PMC-660 Series

Advanced Power Quality Meter

User Manual

Version: V1.0A

06/12/2012

Ceiec Electric Technology

Standards Compliance

CE

DANGER

This symbol indicates the presence of danger that may result in severe injury or death and permanent equipment damage if proper precautions are not taken during the installation, operation or maintenance of the device.

CAUTION

This symbol indicates the potential of personal injury or equipment damage if proper precautions are not taken during the installation, operation or maintenance of the device.

DANGER

Failure to observe the following instructions may result in severe injury or death and/or equipment damage.

- Installation, operation and maintenance of the meter should only be performed by qualified, competent personnel that have the appropriate training and experience with high voltage and current devices. The meter must be installed in accordance with all local and national electrical codes.
- Ensure that all incoming AC power and other power sources are turned OFF before performing any work on the meter.
- Before connecting the meter to the power source, check the label on top of the meter to ensure that it is equipped with the appropriate power supply, and the correct voltage and current input specifications for your application.
- During normal operation of the meter, hazardous voltages are present on its terminal strips and throughout the connected potential transformers (PT) and current transformers (CT). PT and CT secondary circuits are capable of generating lethal voltages and currents with their primary circuits energized. Follow standard safety precautions while performing any installation or service work (i.e. removing PT fuses, shorting CT secondaries, …etc).
- Do not use the meter for primary protection functions where failure of the device can cause fire, injury or death. The meter should only be used for shadow protection if needed.
- Under no circumstances should the meter be connected to a power source if it is damaged.
- To prevent potential fire or shock hazard, do not expose the meter to rain or moisture.
- Setup procedures must be performed only by qualified personnel familiar with the instrument and its associated electrical equipment.
- DO NOT open the instrument under any circumstances.

Limited warranty

- Ceiec Electric Technology (CET) offers the customer a minimum of 12-month functional warranty on the meter for faulty parts or workmanship from the date of dispatch from the distributor. This warranty is on a return to factory for repair basis.
- CET does not accept liability for any damage caused by meter malfunctions. CET accepts no responsibility for the suitability of the meter to the application for which it was purchased.
- Failure to install, set up or operate the meter according to the instructions herein will void the warranty.
- Only CET's duly authorized representative may open your meter. The unit should only be opened in a fully anti-static environment. Failure to do so may damage the electronic components and will void the warranty.

Table of Contents

Chapter 1 Introduction

This manual explains how to use the PMC-660 Advanced Power Quality Meter.

This chapter provides an overview of the PMC-660 meter and summarizes many of its key features.

1.1 Overview

The PMC-660 is CET's latest offer for the advanced power quality monitoring of incomers and critical feeders for utilities, data centers, high-tech manufacturing facilities and heavy industries. Housed in an industry-standard DIN form factor measuring 96mmx96mmx125mm, the PMC-660's compact size is perfectly suited for today's space restricting installations. The PMC-660 features quality construction with metal enclosure, advanced power quality and revenue-accurate measurements, high-resolution waveform recording capabilities, comprehensive data logging, extensive I/O and an easy-to-read LCD display, capable of displaying 3-phase measurements at once. With standard dual RS-485 ports and Modbus protocol support, the PMC-660 becomes a vital component of an intelligent Power Quality Monitoring System.

You can setup the meter through its front panel or via our free PMC Setup software. The meter is also supported by our PecStar® iEMS and iPQMS Systems.

Following is a list of typical applications for the PMC-660:

- Class 0.2S Revenue Metering
- Power quality monitoring of main incomer or critical feeder
- Waveform recording at 256 samples per cycle
- Extensive logging capability with 4MB on-board memory
- Utility, industrial and commercial metering
- Substation, building and factory automation
- Low, medium and high voltage applications
- Analog meter replacement
- I4 monitoring

The above are just a few of the many applications. Contact CET Technical Support should you require further assistance with your application.

1.2 Features

Ease of use

- Large, backlit, easy to read LCD display with wide viewing angle
- Password protected setup via front panel or free PMC Setup software
- Easy installation with mounting slide bar, no tools required

Basic Measurements (1 second update)

- 3-phase voltage, current and power measurements
- Neutral current (I4) and Frequency
- Bi-directional energy measurements
- Voltage and Current phase angles

High-speed Measurements

- 3-phase voltage @ ½ cycle
- 3-phase current, neutral current (I4) @ 1 cycle
- 3-phase power and power factor @ 1 cycle

Power Quality

- Fundamental measurements for 3-phase voltage, current, power, PF, and I4
- Voltage and Current Unbalance based on Sequence Components
- Voltage and Frequency Deviation
- THD, TOHD, TEHD, K-Factor and Displacement PF
- Individual harmonics to 63^{rd} on-board, 127^{th} via communications
- Sag/Swell Detection and Transient Capture
- PQ LOG with 1000 entries

Sliding Window and Predicted Demands

- 3-phase voltage, current, power, PF, I4, Frequency, V and I Unbalance, and THD
- Max/Min values per demand interval
- Demand synchronization with DI
- Peak Demands for This Month and Last Month

Setpoints

- 16 standard setpoints with extensive monitoring sources
- 8 high-speed setpoints with high-speed measurements and DI
- Configurable thresholds and time delays
- 6 Logical Modules supporting AND/OR/NAND/NOR operations
- WF Recording, Data Recorder, DO, and Email Alarm trigger

Log memory

- 4MB on-board memory
- Dynamic allocation for Data Recorder Logs, Waveform Recorder Logs and Energy Logs

Waveform Recorder Log

- 2 independent groups of waveform recorders with a combined total of 32 entries
- Simultaneous capture of 3-phase voltage and current signals
- Programmable formats and pre-fault cycles from 256x20 to 16x320
- Support FIFO recording mode

Data Recorder Log

- 12 standard Data Recorder Logs
- 4 high-speed Data Recorder Logs (1 cycle interval)
- Recording interval from 1s to 40 days for standard and 1 to 60 cycles for high-speed
- Programmable sources include almost all real-time, harmonics, unbalance and demand values
- Configurable depth and recording offset
- Support FIFO or stop-when-full recording mode

Interval Energy and Demand Log

- TOU capability without complicated tariff programming
- Interval recording of kWh, kvarh Import/Export and kVAh Total
- Interval recording of Demands and associated Min/Max values per demand interval
- Support FIFO or stop-when-full recording mode

SOE Log

- 512 events time-stamped to ±1ms resolution
- Setup changes, Setpoint events and I/O operations

PQ Log

- 1000 entries time-stamped to ±1ms resolution
- Sag/Swell and Transient detection or other PQ events

Max/Min Log

- Logging of Max/Min values for real-time measurements such as Voltage, Current, Frequency, kW, kvar, kVA, PF, Freq, Unbalance, K-factor, THD of This Month and Last Month

Digital Inputs

- 6 channels, volts free dry contact, 24VDC internally wetted
- External status monitoring with programmable debounce
- Pulse counting with programmable weight for each channel for collecting WAGES information
- Demand Synchronization
- 1000Hz sampling

Digital Outputs

- 3 channels standard without the optional AO
- 2 channels only with the optional AO
- Form A Mechanical relays

Analog Input (Optional)

- 0-20 / 4-20mA DC input
- Can be used to measure external transducer signal
- Programmable zero and full scales

Analog Output (Optional)

- 0-20 / 4-20mA DC output
- Can be "keyed" to any measured quantity
- Programmable zero and full scales

Communications

Port 1 and Port 2

- Optically isolated RS485 port
- Baud rate from 1200 to 38400bps
- Modbus RTU protocol

Ethernet (Optional)

- 10/100BaseT Ethernet with RJ45 connection
- Modbus RTU over TCP/IP, Modbus TCP, Ethernet Gateway, HTTP, SMTP, SNTP

Real-time clock

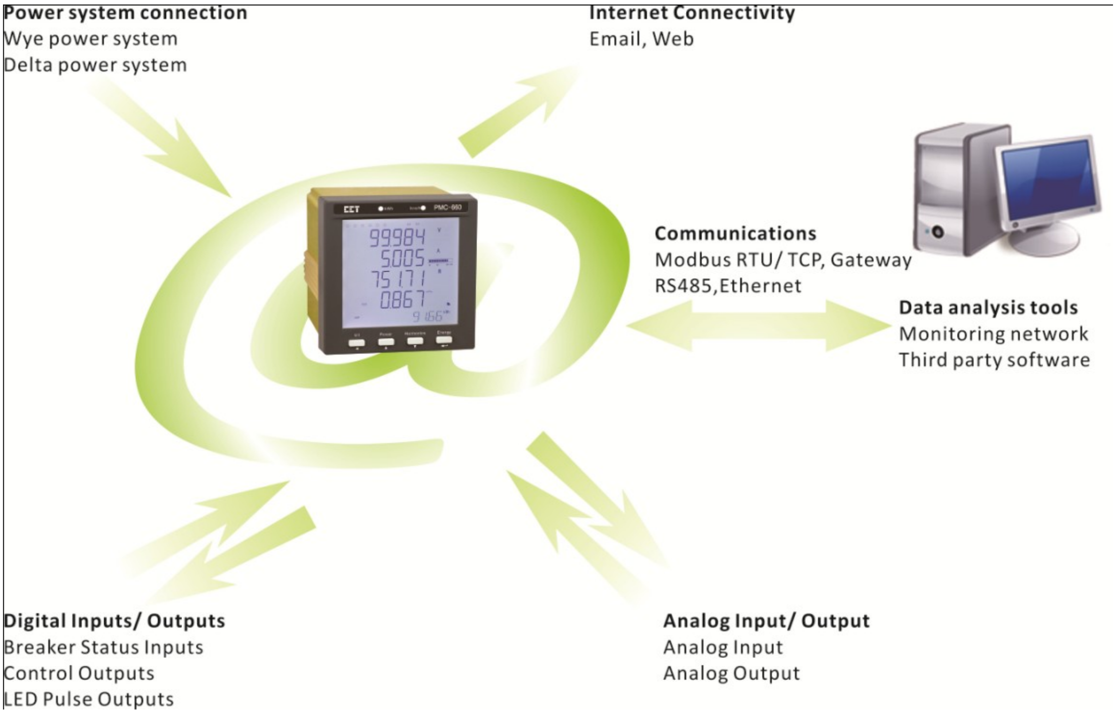
- 6ppm battery-backed real-time clock (<0.5s per day)

System Integration

- Supported by our PecStar® iEMS and iPQMS
- Easy integration into other Automation or SCADA systems via Modbus RTU and Modbus TCP protocols

1.3 PMC-660's application in Power and Energy Management Systems

The PMC-660 can be used to monitor Wye or Delta connected power system. Modbus communications allow real-time data, events, DI status, Data Logs, Waveform and other information to be transmitted to an Integrated Energy Management System such as PecStar® iEMS.



1.4 Getting more information

Additional information is available from CET via the following sources:

- Visit www.ceiec-electric.com
- Contact your local representative
- Contact CET directly via email or telephone

Chapter 2 Installation

Caution

Installation of the PMC-660 should only be performed by qualified, competent personnel that have the appropriate training and experience with high voltage and current devices. The meter must be installed in accordance with all local and national electrical codes.

During the operation of the meter, hazardous voltages are present at the input terminals. Failure to observe precautions can result in serious or even fatal injury and equipment damage.

2.1 Appearance

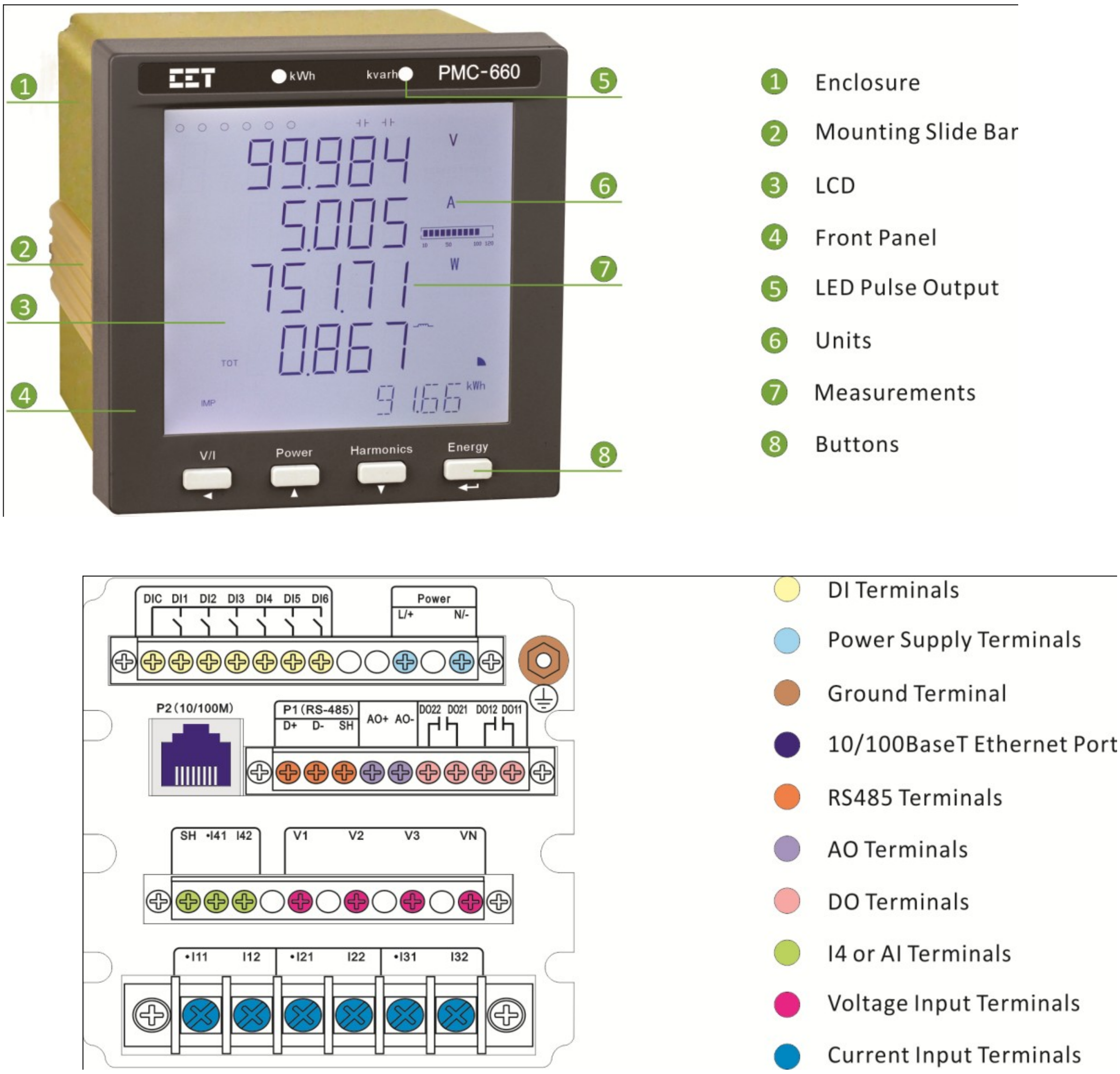
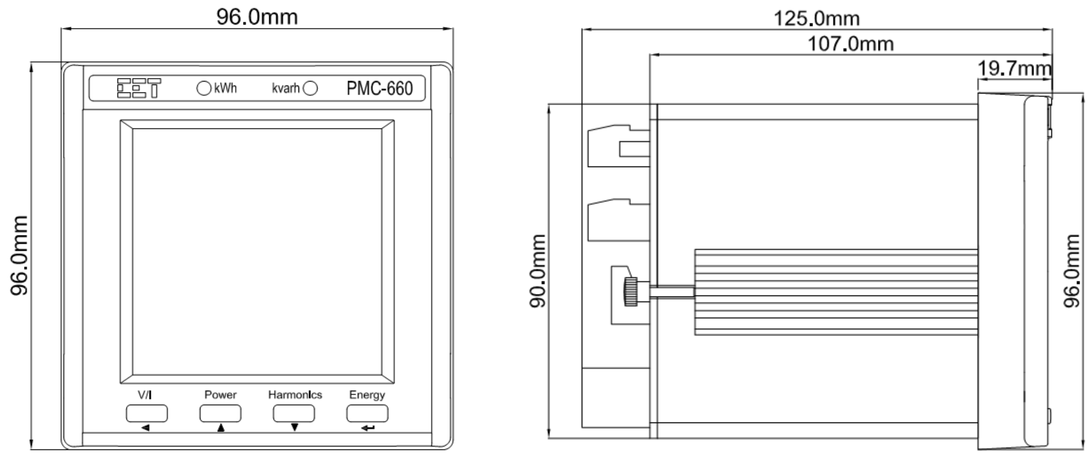


Figure 2-1 Appearance

2.2 Unit Dimensions



Front View **Side View**

Figure 2-2 Dimensions

2.3 Mounting

The PMC-660 should be installed in a dry environment with no dust and kept away from heat, radiation and electrical noise sources.

Installation steps:

- Remove the mounting slide bars from the meter
- Fit the meter through a 92mmx92mm cutout as shown in Figure 2-3
- Re-install the mounting slide bars and tighten the screws against the panel to secure the meter

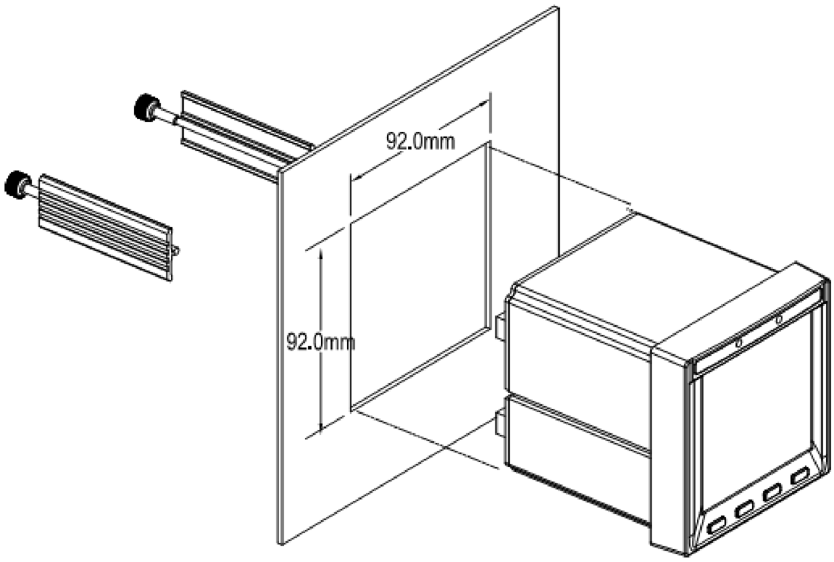


Figure 2-3 Panel Cutout

2.4 Wiring Connections

PMC-660 can satisfy almost any three phase power systems. Please read this section carefully before installation and choose the correct wiring method for your power system. The following wiring modes are supported:

- 3-phase 4-wire Wye Direct Connection
- 3-phase 4-wire Wye with 3PTs and 3CTs
- 3-phase 3-wire Grounded Wye Direct Connection
- 3-phase 3-wire Grounded Wye with 3PTs and 3CTs
- 3-phase 3-wire Open Delta Direct Connection
- 3-phase 3-wire Open Delta with 2PTs and 3CTs
- 3-phase 3-wire Open Delta with 2PTs and 2CTs

Caution

Under no circumstances should the PT secondary be shorted.

Under no circumstances should the CT secondary be open when the CT primary is energized. CT shorting blocks should be installed to allow for easy maintenance.

2.4.1 3-phase 4-wire Wye Direct Connection

Please consult the serial number label to ensure that the system phase voltage is less than or equal to the meter's voltage input specification.

Set the Wiring Mode to Wye.

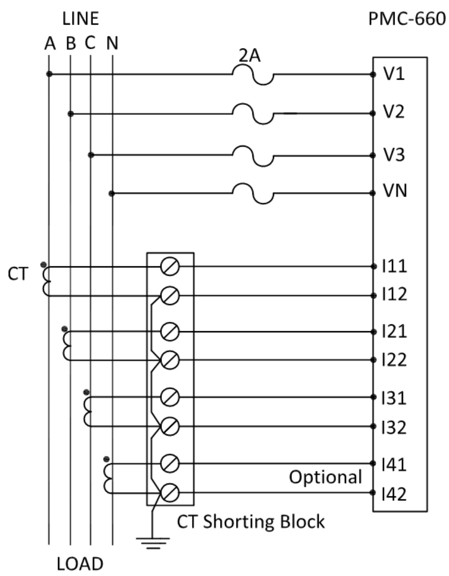


Figure 2-4 4-Wire Wye, Direct Connection

2.4.2 3-phase 4-wire Wye with 3PTs and 3CTs

Please consult the serial number label to ensure that the rated PT secondary voltage is less than or equal to the meter's voltage input specification.

Set the Wiring Mode to Wye.

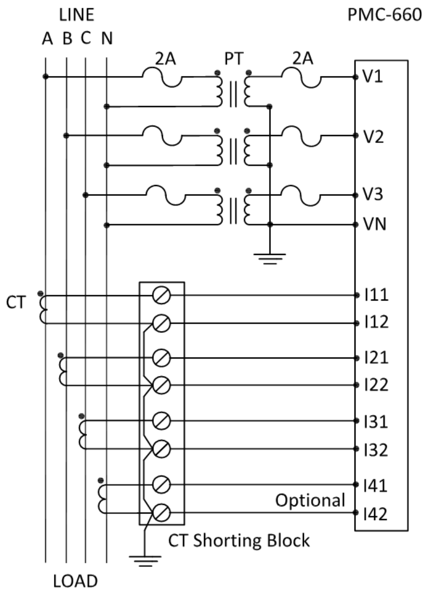


Figure 2-5 4-Wire Wye, 3PTs, 3CTs

2.4.3 3-phase 3-wire Grounded Wye Direct Connection

Please consult the serial number label to ensure that the system phase voltage is less than or equal to the meter's voltage input specification.

Set the Wiring Mode to Wye.

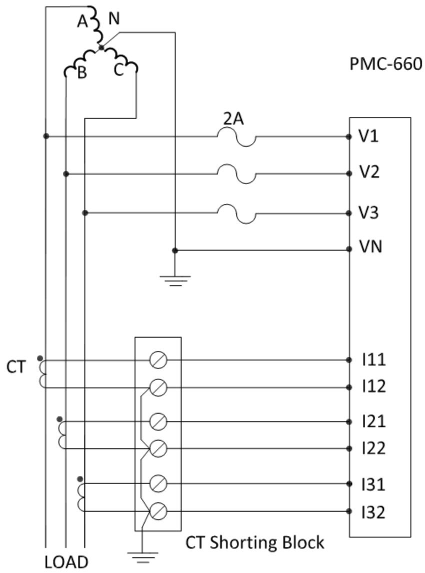


Figure 2-6 3-Wire Grounded Wye, Direct Connection

2.4.4 3-phase 3-wire Grounded Wye with 3PTs and 3CTs

Please consult the serial number label to ensure that the rated PT secondary voltage is less than or equal to the meter's voltage input specification.

Set the Wiring Mode to Wye.

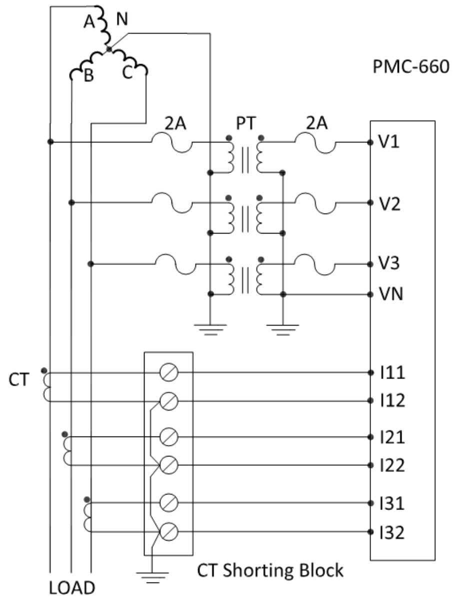


Figure 2-7 3-Wire Grounded Wye, 3PTs, 3CTs

2.4.5 3-phase 3-wire Open Delta Direct Connection

Please consult the serial number label to ensure that the that the system line voltage is less than or equal to the meter's voltage input specification.

Set the Wiring Mode to Delta.

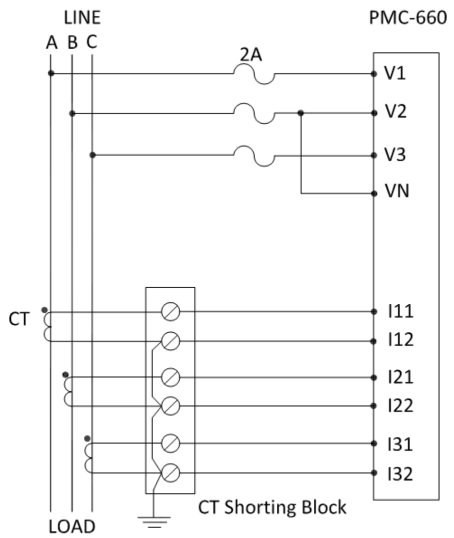


Figure 2-8 3-Wire Delta, no PTs, 3CTs

2.4.6 3-phase 3-wire Open Delta with 2PTs and 3CTs

Please consult the serial number label to ensure that the rated PT secondary voltage is less than or equal to the meter’s voltage input specification.

Set the Wiring Mode to Delta.

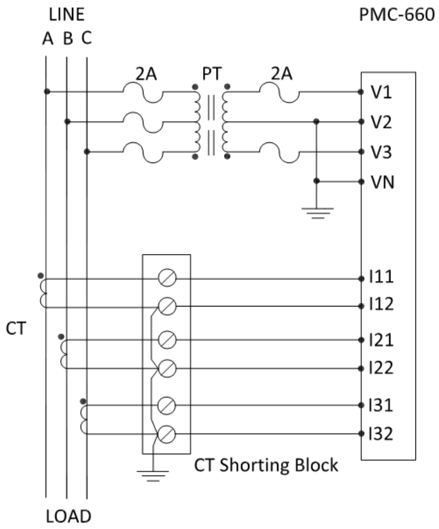


Figure 2-9 3-Wire Delta, 2PTs, 3CTs

2.4.7 3-phase 3-wire Open Delta with 2PTs and 2CTs

Please consult the serial number label to ensure that the rated PT secondary voltage is less than or equal to the meter’s voltage input specification.

Set the Wiring Mode to Delta.

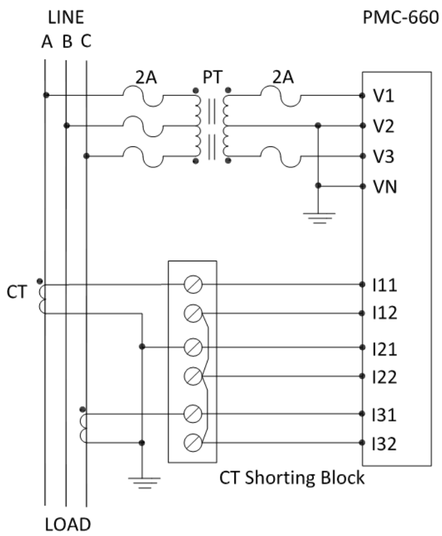


Figure 2-10 3-Wire Delta, 2PTs, 2CTs

2.5 Communications Wiring

2.5.1 RS485 Port

The PMC-660 provides up to two RS485 ports and supports the Modbus RTU protocol. Up to 32 devices can be connected on a RS485 bus. The overall length of the RS485 cable connecting all devices should not exceed 1200m.

If the master station does not have a RS485 communications port, a RS232/RS485 or USB/RS485 converter with optically isolated outputs and surge protection should be used.

