuring display status, examine the maximum and minimum of three-phase current, three-phase phase voltage and three-phase line voltage one by one by pressing the demand key once or twice, the display mode is as following：



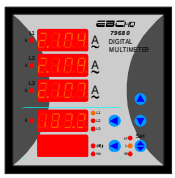
Chapter 5. Programming and usage

5.1 Panel description



5.2 Measuring parameters

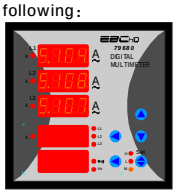
- Current of each phase(A) : IA、IB、IC
- Phase voltage (L-N) : UA、UB、UC
- Line voltage (L-L) :UAB、UBC、UCA
- Power factor(cos ϕ): PFt
- Frequency (Hz) : FREQ
- Minmum(L) and maximum(H) of voltage and current：UAmax、UBmax、UCmax、IAmax、IBmax、ICmax、UAmin、UBmin、UCmin、IAmin、IBmin、ICmin
  (Note: It will record the latest minimum or maximum record value as the new minimum and maximum)
- Demand value of current (M): DemandIa, DemandIb、DemandIc
  (Note: Demand value is the average value of all measuring value in the demand cycle. When demand cycle updates ,for example, the new demand value is more than the previous one, then demand value is updated.



The left picture shows:
Minimum of A-phase current Amin=2.014A;
Minimum of B-phase current IBmin=2.018A;
Minimum of C-phase current ICmin=2.017A;
Minimum of A-phase voltage UAmin=183.2V

Note: start the maximum and minimum detection first before you want to see them.
When lamp L2 is on, the fourth row display window shows minimum of UB phase voltage
When lamp L3 is on, the fourth row display window shows minimum of UC phase voltage
When lamp L1 and L2 is on, the fourth row display window shows minimum of UAB line voltage
When lamp L2 and L3 is on, the fourth row display window shows minimum of UBC line voltage
When lamp L1 and L3 is on, the fourth row display window shows minimum of UCA line voltage
When lamp H is on, the above parameters are maximum.

5.3.5 Demand value display：under measuring display status, examine the demand value of three-phase current by pressing the demand key for three times, the display mode is as following：



The left picture shows:
Demand value of A-phase current DemandIA=5.014A;
Demand value of B-phase current DemandIB=5.018A;
Demand value of C-phase current DemandIC=5.017A

Note: the demand value updates every 15min.

5.4 Key function

Up: under the programmable mode, it is used for progressive increase of parameter value or enter the next menu;

Down: under the programmable mode, it is used for degression of parameter value or enter the previous menu;

Voltage view key：under measuring display status, this key is used to switch between phase voltage and line voltage; Under the programmable mode, it is used to left shift the cursor one digit.

Frequency view key: under measuring display status, this key is used to switch between frequency and power factor，Under the programmable mode, it is used to return to previous menu without storing parameters.

Demand key：under measuring display status, this key is used to switch between maximum, minimum, demand value and real-time measuring value. Instrument prompts to enter the programming password “codE” by pressing this key for two seconds. Under the programmable mode, it is used to return to previous menu with storing parameters. it will return to measuring valve display status automatically if there is no key action for 60s under the programming status.

5.4 Menu framework and significations

Under the programmable mode, five menu setting items including of setting (SEt) , input (inP) , communication (Conn) alarm output(AL), analog quantity output (SEnd) and LED display hierarchical menu framework management are provided by this instrument. It adopt LED display tier menu manage mode.

