APM-96J
Multi-Function Power Meter

User Manual



Version: 1.12

Revision: 2025.05

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Read me

When you use APM-96J multi-function meter, be sure to read this user manual carefully, and be able to fully understand the implications, the correct guidance of operations in accordance with user manual, which will help you make better use of APM-96J multi-function meter and help to solve various problems at the scene.

1. Before the meter turn on the power supply, be sure that the power supplies within the provisions of the instrument;

2. When installation, the current input terminal must be non-open, voltage input terminals must be non-short circuit;

3. Communication terminal (RS232/RS485) is strictly prohibited to impose on high pressure;

4. Be sure the instrument wiring is consistent with the internal system settings;

5. When communicating with the PC, instrument communication parameters must be consistent with the PC.



- **Please read this user manual carefully**
- **Please save this document**

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Directory

1.- SUMMARIZE ..... - 1 -

2.- FEATURES ..... - 2 -

2.1.- ELECTRICITY METERING ..... - 2 -
2.2. - TECHNICAL PARAMETERS ..... - 3 -

3. - INSTALLATION AND START-UP ..... - 5 -

3.1. - INSTALLATION ..... - 5 -
3.2. - CONNECTION TERMINAL ..... - 8 -

4. - SCREEN DISPLAY ..... - 10 -

4.1. - FULL SYMBOL IN DISPLAY SCREEN ..... - 10 -
4.2. - INTRODUCTION OF SCREEN PAGES ..... - 11 -

5. - OPERATION MODE ..... - 15 -

6. - SETUP PROCEDURE ..... - 16 -

6.1. - ENTER SETUP MENU ..... - 16 -
6.2. - INPUT SIGNAL SETUP ..... - 17 -
6.3. - COMMUNICATION PORT SETUP ..... - 18 -
6.4. - DIGITAL OUTPUT SETUP ..... - 20 -
6.5. - ANALOG OUTPUT SETUP ..... - 24 -
6.6. - SYSTEM SETTING ..... - 25 -
6.7. - PARTIAL FLOWCHART EXPLANATION ..... - 26 -
6.8. - MENU CHARACTER DESCRIPTION ..... - 27 -

7. - PULSE OUTPUT ..... - 28 -

8. - COMMUNICATION INTERFACE ..... - 29 -

8.1. - CONNECTION FOR RS485 BUS ..... - 29 -
8.2. - MODBUS © PROTOCOL ..... - 30 -
8.3. - REGISTER MAP ..... - 31 -

9. - SAFETY CONSIDERATIONS ..... - 37 -

10. - MAINTENANCE ..... - 37 -

11. - TECHNICAL SERVICE ..... - 38 -

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1.- SUMMARIZE

APM-96J multi-function power meter has functions such as programmable measurement, display, transmission output, digital communication and power pulse output. It can complete power measurement, power metering, data display, collection and transmission.

The measurement accuracy is 0.2 level, which can be achieved on-site display and remote RS-485/ Modbus-RTU communication and optional Profibus-DP protocol or optional Ethernet interface/ Modbus-TCP & Modbus-RTU protocol.

APM-96J offers optional expansions modules including 2-6 channel digital input (DI), 2-4 channel digital output (DO), and 1-3 channel analog output (AO).

It can measure all power parameters in the power grid:

Current,	Apparent power,	Voltage and current THD%,
Voltage,	Energy (Active/Reactive),	Harmonics factor,
Frequency,	Power factor,	Voltage crest factor,
Active power,	Current harmonics 2~31 times,	Current K-factor,
Reactive power,	Voltage harmonics 2~31 times,	
Voltage /current unbalance,	Voltage/frequency deviation,	

It can replace the traditional analog or many digital measurement instruments (such as ammeter, voltmeter, power meter, power factor meter, frequency meter, etc.) with the advantages of improving system reliability, making the on-site wiring convenient and reducing system cost.

APPLICATIONS

-. Measure all power parameters;
-. Monitor and control, energy measurement and electrical fire;
-. Replace the three-phase power meter, three phase electricity transmitter;
-. Transformers, generators, capacitors and electric motors distributed detection;
-. Medium and low voltage systems;
-. SCADA, EMS, DCS integrators.

2.- FEATURES

2.1.- Electricity Metering

By means of an internal microprocessor it simultaneously measures:

Parameter	Symbol	A-phase	B-phase	C-phase	Total
Phase-line voltage	V	●	●	●	/
Phase-phase voltage	V	●	●	●	/
Current	A	●	●	●	/
Frequency	Hz	●	●	●	●
Power factor	Cos Φ	●	●	●	●
Active power	W	●	●	●	●
Reactive power	Var	●	●	●	●
Apparent power	VA	●	●	●	●
Active energy	Wh	●	●	●	●
Reactive energy	Varh	●	●	●	●
Voltage / frequency deviation	V	●	●	●	●
Voltage / current unbalance	%	●	●	●	●
THD & Harmonic (2~31th)	THD	●	●	●	●

●: Display and communications
o: Optional functions
/ : No such function

Note:

Phase-phase voltage is Uab, Ubc, Uca, voltage data determined by the different wirings.

APM-96J delivers the visualization of parameters listed above by means of segment LCD displays. In the main display area show 3 power parameters, with other display area show the various parameters and state of meter on each page jump. For more details of measurement parameters please refer to the subsequent for displays introduction and RS485 communication instructions.

OTHER FEATURES

-. Low-size (96 x 96 mm), panel mounting meter.
-. True R.M.S. measuring system.
-. 0.2% High-precision measurement
-. Instantaneous, maximum and minimum values of each measured parameter.
-. RS-485 communication to a PC.

2.2. - Technical parameters

- Working Power

AC/DC 85-265V, (DC 48V or AC 380V customized)
45-65Hz
Consumption ≤4VA

- Reference Standard

Basic electricity	IEC 61557-12:2016
Active energy	IEC 62053-21:2018
Reactive energy	IEC 62053-24:2018

- Input

Voltage	AC100V, 220V, 380V type 96mm and 42mm support AC690V, please specify when ordering).
Current	AC1A/5A (please specify when ordering)
Frequency	40~65Hz, accuracy class: ±0.02Hz
Current overload	Measurement: 1.2 times Instantaneous: 10 times/1s
Voltage overload	Measurement: 1.2 times Instantaneous: 2 times/10s

- Output

Digital interface	RS-485, MODBUS-RTU or DLT645-2007
Pulse output	1 channel
DI (optional)	4 DI, dry contact, Ri<500Ω turns on, Ri>100kΩ turns off
DO (optional)	2 DO, Relay contact capacity: 5A@250V AC; 5A@30V DC
AO (optional)	Current 4~20mA, load <390Ω Voltage 0~10V, load >100kΩ

- Load

Voltage: <0.1VA / phase (rated 220V)
Current: <0.4VA / phase (rated 5A)

- Safety

2kV AC RMS 1 minute, between input / output / case / power supply
Input, output and power supply to the chassis ≥100MΩ

- Accuracy

Parameter	Accuracy	A phase	B phase	C phase	All
Voltage	0.2	V1	V2	V3	
Current	0.2	A1	A2	A3	
Active power	0.5s	W1	W2	W3	W
Reactive power	0.5s	var1	var2	var3	var
Apparent power	0.5s	VA1	VA2	VA3	VA
Power factor	0.5s	PF1	PF2	PF3	PF
Active energy	0.5s				Wh
Reactive energy	1.0				varh
Frequency	0.02				Hz

Others

Deviation	Voltage: 0.2%; Frequency: 0.02%
Unbalance	Voltage: 0.2%; Current: 0.2%
Harmonic content	When Uh>2%: 5%Uh; when Uh<=2%: 0.1%UN

- Environment

Working temperature: -10°C ~ +55°C; RH 20% ~ 95% (Non-condensation)
Storage temperature: -30°C ~ +70°C; RH 20% ~ 95% (Non-condensation)

3. - INSTALLATION AND START-UP



The manual you hold contains information and warnings that -users should follow in order to guarantee a proper operation of all the instrument functions and keep it in safety conditions. The instrument must not be powered on and used until its definitive assembly is on the cabinet's door.

If the instrument is not used as manufacturer's specifications, the protection of the instrument will be damaged.

When any protection failure is suspected to exist (for example, it presents external visible damages), the instrument must be immediately powered off. In this case contact a qualified service representative.

