REXGEAR

Your Power Solution Expert

87330 High Precision Three-Phase Power Meter User manual (V1.2)

Contents

Chapter 1: Safety rules

Before using 87330 high precision three-phase power meter or its parting products, please read this user manual carefully, and operate in strict accordance with user manual!

Warning label Warning that the operations, applications, or conditions performed are dangerous, and may result in injury or death. This label is marked where a warning is required in user manual.

Attention label Caution that the operation, application, or condition being performed is dangerous, and may cause damage of analyzer or loss of data stored in instrument. This label is marked where attention is required in user manual.

- The contents of this manual are subject to change with upgrading of performance and functions of instrument a without prior notice.
- The reason for upgrading may cause difference between picture in this manual and the content displayed on instrument screen.
- We strive to perfect the contents of this manual. If you have any questions or find any error, please contact REXGEAR.
- It is strictly prohibited to copy or reprint this manual in whole or in part without the permission of REXGEAR Instruments.
- For consultation and taking of latest user manual, please refer to mailbox on home page.

Chapter 2: Technical indexes

I. Product introduction

87330 series high-precision three-phase power analyzer adopts the latest FPGA+ARM parallel synchronous processing technology, it conforms to IEC standard about 3U compact case with exquisite appearance. It is widely used in the energy efficiency test for three-phase electric equipment, etc. It is equipped with Ethernet TCP-MODBUS standard protocol in standard configuration, and meets the requirements of engineering integration. Optional motor test module can be used to test the torque and speed of three-phase motor, multiple applications are available with one machine.

II. Product features

1. High precision, wide frequency band: Basic precision is up to 0.1%, and data can be displayed and updated as fast as 100ms; Dual AC and DC signals, power test bandwidth is DC0.5Hz ~100kHz, meeting various standard and non-standard sinusoidal waveform load power test.

2. Support the latest motor test module, with the reserved motor sensor test interface, it is suitable for sensor signal test for majority of motors available on market; with single-machine, three-phase motor efficiency test can be made, it can ensure signal synchronization, and thus improve test accuracy.

3. Support RS232/RS485, Ethernet communication interface, standard MODBUS, MODBUS/TCP, and other optional communication protocols;

4. Adopt frequency-mixing sampling technology to measure high-frequency waveform more accurately;

5. Support three-phase interphase angle test.

III. Technical parameters

Model	87330
Current specification	20A *1/5/50A optional
Wiring method	1P3W (single-phase 3-wires) 3P3W (three-phases 3-wires, 2 voltages, 2 currents) 3V3A (three-phases 3-wires, 3 voltages, 3 currents) 3P4W (three-phases 4-wires)
Input impedance of each phase	Voltage: About 2MΩ Current sensor: About 100kΩ Direct input of current(20A): About 10mΩ *50A: 2.5mΩ; 5A: 50mΩ; 1A: 200mΩ
Peak factor of full range	3 *Highest range: 1.5
Rated range of voltage (Direct input)	15 / 30 / 60 / 100 / 150 / 300 / 600 /1000*[V]
Rated range of current (Direct input)	100 m / 200 m / 500 m / 1 / 2 / 5 / 10 /20*[A]
Rated range of current (Sensor input)	50 m / 100 m / 200 m / 500 m / 1 / 2 / 5 /10[V]
Voltage/current Precision scope	(1%~110%) ×range *Voltage 1000V range, current 20A range, precision range is (1%~100%) ×range
Range of power factor	±(0.0001 ~ 1.0000)

Measurement precision of voltage	DC	±(0.1%x reading value +0.2%×range)
	0.5Hz≤f < 45Hz	±(0.1%x reading value +0.2%×range)
	45Hz≤f≤66Hz	±(0.1%x reading value +0.1%×range)
	66Hz < f≤1kHz	±(0.1%x reading value +0.2%×range)
	1kHz < f≤10kHz	±({0.07×f}%x reading value +0.3%×range)
	10kHz < f≤100kHz	±(0.5%x reading value +0.5%×range)，±[{0.04×(f–10)}%xreading value]
Current precision	DC	±(0.1%x reading value +0.2%×range)
	0.5Hz≤f < 45Hz	±(0.1%x reading value +0.2%×range)
	45Hz≤f≤66Hz	±(0.1%x reading value +0.1%×range)
	66Hz < f≤1kHz	±(0.1%x reading value +0.2%×range)
	1kHz < f≤10kHz	±({0.07×f}%x reading value +0.3%×range)
	10kHz < f≤100kHz	±(0.5%x reading value +0.5%×range)，±[{0.04×(f–10)}%xreading value]
Measurement precision of active power	DC	±(0.1%x reading value +0.2%×range)
	0.5Hz≤f < 45Hz	±(0.3%x reading value +0.2%×range)
	45Hz≤f≤66Hz	±(0.1%x reading value +0.1%×range)
	66Hz < f≤1kHz	±(0.2%x reading value +0.2%×range)
	1kHz < f≤10kHz	±(0.1%x reading value +0.3%x range), ±[{0.067×(f–1)}%x reading value]
	10kHz < f≤100kHz	±(0.5%x reading value +0.5%x range), ±[{0.09×(f–10)}%x reading value]
Measurement range of active power	4.4mW~4.4kW/phase @220V, PF=0.01~1	
Max resolution of active power	0.1mW	
Measurement range of frequency	DC，0.5Hz ～ 100kHz	
Measurement precision of frequency	±0.1%×reading value	
Harmonic measurement	10Hz ~ 600Hz, 1~50 harmonic content, total distortion	
Measurement range of electric energy	0~99999MWh (resolution: 1mWh/0.01mAh)	
Measurement precision of electric energy	±0.2%×reading value	
Timing of electric energy	9999h 59m 59s	
Functions of filter	500Hz, 5.5kHz voltage circuit, current circuit amd frequency filter	
Range of voltage and current transformation ratio	1.0～ 5000.0	
Change of external input	0.010~100.000	
Data update cycle	100 m / 200 m / 500 m / 1 / 2 / 5 /10[s]	
Alarm function	Setting for upper/lower limit and threshold of total three-phase voltage, total three-phase current and total three-phase power	
Control interface	Standard configuration: RS-232，Ethernet; Option: RS-485，motor measurement board/card (pulse type torque RPM sensor)	
Communication protocol	REXGEAR3.0，Modbus，TCP Modbus	
Outline dimension	213(W) ×132.5(H) ×400(D) mm	
Opening size	213(W) ×132.5(H) mm	
Foot height	15 mm	
Machine weight	About 4 kg	
Power consumption of whole machine	About 60VA	

1. [Condition] temperature: 23±5℃, humidity: 30%~75%RH, input wave form: Sine wave, common mode voltage: 0V, line filter: OFF, frequency filter: 440Hz below ON, power factorλ: 1, Peak factor: 3. After pre-heating In the wiring state, after zeroing or changing the range.
2. In the measurement accuracy formula, f is frequency, unit kHz.
3. When the data update rate is 100ms, all accuracy + 0.05% of the reading.
4. Influence of temperature change after zeroing or range changing:
   Voltage DC precision + 0.02%/℃ of range, current DC precision + 500μA/℃, external sensor DC precision + 50μV/℃, power DC precision + product of voltage and current influence.

IV. The influence of system setting on measurement accuracy

1. Influence of line filter on measurement accuracy

Line filter locates in voltage and current measurement circuit, when turning on line filter, the measured value does not contain high frequency component, which can remove noise from inverter, switching power supply or distortion waveform, so will directly affect the measurement precision of voltage, current and power; therefore, when turning on line filter, the influence on measurement precision is as follows:

Line filter	Voltage /current	Power
On	When the cutoff frequency is 500Hz, 45Hz~66Hz: + 0.2% of reading value ＜45Hz： + 0.5% of reading value When the cutoff frequency is 5.5kHz ≤66Hz： + 0.2% of reading value 66Hz~500Hz： + 0.5% of reading value	When the cutoff frequency is 500Hz, 45Hz~66Hz: + 0.3% of reading value ＜45Hz： + 1% of reading value When the cutoff frequency is 5.5kHz ≤66Hz： + 0.4% of reading value 66Hz~500Hz： + 1.2% of reading value

2. Influence of harmonics on measurement accuracy

When the harmonic measurement is turned on, the measurement accuracy (reading error + range error) is as follows:

(1) When line filtering is on (5.5kHz)

Frequency	Voltage /current	Power
10Hz≤f＜45Hz	0.4% of reading value + 0.35% of range	0.85% of reading value + 0.5% of range
45Hz≤f<440Hz	0.75% of reading value + 0.35% of range	1.5% of reading value + 0.5% of range
440Hz≤f<1kHz	1.2% of reading value + 0.35% of range	2.4% of reading value + 0.5% of range

(2) When the line filter is turned off

Frequency	Voltage /current	Power
10Hz≤f＜45Hz	0.15% of reading value + 0.35% of range	0.35% of reading value + 0.5% of range
45Hz≤f<440Hz	0.15% of reading value + 0.35% of range	0.25% of reading value + 0.5% of range
440Hz≤f<1kHz	0.2% of reading value + 0.35% of range	0.4% of reading value + 0.5% of range

3. Calculation cycle and lower limit of frequency measurement

The measurement range of frequency varies with different data calculation cycles, and the specific relationship is as follows:

Computation cycle	0.1s	0.25s	0.5s
Measurement range of frequency	25Hz~100kHz	10Hz~100kHz	5Hz~100kHz
	1s	2s	5s
	2.5Hz~100kHz	1.5Hz~50kHz	0.5Hz~20kHz

V. Outline dimension

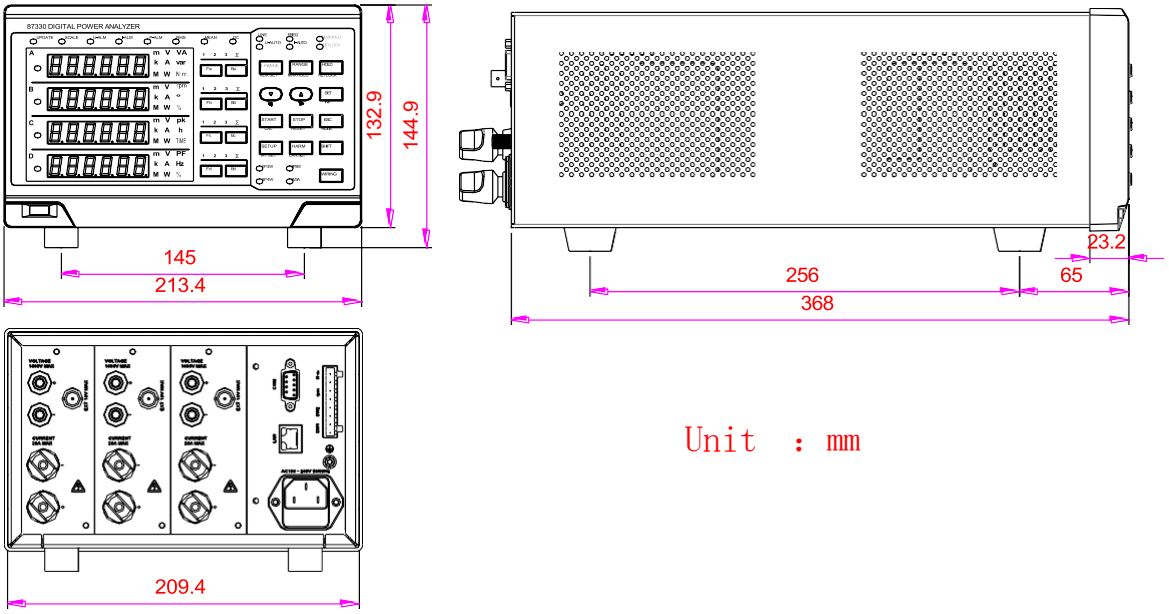


Figure 2-1: Outline dimension drawing

Chapter 3: Operation instruction

I. Introduction of front panel

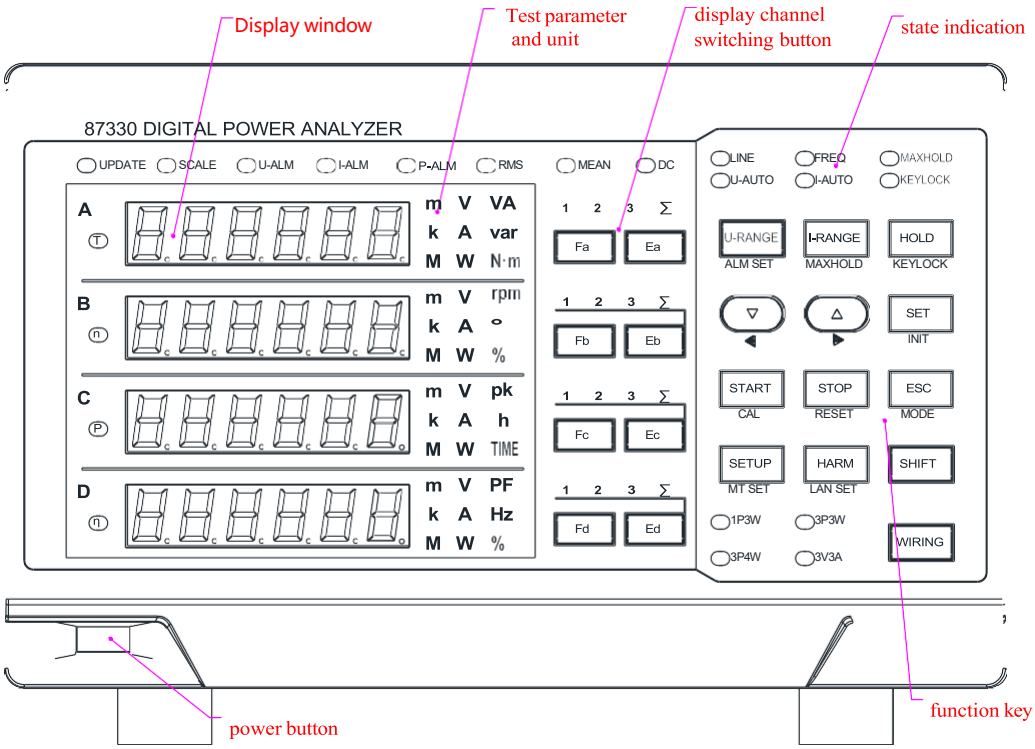


Figure 3-1: Schematic diagram for front panel of instrument

1. Display window:

Four display windows can display following test parameters respectively (see Table 3-1).

Table 3-1: Instrument test parameters description

Indicator lamp	Parameters	Unit	
V	Voltage	Volt	m, k, M indocator light: 1M—1000k 1k—1000 1m—0.001
A	Current	Ampere	
W	Active power	Watt	
VA	Apparent power	VA	
var	Reactive power	Var	
TIME	Time	Hour: Minute: Second	
PF	Power factor		
○	Phase angle	Degree	
%	Harmonic (B&D zone)		
%	Mechanical power (D zone)		
Vpk	Voltage peak	Volt	
Vpk	Current peak	Ampere	
Wh	Electric power	Wh	
Ah	Electric energy	Ah	
Hz	Frequency	Hz	
N·m	Torque	Nm	
rpm	Rotation speed	Rotation /min	

2. Character comparison table:

The instrument adopts seven-segment LED to display all characters and data, and display comparison for common number and character is shown in the figure below:

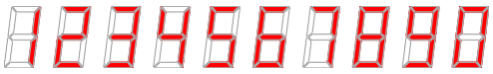


Figure 3-2: Display comparison of Arabic numerals

Figure 3-3: Display comparison of English letters

3. Meaning of special characters:

- - - - - - : Dash The dash is displayed for the time before starting integration and for abnormal harmonic source.

- - O H - - : Beyond range In the measured state, an overrange occurs when the measured voltage or current exceeds 110% of current range. When automatic range is used, the instrument will automatically shift upward, and overrange occurs when 110% of the maximum range is exceeded.

