PZ96 Series Power Analyzer

Measurement of AC signals 50-60Hz

Single-phase network
3-phase balanced network
3-phase unbalanced network, 3 wires
3-phase unbalanced network, 4 wires

Operation Manuel

Version:20090228

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1. General

PZ96 series power analyzer specializes in measuring the data of all kinds of AC networksIt may be used for local display, or it is connected with the control equipment in measuring and controlling system. They comply EN 61326:2006 and EN 61010-1:2001.

They are a kind of programmable analyzer. With the 4 key on the front, we can set their parameters according to the network which we measure. They have many option functions. They can be equipped RS-485 communication Modbus-RTU; or they can output analog signal. With logic input or logic output, we can realize controlling other equipment remotely

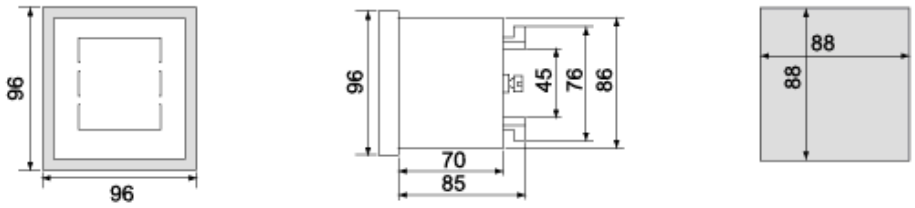
They are a kind of analyzer with excellent cost performance, since they regroup the functions of traditional electric transmitter and digital meters. Therefore they are widely being used in kinds of control system, SCADA system and power management system.

2. Technical parameters

Technical parameters		Value
Input	Network	Single-phase network; 3-phase balanced network 3-phase unbalanced, 3 wires; 3-phase unbalanced, 4 wires
	Measurable	Ia,Ib,Ic,Ua,Ub,Uc,Uab,Ubc,Uca,F,∑P, Pa,Pb,Pc, ∑Q, Qa,Qb,Qc,∑S, Sa,Sb,Sc,∑PF, PFa,PFb,PFc, 4 quadrant energies, multi-rate energies
	Frequency	45 ~ 65Hz
	Voltage	AC 100V, 400V (programmable)
		Overload: 480V (continuous); 800V during 30s
		Consumption: < 0.2VA
	Current	Rating: AC 1A, 5A (programmable)
		Overload: 6A (continuous); 50A during 1s
		Consumption: < 0.2VA
	Thermal drift	<200ppm
Transformation ratio		Programmable
Options	Analog output	1 or 2 outputs, 0 ~ 20mA, 4 ~ 20mA programmable
		Load capacity: ≤500Ω
	Logic output (DO)	2 relays NO contact outputs (for remote terminal)
		Contact capacity: AC 250V/3A, DC 30V/3A
	Alarm output	the alarm of over voltage, under voltage and over current
	Communication	RS485 (Modbus-RTU protocol)
	Logic input (DI)	2 or 4 dry contacts (with 5V power)
	Pulse	2 pulse outputs (open-collector),
		Pulse constant: 10000, 40000, 160000 imp/kWh
Precision		0.5 (F: 0.05Hz; kVar: 1)
Power supply		AC/DC 85 ~ 270V; Consumption ≤ 4VA
Test voltage		2kVAC/min (voltage input / power; between current inputs)
		1.5kVAC/min (outputs / power)
Insulation		input / housing and output / housing >100MΩ
Environment		Work T: -10℃ ~ +45℃; Storage T: -20℃ ~ +70℃
		Relative humidity: 5% ~ 95% (no condensation)
		Altitude: ≤2500m