The following figure illustrates the RS485 communications connections on the PMC-660:

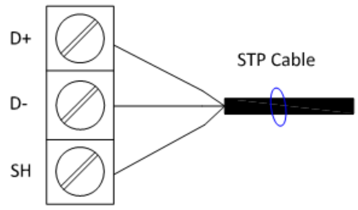


Figure 2-11 RS485 Communications Connections

2.5.2 Ethernet Port (10/100BaseT)

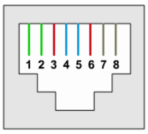
RJ45 Connector	Pin	Meaning
	1	Transmit Data+
	2	Transmit Data-
	3	Receive Data+
	4,5,7,8,	NC
	6	Receive Data-

Table 2-1 RJ45 Connector Pin Description for 10/100BaseT Applications

2.6 Digital Input Wiring

The following figure illustrates the Digital Input connections on the PMC-660:

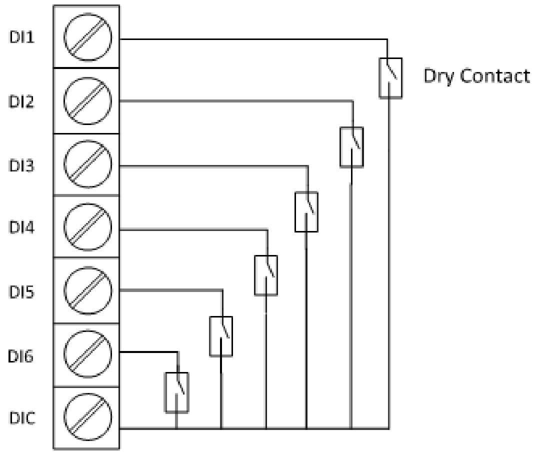


Figure 2-12 DI Connections

2.7 GPS 1PPS Input wiring

The Digital Input on the PMC-660 can be used for time synchronization with a GPS 1PPS output. The following figure illustrates the wiring connections:

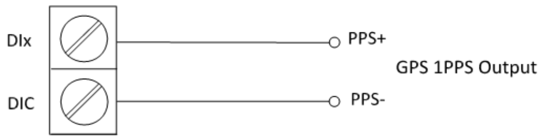


Figure 2-13 Time Sync. Connections

2.8 Digital Output Wiring

The following figure illustrates the Digital Output connections on the PMC-660:

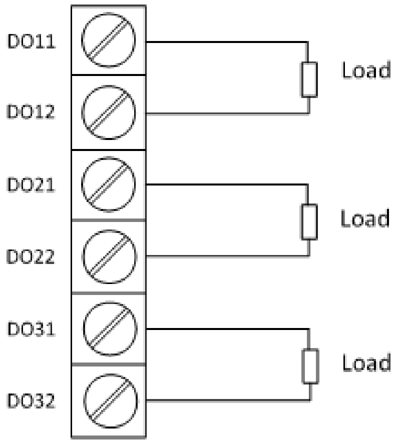


Figure 2-14 DO Connections

2.9 Analog Input Wiring

The following figure illustrates the Analog Input connections on the PMC-660:

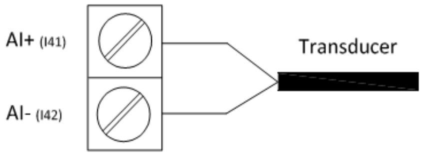


Figure 2-15 AI Connections

2.10 Analog Output Wiring

The following figure illustrates the Analog Output connections on the PMC-660:

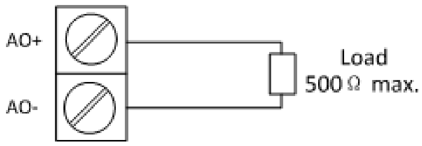


Figure 2-16 AO Connections

2.11 Power supply Wiring

For AC supply, connect the live wire to the L/+ terminal and the neutral wire to the N/- terminal. For DC supply, connect the positive wire to the L/+ terminal and the negative wire to the N/- terminal.

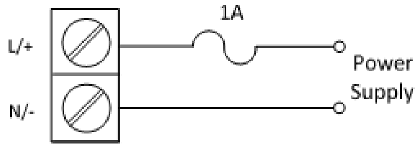


Figure 2-17 Power Supply Connections

2.12 Chassis Ground Wiring

Connect the G terminal to earth ground.

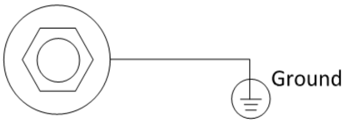


Figure 2-18 Chassis Ground connection

Chapter 3 Front Panel

The PMC-660 has a large, easy to read LCD display with backlight and four buttons for data display and meter configuration. This chapter introduces the front panel operations.

Figure 3-1 Front Panel

a	DI Status
b	LED Pulse Output
c	DO Status
d	Measurements
e	Measurement Unit
f	P.F. Quadrant Indicator
g	Energy Data

Table 3-1 Front Panel display

3.1 Display Screen Types

The front panel provides two display modes: Data Display and Setup Configuration. There are four buttons on the front panel: **<V/I>**, **<Power>**, **<Harmonics>** and **<Energy>**. Use these buttons to view metering data and configure setup parameters.

3.1.1 LCD Testing

Pressing both the <**Power>** and the <**Harmonics>** buttons simultaneously for 2 seconds enters the LCD Testing mode. During testing, all LCD segments are illuminated for 5 seconds and then turned off for 1 second. This cycle will repeat 3 times to allow for the detection of faulty segments. The LCD will return to its normal Data Display mode afterwards.

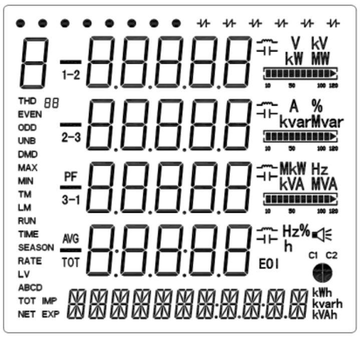


Figure 3-2 PMC-660 Full Display

3.1.2 LCD Display Areas

This section provides a description of the LCD display areas. The PMC-660 LCD display can generally be divided into 5 areas:

A: Displays symbols for parameters such as Voltage, Current, Fundamental, Power, THD, TOHD, TEHD, 2nd to 31st Individual Harmonics, k-Factor, Unbalance, PF, Voltage Phase Angle, Current Phase Angle and Demand etc.

B: Displays the indicators for DI status and DO status

C: Displays Measurement Units, Loading Rate and PF Quadrant status

D: Displays Measurement values

E: Displays energy information such as kWh/kvarh Imp/Exp/Net/Total and kVAh Total

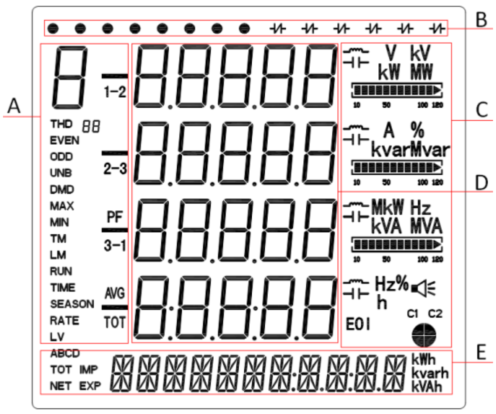


Figure 3-3 LCD Display

The following table shows the special LCD display symbols:

NO.	Label	Description			
	8	U Voltage	I Current	P kW	q kvar
		S kVA	d Fundamental	t K-Factor	F Frequency
		A Phase A	b Phase B	C Phase C	P DMD Predicted Demand
A	1-2 88 2-3 PF 3-1 AVG TOT	1 2 3 Line to Neutral	1-2 2-3 3-1 Line to Line	PF Power Factor	AVG Average
		TOT Total	– Negative Symbol	PA Phase Angle	

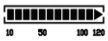
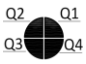
	THD 88 EVEN ODD UNB DMD MAX MIN TM LM RUN TIME SEASON RATE LV	THD THD	THD EVEN TEHD	THD ODD TOHD	HD 2 to THD 31 2nd to 31st Harmonics
		UNB Unbalance	DMD Demand	MAX Maximum	MIN Minimum
		TM This Month	LM Last Month	RUN TIME SEASON RATE LV Reserved	
B	● -/|-	○ DI Open	● DI Close	-||- DO Open	-/|- DO Close
C		V kV A % Hz Units for voltage, current, %harmonics distortion and frequency			kW MW kvarMvar kVA MVA Units for Real, Reactive and Apparent Power
		 %Loading	Inductive Load Capacitive Load	C1 C2 COM 1 Port Status COM 2 Port Status	Alarm Symbol
		 PF Quadrant – Q1/Q2/Q3/Q4			E01 Reserved
E		IMP kWh kWh Import	EXP kWh kWh Export	NET kWh kWh Net	TOT kWh kWh Total
		IMP kvarh kvarh Import	EXP kvarh kvarh Export	NET kvarh kvarh Net	TOT kvarh kvarh Total
		kVAh kVAh Energy	ABCD Reserved		

Table 3-2 LCD Display Symbols

3.1.3 Peak Demand Display

The following special arrangements have been made for the display of the Peak Demand and its timestamp with the appropriate unit displayed in the Measurement Units area.

a: Peak Demand Indicator – Peak Demand of This/Last Month:

b: Peak Demand value

c: Date portion of the Peak Demand timestamp

d: Time portion of the Peak Demand timestamp

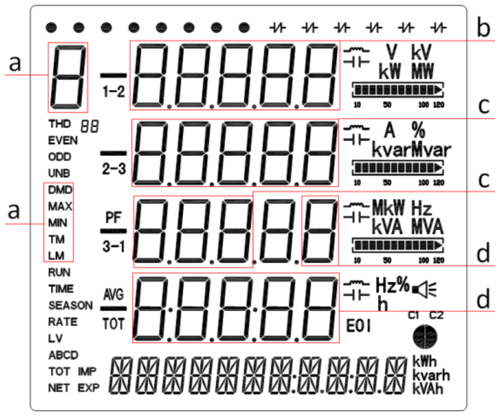


Figure 3-4 Peak Demand Display

Area	Symbol Description				
a	P kW	q kvar	S kVA	A Phase A	b Phase B
	C Phase C	DMD Demand	MAX Maximum	TM This Month	LM Last Month
b	Peak Demand Value				
c	Peak Demand Timestamp (Date Portion) - YYYY.MM.DD				
d	Peak Demand Timestamp (Time Portion) – HH:MM:SS				

Table 3-3 Peak Demand Display

3.1.4 Data Display

The following table illustrates the display screens for the different PMC-660 models.

Press Button	Display screens	First row	Second row	Third row	Fourth row
<V,I>	Display 1	VLL average	I average	∑kW	∑P.F.
	Display 2[1]	Va	Vb	Vc	VLN average
	Display 3	Vab	Vbc	Vca	VLL average
	Display 4	Ia	Ib	Ic	I average
	Display 5[2]		I4		
	Display 6[3,#]		I0		
	Display 7[1]	dVa	dVb	dVc	dVLN average
	Display 8	dIa	dIb	dIc	dI average
	Display 9			Frequency	
	Display 10		V Unbalance		
	Display 11		I Unbalance		
	Display 12[4]		AI		
	Display 13	Va Angle	Vb Angle	Vc Angle	

	Display 14	Ia Angle	Ib Angle	Ic Angle	
	Display 15	Ia Demand	Ib Demand	Ic Demand	
	Display 16		I4 Demand		
	Display 17	Ia Peak Demand of This Month		YYYY.MM.DD HH:MM:SS	
	Display 18	Ib Peak Demand of This Month		YYYY.MM.DD HH:MM:SS	
	Display 19	Ic Peak Demand of This Month		YYYY.MM.DD HH:MM:SS	
	Display 20	Ia Peak Demand of Last Month		YYYY.MM.DD HH:MM:SS	
	Display 21	Ib Peak Demand of Last Month		YYYY.MM.DD HH:MM:SS	
	Display 22	Ic Peak Demand of Last Month		YYYY.MM.DD HH:MM:SS	
<Power>	Display 1[1]	kWa	kWb	kWc	∑kW
	Display 2[1]	kvara	kvarb	kvarc	∑kvar
	Display 3[1]	kVAa	kVAb	kVAc	∑kVA
	Display 4[1]	P.F.a	P.F.b	P.F.c	∑P.F.
	Display 5[1]	dkWa	dkWb	dkWc	d∑kW
	Display 6[1]	dkvara	dkvarb	dkvarc	d∑kvar
	Display 7[1]	dkVAa	dkVAb	dkVAc	d∑kVA
	Display 8[1]	dP.F.a	dP.F.b	dP.F.c	d∑P.F.
	Display 9	∑kW	∑kvar	∑kVA	∑P.F.
	Display 10	d∑kW	d∑kvar	d∑kVA	d∑P.F.
	Display 11	∑kW Demand	∑kvar Demand	∑kVA Demand	∑P.F. Demand
	Display 12	∑kW Predicted Demand	∑kvar Predicted Demand	∑kVA Predicted Demand	∑P.F. Predicted Demand
	Display 13	kW Peak Demand of This Month		YYYY.MM.DD HH:MM:SS	
	Display 14	kvar Peak Demand of This Month		YYYY.MM.DD HH:MM:SS	
	Display 15	kVA Peak Demand of This Month		YYYY.MM.DD HH:MM:SS	
	Display 16	kW Peak Demand of Last Month		YYYY.MM.DD HH:MM:SS	
	Display 17	kvar Peak Demand of Last Month		YYYY.MM.DD HH:MM:SS	

	Display 18	kVA Peak Demand of Last Month	YYYY.MM.DD HH:MM:SS		
<Harmonics>	Display 1	Va THD	Vb THD	Vc THD	VLN avg. THD
	Display 2	Ia THD	Ib THD	Ic THD	I avg. THD
	Display 3	Ia K-Factor	Ib K-Factor	Ic K-Factor	
	Display 4	Va TEHD	Vb TEHD	Vc TEHD	VLN avg. TEHD
	Display 5	Ia TEHD	Ib TEHD	Ic TEHD	I avg. TEHD
	Display 6	Va TOHD	Vb TOHD	Vc TOHD	VLN avg. TOHD
	Display 7	Ia TOHD	Ib TOHD	Ic TOHD	I avg. TOHD
	Display 8	Va 2nd Harmonic	Vb 2nd Harmonic	Vc 2nd Harmonic	VLN avg. 2nd Harmonic
	Display 9	Ia 2nd Harmonic	Ib 2nd Harmonic	Ic 2nd Harmonic	I avg. 2nd Harmonic
	……				
	Display 66	Va 31st Harmonic	Vb 31st Harmonic	Vc 31st Harmonic	VLN avg. 31st Harmonic
	Display 67	Ia 31st Harmonic	Ib 31st Harmonic	Ic 31st Harmonic	I avg. 31st Harmonic
<Energy>	Display 1	kWh Import			
	Display 2	kWh Export			
	Display 3	kWh Net			
	Display 4	kWh Total			
	Display 5	kvarh Import			
	Display 6	kvarh Export			
	Display 7	kvarh Net			
	Display 8	kvarh Total			
	Display 9	kVAh			

[#] Available in firmware version V1.00.04 or later

Table 3-4 PMC-660 Data Display Screens

Notes:

1) When the wiring mode is Delta, the screens that display per phase line-to-neutral voltages, kWs, kvars, kVAs and PFs are bypassed and do not appear.

2) I4 is the neutral current measurement. If the meter is not equipped with the I4 Input, this screen will not appear.

3) I0 is the calculated neutral current.

4) This display only appears if the meter is equipped with the Analog Input.

3.2 Setup Configuration via the Front Panel

Pressing the **<Energy>** button for more than 3 seconds enters the Setup Configuration mode where setup parameters can be changed. Upon completion, pressing the **<Energy>** button for more than 3 seconds returns to the Data Display mode.

3.2.1 Functions of buttons

The four front panel buttons take on different meanings in the Setup Configuration mode and are described below:

<Energy>: Pressing this button for more than three seconds toggles between Data Display mode and Setup Configuration mode. Once inside the Setup Configuration mode, pressing this button selects a parameter for modification. After changing the parameter, pressing this button again saves the new setting into memory.

<Power>: Before a parameter is selected for modification, pressing this button advances to the next parameter in the menu. If a parameter is already selected, pressing this button increments a numeric value or advances to the next value in the selection list.

<Harmonics>: Before a parameter is selected for modification, pressing this button goes back to the last parameter in the menu. If a parameter is already selected, pressing this button decrements a numeric value or goes back to the last value in the selection list**.**

<V/I>: Once a parameter is selected, pressing this button moves the cursor to the left by one position if the parameter being changed is a numeric value. Otherwise, this button is ignored.

Making setup changes:

- Press the **<Energy>** button for more than 3 seconds to access Setup Configuration mode.
- Press the **<Power>** button to advance to the Password page.
- A correct password must be entered before changes are allowed. The factory default password is zero. Press the **<Energy>** button to select the parameter for modification. Use the **<Power>**, **<Harmonics>** and **<V/I>** buttons to enter the correct password.

Selecting a parameter to change:

- Use the **<Power>** and **<Harmonics>** buttons to scroll to the desired parameter.
- Press the **<Energy>** button to select the parameter. Once selected, the parameter value will blink.

Changing and saving a parameter:

- Use the **<Power>**, **<Harmonics>** and **<V/I>** buttons to make modification to the selected parameter.
- After modification, press the **<Energy>** button to save the new value into memory.

Returning to the Data Display mode:

- Pressing the **<Energy>** button for more than three seconds to return to the default display screen.

3.2.2 Setup Menu

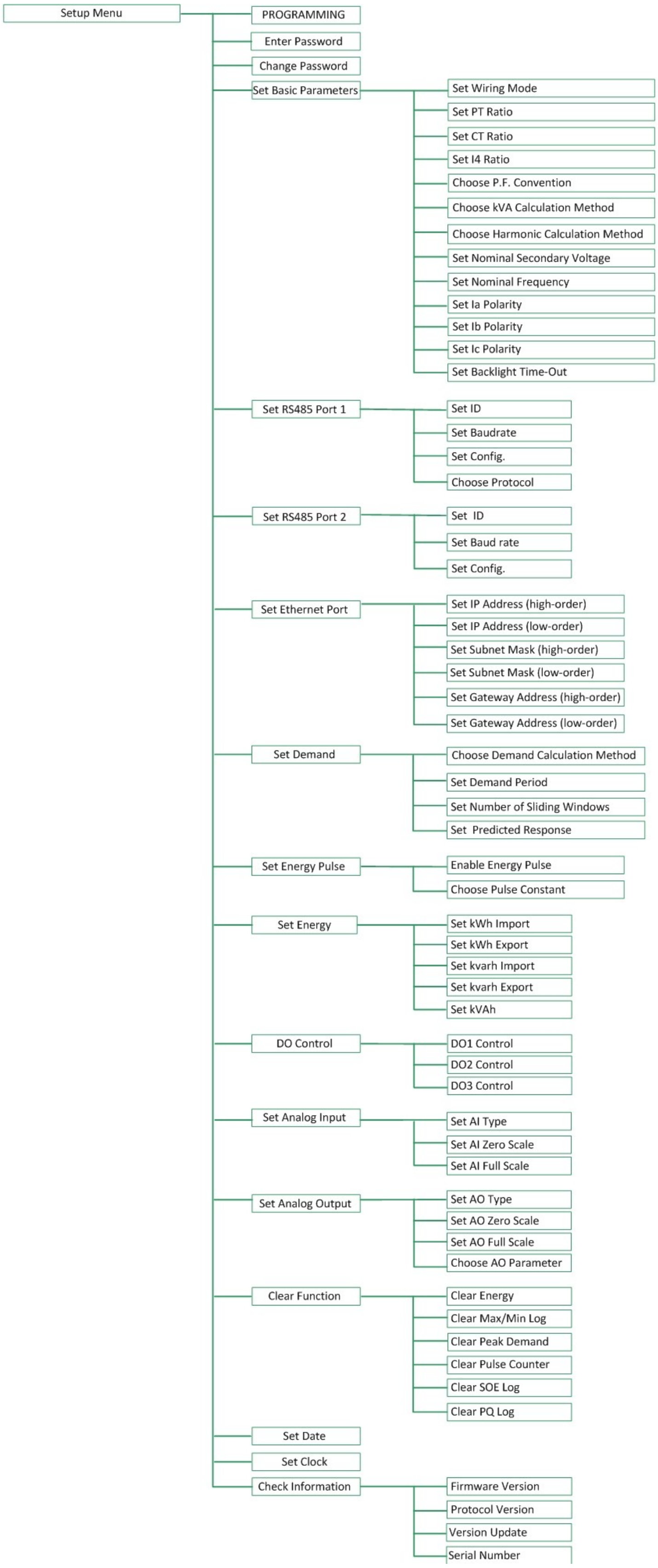


Figure 3-5 Setup Menu

3.2.3 Front Panel Setup Parameters

The Setup Configuration mode provides access to the following setup parameters:

Label menu 1st	Label menu 2nd	Parameters	Description	Options/Range	Default
PROGRAMMING			Setup Configuration mode	/	/
PASWORD		Password	Enter Password	/	"0"
PAS SET			Change Password?	YES/NO	NO
	New PAS	New Password	Change Password	0000 to 9999	"0"
SYS SET			Configure System Parameters?	YES/NO	NO
	TYPE	Wiring Mode	The Wiring Connection of the meter	WYE/DELTA/DEMO	WYE
	PT	PT Ratio[1]	PT Ratio	1 to 10,000	1
	CT	CT Ratio[1]	CT Ratio	1 to 30,000 (1A) 1 to 6,000 (5A)	1
	I4	I4 Ratio	I4 Ratio	1 to 10,000	1
	PF SET	P.F. Convention[2]	P.F. Convention	IEC/IEEE/-IEEE	IEC
	KVA SET	kVA Calculation[3]	kVA Calculation Method	V/S	V
	HD SET	Harmonics Calculation[4]	Harmonics Distortion Calculation Method	FUND/RMS	FUND
	V NOM	Nominal Secondary Voltage ($V_{nominal}$)	The Nominal Voltage of Secondary Side	100 to 700 (V)	100
	Hz NOM	Nominal Frequency ($f_{nominal}$)	Nominal Frequency	50/60	50
	I1 REV	Phase A CT	Reverse Phase A CT Polarity	YES/NO	NO
	I2 REV	Phase B CT	Reverse Phase B CT Polarity	YES/NO	NO
	I3 REV	Phase C CT	Reverse Phase C CT Polarity	YES/NO	NO
	BLTO SET	Backlight Time-Out[5]	Set Backlight Time-out	0 to 60 (mins)	3
COM1 SET			Configure COM1 Parameters?	YES/NO	NO
	ID1	Port 1 Meter Address	Modbus Address	1-247	100
	BAUD1	Port 1 Baud rate	Data rate in bits per second	1200/2400/4800/ 9600/19200/38400bps	9600
	CONFIG1	Port 1 Configuration	Data Format	8N2/8O1/8E1/8N1/8O2/8E2	8E1

PRO	Protocol	Communication Protocol	MODBUS/EGATE	MODBUS
COM2 SET		Configure COM2 Parameters?	YES/NO	NO
ID2	Port 2 Meter Address	Modbus Address	1-247	101
BAUD2	Port 2 Baud rate	Data rate in bits per second	1200/2400/4800/ 9600/19200/38400bps	9600
CONFIG2	Port 2 Configuration	Data Format	8N2/8O1/8E1/8N1/8O2/8E2	8E1
ETH SET[6]		Configure Ethernet Parameters?	YES/NO	NO
IPH	IP Address	IP Address (high-order)	For example: IP Address is 192.168.8.97, IP Address(high-order) is 192.168	192.168
IPL	IP Address	IP Address (low-order)	For example: IP Address is 192.168.8.97, IP Address(low-order) is 0.250	8.97
SMH	Subnet Mask	Subnet Mask (high-order)	For example: Subnet Mask is 255.255.255.0, Subnet Mask(high-order) is 255.255	255.255
SML	Subnet Mask	Subnet Mask (low-order)	For example: Subnet Mask is 255.255.255.0, Subnet Mask(low-order) is 255.0	255.0
GWH	Gateway Address	Gateway Address (high-order)	For example: Gateway Address is 192.168.8.1, Gateway Address (high-order) is 192.168	192.168
GWL	Gateway Address	Gateway Address (low-order)	For example: Gateway Address is 192.168.8.1, Gateway Address (low-order) is 0.1	8.1
DMD SET		Configure Demand Parameters?	YES/NO	NO
MODE	Demand Sync. Mode	Demand Sync. Mode	SLD/SYNC	SLD
PERIOD	Sliding Window Interval	Sliding Window Interval	1 to 99 (minutes)	15
NUM	Number of Sliding Windows	Number of Sliding Windows	1 to 15	1
SENS	Predicted Response	Predicted Demand Sensitivity	70 to 99	70
PULS SET		Configure Pulse Output?	YES/NO	NO
EN PULSE	Energy Pulse	Enable Energy Pulsing	YES/NO	NO

EN CONST	Pulse Constant	Pulse Constant	1k(1000)/3.2k(3200)/5k(5000)	5k
ENGY SET	Energy Values	Preset Energy Values	YES/NO	NO
IMP kWh	kWh Import	Preset kWh Import Value	0 to 999,999,999	0
EXP kWh	kWh Export	Preset kWh Export value	0 to 999,999,999	0
IMP kvarh	kvarh Import	Preset kvarh Import Value	0 to 999,999,999	0
EXP kvarh	kvarh Export	Preset kvarh Export value	0 to 999,999,999	0
kVAh	kVAh	Preset kVAh Value	0 to 999,999,999	0
DO SET	DO Control	DO Control	YES/NO	NO
DO1	DO1 Control	DO1 Control	NORMAL/ON/OFF	NORMAL
DO2	DO2 Control	DO2 Control	NORMAL/ON/OFF	NORMAL
DO3	DO3 Control	DO3 Control	NORMAL/ON/OFF	NORMAL
AI SET	Analog Input	Configure Analog Input	YES/NO	NO
TYPE	Analog Input Type	Select between 0-20mA or 4-20mA input	4-20 / 0-20	4-20
ZERO	Zero Scale	The value that corresponds to the minimum Analog Input of 0 mA or 4 mA	-999,999 to 999,999	0
FULL	Full Scale	The value that corresponds to the maximum Analog Input of 20 mA	-999,999 to 999,999	5000
AO SET	Analog Output	Configure Analog Output	YES/NO	NO
TYPE	Analog Output Type	Select between 0-20mA or 4-20mA output	4-20 / 0-20	4-20
ZERO	Zero Scale	The parameter value that corresponds to the minimum Analog Output of 0 mA or 4 mA	-999,999 to 999,999	0
FULL	Full scale	The parameter value that corresponds to the maximum Analog Output of 20 mA	-999,999 to 999,999	5000
KEY[7]	Analog Output Parameter	The parameter to which the Analog Output is proportional	Vab/Vbc/Vca/VLL avg./ Ia/Ib/Ic/Iavg./ ∑kW/∑kvar/∑kVA/∑P.F./ Freq./ ∑kW Demand/ ∑kvar Demand/ ∑kVA Demand /∑P.F Demand.	Vab
CLR SET		Clear Logs	YES/NO	NO
CLR ENGY	Clear Energy	Clear kWh, kvarh and kVAh	YES/NO	NO
CLR MXMN	Clear Max/Min	Clear Max/Min Logs of This Month	YES/NO	NO
CLR PDMD	Clear Demand	Clear Peak Demands of This Month	YES/NO	NO

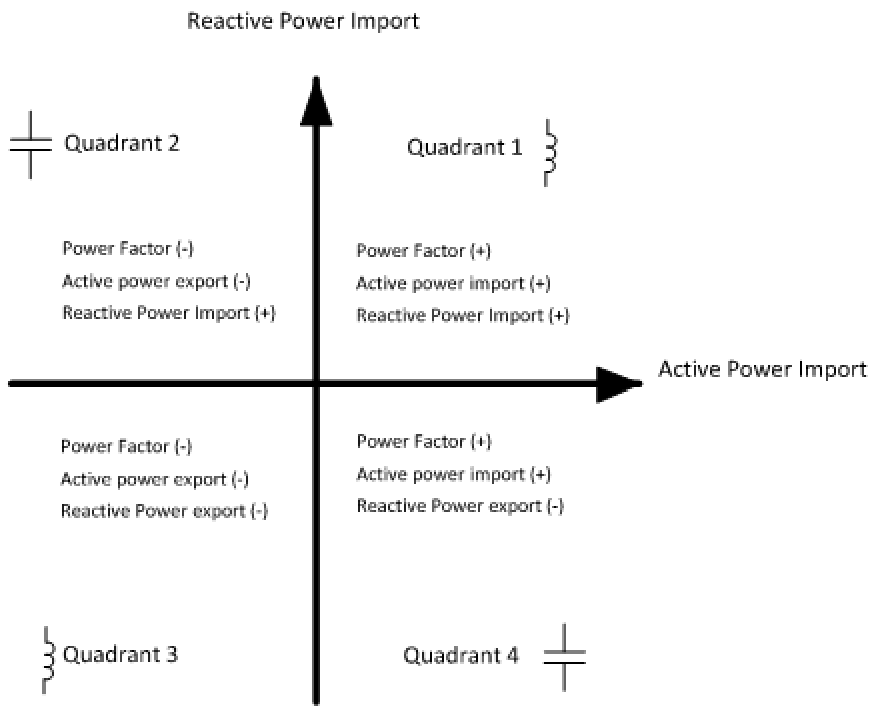
CLR DIC	Clear Pulse Counter	Clear Pulse Counter	YES/NO	NO
CLR SOE	Clear SOE	Clear SOE Log	YES/NO	NO
CLR PQ	Clear PQ Log	Clear PQ Log	YES/NO	NO
DAT	Date	Enter the Current Date	(20)YY-MM-DD	/
CLk	Time	Enter the Current Time	HH:MM:SS	/
INFO	Information (Read Only)	Check meter information	YES/NO	NO
660	Version	Firmware Version	For example, 660 10000 means the meter is PMC-660 and the firmware version is V1.00.00.	/
PRO VER	Protocol Version	Protocol Version	e.g. 10 means V1.0	/
UPDAT	Update Date	Date of the latest firmware update	e.g. 090821	/
	Serial Number	Meter Serial Number	e.g. 0908471895	/

Table 3-5 Setup Parameters

Notes:

1) For 5A configuration, PT Ratio × CT Ratio must be less than 1,000,000
   For 1A configuration, PT Ratio x CT Ratio must be less than 5,000,000

2) P.F. Convention: -IEEE is the same as IEEE but with the opposite sign.