- - O L - - : Exceed max measurement value. In the measured state, when the measured voltage or current exceeds the maximum limit defined for this meter.

- - H H - - : Beyond upper limit In the measured state, when the measured voltage or current exceeds the upper limit setting of alarm.

- - L L - - : Beyond lower limit In the measured state, when the measured voltage or current is below the lower limit setting of alarm.

- ERROR : No signal In the harmonic state, when there is not signal input during interphase angle test.

- ADJXXX: Channel X coefficient is the initial value.

- BNCXXX: Channel X BNC coefficient is the initial value.

- ERROR1 : Abnormal communication between FPGA and STM32

- ERROR2 : Abnormal communication between network port chip and STM32

- HARM ERROR : Harmonic frequency acquisition is abnormal, all parameters are not displayed.

4. State indicator light:

Table 3-2: Status indicator light description

Indicator lamp	Meaning	Remarks
UPDATE	Data update indicator light	During normal operation, this indicator light is On with slight flashing
SCALE	Transformation ratio indicator light	When transformation ratio function is On, this indicator light is On
U-ALM	Voltage alarm indicator light	When voltage exceeds alarm setting value, this indicator light is On
I-ALM	Current alarm indicator light	When current exceeds alarm setting value, this indicator light is On
P-ALM	Power alarm indicator light	When power exceeds alarm setting value, this indicator light is On
RMS	Measurement mode for valid value	Valid value of measured signal
DC	Measurement mode for DC component	DC component of measured signal
MEAN	Measurement mode for average rectification value	Average rectification value for valid value of measured signal
I-AUTO	Auto current range indicator light	When current range is in auto selection mode, this indicator light is On
U-AUTO	Auto voltage range indicator light	When voltage range is in auto selection mod, this indicator light is On
LINE	Line filter indicator light	When line filter is On, this indicator light is On
FREQ	Frequency filter indicator light	When frequency filter is On, this indicator light is On
MAXHOLD	Max value holding indicator light	When MAXHOLD function in On, this indicator light is On
KEYLOCK	Key locking indicator light	When operation key is locked, this indicator light will flash
T	Torque indicator light	When displaying torque test interface, this indicator light is On
n	RPM indicator light	When displaying RPM measurement interface, this indicator light is On
P	Mechanical work indicator light	When displaying mechanical work measurement interface, this indicator light is On
η	mechanical power indicator light	When displaying mechanical power measurement interface, this indicator light is On
1P3W	Wiring system indicator light	Single-phase 3-wires
3P3W	Wiring system indicator light	Three-phase three-wire
3P4W	Wiring system indicator light	Three-phases 4-wires
3V3A	Wiring system indicator light	3-voltages, 3-currents

II. Description of rear panel

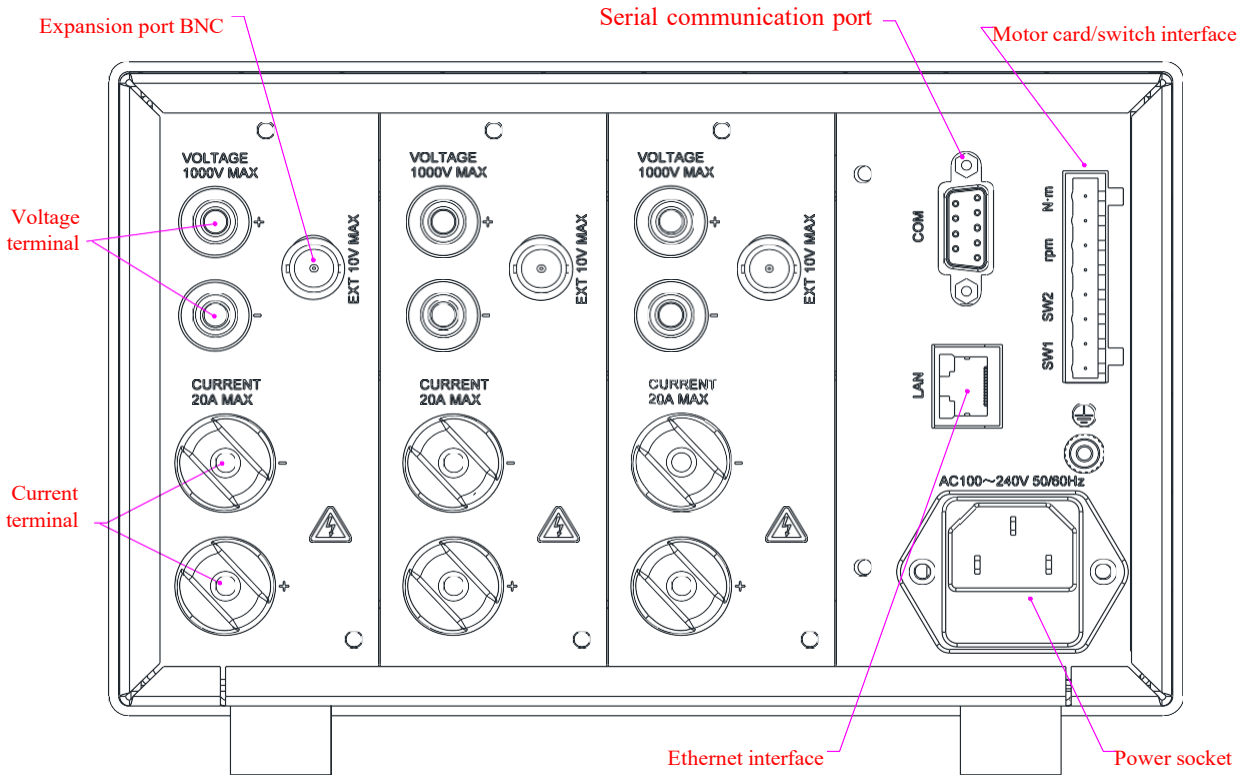


Figure 3-4: Schematic diagram for rear panel of instrument

1. The rear panel consists of following parts: Power socket, voltage/current terminal, serial port, extended BNC interface, motor card/switch interface, Ethernet port.

2. The power socket is the power input for meter. Fuse locates below the socket, 250V 3A.

3. The voltage/current terminals are the terminals that can be connected to measurement loop.

4, Serial port is RS232/RS485 optional, standard configuration RS232.

5, Network port is RJ-45 port.

III. Wiring description

1. Voltage input terminal

Terminal is safety bananas jack of Φ 4 mm.

Please insert the safety connector (conductor not exposed) into voltage input terminal. A voltage test line with safety connector and test clamp is provided with the box.

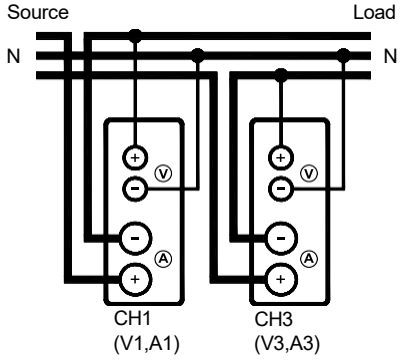
2. Current input terminal

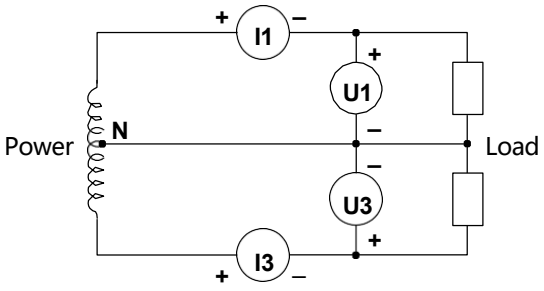
The terminals are M8 stud terminals. It is recommended to use professional OT wire-pressing terminal for pretreatment of test line, fasten the OT terminal to the stud, and then hold the terminal knob and tighten it. No current test line is provided with the box.

3. Configuration and wiring

The optional wiring method for analyzer depends on number of measurement channels configured. The wiring methods mainly include 1P3W, 3P3W, 3V3A, 3P4W, etc.

3.1 Wiring example of single-phase 3-wires (1P3W)



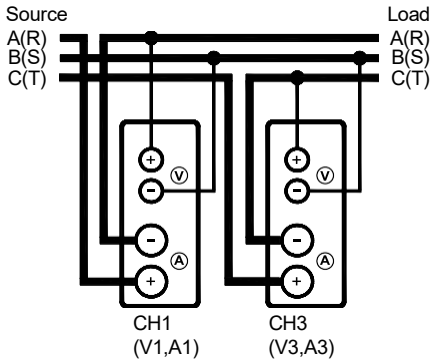


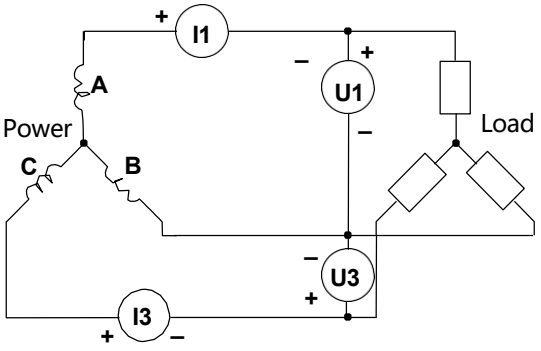
3.2 Wiring example of three-phases 3-wires (3P3W)

3P3W wiring must be in strict accordance with the following diagram, and the channel sequence cannot be changed.

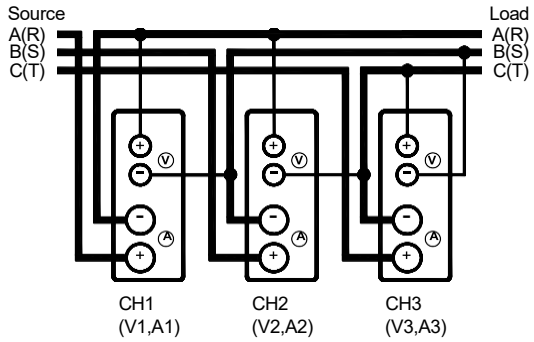
The power value of a single channel measured in 3P3W wiring may be negative, because the power is calculated by the line voltage and the phase current. The power of a single channel is meaningless. And the total three-phase power is meaningful.

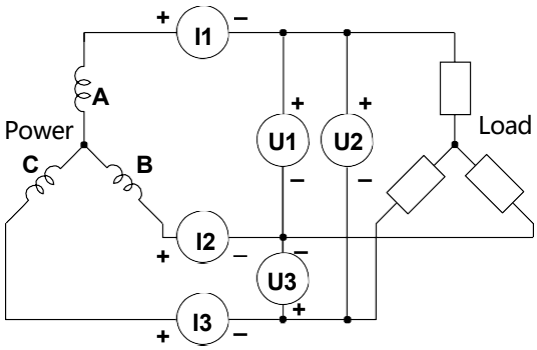
2-meters wiring (2V2A)



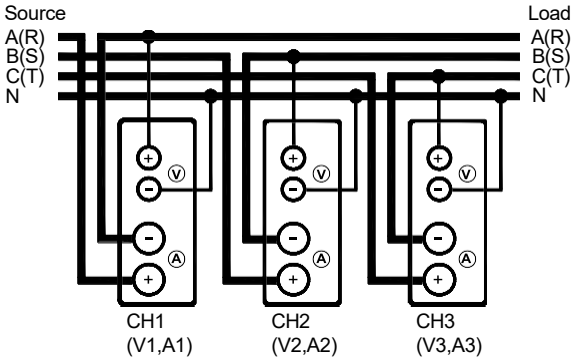


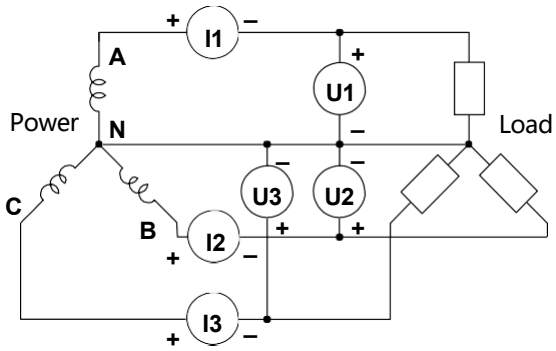
3- meters wiring (3V3A)



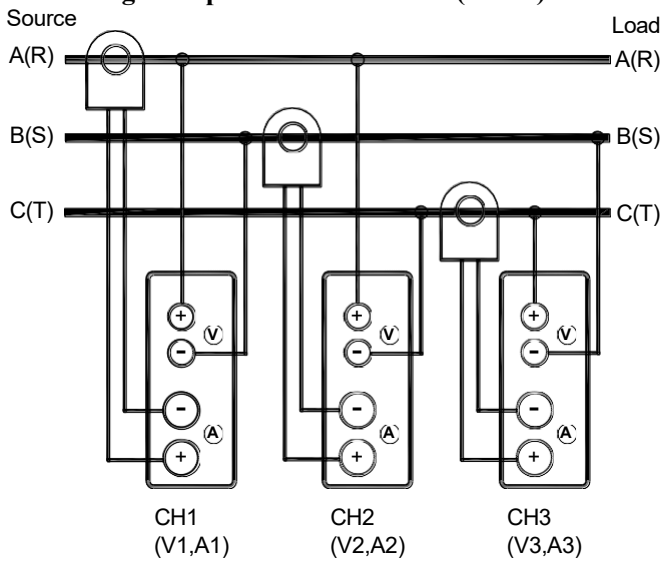


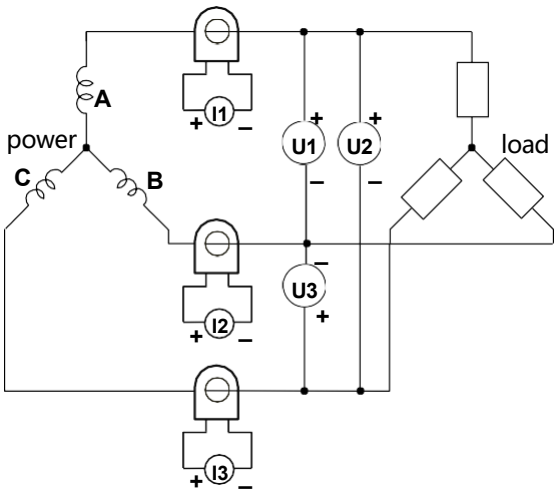
3.3 Wiring example of three-phases 4-wires (3P4W)





3.4 Wiring example of current sensor (3P4W)





4. Use metrological verification wiring of standard source

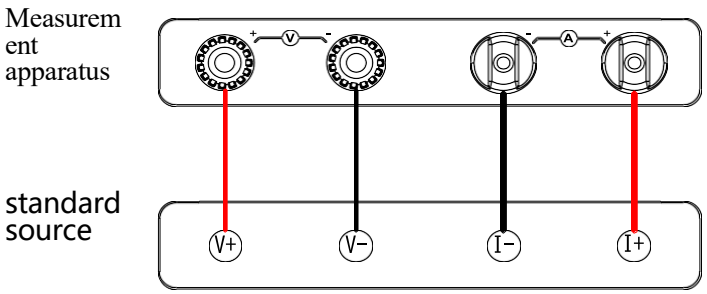


Figure 3-5: Schematic diagram for metrological verification wiring of standard source

5. Use metrological verification wiring of standard meter

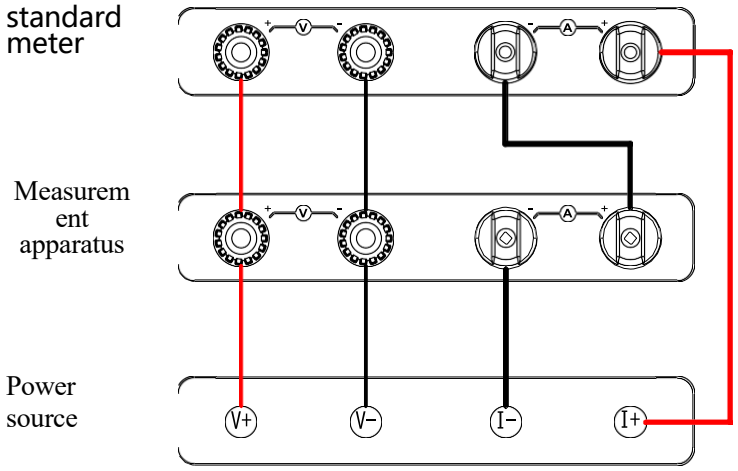


Figure 3-6: Schematic diagram for metrological verification wiring of standard meter

WARNING

Notes:

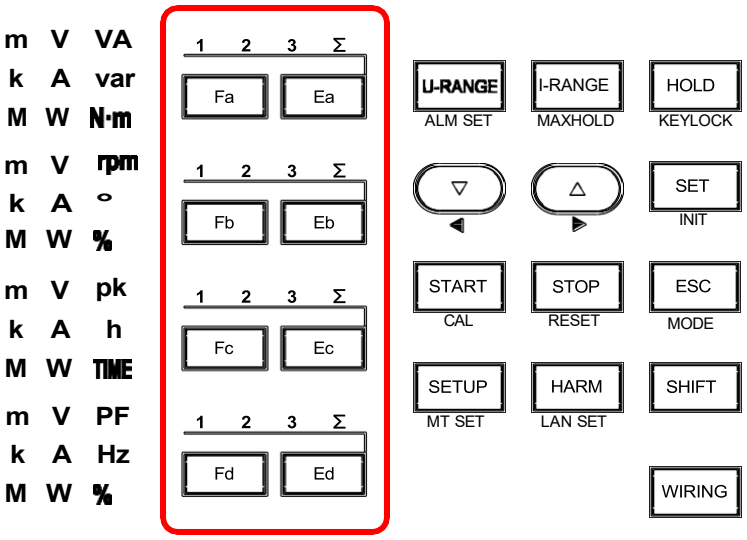
- Press combination key (SHIFT+SET) to restore factory settings (INIT) before metering.
- For current measurement, the input voltage of analyzer shall be greater than 60V.

