PMC-660 Series

Advanced Power Quality Meter

User Manual

Version: V1.1A

August 14, 2018

The information contained in this Manual is believed to be accurate at the time of publication; however, CET assumes no responsibility for any errors which may appear here and reserves the right to make changes without notice. Please consult CET or your local representative for latest product specifications.

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

- CET 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. Throughout the manual the term “meter” generally refers to all models.

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 with 4MB memory, extensive I/O and an easy-to-read LCD display, capable of displaying 5 measurements at once. With standard dual RS-485 ports and optional 100BaseT Ethernet port as well as Modbus RTU and TCP protocols 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 Integrated Energy Management System. 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
- Utility, Industrial and Commercial Metering
- Substation, Building and Factory Automation
- Low, Medium and High Voltage applications
- Neutral (I4) or Residual/Leakage Current (via optional AI) Monitoring

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 True RMS Measurements (1 second update)

- 3-Phase Voltage, Current and Power measurements
- Neutral Current (I4) and Frequency
- kWh/kvarh Import/Export/Net/Total, kVAh Total
- kvarh Q1 - Q4
- Voltage and Current Phase Angles (equivalent to Vector Diagram)
- Interval Energy measurements for kWh Import/Export, kvarh Import/Export and kVAh with programmable **EN Period***
- Device Operating Time (Running Hours)*
- Calculated Residual Current (Ir)* with the I4 measurement option

*Available in Firmware V2.00.00 or later

High-speed RMS Measurements

- 3-phase Voltage @ ½ cycle
- 3-phase Current and Neutral Current (I4) and I0 @ 1 cycle
- 3-phase Power and Power Factor @ 1 cycle

Power Quality

- Waveform Recording at 256 samples per cycle
- Fundamental measurements for 3-Phase Voltage, Current, Power, PF
- Voltage and Current Unbalance
- Voltage and Frequency Deviation
- U and I Symmetrical Components*
- THD, TOHD, TEHD, K-Factor and Displacement PF
- Individual Harmonics up to 31st via Front Panel and 63rd via communications
- Dip/Swell Detection and Transient Capture
- PQ Log with 1000 entries

*Available in Firmware V2.00.00 or later

Sliding Window and Predicted Demands

- Demands and Predicted Demands for 3-Phase Voltage, Current, Power and PF as well as I4, Frequency, U and I Unbalance and THD
- Peak Demands with Timestamp for This Month and Last Month (or Since and Before Last Reset)
- Max./Min. values per demand interval
- Demand synchronization with DI

Setpoints

- 16 Standard Setpoints with extensive list of monitoring parameters including Voltage, Current, Power, Demands and THD, … etc.
- 8 High-Speed Setpoints for 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 Interval Energy Recorder Log

Multi-Tariff TOU Capability*

- Two independent sets of TOU Schedules
  - Up to 12 Seasons
  - 90 Holidays or Alternate Days
  - 20 Daily Profiles, each with 12 Periods with minimum 15-minute interval
  - 8 Tariffs, each providing kWh/kvarh Import/Export and kVAh
- Switch between two TOU schedules according to programmable time with the switching event stored in the SOE Log
- Tariff switching based on DI status*

*Available in Firmware V2.00.00 or later

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

Interval Energy Recorder Log

- Interval recording of kWh/kvarh Import/Export and kVAh Total
- Support FIFO or Stop-When-Full Recording Mode

Data Recorder Log

- 12 Standard Data Recorder Logs and 4 High-Speed Data Recorder Logs
- Recording interval from 1s to 40 days for standard and 1 to 60 cycles for High-Speed DR
- Programmable sources include almost all real-time measurements, Harmonics, Unbalance and Demand values
- Configurable Depth and Recording Offset
- 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
- Dip/Swell and Transient detection or other PQ events

Max./Min. Log

- Logging of Max./Min. values for measurements such as Voltage, Current, Frequency, kW, kvar, kVA, PF, Unbalance, K-factor, THD and Ir with Timestamp for This Month and Last Month (or Since and Before Last Reset)

Digital Inputs

- 6 channels, volts free dry contact, 24VDC internally wetted
- 1000Hz sampling for status monitoring with programmable debounce
- Pulse counting with programmable weight for each channel for collecting WAGES (Water, Air, Gas, Electricity, Steam) information
- Demand Synchronization
- Tariff switching based on DI status*

*Available in Firmware V2.00.00 or later

Digital Outputs

- Up to 3 channels Form A Mechanical Relays for alarming and control

Analog Input (Optional)

- 0/4-20mA DC input with programmable zero and full scales
- Can be used to measure external transducer signal such as Residual or Leakage Current