IEC

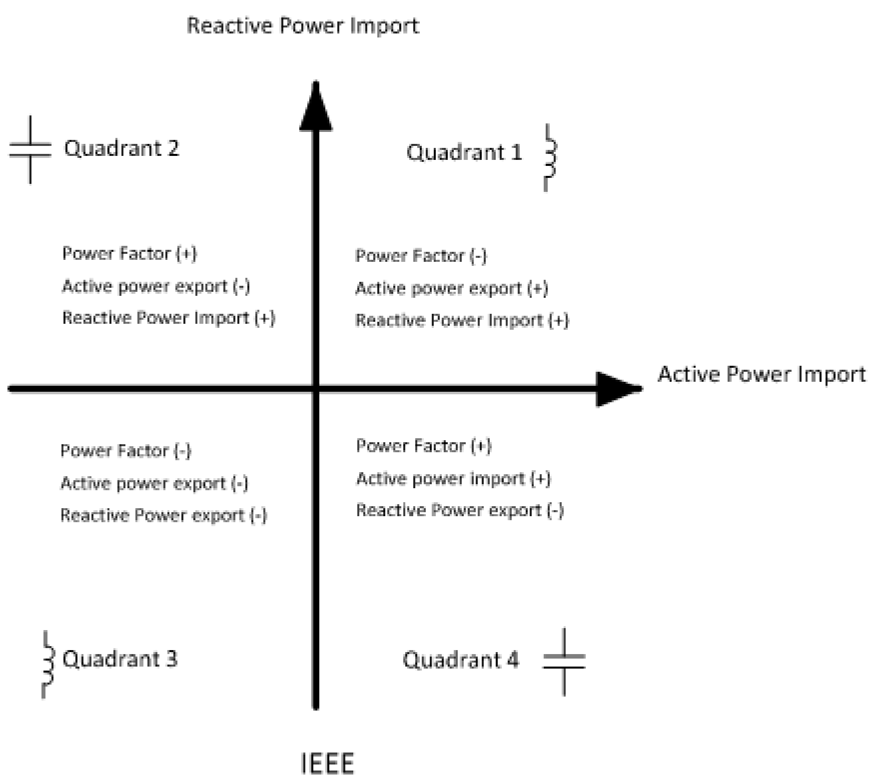


Figure 3-6 Power Factor Definitions

3) There are two ways to calculate kVA:

Mode V (Vector method**):** $kVA_{total} = \sqrt{kW_{total}^2 + kvar_{total}^2}$

Mode S (Scalar method**):** $kVA_{total} = kVA_a + kVA_b + kVA_c$

4) There are two ways to calculate the individual harmonic distortion:

% of Fundamental Method:

Voltage K^{th} Harmonic Distortion= $\frac{U_k}{U_1}X100\%$, U_1 is Fundamental Voltage

Current K^{th} Harmonic Distortion= $\frac{I_k}{I_1}X100\%$, I_1 is Fundamental Current

% of RMS Method:

Voltage K^{th} Harmonic Distortion= $\frac{U_k}{\sqrt{\sum_{K=1}^{\infty} U_K^2}}X100\%$

Current K^{th} Harmonic Distortion= $\frac{I_k}{\sqrt{\sum_{K=1}^{\infty} I_K^2}}X100\%$

5) The Backlight Time-out can be set from 0 to 60 minutes. If the value is 0, the backlight is always on. This setup parameter is available in Firmware Version V1.00.04 or later.

6) The PMC-660 supports two types of Modbus protocols for its Ethernet port:
   a. RTU – Modbus RTU over TCP/IP (IP Port No. = 27011)
   b. TCP – Modbus TCP (IP Port No. = 502)

7) Analog Output Parameters

If **∑PF** is chosen as the AO parameter, the values for **ZERO** (zero scale) and **FULL** (full scale) should be set as 1000 times the actual value.

The Units for voltage, current, kW, kvar, kVA and FREQ are V, A, kW, kvar, kVA and Hz, respectively.

Key	0	1	2	3	4	5
Parameter	Vab	Vbc	Vca	VLL avg	Ia	Ib
Key	6	7	8	9	10	11
Parameter	Ic	I avg	∑kW	∑kvar	∑kVA	∑PF
Key	12	13	14	15	16	
Parameter	FREQ	∑kW Demand	∑kvar Demand	∑kVA Demand	∑PF Demand	

Table 3-6 Analog Output Parameters

Chapter 4 Applications

4.1 Inputs and Outputs

4.1.1 Digital Inputs

The PMC-660 comes standard with six self-excited Digital Inputs that are internally wetted at 24 VDC.

Digital Inputs on the PMC-660 can be used in the following applications:

1) Digital Inputs are typically used for monitoring external status which can help prevent equipment damage, improve maintenance, and track security breaches. The real-time statuses of the Digital Inputs are available on the front panel LCD Display as well as through communications. Changes in Digital Input status are stored as events in the SOE Log in 1 ms resolution.

2) Digital Inputs can be used for pulse counting to collect WAGES (Water, Air, Gas, Electricity and Steam) information. The DI Pulse Counter information is available via communications. Pulse Counters can be reset from the front panel or via communications.

   There are 3 setup parameters:
   DI Function: 0 = Digital Input; **1 = Pulse Counter**; 2 = SYNC DI; 3 = PPS
   DI Debounce: Between 0 and 1000 (ms). The default value is 20 (ms).
   DI Pulse Weight: Between 1 and 1,000,000 (x0.001). The default value is 1 (0.001).

3) One of the Digital Inputs can be programmed to receive Demand Sync Pulse. Please refer to Section 4.2.5 for a detailed description.

4) The Digital Inputs can be used as external time synchronization pulse. Please refer to Section 4.7 for a detailed description.

4.1.2 Digital Outputs

The PMC-660 comes standard with three Form A Electromechanical Digital Outputs. Digital Outputs are normally used for setpoint alarming, load control, or remote control applications.

Digital Outputs on the PMC-660 can be used in the following applications:

Front Panel Control: Manually operated from the front panel. Please refer to the **DO SET** setup parameter in Section 3.2.3 for a detailed description.

Remote Control: Remotely operated over communications via our free PMC Setup software or the PecStar® iEMS.

Control Setpoint: Control setpoints can be programmed to trigger DO, Data Recorder, Waveform Recorder or Alarm Email upon becoming active. Please refer to Section 4.3 for a detailed description.

Logical Module: Logical Module can be programmed to trigger DO, Data Recorder, or Waveform Recorder upon becoming active. Please refer to Section 4.4 for a detailed description.

Sag/Swell Setpoint: Sag/Swell setpoint can be programmed to trigger DO, Data Recorder, Waveform Recorder or Alarm Email upon becoming active. Please refer to Section 4.6.5 for a detailed description.

Transient Setpoint: Transient setpoint can be programmed to trigger DO, Data Recorder, Waveform Recorder or Alarm Email upon becoming active. Please refer to Section 4.6.6 for a detailed description.

Since there are so many ways to utilize the Digital Outputs on the PMC-660, a prioritized scheme has been developed to avoid conflicts between different applications. In general, Front Panel Control has a higher priority and can override the other applications. Remote Control, Control Setpoints, Logical Module, Sag/Swell Setpoint and Transient Setpoint share the same priority, meaning that they can all be programmed to control the same Digital Output. This scheme is equivalent to having an implicit Logical OR operation for the control of a Digital Output and may be useful in providing a generic alarm output signal. However, the sharing of a Digital Output is not recommended if the user intends to generate a control signal in response to a specific setpoint condition.

4.1.3 Energy Pulse Outputs

The PMC-660 comes standard with two front panel LED Pulse Outputs for kWh and kvarh pulsing. Energy pulsing can be enabled from the front panel through the **EN PULSE** setup parameter. Energy Pulse Outputs are typically used for accuracy testing. The pulse constant can be configured as 1000/3200/5000 imp/kxh. The pulse width is fixed at 80ms.

4.1.4 Analog Input

The PMC-660 comes optionally with an Analog Input which can be programmed as 0mA to 20mA or 4mA to 20mA input.

There are 3 setup parameters:

Type: Select between 0-20mA or 4-20mA input.

AI Zero: This value corresponds to the minimum Analog Input of 0 mA (for 0-20mA input) or 4 mA (for 4-20mA input) and has a range of -999,999 to +999,999.

AI Full: This value corresponds to the maximum Analog Input of 20 mA and has a range of -999,999 to +999,999.

For example, to measure the oil temperature of a transformer, connect the outputs of the temperature sensor to the AI terminals of the PMC-660. The temperature sensor outputs 4mA when the temperature is -25°C and 20mA when the temperature is 100°C . As such, the **Type** parameter should be programmed as **4-20mA**. The **AI FULL** parameter should be programmed with the value 100, and the **AI ZERO** parameter should be programmed with the value -25. Therefore, when the output of the sensor is 20mA, the reading will be 100.00°C. When the output is 4mA, the reading will be -25.00°C. When the output is 12mA, the reading will be (100°C - (-25°C)) x (12mA-4mA) / (20mA-4mA) + (-25°C) = 37.50°C.

4.1.5 Analog Output

The PMC-660 comes optionally with an Analog Output which can be programmed as 0mA to 20mA or 4mA to 20mA output.

There are 4 setup parameters:

Type: Select between 0-20mA or 4-20mA output.

AO Zero: Defines the zero scale value of the parameter when the Analog Output is 0 mA (for 0-20mA output) or 4 mA (for 4-20mA output). The value ranges between -999,999 to +999,999.

AO Full: Defines the full scale value of the parameter when the Analog Output is 20 mA. The value ranges between -999,999 and +999,999.

Key: Defines the parameter to which the Analog Output is proportional. The Analog Output Parameters are listed in Table 3-6.

For example, an AO of 4-20mA is required to be proportional to Phase A current. The maximum value of phase A current is 2000A, and the minimum value is 500A. As such, the **Type** parameter should be programmed as **4-20mA**. The **Key** parameter should be programmed with Ia (Phase A Current). The **AO FULL** parameter should be programmed with the value 2000. The **AO ZERO** parameter should be programmed with the value 500. Therefore, when Phase A Current is 500A or below, The AO output is 4mA. When Phase A Current is 2000A, the AO output is 20mA. When Phase A Current is 1250A, The AO is (1250A-500A) x (20mA-4mA) / (2000A-500A) + 4mA = 12.00(mA).

4.2 Power and Energy

4.2.1 Basic Measurements

The PMC-660 provides the following basic measurements with 1 second update rate:

- 3-phase voltage and current
- 3-phase power and power factor
- Neutral current (I4) and Frequency
- Bi-directional energy measurements
- Voltage and Current phase angles

4.2.2 High-speed Measurements

The PMC-660 provides the following high-speed measurements:

- 3-phase voltage with ½ cycle update rate
- 3-phase current and neutral current (I4) with 1 cycle update rate
- 3-phase power and power factor with 1 cycle update rate

4.2.3 Phase Angle

Phase analysis is used to identify the angle relationship between the three-phase voltages and currents.

For Wye connected systems, the per phase difference of the current and voltage angles should correspond to the per phase PF. For example, if the power factor is 0.5 Lag and the voltage phase angles are 0.0°, 240.0° and 120.0°, the current phase angles should have the values of -60.0°, 180.0° and 60.0°.

For Delta connected systems, the current phasors lag line-to-line voltage phasors by 30°. For example, if the total power factor for a balanced 3-phase system is 0.5 Lag and the line-to-line voltage phase angles are 0.0°, 240.0° and 120.0°, the current phase angles should have the values of -90.0°, 150.0° and 30.0°.

4.2.4 Energy

Basic energy parameters include active energy (kWh), reactive energy (kvarh) and apparent energy (kVAh) with a resolution of 0.01 and a maximum value of ±999,999,999.99. When the maximum value is reached, it will automatically roll over to zero.
The energy can be reset manually or preset to user-defined values through the front panel or via communications.

The PMC-660 provides the following energy measurements:

Active Energy	kWh Import	kWh Export	kWh Net	kWh Total
Reactive Energy	kvarh Import	kvarh Export	kvarh Net	kvarh Total
	kvar Q1	kvar Q2	kvar Q3	kvar Q4
Apparent Energy	kVAh Total			

Table 4-1 Energy Measurements

4.2.5 Demands

Demand is defined as the average power consumption over a fixed interval (usually 15 minutes). The PMC-660 supports the sliding window demand calculation and has the following setup parameters:

Demand Sync. Mode: **SLD** - Internally synchronized to the meter clock
SYNC DI - Externally synchronized to a DI that has been programmed as a Demand Sync Input by setting the **DI Function** setup parameter as "**SYNC DI**".

# of Sliding Windows: 1-15

Demand Period: 1 to 99 minutes. For example, if the # of Sliding Windows is set as 1 and the Demand Period is 15, the demand cycle will be 1×15=15min.

Predicted Response: 70 to 99. The Predicated Response shows the speed of the predicted demand output. A value between 70 and 99 is recommended for a reasonably fast response. Specify a higher value for higher sensitivity.

The PMC-660 provides the following Demand parameters:

Present Demand	Predicted Demand
Va Demand	Va Predicted Demand
Vb Demand	Vb Predicted Demand
Vc Demand	Vc Predicted Demand
VLN average Demand	VLN average Predicted Demand
Vab Demand	Vab Predicted Demand
Vbc Demand	Vbc Predicted Demand
Vca Demand	Vca Predicted Demand
VLL average Demand	VLL average Predicted Demand
Ia Demand	Ia Predicted Demand
Ib Demand	Ib Predicted Demand

Ic Demand	Ic Predicted Demand
I average Demand	I average Predicted Demand
I4 Demand	I4 Predicted Demand
kWa Demand	kWa Predicted Demand
kWb Demand	kWb Predicted Demand
kWc Demand	kWc Predicted Demand
∑kW Demand	∑kW Predicted Demand
kvara Demand	kvara Predicted Demand
kvarb Demand	kvarb Predicted Demand
kvarc Demand	kvarc Predicted Demand
∑kvar Demand	∑kvar Predicted Demand
kVAa Demand	kVAa Predicted Demand
kVAb Demand	kVAb Predicted Demand
kVAc Demand	kVAc Predicted Demand
∑kVA Demand	∑kVA Predicted Demand
P.F.a Demand	P.F.a Predicted Demand
P.F.b Demand	P.F.b Predicted Demand
P.F.c Demand	P.F.c Predicted Demand
∑P.F. Demand	∑P.F. Predicted Demand
FREQ Demand	FREQ Predicted Demand
Voltage Unbalance Demand	V Unbalance Predicted Demand
Current Unbalance Demand	I Unbalance Predicted Demand
Va THD Demand	Va THD Predicted Demand
Vb THD Demand	Vb THD Predicted Demand
Vc THD Demand	Vc THD Predicted Demand
Ia THD Demand	Ia THD Predicted Demand
Ib THD Demand	Ib THD Predicted Demand
Ic THD Demand	Ic THD Predicted Demand

Table 4-2 Demand Parameters

Note:

1) The Peak Demand of This Month can be reset manually through the front panel or via communications.

4.2.6 Max/Max per Demand Period

The PMC-660 calculated the max/min value per demand period of the following measurements:

1) 3-phase voltage and current, and Frequency
2) 3-phase current and neutral current (I4)
3) 3-phase power and power factor
4) Voltage and Current Unbalance
5) Voltage and Current THD

All Max/Min data can be accessed through communication.

4.3 Setpoints

The PMC-660 comes standard with 24 user programmable setpoints which provide extensive control by allowing a user to initiate an action in response to a specific condition. The Setpoint #1 to #16 are standard Setpoints and the Setpoint #17 to #24 are High-Speed Setpoints. Typical setpoint applications include alarming, fault detection and power quality monitoring.

The alarm symbol 🔈 at the right side of the LCD display is lit if there are any active Setpoints. The setpoints can be programmed over communications and have the following setup parameters:

Setpoint Type:

Specify the monitoring condition – Over Setpoint, Under Setpoint, or Disabled.

1) **Setpoint Parameter:**

Specify the parameter to be monitored. Table 4-3 below provides a list of Setpoint Parameters. For the Standard Setpoint, Parameters #1 to #31 are available; and for the High Speed Setpoint, Parameters #1 to #14 are available.

2) **Setpoint Active Limit** :

Specify the value that the setpoint parameter must exceed for Over Setpoint or go below for Under Setpoint for the setpoint to become active.

3) **Setpoint Inactive Limit**:

Specify the value that the setpoint parameter must go below for Over Setpoint or exceed for Under Setpoint for the setpoint to becomes inactive.

4) **Setpoint Active Delay**:

Specify the minimum duration that the setpoint condition must be met before the setpoint becomes active. An event will be generated and stored in the SOE Log. The range of the **Setpoint Active Delay** for the Standard Setpoint is between 0 and 9,999 (seconds). And the range of the **Setpoint Active Delay** for the High Speed Setpoint is between 0 and 9,999 (cycles).

5) **Setpoint Inactive Delay**:

Specify the minimum duration that the setpoint Return condition must be met before the setpoint becomes inactive. An event will be generated and stored in the SOE Log. The range of the **Setpoint Active Delay** for the Standard Setpoint is between 0 and 9,999 (seconds). And the range of the **Setpoint Active Delay** for the High Speed Setpoint is between 0 and 9,999 (cycles).

6) **Setpoint Trigger 1 and Setpoint Trigger 2**:

Specify what action the setpoint will take when it becomes active. Table 4-4 below provides a list of Setpoint Triggers.

The PMC-660 provides the following Setpoint Parameters:

Key	Parameter	Scale/Unit
1	VLN	x100, V
2	VLL	x100, V
3	I	x1000, A
4	I4	x1000, A
5	Freq Deviation	x100, Hz
6	∑kW	kW
7	∑kvar	kvar
8	P.F.	x1000
9	DI1	1) For Over Setpoint, the Active Limit is DI Close (**DI=1**), and Inactive Limit is DI Open (**DI=0**); 2) For Under Setpoint, the Active Limit is DI Open (**DI=0**), and Inactive Limit is DI Close (**DI=1**);
10	DI2	
11	DI3	
12	DI4	
13	DI5	
14	DI6	
15	AI	/
16	∑kW Demand	kW
17	∑kvar Demand	kvar
18	P.F. Demand	x1000
19	∑kW Predicted Demand	kW
20	∑kvar Predicted Demand	kvar
21	P.F. Predicted Demand	x1000
22	V THD	x100, %
23	V TOHD	x100, %
24	V TEHD	x100, %
25	I THD	x100, %
26	I TOHD	x100, %
27	I TEHD	x100, %
28	Voltage Unbalance	x10, %
29	Current Unbalance	x10, %
30	V Deviation	x100, %
31	Phase Reversal	1) For Over Setpoint, the Active Limit is negative-phase sequence, and Inactive Limit is positive phase sequence; 2) For Under Setpoint, the Active Limit is positive phase sequence, and Inactive Limit is negative-phase sequence;

Table 4-3 Setpoint Parameters

The PMC-660 provides the following Setpoint Triggers:

Key	Action	Key	Action
0	None	**12**	DR 9
1	DO1	**13**	DR 10

2	DO2	**14**	DR 11
3	DO3	**15**	DR 12
4	DR 1	**16**	DR 13
5	DR 2	**17**	DR 14
6	DR 3	**18**	DR 15
7	DR 4	**19**	DR 16
8	DR 5	**20**	WR 1
8	DR 6	**21**	WR 2
10	DR 7	**22**	Alarm Email
11	DR 8		

Table 4-4 Setpoint Triggers

4.4 Logical Module

The PMC-660 comes standard with 6 user programmable Logical Modules which perform an AND, NAND, OR or NOR logical operation. The Logical Module provides extensive control by allowing a user to initiate an action based on the combinational logic of four different Setpoint conditions

The alarm symbol at the right side of the LCD display is lit if there are any active Logical Modules. The Logical Modules can be programmed over communications and have the following setup parameters:

1) **Enable Logical Module:**

   Enable the Logical Module – Enable or Disable.

2) **Mode 1 / 2 / 3:**

   Specify the type of logical evaluation to be performed – AND, OR, NAND or NOR

3) **Source 1 / 2 / 3 / 4**:

   Specify the source input – Table 4-5 below provides a list of source inputs.

4) **Trigger 1 and Trigger 2**:

   Specify what action the Logical Module will take when it becomes active. Table 4-6 below provides a list of Logical Module Triggers.

Logical Equation= ((**Source 1** [Mode 1] **Source 2)** [Mode 2] **Source 3)** [Mode 3] **Source 4**

The PMC-660 provides the following Logical Module Sources.

Key	Source	Key	Source
1	Setpoint #1 (Standard)	**13**	Setpoint #13 (Standard)
2	Setpoint #2 (Standard)	**14**	Setpoint #14 (Standard)
3	Setpoint #3 (Standard)	**15**	Setpoint #15 (Standard)
4	Setpoint #4 (Standard)	**16**	Setpoint #16 (Standard)
5	Setpoint #5 (Standard)	**17**	Setpoint #17 (High Speed)
6	Setpoint #6 (Standard)	**18**	Setpoint #18 (High Speed)
7	Setpoint #7 (Standard)	**19**	Setpoint #19 (High Speed)

8	Setpoint #8 (Standard)	**20**	Setpoint #20 (High Speed)
9	Setpoint #9 (Standard)	**21**	Setpoint #21 (High Speed)
10	Setpoint #10 (Standard)	**22**	Setpoint #22 (High Speed)
11	Setpoint #11 (Standard)	**23**	Setpoint #23 (High Speed)
12	Setpoint #12 (Standard)	**24**	Setpoint #24 (High Speed)

Table 4-5 Logical Module Sources

The PMC-660 provides the following Logical Module Triggers:

Key	Action	Key	Action
0	None	**11**	DR 8
1	DO1	**12**	DR 9
2	DO2	**13**	DR 10
3	DO3	**14**	DR 11
4	DR 1	**15**	DR 12
5	DR 2	**16**	DR 13
6	DR 3	**17**	DR 14
7	DR 4	**18**	DR 15
8	DR 5	**19**	DR 16
8	DR 6	**20**	WR 1
10	DR 7	**21**	WR 2

Table 4-6 Logical Module Triggers

4.5 Logging

4.5.1 Peak Demand Log

The PMC-660 stores peak demand data of **This Month** and **Last Month** with timestamp for Ia, Ib, Ic, kW, kvar, and kVA. All of the peak demand data can be accessed through front panel LCD as well as communications.

The **Self-Read Time** allows the user to specify the time and day of the month for the Peak Demand Self-Read operation. At the specified time in each month, the Peak Demand register of **This Month** is transferred to the Peak Demand register of **Last Month** and then zeroed. The **Self-Read Time** supports two options:

- A zero value means that the Self-Read will take place at 00:00 of the first day of each month.
- A non-zero value means that the Self-Read will take place at a specific time and day based on the formula: Self-Read Time = Day * 100 + Hour where $0 \le \text{Hour} \le 23$ and $1 \le \text{Day} \le 28$. For example, the value 1512 means that the Self-Read will take place at 12:00pm on the 15^{th} day of each month.

The peak demand data of this month can be reset manually through the front panel or via communications.

The PMC-660 provides the following Peak Demand parameters:

Peak Demand of This Month	Peak Demand of Last Month
∑kW Peak Demand of This Month	∑kW Peak Demand of Last Month
∑kvar Peak Demand of This Month	∑kvar Peak Demand of Last Month

∑kVA Peak Demand of This Month	∑kVA Peak Demand of Last Month
Ia Peak Demand of This Month	Ia Peak Demand of Last Month
Ib Peak Demand of This Month	Ib Peak Demand of Last Month
Ic Peak Demand of This Month	Ic Peak Demand of Last Month

Table 4-7 Peak Demand Measurements

4.5.2 Max/Min Log

The PMC-660 records the minimum and maximum data of **This Month** and **Last Month** with timestamp for VLN, VLL, I, ∑kW, ∑kvar, ∑kVA, frequency, THD, K-Factor, and Unbalance. The Max/Min data is stored in the device's non-volatile memory and will not suffer any loss in the event of power failure. All of the maximum and minimum data can be accessed through communications.

The **Self-Read Time** allows the user to specify the time and day of the month for the Min/Min Self-Read operation. At the specified time in each month, the Max/Min register of **This Month** is transferred to the Max/Min register of **Last Month** and then reset. The **Self-Read Time** supports two options:

- A zero value means that the Self-Read will take place at 00:00 of the first day of each month.
- A non-zero value means that the Self-Read will take place at a specific time and day based on the formula: Self-Read Time = Day * 100 + Hour where 0 ≤ Hour ≤ 23 and 1 ≤ Day ≤ 28. For example, the value 1512 means that the Self-Read will take place at 12:00pm on the 15th day of each month.

The maximum and minimum data of this month can be reset manually from the front panel or via communications.