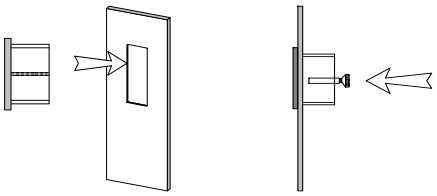
3. Installing and Wiring

3.1 Outline（Unit: mm）



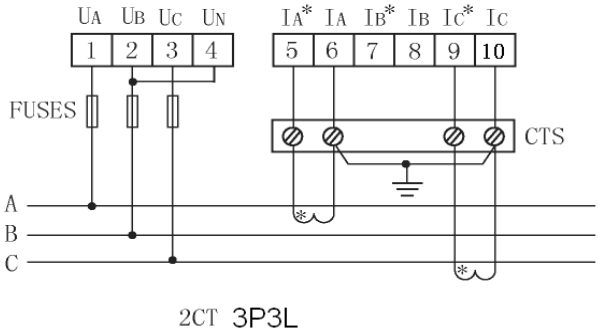
3.2 Installing

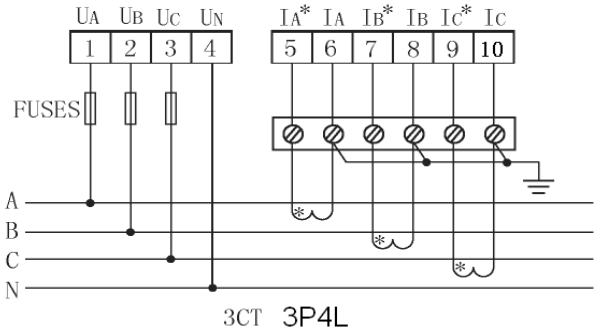
1. Take down the bolts and shelfs in back, and put tha analyzer into the hole.
2. Mount the the bolts and shelfs from back.

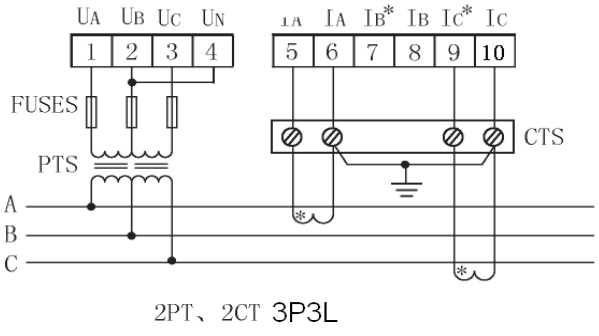


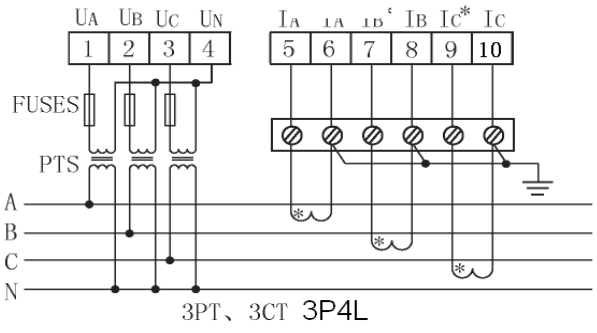
3.3 Wiring

3.3.1 Voltage / Current inputs









Note:

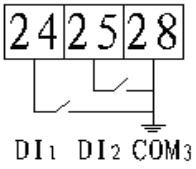
1. When the voltage is more than 1.2 times of rated, should use PT; at the voltage input, you should use a 1A fuse

2. When the current is more than 5A, should use CT;

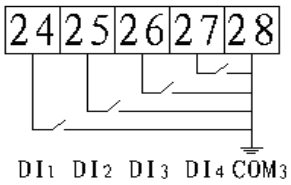
Make sure of the correspondance of current input and voltage input, otherwise there will be the error of measure or sign. On the line of CT there are other meters, please make them series

When out the connection of current input, please cut the CT current input first of all.

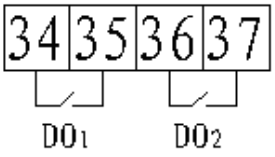
3.3.2 Relay outputs and Logic inputs



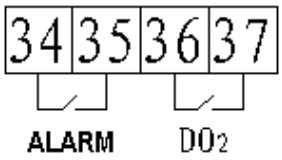
2 Logic input



4 Logic inputs

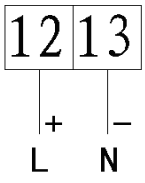


2 Logic outputs

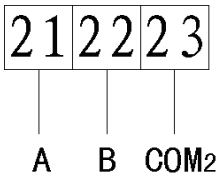


Alarm output and 1 logic output

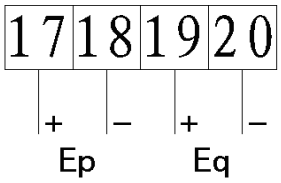
3.3.3 Power supply, RS485 communication, pulse Output



Power



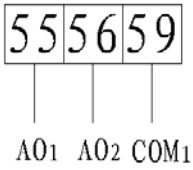
RS485



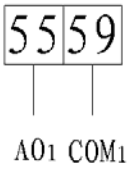
Pulse output

Note: You'd better use 3-core shielded wire, and its diameter is less then 0.5mm2. When wiring, please avoid in the strong electric interfence environment; and between the analyzers at end of the Modbus network, we propose to use 120Ω ~ 10kΩ resistence.