6. Requirement for wire diameter

The current carrying capacity of copper conductor cables is specified in section 523 – Current carrying capacity, part V Building Installations, IEC, standard no.: IEC 60364-5-523 1983 When the measuring current of analyzer reaches 20A, it is recommended to use copper wires with a cross-sectional area ≥4mm2.

IV. Keys description

1. Functions of keys



Display selection key (Fa~Fd) : 4 in total. They are used to select content of each display window.

Fa : Switch among V, A, W, Va and var.

Fb : Switch among V, A, W and °. (A%, V% optional under harmonic state)

Fc : Switch among V, A, W, Vpk, Apk, Wh, Ah and TIME.

Fd : Switch among V, A, W, PF, Hz and %. (A%, V% optional under harmonic state)

Channel selection key (Ea~Ed) : 4 in total, they are used to select content of each display window respectively.

Display window A~D(Ea~Ed) : Switch among channel 1, channel 2, channel 3 and ∑.

Explain:

①When harmonic state is ON:

B zone A% and V% means the harmonic content of each order. EG: "01100.0" means harmonic content 100.0% in order 1; "03 12.4" means harmonic content 12.4% in order 3. Press "▼" or "▲" to switch order.

D zone A% and V% means ATHD and VTHD.

②When B zone "°" is ON, pressing Eb to switch among:

Phase angle: A-phase, B-phase, C-phase. (unit °)

Interface angle: U1 – U2, U2 – U3, U1 – U3. (unit V °)

interface angle: I1 – I2, I2 – I3, I1 – I3. (unit A °)

③When 'MT SET – MT - DISP' is ON, it is possible to display MT parameter:

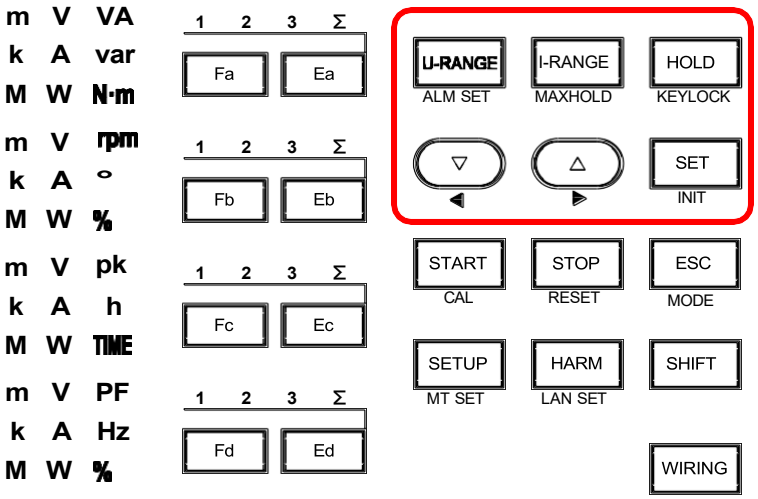
A zone can display torque: Press "Fa" until light "T" and "N·m" on.

B zone can display RPM: Press "Fb" until light "n" and "rmp" on.

C zone can display mechanical work: Press "Fc" until light "p" and "W" on.

D zone can display mechanical efficiency: Press "Fd" until light "η" and "%" on. The mechanical efficiency is mechanical power divided by electric power. The channel of the electric power is directed by the channel light, and can be switched by key "Ed".

④After the parameters of zones A, B, C and D are selected, the instrument will automatically remember the selected parameters, and data will not lose when shutting down.



Current range key (I-RANGE) : Enter current range selection interface.

Voltage range key (U-RANGE) : Enter voltage range selection interface.

Explain: In range selection interface, It is possible to press "▼" and "▲" to change range. Press "set" to save range and exit to test interface. Press "I-RANGE" / "U-RANGE" or "ESC" will exit to test state without saving range.

Direction key:

"▼"key: Decrease the setting parameter value at current flashing position or switch to next setting parameter.

"▲" key: Increase the setting parameter value at current flashing position or switch to next setting parameter.

"◄" key: Combination key (SHIFT+▼), left shift of circulation, change position of current Nixie tube (flashing position) of setting parameter.

"►" key: Combination key (SHIFT+▲), right shift of circulation, change position of current Nixie tube (flashing position) of setting parameter.

Set parameter key (SET) : Determine the selected item.

Restore factory setting key (INIT) : Combination key (SHIFT+ SET), restore all parameters to factory setting.

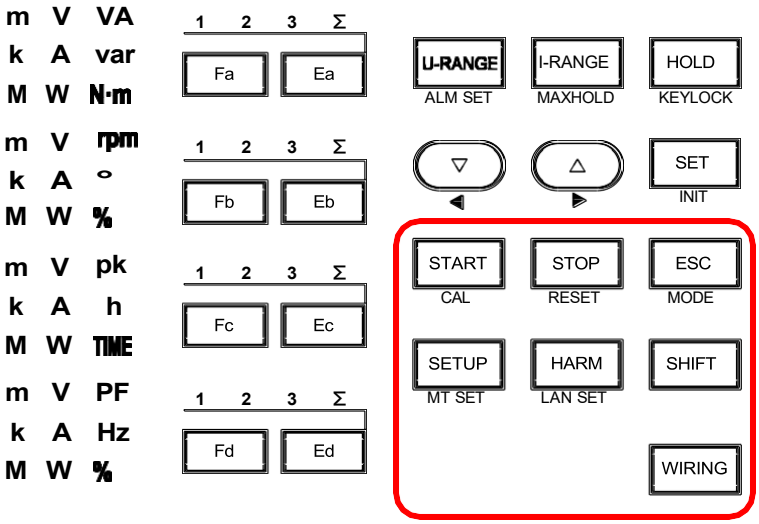
Esc key (ESC) : Close setting menu, return to measurement data interface.

Value holding key (HOLD) : The current display data stops updating and holds. Pressing "HOLD" key again can update display again.

Key locking key (KEYLOCK) : Combination key (SHIFT+HOLD), when this key is pressed, the key is locked. Press again to unlock.

Max value holding key (MAXHOLD) : Combination key (SHIFT+I-RANGE), with this feature enabled, if the measured value is larger than the current holding value, the larger value will be remained.

Three-phase parameter alarm setting key(ALM SET) : Combination key (SHIFT+U-RANGE). It is used to set alarm parameters for three-phase voltage, current and power. See page 20 for details.



Start key (START) : Press in test state, start integral of electric energy. During accumulation of electric energy, the TIME parameter will accumulate every second.

Stop key (STOP) : When electric energy is in state of **START**, press in test state to stop integral of electric energy.

Reset key (RESET) : Combination key (SHIFT+STOP), when electric energy is in state of **STOP**, press this key to reset the electric energy record time record.

Zero calculation key (CAL) **:** Combination key (SHIFT+START), press in test state, calculate zero point of current shift.

Mode key (MODE) : Combination key (SHIFT+ESC), it is used for switching among measurement modes RMS, DC and MEAN.

Shift functional key (SHIFT) : Press SHIFT once, key light will be On, indicating that this key is in switching state, it can be used for reusing corresponding function given by key name below relevant key. Pressing SHIFT key again can release the switching state.

Wiring system switching key (WIRING): Switch among single-phase 3-wires, three-phases 3-wires, three-phases 4-wires and 3-voltages 3-currents.

Harmonic key (HARM) : Enable /disable harmonic function

Explain: When harmonic state is ON:

B zone A% and V% means the harmonic content of each order. EG: 01100.0 means the harmonic content of the order 1 is 100.0%; 03 12.4 means the harmonic content of the order 3 is 12.4%. Press '▼' or '▲' to switch order.

D zone A% and V% means ATHD and VTHD.

Setup key (SETUP) : Set the ordinary parameters like scale, com, harmonic and source. See page 17 for details.

Network setting key (LAN SET) : Combination key (SHIFT+HARM) Set the TCP parameters like IP address and port. See page 19 for details.

Motor setting key (MT SET) : Combination key (SHIFT+SETUP) : Set the MT parameters. See page 21 for details.

2. The operation of the setting interface

Press these four keys can enter different setting interface:

SETUP: Set the ordinary parameters like scale, com, harmonic and source.

LAN SET: Combination key (SHIFT+HARM). Set the TCP parameters like IP address and port.

ALM SET: Combination key (SHIFT+U-RANGE). Set the alarm parameters for three-phase voltage, current and power.

MT SET: Combination key (SHIFT+SETUP). Set the MT parameters.

The operation logics are same in these setting interface. In SETUP case:

Step 1: In the test state, press “SETUP” to enter ordinary parameters setting interface.

Step 2: press “▼” or “▲” to switch parameter type to be set, character in display window B will flash;

Step 3: press "SET" key to determine the parameter to be set, and characters in display window C will flash;

Step 4: press “▼”、“▲”、“◀”、 “▶” key to set parameters;

Step 5: press "SET" key to confirm setting and return to previous menu. Repeat the above steps to continue setting other parameters;

Step 6: press "SETUP" key again to save the instrument settings and exit to the test state.

notes:

1. Some parameters require the energy state to be “RESET”.
2. Pressing “ESC” will exit to test state without save.

3. The list of the setting interface

SETUP: Set the ordinary parameters like scale, com, harmonic and source.

Table 3-3: Parameter Settings of the instrument system

Window A Display character	Window B Display character	Window C Set parameter	Description
diSP DISP	uPdAtE UPDATE	Display refreshing rate	0.1s、0.2s、0.5s、1s、2s、5s、10s Default value: 0.5s
UoLt VOLT	SCALE SCALE	Voltage transformation ratio	1.0-5000.0 Default value: 1.0
CurrT CURR	SCALE SCALE	Current transformation ratio	1.0-5000.0 Default value: 1.0
bnc BNC	SCALE SCALE	BNC transformation ratio	0.010-100.000mV/A Default value: 1.000mV/A
PoR POR	AMPLIT AMPLIT	Threshold current for integral of electric energy	0.000A-22.000A Default value: 0.000A When the measured current value is greater than this value, the electric energy begins to integrate
	TIME TIME	Integral time of electric energy	HH.MM.SS (Hour. Minute. Second) Default 00.00.00 Integral time. Max 48h. When it set to 00.00.00 means time not limit.
CoM COM	AddR ADDR	Communication address	1-255 Default value: 1
	bAud BAUD	Baud rate of communication	Optional value: 9600，19200，38400 Default value: 38400
	MODE MODE	Selection of communication mode	Serial port RS23, network port TCP Default value: RS232
	PRotO PROTO	Communication protocol specification	In serial mode: REXGEAR protocol, MODBUS protocol Default: REXGEAR protocol In network port mode: RTU(MODBUS protocol), TCP(MODBUS-TCP) protocol Default: RTU protocol

ALA AL A	bEEP BEEP	Buzzer alarm switch	ON/OFF Default value: ON
	thrE THRE	Zero threshold switch	ON/OFF Default value: ON ON – no alarm for zero value, OFF- alarm for zero value
FLit FLIT	LinE LI NE	Line filter switch	ON/OFF Default value: OFF OFF - off, 1 - 500Hz, 2 - 5.5kHz
	FrE FRE	Frequency filter switch	ON/OFF Default value: OFF
SYnc SYNC	SourCE S OUR CE	Selection of sync source	U1, I1, U2, I2, U3, I3 Default value: U1
CurrT CURR	SourCE S OUR CE	Selection of current source	Current AMP, BNC input BNC Default value: AMP
hArn H A R M	SourCE S OUR CE	Selection of harmonic source	U1, I1, U2, I2, U3, I3 Default value: U1
inTEG I N T E G	nodE M O D E	Selection of integral mode	Normal mode NOR, continuous integral mode CONT Default value: NOR
thd T H D	nodE M O D E	Selection of THD calculation formula	IEC mode CSA mode Default value: IEC
AVE A V E	nodE M O D E	Selection of mean processing mode	Average mobile LIN, average index EP Default value: LIN
	En E N	Enable/disable average function	ON/OFF Default value: OFF
	Count C O U N T	Average coefficient	8/16/32. Default value: 8
SAVE SAVE	rAnGE R AN GE	Range Save Switch	ON/OFF Default value: OFF When set to ON, the range will saved after shut down.
CF C F		Selection of peak factor	3,6 Default value: 3

LAN SET: Combination key (SHIFT+HARM). Set the TCP parameters like IP address and port.

Note: Mac address is static hardware address that cannot be changed by user.

Table 3-4: Parameter Settings for network port of instrument

Window A Display character	Window B Display character	Window C Set parameter	Description
IP	ADDR1	IP address 1	0-255 Default value: 192
	ADDR2	IP address 2	0-255 Default value: 168
	ADDR3	IP address 3	0-255 Default value: 1
	ADDR4	IP address 4	0-255 Default value: 10
NM	ADDR1	Subnet mask 1	0-255 Default value: 255
	ADDR2	Subnet mask 2	0-255 Default value: 255
	ADDR3	Subnet mask 3	0-255 Default value: 255
	ADDR4	Subnet mask 4	0-255 Default value: 0
GATE	ADDR1	Gateway 1	0-255 Default value: 192
	ADDR2	Gateway 2	0-255 Default value: 168
	ADDR3	Gateway 3	0-255 Default value: 1
	ADDR4	Gateway 4	0-255 Default value: 1
LOCAL	PORT	Local port	0-9999 Default value: 502
TCP	TIME	TCP connection time	0-9999 Default value: 0 Short connection, reconnect if timeout; if "0", it is a long connection

ALM SET: Combination key (SHIFT+U-RANGE). Set the alarm parameters for three-phase voltage, current and power.