The PMC-660 provides the following Max/Min parameters:

Max/Min Value of This Month		Max/Min Value of Last Month	
Va max	Va min	Va max	Va min
Vb max	Vb min	Vb max	Vb min
Vc max	Vc min	Vc max	Vc min
VLN avg. max	VLN avg. min	VLN avg. max	VLN avg. min
Vab max	Vab min	Vab max	Vab min
Vbc max	Vbc min	Vbc max	Vbc min
Vca max	Vca min	Vca max	Vca min
VLL avg. max	VLL avg. min	VLL avg. max	VLL avg. min
Ia max	Ia min	Ia max	Ia min
Ib max	Ib min	Ib max	Ib min
Ic max	Ic min	Ic max	Ic min
I avg. max	I avg. min	I avg. max	I avg. min
I4 max	I4 min	I4 max	I4 min
∑kW max	∑kW min	∑kW max	∑kW min
∑kvar max	∑kvar min	∑kvar max	∑kvar min
∑kVA max	∑kVA min	∑kVA max	∑kVA min
∑P.F. max	∑P.F. min	∑P.F. max	∑P.F. min
FREQ max	FREQ min	FREQ max	FREQ min

Va THD max	Va THD min	Va THD max	Va THD min
Vb THD max	Vb THD min	Vb THD max	Vb THD min
Vc THD max	Vc THD min	Vc THD max	Vc THD min
Ia THD max	Ia THD min	Ia THD max	Ia THD min
Ib THD max	Ib THD min	Ib THD max	Ib THD min
Ic THD max	Ic THD min	Ic THD max	Ic THD min
Ia K-Factor max	Ia K-Factor min	Ia K-Factor max	Ia K-Factor min
Ib K-Factor max	Ib K-Factor min	Ib K-Factor max	Ib K-Factor min
Ic K-Factor max	Ic K-Factor min	Ic K-Factor max	Ic K-Factor min
Voltage Unbalance max	Voltage Unbalance min	Voltage Unbalance max	Voltage Unbalance min
Current Unbalance max	Current Unbalance min	Current Unbalance max	Current Unbalance min

Table 4-8 Max/Min Measurements

4.5.3 Data Recorder (DR) Log

The PMC-660 comes equipped with 4MB of memory and provides 4 High-Speed Data Recorders (**HS DR**) and 12 Standard Data Recorders (**DR**) capable of recording 16 parameters each. The recorded data is stored in the device's non-volatile memory and will not suffer any loss in the event of power failure.

The programming of the Data Recorder is only supported over communications. Each Data Recorder provides the following setup parameters:

1) **Triggered Mode:** 0=Disabled / 1=Triggered by Timer / 2=Triggered by Setpoint
2) **Recording Mode**: 0=Stop-When-Full / 1= First-In-First-Out for Standard DR
   1=Stop-When-Full for HS DR
3) **Recording Depth**: 0 to 65535 (entry)
4) **Recording Interval**: 0 to 3456000 seconds for Standard Data Recorder
   0 to 60 cycles for High-Speed Data Recorder
5) **Recording Offset:** 0 to 43200 seconds
6) **Number of Parameters**: 0 to 16
7) **Parameter 1 to 16**: 0 to 328 for Standard Data Recorder
   0 to 28 for High-Speed Data Recorder
   Please see refer to **Appendix A** for more information.

The Data Recorder Log is only operational when the values of **Triggered Mode**, **Recording Mode**, **Recording Depth**, **Recording Interval**, and **Number of Parameters** are all non-zero.

Data Recorder #X can be triggered by clearing the Data Recorder #X when it is full in Stop-When-Full mode (See Section 5.2.2).

For Standard Data Recorder, the **Recording Offset** parameter can be used to delay the recording by a fixed time from the **Recording Interval**. For example, if the **Recording Interval** parameter is set to 3600 (hourly) and the **Recording Offset** parameter is set to 300 (5 minutes), the recording will take place at 5 minutes after the hour every hour, i.e. 00:05, 01:05, 02:05…etc. The programmed value of the **Recording Offset** parameter should be less than that of the **Recording Interval** parameter.

For High-speed Data Recorder, the **Recording Offset** parameter can be used to delay starting the recording by a fixed time. For example, if the **Recording Offset** parameter is set to 300 (5 minutes), the recording will take place at 5 minutes after the High-speed Data Recorder is enabled. For Data Recorder triggered by Setpoint, **Recording Offset** is ignored.

4.5.4 Energy Log

The PMC-660 provides an Energy Log capable of recording the interval energy consumption for kWh/kvarh Import/Export and kVAh. If the users wish to record the accumulative energy values instead of the interval energy consumption, the Data Recorder function should be used in the PMC-660. The recorded data is stored in the device's non-volatile memory and will not suffer any loss in the event of power failure.

The programming of the Energy Log is only supported over communications. Energy Log provides the following setup parameters:

1) **Recording Mode**: 0=Disabled / 1=Stop-When-Full / 2=First-In-First-Out
2) **Recording Depth**: 0 to 65535 (entry)
3) **Recording Interval**: 0=5mins / 1=10mins / 2=15mins / 3=30mins / 4=60mins
4) **Start Time:** 20YY/MM/DD, HH:MM:SS
5) **Number of Parameters**: 0 to 5
6) **Parameter 1 to 5**: 0 to 4

The Data Recorder Log is only operational when the values of **Recording Mode**, **Recording Depth**, **Recording Interval**, **Start Time** and **Number of Parameters** are all non-zero.

When the current time meets the "**Start Time**", the Energy Log will start to record

The PMC-660 Energy Log can record the following parameters:

Parameters	kWh Import	kWh Export	kvarh Import	kvarh Export	kVAh

Table 4-9 Energy Log Parameters

4.5.5 Waveform Recorder Log

The PMC-660 provides 2 independent groups of waveform recorders (**WFR**) with a combined total of 32 entries. Each Waveform Recorder Log can simultaneously capture 3-phase voltage and current signals at a maximum resolution of 256 samples per cycles. Waveform Recorder on the PMC-660 can be triggered by Setpoints, Sag/Swell, Transient or manually through communications. The manual trigger command has a higher priority. When Waveform Recorder is already in progress, other Waveform Recorder commands will be ignored until the current recording has completed. The Waveform Recorder Log has a capacity of 32 entries organized in a first-in-first-out basis, with the newest waveform log replacing the oldest one. The waveform data is stored in the device's non-volatile memory and will not suffer any loss in the event of power failure.

The programming of the Waveform Recorder Log is only supported over communications. Waveform Recorder Log provides the following setup parameters:

1) **Recording Depth**: 0 to 32 (entry)
2) **# of Samples**: 16 / 32 / 64 / 128 / 256 (samples)
3) **Number of Cycle:** 320 / 160 / 80 / 40 / 20 (cycles)
4) **Pre-fault Cycle**: 0 to 10 (cycles)

The total capacity of WFR 1 and WFR 2 is 32. The valid formats (# of samples/cycle x # of cycles) of WFR include 16x320, 32x160, 64x80, 128x40 and 256x20. When the WFR format is 256 samples/cycles, the "**Pre-fault Cycle**" can only be set between 0 and 5.

All waveform recorder logs can be retrieved via communications by our PecStar® iEMS or our free PMC Setup Software for display.

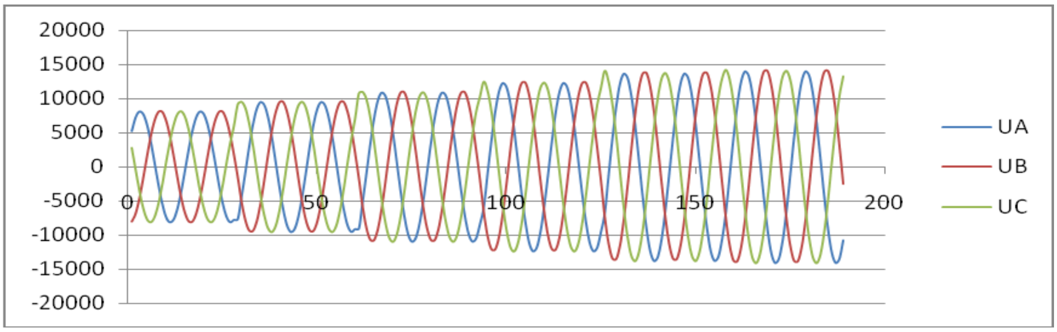


Figure 4-1 Waveform Recording displayed in PecStar®

4.5.6 PQ Log

The PMC-660's PQ Log can store up to 1000 PQ events such as sag/swell and transient. Each event record includes the event classification, its relevant voltage values and a timestamp in 1ms resolution.

All events can be retrieved via communications for display. If there are more than 1000 events, the newest event will replace the oldest event on a first-in-first-out basis. The PQ Log can be reset from the front panel or via communications.

4.5.7 SOE Log

The PMC-660's SOE Log can store up to 512 events such as power-on, power-off, setpoint actions, relay actions, Digital Input status changes and setup changes in its non-volatile memory. Each event record includes the event classification, its relevant parameter values and a timestamp in 1ms resolution.

All events can be retrieved via communications for display. If there are more than 512 events, the newest event will replace the oldest event on a first-in-first-out basis. The SOE Log can be reset from the front panel or via communications.

4.6 Power Quality

4.6.1 Fundamental

The PMC-660 provides the following fundamental components (Displacement RMS values):

Fundamental Components			
dVa	dVb	dVc	dVLN average
dVab	dVbc	dVca	dVLL average
dIa	dIb	dIc	dI average
dkWa	dkWb	dkWc	d∑kW
dkvara	dkvarb	dkvarc	d∑kvar
dkVAa	dkVAb	dkVAc	d∑kVA
dP.F.a	dP.F.b	dP.F.c	d∑P.F.
dI4			

Table 4-10 Fundamental Components

4.6.2 Harmonics

The PMC-660 provides on-board harmonics analysis for THD, TOHD, TEHD, K-factor and Individual Harmonics up to the 63rd order. All harmonics parameters are available through communications, and individual harmonics from 2nd to 31st are available through the front panel LCD display.

There are two ways to calculate the individual harmonic distortion:

% of Fundamental Method:

Voltage K^{th} Harmonic Distortion= $\frac{U_k}{U_1} X100\%$, U_1 is Fundamental Voltage

Current K^{th} Harmonic Distortion= $\frac{I_k}{I_1} X100\%$, I_1 is Fundamental Current

% of RMS Method:

Voltage K^{th} Harmonic Distortion= $\frac{U_k}{\sqrt{\sum_{K=1}^{\infty} U_K^2}} X100\%$

Current K^{th} Harmonic Distortion= $\frac{I_k}{\sqrt{\sum_{K=1}^{\infty} I_K^2}} X100\%$

The PMC-660 provides the following Harmonic measurements:

<table>
<tr><th></th><th>Phase A</th><th>Phase B</th><th>Phase C</th></tr>
<tr><td rowspan="6">Harmonics-Voltage</td><td>THD</td><td>THD</td><td>THD</td></tr>
<tr><td>TEHD</td><td>TEHD</td><td>TEHD</td></tr>
<tr><td>TOHD</td><td>TOHD</td><td>TOHD</td></tr>
<tr><td>2nd Harmonics</td><td>2nd Harmonics</td><td>2nd Harmonics of</td></tr>
<tr><td colspan="3">……</td></tr>
<tr><td>63rd Harmonics</td><td>63rd Harmonics</td><td>63rd Harmonics</td></tr>
<tr><td rowspan="7">Harmonics-Current</td><td>THD</td><td>THD</td><td>THD</td></tr>
<tr><td>TEHD</td><td>TEHD</td><td>TEHD</td></tr>
<tr><td>TOHD</td><td>TOHD</td><td>TOHD</td></tr>
<tr><td>K-Factor</td><td>K-Factor</td><td>K-Factor</td></tr>
<tr><td>2nd Harmonics</td><td>2nd Harmonics</td><td>2nd Harmonics</td></tr>
<tr><td colspan="3">……</td></tr>
<tr><td>63rd Harmonics</td><td>63rd Harmonics</td><td>63rd Harmonics</td></tr>
</table>

Table 4-11 Harmonics Measurements

The calculation method of K-Factor is listed below:

$$K-Factor = \frac{\sum_{h=1}^{h=h_{max}} (I_h h)^2}{\sum_{h=1}^{h=h_{max}} (I_h)^2}$$

I_h = RMS current at the h_{th} harmonic

h_{max} = the highest harmonic order number

h = the harmonic order number

4.6.3 Unbalance

The PMC-660 can measure Voltage and Current Unbalances. The calculation method of Voltage and Current Unbalances is listed below:

$$\text{Voltage Unblance} = \frac{V_2}{V_1} \times 100\%,$$

where V_1 is Positive Sequence Voltage and V_2 is Negative Sequence Voltage

$$\text{Current Unblance} = \frac{I_2}{I_1} \times 100\%$$

where I_1 is Positive Sequence Current and I_2 is Negative Sequence Current

4.6.4 Deviation

The PMC-660 can measure Va/Vb/Vc Deviation and Frequency Deviation. The calculation method of Voltage and Frequency Deviation is listed below:

$$\text{Voltage Deviation} = \frac{V - V_{nominal}}{V_{nominal}} \times 100\%,$$

, where $V_{nominal}$ is the Secondary Nominal Voltage

$$\text{Frequency Deviation} = \frac{f - f_{nominal}}{f_{nominal}} \times 100\%$$

, where $f_{nominal}$ is the nominal frequency

4.6.5 Sag/Swell Setpoint

The PMC-660 provides Sag/Swell Detection for the supply voltage quality monitoring. The programming of the Sag/Swell setpoint is only supported over communications. The Sag/Swell setpoint provides the following setup parameters:

1) **Sag/Swell Enable**: Disabled / Enable
2) **Swell Limit**: $1.05xV_{nominal}$ to $2.00xV_{nominal}$
3) **Sag Limit**: $0.1xV_{nominal}$ to $0.95xV_{nominal}$
4) **Sag/Swell Trigger 1 / 2:** DO1 to DO3 / DR1 to DR 16 / WR 1 to WR 2 / Alarm Email

4.6.6 Transient Setpoint

The PMC-660 provides Transient Capture capability for detecting voltage disturbances. The programming of the Transient setpoint is only supported over communications. The Transient setpoint provides the following setup parameters:

1) **Transient Enable**: Disabled / Enable
2) **Transient Limit**: $0.05xV_{nominal}$ to $1.00xV_{nominal}$
3) **Transient Trigger 1/2:** DO1 to DO3 / DR1 to DR 16 / WR 1 to WR 2 / Alarm Email

4.7 Time Synchronization

The PMC-660 provides timestamps for all recorded data, so the clock needs to be configured properly to achieve precise events and power quality analysis.

The PMC-660 comes with a 6ppm, battery-backed real-time clock that has a maximum error of 0.5s per day. If the supply power is lost or removed, the internal battery keeps the real-time clock running until power is restored.

There are several methods to synchronize the PMC-660's clock:

1) **PMC Setup** can be used to manually set the time of an individual meter through the "Set Time" function on the Manual Operate page using the computer's clock as the clock source.

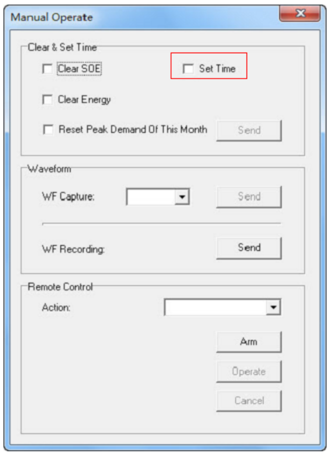


Figure 4-2 Set Time via PMC Setup

2) **PecStar®** iEMS can be configured to provide regular time synchronization by broadcasting time-sync packets over the connected medium, whether it be RS485 or Ethernet. The default time synchronization interval of is 60 minutes.

3) **SNTP server** can be used to synchronize the PMC-660's clock through its optional Ethernet port providing that the network where the PMC-660 is connected to the Internet. The programming of the SNTP server is only supported over communications. The SNTP server provides the following setup parameters:

Setup Parameters	Option
SNTP Enable	Disabled*/Enable
Time Zone	GMT-12:00 / GMT-11:00 / GMT-10:00 / GMT-9:00 / GMT-8:00 / GMT-7:00 / GMT-6:00 / GMT-5:00 / GMT-4:00 / GMT-3:30 / GMT-3:00 / GMT-2:00 / GMT-1:00 / GMT-0:00 / GMT+1:00 / GMT+2:00 / GMT+3:00 / GMT+3:30 / GMT+4:00 / GMT+4:30/ GMT+5:00 / GMT+5:30 / GMT+5:45 / GMT+6:00 / GMT+6:30 / GMT+7:00 / GMT+8:00*/ GMT+9:00 / GMT+9:30 / GMT+10:00 / GMT+11:00 / GMT+12:00 / GMT+13:00
Sync. Interval	10* to 1440 minutes
IP Address of Time Server	Set the IP address of your Time Server

*Default

Table 4-12 SNTP Setup Parameters

4) Further, A GPS that has a 1 PPS output can be used to synchronize the millisecond clock through one of PMC-660's **Digital Inputs**. The programming of the DI is only supported over communications. The PMC-660 provides the following setup parameters (please refer to Modbus registers 6025 to 6047 in Section 5.2.1 for a complete description of these DI Setup registers):

Setup Parameters	Recommended Settings
DI Function	0 = Digital Input; 1 = Pulse Counter; 2 = SYNC DI; **3 = PPS**
DI Debounce	0 and 1000 (ms); Default = 20 (ms);
DI Pulse Weight	1 and 1000000 (x0.001); Default = 1 (0.001);

Table 4-13 DI Setup Parameters

Please also refer to Figure 2-13 for the time synchronization wiring diagram.

4.8 On-board Web Server

The PMC-660's optional Ethernet port comes with an on-board web server which provides quick and easy access to the basic measurements and device information via a web browser like Microsoft's Internet Explorer. The PMC-660 currently comes with only one web page as displayed in Figure 4-3. The PMC-660's web server supports simultaneous access from two different computers.

Viewing PMC-660's on-board Web Page:

1) Make sure the Ethernet settings of your computer and the PMC-660 are in the same subnet.

2) Enter the IP Address of the PMC-660 in the Address input box of the Internet Explorer and then press <Enter>.

3) The PMC-660's web page appears as follows.

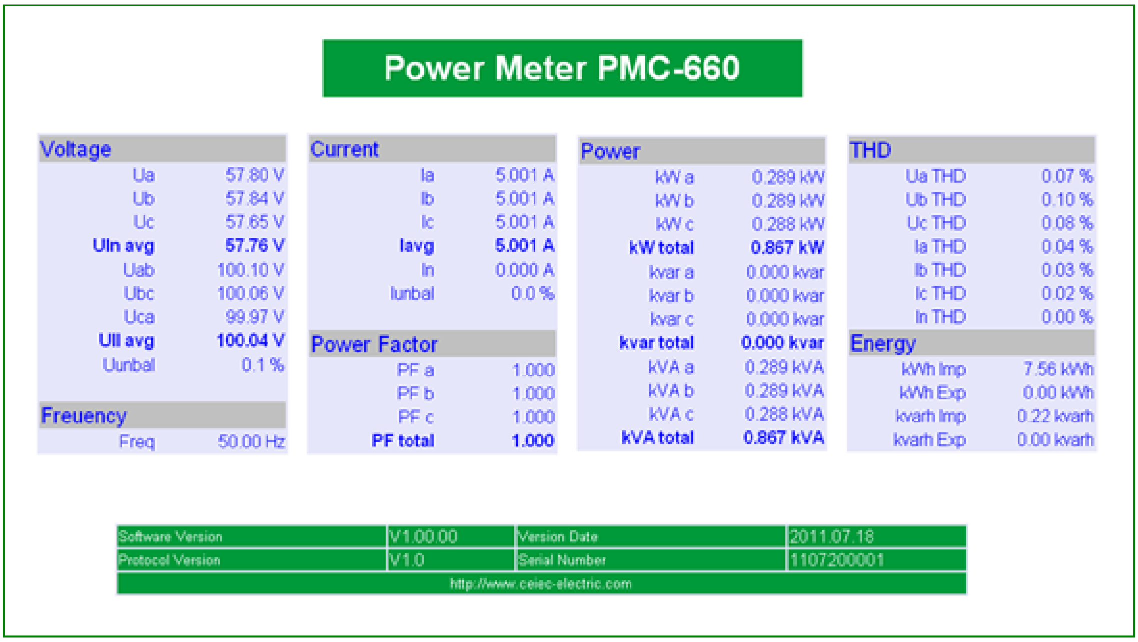


Figure 4-3 PMC-660's Web Page

4.9 Meter Email

The PMC-660 supports the SMTP and ESMTP protocols and can be configured to send alarm messages via email. The alarm massage includes events of Setpoints, Sag/Swell and Transient.

The email shows the following information in text format:

1) PMC-660's serial number
2) Event description
3) Event time stamp

The programming of the Email is only supported over communications. The PMC-660 provides the following setup parameters:

Setup Parameters	Option
SMTP TCP Port	0 to 65535 (Default=25)
SMTP Server IP Address	IP Address of the SMTP Server
Source Email Address	Source email address that appears in the "From" field of the email. This string may be up to 35 characters long.
Logon Password	Set the logon password to send an email using the Source Email account. This string may be up to 19 characters long.
Destination Email Address	Destination email address that appears in the "To" field of the email. This string may be up to 35 characters long.
Test Email	Sends a "test email" to the destination email address.

Table 4-14 Email Setup Parameters

4.10 Ethernet Gateway

The PMC-660's optional Ethernet port and its RS485 port together can be used as an Ethernet Gateway to allow communications between a Master on the Ethernet network to a network of serial devices connected to the PMC-660's RS485 port as shown in Figure 4-4 below.

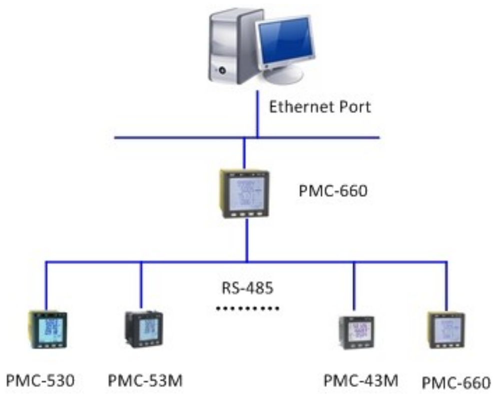


Figure 4-4 Topological Graph

To use the PMC-660 as an Ethernet Gateway, the following parameters should be configured via its Front Panel:

1) Set the IP address, Subnet Mask and Gateway Address

2) Set the Protocol of the RS485 Port as **EGATE**
3) Use 6000 as the IP Port No. to connect to PMC-660's Ethernet Gateway with your software
4) Please refer to Section 3.2.3 for more information

For detailed information on how to use the Ethernet Gateway feature, please also refer to PMC Setup's User Manual.

Chapter 5 Modbus Register Map

This chapter provides a complete description of the Modbus register map (**Protocol Versions 1.1** and above) for the PMC-660 Power Quality Monitor to facilitate the development of 3rd party communications driver for accessing information on the PMC-660.

The PMC-660 supports the following Modbus functions:

1) Read Holding Registers (Function Code 0x03)
2) Force Single Coil (Function Code 0x05)
3) Preset Multiple Registers (Function Code 0x10)
4) Read General Reference (Function Code 0x14)

For a complete Modbus Protocol Specification, please visit http://www.modbus.org.

Read General Reference Packet Structure (Function Code 0x14)

Read Reference Request Packet (Master Station to PMC-660)	
Slave Address	1 Byte
Function Code (0x14)	1 Byte
Byte Count	1 Byte
Sub-Req X, Reference Type (0x06)	1 Byte
Sub-Req X, File Number	2 Bytes
Sub-Req X, Start Address	2 Bytes
Sub-Req X, Register Count	2 Bytes
Sub-Req X+1……	
Error Check (CRC)	2 Byte

Read Reference Response Packet (PMC-660 to Master Station)	
Salve Address	1 Byte
Function Code (0x14)	1 Byte
Byte Count	1 Byte (NxN_0+2)
Sub-Res X, Byte Count	1 Byte (NxN_0+1)
Sub-Res X, Reference Type (0x06)	1 Byte
Sub-Res X, Register Data	NxN_0 Bytes
Sub-Res X+1……	
Error Check (CRC)	2 Bytes

Notes:

1) Modbus function code 0x14 is used to access the Data Recorder Log, Energy Log, PQ Log and Waveform Recorder Log.

2) Start Address = [**Log #X Pointer** / **Log #X Depth**].

3) In the Request Packet, the **File Number** parameter is used to reference which log to read:
   a) For Data Recorder Logs 1 to 16, **File Number** = 1 to 16
   b) For Energy Log, **File Number** = 17
   c) For PQ Log, **File Number** = 18
   d) For Waveform Recorder Log, **File Number** = 19 to 50

4) In the Response Packet, **N** represents the number of logs returned, and $\mathbf{N_0}$ is the length of a single log:
   a) For Data Recorder, $\mathbf{N_0}$ = n*4+8 where n is the number of parameters for a particular Data Recorder
   b) For Energy Log, $\mathbf{N_0}$ = n*4+8 where n is the number of parameters for the Energy Log
   c) For PQ Log, $\mathbf{N_0}$ = 16
   d) For Waveform Recorder Log, $\mathbf{N_0}$ = 2

5.1 Data Register

5.1.1 Basic Measurements

Register	Property	Description	Format	Scale/Unit
0000	RO	Va[1]	Float	V
0002	RO	Vb[1]	Float	V
0004	RO	Vc[1]	Float	V
0006	RO	VLN average[1]	Float	V
0008	RO	Vab	Float	V
0010	RO	Vbc	Float	V
0012	RO	Vca	Float	V
0014	RO	VLL average	Float	V
0016	RO	Ia	Float	A
0018	RO	Ib	Float	A
0020	RO	Ic	Float	A
0022	RO	I average	Float	A
0024	RO	kWa[1]	Float	W
0026	RO	kWb[1]	Float	W
0028	RO	kWc[1]	Float	W
0030	RO	∑kW	Float	W
0032	RO	kvara[1]	Float	var
0034	RO	kvarb[1]	Float	var
0036	RO	kvarc[1]	Float	var
0038	RO	∑kvar	Float	var
0040	RO	kVAa[1]	Float	VA
0042	RO	kVAb[1]	Float	VA
0044	RO	kVAc[1]	Float	VA
0046	RO	∑kVA	Float	VA
0048	RO	P.F.a[1]	Float	-
0050	RO	P.F.b[1]	Float	-
0052	RO	P.F.c[1]	Float	-
0054	RO	∑P.F.	Float	-
0056	RO	FREQ	Float	Hz
0058	RO	I4 Measured	Float	A
0060	RO	I0 (I4 Calculated)[#]	Float	A
0062 - 0069		Reserved		
0070	RO	Voltage Unbalance	UINT16	×1000
0071	RO	Current Unbalance	UINT16	×1000
0072	RO	Va Deviation	INT16	x10000
0073	RO	Vb Deviation	INT16	x10000
0074	RO	Vc Deviation	INT16	x10000
0075	RO	FREQ Deviation	INT16	x10000

0076	RO	Va Angle	UINT16	x 100, °
0077	RO	Vb Angle	UINT16	x 100, °
0078	RO	Vc Angle	UINT16	x 100, °
0079	RO	Ia Angle	UINT16	x 100, °
0080	RO	Ib Angle	UINT16	x 100, °
0081	RO	Ic Angle	UINT16	x 100, °
0082	RO	AI	Float	
0084	RO	AO	UINT16	x 100, mA[2]
0085	RO	DI Status [3]	UINT16	
0086	RO	DO Status [4]	UINT16	
0087	RO	Alarm [5]	UINT32	
0089	RO	SOE Pointer [6]	UINT32	
0091	RO	PQ Log Pointer [7]	UINT32	
0093	RO	WFR Log #1 Pointer[8]	UINT32	
0095	RO	WFR Log #2 Pointer [8]	UINT32	
0097	RO	Energy Log Pointer[9]	UINT32	
0099	RO	DR #1 Pointer (HS)[10]	UINT32	
0101	RO	DR #2 Pointer (HS)[10]	UINT32	
0103	RO	DR #3 Pointer (HS)[10]	UINT32	
0105	RO	DR #4 Pointer (HS)[10]	UINT32	
0107	RO	DR #5 Pointer (Standard) [10]	UINT32	
……		……		
0129	RO	DR #16 Pointer (Standard)[10]	UINT32	
0131	RO	Total Memory Size[11]	UINT32	kB
0133	RO	Available Memory[11]	UINT32	kB

[#] Available in firmware version V1.00.04 or later

Table 5-1 Basic Measurements

Notes:

1) When the **Wiring Mode** is Delta, the per phase line-to-neutral voltages, kWs, kvars, kVAs and PFs have no meaning, and their registers are reserved.