3.3.4 Analog outputs



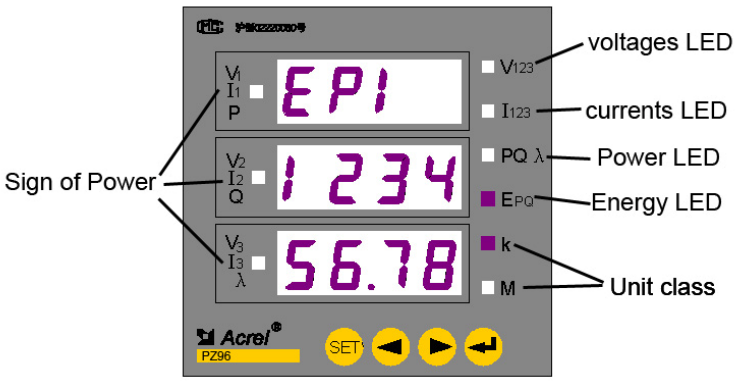
2 analog outputs



1 analog output

4. Reading and programming

4.1 Explanation of front



LCD type: the symbole and the unit of parameter are all on the LCD.

LED type: When the left LED is of power sign active, it indicates the P/Q/cos in this line is negative.

4.2 Explanation of keys

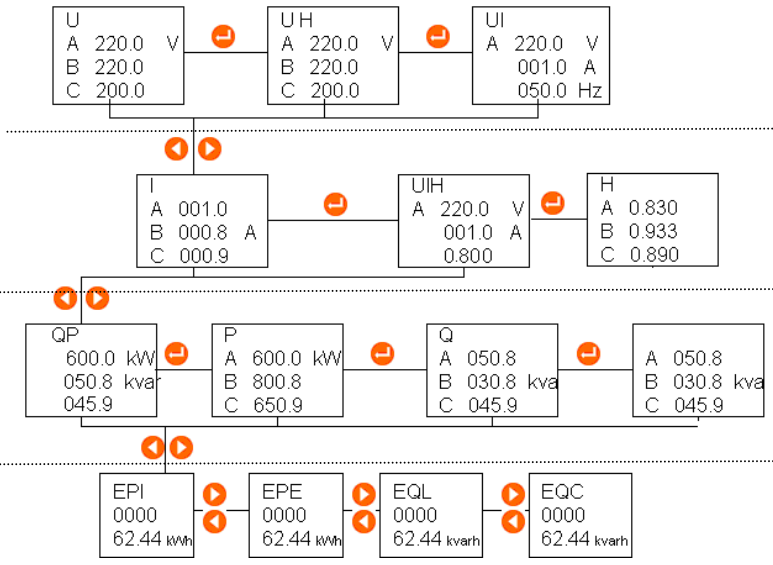
SET 1. Click into the programming menu; 2. Return to previous menu

1. Choose the menu; 2. Change value

1. Enter menu; 2. valid the value

4.3 Read mode

PZ96L-3E read mode (LCD type)



Press, keep and loosen ↵ to change the display.

U: 3 phase voltages

UH: 3 line voltages

UI: the voltage, current, frequency of phase A

I: 3 line currents

UIH: the voltage, current, power factor of phase A

H: 3 power factors

QP: Total P, Q and S

P: 3 active powers

Q: 3 reactive powers

S: 3 apparent powers

4 quadrant energies

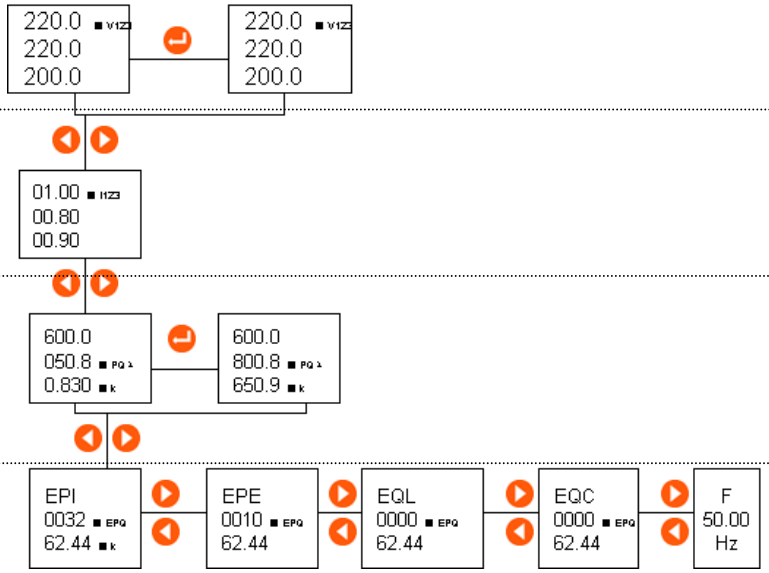
EPI (Import kWh);

