دفترچه راهنما

Universal Measuring Device

Zmp8800E

ZILUG

مولتی فانکشن پاور متر

مجهز به دیتا لاگر

مدل: Zmp8800e

ZILUG

احتیاط برای استفاده ایمن
تجهیزات

لطفا قبل از استفاده از این دستگاه، دستورالعمل ها را دقیقا بخوانید. نمادهای زیر در طول این دفترچه راهنما برای نشان دادن خطرات بالقوه یا وضعیت خطرناکی که در هنگام کارکرد تجهیزات بوجود می آیند، استفاده شده اند.
zilug -aksa برای استفاده نادرست از دستگاه مندرج در این دفترچه راهنما مسئول نیست .


DANGER

خطر

این نماد نشان می دهد استفاده نادرست از دستگاه توسط پرسنل مجرب می تواند باعث آسیب جدی یا مرگ شود.


WARNING

اخطار

این نماد نشان می دهد که اگر دستورالعمل ها به دقت دنبال نشوند، ممکن است وضعیت بالقوه خطرناک بوجود آید که موجب صدمات جدی یا مرگ شود.


CAUTION

احتیاط

این نماد نشان می دهد که اگر دستورالعمل های ذکر شده رعایت نشود، صدمه به کاربر یا آسیب به ،دستگاه ممکن است رخ دهد

لطفاً دفترچه مقابل را قبل از هر گونه عملیات نصب و راه اندازی و نگهداری به دقت بخوانید.

نکات کاربردی داخل این دفترچه برای دستگاه اندازه گیری ZMP می باشد تا از خطرات و تاثیرات ناشی از کارکرد با این دستگاه در زمان کار و نصب بصورت سریع شما را آگاه سازد.

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CONTENTS

شکلها

جداول

1. بررسی اجمالی

1.1. Introduction

Powerful Multifunction Power Meter

ZMP Series Multifunction power meter was designed by used of latest microprocessor and digital signal process technology. Electric power parameters, energy and demand metering, power quality monitoring, remote control, statistics and records, all these functions are only in one pocket-size unit.
It combines high accuracy measurement with intelligent multifunction and simple HMI interface.

Ideal Choice for Electric Automation SCADA System

ZMP can be used to replace all traditional electric meters. It also can be used as Remote Terminal Unit (RTU) for monitoring and controlling in a SCADA system. All the measured data is available via digital RS485 communication ports running the MobusTMprotocol.

Energy Management

ZMP can measure double directions four quadrants kWh and kvarh with accuracy up to 0.5%. It can provide high standard energy data and energy demand data. All these data are important for statistics for each line feeder and total.

1.2. The Application Area of ZMP

- ✓ Power Distribution Automation
- ✓ Intelligent Electric Switch Gear
- ✓ Industry Automation
- ✓ Building Automation
- ✓ Energy Manage System
- ✓ Large UPS System

1.3. The Function of ZMP

Multifunction, High Accuracy

ZMP Series Intelligent power meter was designed by use of latest microprocessor and digital signal process technology. Electric power parameters metering, energy and demand recording, power quality monitoring, remote controlling, statistics and records, all these functions are only in one pocket size unit. Unbalance Factors, Demands and Pulse Output based on Energy or Reactive Energy in ZMP. It combines high accuracy measurement with intelligent multifunction and friendly HMI interface.

Small Size and Easy Installation

With the size of DIN96×96 and 55mm depth after mounting, the ZMP can be installed in a small cabin. The fixing clips are used for easy installation and remove.
Easy to Use
By using of large screen high density LCD, the display of ZMP is easy to read and use. All the setting parameters can be access by using panel keys or communication port. The setting parameters are protected in EPROM, which will maintain its content after

the meter is power off. With the backlight of the LCD, the display can be easily read in the dim environment. The back light "on" time is selectable.

Multiple Wiring Modes

In either high voltage or low voltage or three phase three wire or three phase four wire or single phase system, the ZMP can be easily used.

Powerful Multifunction Power Meter

The ZMP8800 II series multifunction digital power meter is designed using modern MCU and DSP technology. It integrates three-phase energy measuring and displaying, energy accumulating, power quality analysis, malfunction alarming, data logging and network communication. A vivid LCD display with large characters and, time of use programmable backlight provides a clear real time data readout.

An Ideal for Electric Automation SCADA Systems

The ZMP8800 II series meter is the ideal choice for replacing traditional, analog electric meters. In addition to providing clear real-time readings on the meter front, it can also be used as a remote terminal unit (RTU) for monitoring and controlling for a SCADA system. Users can access all measurement parameters via the standard RS485 communication port (or the optional Ethernet port) with the ModbusTM protocol.

Energy Management

The ZMP8800 II series meter is able to measure bidirectional, four quadrants kWh and kvarh. It provides maximum/minimum records for power usage and power demand parameters. All power and energy parameters can be viewed remotely via software in order to easily monitor various parameters. In addition, measurement tables can be viewed from the free ZMPView software.

Remote Power Control

This meter is designed for measuring and monitoring power quality parameters. Since different I/O modules can be added to the meter, this expands the capabilities and provides a very flexible platform for using the meter as a distributed RTU, for metering, monitoring and remote controlling, all in one unit.

Power Quality Analysis

Utilizing digital signal processing (DSP) technology, the ZMP8800 II series meter provides high accuracy power quality analysis and supports remote monitoring via the Ethernet module. The meter continuously updates metering results and allows users to access the meter online to monitor parameters such as voltage and current THD, harmonics up to the 31st, voltage crest factor, current K factor, and voltage and current unbalance factor etc.

Data Logging

The ZMP8800 meter contains 8 megabytes of onboard memory for data logging and historical trending. Since the meter contains a real-time clock, all events and logged data will be time stamped.

Energy Tariffs

User can assign up to 4 different tariffs to different time period within a day according to the billing requirements. The meter will calculate and accumulate energy to different tariffs according to the meter's internal clock timing.

Minimum and Maximum Logging

When a Minimum and Maximum event happens, such as voltage, etc., ZMP8800E will record the timestamp and the triggering condition of the event.

ZMP series

The ZMP series products have three kinds of products, the standard ZMP and the advanced ZMP8800+ and economy model. these products have multiple choice.

Function	Parameter	ZMP8800E	ZMP8800	ZMP8800+
Phase Voltage	V1,V2,V3,Vlnavg	√	√	√
Line Voltage	V12,V23,V31,Vllavg	√	√	√
Current	I1,I2,I3,Iavg	√	√	√
Natural Current	Calculated	√		√
Natural Current	In (direct with separate CT) Measured	√	√	√
Power	P1,P2,P3,Ptotal	√	√	√
Reactive Power	Q1,Q2,Q3,Qtotal	√	√	√
Apparent Power	S1,S2,S3,Stotal	√	√	√
Power Factor	PF1,PF2,PF3,PFT	√	√	√
Frequency	Frequency	√	√	√
Energy	Ep_imp, Ep_exp	√	√	√
	Ep_total, Ep_net			
Reactive Energy	Eq_imp, Eq_exp	√	√	√
	Eq_total, Eq_net			
Demand	Dmd_P, Dmd_Q, Dmd_S	√	√	√
Voltage Unbalance	U_unbl	√	√	√
Current Unbalance	I_unbl	√	√	√
Voltage THD	THD_V1, THD_V2, THD_V3	√		√
	THD_V1_Even, HD_V2_Even, THD_V3_Even THD_V1_Odd, THD_V2_Odd, THD_V3_Odd THD_V1+N, THD_V2+N, THD_V3+N			
Current THD	THD_I1, THD_I2, THD_I3	√		√
	THD_I1_Even, HD_I2_Even, THD_I3_Even THD_I1_Odd, THD_I2_Odd,			

	THD_I3_Odd THD_I1+N, THD_I2+N, THD_I3+N TDD_I1, TDD_I2, TDD_I3			
Harmonics	Harmonics 2nd to 31st	√		√
Voltage Crest Factor	Crest Factor	√		√
Current K factor	K_Factor	√		√
MAX with Time Stamp		√		√
MIN with Time Stamp		√		√
Switch Status(DI)	Isolated digital input			√
Relay Output(RO)	Two 2A output Relay			√
LED Pulse Output	MC for active , reactive , apparent energies	√		√
RS485 Port	Modbus Protocol (RTU)	√	√	√
Real Time Clock	Miladi , Shamsi , Daylight Saving	√	√	√
Real Time Clock	RTC Calibration	√		√
Astronomical timer	Lighting control relay			√
thermostat	Fan control relay			√
USB PORT	USB version 2 + safe Port	√	√	√
Digital input				√
Wi-Fi Modem	As access point or station (multi-client)			√
Voltage and current sequence		√	√	√
Unit Software Update		√	√	√
Power Supply	Switching power supply 80-260V input	√		√

Table 1 Comparison of ZMP models

Note1:
There are One DI in the ZMP8800+.

Note2:

The 2 DOs may be used as General purpose or Thermostat or Astronomical Timer controller.

Note3:
Class 0.2S IEC 62053-22 four-quadrant active and reactive energy polyphase static meter

2. SETTING UP THE ZMP

2.1. Installation

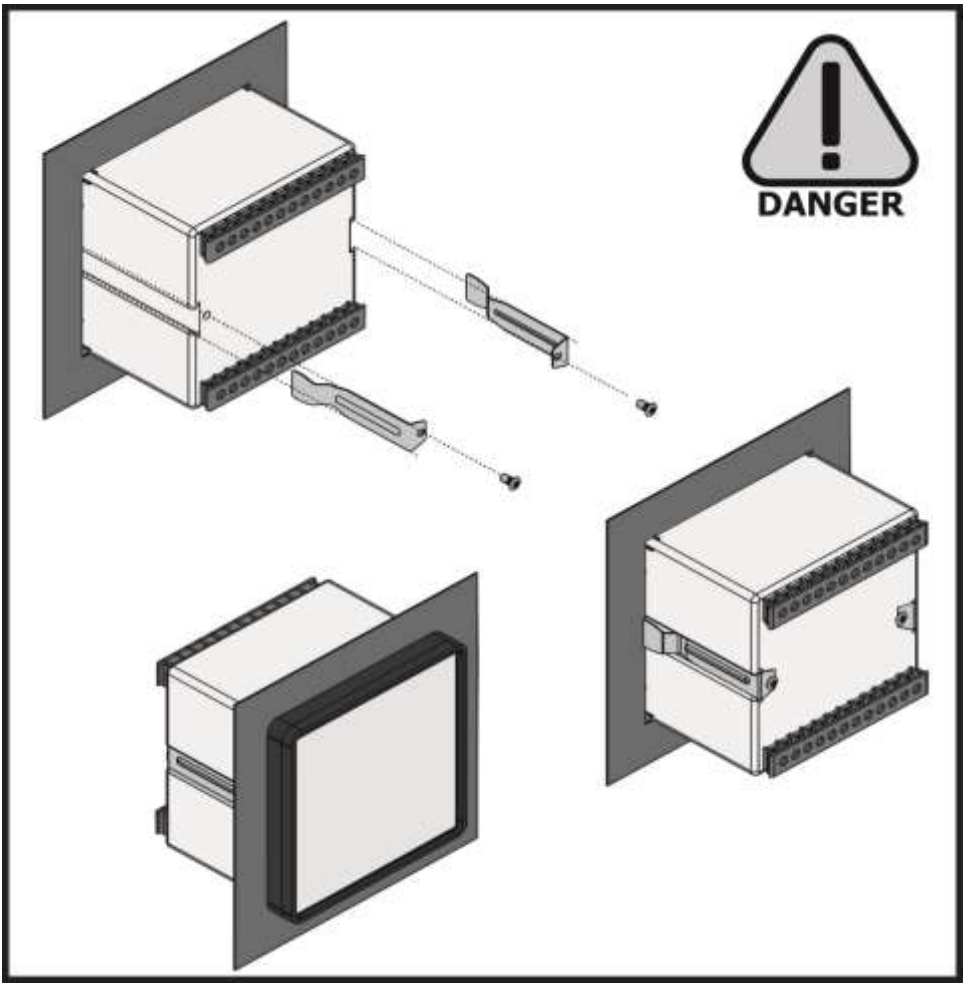

Figure 1 Installation

Note:
Product wiring will change from time to time. Detail wiring please refer to the wire connection in product label.

Terminal Strips

There are four group terminals on the back of ZMP, Voltages & Currents and RS485 Input Terminal, Auxiliary Power Terminal.

Auxiliary Power

The auxiliary power supply of the ZMP meter is 230Vac or 80-260V ac or dc (on ZMP8800+). Typical power consumption of the meter is less than 2W. A regulator or a UPS should be used when the power supply undulates.
A switch or circuit-breaker shall be included in the building installation, and it shall be in close proximity to the equipment and within easy reach of the operator, and it shall be marked as the disconnecting device for the equipment. A fuse (typical 1A/250Vac) should be used in auxiliary power supply loop.
An isolated transformer or EMI filter should be used in the auxiliary power supply loop if there is power quality problem in the power supply.

Voltage Input

Two Voltage Input options are included in ZMP (100Vac and 400Vac). 100Vac is suitable for high or medium voltage system that the secondary of PT is 100Vac. 400Vac is suitable for low voltage system that less than 480Vac. The voltage input could be directly connected to the terminal of ZMP without the use of PT. The input line to line voltage should be less than 480Vac. If the input voltage is higher than 480Vac, the PT should be used. A fuse (typical 1A/250Vac) should be used in voltage input loop.
PT should be used to transform the high voltage into measurement range of ZMP if it is used in high voltage system.
The wire number of voltage input could be AWG16-12 or 1.3-2.0mm^2

Current Input

In a practical engineering application, CTs should be installed in the loop of measuring. Normally the secondary of CT is 5A. 1A is possible in ZMP. A CT of accuracy over 0.5% (rating over 3VA) is recommended and it will influence the measuring accuracy. The wire between CT and ZMP should be as shorter as possible. The length of the wire may increase the error of the measurement. CTs must be required if the rated current over 5A.
The wire number of current input could be AWG15-10 or 1.5-2.5mm^2

The CT loop should not be open circuit in any circumstance when the power is on. There should not be any fuse or switch in the CT loop
and one end of the CT loop should be well connected to the ground.

Vn Connection

Vn is the reference point of ZMP voltage input. The lower is the wire resistance the less is the error.

Three phase wiring diagram

ZMP can satisfy almost all kinds of three phase wiring diagram. The current input wiring mode can be set separately in the meter parameter setting process. The current input wiring mode could be 3CT or 4CT. In 3CT wiring the natural current calculate from three phase currents and in 4CT wiring the natural current is measured from individual CT for natural line.