2) "×100, mA" indicates the value returned in the register is 100 times the actual engineering value with the unit mA. For example, if a register contains a value 505, the actual value is 505/100=5.05mA.

3) For the **DI Status** register, the bit values of B0 to B5 represent the states of DI1 to DI6, respectively, with "1" meaning active (closed) and "0" meaning inactive (open).

4) For the **DO Status** register, the bit values of B0 to B2 represent the states of DO1 to DO3, respectively, with "1" meaning active (closed) and "0" meaning inactive (open).

5) The Alarm register indicates the various alarm states with a bit value of 1 meaning active and 0 meaning inactive. The following table illustrates the details of the Alarm register.

Bit	Alarm Event	Bit	Alarm Event
B0	Setpoint #1 (Standard)	B16	Setpoint #17 (High-Speed)

B1	Setpoint #2 (Standard)	B17	Setpoint #18 (High-Speed)
B2	Setpoint #3 (Standard)	B18	Setpoint #19 (High-Speed)
B3	Setpoint #4 (Standard)	B19	Setpoint #20 (High-Speed)
B4	Setpoint #5 (Standard)	B20	Setpoint #21 (High-Speed)
B5	Setpoint #6 (Standard)	B21	Setpoint #22 (High-Speed)
B6	Setpoint #7 (Standard)	B22	Setpoint #23 (High-Speed)
B7	Setpoint #8 (Standard)	B23	Setpoint #24 (High-Speed)
B8	Setpoint #9 (Standard)	B24	Logical Module #1
B9	Setpoint #10 (Standard)	B25	Logical Module #2
B10	Setpoint #11 (Standard)	B26	Logical Module #3
B11	Setpoint #12 (Standard)	B27	Logical Module #4
B12	Setpoint #13 (Standard)	B28	Logical Module #5
B13	Setpoint #14 (Standard)	B29	Logical Module #6
B14	Setpoint #15 (Standard)	B30	Reserved
B15	Setpoint #16 (Standard)	B31	Reserved

Table 5-2 Alarm Register (0087)

6) The range of the **SOE Pointer** is between 0 and 0xFFFFFFFF. The **SOE Pointer** is incremented by one for every event generated and will roll over to 0 if its current value is 0xFFFFFFFF. Since the **SOE Pointer** is a 32-bit value and the SOE Log capacity is relatively small with only 512 events in the PMC-660, an assumption has been made that the **SOE Pointer** will never roll over. If a **CLR SOE** is performed from the front panel or via communications, the **SOE Pointer** will be reset to zero and then immediately incremented by one with a new "Clear SOE via Front Panel" or "Clear SOE via Communications" event. Therefore, any 3rd party software should assume that a **CLR SOE** action has been performed if it sees the **SOE Pointer** rolling over to one or to a value that is smaller than its own pointer. In this case, the new **SOE Pointer** also indicates the number of events in the SOE Log if it is less than 512. Otherwise, there will always be 512 events in the SOE Log.

7) The range of the **PQ Log Pointer** is between 0 and 0xFFFFFFFF. The **PQ Log Pointer** is incremented by one for every PQ log generated and will roll over to 0 if its current value is 0xFFFFFFFF. Since the **PQ Log Pointer** is a 32-bit value and the PQ Log capacity is relatively small with only 1000 PQ Logs in the PMC-660, an assumption has been made that the **PQ Log pointer** will never roll over. If a **CLR PQ** is performed from the front panel or via communications, the **PQ Log Pointer** will be reset to zero. Therefore, any 3rd party software should assume that a **CLR PQ** action has been performed if it sees the **PQ Log Pointer** rolling over to zero or to a value that is smaller than its own pointer. In this case, the new **PQ Log Pointer** also indicates the number of logs in the PQ Log if it is less than 1000. Otherwise, there will always be 1000 logs in the PQ Log.

8) The PMC-660 has two Waveform Recorders (**WFR #1 and WFR #2**). Each **WFR** has a Pointer that indicates its current logging position. The range of the **WFR Pointer** is between 0 and 0xFFFFFFFF. The **WFR Pointer** is incremented by one for every WFR log generated and will roll over to 0 if its current value is 0xFFFFFFFF. A value of zero indicates that the device does not contain any WFR Log. The total depth of **WFR #1** and **WFR #2** is

32 records. Since the **WFR Pointers** are 32-bit values, an assumption has been made that these pointers will never roll over. If a **Clear WFR** is performed via communications, the **WFR Pointers** will be reset to zero.

To determine the latest WFR log location:
WFR #1 latest log location = Modulo [**WFR #1 Pointer**/ **WFR #1 Depth**]
WFR #2 latest log location = Modulo [**WFR #2 Pointer**/ **WFR #2 Depth**]

9) The range of the **Energy Log Pointer** is between 0 and 0xFFFFFFFF. The pointers point to the current logging position and are incremented by one for every new record generated and will roll over to 0 if its current value is 0xFFFFFFFF. A value of zero indicates that the device does not contain any Energy Log. If a **Clear Energy Log** is performed via communications, the **Energy Log Pointer** will be reset to zero.

   To determine the latest Energy Log location:
   Energy Log latest log location = Modulo [**Energy Log Pointer**/ **Energy Log Depth**]

10) The PMC-660 has sixteen Data Recorders (**DR #1 / 2 /… / 16**). Each **DR** has a Pointer that indicates its current logging position. The range of the **DR Pointer** is between 0 and 0xFFFFFFFF. The **DR Pointer** is incremented by one for every DR log generated and will roll over to 0 if its current value is 0xFFFFFFFF. A value of zero indicates that the device does not contain any DR Log. If a **Clear DR** is performed via communications, the **DR Pointer** will be reset to zero.

    To determine the latest DR #X log location (X=1 to 16):
    DR #X latest log location = Modulo [**DR #X Pointer**/ **DR #X Depth**]

11) The Total Memory Size of the PMC-660 is 4MB (4096kB). **Used Memory** = 3936kB **-** Available Memory.

5.1.2 Energy Measurements

The Energy registers have a maximum value of 999,999,999 and will roll over to zero automatically when it is reached. The PMC-660 also provides energy measurements in fractional values if they are required. Using the "Fractional" registers, having units such as W·sec, var·sec and VA·sec, the user can obtain decimal resolution for achieving higher accuracy. For example, if the value of the kWh fractional register is 3200000 W ·sec, the decimal value is 3200000/3600000=0.8889kWh. If the higher resolution is not required, it is not necessary to read the fractional energy registers.

Register	Property	Description	Format	Unit
0200	RW	kWh Import	UINT32	kWh
0202	RW	kWh Export	UINT32	kWh
0204	RO	kWh Net	INT32	kWh
0206	RO	kWh Total	UINT32	kWh
0208	RW	kvarh Import	UINT32	kvarh
0210	RW	kvarh Export	UINT32	kvarh
0212	RO	kvarh Net	INT32	kvarh
0214	RO	kvarh Total	UINT32	kvarh

0216	RW	kVAh	UINT32	kVAh
0218	RW	kvarh Q1	UINT32	kvarh
0220	RW	kvarh Q2	UINT32	kvarh
0222	RW	kvarh Q3	UINT32	kvarh
0224	RW	kvarh Q4	UINT32	kvarh
0226	RO	kWh Import Fractional	Float	W ·sec
0228	RO	kWh Export Fractional	Float	W ·sec
0230	RO	kWh Net Fractional	Float	W ·sec
0232	RO	kWh Total Fractional	Float	W ·sec
0234	RO	kvarh Import Fractional	Float	var ·sec
0236	RO	kvarh Export Fractional	Float	var ·sec
0238	RO	kvarh Net Fractional	Float	var ·sec
0240	RO	kvarh Total Fractional	Float	var ·sec
0242	RO	kVAh Fractional	Float	VA ·sec
0244	RO	kvarh Q1 Fractional	Float	var ·sec
0246	RO	kvarh Q2 Fractional	Float	var ·sec
0248	RO	kvarh Q3 Fractional	Float	var ·sec
0250	RO	kvarh Q4 Fractional	Float	var ·sec

Table 5-3 Energy Measurements

5.1.3 Pulse Counter

The Pulse Counter data returned is 1000 times the actual value. For example, if the register contains a value of 1234567, the actual counter value is 1234.567.

Register	Property	Description	Format
0350	RW	Counter #1 (DI1)	UINT32
0352	RW	Counter #2 (DI2)	UINT32
0354	RW	Counter #3 (DI3)	UINT32
0356	RW	Counter #4 (DI4)	UINT32
0358	RW	Counter #5 (DI5)	UINT32
0360	RW	Counter #6 (DI6)	UINT32

Table 5-4 Pulse Counter

5.1.4 Fundamental measurements

Register	Property	Description	Format	Unit
0400	RO	dVa[1]	Float	V
0402	RO	dVb[1]	Float	V
0404	RO	dVc[1]	Float	V
0406	RO	dVLN average[1]	Float	V
0408	RO	dVab[2]	Float	V
0410	RO	dVbc[2]	Float	V
0412	RO	dVca[2]	Float	V
0414	RO	dVLL average[2]	Float	V

0416	RO	dIa	Float	A
0418	RO	dIb	Float	A
0420	RO	dIc	Float	A
0422	RO	dI average	Float	A
0424	RO	dI4[3]	Float	A
0426	RO	dkWa[1]	Float	W
0428	RO	dkWb[1]	Float	W
0430	RO	dkWc[1]	Float	W
0432	RO	d∑kW	Float	W
0434	RO	dkvara[1]	Float	var
0436	RO	dkvarb[1]	Float	var
0438	RO	dkvarc[1]	Float	var
0440	RO	d∑kvar	Float	var
0442	RO	dkVAa[1]	Float	VA
0444	RO	dkVAb[1]	Float	VA
0446	RO	dkVAc[1]	Float	VA
0448	RO	d∑kVA	Float	VA
0450	RO	dP.F.a[1]	Float	
0452	RO	dP.F.b[1]	Float	
0454	RO	dP.F.c[1]	Float	
0456	RO	d∑P.F.	Float	

Table 5-5 Fundamental measurements

Notes:

1) When the **Wiring Mode** is Delta, the fundamental components of per phase line-to-neutral voltages, kWs, kvars, kVAs and PFs have no meaning, and their registers are reserved.

2) When the **Wiring Mode** is Wye, the fundamental components of line-to-line voltages have no meaning, and their registers are reserved.

3) Register 0424 is valid only if the device is equipped with the Zero-sequence Current Input. Otherwise, it is reserved.

5.1.5 Harmonic Measurements

The Harmonics data (Individual Harmonics, THD, TOHD and TEHD) returned is 10000 times the actual value. For example, if the register contains a value of 1031, the actual harmonic value is 0.1031 or 10.31%. The K Factor data is returned is 10 times the actual value.

Register	Property	Description	Format	Scale/Unit
0458	RO	Ia K Factor	UINT16	×10
0459	RO	Ib K Factor	UINT16	×10
0460	RO	Ic K Factor	UINT16	×10
0461	RO	Va THD	UINT16	×10000
0462	RO	Vb THD	UINT16	×10000
0463	RO	Vc THD	UINT16	×10000

0464	RO	Ia THD	UINT16	×10000
0465	RO	Ib THD	UINT16	×10000
0466	RO	Ic THD	UINT16	×10000
0467	RO	I4 THD[1]	UINT16	×10000
0468	RO	Va TOHD	UINT16	×10000
0469	RO	Vb TOHD	UINT16	×10000
0470	RO	Vc TOHD	UINT16	×10000
0471	RO	Ia TOHD	UINT16	×10000
0472	RO	Ib TOHD	UINT16	×10000
0473	RO	Ic TOHD	UINT16	×10000
0474	RO	I4 TOHD[1]	UINT16	×10000
0475	RO	Va TEHD	UINT16	×10000
0476	RO	Vb TEHD	UINT16	×10000
0477	RO	Vc TEHD	UINT16	×10000
0478	RO	Ia TEHD	UINT16	×10000
0479	RO	Ib TEHD	UINT16	×10000
0480	RO	Ic TEHD	UINT16	×10000
0481	RO	I4 TEHD[1]	UINT16	×10000
0482	RO	Va 2nd Harmonic	UINT16	×10000
0483	RO	Vb 2nd Harmonic	UINT16	×10000
0484	RO	Vc 2nd Harmonic	UINT16	×10000
0485	RO	Ia 2nd Harmonic	UINT16	×10000
0486	RO	Ib 2nd Harmonic	UINT16	×10000
0487	RO	Ic 2nd Harmonic	UINT16	×10000
0488	RO	I4 2nd Harmonic[1]	UINT16	×10000
……		……		×10000
0909	RO	Va 63rd Harmonic	UINT16	×10000
0910	RO	Vb 63rd Harmonic	UINT16	×10000
0911	RO	Vc 63rd Harmonic	UINT16	×10000
0912	RO	Ia 63rd Harmonic	UINT16	×10000
0913	RO	Ib 63rd Harmonic	UINT16	×10000
0914	RO	Ic 63rd Harmonic	UINT16	×10000
0915	RO	I4 63rd Harmonic[1]	UINT16	×10000

Table 5-6 Harmonics Measurements

Notes:

1) Registers of I4 harmonics is valid only if the device is equipped with the I4 Input. Otherwise, it is reserved.

5.1.6 High-speed Measurements

Register	Property	Description	Format	Unit
0930	RO	Va[1]	Float	V
0932	RO	Vb[1]	Float	V

0934	RO	Vc[1]	Float	V
0936	RO	VLN average[1]	Float	V
0938	RO	Vab	Float	V
0940	RO	Vbc	Float	V
0942	RO	Vca	Float	V
0944	RO	VLL average	Float	V
0946	RO	Ia	Float	A
0948	RO	Ib	Float	A
0950	RO	Ic	Float	A
0952	RO	I average	Float	A
0954	RO	I4[2]	Float	A
0956	RO	kWa[1]	Float	W
0958	RO	kWb[1]	Float	W
0960	RO	kWc[1]	Float	W
0962	RO	∑kW	Float	W
0964	RO	kvara[1]	Float	var
0966	RO	kvarb[1]	Float	var
0968	RO	kvarc[1]	Float	var
0970	RO	∑kvar	Float	var
0972	RO	kVAa[1]	Float	VA
0974	RO	kVAb[1]	Float	VA
0976	RO	kVAc[1]	Float	VA
0978	RO	∑kVA	Float	VA
0980	RO	P.F.a[1]	Float	
0982	RO	P.F.b[1]	Float	
0984	RO	P.F.c[1]	Float	
0986	RO	∑P.F.	Float	

Table 5-7 High-speed Measurements

Notes:

1) When the **Wiring Mode** is Delta, the per phase line-to-neutral voltages, kWs, kvars, kVAs and PFs have no meaning, and their registers are reserved.

2) Register 0954 is valid only if the device is equipped with the I4 Current Input. Otherwise, it is reserved.

5.1.7 Present Demand

Register	Property	Description	Format	Scale/Unit
1000	RO	Va Demand	INT32	x100, V
1002	RO	Vb Demand	INT32	x100, V
1004	RO	Vc Demand	INT32	x100, V
1006	RO	VLN average Demand	INT32	x100, V
1008	RO	Vab Demand	INT32	x100, V
1010	RO	Vbc Demand	INT32	x100, V

1012	RO	Vca Demand	INT32	x100, V
1014	RO	VLL average Demand	INT32	x100, V
1016	RO	Ia Demand	INT32	x1000, A
1018	RO	Ib Demand	INT32	x1000, A
1020	RO	Ic Demand	INT32	x1000, A
1022	RO	I average Demand	INT32	x1000, A
1024	RO	I4 Demand[1]	INT32	x1000, A
1026	RO	kWa Demand	INT32	W
1028	RO	kWb Demand	INT32	W
1030	RO	kWc Demand	INT32	W
1032	RO	∑kW Demand	INT32	W
1034	RO	kvara Demand	INT32	var
1036	RO	kvarb Demand	INT32	var
1038	RO	kvarc Demand	INT32	var
1040	RO	∑kvar Demand	INT32	var
1042	RO	kVAa Demand	INT32	VA
1044	RO	kVAb Demand	INT32	VA
1046	RO	kVAc Demand	INT32	VA
1048	RO	∑kVA Demand	INT32	VA
1050	RO	P.F.a Demand	INT32	x1000
1052	RO	P.F.b Demand	INT32	x1000
1054	RO	P.F.c Demand	INT32	x1000
1056	RO	∑P.F. Demand	INT32	x1000
1058	RO	FREQ Demand	INT32	x100, Hz
1060	RO	V Unbalance Demand	INT32	x1000
1062	RO	I Unbalance Demand	INT32	x1000
1064	RO	Va THD Demand	INT32	x10000
1066	RO	Vb THD Demand	INT32	x10000
1068	RO	Vc THD Demand	INT32	x10000
1070	RO	Ia THD Demand	INT32	x10000
1072	RO	Ib THD Demand	INT32	x10000
1074	RO	Ic THD Demand	INT32	x10000

Table 5-8 Present Demand

Note:

1) Register 1024 is valid only if the device is equipped with the I4 Current Input. Otherwise, it is reserved.

5.1.8 Predicted Demand

Register	Property	Description	Format	Scale/Unit
1200	RO	Va Predicted Demand	INT32	x100, V
1202	RO	Vb Predicted Demand	INT32	x100, V
1204	RO	Vc Predicted Demand	INT32	x100, V

1206	RO	VLN average Predicted Demand	INT32	x100, V
1208	RO	Vab Predicted Demand	INT32	x100, V
1210	RO	Vbc Predicted Demand	INT32	x100, V
1212	RO	Vca Predicted Demand	INT32	x100, V
1214	RO	VLL average Predicted Demand	INT32	x100, V
1216	RO	Ia Predicted Demand	INT32	x1000, A
1218	RO	Ib Predicted Demand	INT32	x1000, A
1220	RO	Ic Predicted Demand	INT32	x1000, A
1222	RO	I average Predicted Demand	INT32	x1000, A
1224	RO	I4 Predicted Demand[1]	INT32	x1000, A
1226	RO	kWa Predicted Demand	INT32	W
1228	RO	kWb Predicted Demand	INT32	W
1230	RO	kWc Predicted Demand	INT32	W
1232	RO	∑kW Predicted Demand	INT32	W
1234	RO	kvara Predicted Demand	INT32	var
1236	RO	kvarb Predicted Demand	INT32	var
1238	RO	kvarc Predicted Demand	INT32	var
1240	RO	∑kvar Predicted Demand	INT32	var
1242	RO	kVAa Predicted Demand	INT32	VA
1244	RO	kVAb Predicted Demand	INT32	VA
1246	RO	kVAc Predicted Demand	INT32	VA
1248	RO	∑kVA Predicted Demand	INT32	VA
1250	RO	P.F.a Predicted Demand	INT32	x1000
1252	RO	P.F.b Predicted Demand	INT32	x1000
1254	RO	P.F.c Predicted Demand	INT32	x1000
1256	RO	∑P.F. Predicted Demand	INT32	x1000
1258	RO	FREQ Predicted Demand	INT32	x100, Hz
1260	RO	V Unbalance Predicted Demand	INT32	x1000
1262	RO	I Unbalance Predicted Demand	INT32	x1000
1264	RO	Va THD Predicted Demand	INT32	x10000
1266	RO	Vb THD Predicted Demand	INT32	x10000
1268	RO	Vc THD Predicted Demand	INT32	x10000
1270	RO	Ia THD Predicted Demand	INT32	x10000
1272	RO	Ib THD Predicted Demand	INT32	x10000
1274	RO	Ic THD Predicted Demand	INT32	x10000

Table 5-9 Predicted Demand

Note:

1) Register 1224 is valid only if the device is equipped with the I4 Current Input. Otherwise, it is reserved.

5.1.9 Max/Min Value per Demand Period

Register	Property	Description	Format	Scale/Unit
1400	RO	Va max	INT32	x100, V

1402	RO	Vb max	INT32	x100, V
1404	RO	Vc max	INT32	x100, V
1406	RO	VLN average max	INT32	x100, V
1408	RO	Vab max	INT32	x100, V
1410	RO	Vbc max	INT32	x100, V
1412	RO	Vca max	INT32	x100, V
1414	RO	VLL average max	INT32	x100, V
1416	RO	Ia max	INT32	x1000, A
1418	RO	Ib max	INT32	x1000, A
1420	RO	Ic max	INT32	x1000, A
1422	RO	I average max	INT32	x1000, A
1424	RO	I4 max[1]	INT32	x1000, A
1426	RO	kWa max	INT32	W
1428	RO	kWb max	INT32	W
1430	RO	kWc max	INT32	W
1432	RO	∑kW max	INT32	W
1434	RO	kvara max	INT32	var
1436	RO	kvarb max	INT32	var
1438	RO	kvarc max	INT32	var
1440	RO	∑kvar max	INT32	var
1442	RO	kVAa max	INT32	VA
1444	RO	kVAb max	INT32	VA
1446	RO	kVAc max	INT32	VA
1448	RO	∑kVA max	INT32	VA
1450	RO	P.F.a max	INT32	x1000
1452	RO	P.F.b max	INT32	x1000
1454	RO	P.F.c max	INT32	x1000
1456	RO	∑P.F. max	INT32	x1000
1458	RO	FREQ max	INT32	x100, Hz
1460	RO	V Unbalance max	INT32	x1000
1462	RO	I Unbalance max	INT32	x1000
1464	RO	Va THD max	INT32	x10000
1466	RO	Vb THD max	INT32	x10000
1468	RO	Vc THD max	INT32	x10000
1470	RO	Ia THD max	INT32	x10000
1472	RO	Ib THD max	INT32	x10000
1474	RO	Ic THD max	INT32	x10000

Register	Property	Description	Format	Scale/Unit
1600	RO	Va min	INT32	x100, V
1602	RO	Vb min	INT32	x100, V
1604	RO	Vc min	INT32	x100, V
1606	RO	VLN average min	INT32	x100, V
1608	RO	Vab min	INT32	x100, V
1610	RO	Vbc min	INT32	x100, V
1612	RO	Vca min	INT32	x100, V
1614	RO	VLL average min	INT32	x100, V
1616	RO	Ia min	INT32	x1000, A

1618	RO	Ib min	INT32	x1000, A
1620	RO	Ic min	INT32	x1000, A
1622	RO	I average min	INT32	x1000, A
1624	RO	I4 min[1]	INT32	x1000, A
1626	RO	kWa min	INT32	W
1628	RO	kWb min	INT32	W
1630	RO	kWc min	INT32	W
1632	RO	∑kW min	INT32	W
1634	RO	kvara min	INT32	var
1636	RO	kvarb min	INT32	var
1638	RO	kvarc min	INT32	var
1640	RO	∑kvar min	INT32	var
1642	RO	kVAa min	INT32	VA
1644	RO	kVAb min	INT32	VA
1646	RO	kVAc min	INT32	VA
1648	RO	∑kVA min	INT32	VA
1650	RO	P.F.a min	INT32	x1000
1652	RO	P.F.b min	INT32	x1000
1654	RO	P.F.c min	INT32	x1000
1656	RO	∑P.F. min	INT32	x1000
1658	RO	FREQ min	INT32	x100, Hz
1660	RO	V Unbalance min	INT32	x1000
1662	RO	I Unbalance min	INT32	x1000
1664	RO	Va THD min	INT32	x10000
1666	RO	Vb THD min	INT32	x10000
1668	RO	Vc THD min	INT32	x10000
1670	RO	Ia THD min	INT32	x10000
1672	RO	Ib THD min	INT32	x10000
1674	RO	Ic THD min	INT32	x10000

Table 5-10 Max/Min Value per Demand Period

Note:

1) Register 1424 and 1624 are valid only if the device is equipped with the I4 Current Input. Otherwise, they are reserved.

5.1.10 Peak Demand Log

The Current Peak Demand data is 1000 times the actual value. For example, if the register#1818 contains a value of 5005, the actual kW Peak Demand value is 5.005A.

Register	Property	Description	Format	Scale/Unit
1800-1805	RO	∑kW Peak Demand of This Month	See Section 5.13.1 Peak Demand Data Structure	W
1806-1811	RO	∑kvar Peak Demand of This Month		var
1812-1817	RO	∑kVA Peak Demand of This Month		VA
1818-1823	RO	Ia Peak Demand of This Month		x1000, A
1824-1829	RO	Ib Peak Demand of This Month		x1000, A
1830-1835	RO	Ic Peak Demand of This Month		x1000, A
Register	**Property**	**Description**	**Format**	**Scale/Unit**

1850-1855	RO	∑kW Peak Demand of Last Month	See Section 5.13.1 Peak Demand Data Structure	W
1856-1861	RO	∑kvar Peak Demand of Last Month		var
1862-1867	RO	∑kVA Peak Demand of Last Month		VA
1868-1873	RO	Ia Peak Demand of Last Month		x1000, A
1874-1879	RO	Ib Peak Demand of Last Month		x1000, A
1880-1885	RO	Ic Peak Demand of Last Month		x1000, A

Table 5-11 Peak Demand

5.1.11 Max/Min Log

5.1.11.1 Max Log of This Month

Register	Property	Description	Format	Scale/Unit
2000-2005	RO	Va max	See Section 5.13.2 Max/Min Data Structure	x100, V
2006-2011	RO	Vb max		x100, V
2012-2017	RO	Vc max		x100, V
2018-2023	RO	VLN average max		x100, V
2024-2029	RO	Vab max		x100, V
2030-2035	RO	Vbc max		x100, V
2036-2041	RO	Vca max		x100, V
2042-2047	RO	VLL average max		x100, V
2048-2053	RO	Ia max		x1000, A
2054-2059	RO	Ib max		x1000, A
2060-2065	RO	Ic max		x1000, A
2066-2071	RO	I average max		x1000, A
2072-2077	RO	I4 max[1]		x1000, A
2078-2083	RO	∑kW max		W
2084-2089	RO	∑kvar max		var
2090-2095	RO	∑kVA max		VA
2096-2101	RO	∑P.F. max		x1000
2102-2107	RO	FREQ max		x100, Hz
2108-2113	RO	Va THD max		x10000
2114-2119	RO	Vb THD max		x10000
2120-2125	RO	Vc THD max		x10000
2126-2131	RO	Ia THD max		x10000
2132-2137	RO	Ib THD max		x10000
2138-2143	RO	Ic THD max		x10000
2144-2149	RO	Ia K-Factor max		x10
2150-2155	RO	Ib K-Factor max		x10
2156-2161	RO	Ic K-Factor max		x10
2162-2167	RO	V Unbalance max		x1000
2168-2173	RO	I Unbalance max		x1000

Table 5-12 Max Log of This Month

Note:

1) Registers 2072-2077 are valid only if the device is equipped with the Zero-sequence Current Input. Otherwise, they are reserved.