EPE (Export kWh)

EQL (Import kVarh);

EQC (Export kVarh)

PZ96L-3E read mode (LED type)



Press, keep and loosen ↵ to change the display.
The left 3 LED are the symbol of value

V123: press ↵ to switch diplay phase voltage and line voltage;

I123: display the 3 current;

PQλ: Total P, Q, cos
press ↵ to display the 3 active powers

4 quadrant energies
EPI (Import kWh);
EPE (Export kWh)
EQL (Import kVarh);
EQC (Export kVarh)
F: The network frequency

4.3 Programming menu

The setting of system

SyS	**dISP**	**0001~0008**	Choose start display
	CodE	**0001~9999**	Set password (default 0001)
	Clr.E		Press↵, clear energy
	Clr.d		Press↵, clear maximal demand energy
	PL.do	**0000~0255**	Set relay: 0000 (level mode); 0001-0255 (pulse mode, 0.01s)
	b.Lcd	**0000~0255**	Set LCD backlight time: 0000 alwaty ON; 0001-0255 seconds of ON

The setting of input

In	**LinE**	**3P4L**	Choose networkL: 3-phase 4 wires
		3P3L	3-phase 3 wires
	In.U	**100**, **400**	Choose voltage range: 100V, 400V
	In.I	**1**, **5**	Choose current range: 1A, 5A
	In.Pt	**0000~9999**	Set ratio of PT
	In.Ct	**0000~9999**	Set ratio of CT

The setting of communication

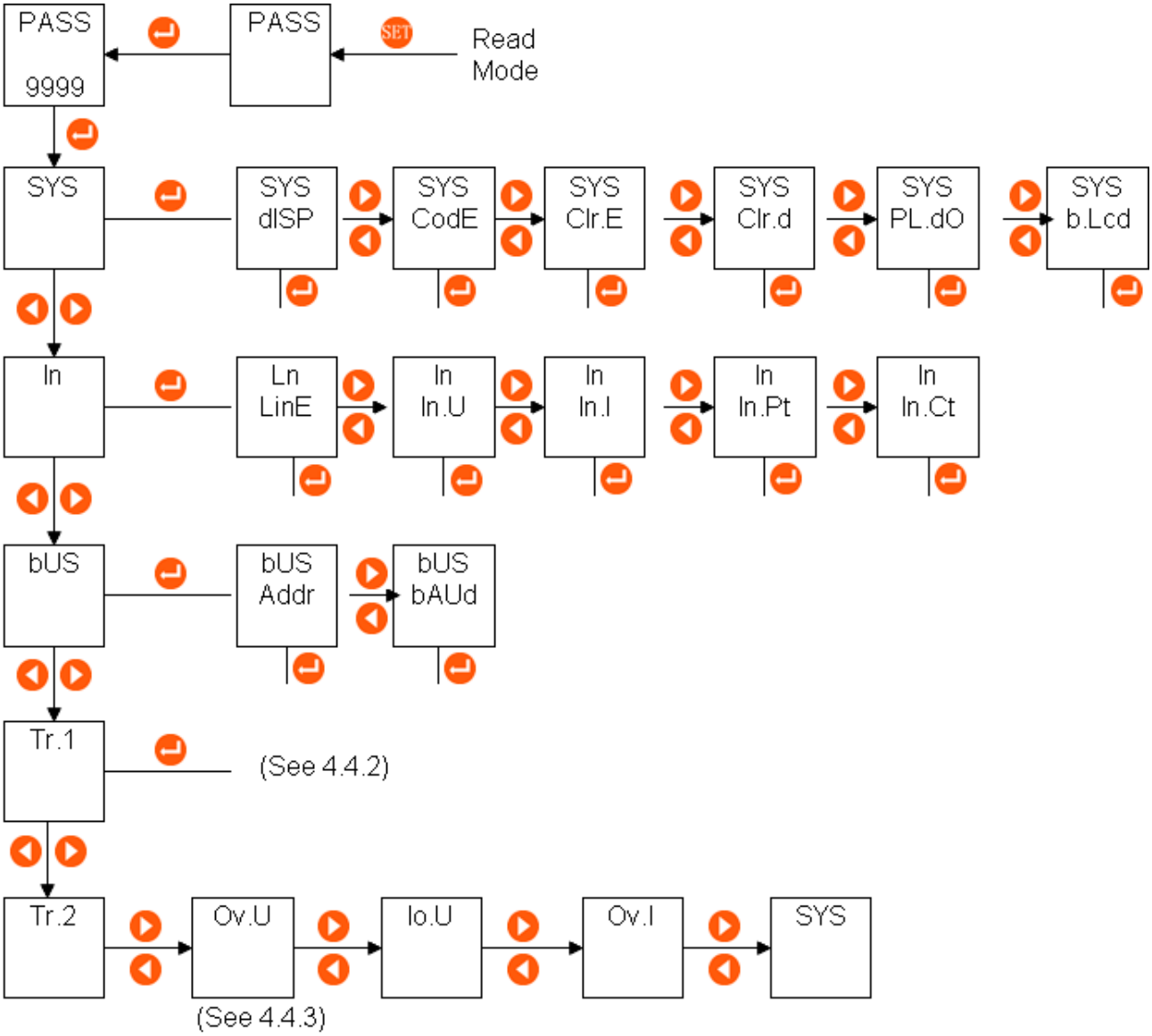
bUS	**Addr**	**0001~0247**	Set slave address
	bAUd	**4800,9600,19200,38400**	Set the speed of communication