Voltage Input Wiring

3-Phase 4-Line Wye mode (3LN) the 3-Phase 4-Line Wye mode is popularly used in low voltage electric distribution power system. The power line can be connected to the meter voltage input directly. In the high voltage input system, 3PT Wye mode is often used.

Current Input Wiring

3CT: All the current input of three phase system can be looked as 3CT one, the 4CT: All the current input of three phase system and natural line can be looked as 4CT one, in this current input wiring mode natural current measured directly too.

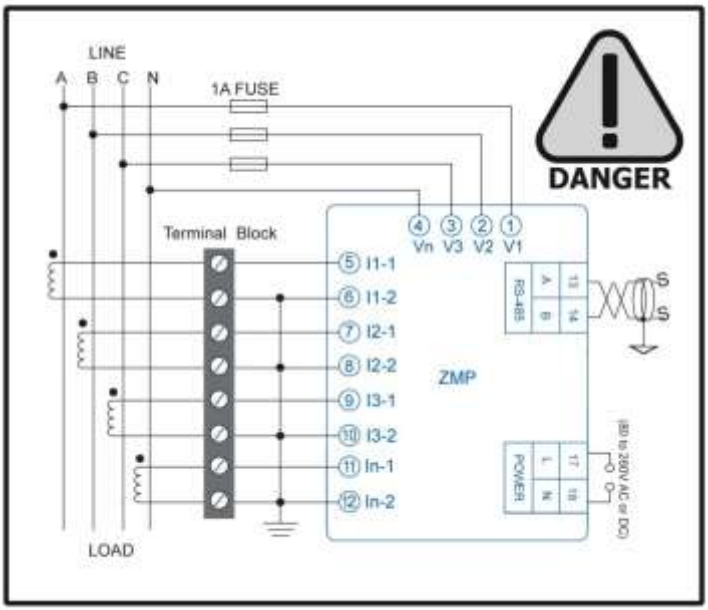

Figure 2 Wiring Diagram

3. DISPLAY


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WELCOME
MAX
MIN
Measurement
MULTIFUNCTION POWER METER
ESC
SET

3.1. Appearance

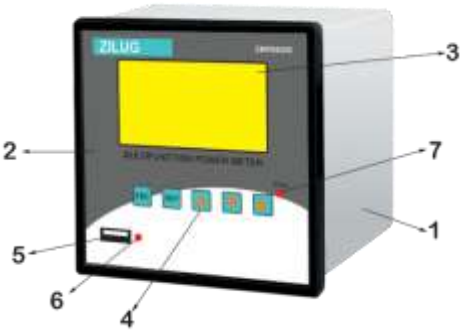

Figure 3 Appearance of ZMP

Part Name	Description
1. Enclosure	The ZMP enclosure are made of high strength ant combustion engineering plastic
2. Front Casing	After the installation, this part is before the panel.
3. LCD Display	128x64 GLCD with backlight
4. Key	The ZMP8800E is provided with five navigation buttons
5.USB Port	Used data transfer and unit software upgrade
6.USB LED	USB notification light
7.Impule LED	A pulse output corresponds to a defined amount of energy passing through the meter

Table 2 Part Name of ZMP

3.2. Dimensions

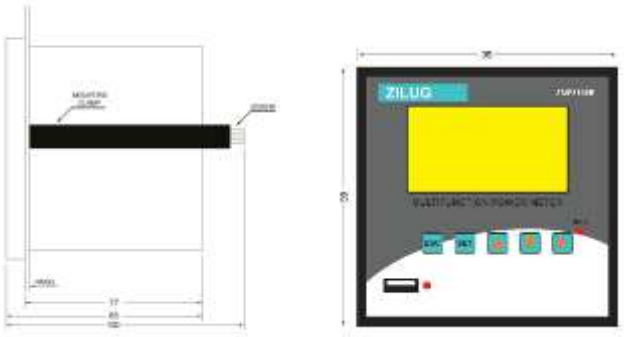

Figure 4 Dimensions

3.3. Installation Method

Environmental

Please check the environment temperature and humidity to ensure the satisfaction of ZMP meter's requirement before the meter installation.

Temperature

Operation: -20°C to 70°C

Storage: -40°C to 85°C

Humidity

5% to 95% non-condensing ZMP meter should be installed in dry and dust free environment and avoid heat, radiation and high electrical noise source.

Maximum Altitude

2,000m

Site Requirement

Indoor Use

Installation Steps

Normally, ZMP was installed on the panel of switch gear.

1. Firstly, cut a square hole on the panel of the switch gear.

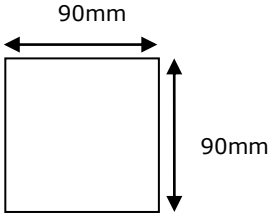

Figure 5 Panel cutting

2. Secondly, remove the clips from the meter and insert the meter into the square hole from the front side.

3. Finally, put clips back to the meter from the backside and push the clip tightly so that the meter is fixed on the panel.

4. MENU OPERATION

The ZMP8800E has a high-contrast graphical LCD display with backlight for local data read outs and meter setup. Multi-page data display mode allows you to scroll through display screens and pages to view various data. The display is normally updated once per second. You can go through icons by ▲ , ▼ or ▶ keys. Press ↵ to enter each icons sub menu.

4.1. MEASUREMENT

Figure 6 Welcome icons

If press ↵ when Measurement icon is highlighted or press ESC ZMP returns measurement screen.

Note:

Press ▲ or ▶ to move next icon and press ▼ to back previous icon.

4.1.1. VOLTAGE

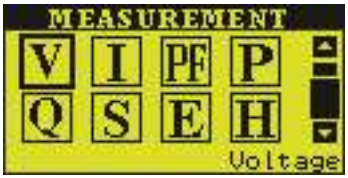

Figure 7 Voltage

First icon is for display Voltage values include Voltage of Line to neutral and voltage of line to line Press ↵ to enter Display sub menu.

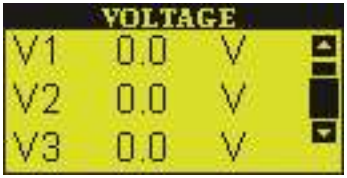

Figure 8 Voltage L-N values

Press ▲ or ▼ to scroll to the next measured items.

Figure 9 Voltage L-L values

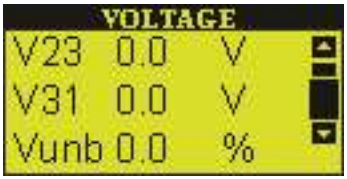

Figure 10 Voltages Unbalance value

4.1.2. Current

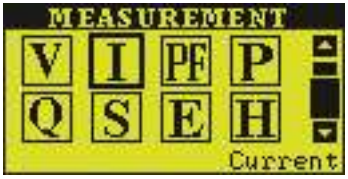

Figure 11 Current

Second icon is for display current of each phase and neutral.
Press ↵ to enter Display sub menu.

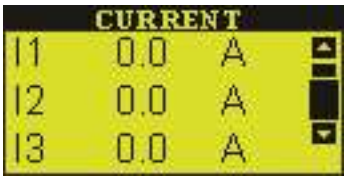

Figure 12 current values

Press ▲ or ▼ to scroll to the next measured items.

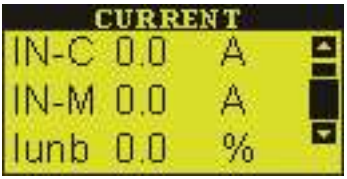

Figure 13 natural current and unbalance

NOTE:
IN-C means calculated value of neutral current.
IN-M means measured value of neutral current via its current transformer.

4.1.3. Power Factor

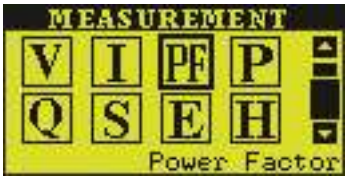

Figure 14 Power Factor

Third icon is for display power factor of each phase PF1, PF2, PF3 and system average power factor PFT With inductive and capacitive sign.
Press ↵ to enter Display sub menu

Figure 15 each phase PF

Press ▲ or ▼ to scroll to the next measured items.

Figure 16 average PF

4.1.4. Active Power

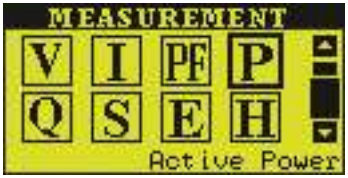

Figure 17 Active Power

fourth icon is for display power of each phase P1, P2, P3 and system total power PT.
Press ↵ to enter Display sub menu

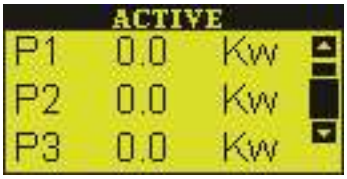

Figure 18 phase active power

Press ▲ or ▼ to scroll to the next measured items.

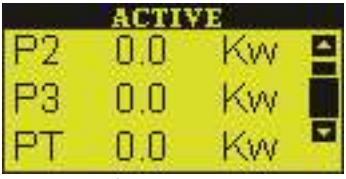

Figure 19 total active power

4.1.5. Reactive Power

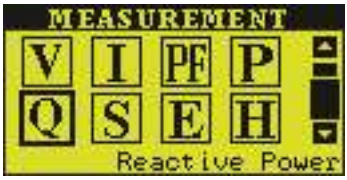

Figure 20 Reactive Power

fifth icon is for display reactive power of each phase, Q1, Q2, Q3 and system total reactive power QT.
Press ↵ to enter Display sub menu

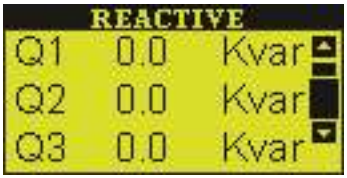

Figure 21 phase reactive power

Press ▲ or ▼ to scroll to the next measured items.

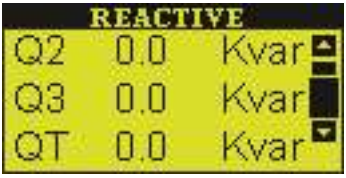

Figure 22 total reactive power

4.1.6. Apparent Power

Figure 23 Apparent Power

sixth icon is for display apparent power of each phase S1, S2, S3 and system total apparent Power ST.
Press ↵ to enter Display sub menu

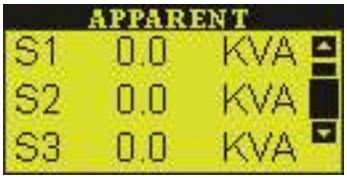

Figure 24 phase apparent power

Press ▲ or ▼ to scroll to the next measured items.

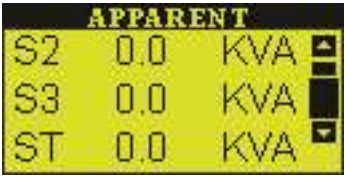

Figure 25 total apparent power

4.1.7. Energy Meter

Figure 26 Energy Meter

seventh icon is for display energy values.
Press ↵ to enter Display sub menu

4.1.7.1. ACTIVE (+)

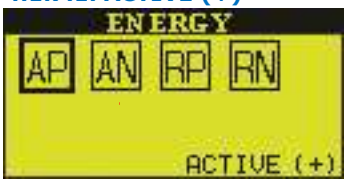

Figure 27 Import active energy

Press ↵ to view import active energy (+).

Figure 28 import active energy window1

Figure 29 import active energy window2

Press ▲ or ▼ to scroll to the next tariff measured items.

4.1.7.2. ACTIVE (-)

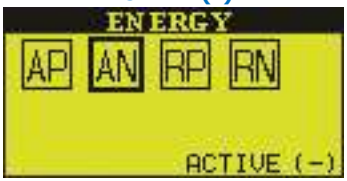

Figure 30 Export active energy

Press ↵ to view export active energy (-).

Figure 31 export active energy window1

Figure 32 export active energy window2

Press ▲ or ▼ to scroll to the next tariff measured items.

4.1.7.3. REACTIVE (+)

Figure 33 Import reactive energy

Press ↵ to view import reactive energy (+).

Figure 34 import reactive energy window1

Figure 35 import reactive energy window2

Press ▲ or ▼ to scroll to the next tariff measured items.

4.1.7.4. REACTIVE (-)

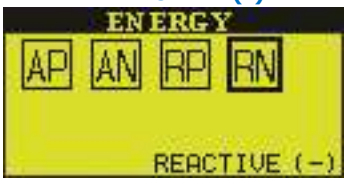

Figure 36 Export reactive energy

Press ↵ to view export reactive energy (-).

Figure 37 export reactive energy window1

Figure 38 export reactive energy window2

Press ▲ or ▼ to scroll to the next tariff measured items.

4.1.8. Harmonic

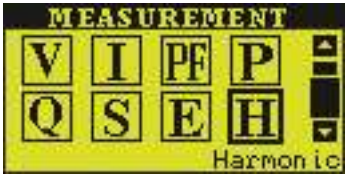

Figure 39 Harmonic

eighth icon is for display Harmonic values
Press ↵ to enter Display sub menu

4.1.8.1. V-HARMONIC

Figure 40 Voltage harmonic

Press ↵ to view harmonic ratio percent of voltages

Figure 41 voltage harmonics 2nd to 31st

4.1.8.2. I-HARMONIC

Figure 42 Current harmonic

Press ↵ to view harmonic ratio percent of currents

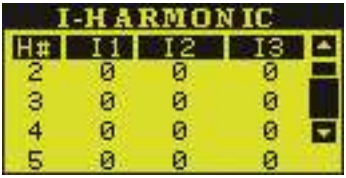

Figure 43 current harmonics 2nd to 31st

4.1.8.3. POWER QUALITY

Figure 44 Power Quality

Press ↵ to view power quality items of three phase network

Figure 45 network quality values window1

Figure 46 network quality values window2

Press ▲ or ▼ to scroll to the next measured items.

4.2. Statistic

Figure 47 Statistic

The second icon of welcome window is for display the Max and Min value of metering data with time stamp.

Press ↵ to enter Display sub menu

4.2.1. Maximum

Figure 48 Maximum

First icon is for display maximum values with time stamp.

Press ↵ to enter Display sub menu.

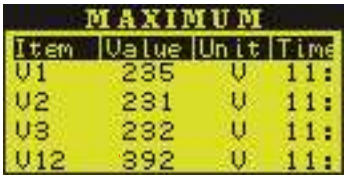

Figure 49 maximums with time window1

Press ▲ or ▼ to scroll to the next measured items and ▶ key to view time stamp.