5.1.11.2 Min Log of This Month

Register	Property	Description	Format	Scale/Unit
2300-2305	RO	Va min	See Section 5.13.2 Max/Min Data Structure	x100, V
2306-2311	RO	Vb min		x100, V
2312-2317	RO	Vc min		x100, V
2318-2323	RO	VLN average min		x100, V
2324-2329	RO	Vab min		x100, V
2330-2335	RO	Vbc min		x100, V
2336-2341	RO	Vca min		x100, V
2342-2347	RO	VLL average min		x100, V
2348-2353	RO	Ia min		x1000, A
2354-2359	RO	Ib min		x1000, A
2360-2365	RO	Ic min		x1000, A
2366-2371	RO	I average min		x1000, A
2372-2377	RO	I4 min[1]		x1000, A
2378-2383	RO	∑kW min		W
2384-2389	RO	∑kvar min		var
2390-2395	RO	∑kVA min		VA
2396-2401	RO	∑P.F. min		x1000
2402-2407	RO	FREQ min		x100, Hz
2408-2413	RO	Va THD min		x10000
2414-2419	RO	Vb THD min		x10000
2420-2425	RO	Vc THD min		x10000
2426-2431	RO	Ia THD min		x10000
2432-2437	RO	Ib THD min		x10000
2438-2443	RO	Ic THD min		x10000
2444-2449	RO	Ia K-Factor min		x10
2450-2455	RO	Ib K-Factor min		x10
2456-2461	RO	Ic K-Factor min		x10
2462-2467	RO	V Unbalance min		x1000
2468-2473	RO	I Unbalance min		x1000

Table 5-13 Min Log of This Month

Note:

1) Registers 2372-2377 are valid only if the device is equipped with the I4 Current Input. Otherwise, they are reserved.

5.1.11.3 Max Log of Last Month

Register	Property	Description	Format	Scale/Unit
2600-2605	RO	Va max	See Section 5.13.2 Max/Min Data Structure	x100, V
2606-2611	RO	Vb max		x100, V
2612-2617	RO	Vc max		x100, V
2618-2623	RO	VLN average max		x100, V

2624-2629	RO	Vab max		x100, V
2630-2635	RO	Vbc max		x100, V
2636-2641	RO	Vca max		x100, V
2642-2647	RO	VLL average max		x100, V
2648-2653	RO	Ia max		x1000, A
2654-2659	RO	Ib max		x1000, A
2660-2665	RO	Ic max		x1000, A
2666-2671	RO	I average max		x1000, A
2672-2677	RO	I4 max[1]		x1000, A
2678-2683	RO	∑kW max		W
2684-2689	RO	∑kvar max		var
2690-2695	RO	∑kVA max		VA
2696-2701	RO	∑P.F. max		x1000
2702-2707	RO	FREQ max		x100, Hz
2708-2713	RO	Va THD max		x10000
2714-2719	RO	Vb THD max		x10000
2720-2725	RO	Vc THD max		x10000
2726-2731	RO	Ia THD max		x10000
2732-2737	RO	Ib THD max		x10000
2738-2743	RO	Ic THD max		x10000
2744-2749	RO	Ia K-Factor max		x10
2750-2755	RO	Ib K-Factor max		x10
2756-2761	RO	Ic K-Factor max		x10
2762-2767	RO	V Unbalance min		x1000
2768-2773	RO	I Unbalance min		x1000

Table 5-14 Max Log of Last Month

Note:

1) Registers 2672-2677 are valid only if the device is equipped with the I4 Current Input. Otherwise, they are reserved.

5.1.11.4 Min Log of Last Month

Register	Property	Description	Format	Scale/Unit
2900-2905	RO	Va min	See Section 5.13.2 Max/Min Data Structure	x100, V
2906-2911	RO	Vb min		x100, V
2912-2917	RO	Vc min		x100, V
2918-2923	RO	VLN average min		x100, V
2924-2929	RO	Vab min		x100, V
2930-2935	RO	Vbc min		x100, V
2936-2941	RO	Vca min		x100, V
2942-2947	RO	VLL average min		x100, V
2948-2953	RO	Ia min		x1000, A
2954-2959	RO	Ib min		x1000, A

2960-2965	RO	Ic min		x1000, A
2966-2971	RO	I average min		x1000, A
2972-2977	RO	I4 min[1]		x1000, A
2978-2983	RO	∑kW min		W
2984-2989	RO	∑kvar min		var
2990-2995	RO	∑kVA min		VA
2996-3001	RO	∑P.F. min		x1000
3002-3007	RO	FREQ min		x100, Hz
3008-3013	RO	Va THD min		x10000
3014-3019	RO	Vb THD min		x10000
3020-3025	RO	Vc THD min		x10000
3026-3031	RO	Ia THD min		x10000
3032-3037	RO	Ib THD min		x10000
3038-3043	RO	Ic THD min		x10000
3044-3049	RO	Ia K-Factor min		x10
3050-3055	RO	Ib K-Factor min		x10
3056-3061	RO	Ic K-Factor min		x10
3062-3067	RO	V Unbalance min		x1000
3068-3073	RO	I Unbalance min		x1000

Table 5-15 Min Log of Last Month

Note:

1) Registers 2972-2977 are valid only if the device is equipped with the I4 Current Input. Otherwise, they are reserved.

5.2 Setup Register

5.2.1 Basic Setup Parameters

Register	Property	Description	Format	Range/Options
6000	RW	PT Ratio[1]	UINT16	1* to 10000
6001	RW	CT Ratio[1]	UINT16	1* to 6000 (5A input) 1* to 30000 (1A input)
6002	RW	I4 Ratio	UINT16	1 to 10000 (Default = 2)
6003	RW	Wiring Mode	UINT16	0=WYE* 1=DELTA 2=DEMO
6004	RW	Nominal Secondary Voltage ($V_{nominal}$)	UINT16	100V* to 700V (VLL)
6005	RW	Nominal Frequency ($f_{nominal}$)	UINT16	0=50Hz* 1=60Hz
6006	RW	Port 1 Protocol	UINT16	0=Modbus* 1= EGATE
6007	RW	Port 1 Unit ID	UINT16	1 to 247 (Default = 100)

6008	RW	Port 1 Baud rate	UINT16	0=1200 1=2400 2=4800 3=9600* 4=19200 5=38400
6009	RW	Port 1 Configuration	UINT16	0=8N2 1=8O1 2=8E1* 3=8N1 4=8O2 5=8E2
6010	RW	Port 2 Unit ID	UINT16	1 to 247 (Default = 101)
6011	RW	Port 2 Baud rate	UINT16	0=1200 1=2400 2=4800 3=9600* 4=19200 5=38400
6012	RW	Port 2 Configuration	UINT16	0=8N2 1=8O1 2=8E1* 3=8N1 4=8O2 5=8E2
6013	RW	IP Address	UINT32	E.g. if the IP Address is "192.168.8.97", write "0xC0A80861" to this register (Default=192.168.8.97)
6015	RW	Subnet Mask	UINT32	E.g. if the Subnet Mask is "255.255.255.0", write "0xFFFFFF00" to this register (Default=255.255.255.0)
6017	RW	Gateway Address	UINT32	E.g. if the Gateway Address is "192.168.8.1", write "0XC0A80801" to this register (Default=192.168.8.1)
6019	RW	Power Factor Convention	UINT16	0=IEC* 1=IEEE 2=-IEEE
6020	RW	kVA Calculation	UINT16	0=Vector* 1=Scalar
6021	RW	Demand Sync.	UINT16	0= SLD*

				1=SYNC DI
6022	RW	Demand Period	UINT16	1 to 99 (minutes) (Default = 15)
6023	RW	Number of Sliding Windows	UINT16	1* to 15
6024	RW	Predicted Response[2]	UINT16	70* to 99
6025	RW	DI1 Function	UINT16	0=Digital Input* 1=Pulse Counter 2=SYNC DI 3=PPS
6026	RW	DI2 Function	UINT16	
6027	RW	DI3 Function	UINT16	
6028	RW	DI4 Function	UINT16	
6029	RW	DI5 Function	UINT16	
6030	RW	DI6 Function	UINT16	
6031	RW	DI1 Debounce	UINT16	1 to 1000 (ms) (Default=20ms)
6032	RW	DI2 Debounce	UINT16	
6033	RW	DI3 Debounce	UINT16	
6034	RW	DI4 Debounce	UINT16	
6035	RW	DI5 Debounce	UINT16	
6036	RW	DI6 Debounce	UINT16	
6037	RW	DI1 Pulse Weight	UINT16	1* to 1000000
6039	RW	DI2 Pulse Weight	UINT16	
6041	RW	DI3 Pulse Weight	UINT16	
6043	RW	DI4 Pulse Weight	UINT16	
6045	RW	DI5 Pulse Weight	UINT16	
6047	RW	DI6 Pulse Weight	UINT16	
6049	RW	DO1 Function	UINT16	0 = Digital Output* Others Reserved
6050	RW	DO2 Function	UINT16	
6051	RW	DO3 Function	UINT16	
6052	RW	DO1 Pulse Width	UINT16	0 to 999 (x0.1s) 0 = Latch Mode (Default = 10)
6053	RW	DO2 Pulse Width	UINT16	
6054	RW	DO3 Pulse Width	UINT16	
6055	RW	AI Type	UINT16	0 = 4-20mA* 1 = 0-20mA
6056	RW	AI Zero scale	INT32	-999,999 to +999,999 (Default = 0)
6058	RW	AI Full scale	INT32	-999,999 to +999,999 (Default = 5000)
6060	RW	AO Key[3]	UINT16	(See Note 3)
6061	RW	AO Type	UINT16	0=4-20mA* 1=0-20mA
6062	RW	AO Zero scale	INT32	-999,999 to +999,999 (Default = 0)
6064	RW	AO Full scale	INT32	-999,999 to +999,999 (Default = 5000)

6066	RW	Ia Polarity	UINT16	0=Normal* 1=Reverse
6067	RW	Ib Polarity	UINT16	
6068	RW	Ic Polarity	UINT16	
6069	RW	Harmonic Calculation	UINT16	0=Fundamental 1=RMS*
6070	RW	Enable Energy Pulse	UINT16	0=Disabled* 1=Enabled
6071	RW	Pulse Constant	UINT16	0=1000 imp/kxh 1=3200 imp/kxh 2=5000 imp/kxh*
6072	RW	Peak Demand Log & Max/Min Log Self-Read Time[4]	UINT16	0*
6073	RW	Sag/Swell Enable	UINT16	0=Disabled* 1=Enabled
6074	RW	Swell Limit	UINT16	105* to 200 (x0.01$V_{nominal}$)
6075	RW	Sag Limit	UINT16	10 to 95 (x0.01$V_{nominal}$) (Default=70)
6076	RW	Sag/Swell Trigger 1	UINT16	0=None* 1 - 3=DO1 to DO3 4 - 19=DR1 to DR 16 20 - 21=WR 1 to WR 2 22= Alarm Email
6077	RW	Sag/Swell Trigger 2	UINT16	
6078	RW	SNTP Enable[5]	UINT16	0=Disabled* 1=Enabled
6079	RW	Time Zone[6]	UINT16	0 to 32 (Default=26)
6080	RW	SNTP Sync. Interval[7]	UINT16	10-1440 (min) (Default=60)
6081	RW	IP Address of Time Server	UINT32	If IP address is 192.168.8.94, write “0xC0A8085E” to this register (Default=192.168.8.94)
6083	RW	SMTP IP Port	UINT16	0 to 65535 (Default=25)
6084	RW	IP Address of SMTP Server	UINT32	If address is 191.0.0.6, write “0XBF000006” to this register (Default=191.0.0.6)
6086-6121	RW	Source Email[8]	UINT16	See Note (8)
6122-6141	RW	Logon Password [9]	UINT16	See Note (9)
6142-6177	RW	Destination Email[10]	UINT16	See Note (10)
6178	RW	Transient Enable	UINT16	0=Disabled* 1=Enabled
6179	RW	Transient Limit	UINT16	5-100 (x0.01 $V_{nominal}$) (Default=50)

6180	RW	Transient Trigger 1	UINT16	0=None* 1 - 3=DO1 to DO3 4 - 19=DR1 to DR 16 20 - 21=WR 1 to WR 2 22= Alarm Email
6181	RW	Transient Trigger 2	UINT16	
6182	RW	Email Language	UINT16	0=English*Others = Reserved
6183	RW	Backlight Time-out[11]	UINT16	0 to 60 (mins) (Default=3)
6184-6187		Reserved		
6188	WO	Send Test Email	UINT16	Writing "0xFF00" to the Register sends a test Email to the specified Destination Email address.

* Default

Table 5-16 Basic Setup Parameters

Notes:

1) For 5A configuration, PT Ratio × CT Ratio must be less than 1,000,000
   For 1A configuration, PT Ratio × CT Ratio must be less than 5,000,000
2) The **Predicated Response** setup parameter allows the user to adjust the sensitivity of the predicted demand output. A value between 70 and 99 is recommended for a reasonably fast response. Specify a higher value for higher sensitivity.
3) Analog Output Parameters
   If **∑PF** is chosen as the AO parameter, the values for **ZERO** (zero scale) and **FULL** (full scale) should be set as 1000 times the actual value.
   The Units for voltage, current, kW, kvar, kVA and FREQ are V, A, kW, kvar, kVA and Hz, respectively.

Key	0	1	2	3	4	5
Parameter	Vab	Vbc	Vca	VLL avg	Ia	Ib
Key	6	7	8	9	10	11
Parameter	Ic	I avg	∑kW	∑kvar	∑kVA	∑PF
Key	12	13	14	15	16	
Parameter	FREQ	∑kW Demand	∑kvar Demand	∑kVA Demand	∑PF Demand	

Table 5-17 Analog Output Parameters

4) Self-Read Time is applied to Peak Demand Log and Max/Min Log.
   There are two types of Self-Read Time. The value 0 indicates that the transfer will happen at 00:00 of the first day of every month. A non-zero value indicates that the transfer will happen at a specific time based on the formula [Hour+Day*100] where 0≤Hour≤23 and 1≤Day≤28. For example, the value 1512 means that the Peak Demand of Current Month will be transferred to the Peak Demand of Last Month register at 12:00pm on the 15th day of each month.
5) If the PMC-660 is not equipped with the optional Ethernet Port, SNTP is disabled.

6) SNTP doesn't support Daylight Time Saving (**DTS**). The following table lists the supported Time Zones:

Code	Time Zone	Code	Time Zone
0	GMT-12:00	**17**	GMT+3:30
1	GMT-11:00	**18**	GMT+4:00
2	GMT-10:00	**19**	GMT+4:30
3	GMT-9:00	**20**	GMT+5:00
4	GMT-8:00	**21**	GMT+5:30
5	GMT-7:00	**22**	GMT+5:45
6	GMT-6:00	**23**	GMT+6:00
7	GMT-5:00	**24**	GMT+6:30
8	GMT-4:00	**25**	GMT+7:00
9	GMT-3:30	**26**	GMT+8:00
10	GMT-3:00	**27**	GMT+9:00
11	GMT-2:00	**28**	GMT+9:30
12	GMT-1:00	**29**	GMT+10:00
13	GMT-0:00	**30**	GMT+11:00
14	GMT+1:00	**31**	GMT+12:00
15	GMT+2:00	**32**	GMT+13:00
16	GMT+3:00		

Table 5-18 Time Zones

7) The synchronization Interval should be set between 10 and 1440 minutes.
8) This string register specifies the source email address that appears in the "From" field of the email. This string may be up to 35 characters long. Please add the value zero "0000" at the end of the string as the string terminator. For example, if the email address is PMC-660@ceiec-electric.com, set the registers as"0050 004D 0043 002D 0036 0036 0030 0040 0063 0065 0069 0065 0063 002D 0065 006C 0065 0063 0074 0072 0069 0063 002E 0063 006F 006D 0000".
9) This string register specifies the Logon Password to login the "Source **Email**" account. This string may be up to 19 characters long. Please add the value zero "0000" at the end of the string as the string terminator. For example, if the password is "PMC-660", set the registers as "0050 004D 0043 002D 0036 0036 0030 0000"
10) This string register specifies the destination email address that appears in the "To" field of the email. This string may be up to 35 characters long. Please add the value zero "0000" at the end of the string as the string terminator. For example, if the email address is PMC-660-R@ceiec-electric.com, so set the registers as"0050 004D 0043 002D 0036 0036 0030 002D 0052 0040 0063 0065 0069 0065 0063 002D 0065 006C 0065 0063 0074 0072 0069 0063 002E 0063 006F 006D 0000".
11) The Backlight Time-out can be set from 0 to 60 minutes. A zero (0) value indicates that the backlight time-out is disabled. This setup parameter is available in Firmware Version V1.00.04 or later.

5.2.2 Clear/Reset Register

Register	Property	Description	Format	Note
6400	WO	Manual WFR Log #1 Trigger	UINT16	Writing ”0xFF00” triggers the respective Waveform Recorder
6401	WO	Manual WFR Log #2 Trigger	UINT16	
6402	WO	Clear DR #1 (High-Speed)	UINT16	Writing “0xFF00” to the register clears the respective Data Recorder
6403	WO	Clear DR #2 (High-Speed)	UINT16	
6404	WO	Clear DR #3 (High-Speed)	UINT16	
6405	WO	Clear DR #4 (High-Speed)	UINT16	
5406	WO	Clear DR #5 (Standard)	UINT16	
……	WO	……	UINT16	
6416	WO	Clear DR #15 (Standard)	UINT16	
6417	WO	Clear DR #16 (Standard)	UINT16	
6418	WO	Clear WFR Log #1	UINT16	Writing “0xFF00” to the register clears the respective Waveform Recorder
6419	WO	Clear WFR Log #2	UINT16	
6420	WO	Clear Energy Log	UINT16	Writing “0xFF00” to the register clears the Energy Log
6421	WO	Clear PQ Log	UINT16	Writing “0xFF00” to the register clears the PQ Log
6422	WO	Clear SOE Log	UINT16	Writing “0xFF00” to the register clears the SOE Log
6423	WO	Clear Energy	UINT16	Writing “0xFF00” to the register clears all energy registers
6424	WO	Clear Max/Min Log of This Month	UINT16	Writing “0xFF00” to the register clears the Max/Min Log of This Month
6425	WO	Clear Peak Demand Log of This Month	UINT16	Writing”0XFF00” to the register clears the Peak Demand Log of This Month
6426	WO	Clear Counter #1 (DI1)	UINT16	Writing “0xFF00” to the register clears the respective DI Counter register
6427	WO	Clear Counter #2 (DI2)	UINT16	
……	WO	……	UINT16	
6430	WO	Clear Counter #5 (DI5)	UINT16	
6431	WO	Clear Counter #6 (DI6)	UINT16	
6432-6436		Reserved	UINT16	

6437	WO	Clear all Logs[1]	UINT16	Writing “0xFF00” to the register clears all of the above

Table 5-19 SOE Log

Notes:

1) Writing “0XFF00” to the register clears all logs, including Data Recorder, Waveform Recorder, Energy Log, PQ Log, SOE Log, Max/Min Log of This Month, Peak Demand of This Month, DI Counters and Energy.

5.3 Setpoint Setup Parameters

5.3.1 Setpoint Setup Registers

Register	Property	Description	Format
6600-6609	RW	Setpoint #1 (Standard)	See Section 5.3.2 Setpoint Setup Register Structure
6610-6619	RW	Setpoint #2 (Standard)	
6620-6629	RW	Setpoint #3 (Standard)	
6630-6639	RW	Setpoint #4 (Standard)	
6640-6649	RW	Setpoint #5 (Standard)	
6650-6659	RW	Setpoint #6 (Standard)	
6660-6669	RW	Setpoint #7 (Standard)	
6670-6679	RW	Setpoint #8 (Standard)	
6680-6689	RW	Setpoint #9 (Standard)	
6690-6699	RW	Setpoint #10 (Standard)	
6700-6709	RW	Setpoint #11 (Standard)	
6710-6719	RW	Setpoint #12 (Standard)	
6720-6729	RW	Setpoint #13 (Standard)	
6730-6739	RW	Setpoint #14 (Standard)	
6740-6749	RW	Setpoint #15 (Standard)	
6750-6759	RW	Setpoint #16 (Standard)	
6760-6769	RW	Setpoint #17 (High-Speed)	
6770-6779	RW	Setpoint #18 (High-Speed)	
6780-6789	RW	Setpoint #19 (High-Speed)	
6790-6799	RW	Setpoint #20 (High-Speed)	
6800-6809	RW	Setpoint #21 (High-Speed)	
6810-6819	RW	Setpoint #22 (High-Speed)	
6820-6829	RW	Setpoint #23 (High-Speed)	
6830-6839	RW	Setpoint #24 (High-Speed)	

Table 5-20 Setpoints

5.3.2 Setpoint Setup Data Structure

Offset	Property	Description		Format	Range/Options
+0	RW	Standard Setpoint	Type	UINT16	0=Disabled* 1=Over Setpoint 2=Under Setpoint
+1	RW		Paramenter[1]	UINT16	1* to 31
+2	RW		Active Limit	INT32	Default=5000
+4	RW		Inactive Limit	INT32	Default=1000
+6	RW		Active Delay	UINT16	0* to 9999 (second) (Default=1)
+7	RW		Inactive Delay	UINT16	0* to 9999 (second) (Default=1)
+8	RW		Trigger 1[2]	UINT16	0 to 22 (Default=1)
+9	RW		Trigger 2[2]	UINT16	0 to 22 (Default=2)
Offset	**Property**	**Description**		**Format**	**Range/Options**
+0	RW	High-speed Setpoint	Type	UINT16	0=Disabled* 1=Over Setpoint 2=Under Setpoint
+1	RW		Paramenter[1]	UINT16	1* to 14
+2	RW		Active Limit	INT32	Default=5000
+4	RW		Inactive Limit	INT32	Default=1000
+6	RW		Active Delay	UINT16	0* to 9999 (cycle) (Default=1)
+7	RW		Inactive Delay	UINT16	0* to 9999 (cycle) (Default=1)
+8	RW		Trigger 1[2]	UINT16	0 to 22 (Default=1)
+9	RW		Trigger 2[2]	UINT16	0 to 22 (Default=2)

* Default

Table 5-21 Setpoint Setup Register Structure

Notes:

1) "**Parameter**" specifies the parameter to be monitored. Table 5-22 below provides a list of Setpoint Parameters.

Key	Parameter	Scale/Unit
1	VLN	x100, V
2	VLL	x100, V
3	I	x1000, A
4	I4	x1000, A
5	Freq Deviation	x100, Hz
6	∑kW	kW
7	∑kvar	kvar
8	P.F.	x1000,
9	DI1	1) For Over Setpoint, the Active Limit is DI Close (**DI=1**), and Inactive Limit is DI Open (**DI=0**);
10	DI2	

11	DI3	2) For Under Setpoint, the Active Limit is DI Open (**DI=0**), and Inactive Limit is DI Close (**DI=1**);
12	DI4	
13	DI5	
14	DI6	
15	AI	/
16	∑kW Demand	kW
17	∑kvar Demand	kvar
18	P.F. Demand	x1000
19	∑kW Predicted Demand	kW
20	∑kvar Predicted Demand	kvar
21	P.F. Predicted Demand	x1000
22	V THD	x10000
23	V TOHD	x10000
24	V TEHD	x10000
25	I THD	x10000
26	I TOHD	x10000
27	I TEHD	x10000
28	Voltage Unbalance	x1000
29	Current Unbalance	x1000
30	V Deviation	x10000
31	Phase Reversal	1) For Over Setpoint, the Active Limit is Negative Phase Sequence, and Inactive Limit is Positive Phase Sequence. 2) For Under Setpoint, the Active Limit is Positive Phase Sequence, and Inactive Limit is Negative Phase Sequence.

Table 5-22 Setpoint Parameters

2) "**Trigger**" specifies what action the setpoint will take when it becomes active. Table 5-23 below provides a list of Setpoint Triggers.

Key	Action	Key	Action
0	None	**12**	DR #9
1	DO1	**13**	DR #10
2	DO2	**14**	DR #11
3	DO3	**15**	DR #12
4	DR #1	**16**	DR #13
5	DR #2	**17**	DR #14
6	DR #3	**18**	DR #15
7	DR #4	**19**	DR #16
8	DR #5	**20**	WR #1
8	DR #6	**21**	WR #2
10	DR #7	**22**	Alarm Email
11	DR #8		

Table 5-23 Setpoint Triggers

5.4 Logical Module Setup Parameters

5.4.1 Logical Module Setup Registers

Register	Property	Description	Format
6840-6849	RW	Logical Module #1	See Section 5.4.2 Logical Module Setup Data Structure
6850-6859	RW	Logical Module #2	
6860-6869	RW	Logical Module #3	
6870-6879	RW	Logical Module #4	
6880-6889	RW	Logical Module #5	
6890-6899	RW	Logical Module #6	

Table 5-24 Logical Modules

5.4.2 Logical Module Setup Data Structure

Register	Property	Description	Format	Range/Options
+0	RW	Enable Logical Module	UINT16	0=Disabled* 1=Enabled
+1	RW	Mode 1	UINT16	0=AND* 1=OR 2=NAND 3=NOR
+2	RW	Mode 2	UINT16	
+3	RW	Mode 3	UINT16	
+4	RW	Source 1[1]	UINT16	0 to 24 (Default=1)
+5	RW	Source 2[1]	UINT16	0 to 24 (Default=2)
+6	RW	Source 3[1]	UINT16	0 to 24 (Default=3)
+7	RW	Source 4[1]	UINT16	0 to 24 (Default=4)
+8	RW	Trigger 1[2]	UINT16	0 to 21 (Default=1)
+9	RW	Trigger 2[2]	UINT16	0 to 21 (Default=0)

* Default

Table 5-25 Logical Module Data Structure

Notes:

1) The Logical Modules can have up to 4 Source inputs. Table 5-26 below provides a list of Logical Module Sources.

Key	Source	Key	Source
0	None	**13**	Setpoint #13 (Standard)
1	Setpoint #1 (Standard)	**14**	Setpoint #14 (Standard)
2	Setpoint #2 (Standard)	**15**	Setpoint #15 (Standard)
3	Setpoint #3 (Standard)	**16**	Setpoint #16 (Standard)
4	Setpoint #4 (Standard)	**17**	Setpoint #17 (High-Speed)
5	Setpoint #5 (Standard)	**18**	Setpoint #18 (High-Speed)
6	Setpoint #6 (Standard)	**19**	Setpoint #19 (High-Speed)
7	Setpoint #7 (Standard)	**20**	Setpoint #20 (High-Speed)
8	Setpoint #8 (Standard)	**21**	Setpoint #21 (High-Speed)
9	Setpoint #9 (Standard)	**22**	Setpoint #22 (High-Speed)
10	Setpoint #10 (Standard)	**23**	Setpoint #23 (High-Speed)

11	Setpoint #11 (Standard)	**24**	Setpoint #24 (High-Speed)
12	Setpoint #12 (Standard)		

Table 5-26 Logical Module Sources

2) “**Trigger**” specifies what action the Logical Module will take when it becomes active. Table 5-27 below provides a list of Logical Module Triggers.