Table 3-5: Setting of instrument alarm parameters

Window A Display character	Window B Display character	Window C Set parameter	Description
VOLT	UPLIT	Upper limit of voltage alarm	0.00V-1000.00V Default value: 1000.00V, when the measured voltage is larger than this value, upper alarm will be triggered
	LOLIT	Lower limit of voltage alarm	0.00V-1000.00V Default value: 0.00V, when the measured voltage is less than this value, lower alarm will be triggered
	THRE	Threshold value of voltage alarm	0.00V-1000.00V Default value: 0.00V, only when the measured voltage is larger than this value, the alarm function will be valid
CURR	UPLIT	Upper limit of current alarm	0.000A-22.000A Default value: 22.000A, when the measured current is larger than this value, upper alarm will be triggered
	LOLIT	Lower limit of current alarm	0.000A-22.000A Default value: 0.000A, when the measured current is less than this value, lower alarm will be triggered
	THRE	Threshold value of current alarm	0.000A-22.000A Default value: 0.000A, only when the measured current is larger than this value, the alarm function will be valid
POR	UPLIT	Upper limit of power alarm	0.00W-66.000kW Default value: 22.000kW, when the measured power is larger than this value, upper alarm will be triggered
	LOLIT	Lower limit of power alarm	0.00W-66.000kW Default value: 0.00W, when the measured power is less than this value, lower alarm will be triggered
	THRE	Threshold value of power alarm	0.00W-66.000kW Default value: 0.00W, only when the measured power is larger than this value, the alarm function will be valid
ALA	TIME	Alarm delay time	0.0-20.0s Default value: 0.0 , when the alarm occurs, the timing will start. If the parameters are still over the limit at the end of timing, the alarm will start

MT SET: Combination key (SHIFT+SETUP). Set the MT parameters.

Table 3-6: Parameter settings of instrument motor

Window A Display character	Window B Display character	Window C Set parameter	Description
MT	DISP	MT display switch	ON/OFF Default value: OFF
NM	RANGE	Full torque range (Nm)	0-1000.0 Represent 0-1000.0Nm Default value: 10
	FREHI	Forward full range output frequency f_p (kHz)	0.001-99.999 Represent 0-99.999kHZ Default value: 15
	FRELO	Negative full range output frequency f (kHz)	0.001-99.999 Represent 0-99.999kHZ Default value: 5
	FREMI	Output frequency at zero point of torque f_0 (kHz)	0.001-99.999 Represent 0-99.999kHZ Default value: 10
RPM	NUM	Output frequency pulse count of torque	1-1000 represent 1-1000 pieces Default value: 60

ATTENTION Notes: Hold down (SHIFT+INIT) in the regular setting interface to set parameter to default value, and hold down (SHIFT+STOP) in "MT SET" setting interface to collect zero point data, ensuring that the collection can be completed only when frequency at this time is between the preset forward full range output frequency and reverse full range output frequency.

Chapter 4: Description of the main functions

I. Measure and calculate

The principle of power analyzer calculation is to sample voltage and current for 200000 times per second. Then power analyzer calculates all electrical parameters according to the sampling data. The following is the calculation formula of some electrical parameters. (Analog)

1. Current and Voltage

Take the voltage $u(t)$ in T period as an example. The calculation formula of each mode:

RMS

$$U_{rms} = \sqrt{\frac{1}{T}\int_0^T u^2(t)\,dt}$$

DC

$$U_{dc} = \frac{\int_0^T u(t)\,dt}{T}$$

MEAN

$$U_{mean} = \frac{\int_0^T |u(t)|\,dt}{T}$$

2. Power

Power calculation does not distinguish among modes:

$$P = \frac{\int_0^T u(t)i(t)\,dt}{T}$$

$$\mathrm{S} = U_{rms} \times I_{rms}$$

$$\mathrm{Q} = \sqrt{S^2 - P^2}$$

3. Three-phase parameter calculation

Press “WIRING” to Switch among wirings.

1P3W：

$$P_\Sigma = P_1 + P_3$$
$$U_\Sigma = \frac{U_1 + U_3}{2}$$
$$I_\Sigma = \frac{I_1 + I_3}{2}$$

3P3W：

2V2A

$$P_\Sigma = P_1 + P_3$$
$$U_\Sigma = \frac{U_1 + U_3}{2}$$
$$I_\Sigma = \frac{I_1 + I_3}{2}$$

3V3A

$$P_\Sigma = P_1 + P_3$$

$$U_\Sigma = \frac{U_1 + U_2 + U_3}{3}$$

$$I_\Sigma = \frac{I_1 + I_2 + I_3}{3}$$

3P4W：

$$P_\Sigma = P_1 + P_2 + P_3$$

$$U_\Sigma = \frac{U_1 + U_2 + U_3}{3}$$

$$I_\Sigma = \frac{I_1 + I_2 + I_3}{3}$$

II. Range select

1. Manual

The power analyzer voltage and current have eight range respectively. Press “I-RANGE/U-RANGE” to enter range selection interface.

In range selection interface, press “▼” and “▲” to change range. Press “set” to save range and exit to test interface. Press “I-RANGE/U-RANGE” or “ESC” will exit to test state without saving range.

2. Automatic

In automatic mode, light “U-AUTO/I-AUTO” on. If RMS Value is Lower than 30% of range or higher than 110%, the range will shift automatically.

3. Settings

Range Save Switch (SETUP – RANGE -SAVE): When set to ON, the range will saved after shut down.

4. Note

The value cannot be measured normally when range is shifting. So please do not read the value immediately when range is changing. Wait at least 0.5s plus two refresh periods.

III. Harmonic

1. Function description

Press “HARM” to enable harmonic function.

B zone and D zone on screen is able to display harmonic parameters.

B zone A% and V% means the harmonic content of each order. EG: 01100.0 means harmonic content 100.0% in order 1; 03 12.4 means harmonic content 12.4% in order 3. Press ‘▼’ or ‘▲’ to switch order.

D zone A% and V% means ATHD and VTHD.

2. Settings

Ensure that the harmonic source has stable 10-600Hz signal when the harmonic is turned on. Otherwise, "HARM ERROR" will be displayed on the screen.

Harmonic source can be change in SETUP – HARM – SOURCE. Default harmonic source is U1.

3. Harmonic mode (SETUP – THD – MODE) description

The calculation formula of IEC mode:

$$\left[\sqrt{\sum_{k=2}^{n}(C_k)^2}\ /C_1\right]$$

The calculation formula of CSA mode:

$$\left[\sqrt{\sum_{k=2}^{n}(C_k)^2}\right] / \left[\sqrt{\sum_{k=1}^{n}(C_k)^2}\right]$$

IV. Communication

The power analyzer is equipped with network port and serial port. The relevant communication settings are as follows. See Chapter 6 for the communication protocol

1. Serial mode

The communication mode (SETUP – COM - MODE) needs to be set to RS232; The baud rate of communication (SETUP – COM - BAUD) needs to be set to be same as the computer. The Communication protocol (SETUP - COM – PROTO) needs to match the computer.

Default serial type is RS232, RS485 optional. The interface of computer , power analyzer and communication line shall be of the same type.

The COM port of the upper computer software should select the COM port witch actually connected to the power analyzer.

2. Network port mode

SETUP: Communication mode needs to be set to TCP. The Communication protocol (SETUP - COM – PROTO) needs to match the upper computer.

LAN SET (SHIFT + HARM) : The IP address and Local port is set correctly on the upper computer and the power analyzer.

V. Integral

1. **Function description**

Press “START” to start integral. In START state, Press “STOP” to stop integral. In STOP mode, Press “RESET” (SHIFT + STOP) to clear all the integral date.

Screen C zone is possible to display integral data: TIME – Integral time. Wh - Electric power. Ah - Electric energy.

2. Settings

Threshold current for integral of electric energy (SETUP – POR - AMPLIT): When the measured current value is greater than this value, the electric energy begins to integrate.

Integral time of electric energy (SETUP – POR - TIME) : The integration will automatically stop when reaches this time.

3. Notes

Range changing will affect the integration accuracy. It is recommended to reduce the shift action during integration.

After pressing “STOP”, the integration will not stop immediately, but will stop in an integer second. The calculation of the average power of the short-term integration needs to wait until the integration stops.

VI. Current sensor

The current sensor directly outputs the current signal. The power analyzer can directly measure the current signal. It can also be connected to the output voltage signal of the sampling resistance by BNC port.

1. Current sensor for output current

Connection: Take a typical sensor as an example. The sensor has four interfaces: +15V, -15V, M, GND. Connect the sensor ±15V and GND to the external power supply. Connect sensor M to the positive (red) current input of the power analyzer and GND to the negative (black) current input of the power analyzer.

Settings: Current source (SETUP – CURR - SOURCE) needs to be AMP. Current transformation ratio (SETUP – CURR - SCALE) needs to be set as the ratio of the current sensor.

Circuit diagram: See Page 11.

2. Current sensor for output voltage

Connection: The sensor has four interfaces: +15V, -15V, EXT port, GND. Connect the sensor ± 15V and GND to the external power supply. Connect sensor EXT port and the BNC port of power analyzer.

Settings: Current source (SETUP – CURR - SOURCE) needs to be BNC. BNC transformation ratio (SETUP – BNC - SCALE) needs to be set as appropriate value. For example, the ratio of the current sensor is 2000: 1 and the sampling resistance is 5Ω. According to the calculation, the output voltage is 2.5mV when the actual current is 1A, so the BNC transformation ratio should be set to 2.5mV/A.

Circuit diagram: Similar as Page 11.

VII. Average function

When the power supply, load or low frequency signal input changes abruptly, the data may fluctuate greatly, and the average function can be used to stabilize the display value.

1. Settings

" SETUP – AVE – EN" : Enable/disable average function;

" SETUP – AVE – COUNT" : Set average coefficient;

" SETUP – AVE – MODE" : Selection of mean processing mode.

2. calculation formula

If D_n is the current display value, S_n is the current measure value, and K is the average coefficient.

LIN:

$$D_n = \frac{S_n + S_{n-1} \ldots S_{(n-K+1)}}{\mathrm{K}}$$

EP:

$$D_n = \frac{1}{K} S_n + \frac{K-1}{K} D_{n-1}$$

3. Notes

When the average function is on, the following values will be averaged: P , U_{rms} ,U_{dc} , I_{rms} , I_{dc} , other value will not be averaged.

The power analyzer will automatically shift range according to the averaged value, but if the peak value of the measurement overflows, it will shift immediately.

After shifting, the average value in the cache will be discarded.

VII. Alarm function

The instrument has the functions of over-limit alarm.

1. Function description

When the measured value is greater than the threshold value, make alarm judgment. If it is higher than the upper limit or lower than the lower limit, delay for a period of time to trigger the alarm action:

The alarm lights U-ALM, I-ALM, P-ALM are on.

Display interface displays alarm characters. " - - HH - - " means higher than the upper limit. " - - LL - - " means lower than the lower limit.

2. Settings

Press "ALM SET" (SHIFT+U-RANGE) to enter the alarm parameters setting interface: Set upper limit, lower limit and threshold value of U, I, P.

Press "SETUP" to enter the ordinary parameters setting interface: The buzzer alarm switch (SETUP - ALA - BEEP) can set whether the buzzer sounds when alarming. Zero value threshold switch (SETUP – ALA - THRE) can set whether to alarm when there is no input signal.

Chapter 5: Description of external interfaces

There is a 9-pin D-type communication port (male port) on rear panel of analyzer, which can provide RS-232 or RS-485 communication data transmission function, and a LAN interface which can be used for network port communication.

I. RS-232/485 communication port

The analyzer provides two serial ports for users to select, RS-232 and RS-485. For 87330, it is RS-232 by default, and the product is equipped with a standard RS-232 communication line. RS-485 communication shall be explained at the time of ordering (special RS-485 communication cable is equipped for product delivered).

1. Definition of RS-232 communication port

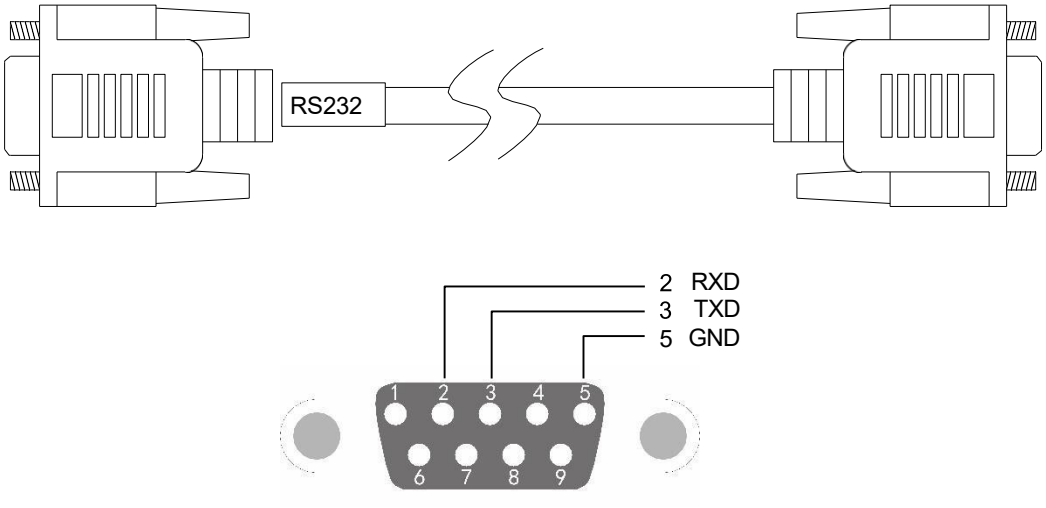
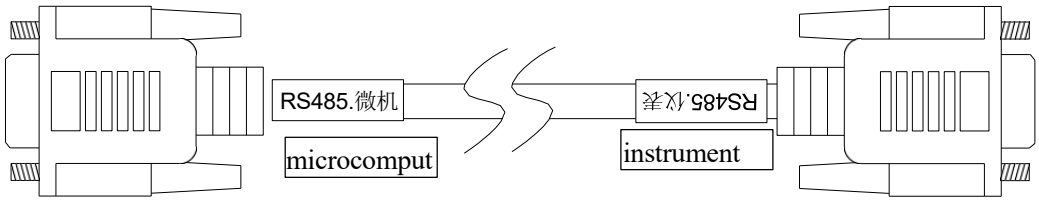


Figure 4-1: Definition of RS-232 cable port (same definition for microcomputer and instrument)

Microcomputer (9-pins female)	Instrument (9-pins female)
1	1
2	3
3	2
4	6
5	5
6	4
7	8
8	7
9	9
Metal housing	Metal housing (connection with metal shielding layer)

2. Defination of RS-485 communication port



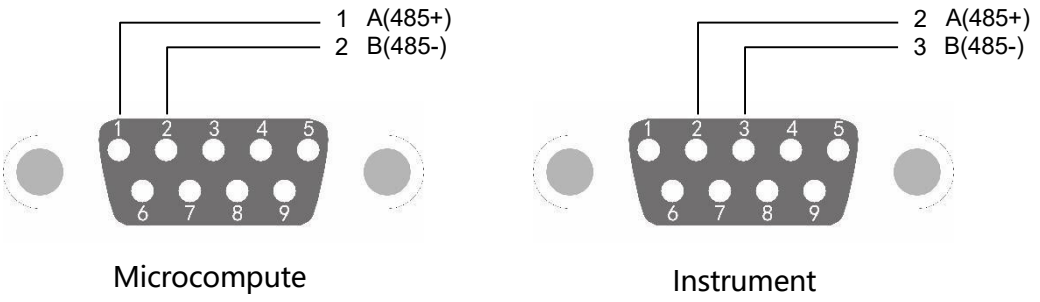


Figure 4-2: Definition of RS-485 cable port

Microcomputer (9-pins female)	Instrument (9-pins female)
1	2
2	3
Metal housing	Metal housing (connection with metal shielding layer)

II. Ethernet communication port

Interface	RJ-45
Standard	IEEE802.3
Protocol	UTP
Transmission rate	10/100Mbps

ATTENTION Notes: The communication address and baud rate of instrument shall be same as that of upper computer. The analyzer supports REXGEAR internal protocol, Modbus general protocol and Modbus/TCP protocol.