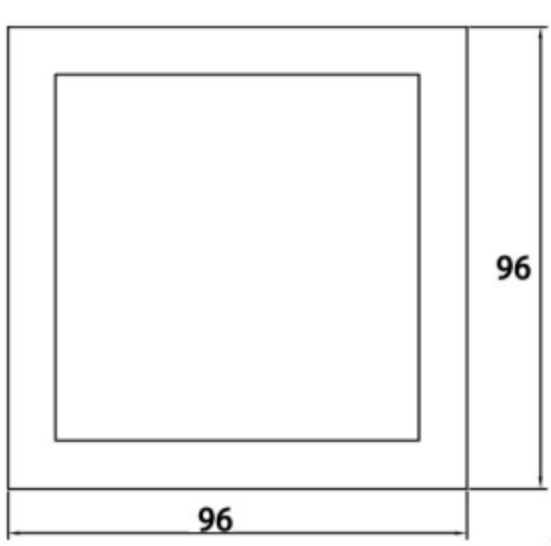
3.1. - Installation

Mounting

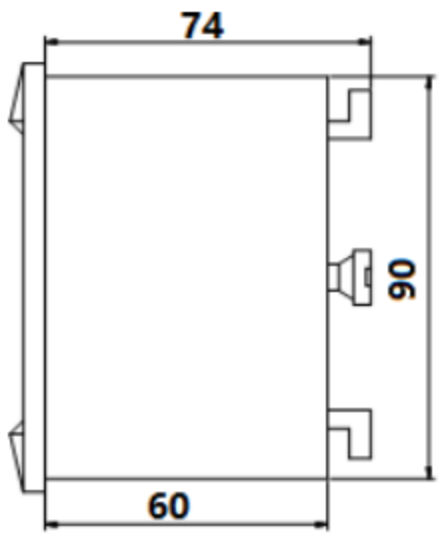
Instrument is to be mounted on panel (cut-out *91 x 91mm*). Keep all connections into the cabinet.

Please note that as the instrument be powered on, the terminals could be dangerous to touch and cover opening actions or elements removal may allow accessing dangerous parts. Therefore, the instrument must not be used until this is completely installed.

Dimension: **Unit: mm**



Front view



Side view

Notes:

Input signal: APM-96J using a separate acquisition calculate for each measurement channel, to ensure consistent in use, for different load forms, it's a variety of connection mode. Access wire shall be met 2.5 square mm.

A. Voltage input

Input voltage should not exceed the rated input voltage products 450V.
Otherwise, you should use external VT. Suggest 1A fuse be installed in the voltage input side.

B. Current Input

Standard input current is 5A or 1A, if greater than 5A/1A should use external CT.
When the CT is connected with other meters, make sure wiring methods be used in series.

Warming: Forbid to install a CT on the live feeder wire with open secondary leads. This can be extremely dangerous!

Before remove the current input connection, must be sure to disconnect the primary circuit or shorted secondary circuit of CT.

C. Sequence of wire

Warming: Please make sure that the input voltage and current corresponding to the same phase, sequence, and the same direction; Otherwise, the Values and symbols will be wrong! (Power and Energy)

Always observe the physical orientation of CT (P1 - P2) when installing on the feeder wire.
Always pay attention to wiring polarity and phasing when terminating the CT leads to the APM-96J.
S1 connect to Ix*, S2 connect to Ix.

The input network configuration of instrument depends on the CT number of the system:
in the condition of 2 CT, select the three-phase, three-lines two components;
in the condition of 3 CT, select the three-phase, four-lines three component mode.

Instrument connection mode, set of the instrument (programming input network NET) should be the same load wiring as measured wiring. Otherwise, the measurement instrument will lead to incorrect voltage or power.

In three-phase 3 wire mode, measurement and shows the line voltage;
In three-phase 4 wire mode, measurement and shows the phase voltage and line voltage both.

D. Auxiliary power

APM-96J with universal (AC / DC) power input, if not for a special statement, we provide the 90-240AC/DC power interface for standard products, please ensure that the auxiliary power can match with meter to prevent unexpected damage.

A. Suggest install 1A fuse in the fire line side.

B. For the areas with poor power quality, suggest install lightning surge suppressor and rapid burst suppressor to prevent lightning strikes.

3.2. - Connection Terminal

Upper: (Power supply and function output (15-pin)

No.	Marked	Notes
1	**L**	AUX input 85-265Vac/dc
2	**N**	
58	**RS485**	RS485+
59		RS485-
47	**Pulse output**	Pulse output+
48		Pulse output-
70 71 72 73 74	**4 DI**	4 channel digital input
19 20 21 22	**2 DO**	2 channels digital output

Upper: (Power supply and optional AO (11-pin)

No.	Marked	Notes
1	**L**	AUX input 85-265Vac/dc
2	**N**	
58	**RS485**	RS485+
59		RS485-
47	**Pulse output**	Pulse output+
48		Pulse output-
15 16 17	**3 AO**	3 channels Analog output

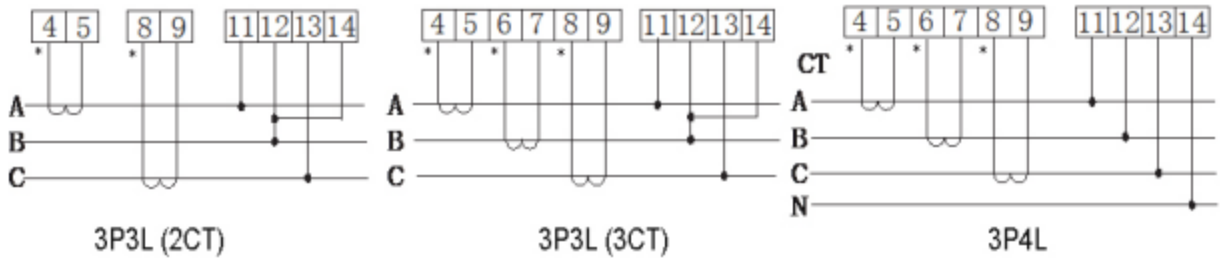
Lower: Signal (10-pin)

No.	Marked	Notes
11 12 13 14	**Ua** **Ub** **Uc** **Un**	Voltage A-phase input Voltage B-phase input Voltage C-phase input Neutral Voltage input
8 9	**C-phase Current**	Current C-phase - S1 input Current C-phase - S2 input
6 7	**B-phase Current**	Current B-phase - S1 input Current B-phase - S2 input
4 5	**A-phase Current**	Current A-phase - S1 input Current A-phase - S2 input

Note:

The terminal pin definition may change depends on customer order; please refer to the label on the meter!

3.3. - Typical Wiring



Note:

This connection drawing is for reference only; the actual connecting terminal, please refer to the label on the rear part.

WARINGS!

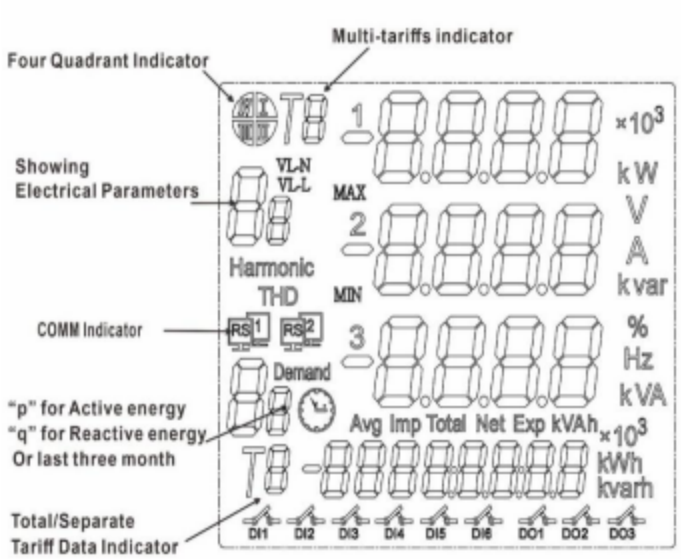
If power = -0.01 is shown for any of the phases and voltage and current are not zero for this phase, check out following points:

- Assure that A, B and C phases coincide in voltage and current.
- Correct polarity? Reverse the current transformer placed at this phase.