Table 5

The first tier of menu	The second tier of menu	The third tier of menu	Parameter value	Description
PASS	CodE		/	Prompt to enter the programmable password "codE", only correct password is allowed to enter the programming mode
SEt	FiLt		0 ~ 50	Set the digital filtering coefficient FiLt
	CodE		0 ~ 9999	Modify programming password codE (Factory setting is 0)
	dmdt		1 ~ 60	Demand value cycle (Unit: min, default as 15min)
	SCLr		YES	Start the maximum and minimum detection by pressing" SET" key under this surface
	CLrd		YES	Clear demand value of the instrument by pressing" SET" key under this surface.
inP	nEt		n3.3	Select input network nEt 0: n3.3 stand for three-phase three-wire 1: n3.4 stand for three-phase four-wire
			n3.4	
	UrAn		57.7	Select voltage measuring range U 0: 57.7V 1: 100V 2: 220V 3: 380V
			100	
			220	
			380	
	PrtP		1 ~ 9999	Set multiplying power of potential transformer "Pt" (Primary value of potential transformer/secondary value)
	IrAn		1A	Select current measuring range A 0: 1A 1: 5A
			5A	
	CtP		1 ~ 2000	Set multiplying power of current transformer "Ct" (Primary value of current transformer/secondary value)
Conn	Addr		1 ~ 247	Set Rs485 communication address "Addr"
	bAud		oFF	Select communication baud rate "bAud" 0: oFF stand for communication is closed 1: 1200 2: 2400 3: 4800 4: 9600
			1200	
			2400	
			4800	
			9600	
AL	AL1	AL1P	See table 6	Select the first-channel alarm output object "AL1P"
		AL1L	-10.0 ~ 120.0	Set the first-channel lower limit of alarm output range "AL1L"
		AL1H	-10.0 ~ 120.0	Set the first-channel higher limit of alarm output range "AL1H"
	AL2	AL2P	See table 6	Select the second-channel alarm output object "AL2P"
		AL2L	-10.0 ~ 120.0	Set the second-channel lower limit of alarm output range "AL2L"
		AL2H	-10.0 ~ 120.0	Set the second-channel higher limit of alarm output range "AL2H"
	AL3	AL3P	See table 6	Select the third-channel alarm output object "AL3P"
		AL3L	-10.0 ~ 120.0	Set the third-channel lower limit of alarm output range "AL3L"
		AL3H	-10.0 ~ 120.0	Set the third-channel higher limit of alarm output range "AL3H"
	AL4	AL4P	See table 6	Select the fourth-channel alarm output object "AL4P"
		AL4L	-10.0 ~ 120.0	Set the fourth-channel lower limit of alarm output range "AL4L"
		AL4H	-10.0 ~ 120.0	Set the fourth-channel higher limit of alarm output range "AL4H"
	dF		0.1 ~ 50.0	Set alarm return difference "dF"
	LAg		0.0 ~ 600.0	Set alarm output lag time lag "LAg"(Unit:s)
SEnd	Sd1	Sd1P	See table 6	Select the first-channel transmitting output object "Sd1P"
		Sd1L	0.0 ~ 100.0	Set the first-channel lower limit of transmitting output range "Sd1L"
		Sd1H	0.0 ~ 100.0	Set the first-channel higher limit of transmitting output range "Sd1H"
	Sd2	Sd2P	See table 6	Select the second-channel transmitting output object "Sd2P"
		Sd2L	0.0 ~ 100.0	Set the second-channel lower limit of transmitting output range "Sd2L"
		Sd2H	0.0 ~ 100.0	Set the second-channel higher limit of transmitting output range "Sd2H"
	Sd3	Sd3P	See table 6	Select the third-channel transmitting output object "Sd3P"
		Sd3L	0.0 ~ 100.0	Set the third-channel lower limit of transmitting output range "Sd3L"
		Sd3H	0.0 ~ 100.0	Set the third-channel higher limit of transmitting output range "Sd3H"
	Sd4	Sd4P	See table 6	Select the fourth-channel transmitting output object "Sd4P"
		Sd4L	0.0 ~ 100.0	Set the fourth-channel lower limit of transmitting output range "Sd4L"
		Sd4H	0.0 ~ 100.0	Set the fourth-channel higher limit of transmitting output range "Sd4H"
	Sdt		oFF	Select transmitting output specification "Sdt" 0: oFF (no transmitting) 1: 0 – 20mA 2: 4 – 20mA
			0-20	
			4-20	

Note: Parameter values of alarm and transmitting output range are expressed as the percentage of selected electricity measuring range.