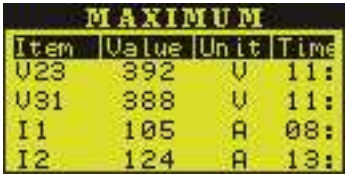

Figure 50 maximums with time window2

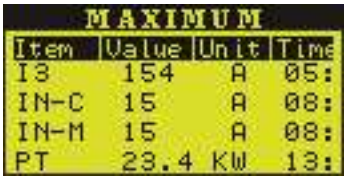

Figure 51 maximums with time window3

Press ▲ or ▼ to scroll to the next measured items and ▶ key to view time stamp.

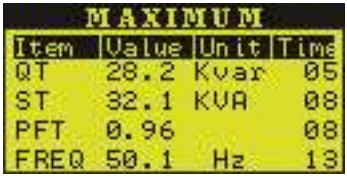

Figure 52 maximums with time window4

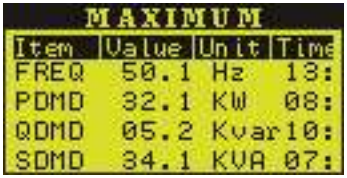

Figure 53 maximums with time window5

4.2.2. Minimum

Figure 54 Minimum

second icon is for display minimum values with time stamp.
Press ↵ to enter Display sub menu.

4.2.3. Statistic Clear

Figure 55 Statistic Clear

Press ↵ to clear stored maximum and minimum values.

Figure 56 confirm statistic clear

4.3. Clock

Figure 57 Clock

Press ↵ to view time and date of ZMP.

Figure 58 ZMP time and date

4.4. Setting (Password)

Figure 59 Setting

Press ↵ to enter setting sub menu Enter password (The default password is 0000).

Figure 60 request password for setting

Password security for protecting meter setups and accumulated data from unauthorized changes.

Note:

Press ▲ to increase and ▼ to decrease blinked digit and press ▶ to go to next digit and finally press ↵ to enter number.

4.4.1. Display

Figure 61 Display

First icon is for display settings Press ↵ to enter Display sub menu

4.4.1.1. Display Mode

Figure 62 ALL mode selected

Press ↵ to change display mode to SIMPLE or ALL mode.

Figure 63 SIMPLE mode selected

In ALL mode, The ZMP display all of measurement parameters in high-resolution but in SIMPLE mode items with low-resolution will be displayed.
And in ALL mode ZMP display harmonics spectrum up to order 32 and in SIMPLE up to order 15.

4.4.1.2. Backlight Time

Figure 64 Backlight Time

Press ↵ to adjust backlight on time

Figure 65 Backlight Time value

The backlight will go to off for the purpose of energy saving and component duration. if any key does not be touched for a period time the backlight goes off. The on time can be set from 1 to 120 Minute. As in Figure 23, the setting time of the backlight by default is 10 minute so backlight will automatically go to off if there is no touch on the keys in 10 minute.

Note1:
Press ▲ to increase and ▼ to decrease blinked digit and press ▶ to go next digit and finally press ↵ until save the number , Press ESC key to discard modification.

Note2:
To exit current menu and return to previous menu press ESC.

4.4.2. CT Factor

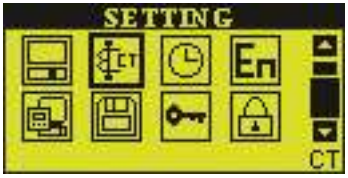

Figure 66 CT

The second icon is for CT (current transformer) ratio settings press ↵ to enter CT Factor sub menu

4.4.2.1. CT Primary

Figure 67 CT Primary

Press ↵ to adjust CT primary rating current

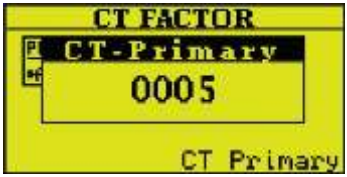

Figure 68 CT Primary value

CT primary value is an integer from 5A to 8000A.

4.4.2.2. CT Secondary

Figure 69 CT Secondary

Press ↵ to adjust CT secondary value

Figure 70 CT Secondary value

CT secondary value is 1A or 5A.

4.4.3. Clock

Figure 71 Clock

Press ↵ to enter Clock Setting sub menu

4.4.3.1. Date Type

Figure 72 Date Type is SHAMSI

Press ↵ to change date type to SH(shamsi) or M(miladi).

Figure 73 Date Type is MILADI

4.4.3.2. Date

Figure 74 Date

Press ↵ to adjust date according date type

Figure 75 Date value

4.4.3.3. Time

Figure 76 Time

Press ↵ to adjust unit clock

Figure 77 Time value

4.4.3.4. Daylight Saving

Figure 78 Daylight Saving is enable

Press ↵ to enable or disable daylight saving future.

Figure 79 Daylight Saving is disable

4.4.3.5. RTC Calibration

Figure 80 RTC calibration

Press ↵ to adjust RTC calibration offset

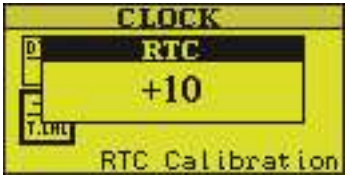

Figure 81 RTC calibration value

Note:
Calibration of Real Time Clock: you can calibrate internal RTC by Adding or Subtracting seconds in 24hour.
For example, if the RTC in 24 hours 3 seconds additive count you can set RTC calibration value to -3, so you will be able to accurate RTC.
This value is between -99 to +99 seconds variable.

4.4.4. Energy

Figure 82 Energy

The fourth icon is for energy meter setting. press ↵ to enter ZMP settings sub menu.

4.4.4.1. Number of Tariff

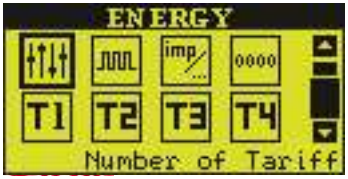

Figure 83 Number of Tariff

Press ↵ to adjust Number of Tariff

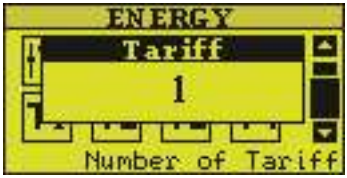

Figure 84 enter number of tariff

4.4.4.2. Pulse

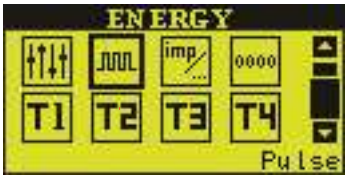

Figure 85 Pulse

Press ↵ to adjust output pulse LED type

Figure 86 select type of LED pulse

Note:
The ZMP8800E has a red "Energy Pulse" LED. It flashes at a constant rate based on active or reactive or apparent energy of system when a load is applied to the meter.

4.4.4.3. Meter Constant

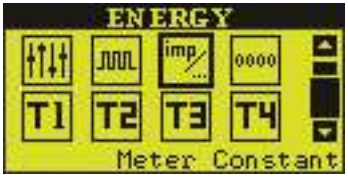

Figure 87 Meter Constant

Press ↵ to adjust meter constant

Figure 88 meter constant value

Note:
The accumulated energy is converted to frequency of the LED pulses. One LED Pulse usually corresponds to 1KWh/MC or 1KVARH/MC or 1KVAH/MC.
MC is Meter Constant, e.g. 3200 imp/kWh

4.4.4.4. Clear Energy

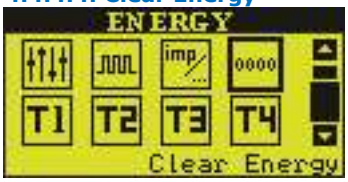

Figure 89 Clear energy

Press ↵ to Clearance of energy values.

Figure 90 confirm to clear energy values

4.4.4.5. Tariff 1

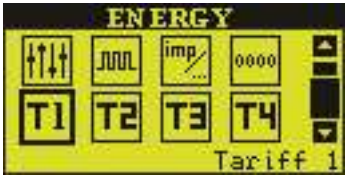

Figure 91 Tariff 1

Press ↵ to adjust start time of Tariff1

Figure 92 Tariff 1 start time

4.4.4.6. Tariff 2

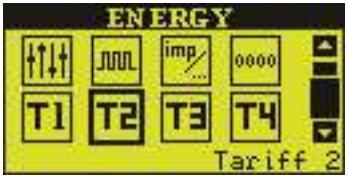

Figure 93 Tariff 2

Press ↵ to adjust start time of Tariff2

Figure 94 Tariff 2 start time

4.4.4.7. Tariff 3

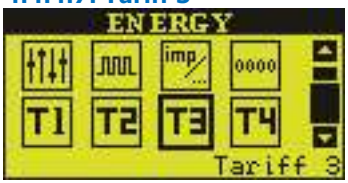

Figure 95 Tariff 3

Press ↵ to adjust start time of Tariff3

Figure 96 Tariff 3 start time

4.4.4.8. Tariff 4

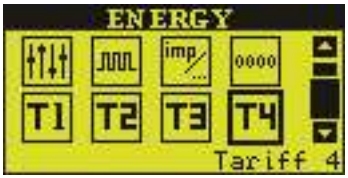

Figure 97 Tariff 4

Press ↵ to adjust start time of Tariff4

Figure 98 Tariff 4 start time

4.4.5. MODBUS

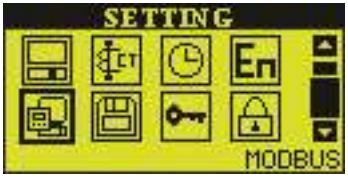

Figure 99 MODBUS

Press ↵ to enter ZMP Modbus sub menu

By validating the Modbus-RTU protocol, the ZMP can communicate in a Modbus supervision system.
All ZMP parameters as well as the ZMP measurements are accessible.

4.4.5.1. Baud Rate

Figure 100 Baud Rate

Press ↵ to adjust the communication speed (bits/second).

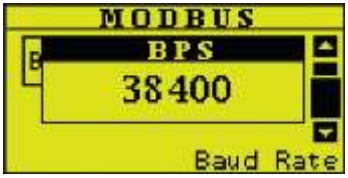

Figure 101 Baud Rate value

Baud rate could be one of the six, 1200, 2400, 4800, 9600, 19200, 38400, 57400, 115200.

4.4.5.2. Slave Address

Figure 102 Slave Address

Press ↵ to adjust the address of the Modbus-RTU slave.

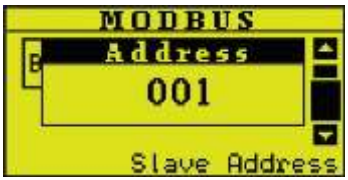

Figure 103 Slave Address value

Slave address: The Modbus master will refer to this address for each query / answer transaction with this ZMP. It is any digit number from 1 to 247

4.4.6. Logger

Figure 104 Logger

Press ↵ to enter ZMP logger sub menu

4.4.6.1. Logger Status

Figure 105 Logger Start

Press ↵ to Disable or enable of unit logger

Figure 106 Logger Stop

4.4.6.2. Logger Type

Figure 107 Logger FIFO

Press ↵ to select type of logger

Figure 108 Logger Fill and Hold

You can define the way to unit record parameters on internal flash. If you select FIFO after flash was full unit erases old ones and overwrites new ones, so you will access to recent measurement records when reading unit memory, and if select FILL AND HOLD the unit save items until internal memory be full after that unit stop recording.

4.4.6.3. Sampling Time

Figure 109 Sampling Time

Press ↵ to adjust sampling time of logger, the unit is second

Figure 110 sampling time value

The interval time of between recordings of measured values on internal flash memory with time stamp. The interval can be set from 1 second to 3600 second (60 minute).

4.4.6.4. Slide Time

Figure 111 Slide Time

Press ↵ to adjust sliding window time of demand, the unit is minute

Figure 112 slide time value

Sliding window time of demand is from 1 to 30 Minute. The window slid once per Minute.

4.4.6.5. Logger Clear

Figure 113 Logger Clear

Press ↵ to erase internal memory of unit

Figure 114 confirm to clear logger

4.4.6.6. Memory Status

Figure 115 Memory status

Press ↵ to view internal memory status

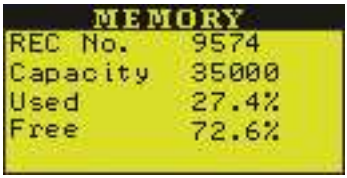

Figure 116 internal memory

4.4.7. Change Password

Figure 117 Change Password

Press ↵ to change password

Figure 118 New Password value

As a protection against mal-operation some setting has an access code.
Factory setting is 0000, The password can be changed by user.

4.4.8. Factory (Password Protected)

Figure 119 Factory

This menu is only usable in factory for repair and calibration purpose.

4.5. Temperature

Figure 120 Temperature

Press ↵ to view internal temperature of unit

Figure 121 ZMP internal temperature

4.6. Wiring Check

Figure 122 Wiring Check

Press ↵ to check sequence of wiring of voltages and currents

Figure 123 voltages displacement

Display three phase voltage phase displacement with each other in degree.
Display three phase currents phase displacement with each other in degree.

Figure 124 current displacement

4.7. Restore Default (Password Protected)

Figure 125 Restore Default

Press ↵ to reset ZMP to default factory setting

Figure 126 Restore Default Password

Figure 127 Restore Default Process

Figure 128 Restore Default Finished

Note:
By selecting and validating the Restore default icon, all the values of the ZMP parameters are reset to their default values (see appendix C).

4.8. About

Figure 129 About

Press ↵ to enter ZMP about sub menu
This menu gives ZMP serial number, software version, hardware version, time of use (hour), Production date.

Figure 130 About Information

Easy upgrading device firmware through a serial or USB memory stick.

5. COMUNICATION

5.1. Communication Setup

The communication port and protocol of ZMP is RS485 and Modbus-RTU. The terminals of communication are RS-, RS+. Up to 32 devices can be connected on a RS485 bus. Use good quality shielded twisted pair cable, AWG22 (0.5mm2) or larger. The overall length of the RS485 cable connecting all devices cannot exceed 1200m (4000ft). ZMP is used as a slave device of master like PC, PLC, data collector or RTU. If the master does not have RS485 communication port, a converter has to be used. Normally a RS232/RS485 or USB/RS485 is adopted.