Chapter 6: Communication protocol appendix

I. Modbusrtu communication protocol

1. Query category

Note: (In the specification, X stands for channel no. 1-3 of power analyzer. It reads no more than 100 bytes each time, and can only be read continuously within range of each parameter. The harmonic content shall be read separately. The reading test parameters include voltage, current and BNC transformation ratio)

1.1 Frame format

1.1.1 Read contents of meter register (function code 03H) as shown in table 1:

Sequence	Code	Example	Description
1	Instrument address	01H	nstrument communicationaddress (01H-FFH, representing 1-255)
2	03H	03H	Function code (query)
3	High byte of starting register address	11H	Starting address of register 1100H
4	Low byte of starting register address	00H	
5	High byte of number of registers	00H	Number of registers 02H
6	Low byte of number of registers	02H	
7	Low byte of CRC16 check	C1H	CRC check data
8	High byte of CRC16 check	37H	

Table 1

1.1.2 The frame format (correct instruction) of instrument echo is shown in table 2:

Sequence	Code	Description
1	Instrument address	nstrument communicationaddress (01H-FFH, representing 1-255)
2	03H	Function code (query)
3	Echo data domain byte (M)	
------	First register data	
	Nth register data	
M+4	Low byte of CRC16 check	
M+5	High byte of CRC16 check	

Table 2

1.1.3 The query instruction is wrong, and the meter echo content is shown in table 3:

Sequence	Code	Example	Description
1	Instrument address	01H	nstrument communicationaddress (01H-FFH,

			representing 1-255)
2	83H	83H	Function code (query instruction error)
3	02H	02H	Error code
4	Low byte of CRC check	C0H	
5	High byte of CRC check	F1H	

Table 3

Error code:
01H —— Function code error
02H ——Instruction length error
03H ——Reading register error

1.2 Description about register address

Serial number	**Register address** Hexadecimal	Data name	Data Format	Register Number	Number of bytes	Remarks	Description
1	1X00H	Valid value of voltage (V)	Float32	2	4	Read-only	Normal parameter
2	1X02H	Valid value of current (mA)	Float32	2	4	Read-only	
3	1X04H	Power (W)	Float32	2	4	Read-only	
4	1X06H	Power factor	Float32	2	4	Read-only	
5	1X08H	Apparent power (Va)	Float32	2	4	Read-only	
6	1X0AH	Reactive power (Var)	Float32	2	4	Read-only	
7	1X0CH	Voltage frequency (HZ)	Float32	2	4	Read-only	
8	1X0EH	Current frequency (HZ)	Float32	2	4	Read-only	
9	1X10H	Phase angle (°)	Float32	2	4	Read-only	
10	1X12H	Rectified mean value of voltage (V)	Float32	2	4	Read-only	
11	1X14H	Simple mean value of voltage (V)	Float32	2	4	Read-only	
12	1X16H	High point of voltage peak (V)	Float32	2	4	Read-only	
13	1X18H	Low point of voltage peak (V)	Float32	2	4	Read-only	
14	1X1AH	Voltage peak (V)	Float32	2	4	Read-only	
15	1X1CH	Rectified mean value of current (mA)	Float32	2	4	Read-only	
16	1X1EH	Simple mean value of current (mA)	Float32	2	4	Read-only	
17	1X20H	High point of current peak (mA)	Float32	2	4	Read-only	
18	1X22H	Low point of current peak (mA)	Float32	2	4	Read-only	
19	1X24H	Current peak (mA)	Float32	2	4	Read-only	

20	1X26H	Running time of electric energy – h	Float32	2	4	Read-only	Electric energy parameter
21	1X28H	Running time of electric energy - min	Float32	2	4	Read-only	
22	1X2AH	Running time of electric energy - s	Float32	2	4	Read-only	
23	1X2CH	Energy value of positive voltage (Wh)	Float32	2	4	Read-only	
24	1X2EH	Energy value of negative voltage (Wh)	Float32	2	4	Read-only	
25	1X30H	Electric energy value (Wh)	Float32	2	4	Read-only	
26	1X32H	Energy value of positive voltage (mAh)	Float32	2	4	Read-only	
27	1X34H	Energy value of negative voltage (mAh)	Float32	2	4	Read-only	
28	1X36H	Electric energy (mAh)	Float32	2	4	Read-only	
29	1X38H	RPM	Float32	2	4	Read-only	Motor parameter
30	1X3AH	Torque (Nm)	Float32	2	4	Read-only	
31	1X3CH	Mechanical work (W)	Float32	2	4	Read-only	
32	1X3EH	Mechanical efficiency of each channel (%)	Float32	2	4	Read-only	
33	1X40H	Total mechanical efficiency of three phases (%)	Float32	2	4	Read-only	
34	2X00H	Valid value of current base wave (mA)	Float32	2	4	Read-only	Harmonic parameter
35	2X02H	Valid value of voltage base wave (V)	Float32	2	4	Read-only	
36	2X04H	Valid value of power base wave (W)	Float32	2	4	Read-only	
37	2X06H	Total distortion of current harmonics (%)	Float32	2	4	Read-only	
38	2X08H	Total distortion voltage harmonics (%)	Float32	2	4	Read-only	
39	2X0AH	Total distortion power harmonics (%)	Float32	2	4	Read-only	
40	2X0CH	Apparent power of base wave (VA)	Float32	2	4	Read-only	
41	2X0EH	Reactive power of base wave (var)	Float32	2	4	Read-only	
42	2X10H	Power factor of base wave	Float32	2	4	Read-only	
43	2X12H	U1-U2 phase angle (°)	Float32	2	4	Read-only	
44	2X14H	U2-U3 phase angle (°)	Float32	2	4	Read-only	
45	2X16H	U1-U3 phase angle (°)	Float32	2	4	Read-only	

46	2X18H	I1-I2 phase angle (°)	Float32	2	4	Read-only	
47	2X1AH	I2-I3 phase angle (°)	Float32	2	4	Read-only	
48	2X1CH	I1-I3 phase angle (°)	Float32	2	4	Read-only	
49	2X1E~4FH	Content of current harmonics *100(%)(1~50, hexadecimal, back haul 0BH, correspond to 12, represent 0.12%)	int	50	100	Read-only	
50	2X50~81H	Content of voltage harmonics *100(%)(1~50, hexadecimal, back haul 0BH, correspond to 12, represent 0.12%)	int	50	100	Read-only	
51	3000H	Total voltage of three phases (V)	Float32	2	4	Read-only	Three-phase parameter
52	3002H	Total current of three phases (mA)	Float32	2	4	Read-only	
53	3004H	Total power of three phases (W)	Float32	2	4	Read-only	
54	3006H	Power factor of three phases	Float32	2	4	Read-only	
55	3008H	Apparent power of three phases (VA)	Float32	2	4	Read-only	
56	300AH	Reactive power of three phases (var)	Float32	2	4	Read-only	
57	301CH	Total Energy value of positive voltage (Wh)	Float32	2	4	Read-only	
58	301EH	Total Energy value of negative voltage (Wh)	Float32	2	4	Read-only	
59	3020H	Total Electric energy value (Wh)	Float32	2	4	Read-only	
60	3022H	Total Energy value of positive voltage (mAh)	Float32	2	4	Read-only	
61	3024H	Total Energy value of negative voltage (mAh)	Float32	2	4	Read-only	
62	3026H	Total Electric energy (mAh)	Float32	2	4	Read-only	

Setting category (read-only)

Serial number	Register address Hexadecimal	Data name	Data Format	Register Number	Number of bytes	Remarks	Description
1	5000H	Integral time (range in minutes: 0-5000)	Float 32	2	4	Read-only	Control specific param
2	5002H	Integral state (Range 0-2, 0 - zeroing, 1 - starting, 2 - stopping)	Float32	2	4	Read-only	

3	5004H	Load type of 123 channel (range: 0-3， 0—1P3W，1—3P3W，2—3P4W，3—3V3A)	Float32	2	4	Read-only	eter
4	5006H	Calculation cycle (range 0-6, 0 - 0.1s, 1 - 0.2s, 2 - 0.5s, 3 - 1s, 4 - 2s, 5 - 5s, 6 - 10s)	Float32	2	4	Read-only	
5	5X08H	Voltage range of each channel. Range 0-7 representing 8 ranges of voltage, 8 for auto range. (0—15V，1—30 V，2—60 V，3—100 V，4—150 V，5—300 V，6—600 V，7—1000 V)	Float32	2	4	Read-only	
6	5X0AH	Current range of each channel. Range 0-7 representing 8 ranges of current , 8 for auto range. (0 - 100mA, 1 - 200mA, 2 - 500mA, 3 - 1A, 4 - 2A, 5 - 5A, 6 - 10A, 7 - 20A)	Float32	2	4	Read-only	
7	5X0CH	Current source of each channel (range 2-3, 2 – BNC input, 3 – direct input)	Float32	2	4	Read-only	
8	5X0EH	Sync source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)	Float32	2	4	Read-only	
9	5010H	Harmonic source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)	Float32	2	4	Read-only	
10	5012H	Harmonic switch (range 0-1, 0 – off (normal measurement), 1 - On (harmonic measurement))	Float32	2	4	Read-only	
11	5014H	Line filter (range 0-2, 0 - off, 1 - 500Hz, 2 - 5.5kHz)	Float32	2	4	Read-only	
12	5016H	Frequency filter (range 0-1, 0 - off, 1 - on)	Float32	2	4	Read-only	
13	5018H	Max range of torque (range 0-10000, representing 0-1000.0Nm)	Float32	2	4	Read-only	
14	501AH	Max output frequency of torque (range 0-9999, representing 0-99.99kHz)	Float32	2	4	Read-only	Motor param eter
15	501CH	Max output frequency of torque (range 0-9999, representing 0-99.99kHz)	Float32	2	4	Read-only	
16	501EH	Zero point of output frequency of torque (range 0-9999, representing 0-99.99kHz)	Float32	2	4	Read-only	
17	5020H	Number of pulses per turn of motor (range 0-1000, representing 0-1000)	Float32	2	4	Read-only	
18	5022H	Voltage transformation ratio (range 10-50000, representing 1.0-5000.0)	Float32	2	4	Read-only	Transf ormati
19	5024H	Current transformation ratio (range 10-50000, representing 1.0-5000.0)	Float32	2	4	Read-only	

20	5026H	BNC transformation ratio (range 10-100000, representing 0.010-100.000mV/A)	Float32	2	4	Read-only	on ratio param eter

1.3 Example of instrument communication data (all data below will be in hexadecimal)

(1) Read instrument voltage (channel 1):

A, Send from upper machine

01H	03H	11H	00H	00H	02H	C1H	37H
Instrument address	Command	Starting register address, high, low bytes		Number of register, high, low bytes		CRC check, low, high bytes	

B, Data returned from instrument: Voltage=238.97V

01H	03H	04H	43H	6EH	F8H	A0H	CDH	D2H
Instrument address	Command	Number of bytes	Float32 data, high byte in front				CRC check code	

(2) Read instrument voltage, current and power:

A, Send from upper machine

01H	03H	11H	00H	00H	06H	C0H	F4H
Instrument address	Command	Starting register address, high, low bytes		Number of register, high, low bytes		CRC check, low, high bytes	

B, Data returned from instrument: Voltage =230.8V, current =4.089A, power =943.88W

01H	03H	0CH	43,66,CD,C8-40,82,DD,6E-44,6B,F8,45	6FH	A2H
Instrument address	Command	Number of bytes	Float32 data, high byte in front	CRC check code	

2. Setting category

2.1 frame format

2.1.1 Set contents of meter register (function code 06H) as shown in table 4:

Sequence	Code	Example	Description
1	Instrument address	01H	nstrument communicationaddress (01H-FFH representing 1-255)

2	06H	06H	Function code (setting)
3	High byte of starting register address	20H	Register address 2000H
4	Low byte of starting register address	00H	
5	Write high byte of data	00H	Write data 01H Write data of BNC transformation ratio, four bytes, and CRC check bit corresponds to a rear two bytes.)
6	Write low byte of data	01H	
7	Low byte of CRC16 check	43H	CRC check data
8	High byte of CRC16 check	CAH	

Table 4

2.1.2 Frame format of instrument echo: If written correctly, the meter will echo with same frame format as given in table 4.

2.1.3 The setting instruction is wrong, and the instrument echo is shown in table 5:

Sequence	Code	Example	Description
1	Instrument address	01H	nstrument communicationaddress (01H-FFH, representing 1-255)
2	86H	86H	Function code (setting instruction error)
3	03H	03H	Error code
4	High byte of CRC check	02H	
5	Low byte of CRC check	61H	

Table 5

Error code:

01H —— Function code error
02H—— Instruction length error
03H ——Reading register error
04H —— Error of setting beyond range

2.2 Register address description

Serial number	**Register address** Hexadecimal	Data name	Data Format	Register Number	Number of bytes	Remarks	Description
1	4000H	Integral time (range in minutes: 0-2880, 48h)	int32	1	2	Write only	
2	4001H	Integral state (Range 0-2, 0 - zeroing, 1 - starting, 2 - stopping)	int32	1	2	Write only	
3	4002H	Load type of 123 channel (range: 0-3，0— 1P3W，1—3P3W，2—3P4W，3—3V3A)	int32	1	2	Write only	

4	4003H	Calculation cycle (range 0-6, 0 - 0.1s, 1 - 0.2s, 2 - 0.5s, 3 - 1s, 4 - 2s, 5 - 5s, 6 - 10s)	int32	1	2	Write only	
5	4004H	Voltage range of each channel. Range 0-7 representing 8 ranges of voltage, 8 for auto range. (0—15V，1—30 V，2—60 V，3—100 V，4—150 V，5—300 V，6—600 V，7—1000 V)	int32	1	2	Write only	
6	4005H	Current range of each channel. Range 0-7 representing 8 ranges of current , 8 for auto range. (0 - 100mA, 1 - 200mA, 2 - 500mA, 3 - 1A, 4 - 2A, 5 - 5A, 6 - 10A, 7 - 20A)	int32	1	2	Write only	
7	4006H	Current source of each channel (range 2-3, 2 – BNC input, 3 – direct input)	int32	1	2	Write only	
8	4007H	Sync source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)	int32	1	2	Write only	
9	4008H	Harmonic source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)	int32	1	2	Write only	
10	4009H	Harmonic siwtch (range 0-1, 0 – off (normal measurement), 1 - On (harmonic measurement))	int32	1	2	Write only	Control specific parameter
11	400AH	Frequency filter for channel 1 (range 0-1, 0 - off, 1 - on)	int32	1	2	Write only	
12	400BH	Line filter for channel 1 (range 0-2, 0 - off, 1 - 500Hz, 2 - 5.5kHz)	int32	1	2	Write only	
13	400CH	Max range of torque (range 0-10000, representing 0-1000.0Nm)	int32	1	2	Write only	Motor setting parameter
14	400DH	Max output frequency of torque (range 0-9999, representing 0-99.99kHz)	int32	1	2	Write only	
15	400EH	Max output frequency of torque (range 0-9999, representing 0-99.99kHz)	int32	1	2	Write only	
16	400FH	Zero point of output frequency of torque (range 0-9999, representing 0-99.99kHz)	int32	1	2	Write only	
17	4010H	Number of pulses per turn of motor (range 0-1000, representing 0-1000)	int32	1	2	Write only	
18	4011H	Voltage transformation ratio (range 10-50000, representing 1.0-5000.0)	int32	1	2	Write only	Transformation ratio
19	4012H	Current transformation ratio (range 10-50000, representing 1.0-5000.0)	int32	1	2	Write only	