Analog Output (Optional)

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

Communications

- RS-485 (Port 1 and Port 2)
  - Optically isolated RS485 port
  - Baud rate from 1200 to 38,400bps
  - Modbus RTU protocol
- Ethernet (optional and replaces RS-485 P2)
  - 10/100BaseT Ethernet with RJ45 connection
  - Modbus RTU over TCP/IP, Modbus TCP, Ethernet Gateway, HTTP, SMTP, SNTP

Real-time clock

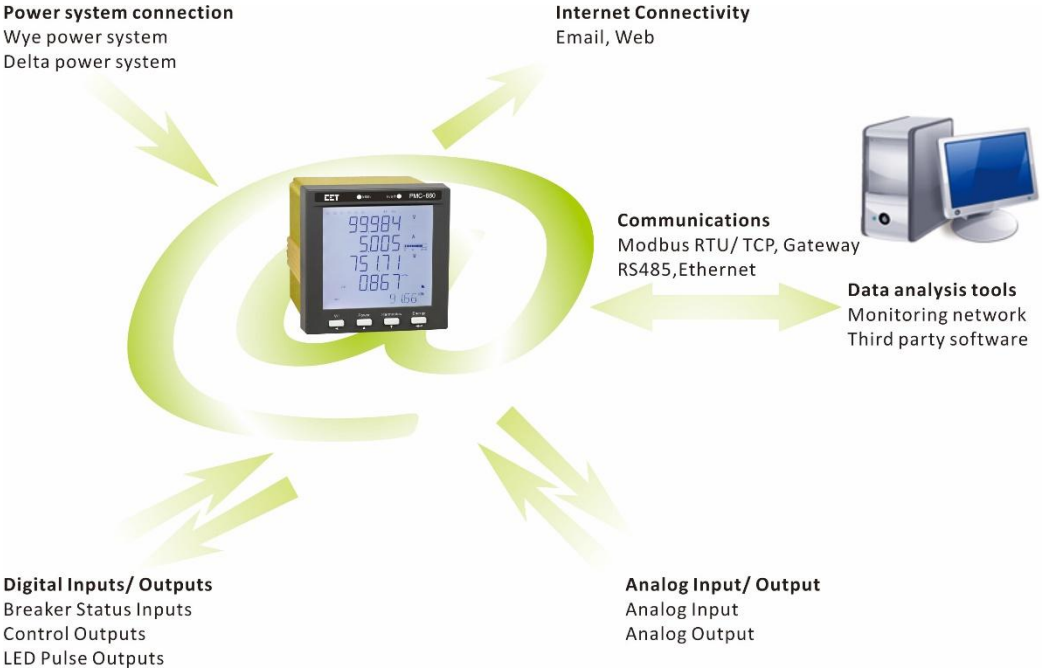
- Equipped with a battery-backed Real-time Clock with 6ppm accuracy (<0.5s per day)

System Integration

- Supported by CET's PecStar® iEMS and iEEM
- Easy integration into other Automation, SCADA or BMS 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.cet-global.com
- Contact your local representative
- Contact CET directly via email at support@cet-global.com

Chapter 2 Installation

Caution

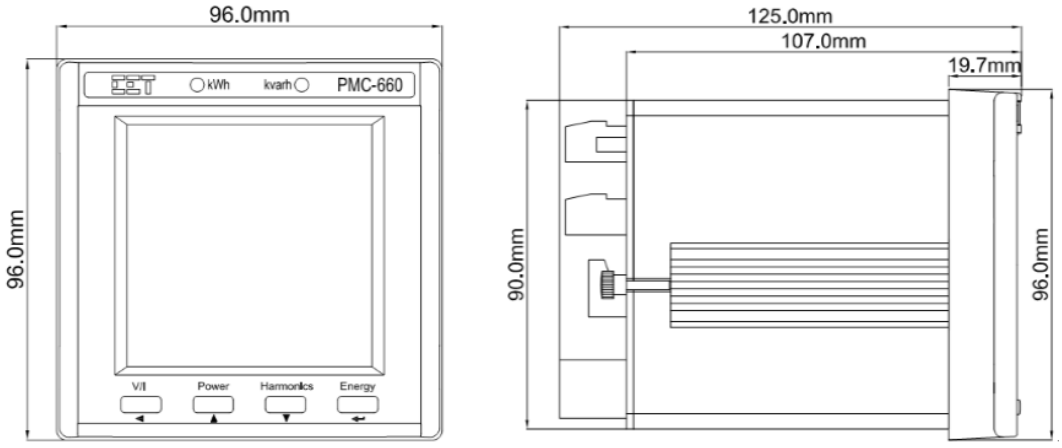
Installation of the PMC-660 should only be performed by qualified, competent personnel that have the appropriate training and experience with high voltage and current devices. The meter must be installed in accordance with all local and national electrical codes.