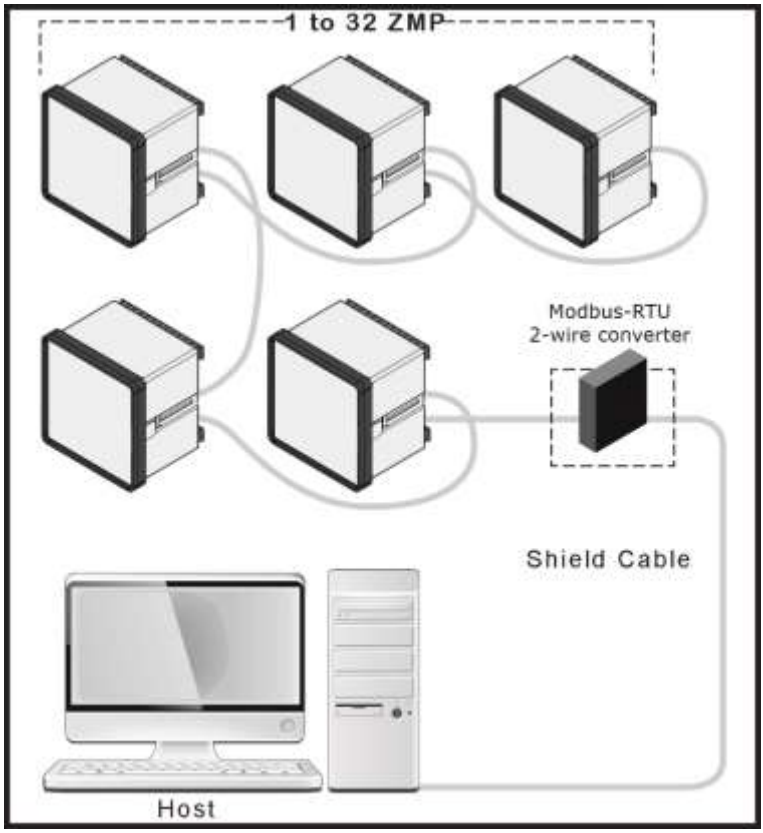

Figure 131 communication wiring

5.2. Introducing Modbus Protocol

The Modbus RTU protocol is used for communication in ZMP. The data format and error check method is defined in Modbus protocol. The half-duplex query and respond mode is adopted in Modbus protocol. There is only one master device in the communication net. The others are slave devices, waiting for the query of the master.

5.3. Transmission mode

The mode of transmission defines the data structure within a frame and the rules used to transmit data. The mode is defined in the following which is compatible with Modbus RTU Mode*.

Coding System	8-bit binary
Start bit	1
Data bits	8
Parity	no parity
Stop bit	1

Table 3 Byte format

*Modbus is trademark of Modicon, Inc.

5.4. Framing

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

Table 4 MODBUS frame over Serial Line

Address Field:

The address field of a message frame contains eight bits. Valid slave device addresses are in the range of 1~247 decimal. A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

Function Field:

The function code field of a message frame contains eight bits. Valid codes are in the range of 1~255 decimal. When a message is sent from a master to a slave device the function code field tells the slave what kind of action to perform.

Code	Meaning	Action
0x03	Read Holding Registers	Obtain current binary value in one or more registers
0x06	Write Single Register	Place specific binary values into a register
0x04	Read Input Registers	Obtain logged values from internal flash memory
0x10	Write Multiple Registers	Place specific binary values into a series of consecutive multiple registers

Table 5 Function Code

Data Field:

The data field is constructed using sets of two hexadecimal digits, in the range of 0x00 to 0xFF hexadecimal. The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the field. For example, if the master requests a slave to read a group of holding

registers (function code 03), the data field specifies the starting register and how many registers are to be read. If the master writes to a group of registers in the slave (function code 0x10 hexadecimal), the data field specifies the starting register, how many registers to write, the count of data bytes to follow in the data field, and the data to be written into the registers.
If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken. The data field can be nonexistent (of zero length) in certain kinds of messages.

Error Check Field:
Messages include an error's checking field that is based on a Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message. The CRC field is two bytes, containing a 16bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message.
The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field If the two values are not equal, an error results. The CRC is started by first preloading a 16-bit register to all 1's. Then a process begins of applying successive 8-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do not apply to the CRC. During generation of the CRC, each 8-bit character is exclusive ORed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined.
If the LSB was a1, the register is then exclusive ORed with a reset, fixed value.
If the LSB was a0, no exclusive OR takes place. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive ORed with the register current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value. When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

5.5. Format of the communication
Explanation of frame:

Slave address	Function	Starting Address Hi	Starting Address Lo	Number of Registers Hi	Number of Registers Lo	CRC Lo	CRC Hi
0x01	0x03	0x00	0x01	0x00	0x21	0xD4	0x12

Table 6 Explanation of frame

5.6. Read Holding Registers (Function Code 0x03)

Query

This function allows the master to obtain the measurement results or settings of ZMP. Table 7 is an example to read the CT primary and CT secondary value from slave device number 1, the data address of ct_p is 0x3006H and ct_s is 0x3007H.

Slave address	Function	Starting Address Hi	Starting Address Lo	Number of Registers Hi	Number of Registers Lo	CRC Lo	CRC Hi
0x01	0x03	0x30	0x06	0x00	0x02	0x2B	0x0A

Table 7 Read ct_p and ct_s query message

Response

The ZMP response includes the ZMP address, function code, quantity of data byte, data, and error checking. An example response to read ct_p and ct_s is: ct_p = 0x0064H (100), ct_s = 0x0005H (5) is shown as Table 8.

Slave address	Function	Byte Count	Register value Hi	Register value Lo	Register value Hi	Register value Lo	CRC Lo	CRC Hi
0x01	0x03	0x04	0x00	0x64	0x00	0x05	0x7B	0xEF

Table 8 Read ct_p and ct_s message

5.7. Read Input Registers (Function Code 0x04)

Query

This function allows the master to obtain the logged values from internal flash. Master by every request query can read one page that includes one recorded values. Table 9 is an example to read second page from slave device number 1.

Slave address	Function	Page Address Hi	Page Address Lo	Quantity of Input Reg. Hi	Quantity of Input Reg. Lo	CRC Lo	CRC Hi
0x01	0x04	0x00	0x02	0x00	0x6E	0xD0	0x26

Table 9 Read second page of internal flash

Response

The ZMP response includes the ZMP address, function code, quantity of data byte, data, and error checking.

Slave address	Function	Byte Count	Byte 0	Byte 1	.....	Byte 255	CRC Lo	CRC Hi
0x01	0x04	0xDC	0x--	0x--		0x--	0x--	0x--

Table 10 transfer 256 byte of internal flash

5.8. Write Single Register (Function Code 0x06)

Query

Function 0x06 allows the user to modify the contents of one Register. Any Register that exists within the ZMP writable memory can have its contents changed by this message. The example below is a request to a ZMP number 1 to Preset CT primary to 1250, while its Hex Value 0x04E2H. ct_p data address is 0x3006H.

Slave address	Function	Register Address Hi	Register Address Lo	Registers Value Hi	Registers Value Lo	CRC Lo	CRC Hi
0x01	0x06	0x30	0x06	0x04	0xE2	0xE4	0x42

Table 11 Preset ct_p

Response

The normal response is an echo of the request, returned after the register contents have been written.

Slave address	Function	Register Address Hi	Register Address Lo	Registers Value Hi	Registers Value Lo	CRC Lo	CRC Hi
0x01	0x06	0x30	0x06	0x04	0xE2	0xE4	0x42

Table 12 Writes single register response message

5.9. Write Multiple Registers (Function Code 0x10)

Query

Function 0x10 allows the user to modify the contents of Multi-Register. Any Register that exists within the ZMP writable memory can have its contents changed by this message.

The example below is a request to a ZMP number 1 to Preset CT primary to 1250, while its Hex Value 0x04E2H and CT secondary to 5 with one query. ct_p data address is 0x3006H and ct_s is 0x3007H.

Slave address	Function	Starting Address Hi	Starting Address Lo	Quantity of Registers Hi	Quantity of Registers Lo	Byte Count	Registers Value Hi	Registers Value Lo	Registers Value Hi	Registers Value Lo	CRC Lo	CRC Hi
0x01	0x10	0x30	0x06	0x00	0x02	0x04	0x04	0xE2	0x00	0x05	0x46	0x81

Table 13 Preset ct_p and ct_s

Response

The normal response returns the function code, starting address, and quantity of registers written.

Slave address	Function	Starting Address Hi	Starting Address Lo	Quantity of Registers Hi	Quantity of Registers Lo	CRC Lo	CRC Hi
0x01	0x10	0x30	0x06	0x00	0x02	0xAE	0xC9

Table 14 Writes multiple registers response message

6. MAINTANENCE

6.1. Cleaning

If the cleaning is restricted only to the front of the closed control cabinet, it is not necessary to isolate the ZMP from the power supply, but in this case also only a dry cleaning cloth may be used.

There are no user serviceable parts on this product. Please do not open the product, as opening it will void the warranty. Please contact your nearest sales representative if the product requires any service or repair.

Getting Technical Support:

For technical support, you can obtain assistances via:

Address	:	No.16, Golestan Building Tabriz, IRAN.
Tel	:	+98 41 3553 8103,4
Fax	:	+98 41 3553 3738
Website	:	www.zilug.com

7. APPENDIX

7.1. APPENDIX A ZMP Specification

METERING	**REAL TIME MEASURING**	Phase Voltage	V1, V2, V3	V
		Line Voltage	V12, V23, V31	V
		Current	I1, I2, I3 In-M, In-C	Separate Input for Neutral Line CT
		Power	P1, P2, P3, Ptotal	KW
		Reactive Power	Q1, Q2, Q3, Qtotal	KVAR
		Apparent Power	S1, S2, S3, Stotal	KVA
		Power Factor	PF1, PF2, PF3, PFtotal	Cap. or Ind.
		Frequency	Frequency	Hz
	ENERGY AND DEMAND	Energy	P_import P_export	KWH
		Reactive Energy	Q_import Q_export	KVARH
		Demand	Demand_P Demand_Q Demand_S	
		Energy Pulse LED	Active, Reactive, Apparent	600 to 32000 Imp
MONITORING	**POWER QUALITY**	Voltage Unbalance Factor		%
		Current Unbalance Factor		%
		R,S,T Detector	Voltage and Current Phase Angels Indications	Degree
		THDV, THDI, TDD K-Factor, Crf, THDFV, THDFI		%
		V / I Harmonics	Up to 32 order	%
	MAX & MIN	MAXIMUM Values	Display and Record	With time stamp
		MINIMUM Values	Display and Record	With time stamp
OTHERS	**COMMUNICATION**	RS485 Port	Modbus Protocol	MODBUS RTU
		Baud Rate	1200 to 115200 bps	

		Slave Address	from 1 to 247	
	TIME	Real Time Clock	Year, Month, date, Hour, minute, Second (shamsi and milady)	Daylight saving Correction (on/off) RTC calibration
	DISPLAY		128*64 Graphic LCD	With backlight
DATA LOGGER	**Logger Capacity**		35000	record
	INTERNAL MEMORY	Erasable Flash Memory	Record metering data in a user defined time interval. Periodic or one period	1 ~ 3600sec
	READ SAMPLES	Created files for recorded samples	Unique serial number of unit	Min-Max Logged Energy Meter Settings
			Via USB Stick	
Voltage input	**Voltage rating**	0 to 250 V AC (direct)		
	Frequency range		45~65Hz	
	Overload	Permissible overload	1.5 Vn	
	Measuring		True RMS	
Current input	**Current rating**	Adjustable from 5 A to 8000 A	5Amp AC nominal F.S. input with 20% over range	
	secondary	1 A or 5 A		
	Overload		10A for continues 100A for 1 second (None recurrence)	
	Measuring		True RMS	
Dimension		DIN43700	96x96mm	

Table 15 ZMP specification

7.2. APPENDIX B Address table of ZMP

Address	Parameter	Range	Object Type	Type of access
Basic Analog Measurements (0x1000 to 0x1100)				
0x1000	Frequency (F)	4500~6500	Word	R

0x1001	Phase Voltage V1	0~65535	Word	R
0x1002	Phase Voltage V2	0~65535	Word	R
0x1003	Phase Voltage V3	0~65535	Word	R
0x1004	Average Phase Voltage VInavg	0~65535	Word	R
0x1005	Line Voltage V12	0~65535	Word	R
0x1006	Line Voltage V23	0~65535	Word	R
0x1007	Line Voltage V31	0~65535	Word	R
0x1008	Average Line Voltage VIlavg	0~65535	Word	R
0x1009	Current I1	0~65535	Word	R
0x100A	Current I2	0~65535	Word	R
0x100B	Current I3	0~65535	Word	R
0x100C	Average Current Iavg	0~65535	Word	R
0x100D	Neutral Line Current In (calculated)	0~65535	Word	R
0x100E	Neutral Line Current In (Measured)	0~65535	Word	R
0x100F	Phase Power P1	-32768~32767	Word	R
0x1010	Phase Power P2	-32768~32767	Word	R
0x1011	Phase Power P3	-32768~32767	Word	R
0x1012	System Power Ptot	-32768~32767	Word	R
0x1013	Phase Reactive Power Q1	-32768~32767	Word	R
0x1014	Phase Reactive Power Q2	-32768~32767	Word	R
0x1015	Phase Reactive Power Q3	-32768~32767	Word	R
0x1016	System Reactive Power Qtot	-32768~32767	Word	R
0x1017	Phase Apparent Power S1	0~65535	Word	R
0x1018	Phase Apparent Power S2	0~65535	Word	R
0x1019	Phase Apparent Power S3	0~65535	Word	R
0x101A	System Apparent Power Stot	0~65535	Word	R
0x101B	Phase Power Factor PF1	-1000~1000	Word	R
0x101C	Phase Power Factor PF2	-1000~1000	Word	R
0x101D	Phase Power Factor PF3	-1000~1000	Word	R
0x101E	System Power Factor PFtot	-1000~1000	Word	R
0x101F	Voltage Unbalance Factor U_unbl	0~3000	Word	R
0x1020	Current Unbalance Factor I_unbl	0~3000	Word	R
0x1021	Power Demand Dmd_Ptot	76/67/82	Word	R
0x1022	Reactive power Demand Dmd_Qtot	-32768~32767	Word	R
0x1023	Apparent Power Demand Dmd_Stot	-32768~32767	Word	R
0x1024	Load Type RT (L/C/R)	0~65535	Word	R
0x1025	Import Energy Tariff1 Ep1_imp (hi Word)	0~999999999	Double Word	R
0x1026	Import Energy Tariff1 Ep1_imp (lo Word)			
0x1027	Export Energy Tariff1 Ep1_exp (hi Word)	0~999999999	Double Word	R
0x1028	Export Energy Tariff1 Ep1_exp (lo Word)			
0x1029	Import Reactive Energy Tariff1 Eq1_imp (hi Word)	0~999999999	Double Word	R
0x102A	Import Reactive Energy Tariff1 Eq1_imp (lo Word)			
0x102B	Export Reactive Energy Tariff1 Eq1_exp (hi Word)	0~999999999	Double Word	R
0x102C	Export Reactive Energy Tariff1 Eq1_exp (lo Word)			
0x102D	Import Energy Tariff2 Ep2_imp (hi Word)	0~999999999	Double Word	R
0x102E	Import Energy Tariff2 Ep2_imp (lo Word)			
0x102F	Export Energy Tariff2 Ep2_exp (hi Word)	0~999999999	Double Word	R
0x1030	Export Energy Tariff3 Ep2_exp (lo Word)			
0x1031	Import Reactive Energy Tariff2 Eq2_imp (hi Word)	0~999999999	Double Word	R
0x1032	Import Reactive Energy Tariff2 Eq2_imp (lo Word)			
0x1033	Export Reactive Energy Tariff2 Eq2_exp (hi Word)	0~999999999	Double	R