Key	Action	Key	Action
0	None	**11**	DR #8
1	DO1	**12**	DR #9
2	DO2	**13**	DR #10
3	DO3	**14**	DR #11
4	DR #1	**15**	DR #12
5	DR #2	**16**	DR #13
6	DR #3	**17**	DR #14
7	DR #4	**18**	DR #15
8	DR #5	**19**	DR #16
8	DR #6	**20**	WR #1
10	DR #7	**21**	WR #2

Table 5-27 Logical Module Triggers

5.5 Data Recorder Log Setup Parameters

5.5.1 Data Recorder Log Setup Registers

Register	Property	Description	Format
7000-7022	RW	Data Recorder #1 (High-Speed)	See Section 5.5.2 High-speed Data Recorder Setup Data Structure
7023-7045	RW	Data Recorder #2 (High-Speed)	
7046-7068	RW	Data Recorder #3 (High-Speed)	
7069-7091	RW	Data Recorder #4 (High-Speed)	
7092-7114	RW	Data Recorder #5 (Standard)	See Section 5.5.3 Standard Data Recorder Setup Data Structure
7115-7137	RW	Data Recorder #6 (Standard)	
7138-7160	RW	Data Recorder #7 (Standard)	
7161-7183	RW	Data Recorder #8 (Standard)	
7184-7206	RW	Data Recorder #9 (Standard)	
7207-7229	RW	Data Recorder #10 (Standard)	
7230-7252	RW	Data Recorder #11 (Standard)	
7253-7275	RW	Data Recorder #12 (Standard)	
7276-7298	RW	Data Recorder #13 (Standard)	
7299-7321	RW	Data Recorder #14 (Standard)	
7322-7344	RW	Data Recorder #15 (Standard)	
7345-7367	RW	Data Recorder #16 (Standard)	
7368	RO	DR #1 Record Size (Bytes)	UINT16
7369	RO	DR #2 Record Size (Bytes)	UINT16
7370	RO	DR #3 Record Size (Bytes)	UINT16
7371	RO	DR #4 Record Size (Bytes)	UINT16
7372	RO	DR #5 Record Size (Bytes)	UINT16

7373	RO	DR #6 Record Size (Bytes)	UINT16
7374	RO	DR #7 Record Size (Bytes)	UINT16
7375	RO	DR #8 Record Size (Bytes)	UINT16
7376	RO	DR #9 Record Size (Bytes)	UINT16
7377	RO	DR #10 Record Size (Bytes)	UINT16
7378	RO	DR #11 Record Size (Bytes)	UINT16
7379	RO	DR #12 Record Size (Bytes)	UINT16
7380	RO	DR #13 Record Size (Bytes)	UINT16
7381	RO	DR #14 Record Size (Bytes)	UINT16
7382	RO	DR #15 Record Size (Bytes)	UINT16
7383	RO	DR #16 Record Size (Bytes)	UINT16

Table 5-28 Data Recorder Setup Registers

Notes:

1) DRx Record Size (Bytes) = **Number of Parameters***4+8.

DRx Log Size=DRx **Recording Depth** ***DRx Record Size**. The Log Size is rounded up to the nearest kB.

5.5.2 High-speed Data Recorder Setup Data Structure

Offset	Property	Description	Format	Range/Options
+0	RW	Trigged Mode [1]	UINT16	0=Disabled* 1=Triggered by Timer 2=Triggered by Setpoint
+1	RW	Recording Mode[2]	UINT16	0=Stop-When-Full*
+2	RW	Recording Depth[3]	UINT16	0* to 65535
+3	RW	Recording Interval	UINT32	1 to 60 (cycles) (Default=2)
+5	RW	Recording Offset[4]	UINT16	0* to 43200 (seconds)
+6	RW	Number of Parameters[5]	UINT16	0 to 16*
+7	RW	Parameter 1	UINT16	0* to 28
+8	RW	Parameter 2	UINT16	0* to 28
+9	RW	Parameter 3	UINT16	0* to 28
+10	RW	Parameter 4	UINT16	0* to 28
+11	RW	Parameter 5	UINT16	0* to 28
+12	RW	Parameter 6	UINT16	0* to 28
+13	RW	Parameter 7	UINT16	0* to 28
+14	RW	Parameter 8	UINT16	0* to 28
+15	RW	Parameter 9	UINT16	0* to 28
+16	RW	Parameter 10	UINT16	0* to 28
+17	RW	Parameter 11	UINT16	0* to 28
+18	RW	Parameter 12	UINT16	0* to 28
+19	RW	Parameter 13	UINT16	0* to 28
+20	RW	Parameter 14	UINT16	0* to 28

+21	RW	Parameter 15	UINT16	0* to 28
+22	RW	Parameter 16	UINT16	0* to 28

* Default

Table 5-29 HS DR Setup Data Structure

Notes:

1) The High-speed Data Recorder can be triggered by Setpoints (**Triggered by Setpoint**) or on a time basis using the meter clock (**Triggered by Timer**).

   For **Triggered by Setpoint**, when the Setpoint goes active, the Data Recorder starts to record, and when the Setpoint becomes inactive, the Data Recorder stops.

2) For High Speed Data Recorder, the **Recording Mode** only supports **Stop-When-Full**.

3) If **Recording Depth** is set to "**0**", the Data Recorder will be disabled.

4) **Recording Offset** can be used to delay the recording by a fixed time. For example, if **Recording Offset** is set to 300 (5 minutes), the recording will take place 5 minutes after the High-speed Data Recorder is enabled. If the Data Recorder is triggered by Setpoint, **Recording Offset** is ignored.

5) **Appendix A** provides a list of available parameters for data recording. Parameters 0 to 28 are available for high-speed data recording. If **Number of parameters** is set to "**0**", the Data Recorder is disabled.

6) Modifying "**Recording Mode**", "**Recording Depth**", "**Recording Interval**", "**Recording Offset**", "**Number of Parameters**" and "**Parameters 1 to 16**" will clear the DRx Log and reset the DRx Pointer to "0".

5.5.3 Standard Data Recorder Setup Data Structure

Offset	Property	Description	Format	Range/Options
+0	RW	Trigged Mode[1]	UINT16	0=Disabled* 1=Triggered by Timer 2=Triggered by Setpoint
+1	RW	Recording Mode	UINT16	0=Stop-When-Full* 1=First-In-First-Out
+2	RW	Recording Depth[2]	UINT16	0 to 65535 (Default=5760)
+3	RW	Recording Interval	UINT32	1 to 3456000 (seconds) (Default=900)
+5	RW	Recording Offset[3]	UINT16	0* to 43200 (seconds)
+6	RW	Number of Parameters[4]	UINT16	0* to 16
+7	RW	Parameter 1	UINT16	0* to 328
+8	RW	Parameter 2	UINT16	0* to 328
+9	RW	Parameter 3	UINT16	0* to 328
+10	RW	Parameter 4	UINT16	0* to 328
+11	RW	Parameter 5	UINT16	0* to 328
+12	RW	Parameter 6	UINT16	0* to 328

+13	RW	Parameter 7	UINT16	0* to 328
+14	RW	Parameter 8	UINT16	0* to 328
+15	RW	Parameter 9	UINT16	0* to 328
+16	RW	Parameter 10	UINT16	0* to 328
+17	RW	Parameter 11	UINT16	0* to 328
+18	RW	Parameter 12	UINT16	0* to 328
+19	RW	Parameter 13	UINT16	0* to 328
+20	RW	Parameter 14	UINT16	0* to 328
+21	RW	Parameter 15	UINT16	0* to 328
+22	RW	Parameter 16	UINT16	0* to 328

* Default

Table 5-30 Standard DR Setup Data Structure

Notes:

1) The Standard Data Recorder can be triggered by Setpoint (**Triggered by Setpoint**) or on a time basis using the meter clock (**Triggered by Timer**).

   For **Triggered by Setpoint**, when the Setpoint goes active, the Data Recorder starts to record, and when the Setpoint becomes inactive, the Data Recorder stops.

2) If the “**Recording Depth**” is set to “**0**”, the Data Recorder will be disabled.

3) **Recording Offset** can be used to delay the recording by a fixed time from the **Recording Interval**. For example, if **Recording Interval** is set to 3600 (hourly) and **Recording Offset** is set to 300 (5 minutes), the recording will take place at 5 minutes after the hour every hour, i.e. 00:05, 01:05, 02:05…etc. The programmed value of **Recording Offset** should be less than that of **Recording Interval**.

4) **Appendix A** provides a list of available parameters for data recording. All parameters are available for standard data recording. If **Number of parameters** is set to “**0**”, the Data Recorder is disabled.

5) Modifying “**Recording Mode**”, “**Recording Depth**”, “**Recording Interval**”, “**Recording Offset**”, “**Number of Parameters**” and “**Parameters 1 to 16**” will clear the DRx Log and reset the **DRx Pointer** to “0”.

5.6 Energy Log

Register	Property	Description	Format	Note
7700	RW	Recording Mode	UINT16	0*=Disabled 1=Stop-When-Full 2= First-In-First-Out
7701	RW	Recording Depth[1]	UINT16	0 to 65535 (Default=5760)
7702	RW	Recording Interval	UINT16	0=5mins 1=10mins 2=15mins* 3=30mins

					4=60mins
7703	RW	Start Time[2]	High-order Byte: Year	UINT16	0-99 (Year-2000)
			Low-order Byte: Month		1 to 12
7704	RW		High-order Byte: Day	UINT16	1 to 31
			Low-order Byte: Hour		0 to 23
7705	RW		High-order Byte: Minute	UINT16	0 to 59
			Low-order Byte: Second		0 to 59
7706	RW	Number of Parameters		UINT16	0 to 5*
7707	RW	Parameter 1		UINT16	0=kWh Import* 1=kWh Export 2=kvarh Import 3=kvarh Export 4=kVAh
7708	RW	Parameter 2		UINT16	0=kWh Import 1=kWh Export* 2=kvarh Import 3=kvarh Export 4=kVAh
7709	RW	Parameter 3		UINT16	0=kWh Import 1=kWh Export 2=kvarh Import* 3=kvarh Export 4=kVAh
7710	RW	Parameter 4		UINT16	0=kWh Import 1=kWh Export 2=kvarh Import 3=kvarh Export* 4=kVAh
7711	RW	Parameter 5		UINT16	0=kWh Import 1=kWh Export 2=kvarh Import 3=kvarh Export 4=kVAh*
7712	RO	Record Size[3]		UINT16	Unit: Bytes

* Default

Table 5-31 Energy Log

Notes:

1) If "**Recording Depth**" is set to "**0**", the Energy Log is disabled.

2) When the current time meets or exceeds the "Start Time", the Interval Energy Log starts to record.

3) **Record Size** (Bytes)=**Number of Parameters***4+8.

Energy Log Size=**Recording Depth** * **Record Size**. The Log Size is rounded up to the nearest kB.

4) Modifying "**Recording Depth**", "**Recording Interval**", "**Start Time**", "**Number of Parameters**" and "**Parameter 1 to 5**" will clear the Energy Log and reset the **Energy Log Pointer** to "0".

5.7 Waveform Recorder Log Setup Parameters

The PMC-660 provides 2 independent groups of waveform recorders (**WFR**) with a combined total of 32 entries. Each Waveform Recorder Log can simultaneously capture 3-phase voltage and current signals at a maximum resolution of 256 samples per cycles.

Register	Property	Description		Format
7600	RW	**WFR Log 1**	Recording Depth[1]	0* to 32
7601	RW		# of Samples[2]	0= 16 1=32 2=64 3=128 4*=256
7602	RW		Number of Cycles[2]	320/160/80/40/20 (Default=10)
7603	RW		Pre-fault Cycles[3]	0* to 10
7604	RW	**WFR Log 2**	Recording Depth[1]	0* to 32
7605	RW		# of Samples[2]	0*= 16 1=32 2=64 3=128 4=256
7606	RW		Number of Cycles[2]	320*/160/80/40/20
7607	RW		Pre-fault Cycles[3]	0* to 10

Table 5-32 Waveform Recorder Log

Notes:

1) The total capacity of **WFR 1** and **WFR 2** is 32, i.e. **WFR Log 1 Recording Depth** + **WFR Log 2 Recording Depth** <= 32

2) The valid WFR formats (# of samples/cycle x # of cycles) include 16x320, 32x160, 64x80, 128x40 and 256x20.

3) When the WFR format is 256x20, the range of "**Pre-fault Cycle**" is between 0 and 5. Otherwise, the range is between 0 and 10.

4) WFR Log Size=(Number of Samples*Number of Cycle*2+10)*Recording Depth; The Log Size is rounded up to the nearest kB.

5) Modifying the Setup Parameters of WFRx will clear the WFRx Log and reset WFRx Pointer will be reset to "0".

5.8 PQ Log

Offset	Property	Description	Format
0 to 7	RO	PQ Log 1	See Section 5.13.6 PQ Log Data Structure
8 to 15	RO	PQ Log 2	
16 to 23	RO	PQ Log 3	
……	RO	……	
7992 to 7999	RO	PQ Log 1000	

Table 5-33 PQ Log

5.9 SOE Log

The SOE Pointer points to the register address within the SOE Log where the next event will be stored. The following formula is used to determine the register address of the most recent SOE event referenced by the SOE Pointer value:

Register Address = 10000 + Modulo((SOE Pointer-1) / 512)*8

Register	Property	Description	Format
10000 – 10007	RO	Event 1	See Section 5.13.7 SOE Log Data Structure
10008 – 10015	RO	Event 2	
10016 – 10023	RO	Event 3	
10024 – 10031	RO	Event 4	
10032 – 10039	RO	Event 5	
10040 -10047	RO	Event 6	
10048 – 10055	RO	Event 7	
10056 – 10063	RO	Event 8	
10064 – 10071	RO	Event 9	
10072 – 10079	RO	Event 10	
10080 – 10087	RO	Event 11	
10088 - 10195	RO	Event 12	
……			
14088 -4095	RO	Event 512	

Table 5-34 SOE Log

5.10 Time

There are two sets of Time registers supported by the PMC-660 - Year/Month/Day/Hour/Minute/Second (Register # 9000 to 9002) and UNIX Time (Register # 9004). When sending time to the PMC-660 over Modbus communications, care should be taken to only write one of the two Time register sets. All registers within a Time register set must be written in a single transaction. If registers 9000 to 9004 are being written to at the same time, both Time register sets will be updated to reflect the new time specified in the UNIX Time register set (9004) and the time specified in registers 9000-9002 will be ignored. Writing to the Millisecond register (9003) is optional during a Time Set operation. When broadcasting time, the function code must be set to 0x10 (Pre-set Multiple Registers). Incorrect date or time values will be rejected by the meter.

Register	Property	Description	Format	Note
9000	RW	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
9001	RW	High-order Byte: Day	UINT16	1 to 31
		Low-order Byte: Hour		0 to 23
9002	RW	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
9003	RW	Millisecond	UINT16	0 to 999
9004	RW	UINX Time	UINT32	(0 to 4102444799) This time shows the number of seconds since 00:00:00 January 1, 1970

Table 5-35 Time Registers

5.11 DO Control

The DO Control registers are implemented as "Write-Only" Modbus Coil Registers (0XXXXX) and can be controlled with the Force Single Coil command (Function Code 0x05). The PMC-660 does not support the Read Coils command (Function Code 0x01) because DO Control registers are "Write-Only". Register 0086 (DO Status) should be read instead to determine the current DO status.

The PMC-660 adopts the ARM before EXECUTE operation for the remote control of its Digital Outputs. Before executing an OPEN or CLOSE command on a Digital Output, it must be "Armed" first. This is achieved by writing the value 0xFF00 to the appropriate register to "Arm" a particular DO operation. The DO will be "Disarmed" automatically if an "Execute" command is not received within 15 seconds after it has been "Armed". If an "Execute" command is received without first having received an "Arm" command, the meter ignores the "Execute" command and returns the 0x04 exception code.

Register	Property	Description	Format	Note
9100	WO	Arm DO1 Close	UINT16	Writing "0xFF00"
9101	WO	Execute DO1 Close	UINT16	Writing "0xFF00"
9102	WO	Arm DO1 Open	UINT16	Writing "0xFF00"
9103	WO	Execute DO1 Open	UINT16	Writing "0xFF00"
9104	WO	Arm DO2 Close	UINT16	Writing "0xFF00"
9105	WO	Execute DO2 Close	UINT16	Writing "0xFF00"
9106	WO	Arm DO2 Open	UINT16	Writing "0xFF00"
9107	WO	Execute DO2 Open	UINT16	Writing "0xFF00"
9108	WO	Arm DO3 Close	UINT16	Writing "0xFF00"
9109	WO	Execute DO3 Close	UINT16	Writing "0xFF00"
9110	WO	Arm DO3 Open	UINT16	Writing "0xFF00"
9111	WO	Execute DO3 Open	UINT16	Writing "0xFF00"

Table 5-36 DO Control

5.12 Meter Information

Register	Property	Description	Format	Note

9800 - 9819	RO	Meter Model[1]	UINT16	
9820	RO	Firmware Version	UINT16	e.g. 10000 shows the version is V1.00.00
9821	RO	Protocol Version	UINT16	e.g. 10 shows the version is V1.0
9822	RO	Firmware Update Date: Year-2000	UINT16	e.g.110709 means July 9,2011
9823	RO	Firmware Update Date: Month	UINT16	
9824	RO	Firmware Update Date: Day	UINT16	
9825	RO	Serial Number: XX(Year-2000) - XX(Month) - XX(Lot Number) - XXXX(Meter Number)	UINT32	e.g. 0908471895 means that this meter was the 1895th meter manufactured in Lot 47 of August 2009
9827-9828		Reserved	UINT16	
9829	RO	Feature Code	UINT16	B3B2B1B0: 0000: 2xRS485+6DI+3DO 0001: 1xRS485+1xEthernet +6DI+3DO 0010: 2xRS485+6DI+2DO+1AO 0011: 1xRS485+1xEthernet +6DI+2DO+1AO Other: Reserved B5B4: 00: 5A I4 CT 01: 1A I4 CT 10: Analog Input 11: Reserved Other bits are reserved.
9830	RO	Current configuration	UINT16	0=1 (A) 1=5 (A)
9831	RO	Voltage configuration	UINT16	0=120 (V) 1=415 (V) 2=690 (V)

Table 5-37 Meter Information

Note:

1) The Meter Model appears in registers 9800 to 9819 and contains the ASCII encoding of the string “PMC-660” as shown in the following table.

Register	Value(Hex)	ANSCII
9800	0x50	P
9801	0x4D	M

9802	0x43	C
9803	0x2D	-
9804	0x36	6
9805	0x36	6
9806	0x30	0
9807-9819	0x20	<Null>

Table 5-38 ASCII Encoding of “PMC-660”

5.13 Data Format

5.13.1 Peak Demand Data Structure

Offset	Property	Description	Format	Note
+0	RO	Peak Demand	INT32	/
+2	RO	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
+3	RO	High-order Byte: Day	UINT16	1 to 31
		Low-order Byte: Hour		0 to 23
+4	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+5	RO	Millisecond	UINT16	0 to 999

Table5-39 DMD-LOG Data Structure

5.13.2 Max/Min Data Structure

Offset	Property	Description	Format	Note
+0	RO	Max/Min Value	INT32	-
+2	RO	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
+3	RO	High-order Byte: Day	UINT16	1 to 31
		Low-order Byte: Hour		0 to 23
+4	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+5	RO	Millisecond	UINT16	0 to 999

Table 5-40 Max-Min-LOG Data Structure

5.13.3 Data Recorder Data Structure

Offset	Property	Description	Format	Note
+0	RO	Parameter 1	INT32	/
+2	RO	Parameter 2	INT32	/
……	RO	……	INT32	/
+2N	RO	Parameter N (N=1 to 16)	INT32	/
+2N+1	RO	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
+2N+2	RO	High-order Byte: Day	UINT16	1 to 31

		Low-order Byte: Hour		0 to 23
+2N+3	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+2N+4	RO	Millisecond	UINT16	0 to 999

Table 5-41 DR-LOG Data Structure

5.13.4 Energy Log Data Structure

Offset	Property	Description	Format	Note
+0	RO	Parameter 1	INT32	-
+2	RO	Parameter 2	INT32	-
……	RO	……	INT32	-
+2N	RO	Parameter N (N=0 to 5)	INT32	-
+2N+1	RO	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
+2N+2	RO	High-order Byte: Day	UINT16	1 to 31
		Low-order Byte: Hour		0 to 23
+2N+3	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+2N+4	RO	Millisecond	UINT16	0 to 999

Table 5-42 Energy Log Data Structure

5.13.5 Waveform Recorder Setup Data Structure

The WF data contains the secondary side value. The Voltage data returned is 10 times of the actual secondary Voltage and the Current data is 1000 times of the actual secondary Current. Therefore, the primary side Voltage and Current values are calculated using the following formulas:

Primary Voltage Value = Voltage Data × PT Ratio ÷ 10

Primary Current Value = Current Data × CT Ratio ÷ 1000

Offset	Property	Description	Format	Note
+0	RO	Trigger Mode	UINT16	0=Disabled* 1=Manual 2=Setpoint 3=Sag/Swell
+1	RO	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
+2	RO	High-order Byte: Day	UINT16	1 to 31
		Low-order Byte: Hour		0 to 23
+3	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+4	RO	Millisecond	UINT16	0 to 999
+5 to N+4	RO	Va sample value (1 to $N^{\#}$)	UINT16	x10, V
+N+5 to 2N+4	RO	Vb sample value (1 to $N^{\#}$)	UINT16	x10, V
+2N+5 to 3N+4	RO	Vc sample value (1 to $N^{\#}$)	UINT16	x10, V
3N+5 to 4N+4	RO	Ia sample value (1 to $N^{\#}$)	UINT16	x1000, A

+4N+5 to 5N+4	RO	Ib sample value (1 to N[#])	UINT16	x1000, A
+5N+5 to 6N+4	RO	Ic sample value (1 to N[#])	UINT16	x1000, A

[#]N=# of Samples

Table 5-43 WFR Data Structure

5.13.6 PQ Log Data Structure

Offset	Property	Description	Format	Note
+0	RO	Reserved	UINT16	/
+1	RO	High-order Byte: Classification	UINT16	7
		Low-order Byte: Sub-Classification[1]		1 to 3
+2	RO	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
+3	RO	High-order Byte: Hour	UINT16	1 to 31
		Low-order Byte: Minute		0 to 23
+4	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+5	RO	Millisecond	UINT16	0 to 999
+6[4, #]	RO	Maximum VLN Disturbance %[2] / Maximum VLN Transient %[3]	INT32	x100, %
+8[4, #]	RO	Duration (µs)	INT32	µs
+10[4, #]	RO	Maximum Va Disturbance %[2] / Maximum Va Transient %[3]	INT32	x100, %
+12[4, #]	RO	Maximum Vb Disturbance %[2] / Maximum Vb Transient %[3]	INT32	x100, %
+14[4, #]	RO	Maximum Vc Disturbance %[2] / Maximum Vc Transient %[3]	INT32	x100, %

[#] Available in firmware version V1.00.04 or later

Table 5-44 PQ Log Data Structure

Notes:

1) The PQ Log Classification is 7. And the following table shows the Sub-Classifications:

Sub-Classification	Description
1	Voltage Sag/Swell Active
2	Voltage Sag/Swell Inactive
3	Voltage Transient

Table 5-45 PQ Sub-Classifications

2) For Sag/Swell Inactive events, Maximum Va/Vb/Vc Disturbance% = $\frac{Va/b/c_{max} - V_{nominal}}{V_{nominal}} X100\%$

Maximum VLN Disturbance% is the maximum value of Va/Vb/Vc Disturbance%.

3) For Transient events, Maximum Va/Vb/Vc Transient % = $\frac{V\,a/b/c_{max}}{V_{nominal}}$ X100%

Maximum VLN Transient% is the maximum value of Va/Vb/Vc Transient%.

4) For Sag/Swell Active events, Register +6 to +14 are reserved.

5.13.7 SOE Log Data Structure

Offset	Properties	Description	Format	Note
+0	RO	Reserved	UINT16	-
+1	RO	High-order Byte: Event Classification	UINT16	See Appendix B
		Low-order Byte: Sub-Classification		See Appendix B
+2	RO	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
+3	RO	High-order Byte: Day	UINT16	1 to 31
		Low-order Byte: Hour		0 to 23
+4	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+5	RO	Millisecond	UNIT16	0 to 999
+6	RO	Event Value	INT32	-

Table 5-46 SOE Log Data Structure

Revision History

Revision	Date	Description
1.0A	20120612	First Edition

Appendix A - Data Recorder Parameter

Key	Parameters	Scale/Unit	Key	Parameters	Scale/Unit
0	Va	x100, V	1	Vb	x100, V
2	Vc	x100, V	3	VLN average	x100, V
4	Vab	x100, V	5	Vbc	x100, V
6	Vca	x100, V	7	VLL average	x100, V
8	Ia	x1000, A	9	Ib	x1000, A
10	Ic	x1000, A	11	I average	x1000, A
12	I4	x1000, A	13	kWa	W
14	kWb	W	15	kWc	W
16	∑kW	W	17	kvara	var
18	kvarb	var	19	kvarc	var
20	∑kvar	var	21	kVAa	VA
22	kVAb	VA	23	kVAc	VA
24	∑kVA	VA	25	P.F.a	x1000
26	P.F.b	x1000	27	P.F.c	x1000
28	∑P.F.	x1000	29	Frequency	x100, Hz
30	Counter #1 (DI1)	/	31	Counter #2 (DI2)	/
32	Counter #3 (DI3)	/	33	Counter #4 (DI4)	/
34	Counter #5 (DI5)	/	35	Counter #6 (DI6)	/
36	Voltage Unbalance	x1000	37	Current Unbalance	x1000
38	Ia K-factor	x10	39	Ib K-factor	x10
40	Ic K-factor	x10	41	Va THD	x10000
42	Vb THD	x10000	43	Vc THD	x10000
44	Va TOHD	x10000	45	Vb TOHD	x10000
46	Vc TOHD	x10000	47	Va TEHD	x10000
48	Vb TEHD	x10000	49	Vc TEHD	x10000
50	Ia THD	x10000	51	Ib THD	x10000
52	Ic THD	x10000	53	Ia TOHD	x10000
54	Ib TOHD	x10000	55	Ic TOHD	x10000
56	Ia TEHD	x10000	57	Ib TEHD	x10000
58	Ic TEHD	x10000	59	Va 2nd Harmonic	x10000
60	Vb 2nd Harmonic	x10000	61	Vc 2nd Harmonic	x10000
62	Va 3rd Harmonic	x10000	63	Vb 3rd Harmonic	x10000
64	Vc 3rd Harmonic	x10000	65	Va 4th Harmonic	x10000
66	Vb 4th Harmonic	x10000	67	Vc 4th Harmonic	x10000
68	Va 5th Harmonic	x10000	69	Vb 5th Harmonic	x10000
70	Vc 5th Harmonic	x10000	71	Va 6th Harmonic	x10000
72	Vb 6th Harmonic	x10000	73	Vc 6th Harmonic	x10000
74	Va 7th Harmonic	x10000	75	Vb 7th Harmonic	x10000
76	Vc 7th Harmonic	x10000	77	Va 8th Harmonic	x10000
78	Vb 8th Harmonic	x10000	79	Vc 8th Harmonic	x10000
80	Va 9th Harmonic	x10000	81	Vb 9th Harmonic	x10000