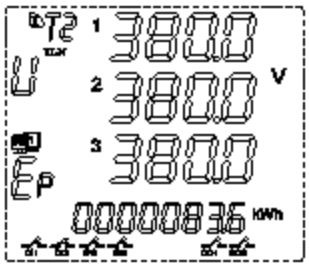
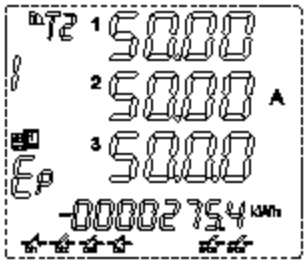
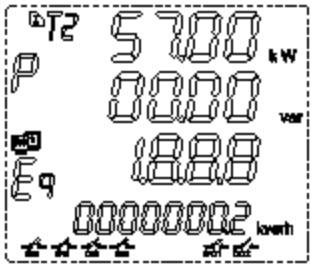
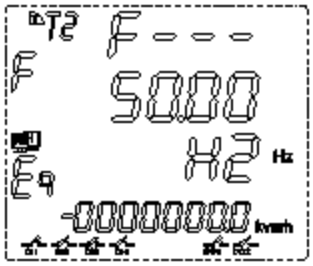
4. - SCREEN DISPLAY

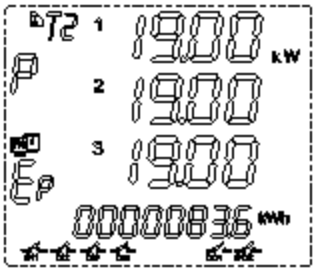
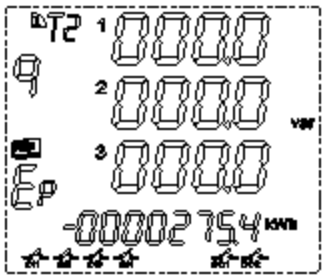
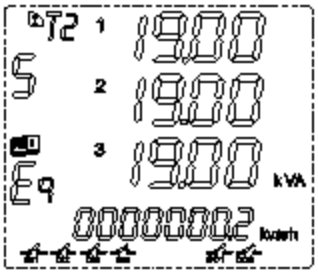
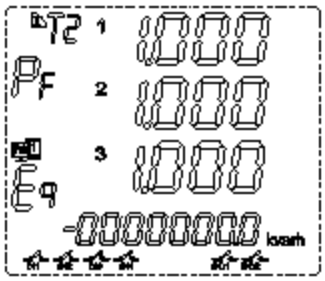
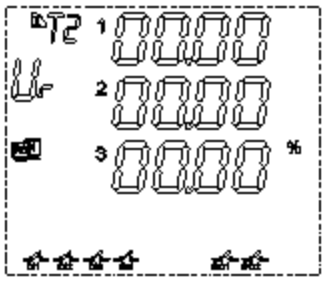
4.1. - Full Symbol in Display Screen

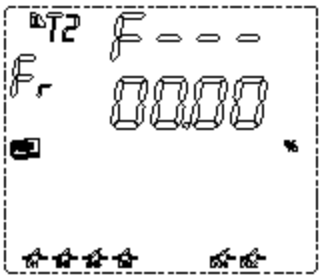
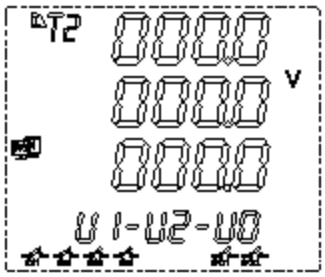
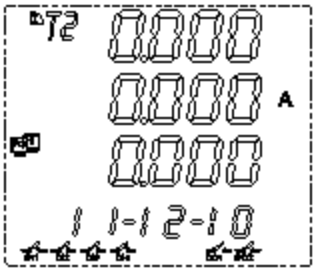
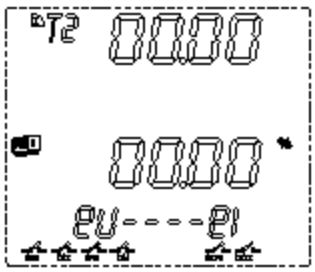
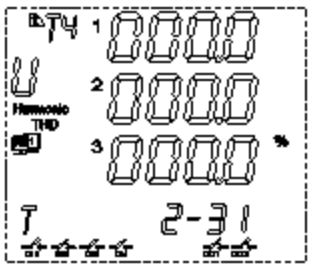
Measurement data display area can display three rows characters including: current, voltage, power, power factor, frequency, etc.

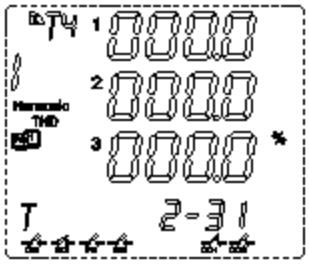
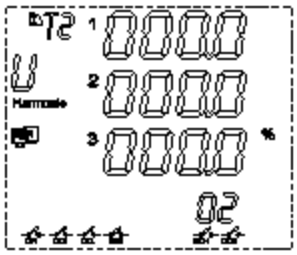
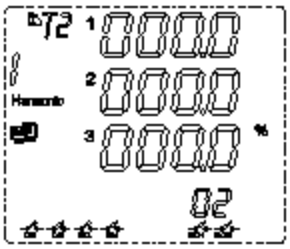


4.2. - Introduction of Screen Pages

Screen No.	Screen interface	Explanation
- 1 -		Three phase voltage Ua, Ub, Uc; **Note:** In high voltage measurement, X10^3 means the showing value multiplied by 1000, in the screen diagram mean the voltage is 10X1,000=10,000volt. Bottom character "Ep" shows **total active energy** is 83.6KWh. **Note:** Detail information for each symbol, please refer **chapter 6.1,** Surround area shows the system information, other screen is same: DI1 DI2 DI3 DI4 show DI1, DI2, DI3, DI4 closed; DO1 DO2 show DO1, DO2 open; flicker show Communication Rx/Tx normal;
- 2 -		Three-phase current Ia, Ib, Ic. Bottom **Ep** shows **total negative active energy.**
- 3 -		Total active power, Total reactive power, and Total factor. Bottom **Eq** shows **total reactive energy.**
- 4 -		Frequency of grid. Bottom **Eq** shows **total negative reactive energy.**

- 5 -		Independent active phase. (only valid in three-phase 4 wire system) Bottom **Ep** shows **total active energy.**
- 6 -		Display independent reactive phase. (only Three-phase 4 wire type) Bottom **Ep** shows **total negative active energy.**
- 7 -		Display independent apparent phase. (only Three-phase 4 wire type) Bottom **Eq** shows **total reactive energy.**
- 8 -		Display independent power factor. (only Three-phase 4 wire type) In the bottom **Eq** shows **total negative reactive energy.**
- 9 -		Three phase voltage deviation, unit % Formula: **Vd**= [(**V_rms**-**V_rate**) / **V_rate**]% **Default V_rate = 220Vac** **Note**: If site power system are other V_rate, please contact our sales team before order

- 10 -		Frequency deviation, unit % Formula: **Fd**= [(**F_rms**-**F_rate**) / **F_rate**]% **Default F_rate = 50Hz** **Note**: If site power system are other F_rate, please contact our sales team before order
- 11 -		Voltage Vector line 1 for positive sequence voltage(V_5+) line 2 for negative sequence voltage(V_5-) line 3 for zero-sequence voltage(V_0)
- 12 -		Current Vector line 1 for positive sequence current (I_5+) line 2 for negative sequence current (I_5-) line 3 for zero-sequence current (I_0)
- 13 -		Voltage & current unbalance line 1 show eU eU = (V_5- / V_5+) % line 3 show eI eI = (I_5- / I_5+)%
- 14 -		Three phase voltage Total Harmonic Distortion (THD_U%) Press [↵] can switch to: **tOhd** (total odd harmonic distortion) **tEhd** (total even harmonic distortion) **tHFF** (telephone harmonic form factor) **CF** (crest factor).

- 15 -		Three phase current Total Harmonic Distortion (THD_I%) Press [↵] can switch to: **tOhd** (total odd harmonic distortion) **tEhd** (total even harmonic distortion) **tHFF** (telephone harmonic form factor) **KF** (k factor).
- 16 -		Three phase voltage Individual Harmonic 2-31th Press [↵] can switch to different harmonic
- 17 -		Three phase current Individual Harmonic 2-31th Press [↵] can switch to different harmonic

Notes:

1. Energy data is displayed in 8-digit decimal format by default.
As counter increased, the decimal point position will move right, data increased by 10 times, the unit display changing from KWh to MWh.

2. In special requirement order or firmware iteration, the screen may add or reduce the screen display pages, please ask the sales team to get latest manual.

5. - OPERATION MODE

When the device is powered on, the entire symbol will be on, and the meter starts to self- test. After few seconds, the meter is ready for operation and shows firmware, then automatic jump to The first screen.