0x1034	Export Reactive Energy Tariff2 Eq2_exp (lo Word)			Word	
0x1035	Import Energy Tariff3 Ep3_imp (hi Word)		0~999999999	Double Word	R
0x1036	Import Energy Tariff3 Ep3_imp (lo Word)				
0x1037	Export Energy Tariff3 Ep3_exp (hi Word)		0~999999999	Double Word	R
0x1038	Export Energy Tariff3 Ep3_exp (lo Word)				
0x1039	Import Reactive Energy Tariff3 Eq3_imp (hi Word)		0~999999999	Double Word	R
0x103A	Import Reactive Energy Tariff3 Eq3_imp (lo Word)				
0x103B	Export Reactive Energy Tariff3 Eq3_exp (hi Word)		0~999999999	Double Word	R
0x103C	Export Reactive Energy Tariff3 Eq3_exp (lo Word)				
0x103D	Import Energy Tariff4 Ep4_imp (hi Word)		0~999999999	Double Word	R
0x103E	Import Energy Tariff4 Ep4_imp (lo Word)				
0x103F	Export Energy Tariff4 Ep4_exp (hi Word)		0~999999999	Double Word	R
0x1040	Export Energy Tariff4 Ep4_exp (lo Word)				
0x1041	Import Reactive Energy Tariff4 Eq4_imp (hi Word)		0~999999999	Double Word	R
0x1042	Import Reactive Energy Tariff4 Eq4_imp (lo Word)				
0x1043	Export Reactive Energy Tariff4 Eq4_exp (hi Word)		0~999999999	Double Word	R
0x1044	Export Reactive Energy Tariff4 Eq4_exp (lo Word)				
Maximum Records 0x1100 to 0x1200					
0x1100	V1_max		0~65535	Word	R
0x1101	Time Stamp of Va_max	year	2020~2050 or 1398~1420	Word	R
0x1102		month	1~12	Word	R
0x1103		day	1~31	Word	R
0x1104		hour	0~23	Word	R
0x1105		minute	0~59	Word	R
0x1106		second	0~59	Word	R
0x1107	V2_max		0~65535	Word	R
0x1108	Time Stamp of Vb_max	year	2020~2050 or 1398~1420	Word	R
0x1109		month	1~12	Word	R
0x110A		day	1~31	Word	R
0x110B		hour	0~23	Word	R
0x110C		minute	0~59	Word	R
0x110D		second	0~59	Word	R
0x110E	V3_max		0~65535	Word	R
0x110F	Time Stamp of Vc_max	year	2020~2050 or 1398~1420	Word	R
0x1110		month	1~12	Word	R
0x1111		day	1~31	Word	R
0x1112		hour	0~23	Word	R
0x1113		minute	0~59	Word	R
0x1114		second	0~59	Word	R
0x1115	V12_max		0~65535	Word	R
0x1116	Time Stamp of Vab_max	year	2020~2050 or 1398~1420	Word	R
0x1117		month	1~12	Word	R
0x1118		day	1~31	Word	R
0x1119		hour	0~23	Word	R
0x111A		minute	0~59	Word	R
0x111B		second	0~59	Word	R
0x111C	V23_max		0~65535	Word	R
0x111D	Time Stamp of Vbc_max	year	2020~2050 or 1398~1420	Word	R
0x111E		month	1~12	Word	R
0x111F		day	1~31	Word	R
0x1120		hour	0~23	Word	R

0x1121		minute	0~59	Word	R
0x1122		second	0~59	Word	R
0x1123	V31_max		0~65535	Word	R
0x1124	Time Stamp of Vca_max	year	2020~2050 or 1398~1420	Word	R
0x1125		month	1~12	Word	R
0x1126		day	1~31	Word	R
0x1127		hour	0~23	Word	R
0x1128		minute	0~59	Word	R
0x1129		second	0~59	Word	R
0x112A	I1_max		0~65535	Word	R
0x112B	Time Stamp of Ia_max	year	2020~2050 or 1398~1420	Word	R
0x112C		month	1~12	Word	R
0x112D		day	1~31	Word	R
0x112E		hour	0~23	Word	R
0x112F		minute	0~59	Word	R
0x1130		second	0~59	Word	R
0x1131	I2_max		0~65535	Word	R
0x1132	Time Stamp of Ib_max	year	2020~2050 or 1398~1420	Word	R
0x1133		month	1~12	Word	R
0x1134		day	1~31	Word	R
0x1135		hour	0~23	Word	R
0x1136		minute	0~59	Word	R
0x1137		second	0~59	Word	R
0x1138	I3_max		0~65535	Word	R
0x1139	Time Stamp of Ic_max	year	2020~2050 or 1398~1420	Word	R
0x113A		month	1~12	Word	R
0x113B		day	1~31	Word	R
0x113C		hour	0~23	Word	R
0x113D		minute	0~59	Word	R
0x113E		second	0~59	Word	R
0x113F	IN0_max		0~65535	Word	R
0x1140	Time Stamp of Ib_max	year	2020~2050 or 1398~1420	Word	R
0x1141		month	1~12	Word	R
0x1142		day	1~31	Word	R
0x1143		hour	0~23	Word	R
0x1144		minute	0~59	Word	R
0x1145		second	0~59	Word	R
0x1146	IN1_max		0~65535	Word	R
0x1147	Time Stamp of Ic_max	year	2020~2050 or 1398~1420	Word	R
0x1148		month	1~12	Word	R
0x1149		day	1~31	Word	R
0x114A		hour	0~23	Word	R
0x114B		minute	0~59	Word	R
0x114C		second	0~59	Word	R
0x114D	Ptot_max		-32768~32767	Word	R
0x114E	Time Stamp of Ptot_max	year	2020~2050 or 1398~1420	Word	R
0x114F		month	1~12	Word	R
0x1150		day	1~31	Word	R
0x1151		hour	0~23	Word	R
0x1152		minute	0~59	Word	R
0x1153		second	0~59	Word	R

0x1154	Qtot_max		-32768~32767	Word	R
0x1155	Time Stamp of Qtot_max	year	2020~2050 or 1398~1420	Word	R
0x1156		month	1~12	Word	R
0x1157		day	1~31	Word	R
0x1158		hour	0~23	Word	R
0x1159		minute	0~59	Word	R
0x115A		second	0~59	Word	R
0x115B	Stot_max		0~65535	Word	R
0x115C	Time Stamp of Stot_max	year	2020~2050 or 1398~1420	Word	R
0x115D		month	1~12	Word	R
0x115E		day	1~31	Word	R
0x115F		hour	0~23	Word	R
0x1160		minute	0~59	Word	R
0x1161		second	0~59	Word	R
0x1162	Dmd_Ptot_max		-32768~32767	Word	R
0x1163	Time Stamp of Dmd_Ptot_max	year	2020~2050 or 1398~1420	Word	R
0x1164		month	1~12	Word	R
0x1165		day	1~31	Word	R
0x1166		hour	0~23	Word	R
0x1167		minute	0~59	Word	R
0x1168		second	0~59	Word	R
0x1169	Dmd_Qtot_max		-32768~32767	Word	R
0x116A	Time Stamp of Dmd_Qtot_max	year	2020~2050 or 1398~1420	Word	R
0x116B		month	1~12	Word	R
0x116C		day	1~31	Word	R
0x116D		hour	0~23	Word	R
0x116E		minute	0~59	Word	R
0x116F		second	0~59	Word	R
0x1170	Dmd_Stot_max		0~65535	Word	R
0x1171	Time Stamp of Dmd_Stot_max	year	2020~2050 or 1398~1420	Word	R
0x1172		month	1~12	Word	R
0x1173		day	1~31	Word	R
0x1174		hour	0~23	Word	R
0x1175		minute	0~59	Word	R
0x1176		second	0~59	Word	R
0x1177	PFtot_max		-1000~1000	Word	R
0x1178	Time Stamp of PFtot_max	year	2020~2050 or 1398~1420	Word	R
0x1179		month	1~12	Word	R
0x117A		day	1~31	Word	R
0x117B		hour	0~23	Word	R
0x117C		minute	0~59	Word	R
0x117D		second	0~59	Word	R
0x117E	Fr_max		4500~6500	Word	R
0x117F	Time Stamp of Fr_max	year	2000~2099	Word	R
0x1180		month	1~12	Word	R
0x1181		day	1~31	Word	R
0x1182		hour	0~23	Word	R
0x1183		minute	0~59	Word	R
0x1184		second	0~59	Word	R
Minimum Records (0x1200 to 0x1300)					
0x1200	V1_min		0~65535	Word	R

0x1201	Time Stamp of Va_min	year	2020~2050 or 1398~1420	Word	R
0x1202		month	1~12	Word	R
0x1203		day	1~31	Word	R
0x1204		hour	0~23	Word	R
0x1205		minute	0~59	Word	R
0x1206		second	0~59	Word	R
0x1207	V2_min		0~65535	Word	R
0x1208	Time Stamp of Vb_min	year	2020~2050 or 1398~1420	Word	R
0x1209		month	1~12	Word	R
0x120A		day	1~31	Word	R
0x120B		hour	0~23	Word	R
0x120C		minute	0~59	Word	R
0x120D		second	0~59	Word	R
0x120E	V3_min		0~65535	Word	R
0x120F	Time Stamp of Vc_min	year	2020~2050 or 1398~1420	Word	R
0x1210		month	1~12	Word	R
0x1211		day	1~31	Word	R
0x1212		hour	0~23	Word	R
0x1213		minute	0~59	Word	R
0x1214		second	0~59	Word	R
0x1215	V12_min		0~65535	Word	R
0x1216	Time Stamp of Vab_min	year	2020~2050 or 1398~1420	Word	R
0x1217		month	1~12	Word	R
0x1218		day	1~31	Word	R
0x1219		hour	0~23	Word	R
0x121A		minute	0~59	Word	R
0x121B		second	0~59	Word	R
0x121C	V23_min		0~65535	Word	R
0x121D	Time Stamp of Vbc_min	year	2020~2050 or 1398~1420	Word	R
0x121E		month	1~12	Word	R
0x121F		day	1~31	Word	R
0x1220		hour	0~23	Word	R
0x1221		minute	0~59	Word	R
0x1222		second	0~59	Word	R
0x1223	V31_min		0~65535	Word	R
0x1224	Time Stamp of Vca_min	year	2020~2050 or 1398~1420	Word	R
0x1225		month	1~12	Word	R
0x1226		day	1~31	Word	R
0x1227		hour	0~23	Word	R
0x1228		minute	0~59	Word	R
0x1229		second	0~59	Word	R
0x122A	I1_min		0~65535	Word	R
0x122B	Time Stamp of Ia_min	year	2020~2050 or 1398~1420	Word	R
0x122C		month	1~12	Word	R
0x122D		day	1~31	Word	R
0x122E		hour	0~23	Word	R
0x122F		minute	0~59	Word	R
0x1230		second	0~59	Word	R
0x1231	I2_min		0~65535	Word	R
0x1232	Time Stamp of Ib_min	year	2020~2050 or 1398~1420	Word	R
0x1233		month	1~12	Word	R

0x1234		day	1~31	Word	R
0x1235		hour	0~23	Word	R
0x1236		minute	0~59	Word	R
0x1237		second	0~59	Word	R
0x1238	I3_min		0~65535	Word	R
0x1239	Time Stamp of Ic_min	year	2020~2050 or 1398~1420	Word	R
0x123A		month	1~12	Word	R
0x123B		day	1~31	Word	R
0x123C		hour	0~23	Word	R
0x123D		minute	0~59	Word	R
0x123E		second	0~59	Word	R
0x123F	IN0_min		0~65535	Word	R
0x1240	Time Stamp of Ib_min	year	2020~2050 or 1398~1420	Word	R
0x1241		month	1~12	Word	R
0x1242		day	1~31	Word	R
0x1243		hour	0~23	Word	R
0x1244		minute	0~59	Word	R
0x1245		second	0~59	Word	R
0x1246	IN1_min		0~65535	Word	R
0x1247	Time Stamp of Ic_min	year	2020~2050 or 1398~1420	Word	R
0x1248		month	1~12	Word	R
0x1249		day	1~31	Word	R
0x124A		hour	0~23	Word	R
0x124B		minute	0~59	Word	R
0x124C		second	0~59	Word	R
0x124D	Ptot_min		-32768~32767	Word	R
0x124E	Time Stamp of Ptot_min	year	2020~2050 or 1398~1420	Word	R
0x124F		month	1~12	Word	R
0x1250		day	1~31	Word	R
0x1251		hour	0~23	Word	R
0x1252		minute	0~59	Word	R
0x1253		second	0~59	Word	R
0x1254	Qtot_min		-32768~32767	Word	R
0x1255	Time Stamp of Qtot_min	year	2020~2050 or 1398~1420	Word	R
0x1256		month	1~12	Word	R
0x1257		day	1~31	Word	R
0x1258		hour	0~23	Word	R
0x1259		minute	0~59	Word	R
0x125A		second	0~59	Word	R
0x125B	Stot_min		0~65535	Word	R
0x125C	Time Stamp of Stot_min	year	2020~2050 or 1398~1420	Word	R
0x125D		month	1~12	Word	R
0x125E		day	1~31	Word	R
0x125F		hour	0~23	Word	R
0x1260		minute	0~59	Word	R
0x1261		second	0~59	Word	R
0x1262	Dmd_Ptot_min		-32768~32767	Word	R
0x1263	Time Stamp of Dmd_Ptot_min	year	2020~2050 or 1398~1420	Word	R
0x1264		month	1~12	Word	R
0x1265		day	1~31	Word	R
0x1266		hour	0~23	Word	R