The setting of analog output (See the “set the analog output”)

tr.1	set the 1st analog output
tr.2	set the 2nd analog output

The setting of alarm output (See the “set the alarm output”)

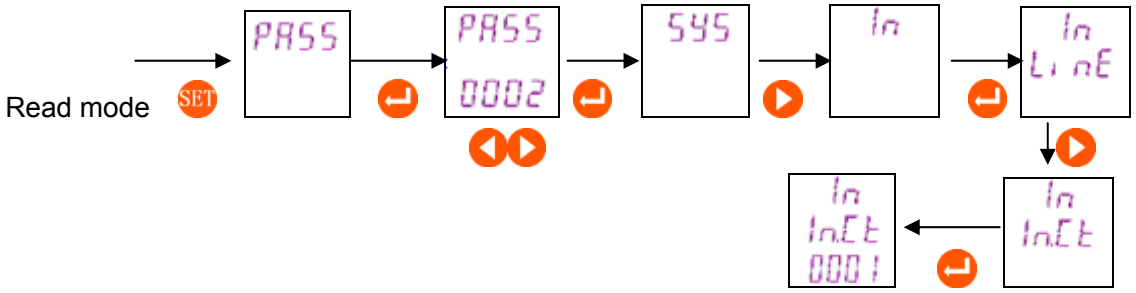
Ou.U	Alarm of over voltage
Io.U	Alarm of low voltage
Ou.I	Alarm of over current



When you finish setiing, please several SET until you see SAUE Yes, press ↵ to confirm your new setting, and to quit setting please press SET until the read mode.

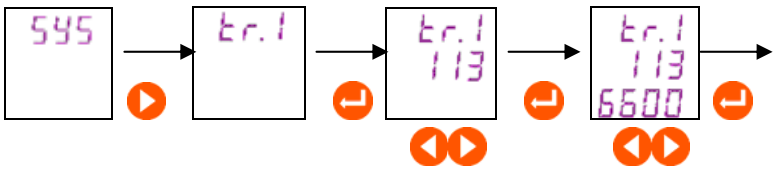
4.4 Programming example

4.4.1 Set CT ratio (Same as setting PT ratio)



4.4.2 Set analog outputs

Analog outputs can tramsmit the 26 measured parameters（UA, UB, UC, UAB, UBC, UCA, IA, IB, IC, PA, PB, PC, P total, QA, QB, QC, Q total, SA, SB, SC, S total, PFA, PFB, PFC, PF, F） to isolated DC signal of 0 ~ 20mA or 4 ~ 20mA.