<table>
<tr><th>Button</th><th>In Monitor Screen</th><th>In Config Sub-menu</th><th>In Parameter Setup</th></tr>
<tr><td></td><td rowspan="2">Screen will move to previous or next page</td><td rowspan="2">Move cursor up and down to select function</td><td>Move setting cursor to left</td></tr>
<tr><td></td><td>Scroll selection number 0 ~ 9</td></tr>
<tr><td></td><td>Call out password screen</td><td colspan="2">Exit & roll back to up level menu.</td></tr>
<tr><td></td><td>Call out sub-screen or version screen</td><td colspan="2">Confirm the values &
Entry or jump to down level menu</td></tr>
</table>

Note: In Setup menu, if change the setting value, press  for exit menu, device will call out confirm screen ask “SAVE”

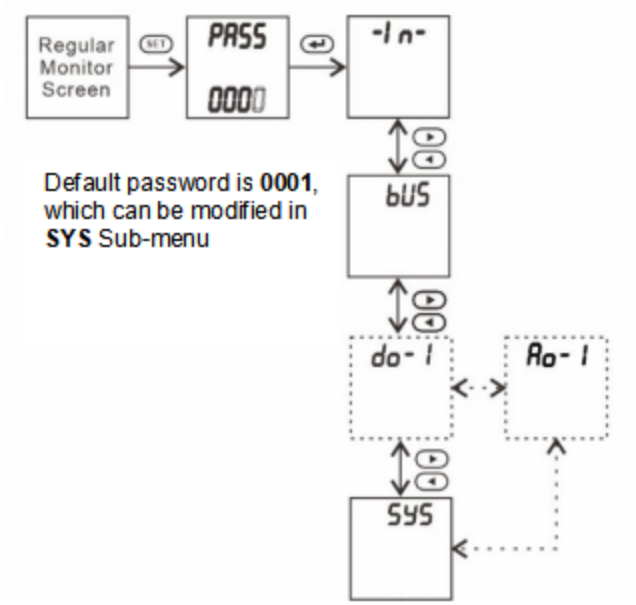
Then press  *exit without saving;*

press  *save and exit.*

6. - SETUP PROCEDURE

The SETUP procedure of the APM-96J is performed by means of several SETUP options. There is a password to protect unexpectedly to enter the Setup menu. Once into the Setup menu, use the keyboard to select different options and enter required variables:

6.1. - Enter Setup Menu



Input signal setup

Refer to [chapter 6.2]

Communication port setup

Refer to [chapter 6.31]

Digital output (relay) & Analog output port setup

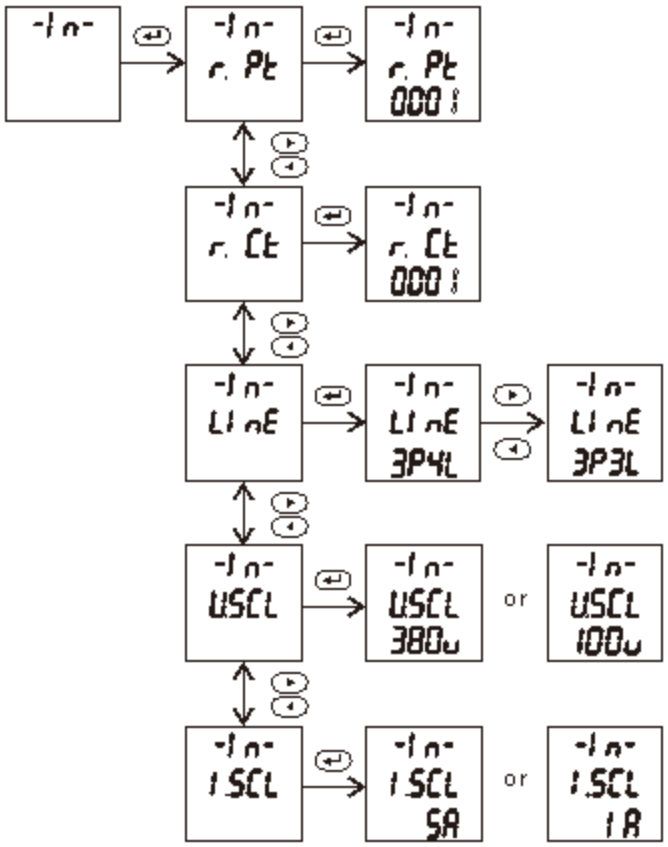
Refer to [chapter 6.4 & 6.5]

Note: If do not select port, no such pages

System parameter setup

Refer to [chapter 6.6]

6.2. - Input Signal Setup



Voltage transformer ratio [1] *

Default **0001**

Current transformer ratio [1] *

Default **0001** or based on order requirement

Power grid mode

Default **3P4L**[2]*

Rated voltage scale

Default **380V**[3]*

Rated current scale

Note: only related to pulse constant chapter 7

Default **5A**

Notes:

(1) In medium or high voltage system, set this value can expand measuring range. Values represent the current transformer (primary side voltage) / (secondary side current). Must set **U.scl** in 100V or other specified VT secondary voltage.

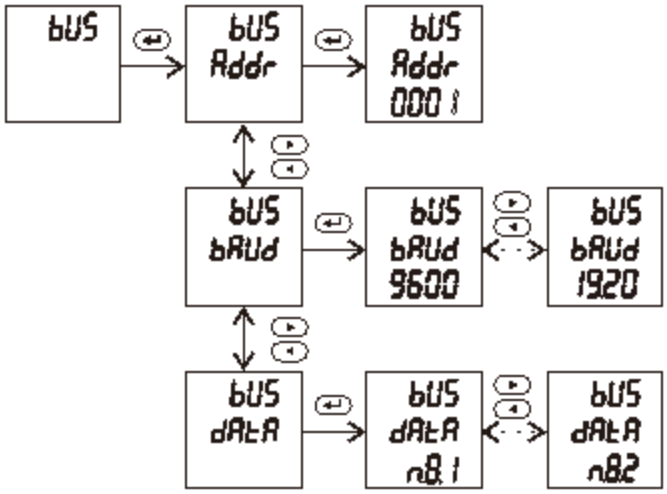
(2) If order specified power grid is 3P3L, Blue Jay will connect **Un** and **Ub** terminal internally. Screen only display phase to phase parameters.

(3) Blue Jay calibrates meter under 380V range, and high-quality linearity performance ensures that the meter can accurately measure in the lower voltage range. That can be compatible with 120V, 220V, 230V, 240V, 277V system.

If need to use in different voltage scale or different types CT, please contact our sales team for more details.

6.3. - Communication Port Setup

6.3.1.- RS485 communication port



Modbus address (1) *

Default **0001**

Comm. port baud ratio (2) *

Default **9600** (2)*

Comm. port data format

Default **n.8.1** , can select n.8.1 / E.8.1 / n.8.2

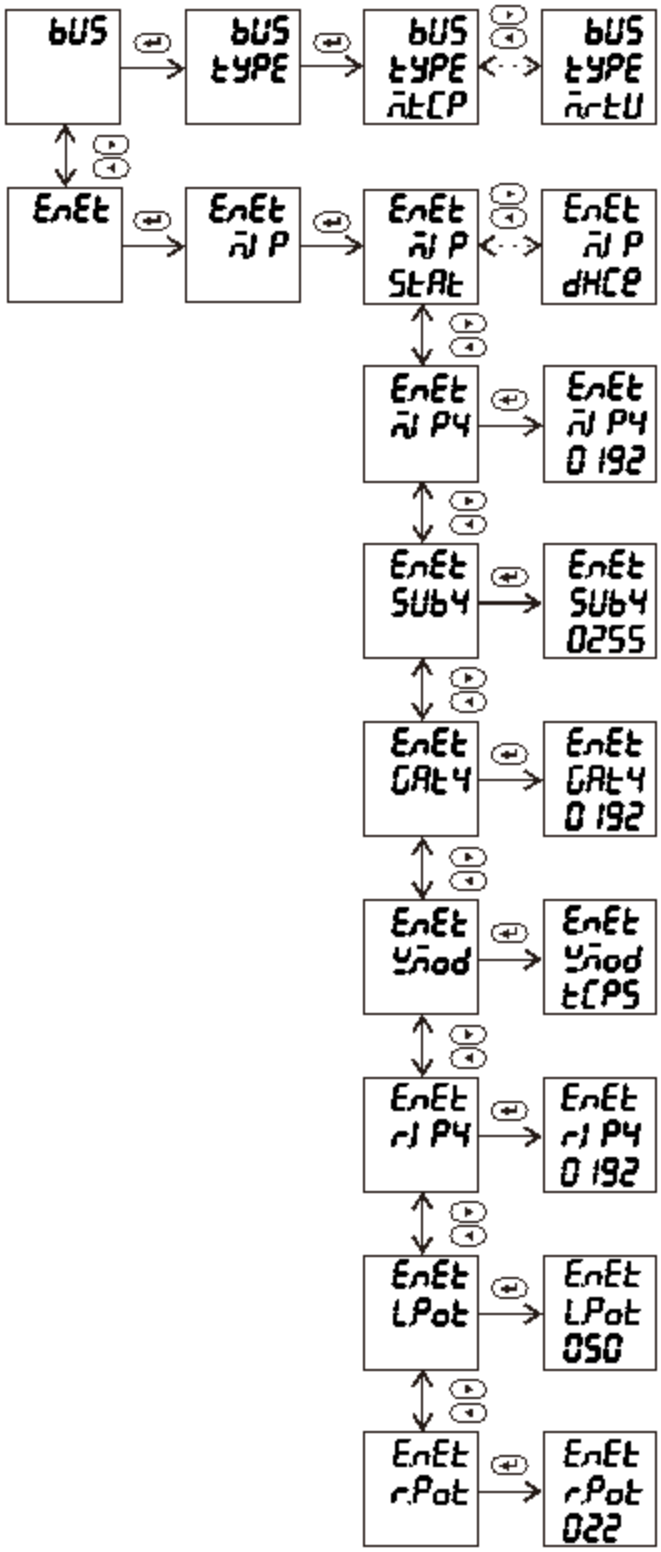
Note:

(1) Modbus address setup range 1-247.