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 (RS485+6DIs+2DOs+AO)

2.2 Unit Dimensions



Front View **Side View**

Figure 2-2 Dimensions

2.3 Terminal Dimensions

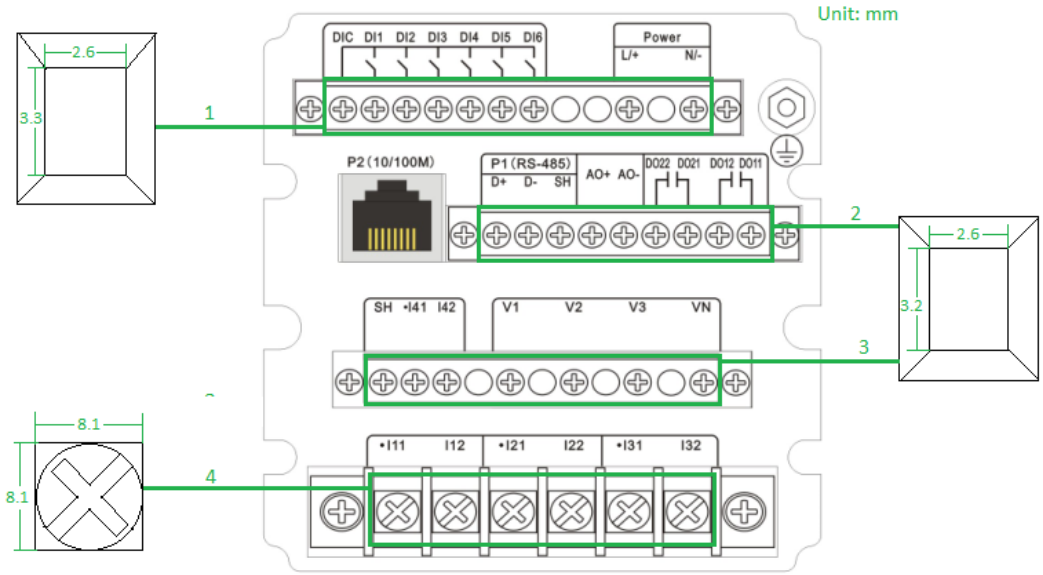


Figure 2-3 Terminal Dimensions

No.	Terminal	Terminal Dimensions	Wire Size	Max. Torque
1	DI	2.6mm x 3.3mm	1.5mm²	5 kgf.cm/M3 (4.3 lb-in)
	Power Supply			
2	RS485	2.6mm x 3.2mm		
	AO			
	DO			
3	I4 Input			
	Voltage Input			
4	Current Input	8.1mm x 8.1mm	1.0mm² - 2.5mm² (14AWG - 22AWG)	18.0 kgf.cm/M4 (15.6 lb-in)

Table 2-1 Terminal Dimensions

2.4 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 2-4
- Re-install the mounting slide bars and tighten the screws against the panel to secure the meter

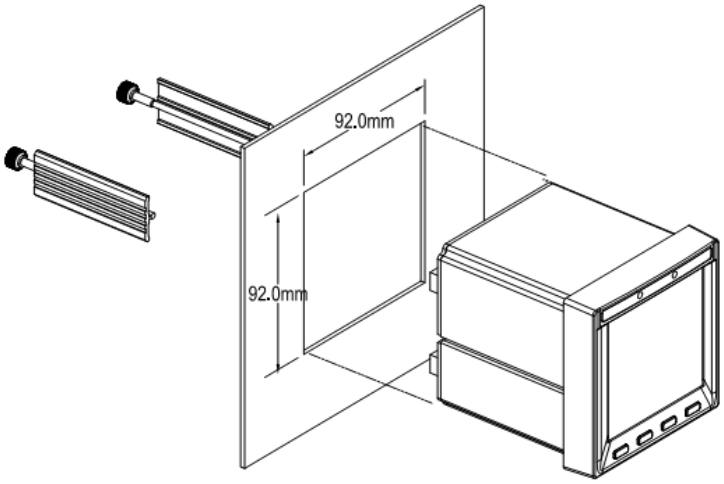


Figure 2-4 Panel Cutout

2.5 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 with 3CTs or 4CTs
- 3-Phase 4-Wire Wye with 3PTs and 3CTs or 4CTs
- 3-Phase 3-Wire Grounded Wye Direct Connection
- 3-Phase 3-Wire Grounded Wye with 3PTs and 3CTs
- 3-Phase 3-Wire Direct Connection with 3CTs or 2CTs
- 3-Phase 3-Wire Open Delta with 2PTs and 3CTs or 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.