0x1267		minute	0~59	Word	R
0x1268		second	0~59	Word	R
0x1269	Dmd_Qtot_min		-32768~32767	Word	R
0x126A	Time Stamp of Dmd_Qtot_min	year	2020~2050 or 1398~1420	Word	R
0x126B		month	1~12	Word	R
0x126C		day	1~31	Word	R
0x126D		hour	0~23	Word	R
0x126E		minute	0~59	Word	R
0x126F		second	0~59	Word	R
0x1270	Dmd_Stot_min		0~65535	Word	R
0x1271	Time Stamp of Dmd_Stot_min	year	2020~2050 or 1398~1420	Word	R
0x1272		month	1~12	Word	R
0x1273		day	1~31	Word	R
0x1274		hour	0~23	Word	R
0x1275		minute	0~59	Word	R
0x1276		second	0~59	Word	R
0x1277	PFtot_min		-1000~1000	Word	R
0x1278	Time Stamp of PFtot_min	year	2020~2050 or 1398~1420	Word	R
0x1279		month	1~12	Word	R
0x127A		day	1~31	Word	R
0x127B		hour	0~23	Word	R
0x127C		minute	0~59	Word	R
0x127D		second	0~59	Word	R
0x127E	Fr_min		4500~6500	Word	R
0x127F	Time Stamp of Fr_min	year	2000~2099	Word	R
0x1280		month	1~12	Word	R
0x1281		day	1~31	Word	R
0x1282		hour	0~23	Word	R
0x1283		minute	0~59	Word	R
0x1284		second	0~59	Word	R
I1 Harmonics (0x1300 to 0x1400)					
0x1300	Current I1 - Harmonic - 2		0~16384	Word	R
0x1301	Current I1 - Harmonic - 3		0~16384	Word	R
0x1302	Current I1 - Harmonic - 4		0~16384	Word	R
0x1303	Current I1 - Harmonic - 5		0~16384	Word	R
0x1304	Current I1 - Harmonic - 6		0~16384	Word	R
0x1305	Current I1 - Harmonic - 7		0~16384	Word	R
0x1306	Current I1 - Harmonic - 8		0~16384	Word	R
0x1307	Current I1 - Harmonic - 9		0~16384	Word	R
0x1308	Current I1 - Harmonic - 10		0~16384	Word	R
0x1309	Current I1 - Harmonic - 11		0~16384	Word	R
0x130A	Current I1 - Harmonic - 12		0~16384	Word	R
0x130B	Current I1 - Harmonic - 13		0~16384	Word	R
0x130C	Current I1 - Harmonic - 14		0~16384	Word	R
0x130D	Current I1 - Harmonic - 15		0~16384	Word	R
0x130E	Current I1 - Harmonic - 16		0~16384	Word	R
0x130F	Current I1 - Harmonic - 17		0~16384	Word	R
0x1310	Current I1 - Harmonic - 18		0~16384	Word	R
0x1311	Current I1 - Harmonic - 19		0~16384	Word	R
0x1312	Current I1 - Harmonic - 20		0~16384	Word	R
0x1313	Current I1 - Harmonic - 21		0~16384	Word	R

0x1314	Current I1 - Harmonic - 22	0~16384	Word	R
0x1315	Current I1 - Harmonic - 23	0~16384	Word	R
0x1316	Current I1 - Harmonic - 24	0~16384	Word	R
0x1317	Current I1 - Harmonic - 25	0~16384	Word	R
0x1318	Current I1 - Harmonic - 26	0~16384	Word	R
0x1319	Current I1 - Harmonic - 27	0~16384	Word	R
0x131A	Current I1 - Harmonic - 28	0~16384	Word	R
0x131B	Current I1 - Harmonic - 29	0~16384	Word	R
0x131C	Current I1 - Harmonic - 30	0~16384	Word	R
0x131D	Current I1 - Harmonic - 31	0~16384	Word	R
0x131E	Current I1 - Harmonic - 32	0~16384	Word	R
0x131F	Current I1 - Harmonic - THD	0~16384	Word	R
I2 Harmonics(0x1400 to 0x1500)				
0x1400	Current I2 - Harmonic - 2	0~16384	Word	R
0x1401	Current I2 - Harmonic - 3	0~16384	Word	R
0x1402	Current I2 - Harmonic - 4	0~16384	Word	R
0x1403	Current I2 - Harmonic - 5	0~16384	Word	R
0x1404	Current I2 - Harmonic - 6	0~16384	Word	R
0x1405	Current I2 - Harmonic - 7	0~16384	Word	R
0x1406	Current I2 - Harmonic - 8	0~16384	Word	R
0x1407	Current I2 - Harmonic - 9	0~16384	Word	R
0x1408	Current I2 - Harmonic - 10	0~16384	Word	R
0x1409	Current I2 - Harmonic - 11	0~16384	Word	R
0x140A	Current I2 - Harmonic - 12	0~16384	Word	R
0x140B	Current I2 - Harmonic - 13	0~16384	Word	R
0x140C	Current I2 - Harmonic - 14	0~16384	Word	R
0x140D	Current I2 - Harmonic - 15	0~16384	Word	R
0x140E	Current I2 - Harmonic - 16	0~16384	Word	R
0x140F	Current I2 - Harmonic - 17	0~16384	Word	R
0x1410	Current I2 - Harmonic - 18	0~16384	Word	R
0x1411	Current I2 - Harmonic - 19	0~16384	Word	R
0x1420	Current I2 - Harmonic - 20	0~16384	Word	R
0x1413	Current I2 - Harmonic - 21	0~16384	Word	R
0x1414	Current I2 - Harmonic - 22	0~16384	Word	R
0x1415	Current I2 - Harmonic - 23	0~16384	Word	R
0x1416	Current I2 - Harmonic - 24	0~16384	Word	R
0x1417	Current I2 - Harmonic - 25	0~16384	Word	R
0x1418	Current I2 - Harmonic - 26	0~16384	Word	R
0x1419	Current I2 - Harmonic - 27	0~16384	Word	R
0x141A	Current I2 - Harmonic - 28	0~16384	Word	R
0x141B	Current I2 - Harmonic - 29	0~16384	Word	R
0x141C	Current I2 - Harmonic - 30	0~16384	Word	R
0x141D	Current I2 - Harmonic - 31	0~16384	Word	R
0x141E	Current I2 - Harmonic - 32	0~16384	Word	R
0x141F	Current I2 - Harmonic - THD	0~16384	Word	R
I3 Harmonics(0x1500 to 0x1600)				
0x1500	Current I3 - Harmonic - 2	0~16384	Word	R
0x1501	Current I3 - Harmonic - 3	0~16384	Word	R
0x1502	Current I3 - Harmonic - 4	0~16384	Word	R
0x1503	Current I3 - Harmonic - 5	0~16384	Word	R
0x1504	Current I3 - Harmonic - 6	0~16384	Word	R

0x1505	Current I3 - Harmonic - 7	0~16384	Word	R
0x1506	Current I3 - Harmonic - 8	0~16384	Word	R
0x1507	Current I3 - Harmonic - 9	0~16384	Word	R
0x1508	Current I3 - Harmonic - 10	0~16384	Word	R
0x1509	Current I3 - Harmonic - 11	0~16384	Word	R
0x150A	Current I3 - Harmonic - 12	0~16384	Word	R
0x150B	Current I3 - Harmonic - 13	0~16384	Word	R
0x150C	Current I3 - Harmonic - 14	0~16384	Word	R
0x150D	Current I3 - Harmonic - 15	0~16384	Word	R
0x150E	Current I3 - Harmonic - 16	0~16384	Word	R
0x150F	Current I3 - Harmonic - 17	0~16384	Word	R
0x1510	Current I3 - Harmonic - 18	0~16384	Word	R
0x1511	Current I3 - Harmonic - 19	0~16384	Word	R
0x1512	Current I3 - Harmonic - 20	0~16384	Word	R
0x1513	Current I3 - Harmonic - 21	0~16384	Word	R
0x1514	Current I3 - Harmonic - 22	0~16384	Word	R
0x1515	Current I3 - Harmonic - 23	0~16384	Word	R
0x1516	Current I3 - Harmonic - 24	0~16384	Word	R
0x1517	Current I3 - Harmonic - 25	0~16384	Word	R
0x1518	Current I3 - Harmonic - 26	0~16384	Word	R
0x1519	Current I3 - Harmonic - 27	0~16384	Word	R
0x151A	Current I3 - Harmonic - 28	0~16384	Word	R
0x151B	Current I3 - Harmonic - 29	0~16384	Word	R
0x151C	Current I3 - Harmonic - 30	0~16384	Word	R
0x151D	Current I3 - Harmonic - 31	0~16384	Word	R
0x151E	Current I3 - Harmonic - 32	0~16384	Word	R
0x151F	Current I3 - Harmonic - THD	0~16384	Word	R
V1 Harmonics(0x1600 to 0x1700)				
0x1600	Voltage V1 - Harmonic - 2	0~16384	Word	R
0x1601	Voltage V1 - Harmonic - 3	0~16384	Word	R
0x1602	Voltage V1 - Harmonic - 4	0~16384	Word	R
0x1603	Voltage V1 - Harmonic - 5	0~16384	Word	R
0x1604	Voltage V1 - Harmonic - 6	0~16384	Word	R
0x1605	Voltage V1 - Harmonic - 7	0~16384	Word	R
0x1606	Voltage V1 - Harmonic - 8	0~16384	Word	R
0x1607	Voltage V1 - Harmonic - 9	0~16384	Word	R
0x1608	Voltage V1 - Harmonic - 10	0~16384	Word	R
0x1609	Voltage V1 - Harmonic - 11	0~16384	Word	R
0x160A	Voltage V1 - Harmonic - 12	0~16384	Word	R
0x160B	Voltage V1 - Harmonic - 13	0~16384	Word	R
0x160C	Voltage V1 - Harmonic - 14	0~16384	Word	R
0x160D	Voltage V1 - Harmonic - 15	0~16384	Word	R
0x160E	Voltage V1 - Harmonic - 16	0~16384	Word	R
0x160F	Voltage V1 - Harmonic - 17	0~16384	Word	R
0x1610	Voltage V1 - Harmonic - 18	0~16384	Word	R
0x1611	Voltage V1 - Harmonic - 19	0~16384	Word	R
0x1612	Voltage V1 - Harmonic - 20	0~16384	Word	R
0x1613	Voltage V1 - Harmonic - 21	0~16384	Word	R
0x1614	Voltage V1 - Harmonic - 22	0~16384	Word	R
0x1615	Voltage V1 - Harmonic - 23	0~16384	Word	R
0x1616	Voltage V1 - Harmonic - 24	0~16384	Word	R

0x1617	Voltage V1 - Harmonic - 25	0~16384	Word	R
0x1618	Voltage V1 - Harmonic - 26	0~16384	Word	R
0x1619	Voltage V1 - Harmonic - 27	0~16384	Word	R
0x161A	Voltage V1 - Harmonic - 28	0~16384	Word	R
0x161B	Voltage V1 - Harmonic - 29	0~16384	Word	R
0x161C	Voltage V1 - Harmonic - 30	0~16384	Word	R
0x161D	Voltage V1 - Harmonic - 31	0~16384	Word	R
0x161E	Voltage V1 - Harmonic - 32	0~16384	Word	R
0x161F	Voltage V1 - Harmonic - THD	0~16384	Word	R
V2 Harmonics (0x1700 to 0x1800)				
0x1700	Voltage V2 - Harmonic - 2	0~16384	Word	R
0x1701	Voltage V2 - Harmonic - 3	0~16384	Word	R
0x1702	Voltage V2 - Harmonic - 4	0~16384	Word	R
0x1703	Voltage V2 - Harmonic - 5	0~16384	Word	R
0x1704	Voltage V2 - Harmonic - 6	0~16384	Word	R
0x1705	Voltage V2 - Harmonic - 7	0~16384	Word	R
0x1706	Voltage V2 - Harmonic - 8	0~16384	Word	R
0x1707	Voltage V2 - Harmonic - 9	0~16384	Word	R
0x1708	Voltage V2 - Harmonic - 10	0~16384	Word	R
0x1709	Voltage V2 - Harmonic - 11	0~16384	Word	R
0x170A	Voltage V2 - Harmonic - 12	0~16384	Word	R
0x170B	Voltage V2 - Harmonic - 13	0~16384	Word	R
0x170C	Voltage V2 - Harmonic - 14	0~16384	Word	R
0x170D	Voltage V2 - Harmonic - 15	0~16384	Word	R
0x170E	Voltage V2 - Harmonic - 16	0~16384	Word	R
0x170F	Voltage V2 - Harmonic - 17	0~16384	Word	R
0x1710	Voltage V2 - Harmonic - 18	0~16384	Word	R
0x1711	Voltage V2 - Harmonic - 19	0~16384	Word	R
0x1712	Voltage V2 - Harmonic - 20	0~16384	Word	R
0x1713	Voltage V2 - Harmonic - 21	0~16384	Word	R
0x1714	Voltage V2 - Harmonic - 22	0~16384	Word	R
0x1715	Voltage V2 - Harmonic - 23	0~16384	Word	R
0x1716	Voltage V2 - Harmonic - 24	0~16384	Word	R
0x1717	Voltage V2 - Harmonic - 25	0~16384	Word	R
0x1718	Voltage V2 - Harmonic - 26	0~16384	Word	R
0x1719	Voltage V2 - Harmonic - 27	0~16384	Word	R
0x171A	Voltage V2 - Harmonic - 28	0~16384	Word	R
0x171B	Voltage V2 - Harmonic - 29	0~16384	Word	R
0x171C	Voltage V2 - Harmonic - 30	0~16384	Word	R
0x171D	Voltage V2 - Harmonic - 31	0~16384	Word	R
0x171E	Voltage V2 - Harmonic - 32	0~16384	Word	R
0x171F	Voltage V2 - Harmonic - THD	0~16384	Word	R
V3 Harmonics (0x1800 to 0x1900)				
0x1800	Voltage V3 - Harmonic - 2	0~16384	Word	R
0x1801	Voltage V3 - Harmonic - 3	0~16384	Word	R
0x1802	Voltage V3 - Harmonic - 4	0~16384	Word	R
0x1803	Voltage V3 - Harmonic - 5	0~16384	Word	R
0x1804	Voltage V3 - Harmonic - 6	0~16384	Word	R
0x1805	Voltage V3 - Harmonic - 7	0~16384	Word	R
0x1806	Voltage V3 - Harmonic - 8	0~16384	Word	R
0x1807	Voltage V3 - Harmonic - 9	0~16384	Word	R