(2) Baud ratio can select 1200 / 2400 / 4800/ 9600, and regular meter equipped with communication port max baud ratio is 19200bps. If need higher speed, please contact Blue Jay sales team.

6.3.2.- Ethernet communication setting

If meter is equipped with RJ45 port, the Bus configuration is as shown below:



Modbus-TCP / Modbus-RTU

Meter can send data to remote IP/TCP, working logic same as standard RS485, Ethernet port work as bridge.

Static IP* / DHCP

*Users need to set IP address and subnet mask

Meter IP address

IP4.IP3.IP2.IP1 for
XXX.XXX.XXX.XXX

Subnet mask

SUB4.SUB3.SUB2.SUB1
XXX.XXX.XXX.XXX

Gateway

GAT4.GAT3.GAT2.GAT1
XXX.XXX.XXX.XXX

TCP working mode

tCPS TCP-server UdPC UDP-Client
HtPL UDP-server tCPC TCP-Client

Destination IP
Meter sends data to remote IP address

IP4.IP3.IP2.IP1 for
XXX.XXX.XXX.XXX

Meter local TCP port

Meter sends data to remote TCP port

Note: In MODBUS-TCP mode are invalid

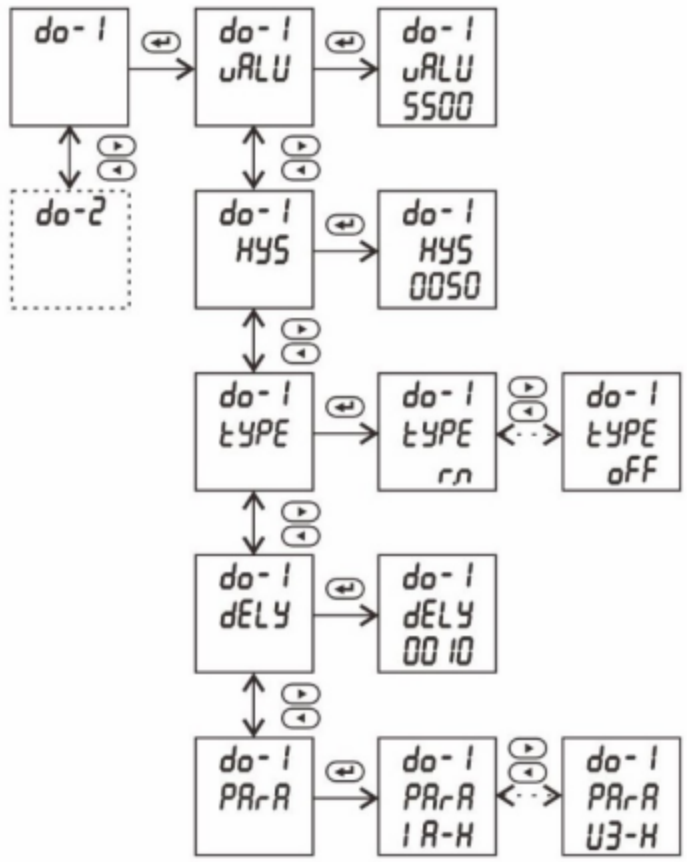
6.4. - Digital Output Setup

DO port is optional module, if do not choose this external port, in Setup menu do not have this sub-menu, and this chapter are invalid.

DO port is optional. If users do not need/ choose this external port, this sub-menu will not be displayed on the setup menu, and this chapter is invalid.

When the device has more than one DO port, you can set the DO-2, as same step.

The physical DO relay standard is 5A 250VAC / 5A 30VDC



Relay trig threshold, value related to secondary side

Default **5500**[1]*

Hysteresis[2] *

Default **0050**

DO working mode[3] *

Default **r.n**

- rn Remote
- ALr Auto Trig
- oFF Turned Off

Delay timer of the trig[4] *

Default **0010**

Parameter be trigged[5] *

Default are **1A-H**

Notes:

(1) Relay trig threshold values have different units:

Voltage - 0.1V	Active power - 0.1W	Power factor - 0.001
Current - 0.001A	Reactive power - 0.1VAR	Frequency- 0.01HZ

(2) Hysteresis value prevents from unexpected relay release, only the measurement parameter falls back or is lower / over a certain difference value from trig threshold, then the DO can be released.

Formula: **Xm** < **X** - **Xr** (Upper edge trig) or **Xm** > **X** + **Xr** (Lower edge trig)

Xr = uRLU **x** HYS / 10000

Xm is measurement rms value of electrical parameter

Example: Trig threshold value 3.700A; hysteresis value 0.03; After relay is trigged, and when measure value **Xm** < 3.589A (3.700-3.700*0.03), the relay will be released.

(3) DO port preset 2 types of working mode, and can be **Turned Off**

Auto Trig – When the measurement parameter is over or lower the preset uRLU, the DO relay act, terminal of DO+ / DO- shorted. After the measurement parameter falls back to a certain value, relay coil can be released.

Remote - DO relay act by RS-485 control command, users can use function code 05 to trig single relay, and the device RS-485 port follow MODBUS-RTU protocol, command as following:

Host inquiry:

Addr.	Code	No.1 Relay register	Relay value (FF00:close; 0000: open)	CRC
01	05	00 01	FF 00	DD FA

Slave response:

Addr.	Code	No.1 Relay register	Relay value (FF00:close; 0000: open)	CRC
01	05	00 01	FF 00	DD FA

Auto trig mode, after **Xm** > uRLU in the specified delay time, DO relay act. Setting value from 0.000sec (no delay) to 999.9 sec, default 0010 = 1sec.

In **Remote** mode, if setup value = 0, output is **Level type**,

If set value = 0, output is **Pulse type**, value = pulse width

(4) Parameters of the DO can be set, preset 52 types parameter that can be used in auto trig mode

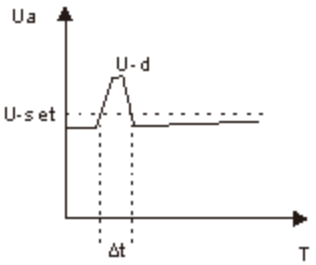
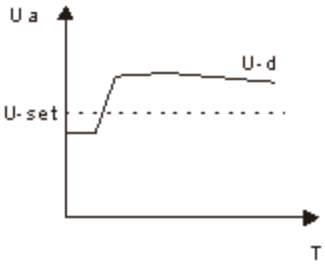
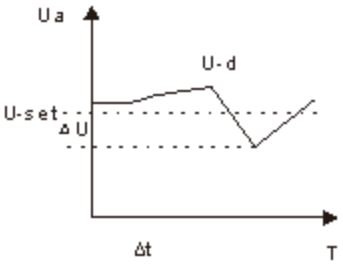
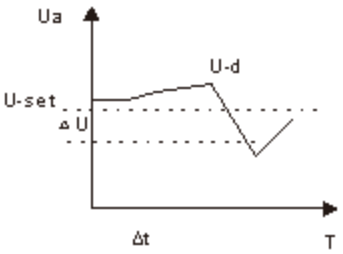
UA-H	A phase voltage upper trig	Qb-H	B phase reactive power upper trig
Ub-H	B phase voltage upper trig	QC-H	C phase reactive power upper trig
UC-H	C phase voltage upper trig	QS-H	Total reactive power upper trig
U3-H	Any one of Ua / Ub / Uc3 upper trig	SA-H	A phase apparent power upper trig
IA-H	A phase current upper trig	Sb-H	B phase apparent power upper trig
Ib-H	B phase current upper trig	SC-H	C phase apparent power upper trig
IC-H	C phase current upper trig	SS-H	Total apparent power upper trig
I3-H	Any one of Ia / Ib / Ic3 upper trig	PF-H	Total power factor upper trig
PA-H	A phase active power upper trig	Fr-H	Frequency upper trig
Pb-H	B phase active power upper trig	di 1H	DI1 closed trig
PC-H	C phase active power upper trig	di 2H	DI2 closed trig
PS-H	Total active power upper trig	di 3H	DI3 closed trig
QA-H	A phase reactive power upper trig	di 4H	DI4 closed trig

Note: If in screen show "XX -L" mean lower limit trig, for DI port mean open loop trig.