2.5.1 3-Phase 4-Wire Wye Direct Connection with 3CTs or 4CTs

Please consult the serial number label to ensure that the rated system phase voltage is less than or equal to the meter's rated **Phase** voltage input specification. Set the **Wiring Mode** to **Wye**.

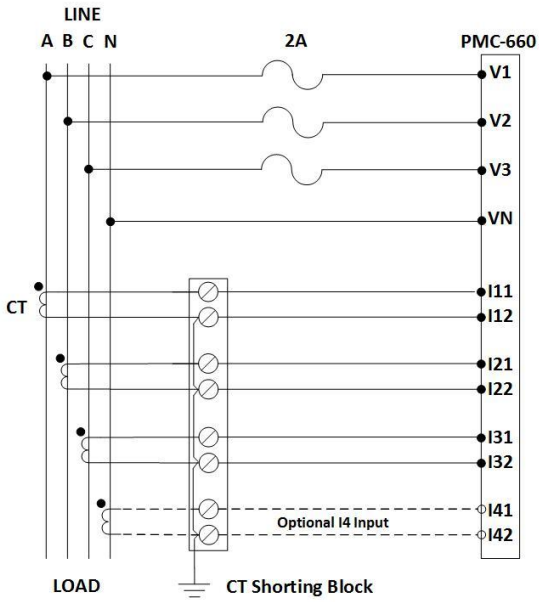


Figure 2-5 3P4W Wye Direct Connection with 3CTs or 4CTs (Optional I41 & I42)

2.5.2 3-Phase 4-Wire Wye with 3PTs and 3CTs or 4CTs

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

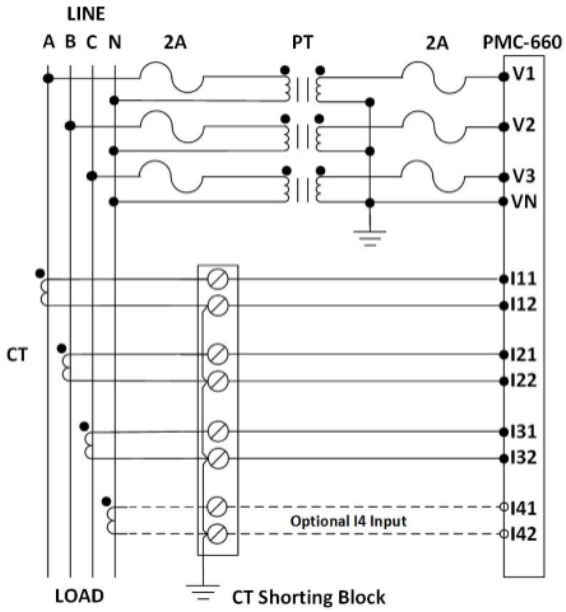


Figure 2-6 3P4W Wye with 3PTs and 3CTs or 4CTs (Optional I41 & I42)

2.5.3 3-Phase 3-Wire Grounded Wye

Please consult the serial number label to ensure that the system phase voltage is less than or equal to the meter's rated **Phase** voltage input specification. Set the **Wiring Mode** to **Wye**.