20	4013H	BNC transformation ratio (range 10-100000, representing 0.010-100.000)	int32	2	4	Write only	parameter

2.3 Example of instrument communication data (all data below will be in hexadecimal)

(1) Set load type for channel 1, 2, 3:

Send from upper machine: Set to 1P3W

01H	06H	40H	02H	00H	01H	FCH	0AH
Instrument address	Command	Starting register address, high, low bytes		2-bytes data bit		CRC check, low, high bytes	

(2) Set voltage range:

Send from upper machine: Set to 30V

01H	06H	40H	04H	00H	01H	1CH	0BH
Instrument address	Command	Starting register address, high, low bytes		2-bytes data bit		CRC check, low, high bytes	

II. ModbusTCP communication specification

1. Query category

Note: (In the specification, X stands for channel no. 1-3 of power analyzer. It reads no more than 100 bytes each time, and can only be read continuously within range of each parameter. The harmonic content shall be read separately. The reading test parameters include voltage, current and BNC transformation ratio)

1.1 Frame format

1.1.1 Read contents of meter register (function code 03H) as shown in table 1:

Sequence (byte)	Code	Example	Description
1	High byte of transaction processing identifier	00H	Identification for Modbus request response/response transaction processing (client generation, service machine returns original value)
2	Low byte of transaction processing identifier	01H	
3	High byte of protocol identifier	00H	0000H=Modbus protocol
4	Low byte of protocol identifier	00H	
5	High byte of frame data length	00H	Start calculating length from 7th byte
6	Low byte of frame data length	06H	
7	Instrument address	01H	Nstrument communicationaddress (01H-FFH, representing 1-255)
8	Function code	03H	Function code (query)
9	High byte of starting register	11H	Starting address of register 1100H

	address		
10	Low byte of starting register address	00H	
11	High byte of number of registers	00H	Number of registers 02H
12	Low byte of number of registers	02H	

Table 1

1.1.2 The frame format (correct instruction) of instrument echo is shown in table 2:

Sequence (byte)	Code	Description
1	High byte of transaction processing identifier	Identification for Modbus request response/response transaction processing (client generation, service machine returns original value)
2	Low byte of transaction processing identifier	
3	High byte of protocol identifier	0000H=Modbus protocol
4	Low byte of protocol identifier	
5	High byte of frame data length	Start calculating length from 7th byte
6	Low byte of frame data length	
7	Instrument address	Nstrument communicationaddress (01H-FFH, representing 1-255)
8	03H	Function code (query)
9	Echo data domain byte (M)	
------	First register data	
M+9	Nth register data	

Table 2

1.1.3 The query instruction is wrong, and the meter echo content is shown in table 3:

Sequence	Code	Example	Description
1	High byte of transaction processing identifier	00H	Identification for Modbus request response/response transaction processing (client generation, service machine returns original value)
2	Low byte of transaction processing identifier	01H	
3	High byte of protocol identifier	00H	0000H=Modbus protocol
4	Low byte of protocol identifier	00H	
5	High byte of frame data length	00H	Start calculating length from 7th byte
6	Low byte of frame data length	03H	
7	Instrument address	01H	nstrument communicationaddress (01H-FFH, representing 1-255)

8	83H	83H	Function code (query instruction error)
9	02H	02H	Error code

Table 3

Error code:
01H —— Function code error
02H —— Instruction length error
03H —— Reading register error

1.2 Description about register address

Serial number	**Register address** Hexadecimal	Data name	Data Format	Register Number	Number of bytes	Remarks	Description
1	1X00H	Valid value of voltage (V)	Float32	2	4	Read-only	Normal parameter
2	1X02H	Valid value of current (mA)	Float32	2	4	Read-only	
3	1X04H	Power (W)	Float32	2	4	Read-only	
4	1X06H	Power factor	Float32	2	4	Read-only	
5	1X08H	Apparent power (Va)	Float32	2	4	Read-only	
6	1X0AH	Reactive power (Var)	Float32	2	4	Read-only	
7	1X0CH	Voltage frequency (HZ)	Float32	2	4	Read-only	
8	1X0EH	Current frequency (HZ)	Float32	2	4	Read-only	
9	1X10H	Phase angle (°)	Float32	2	4	Read-only	
10	1X12H	Rectified mean value of voltage (V)	Float32	2	4	Read-only	
11	1X14H	Simple mean value of voltage (V)	Float32	2	4	Read-only	
12	1X16H	High point of voltage peak (V)	Float32	2	4	Read-only	
13	1X18H	Low point of voltage peak (V)	Float32	2	4	Read-only	
14	1X1AH	Voltage peak (V)	Float32	2	4	Read-only	
15	1X1CH	Rectified mean value of current (mA)	Float32	2	4	Read-only	
16	1X1EH	Simple mean value of current (mA)	Float32	2	4	Read-only	
17	1X20H	High point of current peak (mA)	Float32	2	4	Read-only	
18	1X22H	Low point of current peak (mA)	Float32	2	4	Read-only	
19	1X24H	Current peak (mA)	Float32	2	4	Read-only	
20	1X26H	Running time of electric energy – h	Float32	2	4	Read-only	Electric energy parameter
21	1X28H	Running time of electric energy - min	Float32	2	4	Read-only	

22	1X2AH	Running time of electric energy - s	Float32	2	4	Read-only	
23	1X2CH	Energy value of positive voltage (Wh)	Float32	2	4	Read-only	
24	1X2EH	Energy value of negative voltage (Wh)	Float32	2	4	Read-only	
25	1X30H	Electric energy value (Wh)	Float32	2	4	Read-only	
26	1X32H	Energy value of positive voltage (mAh)	Float32	2	4	Read-only	
27	1X34H	Energy value of negative voltage (mAh)	Float32	2	4	Read-only	
28	1X36H	Electric energy (mAh)	Float32	2	4	Read-only	
29	1X38H	RPM	Float32	2	4	Read-only	Motor parameter
30	1X3AH	Torque (Nm)	Float32	2	4	Read-only	
31	1X3CH	Mechanical work (W)	Float32	2	4	Read-only	
32	1X3EH	Mechanical efficiency of each channel (%)	Float32	2	4	Read-only	
33	1X40H	Total mechanical efficiency of three phases (%)	Float32	2	4	Read-only	
34	2X00H	Valid value of current base wave (mA)	Float32	2	4	Read-only	Harmonic parameters
35	2X02H	Valid value of voltage base wave (V)	Float32	2	4	Read-only	
36	2X04H	Valid value of power base wave (W)	Float32	2	4	Read-only	
37	2X06H	Total distortion of current harmonics (%)	Float32	2	4	Read-only	
38	2X08H	Total distortion voltage harmonics (%)	Float32	2	4	Read-only	
39	2X0AH	Total distortion power harmonics (%)	Float32	2	4	Read-only	
40	2X0CH	Apparent power of base wave (VA)	Float32	2	4	Read-only	
41	2X0EH	Reactive power of base wave (var)	Float32	2	4	Read-only	
42	2X10H	Power factor of base wave	Float32	2	4	Read-only	
43	2X12H	U1-U2 phase angle (°)	Float32	2	4	Read-only	
44	2X14H	U2-U3 phase angle (°)	Float32	2	4	Read-only	

45	2X16H	U1-U3 phase angle (°)	Float32	2	4	Read-only	
46	2X18H	I1-I2 phase angle (°)	Float32	2	4	Read-only	
47	2X1AH	I2-I3 phase angle (°)	Float32	2	4	Read-only	
48	2X1CH	I1-I3 phase angle (°)	Float32	2	4	Read-only	
49	2X1E~4FH	Content of current harmonics *100(%) (1~50, hexadecimal, back haul 0BH, correspond to 12, represent 0.12%)	int	50	100	Read-only	
50	2X50~81H	Content of voltage harmonics *100(%) (1~50, hexadecimal, back haul 0BH, correspond to 12, represent 0.12%)	int	50	100	Read-only	
51	3000H	Total voltage of three phases (V)	Float32	2	4	Read-only	Three-phase parameter
52	3002H	Total current of three phases (mA)	Float32	2	4	Read-only	
53	3004H	Total power of three phases (W)	Float32	2	4	Read-only	
54	3006H	Power factor of three phases	Float32	2	4	Read-only	
55	3008H	Apparent power of three phases (VA)	Float32	2	4	Read-only	
56	300AH	Reactive power of three phases (var)	Float32	2	4	Read-only	
57	301CH	Total Energy value of positive voltage (Wh)	Float32	2	4	Read-only	
58	301EH	Total Energy value of negative voltage (Wh)	Float32	2	4	Read-only	
59	3020H	Total Electric energy value (Wh)	Float32	2	4	Read-only	
60	3022H	Total Energy value of positive voltage (mAh)	Float32	2	4	Read-only	
61	3024H	Total Energy value of negative voltage (mAh)	Float32	2	4	Read-only	
62	3026H	Total Electric energy (mAh)	Float32	2	4	Read-only	

Setting category (read-only)

Serial number	Register address Hexadecimal	Data name	Data Format	Register Number	Number of bytes	Remarks	Description
1	5000H	Integral time (range in minutes: 0-5000)	Float 32	2	4	Read-only	Control specific parameter
2	5002H	Integral state (Range 0-2, 0 - zeroing, 1 - starting, 2 - stopping)	Float32	2	4	Read-only	
3	5004H	Load type of 123 channel (range: 0-3， 0—1P3W，1—3P3W，2—3P4W，3—3V3A)	Float32	2	4	Read-only	
4	5006H	Calculation cycle (range 0-6, 0 - 0.1s, 1 - 0.2s, 2 - 0.5s, 3 - 1s, 4 - 2s, 5 - 5s, 6 - 10s)	Float32	2	4	Read-only	
5	5X08H	Voltage range of each channel. Range 0-7 representing 8 ranges of voltage, 8 for auto range. (0—15V，1—30 V，2—60 V，3—100 V，4—150 V，5—300 V，6—600 V，7—1000 V)	Float32	2	4	Read-only	
6	5X0AH	Current range of each channel. Range 0-7 representing 8 ranges of current , 8 for auto range. (0 - 100mA, 1 - 200mA, 2 - 500mA, 3 - 1A, 4 - 2A, 5 - 5A, 6 - 10A, 7 - 20A)	Float32	2	4	Read-only	
7	5X0CH	Current source of each channel (range 2-3, 2 – BNC input, 3 – direct input)	Float32	2	4	Read-only	
8	5X0EH	Sync source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)	Float32	2	4	Read-only	
9	5010H	Harmonic source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)	Float32	2	4	Read-only	
10	5012H	Harmonic switch (range 0-1, 0 – off (normal measurement), 1 - On (harmonic measurement))	Float32	2	4	Read-only	
11	5014H	Line filter (range 0-2, 0 - off, 1 - 500Hz, 2 - 5.5kHz)	Float32	2	4	Read-only	
12	5016H	Frequency filter (range 0-1, 0 - off, 1 - on)	Float32	2	4	Read-only	
13	5018H	Max range of torque (range 0-10000, representing 0-1000.0Nm)	Float32	2	4	Read-only	
14	501AH	Max output frequency of torque (range 0-9999, representing 0-99.99kHz)	Float32	2	4	Read-only	

15	501CH	Max output frequency of torque (range 0-9999, representing 0-99.99kHz)	Float32	2	4	Read-only	Motor parameter
16	501EH	Zero point of output frequency of torque (range 0-9999, representing 0-99.99kHz)	Float32	2	4	Read-only	
17	5020H	Number of pulses per turn of motor (range 0-1000, representing 0-1000)	Float32	2	4	Read-only	
18	5022H	Voltage transformation ratio (range 10-50000, representing 1.0-5000.0)	Float32	2	4	Read-only	Transformation ratio parameter
19	5024H	Current transformation ratio (range 10-50000, representing 1.0-5000.0)	Float32	2	4	Read-only	
20	5026H	BNC transformation ratio (range 10-100000, representing 0.010-100.000mV/A)	Float32	2	4	Read-only	

1.3 **Example of instrument communication data (all data below will be in hexidecimal)**

(1) Read instrument voltage (channel 1):

A, Send from upper machine

0001H	0000H	0006H	01H	03H	11H	00H	00H	02H
Transaction processing identifier	Modbus protocol	Frame data length	Instrument address	Command	Starting register address, high, low bytes		Number of register, high, low bytes	

B, Data returned from instrument: Voltage=238.97V

0001H	0000H	0007H	01H	03H	04H	43H	6EH	F8H	A0H
Transaction processing identifier	Modbus protocol	Frame data length	Instrument address	Command	Number of bytes	Float32 data, high byte in front			

(2) Read instrument voltage, current and power:

A, Send from upper machine

0001H	0000H	0006H	01H	03H	11H	00H	00H	06H
Transaction processing identifier	Modbus protocol	Frame data length	Instrument address	Command	Starting register address, high, low bytes		Number of register, high, low bytes	

B, Data returned from instrument: Voltage =230.8V, current =4.089A, power =943.88W

0001H	0000H	000FH	01H	03H	0CH	43,66,CD,C8-40,82,DD,6E-44,6B,F8,45
Transaction processing identifier	Modbus protocol	Frame data length	Instrument address	Command	Number of bytes	Float32 data, high byte in front

2. Setting category

2.1 frame format

2.1.1 Set contents of meter register (function code 06H) as shown in table 4:

Sequence	Code	Example	Description
1	High byte of transaction processing identifier	00H	Identification for Modbus request response/response transaction processing (client generation, service machine returns original value)
2	Low byte of transaction processing identifier	01H	
3	High byte of protocol identifier	00H	0000H=Modbus protocol
4	Low byte of protocol identifier	00H	
5	High byte of frame data length	00H	Start calculating length from 7th byte
6	Low byte of frame data length	06H	
7	Instrument address	01H	nstrument communicationaddress (01H-FFH representing 1-255)
8	06H	06H	Function code (setting)
9	High byte of starting register address	20H	Register address 2000H
10	Low byte of starting register address	00H	
11	Write high byte of data	00H	Write data 01H
12	Write low byte of data	01H	

Table 4

2.1.2 Frame format of instrument echo: If written correctly, the meter will echo with same frame format as given in table 4.