0x1808	Voltage V3 - Harmonic - 10	0~16384	Word	R
0x1809	Voltage V3 - Harmonic - 11	0~16384	Word	R
0x180A	Voltage V3 - Harmonic - 12	0~16384	Word	R
0x180B	Voltage V3 - Harmonic - 13	0~16384	Word	R
0x180C	Voltage V3 - Harmonic - 14	0~16384	Word	R
0x180D	Voltage V3 - Harmonic - 15	0~16384	Word	R
0x180E	Voltage V3 - Harmonic - 16	0~16384	Word	R
0x180F	Voltage V3 - Harmonic - 17	0~16384	Word	R
0x1810	Voltage V3 - Harmonic - 18	0~16384	Word	R
0x1811	Voltage V3 - Harmonic - 19	0~16384	Word	R
0x1812	Voltage V3 - Harmonic - 20	0~16384	Word	R
0x1813	Voltage V3 - Harmonic - 21	0~16384	Word	R
0x1814	Voltage V3 - Harmonic - 22	0~16384	Word	R
0x1815	Voltage V3 - Harmonic - 23	0~16384	Word	R
0x1816	Voltage V3 - Harmonic - 24	0~16384	Word	R
0x1817	Voltage V3 - Harmonic - 25	0~16384	Word	R
0x1818	Voltage V3 - Harmonic - 26	0~16384	Word	R
0x1819	Voltage V3 - Harmonic - 27	0~16384	Word	R
0x181A	Voltage V3 - Harmonic - 28	0~16384	Word	R
0x181B	Voltage V3 - Harmonic - 29	0~16384	Word	R
0x181C	Voltage V3 - Harmonic - 30	0~16384	Word	R
0x181D	Voltage V3 - Harmonic - 31	0~16384	Word	R
0x181E	Voltage V3 - Harmonic - 32	0~16384	Word	R
0x181F	Voltage V3 - Harmonic - THD	0~16384	Word	R
Remaining registers				
0x1900	Temperature (1°C resolution)	0~100	Word	R
0x1901	Voltage V2 angle	-180~180	Word	R
0x1902	Voltage V3 angle	-180~180	Word	R
0x1903	Load Percent	0~100	Word	R
0x1904	Number of records	0000~9999	Word	R
0x1905	Internal Battery Status	0~1	Word	NA
0x1907	Year (Miladi)	2000~2099	Word	R
0x1908	Month (Miladi)	1~12	Word	R
0x1909	Day(Miladi)	1~31	Word	R
0x190A	Hour	0~23	Word	R
0x190B	Minute	0~59	Word	R
0x190C	Second	0~59	Word	R
Accurate Float Values				
0x2000 0x2001	Frequency (F)		Float	R
0x2002 0x2003	Phase Voltage V1		Float	R
0x2004 0x2005	Phase Voltage V2		Float	R
0x2006 0x2007	Phase Voltage V3		Float	R
0x2008 0x2009	Average Phase Voltage Vlnavg		Float	R
0x200A 0X200B	Line Voltage V12		Float	R
0x200C 0x200D	Line Voltage V23		Float	R
0x200E	Line Voltage V31		Float	R

0x200F				
0x2010 0x2011	Average Line Voltage Vllavg		Float	R
0x2012 0x2013	Current I1		Float	R
0x2020 0x2015	Current I2		Float	R
0x2016 0x2017	Current I3		Float	R
0x2018 0x2019	Average Current Iavg		Float	R
0x201A 0x201B	Neutral Line Current In (calculated)		Float	R
0x201C 0x201D	Neutral Line Current In (Measured)		Float	R
0x201E 0x201F	Phase Power P1		Float	R
0x2020 0x2021	Phase Power P2		Float	R
0x2022 0x2023	Phase Power P3		Float	R
0x2024 0x2025	System Power Ptot		Float	R
0x2026 0x2027	Phase Reactive Power Q1		Float	R
0x2028 0x2029	Phase Reactive Power Q2		Float	R
0x202A 0x202B	Phase Reactive Power Q3		Float	R
0x202C 0x202D	System Reactive Power Qtot		Float	R
0x202E 0x202F	Phase Apparent Power S1		Float	R
0x2030 0x2031	Phase Apparent Power S2		Float	R
0x2032 0x2033	Phase Apparent Power S3		Float	R
0x2050 0x2035	System Apparent Power Stot		Float	R
0x2036 0x2037	Phase Power Factor PF1		Float	R
0x2038 0x2039	Phase Power Factor PF2		Float	R
0x203A 0x203B	Phase Power Factor PF3		Float	R
0x203C 0x203D	System Power Factor PFtot		Float	R
0x203E 0x203F	Voltage Unbalance Factor U_unbl		Float	R
0x2040 0x2041	Current Unbalance Factor I_unbl		Float	R
0x2042 0x2043	Power Demand Dmd_Ptot		Float	R
0x2044 0x2045	Reactive power Demand Dmd_Qtot		Float	R
0x2046 0x2047	Apparent Power Demand Dmd_Stot		Float	R
0x2048 0x2049	Temperature		Float	R

0x204A 0x204B	Load Percent		Float	R
0x204C 0x204D	Voltage V1 angle		Float	R
0x204E 0x204F	Voltage V2 angle		Float	R
0x2050 0x2051	Voltage V3 angle		Float	R
0x2052 0x2053	Current I1 angle		Float	R
0x2054 0x2055	Current I2 angle		Float	R
0x2056 0x2057	Current I3 angle		Float	R
0x2058 0x2059	Current I1 TDD		Float	R
0x205A 0x205B	Current I2 TDD		Float	R
0x205C 0x205D	Current I3 TDD		Float	R
0x205E 0x205F	Current I1 K_FACTOR		Float	R
0x2060 0x2061	Current I2 K_FACTOR		Float	R
0x2062 0x2063	Current I3 K_FACTOR		Float	R
0x2064 0x2065	Voltage V1 THD+N		Float	R
0x2066 0x2067	Voltage V2 THD+N		Float	R
0x2068 0x2069	Voltage V3 THD+N		Float	R
0x206A 0x206B	Current I1 THD+N		Float	R
0x206C 0x206D	Current I2 THD+N		Float	R
0x206E 0x206F	Current I3 THD+N		Float	R
0x2070 0x2071	Current I1 THD		Float	R
0x2072 0x2073	Current I2 THD		Float	R
0x2074 0x2075	Current I3 THD		Float	R
0x2076 0x2077	Voltage V1 THD		Float	R
0x2078 0x2079	Voltage V2 THD		Float	R
0x207A 0x207B	Voltage V3 THD		Float	R
0x207C 0x207D	Current I1 THD ODD		Float	R
0x207E 0x207F	Current I2 THD ODD		Float	R
0x2080 0x2081	Current I3 THD ODD		Float	R
0x2082 0x2083	Voltage V1 THD ODD		Float	R
0x2084	Voltage V2 THD ODD		Float	R

0x2085				
0x2086 0x2087	Voltage V3 THD ODD		Float	R
0x2088 0x2089	Current I1 THD EVEN		Float	R
0x208A 0x208B	Current I2 THD EVEN		Float	R
0x208C 0x208D	Current I3 THD EVEN		Float	R
0x208E 0x208F	Voltage V1 THD EVEN		Float	R
0x2090 0x2091	Voltage V2 THD EVEN		Float	R
0x2092 0x2093	Voltage V3 THD EVEN		Float	R
0x2094 0x2095	Current I1 CF		Float	R
0x2096 0x2097	Current I2 CF		Float	R
0x2098 0x2099	Current I3 CF		Float	R
0x209A 0x209B	Voltage V1 CF		Float	R
0x209C 0x209D	Voltage V2 CF		Float	R
0x209E 0x209F	Voltage V3 CF		Float	R
0x20A0 0x20A1	Current I1 THDF		Float	R
0x20A2 0x20A3	Current I2 THDF		Float	R
0x20A4 0x20A5	Current I3 THDF		Float	R
0x20A6 0x20A7	Voltage V1 THDF		Float	R
0x20A8 0x20A9	Voltage V2 THDF		Float	R
0x20AA 0x20AB	Voltage V3 THDF		Float	R
0x20AC 0x20AD	Current I1 FUNDEMENTAL		Float	R
0x20AE 0x20AF	Current I2 FUNDEMENTAL		Float	R
0x20B0 0x20B1	Current I3 FUNDEMENTAL		Float	R
0x20B2 0x20B3	Voltage V1 FUNDEMENTAL		Float	R
0x20B4 0x20B5	Voltage V2 FUNDEMENTAL		Float	R
0x20B6 0x20B7	Voltage V3 FUNDEMENTAL		Float	R
Read and Write capable settings(0x3000~0x4000)				
0x3000	Slave address	1~247	Word	R/W
0x3001	Baud rate (1200-2400-4800-9600-19200-38400bps)	1200~38400	Word	R/W
0x3002	Sample time for logging (second)	1~900	Word	R/W
0x3003	PT primary (hi Word)	100~400000	Double Word	NA
0x3004	PT primary (lo Word)			
0x3005	PT secondary	100~400	Word	NA

0x3006	CT primary	5~8000	Word	R/W
0x3007	CT secondary	1 or 5	Word	R/W
0x3008	Light time for LCD backlight (minute)	1~15	Word	R/W
0x3009	Slide time for demand measuring (minute)	1~30	Word	R/W
0x300A	Meter constant (pulse of energy)	600~32000	Word	R/W
0x300B	Relay1 on time	50~3000	Word	NA
0x300C	Relay2 on time	50~3000	Word	NA
0x300D	RTC calibration value	-99~99	Word	R/W
0x300E	Number of Tariff	1~4	Word	R/W
0x300F	Tariff1 start Hour	0~23	Word	R/W
0x3010	Tariff1 start Minute	0~59	Word	R/W
0x3011	Tariff1 start Second	0~59	Word	R/W
0x3012	Tariff2 start Hour	0~23	Word	R/W
0x3013	Tariff2 start Minute	0~59	Word	R/W
0x3014	Tariff2 start Second	0~59	Word	R/W
0x3015	Tariff3 start Hour	0~23	Word	R/W
0x3016	Tariff3 start Minute	0~59	Word	R/W
0x3017	Tariff3 start Second	0~59	Word	R/W
0x3018	Tariff4 start Hour	0~23	Word	R/W
0x3019	Tariff4 start Minute	0~59	Word	R/W
0x301A	Tariff4 start Second	0~59	Word	R/W
0x301B	Number of CT	3~4	Word	NA
0x301C	Buzzer(ON = 1 ; OFF = 0)	0~1	Word	NA
0x301D	Unit ID letter(8)	ASCII	Word	R/W
0x301E	Unit ID letter(7)	ASCII	Word	R/W
0x301F	Unit ID letter(6)	ASCII	Word	R/W
0x3020	Unit ID letter(5)	ASCII	Word	R/W
0x3021	Unit ID letter(4)	ASCII	Word	R/W
0x3022	Unit ID letter(3)	ASCII	Word	R/W
0x3023	Unit ID letter(2)	ASCII	Word	R/W
0x3024	Unit ID letter(1)	ASCII	Word	R/W
0x3025	Type of logging (FIFO:0 and FILL and HOLD:1)	0~1	Word	R/W
0x3026	Daylight Saving(ON = 1 ; OFF = 0)	0~1	Word	R/W
0x3027	Type of date (shamsi:0 and miladi:1)	0~1	Word	R/W
0x3028	Pulse Output(ACTIVE = 2 ; REACTIVE = 1 ; APPERANT = 0)	0~2	Word	R/W
0x3029	Relay1 Type(Momentary = 1 ; Latch = 0)	0~1	Word	NA
0x302A	Relay2 Type(Momentary = 1 ; Latch = 0)	0~1	Word	NA
0x302B	Status of logger (START: 1 and STOP: 0)	0~1	Word	R/W
0x302C	Type of Display (FULL = 1 ; SIMPLE = 0)	0~1	Word	R/W
0x302D	PASSWORD1	0000~9999	Word	R/W
0x302E	PASSWORD2	0000~9999	Word	NA
0x302F	PASSWORD3	0000~9999	Word	NA
0x3030	Access Point Password(letter 1)		Word	NA
0x3031	Access Point Password(letter 2)		Word	NA
0x3032	Access Point Password(letter 3)		Word	NA
0x3033	Access Point Password(letter 4)		Word	NA
0x3034	Access Point Password(letter 5)		Word	NA
0x3035	Access Point Password(letter 6)		Word	NA
0x3036	Access Point Password(letter 7)		Word	NA
0x3037	Access Point Password(letter 8)		Word	NA

0x3038	Port Number	1000~9999	Word	NA
0x3039	IP(xxx.aaa.aaa.aaa)	0~255	Word	NA
0x303A	IP(aaa.xxx.aaa.aaa)	0~255	Word	NA
0x303B	IP(aaa.aaa.xxx.aaa)	0~255	Word	NA
0x303C	IP(aaa.aaa.aaa.xxx)	0~255	Word	NA
0x303D	MASK(xxx.aaa.aaa.aaa)	0~255	Word	NA
0x303E	MASK(aaa.xxx.aaa.aaa)	0~255	Word	NA
0x303F	MASK(aaa.aaa.xxx.aaa)	0~255	Word	NA
0x3040	MASK(aaa.aaa.aaa.xxx)	0~255	Word	NA
0x3041	GATEWAY(xxx.aaa.aaa.aaa)	0~255	Word	NA
0x3042	GATEWAY(aaa.xxx.aaa.aaa)	0~255	Word	NA
0x3043	GATEWAY(aaa.aaa.xxx.aaa)	0~255	Word	NA
0x3044	GATEWAY(aaa.aaa.aaa.xxx)	0~255	Word	NA
0x3045	UTC	-1200~1400	Word	NA
0x3046	Latitude(HI Word)	0~900000	Double Word	NA
0x3047	Latitude(LO Word)			
0x3048	Longitude(HI Word)	0~1800000	Double Word	NA
0x3049	Longitude(LO Word)			
0x304A	Astro timer(ON = 1 ; OFF = 0)	0~1	Word	NA
0x304B	Latitude Sign(North = + = 1 ; South = - = 0)	0~1	Word	NA
0x304C	Longitude Sign (East = + = 1 ; West = - = 0)	0~1	Word	NA
0x304D	Thermostat (ON = 1 ; OFF = 0)	0~1	Word	NA
0x304E	Thermostat set point	1~99	Word	NA
0x304F	Thermostat Hysteresis	1~20	Word	NA
0x3050	Astro Offset minute	-60~60	Word	NA
0x3051	Login Password (letter 1)		Word	NA
0x3052	Login Password (letter 2)		Word	NA
0x3053	Login Password (letter 3)		Word	NA
0x3054	Login Password (letter 4)		Word	NA
0x3055	Login Password (letter 5)		Word	NA
0x3056	Login Password (letter 6)		Word	NA
0x3057	Login Password (letter 7)		Word	NA
0x3058	Login Password (letter 8)		Word	NA
0x3059	Trip detected status		Word	NA
Read only settings				
0x4000	Sunrise Hour	0~23	Word	NA
0x4001	Sunrise Minute	0~59	Word	NA
0x4002	Sunrise Second	0~59	Word	NA
0x4003	Sunset Hour	0~23	Word	NA
0x4004	Sunset Minute	0~59	Word	NA
0x4005	Sunset Second	0~59	Word	NA
0x4006	Relay1 Status	0~1	Word	NA
0x4007	Relay2 Status	0~1	Word	NA
0x4008	Unit Time of use		Word	R
0x4009	Production Year	2020~2050	Word	R
0x400A	Production Month	1~12	Word	R
0x400B	Production Day	1~31	Word	R
0x400C	Unit version (letter1)	ASCII	Word	R
0x400D	Unit version (letter2)	ASCII	Word	R
0x400E	Unit version (letter3)	ASCII	Word	R
0x400F	Unit version (letter4)	ASCII	Word	R