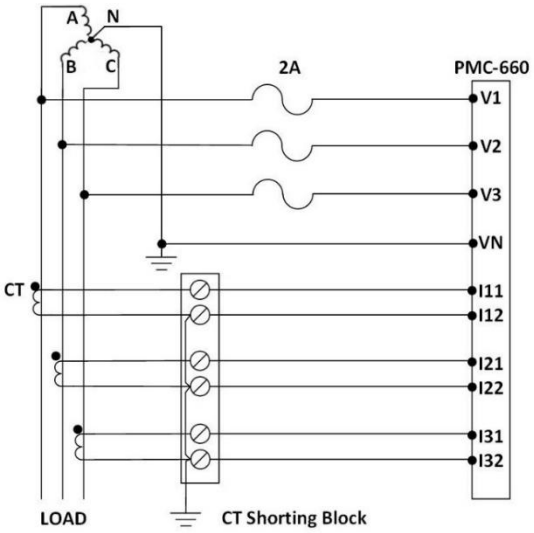


Figure 2-7 3P3W Grounded Wye with 3CTs

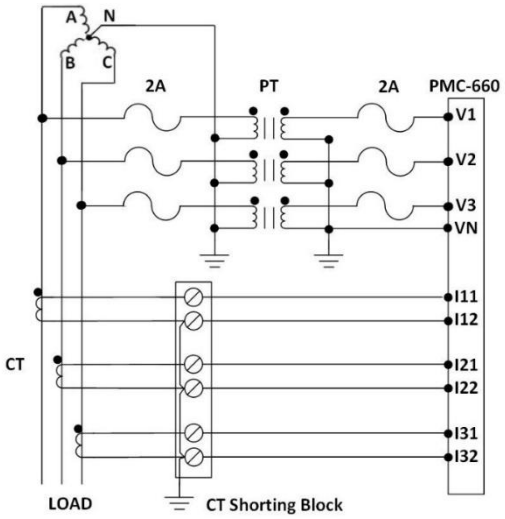


Figure 2-8 3P3W Grounded Wye with 3PTs & 3CTs

2.5.4 3-Phase 3-Wire Direct Delta Connection with 3CTs or 2CTs

Please consult the Serial Number Label to ensure that the rated Ull voltage is less than or equal to the meter's rated **Line** voltage input specification. Set the **Wiring Mode** to **3P3W**.

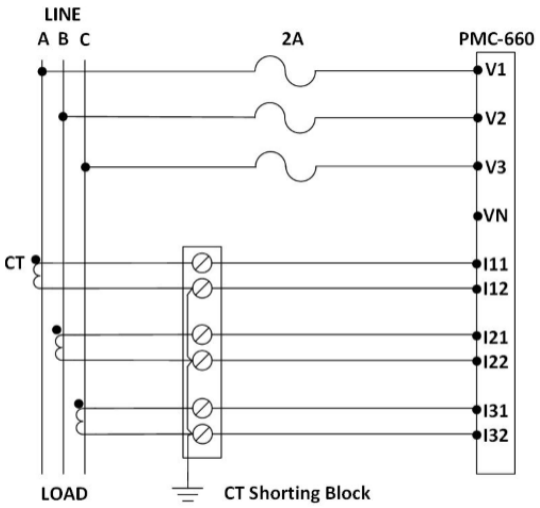


Figure 2-9 3P3W Direct Connection with 3CTs

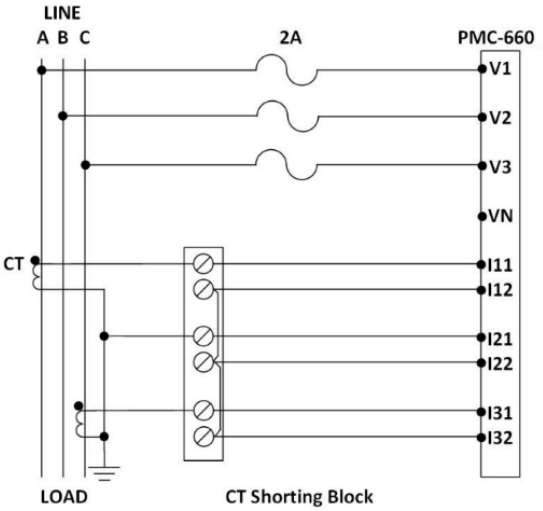


Figure 2-10 3P3W Direct Connection with 2CTs

2.5.5 3-Phase 3-Wire Open Delta with 2PTs and 3CTs or 2CTs

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

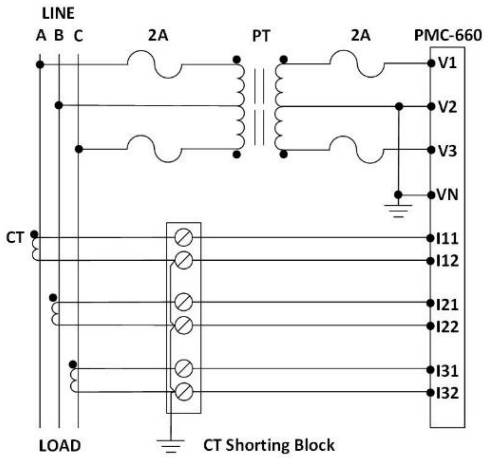


Figure 2-11 3P3W Open Delta with 2PTs & 3CTs

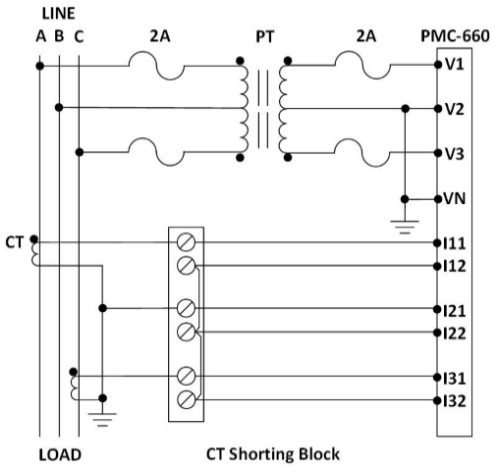


Figure 2-12 3P3W Open Delta with 2PTs & 2CTs

2.6 Communications Wiring

2.6.1 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, USB/RS485 or Ethernet/RS485 converter with optically isolated outputs and surge protection should be used.