81	Vc 9th Harmonic	x10000	**83**	Va 10th Harmonic	x10000
84	Vb 10th Harmonic	x10000	**85**	Vc 10th Harmonic	x10000
86	Va 11th Harmonic	x10000	**87**	Vb 11th Harmonic	x10000
88	Vc 11th Harmonic	x10000	**89**	Va 12th Harmonic	x10000
90	Vb 12th Harmonic	x10000	**91**	Vc 12th Harmonic	x10000
92	Va 13th Harmonic	x10000	**93**	Vb 13th Harmonic	x10000
94	Vc 13th Harmonic	x10000	**95**	Va 14th Harmonic	x10000
96	Vb 14th Harmonic	x10000	**97**	Vc 14th Harmonic	x10000
98	Va 15th Harmonic	x10000	**99**	Vb 15th Harmonic	x10000
100	Vc 15th Harmonic	x10000	**101**	Va 16th Harmonic	x10000
102	Vb 16th Harmonic	x10000	**103**	Vc 16th Harmonic	x10000
104	Va 17th Harmonic	x10000	**105**	Vb 17th Harmonic	x10000
106	Vc 17th Harmonic	x10000	**107**	Va 18th Harmonic	x10000
108	Vb 18th Harmonic	x10000	**109**	Vc 18th Harmonic	x10000
110	Va 19th Harmonic	x10000	**111**	Vb 19th Harmonic	x10000
112	Vc 19th Harmonic	x10000	**113**	Va 20th Harmonic	x10000
114	Vb 20th Harmonic	x10000	**115**	Vc 20th Harmonic	x10000
116	Va 21st Harmonic	x10000	**117**	Vb 21st Harmonic	x10000
118	Vc 21st Harmonic	x10000	**119**	Va 22nd Harmonic	x10000
120	Vb 22nd Harmonic	x10000	**121**	Vc 22nd Harmonic	x10000
122	Va 23rd Harmonic	x10000	**123**	Vb 23rd Harmonic	x10000
124	Vc 23rd Harmonic	x10000	**125**	Va 24th Harmonic	x10000
126	Vb 24th Harmonic	x10000	**127**	Vc 24th Harmonic	x10000
128	Va 25th Harmonic	x10000	**129**	Vb 25th Harmonic	x10000
130	Vc 25th Harmonic	x10000	**131**	Ia 2nd Harmonic	x10000
132	Ib 2nd Harmonic	x10000	**133**	Ic 2nd Harmonic	x10000
134	Ia 3rd Harmonic	x10000	**135**	Ib 3rd Harmonic	x10000
136	Ic 3rd Harmonic	x10000	**137**	Ia 4th Harmonic	x10000
138	Ib 4th Harmonic	x10000	**139**	Ic 4th Harmonic	x10000
140	Ia 5th Harmonic	x10000	**141**	Ib 5th Harmonic	x10000
142	Ic 5th Harmonic	x10000	**143**	Ia 6th Harmonic	x10000
144	Ib 6th Harmonic	x10000	**145**	Ic 6th Harmonic	x10000
146	Ia 7th Harmonic	x10000	**147**	Ib 7th Harmonic	x10000
148	Ic 7th Harmonic	x10000	**149**	Ia 8th Harmonic	x10000
150	Ib 8th Harmonic	x100000	**151**	Ic 8th Harmonic	x10000
152	Ia 9th Harmonic	x10000	**153**	Ib 9th Harmonic	x10000
154	Ic 9th Harmonic	x10000	**155**	Ia 10th Harmonic	x10000
156	Ib 10th Harmonic	x10000	**157**	Ic 10th Harmonic	x10000
158	Ia 11th Harmonic	x10000	**159**	Ib 11th Harmonic	x10000
160	Ic 11th Harmonic	x10000	**161**	Ia 12th Harmonic	x10000
162	Ib 12th Harmonic	x10000	**163**	Ic 12th Harmonic	x10000
164	Ia 13th Harmonic	x10000	**165**	Ib 13th Harmonic	x10000
166	Ic 13th Harmonic	x10000	**167**	Ia 14th Harmonic	x10000

168	Ib 14th Harmonic	x10000	**169**	Ic 14th Harmonic	x10000
170	Ia 15th Harmonic	x10000	**171**	Ib 15th Harmonic	x10000
172	Ic 15th Harmonic	x10000	**173**	Ia 16th Harmonic	x10000
174	Ib 16th Harmonic	x10000	**175**	Ic 16th Harmonic	x10000
176	Ia 17th Harmonic	x10000	**177**	Ib 17th Harmonic	x10000
178	Ic 17th Harmonic	x10000	**179**	Ia 18th Harmonic	x10000
180	Ib 18th Harmonic	x10000	**181**	Ic 18th Harmonic	x10000
182	Ia 19th Harmonic	x10000	**183**	Ib 19th Harmonic	x10000
184	Ic 19th Harmonic	x10000	**185**	Ia 20th Harmonic	x10000
186	Ib 20th Harmonic	x10000	**187**	Ic 20th Harmonic	x10000
188	Ia 21st Harmonic	x10000	**189**	Ib 21st Harmonic	x10000
190	Ic 21st Harmonic	x10000	**191**	Ia 22nd Harmonic	x10000
192	Ib 22nd Harmonic	x10000	**193**	Ic 22nd Harmonic	x10000
194	Ia 23rd Harmonic	x10000	**195**	Ib 23rd Harmonic	x10000
196	Ic 23rd Harmonic	x10000	**197**	Ia 24th Harmonic	x10000
198	Ib 24th Harmonic	x10000	**199**	Ic 24th Harmonic	x10000
200	Ia 25th Harmonic	x10000	**201**	Ib 25th Harmonic	x10000
202	Ic 25th Harmonic	x10000	**203**	Va Demand	x100, V
204	Vb Demand	x100, V	**205**	Vc Demand	x100, V
206	VLN avg. Demand	x100, V	**207**	Vab Demand	x100, V
208	Vbc Demand	x100, V	**209**	Vca Demand	x100, V
210	VLL avg. Demand	x100, V	**211**	Ia Demand	x1000, A
212	Ib Demand	x1000, A	**213**	Ic Demand	x1000, A
214	I avg. Demand	x1000, A	**215**	I4 Demand	x1000, A
216	kWa Demand	W	**217**	kWb Demand	W
218	kWc Demand	W	**219**	∑kW Demand	W
220	kvara Demand	var	**221**	kvarb Demand	var
222	kvarc Demand	var	**223**	∑kvar Demand	var
224	kVAa Demand	VA	**225**	kVAb Demand	VA
226	kVAc Demand	VA	**227**	∑kVA Demand	VA
228	P.F.a Demand	x1000	**229**	P.F.b Demand	x1000
230	P.F.c Demand	x1000	**231**	∑P.F. Demand	x1000
232	Freq. Demand	x100, Hz	**233**	U Unbalance Demand	x1000
234	I Unbalance Demand	x1000	**235**	Va THD Demand	x10000
236	Vb THD Demand	x10000	**237**	Vc THD Demand	x10000
238	Ia THD Demand	x10000	**239**	Ib THD Demand	x10000
240	Ic THD Demand	x10000	**241**	Va max per Demand Period	x100, V
242	Vb max per Demand Period	x100, V	**243**	Vc max per Demand Period	x100, V
244	VLN avg. max Per Demand Period	x100, V	**245**	Vab max per Demand Period	x100, V
246	Vbc max	x100, V	**247**	Vca max	x100, V

	per Demand Period			per Demand Period	
248	VLL avg. max per Demand Period	x100, V	**249**	Ia max per Demand Period	x1000, A
250	Ib max per Demand Period	x1000, A	**251**	Ic max per Demand Period	x1000, A
252	I avg. max Per Demand Period	x1000, A	**253**	I4 max per Demand Period	x1000, A
254	kWa max per Demand Period	W	**255**	kWb max per Demand Period	W
256	kWc max per Demand Period	W	**257**	∑kW max per Demand Period	W
258	kvara max per Demand Period	var	**259**	kvarb max per Demand Period	var
260	kvarc max per Demand Period	var	**261**	∑kvar max per Demand Period	var
262	kVAa max per Demand Period	VA	**263**	kVAb max per Demand Period	VA
264	kVAc max per Demand Period	VA	**265**	∑kVA max per Demand Period	VA
266	P.F.a max per Demand Period	x1000	**267**	P.F.b max per Demand Period	x1000
268	P.F.c max per Demand Period	x1000	**269**	∑P.F. max per Demand Period	x1000
270	Freq. max per Demand Period	x100, Hz	**271**	U Unbalance max Per Demand Period	x1000
272	I Unbalance max Per Demand Period	x1000	**273**	Va THD max per Demand Period	x10000
274	Vb THD max per Demand Period	x10000	**275**	Vc THD max per Demand Period	x10000
276	Ia THD max per Demand Period	x10000	**277**	Ib THD max per Demand Period	x10000
278	Ic THD max per Demand Period	x10000	**279**	Va min per Demand Period	x100, V
280	Vb min per Demand Period	x100, V	**281**	Vc min per Demand Period	x100, V
282	VLN avg. min Per Demand Period	x100, V	**283**	Vab min per Demand Period	x100, V
284	Vbc min per Demand Period	x100, V	**285**	Vca min per Demand Period	x100, V
286	VLL avg. min Per Demand Period	x100, V	**287**	Ia min per Demand Period	x1000, A
288	Ib min per Demand Period	x1000, A	**289**	Ic min per Demand Period	x1000, A

290	I avg. min per Demand Period	x1000, A	**291**	I4 min per Demand Period	x1000, A
292	kWa min per Demand Period	W	**293**	kWb min per Demand Period	W
294	kWc min per Demand Period	W	**295**	∑kW min per Demand Period	W
296	kvara min per Demand Period	var	**297**	kvarb min per Demand Period	var
298	kvarc min per Demand Period	var	**299**	∑kvar min per Demand Period	var
300	kVAa min per Demand Period	VA	**301**	kVAb min per Demand Period	VA
302	kVAc min per Demand Period	VA	**303**	∑kVA min per Demand Period	VA
304	P.F.a min per Demand Period	x1000	**305**	P.F.b min per Demand Period	x1000
306	P.F.c min per Demand Period	x1000	**307**	∑P.F. min per Demand Period	x1000
308	Freq. min Per Demand Period	x100, Hz	**309**	U Unbalance min per Demand Period	x1000
310	I Unbalance per Demand Period	x1000	**311**	Va THD min per Demand Period	x100, V
312	Vb THD min per Demand Period	x10000	**313**	Vc THD min per Demand Period	x10000
314	Ia THD min per Demand Period	x10000	**315**	Ib THD min per Demand Period	x10000
316	Ic THD min per Demand Period	x10000	**317**	dVa/dVab	x100, V
318	dVb/dVbc	x100, V	**319**	dVc/dVca	x100, V
320	dIa	x1000, A	**321**	dIb	x1000, A
322	dIc	x1000, A	**323**	kWh Import*,#	kWh
324	kWh Export*,#	kWh	**325**	∑kWh*,#	kWh
326	kvarh Import*,#	kvarh	**327**	kvarh Export*,#	kvarh
328	∑kvarh*,#	kvarh			

*** Parameters # 323 to 328 are accumulative energy values.**

 # Available in firmware version V1.00.04 or later

Appendix B - Event Classification

Event Classification	Sub-Classification	Event Value Scale/Option	Description
1	1	1/0	DI1 Close/DI1 Open
	2	1/0	DI2 Close/DI2 Open
	3	1/0	DI3 Close/DI3 Open
	4	1/0	DI4 Close/DI4 Open
	5	1/0	DI5 Close/DI5 Open
	6	1/0	DI6 Close/DI6 Open
2	1	1/0	DO1 Operated/Released by Remote Control
	2	1/0	DO2 Operated/Released by Remote Control
	3	1/0	DO3 Operated/Released by Remote Control
	4	1/0	DO1 Operated/Released by Setpoint
	5	1/0	DO2 Operated/Released by Setpoint
	6	1/0	DO3 Operated/Released by Setpoint
	7	1/0	DO1 Operated/Released by Sag/swell
	8	1/0	DO2 Operated/Released by Sag/swell
	9	1/0	DO3 Operated/Released by Sag/swell
	10	1/0	DO1 Operated/Released by Transient
	11	1/0	DO2 Operated/Released by Transient
	12	1/0	DO3 Operated/Released by Transient
3	1	Trigger Value (x100)	Over VLN Setpoint Active
	2	Trigger Value (x100)	Over VLL Setpoint Active
	3	Trigger Value (x1000)	Over Current Setpoint Active
	4	Trigger Value (x1000)	Over I4 Setpoint Active
	5	Trigger Value (x100)	Over Freq. Deviation Setpoint Active
	6	Trigger Value	Over ∑kW Setpoint Active
	7	Trigger Value	Over ∑kvar Setpoint Active
	8	Trigger Value (x1000)	Over ∑P.F. Setpoint Active
	9	1	DI1 Close Setpoint Active
	10	1	DI2 Close Setpoint Active
	11	1	DI3 Close Setpoint Active
	12	1	DI4 Close Setpoint Active
	13	1	DI5 Close Setpoint Active
	14	1	DI6 Close Setpoint Active
	15	Trigger Value	Over AI Setpoint Active
	16	Trigger Value	Over ∑kW Demand Setpoint Active

	17	Trigger Value	Over ∑kvar Demand Setpoint Active
	18	Trigger Value (x1000)	Over ∑P.F. Demand Setpoint Active
	19	Trigger Value	Over ∑kW Predicted Setpoint Active
	20	Trigger Value	Over ∑kvar Predicted Setpoint Active
	21	Trigger Value (x1000)	Over ∑P.F. Predicted Setpoint Active
	22	Trigger Value (x100)	Over Voltage THD Setpoint Active
	23	Trigger Value (x100)	Over Voltage TOHD Setpoint Active
	24	Trigger Value (x100)	Over Voltage TEHD Setpoint Active
	25	Trigger Value (x100)	Over Current THD Setpoint Active
	26	Trigger Value (x100)	Over Current TOHD Setpoint Active
	27	Trigger Value (x100)	Over Current TEHD Setpoint Active
	28	Trigger Value (x10)	Over Voltage Unbalance Setpoint Active
	29	Trigger Value (x10)	Over Current Unbalance Setpoint Active
	30	Trigger Value (x100)	Over Voltage Deviation Setpoint Active
	31	1	Over Phase Reversal Setpoint Active
	46	Return Value (x100)	Over VLN Setpoint Return
	47	Return Value (x100)	Over VLL Setpoint Return
	48	Return Value (x1000)	Over Current Setpoint Return
	49	Return Value (x1000)	Over I4 Setpoint Return
	50	Return Value (x100)	Over Freq. Deviation Setpoint Return
	51	Return Value	Over ∑kW Setpoint Return
	52	Return Value	Over ∑kvar Setpoint Return
	53	Return Value (x1000)	Over ∑P.F. Setpoint Return
	54	0	DI1 Close Setpoint Return
	55	0	DI2 Close Setpoint Return
	56	0	DI3 Close Setpoint Return

	57	0	DI4 Close Setpoint Return
	58	0	DI5 Close Setpoint Return
	59	0	DI6 Close Setpoint Return
	60	Return Value	Over AI Setpoint Return
	61	Return Value	Over ∑kW Demand Setpoint Return
	62	Return Value	Over ∑kvar Demand Setpoint Return
	63	Return Value (x1000)	Over ∑P.F. Demand Setpoint Return
	64	Return Value	Over ∑kW Predicted Setpoint Return
	65	Return Value	Over ∑kvar Predicted Setpoint Return
	66	Return Value (x1000)	Over ∑P.F. Predicted Setpoint Return
	67	Return Value (x100)	Over Voltage THD Setpoint Return
	68	Return Value (x100)	Over Voltage TOHD Setpoint Return
	69	Return Value (x100)	Over Voltage TEHD Setpoint Return
	70	Return Value (x100)	Over Current THD Setpoint Return
	71	Return Value (x100)	Over Current TOHD Setpoint Return
	72	Return Value (x100)	Over Current TEHD Setpoint Return
	73	Return Value (x10)	Over Voltage Unbalance Setpoint Return
	74	Return Value (x10)	Over Current Unbalance Setpoint Return
	75	Return Value (x100)	Over Voltage Deviation Setpoint Return
	76	0	Over Phase Reversal e Setpoint Return
	91	Trigger Value (x100)	Under VLN Setpoint Active
	92	Trigger Value (x100)	Under VLL Setpoint Active
	93	Trigger Value (x1000)	Under Current Setpoint Active
	94	Trigger Value (x1000)	Under I4 Setpoint Active
	95	Trigger Value (x100)	Under Freq. Deviation Setpoint Active
	96	Trigger Value	Under ∑kW Setpoint Active
	97	Trigger Value	Under ∑kvar Setpoint Active

	98	Trigger Value (x1000)	Under ∑P.F. Setpoint Active
	99	0	DI1 Open Setpoint Active
	100	0	DI2 Open Setpoint Active
	101	0	DI3 Open Setpoint Active
	102	0	DI4 Open Setpoint Active
	103	0	DI5 Open Setpoint Active
	104	0	DI6 Open Setpoint Active
	105	Trigger Value	Under AI Setpoint Active
	106	Trigger Value	Under ∑kW Demand Setpoint Active
	107	Trigger Value	Under ∑kvar Demand Setpoint Active
	108	Trigger Value (x1000)	Under ∑P.F. Demand Setpoint Active
	109	Trigger Value	Under ∑kW Predicted Setpoint Active
	110	Trigger Value	Under ∑kvar Predicted Setpoint Active
	111	Trigger Value (x1000)	Under ∑P.F. Predicted Setpoint Active
	112	Trigger Value (x100)	Under Voltage THD Setpoint Active
	113	Trigger Value (x100)	Under Voltage TOHD Setpoint Active
	114	Trigger Value (x100)	Under Voltage TEHD Setpoint Active
	115	Trigger Value (x100)	Under Current THD Setpoint Active
	116	Trigger Value (x100)	Under Current TOHD Setpoint Active
	117	Trigger Value (x100)	Under Current TEHD Setpoint Active
	118	Trigger Value (x10)	Under Voltage Unbalance Setpoint Active
	119	Trigger Value (x10)	Under Current Unbalance Setpoint Active
	120	Trigger Value (x100)	Under Voltage Deviation Setpoint Active
	121	1	Under Phase Reversal Setpoint Active
	136	Return Value (x100)	Under VLN Setpoint Return
	137	Return Value (x100)	Under VLL Setpoint Return
	138	Return Value (x1000)	Under Current Setpoint Return
	139	Return Value	Under I4 Setpoint Return

		(x1000)	
	140	Return Value (x100)	Under Freq. Deviation Setpoint Return
	141	Return Value	Under ∑kW Setpoint Return
	142	Return Value	Under ∑kvar Setpoint Return
	143	Return Value (x1000)	Under ∑P.F. Setpoint Return
	144	1	DI1 Open Setpoint Return
	145	1	DI2 Open Setpoint Return
	146	1	DI3 Open Setpoint Return
	147	1	DI4 Open Setpoint Return
	148	1	DI5 Open Setpoint Return
	149	1	DI6 Open Setpoint Return
	150	Return Value	Under AI Setpoint Return
	151	Return Value	Under ∑kW Demand Setpoint Return
	152	Return Value	Under ∑kvar Demand Setpoint Return
	153	Return Value (x1000)	Under ∑P.F. Demand Setpoint Return
	154	Return Value	Under ∑kW Predicted Setpoint Return
	155	Return Value	Under ∑kvar Predicted Setpoint Return
	156	Return Value (x1000)	Under ∑P.F. Predicted Setpoint Return
	157	Return Value (x100)	Under Voltage THD Setpoint Return
	158	Return Value (x100)	Under Voltage TOHD Setpoint Return
	159	Return Value (x100)	Under Voltage TEHD Setpoint Return
	160	Return Value (x100)	Under Current THD Setpoint Return
	161	Return Value (x100)	Under Current TOHD Setpoint Return
	162	Return Value (x100)	Under Current TEHD Setpoint Return
	163	Return Value (x10)	Under Voltage Unbalance Setpoint Return
	164	Return Value (x10)	Under Current Unbalance Setpoint Return
	165	Return Value (x100)	Under Voltage Deviation Setpoint Return
	166	0	Under Phase Reversal Setpoint Return
4	1	0	Battery Voltage Low
	2	0	Power Supply of CPU Fault

	3	0	A/D Fault
	4	0	NVRAM Fault
	5	0	System Parameter Fault
	6	0	Calibration Parameter Fault
	7	0	Setpoint Parameter Fault
	8	0	Data Recorder Parameter Fault
	9	0	Waveform Recorder Parameter Fault
	10	0	Energy Log Parameter Fault
5	1	0	Power On
	2	0	Power Off
	3	0	Set Clock via Front Panel
	4	0	Setup Changes via Front Panel
	5	0	Clear DI Counter via Front Panel
	6	0	Clear SOE via Front Panel
	7	0	Clear PQ Log via Front Panel
	8	0	Clear Energy via Front Panel
	9	0	Clear Data Recorder Log via Front Panel
	10	0	Clear Waveform Recorder Log via Front Panel
	11	0	Clear Energy Log via Front Panel
	12	0	Clear Max/Min Log of This Month via Front Panel
	13	0	Clear Peak Demand of This Month via Front Panel
	14	0	Setup Changes via Communications
	15	0	Clear DI Counter via Communications
	16	0	Clear SOE via Communications
	17	0	Clear PQ Log via Communications
	18	0	Clear Energy via Communications
	19	0	Clear Data Recorder Log via Communications
	20	0	Clear Waveform Recorder Log via Communications
	21	0	Clear Energy Log via Communications
	22	0	Clear Max/Min Log of This Month via Communications
	23	0	Clear Peak Demand of This Month via Communications
6	1	0	WF Recorder Triggered by Remote Control
	2	Setpoint # X (X = 1 to 24)	WF Recorder Triggered by Setpoint # X
	3	0	WF Recorder Triggered by Sag/Swell
	4	Setpoint # X (X = 1 to 24)	Data Recorder Triggered by Setpoint # X
	5	Setpoint # X (X = 1 to 24)	High Speed Data Recorder Triggered by Setpoint # X
	6	0	Data Recorder Triggered by Say/Swell
	7	0	High Speed Data Recorder Triggered by Sag/Swell

	8	Setpoint # X (X = 1 to 24)	Alarm Email Triggered by Setpoint # X
	9	0	Alarm Email Triggered by Sag/Swell
	10	0	WF Recorder Triggered by Transient
	11	0	Standard Data Recorder Triggered by Transient
	12	0	High Speed Data Recorder Triggered by Transient
	13	0	Alarm Email Triggered by Transient

Appendix C - Technical Specifications

Voltage Inputs (V1, V2, V3, VN)	
Standard (Un)	240VLN/415VLL
Optional (Un)	69VLN/120VLL, 400VLN/690VLL
Range	10% to 120% Un
PT Ratio	1-10,000
Overload	1.2xUn continuous, 2xUn for 10s
Burden	<0.5VA @ 240V
Frequency	45-65Hz
Current Inputs (I11, I12, I21, I22, I31, I32, I41, I42)	
Standard (In / Imax)	5A / 10A
Optional (In / Imax)	1A / 2A
Range	0.1% to 200% In
CT Ratio	1-6,000 (5A) or 1-30,000 (1A)
Overload	2xIn continuous, 20xIn for 1s
Burden	<0.25VA @ 5A
Power Supply (L+, N-)	
Standard	95-415VAC/VDC ± 10%, 47-440Hz
Burden	<5W
Digital Inputs (DI1, DI2, DI3, DI4, DI5, DI6, DIC)	
Type	Dry contact, 24VDC internally wetted
Sampling	1000Hz
Hysteresis	20-2,000ms programmable
Digital Outputs (DO11, DO12, DO21, DO22, DO31, DO32)	
Type	Form A Mechanical Relay
Loading	8A@250VAC / 8A@24VDC, 5A@30VDC for DO1 5A@250VAC / 5A@30VDC for DO2 and DO3
LED Pulse Outputs (kWh, kvarh)	
Type	Optical
Pulse Constant	1000/3200/5000 imp/kxh
Analog Input (I41, I42)	
Type	0-20 / 4-20 mA
Overload	24 mA maximum
Analog Output (AO+, AO-)	
Type	0-20 / 4-20 mA
Loading	500 Ω maximum
Overload	24 mA maximum
Environmental Conditions	
Operating Temp.	-25°C to 70°C
Storage Temp.	-40°C to 85°C
Humidity	5% to 95% non-condensing
Atmospheric Pressure	70 kPa to 106 kPa
Pollution Degree	2
Measurement Category	CAT III

Mechanical Characteristics	
Enclosure	Aluminum Alloy
Panel Cutout	92x92 mm (3.62˝x3.62˝)
Unit Dimensions	96x96x125 mm (3.78˝x3.78˝×4.92˝)
Shipping Dimensions	170x145x155 mm (6.69˝x5.71˝×6.10˝)
IP Rating	52
Shipping Weight	1.1 kg

Accuracy

Parameters	Accuracy	Resolution
Voltage	±0.1% reading	0.01V
Current	±0.1% reading + 0.05% F.S.	0.001A
I4 Measured	±0.1% reading + 0.05% F.S.	0.001A
I4 Calculated	0.5% F.S.	0.001A
kW, KVA	IEC 62053-22 Class 0.2S	0.001k
kWh, kVAh	IEC 62053-22 Class 0.2S	0.01kXh
kvar, kvarh	IEC 62053-23 Class 2	0.001k / 0.01kvarh
P.F.	IEC 62053-22 Class 0.2S	0.001
Frequency	±0.01 Hz	0.01Hz
Harmonics	IEC 61000-4-7 Class A	0.01%
K-Factor	IEC 61000-4-7 Class A	0.1
Phase angles	±1°	0.1°
AI	±0.5% F.S.	-
AO	±0.5% F.S.	-

Appendix D - Standards Compliance

Safety Requirements	
LVD Directive 2006/95/EC	EN61010-1-1-2001
Insulation	IEC 60255-5-2000
Dielectric test	2kV @ 1 minute
Insulation resistance	>100MΩ
Impulse voltage	5kV, 1.2/50μs
Electromagnetic Compatibility EMC Directive 2004/108/EC (EN 61326: 2006)	
Immunity Tests	
Electrostatic discharge	IEC 61000-4-2: 2008 Level III
Radiated fields	IEC 61000-4-3: 2008 Level III
Fast transients	IEC 61000-4-4: 2004 Level IV
Surges	IEC 61000-4-5: 2005 Level IV
Conducted disturbances	IEC 61000-4-6: 2008 Level III
Magnetic Fields	IEC 61000-4-8: 2009 Level IV
Oscillatory waves	IEC 61000-4-12: 2006 Level III
Electromagnetic Emission	IEC 60255-25: 2000
Emission Tests	
Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment	EN 55011: 2009 (CISPR 11)
Limits and methods of measurement of radio disturbance characteristics of information technology equipment	EN 55022: 2006+A1: 2007 (CISPR 22)
Limits for harmonic current emissions for equipment with rated current ≤16 A	EN 61000-3-2: 2006+A1: 2009
Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤16 A	EN 61000-3-3: 2006
Emission standard for residential, commercial and light-industrial environments	EN 61000-6-3: 2007
Electromagnetic Emission Tests for Measuring Relays and Protection Equipment	IEC 60255-25: 2000

Mechanical Tests		
Vibration Test	Response	IEC 60255-21-1:1998 Level I
	Endurance	IEC 60255-21-1:1998 Level I
Shock Test	Response	IEC 60255-21-2:1998 Level I
	Endurance	IEC 60255-21-2:1998 Level I
Bump Test		IEC 60255-21-2:1998 Level I

CE

Appendix E - Ordering Guide

Ceiec Electric Technology *Version 20110804*

Product Code	Description
PMC-660 Power Quality Monitor	
Basic Function	
256 samples per cycle, Class 0.2S Compliant, 3-Phase Metering, Demands, Peak Demands, Min/Max, SOE Log, Ind. Har to 63rd, 4MB Log Memory, 16 Data Recorders, High-Speed Recording, WF Recording, Sag/Swell and Transient Detection	
Display Screen	
A	Integrated LCD Screen
Input Current (I1, I2, I3, I4#)	
5	5A
1	1A
Input Voltage (V1, V2, V3)	
1	69V/120V
3	240V/415V
9*	400V/690V
Power Supply	
2	95-415VAC/DC, 47-440Hz
System Frequency	
5	50Hz
6	60Hz
DI/DO/AO	
A	6DI + 3DO
B*	6DI + 2DO + 1AO (0-20mA or 4-20mA)
AI	
X	No
A*	1 Analog Input (0-20mA or 4-20mA)#
Communications	
B	2 RS-485 ports
D*	1 10/100BaseT Ethernet port + 1 RS-485 port
PMC-660 - A 5 3 2 5 A X B	**PMC-660-A5325AXB (Standard Model)**

* Additional charges apply

With AI option A , I4 is not available

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