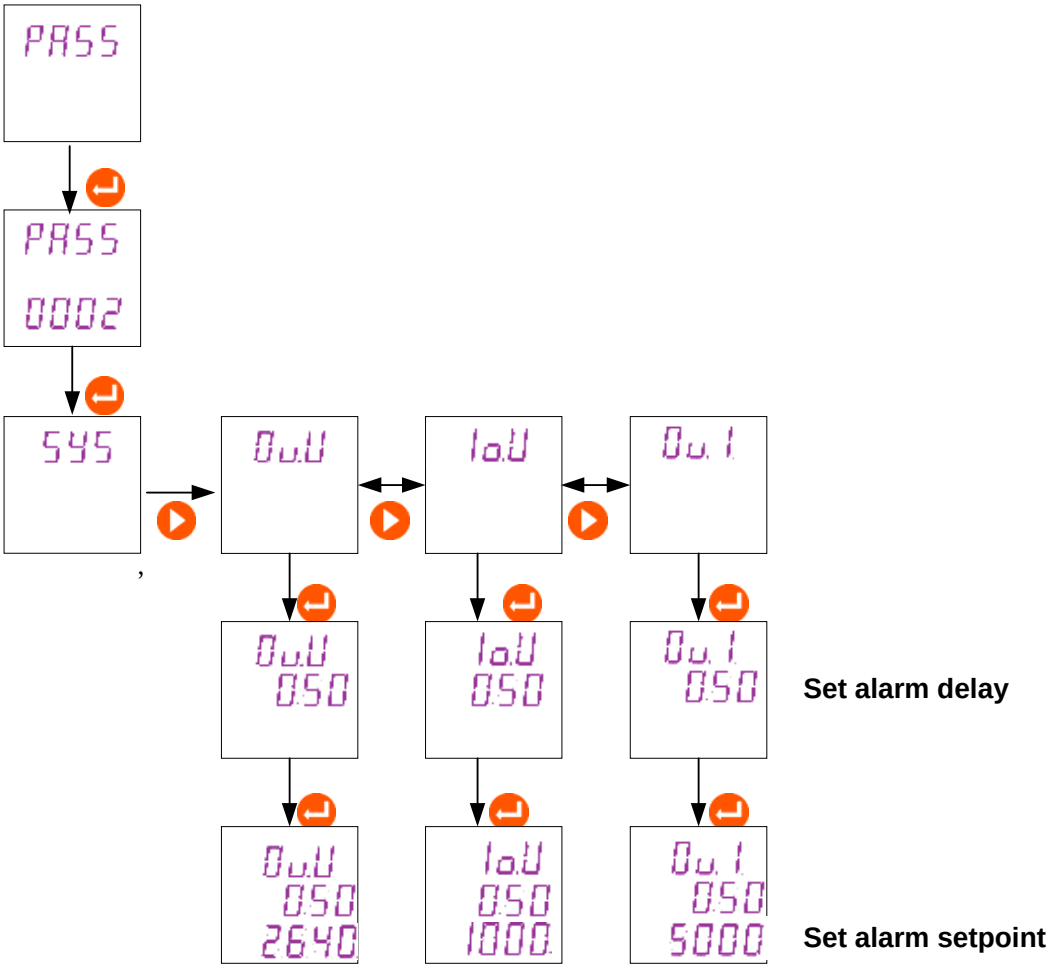
Explanation:

tr.1	**1st analog output**
113	. **The 1st bit is type of analog**, when 0, output 0 ~ 20mA; and when 1, output 4 ~ 20mA. The 2nd & 3rd bit figures the parameter transmitted.

01	02	03	04	05	06	07	08	09	10	11	12	13
Ua	Ub	Uc	Uab	Ubc	Uca	Ia	Ib	Ic	Pa	Pb	Pc	P
14	15	16	17	18	19	20	21	22	23	24	25	26
Qa	Qb	Qc	Q	Sa	Sb	Sc	S	PFa	PFb	PFc	PF	F

6600	**The value of 3rd line is the maximal value analoged.** For example, this 6600kW is corresponding to 20mA of analog ouput

4.4.3 Set relay outputs



Our relay output can be set as the alarms of over voltage, under voltage and over current. The relay is NO, and when there is the fault in the circuit, it change from NO to NC. When the fault disappears, we have to clear the alarm by pressing.

1、Ou.U is alarm of over voltage.

2、lo.U is alarm of under voltage.

3、OU.I is alarm of over current.

The second line is relay delay; press to change its value, the interval is 0.1s

The third line is the value setpoint of alarms, press to change it.

5. Communication

5.1General

PZ Series power analyzer is with Modbus-RTU.

"9600, 8, n, 1"

9600 is default speed which can also be chosen as 1200, 2400, 4800, 19200 etc. 8 figures 8 bits of data; n figures non- parity; 1 figures 1 stop bit.

Error detection: CRC16 (cyclic redundancy checks)

5.2 Protocol

5.2.1 Data frame format

Address	Function	Data	Check
8-Bits	8-Bits	N×8-Bits	16-Bits

5.2.2 Address

The address is at the front of the frame, with one byte (8 bits binary code); Decimal is 0 ~ 255. In our system, only 1 ~ 247 is used, other address is reserved.

5.2.3 Function

The function code tells the function of the analyzer asked.