2.1.3 The setting instruction is wrong, and the instrument echo is shown in table 5:

Sequence	Code	Example	Description
1	High byte of transaction processing identifier	00H	Identification for Modbus request response/response transaction processing

2	Low byte of transaction processing identifier	01H	(client generation, service machine returns original value)
3	High byte of protocol identifier	00H	0000H=Modbus protocol
4	Low byte of protocol identifier	00H	
5	High byte of frame data length	00H	Start calculating length from 7th byte
6	Low byte of frame data length	03H	
7	Instrument address	01H	nstrument communicationaddress (01H-FFH, representing 1-255)
8	86H	86H	Function code (setting instruction error)
9	03H	03H	Error code

Table 5

Error code:
01H ——Function code error
02H ——Instruction length error
03H —— Reading register error
04H ——Error of setting beyond range

2.2 Register address description

Serial number	Register address Hexadecimal	Data name	Data Format	Register Number	Number of bytes	Remarks	Description
1	4000H	Integral time (range in minutes: 0-2880, 48h)	int32	1	2	Write only	
2	4001H	Integral state (Range 0-2, 0 - zeroing, 1 - starting, 2 - stopping)	int32	1	2	Write only	
3	4002H	Load type of 123 channel (range: 0-3，0— 1P3W，1—3P3W，2—3P4W，3—3V3A)	int32	1	2	Write only	
4	4003H	Calculation cycle (range 0-6, 0 - 0.1s, 1 - 0.2s, 2 - 0.5s, 3 - 1s, 4 - 2s, 5 - 5s, 6 - 10s)	int32	1	2	Write only	
5	4004H	Voltage range of each channel. Range 0-7 representing 8 ranges of voltage, 8 for auto range. (0—15V，1—30 V，2—60 V，3—100 V，4—150 V，5—300 V，6—600 V，7—1000 V)	int32	1	2	Write only	
6	4005H	Current range of each channel. Range 0-7 representing 8 ranges of current , 8 for auto range.	int32	1	2	Write only	

		(0 - 100mA, 1 - 200mA, 2 - 500mA, 3 - 1A, 4 - 2A, 5 - 5A, 6 - 10A, 7 - 20A)					
7	4006H	Current source of each channel (range 2-3, 2 – BNC input, 3 – direct input)	int32	1	2	Write only	
8	4007H	Sync source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)	int32	1	2	Write only	
9	4008H	Harmonic source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)	int32	1	2	Write only	
10	4009H	Harmonic siwtch (range 0-1, 0 – off (normal measurement), 1 - On (harmonic measurement)	int32	1	2	Write only	Control specific parameter
11	400AH	Line filter for channel 1 (range 0-2, 0 - off, 1 - 500Hz, 2 - 5.5kHz)	int32	1	2	Write only	
12	400BH	Frequency filter for channel 1 (range 0-1, 0 - off, 1 - on)	int32	1	2	Write only	
13	400CH	Max range of torque (range 0-10000, representing 0-1000.0Nm)	int32	1	2	Write only	Motor setting parameter
14	400DH	Max output frequency of torque (range 0-9999, representing 0-99.99kHz)	int32	1	2	Write only	
15	400EH	Max output frequency of torque (range 0-9999, representing 0-99.99kHz)	int32	1	2	Write only	
16	400FH	Zero point of output frequency of torque (range 0-9999, representing 0-99.99kHz)	int32	1	2	Write only	
17	4010H	Number of pulses per turn of motor (range 0-1000, representing 0-1000)	int32	1	2	Write only	
18	4011H	Voltage transformation ratio (range 10-50000, representing 1.0-5000.0)	int32	1	2	Write only	Transformation ratio parameter
19	4012H	Current transformation ratio (range 10-50000, representing 1.0-5000.0)	int32	1	2	Write only	
20	4013H	BNC transformation ratio (range 10-100000, representing 0.010-100.000)	int32	2	4	Write only	

2.3 Example of instrument communication data (all data below will be in hexidecimal)

(1) Set load type for channel 1, 2, 3:

Send from upper machine: Set to 1P3W

0001H	0000H	0006H	01H	06H	40H	01H	00H	00H
Transaction processing	Modbus protocol	Frame data length	Instrument address	Comm and	Starting register address, high, low bytes		2-bytes data bit	

identifier						

(2) Set voltage range (channel 1) :

Send from upper machine: Set to 30V

0001H	0000H	0006H	01H	06H	40H	04H	00H	01H
Transaction processing identifier	Modbus protocol	Frame data length	Instrument address	Command	Starting register address, high, low bytes		2-bytes data bit	

III. REXGEAR communication protocol

1. Protocol description

1.1 Communication function test

Connect the measuring instrument with upper computer, and open software of upper computer. Before starting communication function test, please set the measuring instrument as required: In "SETUP", communication address (Addr) is set to 1, Baud rate is set to 38400 (or consistent with ones in software of upper computer). After successful setting, return to standby mode.

Note: For other commands and detailed format, see contents below.

1.2 Communication handshake protocol

In the measurement and control network consisting of upper computer (PC) and lower computer (87330 measuring instrument), each communication is initiated by upper computer first, and ended with response of lower computer. One-way handshake protocol is adopted.

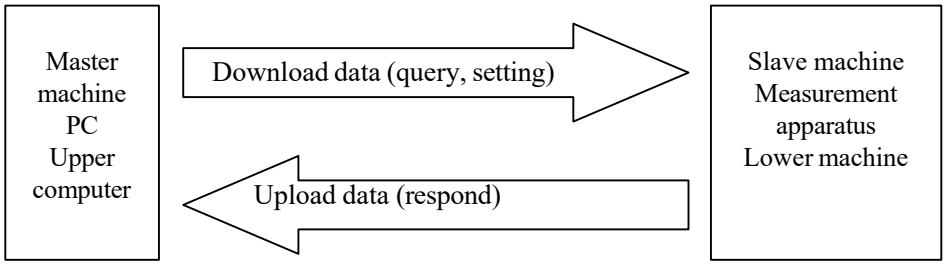


Figure A-1: Handshake protocol

1.3 Communication data format

1, Communication baud rate can be set to 9600, 19200, 38400 manually, default setting is 38400.
2, Address of this mache can be set at will, the range is 1~255.
3, Data frame format is: One starting bit, seven data bits, one stop bit, total 10 bits.
4, Communication can be divided into two types: receiving information and transmitting information. The unified information format is as follows:

Frame head	Total number of bytes	Slave address	Command			Check sum	Frame end
			Class	Command word	Parameters		
0x7B	0xXXXX	0xXX	0xXX	0xXX	0xXXXXX	0xXX	0x7D

Frame head: 1 byte, fixed at 0x7B, the ASCII code of '{'.

Total number of bytes： 2 bytes, the value is the sum of "frame head + Total number of bytes + slave

address + command Class + command word + command parameter + check sum+ frame end" bytes. The high bytes first, and the low bytes last.

Address: 1 byte, communication address of measurement apparatus.

Command <parameter> string: Different byte length, the length of each command is shown in "Communication Command Description".

Check sum: 1 byte (hexadecimal), the check result for the sent data. Horizontal check is adopted, that is, the sum of total bytes + address + command < parameter> string, and low byte is taken as the check sum.

Frame end: 1 byte, fixed to 0x7D, the ASCII code of '{'.

Table A-1: Communication command description

Command			Functions
Class	Command word	Parameters	
Query category (0xF1)	0x00	1 byte (channel no.)	Query normal measurement parameter (including transformation ratio)
	0x01	1 byte (channel no.)	Query relevant parameters of electric energy
	0x02	1 byte (channel no.)	Query parameters in three-phases (including transformation ratio)
	0x03	1 byte (channel no.)	Query relevant parameters of motor
	0x04	1 byte (channel no.)	Query harmonic parameter
	0x05	-	Query phase angle
	0x06	-	Query overview test data (including transformation ratio)
Setting category (0x5A)	0x00	2 bytes (setting data)	Setting specific command set
	0x01	50 bytes (setting data)	Setting alarm specific parameters

ATTENTION When accumulation of electric energy is not started or reset, it is not allowed to set transformation ratio, calculation mode, calculation cycle, current threshold for accumulation of electric energy, and timing for electric energy.

A.4.1 Query specific commands (0xF1)

(1) Query normal measurement parameter (including transformation ratio)

Command character: 0x00

Function: Query all normal measurement parameters

Query valid voltage value (6 bytes) for current channel, valid current value (6 bytes), active power (8 bytes), power factor (2 bytes), apparent power (8 bytes), reactive power (6 bytes), phase angle (2 bytes), voltage frequency (4 bytes), current frequency (4 bytes), rectified mean value of voltage (6 bytes), DC component of voltage (6 bytes), positive voltage peak (6 bytes),,negative voltage peak (6 bytes), voltage peak (6 bytes), rectified mean value of current (6 bytes), DC component of current (6 bytes), positive current peak (6 bytes), negative current peak (6 bytes), current peak (6 bytes) in turn.

Sample: Receive by this machine——7B 00 09 01 F1 00 01 FC 7D

Transmit from this machine——7B 00 73 01 F1 00 01 00 00 00 00 E6 61 00 00 00 03 9B 34 00 00 00 00 00 02 1F 35 26 F8 00 00 00 00 00 02 20 7A 00 00 00 00 25 28 00 27 00 00 C7 3A 00 00 C7 3A 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01 46 20 FF FF FF FE B9 E7 00 00 00 01 46 20 00 00 00 00 2C DB 00 00 00 00 2C DB 00 00 00 05 B8 71 FF FF FF FB 1C B6 00 00 00 05 B8 71 XX 7D

Instructions for receiving: Underline byte 01 represents channel to be queried, range is 01-03, representing CH1-CH3.

Instructions for transmitting:

1) Byte 00 00 00 00 E6 61 corresponds to 58977, representing valid voltage value

58.977V;

2) Byte 00 00 00 03 9B 34 corresponds to 236340, representing valid current value 236.340mA;

3) Byte 00 00 00 00 00 02 1F 35 corresponds to 139061, representing active power 13.9061W;

4) Byte 26 F8 corresponds to 9976, representing power factor 0. 9976;

5) Byte 00 00 00 00 00 02 20 7A corresponds to 139386, representing apparent power 13.9386;

6) Byte 00 00 00 00 25 28 corresponds to 9512, representing reactive power 0.9512;

7) Byte 00 27 corresponds to 39, representing phase angle 3.9°;

8) Byte 00 00 C7 3A corresponds to 51002, representing voltage frequency 51.002Hz;

9) Byte 00 00 C7 3A corresponds to 51002, representing current frequency 51.002Hz;

10) Byte 00 00 00 00 00 00 corresponds to 0, representing rectified mean value of voltage 0.000V;

11) Byte 00 00 00 00 00 00 corresponds to 0, representing DC component of voltage 0.000V;

12) Byte 00 00 00 01 46 20 corresponds to 83488, representing positive voltage peak 83.488V;

13) Byte FF FF FF FE B9 E7 corresponds to -83481, representing negative voltage peak -83.481V;

14) Byte 00 00 00 01 46 20 corresponds to 83488, representing voltage peak 83.488V;

15) Byte 00 00 00 00 2C DB corresponds to 11483, representing rectified mean value of current 11.483mA.

16) Byte 00 00 00 00 2C DB corresponds to 11483, representing DC component of current 11.483mA.

17) Byte 00 00 00 05 B8 71 corresponds to 374897, representing positive current peak 374.897mA;

18) Byte FF FF FF FB 1C B6 corresponds to -320330, representing negative current peak -320.330mA;

19) Byte 00 00 00 05 B8 71 corresponds to 374897, representing current peak 374.897mA;

(2) Query relevant parameters of electric energy

Command character: 0x01

Function: Query relevant parameters of electric energy

Query running time of electric energy -hour (1 byte) for current channel, running time of electric energy – min (1 byte), running time of electric energy – second (1 byte), positive electric energy (8 bytes), negative electric energy (8 bytes), electric energy value (8 bytes), positive electric energy value (8 bytes), negative electric energy value (8 bytes), electric energy value (8 bytes) in turn.

Sample: Receive by this machine——7B 00 09 01 F1 01 01 FD 7D

Transmit from this machine——7B 00 3C 01 F1 01 01 00 00 0A 00
00 00 00 00 00 00 11 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 11 00 00 00 00 00 00 00 39 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 39 CF
7D

Instructions for receiving: Underline byte 01 represents channel to be queried, range is 01-03, representing CH1-CH3.

Instructions for transmitting:

1) Byte 00 corresponds to 0, representing running time of electric energy -h 0;

2) Byte 00 corresponds to 0, representing running time of electric energy -m 0;

3) Byte 0A corresponds to 10, representing running time of electric energy -s 10s;

4) Byte 00 00 00 00 00 00 00 11 corresponds to 17, representing positive electric

energy 0.017mWh;

5) Byte 00 00 00 00 00 00 00 00 corresponds to 0, representing negative electric energy 0;

6) Byte 00 00 00 00 00 00 00 11 corresponds to 17, representing electric energy value 0.017mWh;

7) Byte 00 00 00 00 00 00 00 39 corresponds to 57, representing positive electric energy value 0.057mAh;

8) Byte 00 00 00 00 00 00 00 39 corresponds to 0, representing negative electric energy value 0;

9) Byte 00 00 00 00 00 00 00 39 corresponds to 57, representing electric energy value 0.057mAh.

(3) Query measurement parameter in three-phases mode

Command character: 0x02

Function: Query parameters in three-phases (including transformation ratio)

Total voltage of three-phases (6 bytes), total current (6 bytes), total power (6 bytes), power factor (2 bytes), total apparent power (6 bytes), total reactive power (6 bytes), positive electric energy of three-phases (8 bytes), negative electric energy of three-phases (8 bytes), electric energy value of three-phases (8 bytes), positive electric energy value of three-phases (8 bytes), negative electric energy value of three-phases (8 bytes), electric energy value of three-phases (8 bytes) in turn.

Sample: Receive by this machine——7B 00 09 01 F1 02 00 FD 7D

Transmit from this machine——7B 00 59 01 F1 02 00 00 00 00 00
EA 1C 00 00 00 03 36 3E 00 00 00 03 D8 0A 27 00
00 00 00 03 D9 91 00 00 00 00 36 D4 00 00 00 00
00 00 00 11 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 11 00 00 00 00 00 00 00 39 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 39 E1 7D

Instructions for receiving: 00 is a fixed byte, three-phases query function, do not differentiate channel; when making three-phases data query, analyzer must be operated in three-phases state (three-phases 3-wires or three-phases 4-wires).

Instructions for transmitting:

1) Byte 00 00 00 00 EA 1C corresponds to 59932, representing total voltage of three-phases 59.932V;

2) Byte 00 00 00 03 36 3E corresponds to 210494, representing total current of three-phases 210.494mA;

3) Byte 00 00 00 03 D8 0A corresponds to 251914, representing total power of three-phases 25.1914 W;

4) Byte 27 00 corresponds to 9984, representing three-phases power factor 0.9984;

5) Byte 00 00 00 03 D9 91 corresponds to 252305, representing total apparent power of three-phases 25.2305W;

6) Byte 00 00 00 00 36 D4 corresponds to 14036, representing total reactive power of three-phases 1.4036W;

7) Byte 00 00 00 00 00 00 00 11 corresponds to 17, representing positive electric energy of three-phases 0.017mWh;

8) Byte 00 00 00 00 00 00 00 00 corresponds to 0, representing negative electric energy of three-phases 0;

9) Byte 00 00 00 00 00 00 00 11 corresponds to 17, representing electric energy value of three-phases 0.017mWh;

10) Byte 00 00 00 00 00 00 00 39 corresponds to 57, representing positive electric energy value of three-phases 0.057mAh;

11) Byte 00 00 00 00 00 00 00 00 corresponds to 0, representing negative electric energy value of three-phases 0;

12) Byte 00 00 00 00 00 00 00 39 corresponds to 57, representing electric energy value of three-phases 0.057mAh.

(4) Query relevant parameters of motor

Command character: 0x03

Function: Query relevant parameters of motor

Query torque (4 bytes), RPM (4 bytes), mechanical work (4 bytes), mechanical efficiency of channel 1 (2 bytes), mechanical efficiency of channel 2 (2 bytes), mechanical efficiency of channel 3 (2 bytes), total mechanical efficiency of three-phases (2 bytes) in turn.

Sample: Receive by this machine——7B 00 09 01 F1 03 00 FE 7D

Transmit from this machine——7B 00 1D 01 F1 03 00 00 00 E6 61 00 03 9B 34 00 02 1 F 35 26 F8 26 F8 26 F8 26 F8 CC 7D

Instructions for receiving: Underline byte 00 is a fixed value, not differentiate channel for motor functions

Instructions for transmitting:

1) Byte 00 00 E6 61 corresponds to 5.8977, representing torque 5.8977N.m;

2) Byte 00 03 9B 34 corresponds to 236340, representing RPM 236.340RPM;

3) Byte 00 02 1F 35 corresponds to 139061, representing mechanical work 13.9061W;

4) Byte 26 F8 corresponds to 9976, representing mechanical efficiency of phase-1 99.76%;

5) Byte 26 F8 corresponds to 9976, representing mechanical efficiency of phase-2 99.76%;

6) Byte 26 F8 corresponds to 9976, representing mechanical efficiency of phase-3 99.76%;

7) Byte 26 F8 corresponds to 9976, representing total mechanical efficiency of three-phases 99.76%;

(5) Query harmonic parameters

Command character: 0x04

Function: Query harmonic parameter

Query valid value of voltage base wave (4 bytes) for current channel, valid value of current base wave (4 bytes), valid value of power base wave (4 bytes), total distortion of voltage harmonics (4 bytes), total distortion of current harmonics (4 bytes), total distortion of power harmonics (4 bytes) in turn.