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

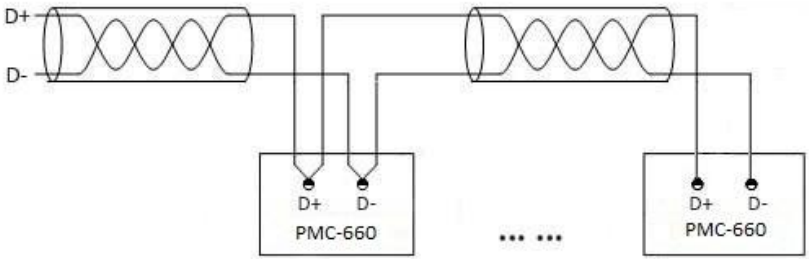


Figure 2-13 RS485 Communications Connections

2.6.2 Ethernet Port (10/100BaseT)

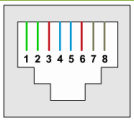
RJ45 Connector	Pin	Meaning
	1	Transmit Data+
	2	Transmit Data-
	3	Receive Data+
	4,5,7,8,	NC
	6	Receive Data-

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

2.7 Digital Input Wiring

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

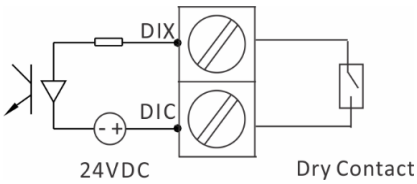


Figure 2-14 DI Connections

2.8 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:

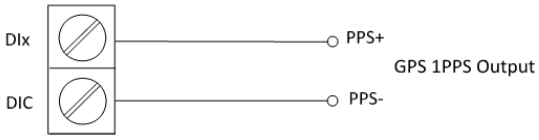


Figure 2-15 Time Sync. Connections

2.9 Digital Output Wiring

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

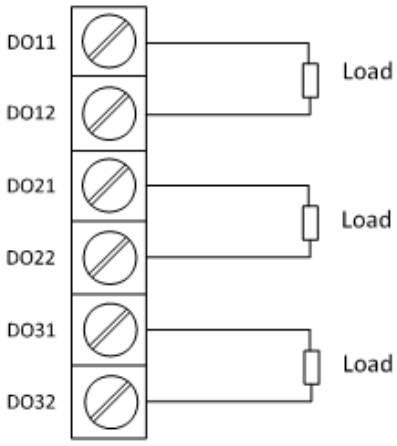


Figure 2-16 DO Connections

2.10 Analog Input Wiring

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

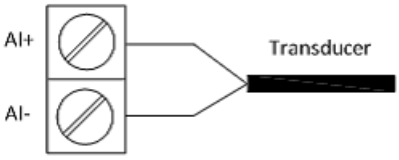


Figure 2-17 AI Connections

2.11 Analog Output Wiring

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

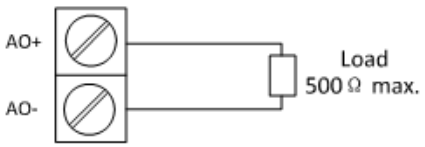


Figure 2-18 AO Connections

2.12 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.

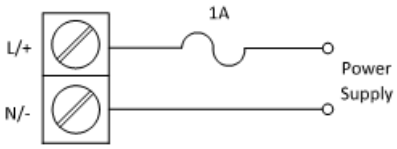


Figure 2-19 Power Supply Connections

2.13 Chassis Ground Wiring

Connect the G terminal to earth ground.

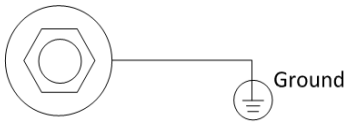


Figure 2-20 Chassis Ground connection

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

3.1 Display

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. All LCD segments are illuminated for 5 seconds and then turned off for 1 second during testing. This cycle will repeat 3 times to allow for the detection of faulty segments. The LCD will return to normal data display afterwards.