Hexadecimal code	Meaning	Action
03H	Read/hold register	Get the current binary value from one or multi hold register
04H	Read/input register	Get the current binary value from one or multi input register
10H	multiregister	Put the binary value into multi hold register.

5.2.4 Data

The data includes the data of specified function needed by analyzer or the data measured by analyzer. These data may be value, parameter address or setting. Example: Function domain asks analyzer to read a register, and data domain must indicate the beginning of register red and the sum of data red.

5.2.5 Error check

Analyzer use CRC16 mode. It allows that main equipment and slave equipment check the error in the transmission of data. Sometimes when a data is transmitted from equipment to another under the interferences; it maybe changes in the transmission. So the error check can assure that the main equipment or slave equipment don't answer the data changing in order to assure the security, reliability and efficiency of system.

5.3 Function code

5.3.1 The function code 03H or 04H: Read register

The user can get the measurement data from this code. There are no data limits in once demand of main, but it can not depass the range of address.

For example, read 3 data from No. 01 slave Uab, Ubc, Uca. Uab address is 0028H; Ubc address is 0029H; Uca address is 002AH.

Master transmitting		Transmitting information
address code		01H
function code		03H
Initial address	High byte	00H
	Low byte	28H
register quantity	High byte	00H
	Low byte	03H
CRC check code	High byte	85H
	Low byte	C3H

Slave returning		Return information
address code		01H
function code		03H
byte quantity		06H
register data	High byte	00H
	Low byte	00H
register data	High byte	00H
	Low byte	00H
register data	High byte	00H
	Low byte	00H
CRC check code	High byte	21H
	Low byte	75H

5.3.2 The function code 10H: Multiregister

Function code 10H permit user to change the value of multiple registers: system parameters, switching output condition etc. The main writes 16 (32 byte) data once.

For example: the NO.01 slave meter with relay output Do1. The statement address of logic input and relay is 0022H. The 9th-12ths bit correspond to DI1-DI4, and the 13th-14th bits correspond to DO1-DO2.

Master transmitting		Transmitting information
Address code		01H
Function code		10H
Initial address	High byte	00H
	Low byte	22H
register quantity	High byte	00H
	Low byte	01H
Byte quantity		02H
0022H data to be written	High byte	10H
	Low byte	00H
CRC check code	High byte	ADH
	Low byte	12H

Slave return		Return information
address code		01H
function code		10H
Initial address	High byte	00H
	Low byte	22H
register quantity	High byte	00H
	Low byte	01H
CRC check code	High byte	A1H
	Low byte	C3H

5.4 Communication application details

5.4.1 Logic input and relay outputt

Our logic input is dry contacts with +5V power. When external contacts is NO or NC, our analyzer will display its statement. And it can transmit the statement by RS485 communication.

Its relay output can be controlled by upper monior（1. electrical level trigger; 2. pulse trigger）; also the user can take it as alarm（over current, over voltage, under voltage）.

The address corresponding to address of logic input and relay output is 0022H

0022H	16	15	14	13	12	11	10	9	8 ~ 1
			DO2	DO1	DI4	DI3	DI2	DI1	Reserved

5.4.2 Power parameters and Electric energy

The measurement value is read by No.3 command of Modbus-RTU protocol. The corresponding relation between the Communication value and actual value as following:（Val_tas Communication value, Val_s as actual value）

1. **Phase voltage UA, UB, UC, line voltage Uab, Ubc, Uca:**
   Val_s = Val_t ×10^（DPT-4）; Unit: V; DPT high byte reeded from 0023H.
2. **Current Ia, Ib, Ic:**
   Val_s = Val_t ×10^（DCT-4）;Unit: A; DCT low byte readed from 0023H.

3, Power Pa, Pb, Pc, P total, Qa, Qb, Qc, Q total:

Val_s = Val_t×10^（DPQ-4）; active power Unit: W, reactive power Unit: var; DPQH high byte readed from 0024, Unit of active power and reactive power are readed by 0024H low byte（from high to low: Q, Qc, Qb, Qa, P, Pc, Pb, Pc）. .