5.6 Additional explanation of alarm and transmitting parameter program setting

The higher and lower limit setting values of alarm and transmitting output range are expressed by the percentage of selected electricity measuring range. For example, the computing formula of AL1L is as following:

Parameter value of AL1L= electrical quantity value corresponding lower alarm limit /measuring range × 100(Note: inapplicability for frequency)

Parameter value of AL1L= (frequency value corresponding lower alarm limit-lower limit of frequency measuring range)/measuring range × 100(Note: special for frequency); By parity of reasoning, the measuring range of all electrical quantity is as the table below:

Table 6

AL1P ~ AL4P Sd1P ~ Sd4P		Alarm/transmitting output object	Measuring value of all electrical quantity	
Parameter value	Corresponding character		When nEt is set as n3.4	When nEt is set as n3.3
0	oFF	No alarm or transmitting output	/	/
1	UA	A-phase voltage UA	U × PT	/
2	Ub	B-phase voltage UB	U × PT	/
3	UC	C-phase voltage UC	U × PT	/
4	UAb	AB line voltage UAB	U × PT ×√3	U × PT
5	UbC	BC line voltage UBC	U × PT ×√3	U × PT
6	UCA	CA line voltage UCA	U × PT ×√3	U × PT
7	IA	A-phase current IA	A × CT	A × CT
8	Ib	B-phase current IB	A × CT	A × CT
9	IC	C-phase current IC	A × CT	A × CT
10	PFt	Total power factor PFT	1	1
11	FrEq	Frequency FREQ	65Hz(Higher limit) – 45Hz(Lower limit) = 20Hz	

Note: U in the formula of table six is voltage measuring range, A is the current measuring range, PT is multiplying power of potential transformer, CT is multiplying power of current transformer (see table five). The measuring values of all electrical quantities are the absolute value of the higher limit of measuring range minus the lower limit of it. Instrument alarm or transmitting output always change to positive value and don't consider the sign digit of measuring value.

When setting the alarm or transmitting output parameters, first all parameter setting of inP menu should be checked if it is consistent with the input specifications of instrument, and then choose a alarm or transmitting object, set AL1P ~ AL4P or Sd1P ~ Sd4P as corresponding electrical quantity, and set the higher and lower alarm limit range (AL1H ~ AL4H,AL1L ~ AL4L) or the higher and lower transmitting limit range (Sd1H ~ Sd4H, Sd1L ~ Sd4L) of the chosen electrical quantity again to ensure that the higher limit setting value should be greater than the lower one. Or it may cause output error.

Example one: An 79680S instrument with input specification of 220V 5A, if you want the four transmitting output channels correspond respectively to A-phase current, B-phase current, C-phase current and power factor. The output specification is 4-20mA, output 4mA when 0A, output 20mA when 5A, output 4mA when power factor is 0, output 20mA when power factor is 1

The setting method is as following:

1.Enter the menu "SEnd", set the parameter Sd1P as IA, the parameter Sd2P as IB, the parameter Sd3P as IC, the parameter Sd4P as Pft.

2.Calculate Sd1H ~ Sd4H and Sd1L ~ Sd4L respectively:

Sd1H=5 ÷ Measuring range × 100, from the table above we can know: Current measuring range=A × CT, the CT transformation ratio of this instrument is 1, therefore, Sd1H=100, setting the parameter Sd1H as 100.0 is OK. In a similar way, set both Sd2H and Sd3H as 100.0; Sd4H=1.000 ÷ Measuring range × 100, from the table above we can know: the measuring value of total power factor is 1, therefore, Sd4H=100, setting the parameter Sd4H as 100.0 is OK. When outputting 4mA, the corresponding current value and power factor is 0, the result must be 0, therefore, Sd1L ~ Sd4L should be written as 0.0;

3. Set parameter "Sdt" as 4-20

After setting, the instrument output as the following mode:

output 4mA from the OUT1 port when A-phase current is 0A and output 20mA when it is 5A; output 4mA from OUT2 port when B-phase current is 0A and output 20mA when it is 5A; output 4mA from OUT3 port when C-phase current is 0A and output 20mA when it is 5A; output 4mA from OUT4 port when the power factor is 0 and output 20mA when it is 1.

Example two: An 79680D instrument with input specification of 220V 5A, if you want to take limit alarm monitoring the four switching value output corresponding to A-phase voltage, B-phase voltage, C-phase voltage and frequency and want the alarm contact breaking in the range of 176V ~ 264V and 45 ~ 55Hz and connecting in the other ranges.

The setting method is as following:

1.Enter the menu "AL" set the parameter AL1P as UA, the parameter AL2P as UB, the parameter AL3P as UC, the parameter AL4P as FREQ;

2.Calculate AL1H ~ AL4H and AL1L ~ AL4L respectively:

AL1H=264 ÷ Measuring range × 100, from the table above we can know: Voltage measuring range=U × PT, the PT transformation ratio of this instrument is 1, therefore, AL1H=120, setting the parameter AL1H as 120.0 is OK. In a similar way, set both AL2H and AL3H as 120.0.