*** Delay & Hysteresis logic**

Example in upper limit alarm of A phase voltage:

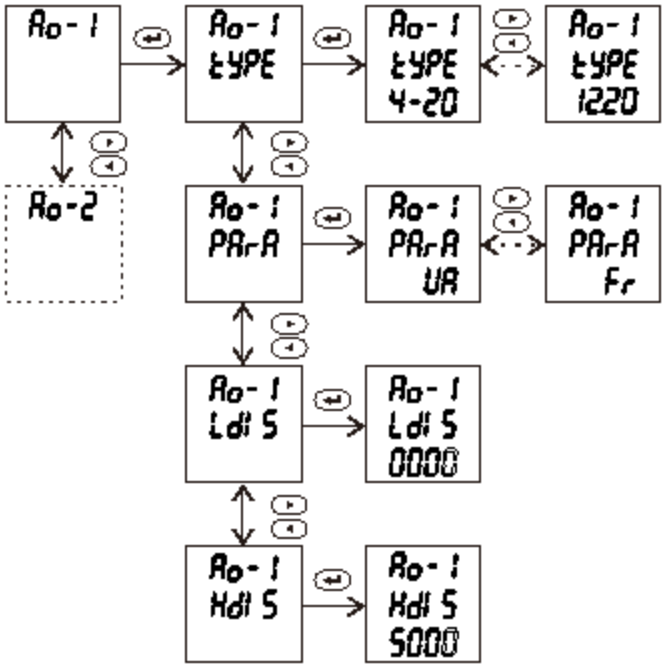
U-d means detected Ua
U-set means Alarm value of A phase

Alarm will not trigged		If Δt < Delay setting value, The Alarm will not be trigged, that can avoid influence of the transient electrical parameters
Alarm trigged		When U-d is over U-set, and after delay setting time cool down, the value is still over U-set, the alarm will be trigged
Alarm will not released		If ΔU < Hysteresis value The Alarm will not be released, that can avoid influence of parameter unexpected fluctuations
Alarm released		When U-d is lower than (U-set -Hysteresis) The Alarmwill be released

6.5. - Analog Output Setup

AO port is optional module, if do not choose this external port, in Setup menu do not have this sub-menu, and this chapter are invalid. When device has more than one AO port, you can set the AO-2…, as same step. Basic specification of AO port:

Accuracy class	0.5S
Overload	120% effective output, the maximum current of 24mA, voltage 15V
Load	R_{max} = 420Ω
Isolation	1KV to other terminal (Between AO-AO port non-isolation)



Analog output signal range [1] *

Default **4-20mA**

Analog output signal parameter [2] *

Default **Ua**

Transfer parameter value of zero span

Default **0000**[3]*

Transfer parameter value of full span

Default **5000**[3]*

Notes:

(1) Signal range default are ampere output, rang 4-20mA, 12-20mA, optional voltage signal output, optional 0-5V, 10-5V, (please contact Blue Jay sales team before order).

(2) The analog parameter can set Ua, Ub, Uc, Uab, Ubc, Uca, Ia, Ib, Ic, Pa, Pb, Pc, PS, Qa, Qb, Qc, Qs, Sa, Sb, Sa, SS, PF, Fr.

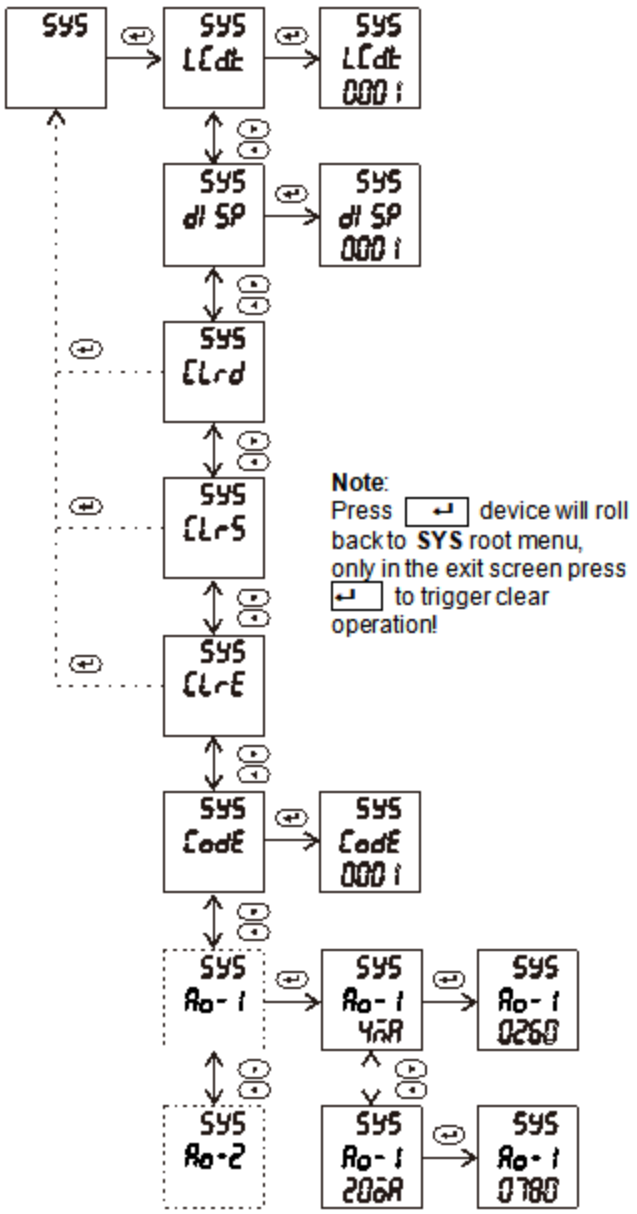
(3) Transfer parameter related secondary side value (such as AC100V, AC5A), units as following:

Voltage - 0.1V	Active power - 0.1W	Power factor - 0.001
Current - 0.001A	Reactive power - 0.1VAR	Frequency- 0.01HZ

Example: Setup variable: **TYPE** 4-20mA **PARA** Ia **LdIS** 0000 **HdIS** 5000

Mean transfer A-phase current is 0.000A output 4mA, current is 5.000A output 20mA;

6.6. - System Setting



Note:
Press ↵ device will roll back to **SYS** root menu, only in the exit screen press ↵ to trigger clear operation!

Duration of LED backlight, unit: **Min**

Default **0005**

Screen scroll interval, unit: **sec**

Default **0000**(1)*

Reset demand record

Reset SOE record

Reset energy counter record

Clear: can be write by RS485 command*

Change password(2)*

Analog output zero span calibration setup(3)*

Analog output full span calibration setup(3)*

Notes:

(1) Set 0000 mean manually switch each monitor screen pages.

(2) If change the password, please keep the password in safety, or only return to Blue Jay for reset new password!

(3) Variable step value is 2/1000. Blue Jay already do calibration before shipping, please use high precision ammeter or voltmeter as reference standard.

(4) Customers can write commands through RS485 or through the screen to clear the energy data to 0. Once the secondary side value of the internal memory reaches to 2^{32}(4294,967,296), counter automatically reset to 0.

6.7. - Partial Flowchart explanation

Layer 1	Layer 2	Layer 3	Layer 4	Description
-SYS.-	CodE	(Default **0001**)		Set password
	DISP	0		Select manual switching
		Display of non-zero values: 1,2....99.....		Switching time, unit is seconds. For example, displaying '1' means that the switching time between screens is 1 second.
	AO-1	4MA	(Default **0290**)	Analog zero span calibration
		20MA	(Default **0850**)	Analog full span calibration
	AO-2	4MA	(Default **0290**)	Analog zero span calibration
		20MA	(Default **0850**)	Analog full span calibration
	U.SIG	(Default **0020**)		Voltage small signal shielding settings
	I.SIG	(Default **0010**)		Current small signal shielding settings
	CLRE			Energy reset
	LIG.t	(Default **0004**)		LED backlight time settings
-IN.-	Line	3P4L,3P3L		Wiring method
	U.SCL	100V,380V		Range of input voltage signal
	I.SCL	5A,1A		Range of input current signal
	r.Pt	(Default **0001**)	Range 1~9999	Set voltage signal ratio
	r.Ct	(Default **0001**)	Range 1~9999	Set current signal transformation ratio
-BUS-	ADDR	(Default **0001**)	Range 1~247	Set meter communication address
	BAUD	1200,2400,4800,9600 (Default **9600**)		Set communication speed (baud rate)
	DATA	n.8.1, o.8.1, e.8.1 (Default **n.8.1**)		Set communication data format

6.8. - Menu character description

PASS	(Password) User password
-In-	(Input) User Display data settings menu
bUS	(Bus) Communication settings menu
SYS	(System) System settings menu (for factory debugging, not open yet)
dAtA	(Data) Communication parameter setting
Addr	(Address) Local communication address setting
bAUd	(Baud) Communication baud rate
o8.1	(o.8.1) Indicates 8 data bits, 1 stop bit, odd parity
E8.1	(e.8.1) Indicates 8 data bits, 1 stop bit, even parity
n8.1	(n.8.1) Indicates 8 data bits, 1 stop bit, no parity bit
SUrE	(Sure) Confirm changes or not
Ao-1	Analog output settings
do-1	Channel 1 analog output setting
do-2	Channel 2 analog output setting
PArA	Para Corresponding parameter selection
uALU	(Value) Set the corresponding alarm value
LdI S	Set lower alarm value
HdI S	Set higher alarm value
HYS	Hysteresis

7. - PULSE OUTPUT

APM-96J provides 1* pulse output for the total active energy & total reactive energy.