4, Power factor value PFA, PFB, PFC, PFS:

Val_s = Val_t / 1000, no Unit

5, Frequency:

Val_s = Val_t / 100, Unit:Hz

6, Electric energy:

There are 2 types of reading energies, and the user can choose according to his need.

a） First of all, read secondary energies: 003FH ~ 0040H （EPI）, 0041H ~ 0042H （EPE）, 0043H ~ 0044H（EQI）, 0045H ~ 0046H（EQC）; then read PT, CT to calculate the primary energies:

Val_t = First word × 65536 + second word

The primary value Val_s = Val_t / 1000 × PT × CT. PT slave from 0003H, CT slave from 0004H .

b）Read primary energies in 0047H ~ 004EH, with fomat of float. It figures the sign by sign bit, and figures the size of number by exponent and mantissa. The meters applies IEEE754 with 24 bits precision, the mantissa high bit is always “1”, so that it can not be saved:

1 Symbol bit, 8 exponent bits, 23 mantissa bits, symbol bit is the highest bit, and mantissa bit is the lowest bit.

For example: the following number (such as 03FH 040H, 2 bytes, there total 4 bytes from high to low,32 bit）

0 10001110 100 1011 1010 1100 0000 0000b

Symbol bit S exponent bit E mantissa M

symbol bit S=0, “1” as negative, “0” as positive;

calculate exponent mantissa E=10001110, change into decimal as 142;

calculate mantissa M=100 1011 1010 1100 0000 0000, change into decimal as 4959232.

Computing formula: **primary energies**

$$=(-1)^S \times 2^{(E-127)} \times \left(1+\frac{M}{2^{23}}\right)=(-1)^0 \times 2^{(142-127)} \times \left(1+\frac{4959232}{2^{23}}\right)$$

= 52140 Wh = 52.14kWh

5.5 Communication address table

Address	Parameter	R/W	Value range	Data type
0000H	Enter password	R/W	0001-9999	word
0001H high byte	Communication address	R/W	0001-0247	word
0001H low byte	Communication speed	R/W	0-3; 38400, 19200, 9600, 4800bps	
0002H	Control word	R/W	8th bit Connection mode (0-3P4L, 1-3P3L) 7th bit- voltage range (0-400V, 1-100V） 2nd bit current range（0-5A, 1-1A）	word
0003H	PT ratio	R/W	0001-9999	word
0004H	CT ratio	R/W	0001-9999	word
0005H -000AH	tr.1-tr.4 4 analog ouputs	R/W	Each output with 3 bytes（1st byte is analog type, 2nd, 3rd byte correspond to full value output）	word
000BH -0010H	Reserved			word
0011H high byte	Backlight setting	R/W	Only for LCD type 0= ON 1-255 = the duration of backlight	word
0011H low byte	Set the pulse width of relay output	R/W	Only for it with relay output	
0022H	The statement of relays	R/W	See 6.3.1	word
0023H high byte	Decimal point U (DPT)	R	3 ~ 7	word
0023H low byte	Decimal point I (DCT)	R	1 ~ 5	
0024H high byte	Decimal point PQ (DPQ)	R	4 ~ 10	word
0024H low byte	Symbol of P, Q	R	high level - low level: Q, Qc, Qb, Qa, P, Pc, Pb, Pa; 0 as positive,1 as negative	
0025H	Phase voltage UA	R	0-9999	word
0026H	Phase voltage UB	R	0-9999	word
0027H	Phase voltage UC	R	0-9999	word
0028H	Line voltage UAB	R	0-9999	word
0029H	Line voltage UBC	R	0-9999	word
002AH	Line voltage UAC	R	0-9999	word

002BH	IA	R	0-9999	word
002CH	IB	R	0-9999	word
002DH	IC	R	0-9999	word
002EH	PA	R	0-9999	word
002FH	PB	R	0-9999	word
0030H	PC	R	0-9999	word
0031H	P total	R	0-9999	word
0032H	QA	R	0-9999	word
0033H	QB	R	0-9999	word
0034H	QC	R	0-9999	word
0035H	Q total	R	0-9999	word
0036H	COSA	R	0-1000	word
0037H	COSB	R	0-1000	word
0038H	COSC	R	0-1000	word
0039H	COS total	R	0-1000	word
003AH	SA	R	0-9999	word
003BH	SB	R	0-9999	word
003CH	SC	R	0-9999	word
003DH	S total	R	0-9999	word
003EH	Frequency F	R	4500-6500	word
Address table of energies				
003FH -0040H	Measued import kWh	R/W	0-999999999	Dword
0041H -0042H	Measued export kWh	R/W	0-999999999	Dword
0043H -0044H	Measued import kVarh	R/W	0-999999999	Dword
0045H -0046H	Measued export kVarh	R/W	0-999999999	Dword
0047H -0048H	Real import kWh	R		Fword
0049H -004AH	Real export kWh	R		Fword
004BH -004CH	Real import kVarh	R		Fword
004DH -004EH	Real Export kVarh	R		Fword