AL1L=176 ÷ Measuring range × 100, the result is: AL1L=80, then setting the parameter AL1L as 80.0 is OK. In a similar way, set both AL2L and AL3L as 80.0;
AL4H=(55-45) ÷ (65-45) × 100, the result is: AL4H=50, then setting the parameter AL4L as 50.0 is OK;
AL4L=(45-45) ÷ (65-45) × 100, the result is: AL4L=0, then setting the parameter AL4L as 0.0 is OK;
c.Set the parameter alarm return difference "dF" (Setting value= Alarm return difference ÷ Measuring range × 100, usually set as 0.5).
4.Set the Alarm lag time"lag" according to needs (unit: s).
After setting, the instrument outputs as following mode: When A-phase voltage is lower than 176V or higher than 264V, the relay contact at OUT1 port keeps connecting, or it breaks; When B-phase voltage is lower than 176V or higher than 264V, the relay contact at OUT2 port keeps connecting, or it breaks; When C-phase voltage is lower than 176V or higher than 264V, the relay contact at OUT31 port keeps connecting, or it breaks; When the frequency in the circuitry is lower than 45Hz or higher than 55Hz, the relay contact at OUT4 port keeps connecting, or it breaks.

Appendix one： MODBUS_RTU communication protocol

Instrument are provided with Rs485 communication interface and apply MODBUS_RTU communication protocol.

1. Type and format of communication data
The information transmission is a synchronous mode with byte as unit. The transmitting communication information between the main station and the secondary station is 11-bit word format, including one start bit(0), eight data bits and two stop bits.(1) The format of message frame：

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

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.
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.
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 two function codes as following:

Function code	Definition	Operation
03H	Read register	Read data of one or multiple register
10H	Write multiple register	Write n 16-bit binary data into n continuous registerl

2.3 Data sector
Data sector are different following the different function code. These data could be numerical value, reference address and son 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 code 03H and 10H) 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.
3. Brief introduction of function code
3.1 function code03H: Read register
For example, if the master device wants to read out the two register data with reading address of 01H and start address of 0CH

Message sent from master device:		Massage sent
Address code		01H
Function code		03H
Address of start register	High byte	00H
	Low byte	28H
Register quantity	High byte	00H
	Low byte	02H
CRC verification code	Low byte	44H
	High byte	03H

If the data of slave device 28H, 29H is 4489H, 8000H, the slave device returns:

Message returned from slave device		Message returned
Address code		01H
Function code		03H
Byte number		04H
Data of register 28H	High byte	44H
	Low byte	89H
Data of register 29H	High byte	80H
	Low byte	00H
CRC verification code	Low byte	5EH
	High byte	E9H

3.2 Function code 10H: Write multiple register
For example, if the master device wants to keep the data of 0001H, 0002H and 0064H to three register with slave device address of 01H and start register address of 04H.

Message sent from master device:		Message sent
Address code		01H
Function code		10H
Address of start register	High byte	00H
	Low byte	04H
Register quantity	High byte	00H
	Low byte	03H
Byte number		06H
Pending written data of register 04H	High byte	00H
	Low byte	01H
Pending written data of register 05H	High byte	00H
	Low byte	02H
Pending written data of register 06H	High byte	00H
	Low byte	64H
CRC verification code	Low byte	3AH
	High byte	BEH

Message returned from slave device:

Message returned from slave device		Massage returned
Address code		01H
Function code		10H
Address of start register	High byte	00H
	Low byte	04H
Register quantity	High byte	00H
	Low byte	03H
CRC verification code	Low byte	C1H
	High byte	C9H