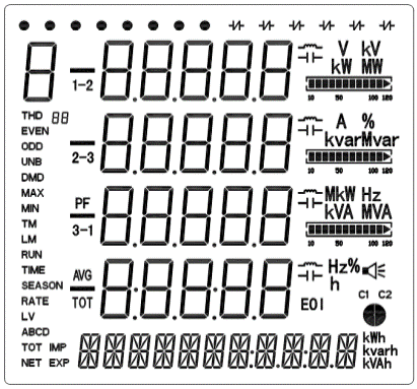


Figure 3-2 PMC-660 Full Display

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: Measurement symbols for parameters such as Voltage, Current, Fundamental, Power, THD, TOHD, TEHD, 2nd to 31st Individual Harmonics, K-Factor, Unbalance, PF, Voltage/Current Phase Angles and Demand, ...etc.

B: DI and DO Status Indicators

C: Measurement Units, Loading Factor and PF Quadrant status

D: Measurement values

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

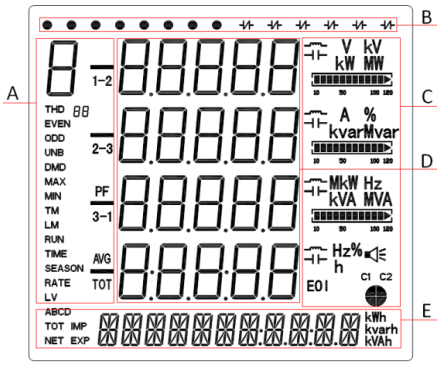


Figure 3-3 LCD Display

The following table shows the special LCD display symbols:

NO.	Label	Description			
A	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
	1-2 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 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 DeviceOperating Time	SEASON RATE LV Reserved

B		DI Open	DI Close	DO Open	DO Close
C&D		V kV A % Hz Units for Voltage, Current, %Harmonic 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
		Q2 Q1 Q3 Q4 PF Quadrant – Q1/Q2/Q3/Q4			h EOI 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
		Reserved	ABCD Reserved		

Table 3-1 LCD Display Symbols

3.1.3 Peak Demand/Max./Min. 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 Unit area.

a: Peak Demand/Max./Min. Indicator – Peak Demand/Max./Min. of This/Last Month:

b: Peak Demand/Max./Min. value

c: Date portion of the Peak Demand timestamp

d: Time portion of the Peak Demand timestamp

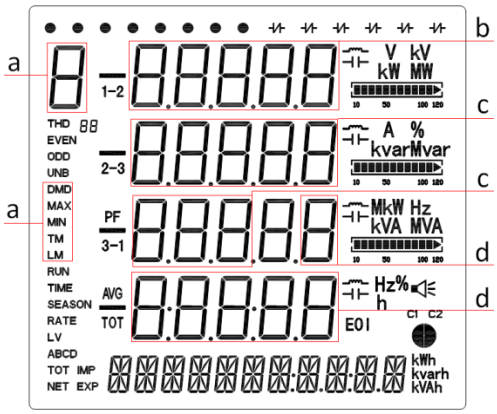


Figure 3-4 Peak Demand Display

Area	Symbol Description				
a	P kW	9 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/Max./Min. Value				
c	Peak Demand/Max./Min. Timestamp (Date Portion) - YYYY.MM.DD				
d	Peak Demand/Max./Min. Timestamp (Time Portion) – HH:MM:SS				

Table 3-2 Peak Demand/Max./Min. Display

3.2 Using the Front Panel Buttons

The button definitions under the **Data Display** and **Setup Configuration** mode are explained in the following table. **The default password is 0.**

Buttons	Data Display Mode	Setup Configuration Mode
<V/I> ◄	Pressing **<V/I>/**◄ views the following parameters - U, I, Freq., Phase Angle, Fundamental U/I, Unbalance, Sequence Components, I Demand and Max. Demand, Max Values for U, I, Freq., Unbalance, …etc.	• 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.
<Power> ▲	Pressing **<Power>/**▲ views the following parameters - P, Q, S, PF, Fundamental Power measurements, P/Q/S Demand & Max. Demand as well as Max. Values for P, Q, S, PF, …etc.	• 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 enumerated item in the selection list.
<Harmonics> ▼	Pressing **<Harmonics>/**▼ views the following parameters - THD, TEHD, TOHD, Individual Harmonics and Max. Values for THD and K-Factor, …etc.	• 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 returns to the last enumerated item in the selection list**.**
<Energy> ↵	Pressing **<Energy>/**↵ views the following parameters – kWh and kvarh Import / Export / Net / Total, kVAh and kWh Import/Export for the different Tariffs.	• Pressing this button for more than three seconds toggles between **Data Display** and **Setup Configuration**. • 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.