The host / PLC / DI module can cumulative the data of both the active and reactive power energy sent by the pulse from opt coupler relay.

1). Electrical specification: voltage VCC ≤ 48V, Iz ≤ 50mA.

2). Pulse: 5000 imp / kWh, pulse up to 80ms.
This means: When the device detects 1 kWh, the port will generate 5000 pulse.

Note: 1 kWh energy is for *secondary side energy data*, if there have PT and CT accessed; primary side energy data is "1 kWh ×PT ratio× CT ratio".

Voltage (V)	Current (A)	Pulse constant (imp / kWh)
380 or 220	5	5000
	1	20000
100	5	20000
	1	80000

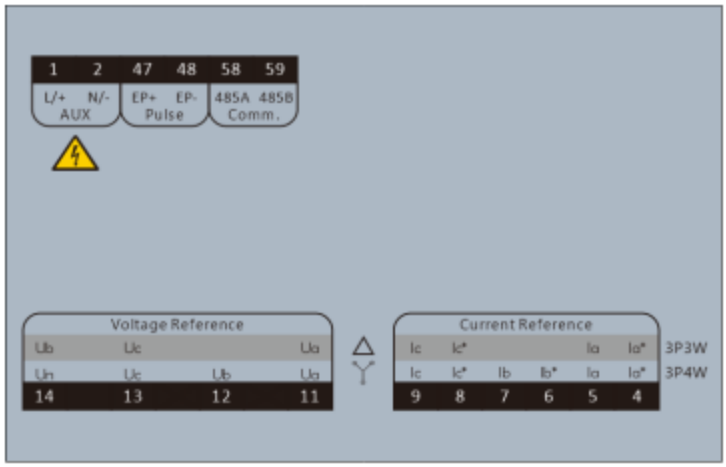
Example: In measure time "T", the received total pulse is "N",
Primary side input of voltage is 10Kv,
Primary side input of current is 400A.
Secondary side measurement range is 100V and 5A.

In the time "T", energy accumulated is: N / 20000 × 100 × 80

8. - COMMUNICATION INTERFACE

8.1. - Connection for RS485 BUS

The composition of the RS-485 cabling must be carried out with a meshed screen cable (minimum 3 wire), diameter of not less than 0.5mm^2, with a maximum distance of 1,200 m between the APM-96J and the master unit. This Bus may connect a maximum of 32pcs APM-96J…



Notes:

-. For communication with the master unit, user can choose RS-485 to RS-232 converter or RS485 to USB adapter to use.

-. For expand the number of devices in the communication network, a signal repeater can be used.

-. Full range of APM series meter RS485 PIN number is 58,59.

-. Due to product modifications or special requirements, the interface pin place may be change. For details, please refer to product label on the rear side.

8.2. - MODBUS © protocol

Modbus RTU Frame Format:

Address code	**1 BYTE**	*Slave device address **1-247***
Function code	**1 BYTE**	*Indicates the function codes like read coils / inputs*
Data code	**4 BYTE**	*Starting address, high byte* *Starting address, low byte* *Number of registers, high byte* *Number of registers, low byte*
Error Check code	**2 BYTE**	*Cyclical Redundancy Check (**CRC**)*

MODBUS FUNCTIONS:

Code	Meaning	Description
FUNCTION 01	Read Coil Status	*Only valid when equipped DO port*
FUNCTION 02	Read Input Status	*Only valid when equipped DI port*
FUNCTION 03	Reading of n Words	*This function permits to read all the electrical parameters of the device.*
FUNCTION 05	Force Single coil	*When DO in remote control mode can work*
FUNCTION 06	Preset Single holding register	*There is an upper limit for writing, please be sure to check the upper limit of the host computer to avoid exhausting the life of the storage machine.*

Note: Float data follow **IEEE754**, float low bit first, high bit next. (**CD AB**)

8.3. - Register map

8.3.1 - Basic power data-primary side

Register	Data	Byte mode		Instruction
0x00	Ua	float	2	Phase to line voltage, Unit: V
0x02	Ub	float	2	
0x04	Uc	float	2	
0x06	Uab	float	2	Phase to phase voltage, Unit: V
0x08	Ubc	float	2	
0x0a	Uca	float	2	
0x0c	Ia	float	2	Three phase current, Unit: A
0x0e	Ib	float	2	
0x10	Ic	float	2	
0x12	Pa	float	2	Individual phase active power, Unit: kW
0x14	Pb	float	2	
0x16	Pc	float	2	
0x18	P∑	float	2	Total active power, Unit: kW
0x1a	Qa	float	2	Individual phase reactive power, Unit: kVar
0x1c	Qb	float	2	
0x1e	Qc	float	2	
0x20	Q∑	float	2	Total reactive power, Unit: kVar
0x22	Sa	float	2	Individual phase apparent power, Unit: kVA
0x24	Sb	float	2	
0x26	Sc	float	2	
0x28	S∑	float	2	Total apparent power, Unit: kVA
0x2a	PFa	float	2	Individual phase power factor, 0~1.000
0x2c	PFb	float	2	
0x2e	PFc	float	2	
0x30	PF∑	float	2	Total power factor, 0~1.000
0x32	FR	float	2	Frequency, Unit:0.01Hz
0x34	Ep+	float	2	Positive active energy, Unit: kWh
0x36	Ep-	float	2	Negative active energy, Unit: kWh
0x38	Eq+	float	2	Inductive reactive power, Unit: kVarh
0x3a	Eq-	float	2	Capacitive reactive power

8.3.2 - Basic power data-secondary side

Register	Data	Byte mode		Instruction
0x100	Ua	int	1	Phase to line voltage, Unit: 0.1V
0x101	Ub	int	1	
0x102	Uc	int	1	
0x103	Uab	int	1	Phase to phase voltage, Unit: 0.1V
0x104	Ubc	int	1	
0x105	Uca	int	1	
0x106	Ia	int	1	Three phase current, Unit: 0.001A
0x107	Ib	int	1	
0x108	Ic	int	1	
0x109	Pa	int	1	Individual phase active power, Unit: W
0x10a	Pb	int	1	
0x10b	Pc	int	1	
0x10c	P∑	int	1	Total active power, Unit: W
0x10d	Qa	int	1	Individual phase reactive power, Unit: Var
0x10e	Qb	int	1	
0x10f	Qc	int	1	
0x110	Q∑	int	1	Total reactive power, Unit: Var
0x111	Sa	int	1	Individual phase apparent power, Unit: kVA
0x112	Sb	int	1	
0x113	Sc	int	1	
0x114	S∑	int	1	Total apparent power, Unit: VA
0x115	PFa	int	1	Individual phase power factor, 0~1.000
0x116	PFb	int	1	
0x117	PFc	int	1	
0x118	PF∑	int	1	Total power factor, 0~1.000
0x119	FR	int	1	Frequency, Unit:0.01Hz
0x11a	Ep+	int	2	Positive active energy, Unit: Wh
0x11c	Ep-	int	2	Negative active energy, Unit: Wh
0x11e	Eq+	int	2	Inductive reactive power, Unit: Varh
0x120	Eq-	int	2	Capacitive reactive power
0x200	DO	int	1	Bit 0~1 show channel 1and channel 2 status 0 for open, 1 for closed
0x201	DI	int	1	Bit 0~3 show channel 1 to channel 4 status 0 for open, 1 for closed