4. 16-bit CRC verification code
Master or slave device can use verification code to judge if the receiving information is correct. Because of electronic noise or other influence, the information sometimes occur errors in the process of transmission. Error verification code (CRC) can verification if the information in the process of transmission of communication data from master or slave device.
The 16-bit CRC verification code, placed at the end of the message frame being delivered, is calculated by the device which sends the message. The message-receiving device will recalculate CRC of the received message to compare with the received CRC. CRC inconsistency indicates errors. Only 8 data bits are involved in CRC calculation, with the exclusion of start bit and end bit. Algorithm of CRC code:
1) Presetting a 16-bit register to hex FFFF (namely 1 for all bits in binary system). The register is called CRC register;
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;
3) Right-shifting the register data by one bit (towards lower bit) and filling the highest bit with 0, then verifying the shift-out bit;
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) Repeating step 3 and step 4 until all of the 8-bit data have been processed after 8 right-shift operations;
6) Repeating step 2 to step 5 to process the next byte of the communication message frame;
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. Processing of error
When the instrument detects error except the CRC code error, the message must be sent back to the master device. The top digit of functional code 1 is the functional code sent back from slave device and master device, which is adding 128 on the basis of the functional code sent from the master device. The error message frame format returned by the slave device is as following:

Address code	Function code (the top bit is 1)	Error code	Low byte of CRC verification code	High byte of CRC verification code
1 byte	1 byte	1 byte	1 byte	1 byte

Error code as following：

01H	Illegal function code	The instruments do not support the function code received
02H	Illegal register address	The register address received is beyond the register address range of instrument.
03H	Illegal register quantity	The register quantity received is beyond the register quantity of instrument.
04H	Illegal data value	The data value received is beyond the data range of the corresponding address.

6. Communication information table

Table 7

Keyboard Parameter				
Parameter address	Parameter code	Parameter description	Data type	Read-write attribute
00H		Reserved		R/W
01H		Reserved		R/W
02H	FiLt	Digital filtering coefficient	Integer	R/W
03H		Reserved		R/W
04H	dt	Demand value cycle	Integer	R/W
05H	codE	Programming password	Integer	R/W
06H	nEt	Input network(0:three-phase three-wire 1:three-phase four-wire)	Integer	R/W
07H	U	Measuring range of voltage(0:57.7V 1:100V 2:220V 3:380V)	Integer	R/W
08H	Pt	Multiplying power of voltage	Integer	R/W
09H	A	Measuring range of current(0:1A 、 1:5A)	Integer	R/W
0AH	Ct	Multiplying power of current	Integer	R/W
0BH	Addr	Communication address	Integer	R/W
0CH	bAud	Communication baud rate(0:oFF 1:1200 2:2400 3:4800 4:9600)	Integer	R/W
0DH	AL1P	The first-channel alarm output object(see table 6)	Integer	R/W
0EH	AL1L	The first-channel lower limit of alarm output range(*)	Integer	R/W
0FH	AL1H	The first-channel higher limit of alarm output range(*)	Integer	R/W
10H	AL2P	The second-channel alarm output object(see table 6)	Integer	R/W
11H	AL2L	The second-channel lower limit of alarm output range(*)	Integer	R/W
12H	AL2H	The second-channel higher limit of alarm output range(*)	Integer	R/W
13H	AL3P	The third-channel alarm output object(see table 6)	Integer	R/W
14H	AL3L	The third-channel lower limit of alarm output range(*)	Integer	R/W
15H	AL3H	The third-channel higher limit of alarm output range(*)	Integer	R/W
16H	AL4P	The fourth-channel alarm output object(see table 6)	Integer	R/W
17H	AL4L	The fourth-channel lower limit of alarm output range(*)	Integer	R/W
18H	AL4H	The fourth-channel higher limit of alarm output range(*)	Integer	R/W
19H	dF	Alarm return difference(*)	Integer	R/W
1AH	LAg	Alarm lag time(*)	Integer	R/W
1BH	Sd1P	The first-channel transmitting output object(see table 6)	Integer	R/W
1CH	Sd1L	The first-channel lower limit of transmitting output range(*)	Integer	R/W
1DH	Sd1H	The first-channel higher limit of transmitting output range(*)	Integer	R/W
1EH	Sd2P	The second-channel transmitting output object(see table 6)	Integer	R/W
1FH	Sd2L	The second-channel lower limit of transmitting output range(*)	Integer	R/W
20H	Sd2H	The second-channel higher limit of transmitting output range(*)	Integer	R/W
21H	Sd3P	The third-channel transmitting output object(see table 6)	Integer	R/W
22H	Sd3L	The third-channel lower limit of transmitting output range(*)	Integer	R/W
23H	Sd3H	The third-channel higher limit of transmitting output range(*)	Integer	R/W
24H	Sd4P	The fourth-channel transmitting output object(see table 6)	Integer	R/W
25H	Sd4L	The fourth-channel lower limit of transmitting output range(*)	Integer	R/W
26H	Sd4H	The fourth-channel higher limit of transmitting output range(*)	Integer	R/W
27H	Sdt	Transmitting output specifications(0:oFF、1: 0~20mA、2: 4~20mA)	Integer	R/W