Sample: Receive by this machine——7B 00 09 01 F1 04 01 00 7D

Transmit from this machine——7B 00 21 01 F1 04 01 00 01 61 1B 00 01 61 1B 00 01 61 1B 00 00 00 3C 00 00 00 3C 00 00 00 3C 43 7D

Instructions for receiving: Underline byte 01 represents channel to be queried, range 01-03, representing CH1-CH3

Instructions for transmitting:

1) Byte 00 01 61 1B corresponds to 90395, representing voltage base wave 90.395V;

2) Byte 00 01 61 1B corresponds to 90395, representing current base wave 90.395mA;

3) Byte 00 01 61 1B corresponds to 90395, representing power base wave 9.0395W;

4) Byte 00 00 00 3C corresponds to 60, representing total distortion of voltage harmonics 0.60%;

5) Byte 00 00 00 3C corresponds to 60, representing total distortion of current harmonics 0.60%;

6) Byte 00 00 00 3C corresponds to 60, representing total distortion of power harmonics 0.60%;

(5) Query phase angle

Command character: 0x05

Function: Query phase angle

Phase angle of phase-A (2 bytes), phase angle of phase-B (2 bytes), phase angle of phase-C (2 bytes), U1-U2 phase angle (2 bytes), U2-U3 phase angle (2 bytes), U1-U3 phase angle (2 bytes), I1-I2 phase angle (2 bytes), I2-I3(2 bytes), I1-I3(2 bytes).

Sample: Receive by this machine - - 7B 00 08 01 F1 05 FF 7D

Transmit from this machine - - 7B 00 1B 01 F1 05 FF 02 99 00 00 00 00 01 94 01 94 00 00 0B 53

0B 53 00 00 92 7D,

Instructions for receiving: Phase angle query function, not differentiate channel

Instructions for transmitting:

1) Byte 02 99 corresponds to 665, representing phase angle of phase-A 66.5°;
2) Byte 00 00 corresponds to 0, representing phase angle of phase-B 0°;
3) Byte 00 00 corresponds to 0, representing phase angle of phase-C 0°;
4) Byte 01 94 corresponds to 404, representing phase angle of phase U1-U2 40.4°;
5) Byte 01 94 corresponds to 404, representing phase angle of phase U2-U3 40.4°;
6) Byte 00 00 corresponds to 0, representing phase angle of phase U1-U3 0°;
7) Byte 0B 53 corresponds to 2899, representing phase angle of phase I1-I2 289.9°;
8) Byte 0B 53 corresponds to 2899, representing phase angle of phase I2-I3 289.9°;
9) Byte 00 00 corresponds to 0, representing phase angle of phase I1-I3 0°;

(6) Query overview test data

Command character: 0x06

Function: Query overview test data (including transformation ratio)

Channel-1 voltage (6 bytes), channel-1 current (6 bytes), channel-1 power (8 bytes), channel-1 power factor (2 bytes), channel-1 voltage frequency (4 bytes), channel-1 current frequency (4 bytes), channel-1 DC component of voltage (6 bytes), channel-1 DC component of current (6 bytes), channel-2 voltage (6 bytes), channel-2 current (6 bytes), channel-2 power (8 bytes), channel-2 power factor (2 bytes), channel-2 voltage frequency (4 bytes), channel-2 current frequency (4 bytes), channel-2 DC component of voltage (6 bytes), channel-2 DC component of current (6 bytes), Channel-3 voltage (6 bytes), channel-3 current (6 bytes), channel-3 power (8 bytes), channel-3 power factor (2 bytes), channel-3 voltage frequency (4 bytes), channel-3 current frequency (4 bytes), channel-3 DC component of voltage (6 bytes), channel-3 DC component of current (6 bytes), Total three-phases voltage (6 bytes), total three-phases current (6 bytes), total three-phases power (6 bytes), three-phases power factor (2 bytes).

Sample: Receive by this machine——7B 00 08 01 F1 **06** 00 7D

Transmit from this machine——7B 00 9B 01 F1 06 00 00 00 00 00 00 E6 61
00 00 00 03 9B 34 00 00 00 00 00 02 1 F 35 26 F8
00 00 C7 3A 00 00 C7 3A 00 00 00 00 00 00 00 00
00 00 01 72 00 00 00 00 E6 61 00 00 00 03 9B 34
00 00 00 00 00 02 1 F 35 26 F8 00 00 C7 3A 00 00
C7 3A 00 00 00 00 00 00 00 00 00 00 01 72 00 00
00 00 E6 61 00 00 00 03 9B 34 00 00 00 00 00 02
1 F 35 26 F8 00 00 C7 3A 00 00 C7 3A 00 00 00 00
00 00 00 00 00 00 01 72 00 00 00 00 EA 1C 00 00
00 03 36 3E 00 00 00 03 D8 0A 27 00 22 7D

Instructions for transmitting:

1) Byte 00 00 00 00 E6 61 corresponds to 58977, representing channel-1 voltage 58.977V;
2) Byte 00 00 00 03 9B 34 corresponds to 236340, representing channel-1 current 236.340mA;
3) Byte 00 00 00 00 00 02 1F 35 corresponds to 139061, representing channel-1 active power 13.9061W;
4) Byte 26 F8 corresponds to 9976, representing channel-1 power factor 0.9976;
5) Byte 00 00 C7 3A corresponds to 51002, representing channel-1 voltage frequency 51.002Hz;
6) Byte 00 00 C7 3A corresponds to 51002, representing channel-1 current frequency 51.002Hz;
7) Byte 00 00 00 00 00 00 corresponds to 0, representing channel-1 DC component of voltage 0.000V;
8) Byte 00 00 00 00 0172 corresponds to 370, representing channel-1 DC component of current 0.370mA;
9) Byte 00 00 00 00 E6 61 corresponds to 58977, representing channel-1 voltage 58.977V;
10) Byte 00 00 00 03 9B 34 corresponds to 236340, representing channel-1 current 236.340mA;
11) Byte 00 00 00 00 00 02 1F 35 corresponds to 139061, representing channel-1 active power 13.9061W;
12) Byte 26 F8 corresponds to 9976, representing channel-1 power factor 0.9976;
13) Byte 00 00 C7 3A corresponds to 51002, representing channel-1 voltage frequency 51.002Hz;
14) Byte 00 00 C7 3A corresponds to 51002, representing channel-1 current frequency 51.002Hz;
15) Byte 00 00 00 00 00 00 corresponds to 0, representing channel-1 DC component of voltage 0.000V;

16) Byte 00 00 00 00 0172 corresponds to 370, representing channel-1 DC component of current 0.370mA;
17) Byte 00 00 00 00 E6 61 corresponds to 58977, representing channel-1 voltage 58.977V;
18) Byte 00 00 00 03 9B 34 corresponds to 236340, representing channel-1 current 236.340mA;
19) Byte 00 00 00 00 00 02 1F 35 corresponds to 139061, representing channel-1 active power 13.9061W;
20) Byte 26 F8 corresponds to 9976, representing channel-1 power factor 0.9976;
21) Byte 00 00 C7 3A corresponds to 51002, representing channel-1 voltage frequency 51.002Hz;
22) Byte 00 00 C7 3A corresponds to 51002, representing channel-1 current frequency 51.002Hz;
23) Byte 00 00 00 00 00 00 corresponds to 0, representing channel-1 DC component of voltage 0.000V;
24) Byte 00 00 00 00 0172 corresponds to 370, representing channel-1 DC component of current 0.370mA;
25) Byte 00 00 00 00 EA 1C corresponds to 59932, representing total three-phases voltage 59.932V;
26) Byte 00 00 00 03 36 3E corresponds to 210494, representing total three-phases current 210.494mA;
27) Byte 00 00 00 03 D8 0A corresponds to 251914, representing total three-phases power 25.1914 W;
28) Byte 27 00 corresponds to 9984, representing three-phases power factor 0.9984;

A.4.2Setting specific commands (0x5A)

(5) Set of setting specific commands

Command character: 0x00

Function: Set control specific parameters, parameters to be set (1 byte, see table below for details), and setting value (1 byte) in turn.

Sample: Receive by this machine --7B 00 0A 01 5A 00 01 00 66 7D

Transmit from this machine - 7B 00 09 01 5A 00 00 64 7D

7th byte	8th byte
00- integral state	Range 0-2, 0 - zeroing, 1 - start, 2 – stop
01- voltage range	Voltage range of each channel. Range 0-7 representing 8 ranges of voltage, 8 for auto range. (0—15V，1—30 V，2—60 V，3—100 V，4—150 V，5—300 V，6—600 V，7—1000 V)
02- current range	Current range of each channel. Range 0-7 representing 8 ranges of current , 8 for auto range. (0 - 100mA, 1 - 200mA, 2 - 500mA, 3 - 1A, 4 - 2A, 5 - 5A, 6 - 10A, 7 - 20A)
03-current source	Range 2-3, 2 – BNC input, 3 – direct input
04- calculation cycle	Calculation cycle (range 0-6, 0 - 0.1s, 1 - 0.2s, 2 - 0.5s, 3 - 1s, 4 - 2s, 5 - 5s, 6 - 10s)
05- sync source	Sync source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)
06- harmonic source	Harmonic source of each channel (range 0-5, 0 - U1, 1 - A1, 2 - U2, 3 - A2, 4 - U3, 5 - A3)
07- harmonic switch	Range 0-1, 0 – off (normal measurement), 1 – on (harmonic measurement)
08- line filter	Range 0-2, 0 - off, 1 - 500Hz, 2 - 5.5kHz
09- frequency filter	Range 0-1, 0 - off, 1 – on
0A- load type	Range: 0-3，0—1P3W，1—3P3W，2—3P4W，3—3V3A

(6) Set alarm specific parameters

Command character: 0x01

Function: Set alarm specific parameters: upper limit of voltage alarm (4 bytes), lower limit (4 bytes), threshold (4 bytes), upper limit of current (4 bytes), lower limit (4 bytes), threshold (4 bytes), upper limit of power (4 bytes), lower limit (4 bytes), threshold (4 bytes), alarm delay time (2 bytes), voltage transformation ratio (4 bytes), current transformation ratio (4 bytes), BNC transformation ratio (4 bytes) in turn.

Sample: Receive by this machine——7B 00 3A 01 5A 01 00 00 00
01 00 00 00 02 00 00 00 03 00 00 00 04 00
00 00 05 00 00 00 06 00 00 00 07 00 00 00
08 00 00 00 09 00 0A 00 00 00 C8 00 00 00
C8 00 00 00 C8 25 7D

Transmit from this machine——7B 00 09 01 5A 01 00 65 7D

Instructions for receiving:

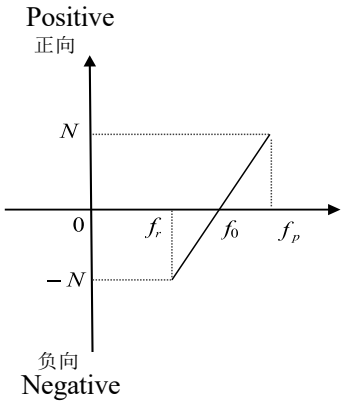
1) Upper limit of voltage alarm , range 0-100000, representing 0-1000.00V (max range)
2) Lower limit of voltage alarm , range 0-100000, representing 0-1000.00V
3) Threshold of voltage alarm , range 0-100000, representing 0-1000.00V
4) upper limit of current alarm , range 0-22000, representing 0-22.000A (max range, similar for other current specifications)
5) Lower limit of current alarm, range 0-22000, representing 0-22.000A
6) Threshold of current alarm, range 0-22000, representing 0-22.000A
7) Upper limit of power alarm, range 0-6600000, representing 0-66000.00W (max range of corresponding voltage and current)
8) Lower limit of power alarm, range 0-6600000, representing 0-66000.00W
9) Threshold of power alarm, range 0-6600000, representing 0-66000.00W
10) Alarm delay time, range 1-200, representing 1-20.0s
11) Voltage transformation ratio, range 10-50000, representing 1.0-5000.0
12) Current transformation ratio, range 10-50000, representing 1.0-5000.0
13) BNCtransformation ratio, range 10-100000, representing 0.010-100.000

Instructions for transmitting: If the command (not including the query specific command) is received and executed correctly, the corresponding execution command will be returned with 0x00 for parameter. If parameter setting is beyond range, the command type returned will be 0x99, as well as the received command word and error code 04.
Receiving by this machine: 7B 00 0A 01 5A 00 0A 04 73 7D (set load type to 4, exceeding range of 0-3)
Transmitting from this machine: 7B 00 09 01 99 00 04 A7 7D

Chapter 7: Motor card function

I. Motor data calculation

87330 can be equipped with an optional motor card. At present, the motor card can realize signal sampling for frequency type torque and RPM sensor. In other words, with frequency sampling, corresponding torque and RPM can be gotten via calculation, and the calculation formula is given below;



1. Torque test

$M_P = N * （f - f_0）/(f_p - f_0)$

$M_r = N * （f_0 - f）/(f_0 - f_r)$

Note:

M_P： Forward torque

M_r： Backward torque

N ： Full range of torque

f_0 ： Output frequency at zero point of torque (kHz)

f_r ： Output frequency for full range of backward torque (kHz)

f_p ： Output frequency for full range of forward torque (kHz)

f ： Actual measured output frequency of torque (kHz)

2. RPM test

$$n = \frac{60*f}{Z}$$

Note:

n ： RPM (r/min)

f ： Actual measured output frequency of RPM (Hz)

Z ： Number of teeth on tachometer disc of sensor

3. Mechanical work

$$P = \frac{T * n}{9550}$$

Note:

P： Mechanical work (kW)

T： Torque (Nm)

n： RPM (r/min)

Chapter 8: Maintenance guide

I. Maintenance and care

1. Periodic maintenance

- For analyzer, input power cable, communication cable and other related accessories, they shall be checked and verified at least once a year to ensure safety of user and accuracy of machine. If the analyzer is used in production sites or under other adverse conditions, it must be checked and calibrated every six months.
- If analyzer is not used for a long time, it shall be powered on regularly. Power-on shall be made usually each month, and the power-on time shall be at least 30 minutes.
- In order to ensure accuracy and reliability of analyzer, it is required to calibrate instrument at least once a year.

2. Daily maintenance

- Do not let analyzer operating over the range for a long time. The amplitude of the shock signal allowed by analyzer shall not exceed 1.6 times of normal signal. When analyzer is not in use, unplug the power cable of meter.
- When analyzer is not in use for a long time, please pack it, and keep it in dry environment without dust or strong vibration.
- If analyzer is operated after long time storage, it shall be turned on for 30min before operation and measurement.

II. Troubleshooting for simple faults

Warning: The analyzer must be repaired and maintained by experienced engineer or technician; if this series analyzer is maintained or repaired by person not passing qualified training, physical injury or death may occur.

Failure	Solution
No display after turning on analyzer.	1) Check whether power supply of instrument is properly connected; 2) Check whether the fuse tube of instrument is broken. If so, please replace the fuse tube with same model. 3) Turn on machine again.
When measuring correctly, the current and power values are zero	1) Check whether the load under test is normal; 2) Check whether the load wiring is correct.
The measured value differs too much from the actual value	1) Check whether the load under test is normal; 2) Check whether the setting of voltage transformation ratio and current transformation ratio is normal; 3) Check whether the load wiring is correct.

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V1.2