0x4010	Unit version (letter5)	ASCII	Word	R
0x4011	Unit version (letter6)	ASCII	Word	R
0x4012	Unit version (letter7)	ASCII	Word	R
0x4013	Hardware version(x.a.a.a)	1~9	Word	R
0x4014	Hardware version(a.x.a.a)	1~9	Word	R
0x4015	Hardware version(a.a.x.a)	1~9	Word	R
0x4016	Hardware version(a.a.a.x)	1~9	Word	R
0x4017	Serial Number(letter 1)	ASCII	Word	R
0x4018	Serial Number(letter 2)	ASCII	Word	R
0x4019	Serial Number(letter 3)	ASCII	Word	R
0x401A	Serial Number(letter 4)	ASCII	Word	R
0x401B	Serial Number(letter 5)	ASCII	Word	R
0x401C	Serial Number(letter 6)	ASCII	Word	R
0x401D	Serial Number(letter 7)	ASCII	Word	R
0x401E	Serial Number(letter 8)	ASCII	Word	R
0x401F	Serial Number(letter 9)	ASCII	Word	R
0x4020	Seed key for login (HI)		Word	NA
0x4021	Seed key for login (LO)		Word	NA
0x4022	Digital Input Status	0~1	Word	NA
0x4023	Power Failure Status	0~1	Word	NA
Write only settings				
0x5000				W
0x5001	Clear Memory(CLEAR = 1)	1	Word	W
0x5002	Clear Energy(CLEAR = 1)	1	Word	W
0x5003	Clear Statistics(CLEAR = 1)	1	Word	W
0x5004	RTC Second	0~59	Word	W
0x5005	RTC Minute	0~59	Word	W
0x5006	RTC Hour	0~23	Word	W
0x5007	RTC Day	1~31	Word	W
0x5008	RTC Month	1~12	Word	W
0x5009	RTC Year	2020~2050	Word	W
0x500A	Relay1 (ON = 1 ; OFF = 0)	0~1	Word	NA
0x500B	Relay2 (ON = 1 ; OFF = 0)	0~1	Word	NA
0x500C	Reset Unit (RESET = 1)	1	Word	W
0x500D	Key for Login to update (hi Word)		Word	W
0x500E	Key for Login to update (lo Word)		Word	W
0x500F	Clear Contactors Counters(CLEAR = 1)	1	Word	NA
Settings of PFC (write in single mode)				
0x6000	PFC (ON = 1 ; OFF = 0)	0~1	Word	NA
0x6001	PFC I/O slave address	1~247	Word	NA
0x6002	PFC action time second	1~120	Word	NA
0x6003	PFC Discharge Time second	1~240	Word	NA
0x6004	Value of Capacitor1	0~9999	Word	NA
0x6005	Value of Capacitor2	0~9999	Word	NA
0x6006	Value of Capacitor3	0~9999	Word	NA
0x6007	Value of Capacitor4	0~9999	Word	NA
0x6008	Value of Capacitor5	0~9999	Word	NA
0x6009	Value of Capacitor6	0~9999	Word	NA
0x600A	Value of Capacitor7	0~9999	Word	NA
0x600B	Value of Capacitor8	0~9999	Word	NA
0x600C	Value of Capacitor9	0~9999	Word	NA

0x600D	Value of Capacitor10	0~9999	Word	NA
0x600E	Value of Capacitor11	0~9999	Word	NA
0x600F	Value of Capacitor12	0~9999	Word	NA
0x6010	Percent of value effect on correction	1~100	Word	NA
0x6011	Percent of contactor count effect on correction	1~100	Word	NA
0x6012	Percent of number of in or out effect on correction	1~100	Word	NA
0x6013	Percent of availability effect on correction	1~100	Word	NA
0x6014	Number of steps	1~12	Word	NA
0x6015	Percent of PFC correction offset	1~100	Word	NA
0x6016	PFC target Power Factor	-100~100	Word	NA
0x6017	Contactor1 Counter	0~9999	Word	NA
0x6018	Contactor2 Counter	0~9999	Word	NA
0x6019	Contactor3 Counter	0~9999	Word	NA
0x601A	Contactor4 Counter	0~9999	Word	NA
0x601B	Contactor5 Counter	0~9999	Word	NA
0x601C	Contactor6 Counter	0~9999	Word	NA
0x601D	Contactor7 Counter	0~9999	Word	NA
0x601E	Contactor8 Counter	0~9999	Word	NA
0x601F	Contactor9 Counter	0~9999	Word	NA
0x6020	Contactor10 Counter	0~9999	Word	NA
0x6021	Contactor11 Counter	0~9999	Word	NA
0x6022	Contactor12 Counter	0~9999	Word	NA

Table 16 Metering data address table

The Relationship between numerical value in register of ZMP and the real physical value is as following table. (Rx is the numerical value in register of ZMP)

Parameter	Relationship	Unit
V1, V2, V3, V12, V23, V31, Vllavg, Vlnavg	U = Rx × (PT_P/PT_S) / 100	Volt(V)
I1, I2, I3, Iavg, In	I = Rx × (CTP/CT_S) / 1000	Amp(A)
P1, P2, P3, Ptot, Dmd_Ptot	P = Rx × (PT_P/PT_S) × (CT_P/ CT_S)	Watt(W)
Q1, Q2, Q3, Qtot, Dmd_Qtot	Q = Rx × (PT_P/PT_S) × (CT_P/ CT_S)	Var
S1, S2, S3, Stot, Dmd_Stot	S = Rx × (PT_P/PT_S) × (CT_P/ CT_S)	VA
PF1, PF2, PF3, PFtot	PF = Rx / 1000	NA
Frequency	F = Rx / 100	Hz
Load Type (L/C/R)	ASCII of L, C, R	NA
U_unbl, I_unbl	Unbl = Rx / 100	%
Active Energy	P = Rx / 10	Kwh
Reactive Energy	Q = Rx / 10	Kvarh
Apparent Energy	S = Rx / 10	KVAh
H2 to H32 ,THD	THD=Rx / 163.84	%

Table 17 Measuring data convert table

7.3. APPENDIX C Address table of Logged Values

Each Page of internal flash memory includes one records, By per query of Modbus function code 0x04 we can read one page from internal memory of logged values.

Below table show arrange of measured values that recorded in one page of flash memory.

record	type
Number	Word
Year	Word
Month	Byte
Day	Byte
Hour	Byte
Minute	Byte
Second	Byte
Va	Word
Vb	Word
Vc	Word
Vn	Word
V unbl	Byte
Vab	Word
Vbc	Word
Vca	Word
Ia	Word
Ib	Word
Ic	Word
In_meas	Word
In_calc	Word
I unbl	Byte
PFa	Byte
PFb	Byte
PFc	Byte
PF total	Byte
Va THD	Byte
Vb THD	Byte
Vc THD	Byte
Ia THD	Byte
Ib THD	Byte
Ic THD	Byte
Pa	Word
Pb	Word
Pc	Word
Qa	Word
Qb	Word
Qc	Word
Sa	Word
Sb	Word
Sc	Word
P total	Word
Q total	Word
S total	Word
Frequency	Word
CRF	Byte
VaH1	Byte
VaH2	Byte
VaH3	Byte
VaH4	Byte
VaH5	Byte
VaH6	Byte
VaH7	Byte
VaH8	Byte
VaH9	Byte
VaH10	Byte
VaH11	Byte
VaH12	Byte
VaH13	Byte
VaH14	Byte
VaH15	Byte
VbH1	Byte
VbH2	Byte
VbH3	Byte
VbH4	Byte
VbH5	Byte
VbH6	Byte
VbH7	Byte
VbH8	Byte
VbH9	Byte

VbH10	Byte
VbH11	Byte
VbH12	Byte
VbH13	Byte
VbH14	Byte
VbH15	Byte
VcH1	Byte
VcH2	Byte
VcH3	Byte
VcH4	Byte
VcH5	Byte
VcH6	Byte
VcH7	Byte
VcH8	Byte
VcH9	Byte
VcH10	Byte
VcH11	Byte
VcH12	Byte
VcH13	Byte
VcH14	Byte
VcH15	Byte
IaH1	Byte
IaH2	Byte
IaH3	Byte
IaH4	Byte
IaH5	Byte
IaH6	Byte
IaH7	Byte
IaH8	Byte
IaH9	Byte
IaH10	Byte
IaH11	Byte
IaH12	Byte
IaH13	Byte
IaH14	Byte
IaH15	Byte
IbH1	Byte
IbH2	Byte
IbH3	Byte
IbH4	Byte
IbH5	Byte
IbH6	Byte
IbH7	Byte
IbH8	Byte
IbH9	Byte
IbH10	Byte
IbH11	Byte
IbH12	Byte
IbH13	Byte
IbH14	Byte
IbH15	Byte
IcH1	Byte
IcH2	Byte
IcH3	Byte
IcH4	Byte
IcH5	Byte
IcH6	Byte
IcH7	Byte
IcH8	Byte
IcH9	Byte
IcH10	Byte
IcH11	Byte
IcH12	Byte
IcH13	Byte
IcH14	Byte
IcH15	Byte

Table 18 Logger data array in internal memory

7.4. APPENDIX D Setting Parameters

CONTROL SETTING PARAMETERS	DEFAULT VALUE	UNIT
Password	0000	

Daylight saving	Enable	
RTC Calibration	00	second
Date type	Shamsi	
CT Primary	5	A
CT Secondary	5	A
Display Mode	SIMPLE	
Backlight Time	10	Minute
Baud Rate	38400	Bps
Slave Address	1	
Logger status	Start	
Logger Type	FIFO	
Logger Sampling Time	900	second
Logger Slide Time	5	minute
Number of Energy Tariff	1	
Tariff 1 start time	00:00:00	
Tariff 2 start time	00:00:00	
Tariff 3 start time	00:00:00	
Tariff 4 start time	00:00:00	
Meter Constant	3200	Imp/…
Energy Pulse Output	Active	
Unit ID	"ALFA-ZMP"	8 Char

Table 19 Setting Parameters and default values

7.5. APPENDIX E Calculations

Almost all electric parameters in power systems can be measured by ZMP series intelligent power meter. Some parameters that do not be familiar by users will be introduced in this part.

Voltage (V): True RMS value of three phase voltages, three line to line voltages and their average are measured and displayed in ZMP.

Current (I): True RMS value of three phase currents, neutral current and their average are measured and displayed in ZMP.

Power (P): Three phase power and system total power are measured and display in ZMP.

Reactive power (Q): Three phase reactive power and system total reactive power are measured and displayed in ZMP.

Apparent power (S): Three phase apparent power and system total apparent power are measured and displayed in ZMP.

Frequency (F): The frequency of V1 phase voltage input is measured as system frequency.

Energy (kWh): Energy is time integral of power. The unit is kWh. As power has direction, positive means consumption and negative means generating. So the energy has also the nature of consumption or generating.
Import (imp): Consumption energy
Export (exp): Generating energy
Total: Absolute sum of import and export energy
Net: Algebraic sum of import and export energy

Reactive Energy (kvarh): Reactive energy is time integral of reactive power. The unit is kvarh. As reactive power has direction, positive means inductive and negative means capacitive, so the reactive energy has also got the nature of inductive and capacitive.
Import (imp): Inductive reactive energy
Export (exp): Capacitive reactive energy
Total: Absolute sum of import and export reactive energy
Net: Algebraic sum of import and export reactive energy
Each of the four reactive energies is measured and stored independently.

Demand: Demand of power, reactive power and apparent power. The demand statistics method in ZMP8800+ is sliding window. The sliding window time can be choosing between 1 to 30 minutes. The window slides one minute each time. For example, the sliding window time is supposed to be 3 minute. If average power of the first Minute is 12, average power of the second minute is 14 and average power of the third minute is 10, then the total demand of the 3 minutes is (12+14+10)/3=12 at the end of the three minute. If another minute passed, the average power of the minute is 8, then the total power demand of the last three minute is (14+10+8)/3=10 at the end of the fourth minute.

Three phase unbalance factor: three phase voltage unbalance factor and three phase current unbalance factor can be measured in ZMP8800+. The unbalance factor is express in percentage.

$$\text{Voltage unbalance factor} = \frac{\text{The Max different value of three voltages}}{\text{Average value of three voltages}}$$

$$\text{Current unbalance factor} = \frac{\text{The Max different value of three currents}}{\text{Average value of three currents}}$$

Max/Min statistics: The maximum and minimum value of the metering data is stored in NV-RAM and can be accessed or cleared from front panel or through communication. These metering data are phase voltage, line to line voltage, current, power, reactive power, apparent power, power factor, frequency, demand.

Real time clock: There is a real time clock in the ZMP. The date, month, year, hour, minute and second can be read or set from front panel or through communication.

Total Harmonic Distortion for Voltage:

$$\%THDv = \sqrt{\sum_{n=2}^{\infty}\left(\frac{{v_n}^2}{{v_1}^2}\right)}$$

v_n = nth order harmonic rms voltage
v_1 = fundamental rms voltage

Total Harmonic Distortion for Current:

$$\%THDi = \sqrt{\sum_{n=2}^{\infty}\left(\frac{{i_n}^2}{{i_1}^2}\right)}$$

i_n = nth order harmonic rms current
i_1 = fundamental rms current