Operation status				
Parameter address	Parameter code	Parameter description	Data type	Read-write attribute
28H	WRST	write into 0xAA55 to clear the demand value data, write into 0x3C3C to start maximum and minimum detection	Integer	R/W
29H	DO	Alarm or switching value output status: bit0～bit3 respectively correspond alarm or switching value output 1～4, 0 means that relay contact is open, 1 means relay contact is closed.	word	R/W
2AH		Reserved		R

Data of electrical quantity				
Parameter address	Parameter code	Parameter description	Data type	Read-write attribute
2BH	UA	A-phase voltage	word	R
2CH	UB	B-phase voltage	word	R
2DH	UC	C-phase voltage	word	R
2EH	UAB	AB line voltage	word	R
2FH	UBC	BC line voltage	word	R
30H	UCA	CA line voltage	word	R
31H	IA	A-phase current	word	R
32H	IB	B-phase current	word	R
33H	IC	C-phase current	word	R
34H	PFT	Total power factor	Integer	R
35H	FREQ	Frequency	word	R
36H	UAmax	Maximum of A-phase voltage	word	R
37H	UAmin	Minimum of A-phase voltage	word	R
38H	UBmax	Maximum of B-phase voltage	word	R
39H	UBmin	Minimum of B-phase voltage	word	R
3AH	UCmax	Maximum of C-phase voltage	word	R
3BH	UCmin	Minimum of C-phase voltage	word	R
3CH	IAmax	Maximum of A-phase current	word	R
3DH	IAmin	Minimum of A-phase current	word	R
3EH	IBmax	Maximum of B-phase current	word	R
3FH	IBmin	Minimum of B-phase current	word	R
40H	ICmax	Maximum of C-phase current	word	R
41H	ICmin	Minimum of C-phase current	word	R
42H	DemandIA	Demand value of A-phase current	word	R
43H	DemandIB	Demand value of B-phase current	word	R
44H	DemandIC	Demand value of C-phase current	word	R

Note: 1)Data type: "word" is 16-digit unsigned integer with scale 0~65535, "Integer" is 16-digit signed integer with scale of -32768~32767, negative number use complement representation,"ulong" is 32-digit unsigned integer with scale of 0～4294927696 the range of data is －32768～+32767;

2)Read-write attribute: "R" read only, use 03H command; "R/W" readable and writable, use 03H and 10H command. Prohibit writing to the address not listed or unwritable.

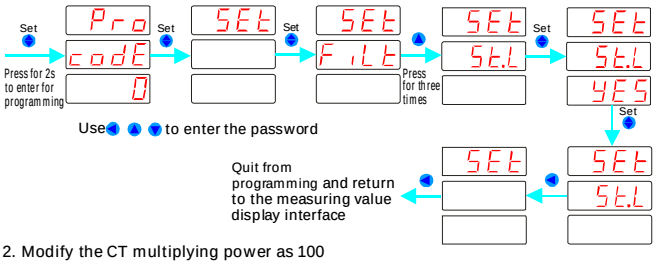
3)Keyboard parameters noted "*" need to be divided by 10 to get the real value.

4)The corresponding relations between electrical quantity is as table below: (stipulate Val_t is communication read-out value, Val_s is real value, PT is potential transformer ratio and CT is current transformer ratio.)

Applicable object	Correspondence	Scope	Unit	Note
Voltage	Val_s=Val_t×PT/100	0~65535	V	UA, UB, UC, UAB, UBC, UCA, UAmax, UAmin, UBmax, UBmin, UBmax, UBmin
Current	Val_s=Val_t×CT/1000	0~65535	A	IA, IB, IC, IAmax, IAmin, IBmax, IBmin, ICmax, ICmin, DemandIA, DemandIB, DemandIC,
Power factor	Val_s=Val_t/10000	-10000~10000		PFT
Frequency	Val_s=Val_t/100	0~65535	Hz	FREQ

Appendix two: Example of programming

1. Start maximum and minimum detection



2. Modify the CT multiplying power as 100