8.3.3 - Advanced electrical parameter - primary side

Register	Data	Byte mode		Instruction
0x320	V_{δ}+	float	2	Positive sequence voltage in primary side
0x322	V_{δ}-	float	2	Negative sequence voltage in primary side
0x324	V_0	float	2	Zero sequence voltage in primary side
0x326	I_{δ}+	float	2	Positive sequence current in primary side
0x328	I_{δ}-	float	2	Negative sequence current in primary side
0x32A	I_0	float	2	Zero sequence current in primary side
0x32C	eU	float	2	Voltage unbalance, eU = (V_{δ}- / V_{δ}+)%
0x32E	eI	float	2	Current unbalance, eI = (I_{δ}- / I_{δ}+)%
0x330	Va_d	float	2	A phase voltage deviation
0x332	Vb_d	float	2	B phase voltage deviation
0x334	Vc_d	float	2	C phase voltage deviation
0x336	F_d	float	2	Frequency deviation

8.3.4- THD and individual harmonic (Max 31 times)

Register	Data	Byte mode		Instruction
0x500	THDUa	int	1	A-phase voltage THD, unit 0.1%
0x501	THDUb	int	1	B-phase voltage THD
0x502	THDUc	int	1	C-phase voltage THD
0x503	THDia	int	1	A-phase current THD, unit 0.1%
0x504	THDib	int	1	B-phase current THD
0x505	THDic	int	1	C-phase current THD
0x508-0x545	HUa	int	62	Three phase voltage individual harmonic 2-31st Three phase current individual harmonic 2-31st **Note:** Within these 62 registers, addresses 1–30 is used, the rest are reserved.
0x548-0x586	HUb	int	62	
0x588-0x5C5	HUc	int	62	
0x5C8-0x605	HIa	int	62	
0x608-0x645	HIb	int	62	
0x648-0x685	HIc	int	62	
0x688	TOHDUa	int	1	Each phase voltage total odd harmonic distortion, Unit 0.1%
0x689	TOHDUb	int	1	
0x68a	TOHDUc	int	1	
0x68b	TEHDUa	int	1	Each phase voltage total even harmonic distortion, unit 0.1%
0x68c	TEHDUb	int	1	
0x68d	TEHDUc	int	1	
0x68e	THFFUa	int	1	Each phase voltage telephone harmonic form factor, unit 0.1%
0x68f	THFFUb	int	1	
0x690	THFFUc	int	1	
0x691	CFUa	int	1	Three phase voltage crest factor, unit 0.001
0x692	CFUb	int	1	
0x693	CFUc	int	1	
0x694	TOHDIa	int	1	Each phase current total odd harmonic distortion, unit 0.1%
0x695	TOHDIb	int	1	
0x696	TOHDIc	int	1	
0x697	TEHDIa	int	1	Each phase current total even harmonic distortion, unit 0.1%
0x698	TEHDIb	int	1	
0x699	TEHDIc	int	1	
0x69a	KFIa	int	1	Three phase current k factor, unit 0.01
0x69b	KFIb	int	1	
0x69c	KFIc	int	1	

8.3.4 - Write operation function definition: Preset single holding register

Register	Data	Byte mode		Instruction
0x900	Line	int	1	Wiring method: 0: 3-phase 4-wire 1: 3-phase 3-wire 2CT 2: 3-phase 3-wire 3CT
0x901	U.SCL	int	1	Voltage range 0:100V 1:380V
0x902	I.SCL	int	1	Current range 0:1A 1:5A
0x903	PT	int	1	Voltage ratio
0x904	CT	int	1	Current ratio
0x905	Communication address	int	1	Range: 1-247
0x906	Communication baud rate	int	1	0:1200 1:2400 2:4800 3:9600 4:19200
0x907	Communication data format	int	1	0:n.8.1 1:o.8.1 2:e.8.1 3:n.8.2

Notes:

1. Not all of the data above can be read by RS485, the reading address will be unsuccessful.
2. The data can be read out depends on your multi-function meter model, please refer to the corresponding product manual before build your software.
3. Some software has different definitions of the start bit of register address, there will be offset, please add 1 for the right address. To get more info, please contact technical support **tech@cqbluejay.com**

8.4. - Example

Host inquiry slave device

Addr.	Func.	Data Address (high)	Data Address (low)	Data Number (high)	Data number (low)	CRC16 (low)	CRC16 (high)
0CH	03H	00H	00H	00H	06H	CRC	CRC

PC user ask upload Ua, Ub, Uc, Uab, Ubc, Uca

Slave device answer

Addr.	Func.	Byte count	Data1-6				CRC16 (low)	CRC16 (high)
0CH	03H	18H	19H	9AH	43H	5CH	CRC	CRC
			33H	33H	43H	5CH		
			E6H	66H	43H	5BH		
			EFH	9EH	40H	9FH		
			00H	00H	40H	A0H		
			10H	62H	40H	A0H		

Show the data:

Float data follow the IEEE754 format, with the low word first and high word second (CD AB).

UA = 199A435C → 435C199A →220.1V.
UB= 3333435C→ 435C3333 →220.2V.
UC= E666435B→ 435BE666 →219.9V.
... ...

Notes:

1. Blue Jay disable the 06 function in default setting, if Activated the write command, please check the host device program to avoid the meaningless write operation, that may reduce the reduce the register working life.
2. When the write is unsuccessful, no return data from the slave device. In this addition, please re-send write inquiry again.

9. - SAFETY CONSIDERATIONS



All installation specification described at the previous chapters named: **INSTALLATION AND STARTUP, INSTALLATION MODES and SPECIFICATIONS.**

Please note that with the instrument powered on, the terminals could be dangerous to touching and cover opening actions or elements removal may allow accessing dangerous parts. This instrument is factory-shipped at proper operation condition.

- The device must have a professional installation and maintenance.
- Any operation of the device, you must cut off the input signal and power.

10. - MAINTENANCE

The APM-96J meter does not require any special maintenance. No adjustment, maintenance or repairing action should be done when the instrument is open and powered on, should those actions are essential, high-qualified operators must perform them.

Before any adjustment, replacement, maintenance or repairing operation is carried out, the instrument must be disconnected from any power supply source.

When any protection failure is suspected to exist, the instrument must be immediately put out of service. The instrument's design allows a quick replacement in case of any failure.

11. - TECHNICAL SERVICE

FAQ's

1.- Once cabled and connected is seen to give a correct voltage and current reading, but shows negative values for active power (generation).

This is an error with the cabling for the current transformer secondary; the direction of the transformer current has to be respected as shown in the connection diagram. The current transformers have a two face primary; the current must pass from P1 to P2 giving the result in secondary (S1 and S2) of 5 amps.

The error stems from:

a). The current transformers have been incorrectly installed. As a result, it gives the direction of the current as passing from P2 to P1; to resolve this problem, the current transformer does not have to be dismantled and installed again, but the transformer secondary (S1 and S2) just has to be inverted.

b). The connection of the current secondary in the current transformers have been incorrectly connected; to resolve this problem just connect the S1 transformer secondary to the S1 on the meter and the S2 on the current transformer to the S2 on the meter.

2.- Once cabled and connected, is seen to give an incoherent Power factor and CosΦ reading (-0.01 or similar).

This is again a current transformer and voltage phase connection error phase A, must correspond to the current transformer installed in phase A; phase B, must correspond to the current transformer installed in phase B; and phase C, must correspond to the current transformer installed in phase C.

This connection terminal is clearly shown on the area side of the device.

3.- The measuring voltage and is displaying the secondary voltage (for example 110 volts).
Ensure that the voltage Transformer ratio has been correctly set (Please refer to voltage PT ratio setting section in chapter **SETUP PROCEDUCE**).

4.- Device does not correctly display the current reading. It shows values varying between 0 to 5 amps of current.
Ensure that the Current Transformer ratio has been correctly set; (Please refer to current CT ratio setting section in chapter **SETUP PROCEDUCE**).

Calculation formula of electrical parameter

Formula	Parameter
$U = \sqrt{\frac{1}{N}\sum_{n=0}^{N} u_n^2} \quad n = 0,1,2.....N$	Voltage RMS value
$I = \sqrt{\frac{1}{N}\sum_{n=0}^{N} i_n^2} \quad n = 0,1,2.....N$	Current RMS value
$P = \frac{1}{N}\sum_{n=1}^{N} (i_{an}u_{an} + i_{bn}u_{bn} + i_{cn}u_{cn})$	Total active power cycle average
$P_s = UI$	Single-phase apparent power cycle average
$\cos\theta = \frac{P_p}{P_S}$	Power factor
$P_q = \sqrt{P_S^2 - P_P^2}$	Reactive power (Pq is positive and the direction cannot be determined; P algorithm can be used to shift the voltage component by 90º)
$W = \int P * dt$	Electric energy

Note: In above formula, N for sampling points in one AC wave, In standard APM-96J, the N=128

For any inquiry about the instrument performance or any failure,
contact to Blue Jay's technical service.

Blue Jay - After-sales service

E-mail: tech@cqbluejay.com