Table 3-3 Buttons Description

3.3 Data Display

Throughout this document, the phase-to-neutral notations of A/B/C and L1/L2/L3 as well as the phase-to-phase notations of AB/BC/CA and L12/L23/L31 may be used interchangeably for specifying a certain parameter to be a phase-to-neutral or phase-to-phase value, respectively.

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

Press Button	Display Screens	1st Row	2nd Row	3rd Row	4th Row
<V,I>	Display 1	Ull average	I average	kW Total	P.F. Total
	Display 2[1]	U1	U2	U3	Uln average
	Display 3	U12	U23	U31	Ull average
	Display 4	I1	I2	I3	I average
	Display 5[2]		I4 (Measured)		
	Display 6~#		I0 (Calculated Neutral Current)		
	Display 7~		Ir (Calculated)		
	Display 8[1]	dU1	dU2	dU3	dUln average
	Display9	dI1	dI2	dI3	dI average
	Display 10			Frequency	
	Display 11		U Unbalance		
	Display 12		I Unbalance		
	Display 13~		U1 SEQ	U2 SEQ	U0 SEQ
	Display 14~		I1 SEQ	I2 SEQ	I0 SEQ
	Display 15[3]		AI		
	Display 16	U1 Angle	U2 Angle	U3 Angle	
	Display 17	I1 Angle	I2 Angle	I3 Angle	
	Display 18~				Operating Time
	Display 19	I1 Demand	I2 Demand	I3 Demand	
	Display 20		I4 Demand		
	Display 21	I1 Peak Demand of This Month (Since Last Reset) with Timestamp			
	Display 22	I2 Peak Demand of This Month (Since Last Reset) with Timestamp			
	Display 23	I3 Peak Demand of This Month (Since Last Reset) with Timestamp			
	Display 24	I1 Peak Demand of Last Month (Before Last Reset) with Timestamp			
	Display 25	I2 Peak Demand of Last Month (Before Last Reset) with Timestamp			
	Display 26	I3 Peak Demand of Last Month (Before Last Reset) with Timestamp			
	Display 27~	U1 Max. of This Month (Since Last Reset) with Timestamp			
	Display 28~	U2 Max. of This Month (Since Last Reset) with Timestamp			
	Display 29~	U3 Max. of This Month (Since Last Reset) with Timestamp			
	Display 30~	Uln Avg. Max. of This Month (Since Last Reset) with Timestamp			
	Display 31~	I1 Max. of This Month (Since Last Reset) with Timestamp			
	Display 32~	I2 Max. of This Month (Since Last Reset) with Timestamp			
	Display 33~	I3 Max. of This Month (Since Last Reset) with Timestamp			
	Display 34~	I Avg. Max. of This Month (Since Last Reset) with Timestamp			
	Display 35~	I4 Max. of This Month (Since Last Reset) with Timestamp			
	Display 36~	Ir Max. of This Month (Since Last Reset) with Timestamp			
	Display 37~	U12 Max. of This Month (Since Last Reset) with Timestamp			
	Display 38~	U23 Max. of This Month (Since Last Reset) with Timestamp			
	Display 39~	U31 Max. of This Month (Since Last Reset) with Timestamp			
	Display 40~	Ull Avg. Max. of This Month (Since Last Reset) with Timestamp			
	Display 41~	Frequency Max. of This Month (Since Last Reset) with Timestamp			
	Display 42~	U Unbalance Max. of This Month (Since Last Reset) with Timestamp			
	Display 43~	I Unbalance Max. of This Month (Since Last Reset) with Timestamp			
	Display 44~	U1 Max. of Last Month (Before Last Reset) with Timestamp			
	Display 45~	U2 Max. of Last Month (Before Last Reset) with Timestamp			
	Display 46~	U3 Max. of Last Month (Before Last Reset)with Timestamp			
	Display 47~	Uln Avg. Max. of Last Month (Before Last Reset) with Timestamp			
	Display 48~	I1 Max. of Last Month (Before Last Reset) with Timestamp			
	Display 49~	I2 Max. of Last Month (Before Last Reset) with Timestamp			
	Display 50~	I3 Max. of Last Month (Before Last Reset) with Timestamp			
	Display 51~	I Avg. Max. of Last Month (Before Last Reset) with Timestamp			
	Display 52~	I4 Max. of Last Month (Before Last Reset) with Timestamp			
	Display 53~	Ir Max. of Last Month (Before Last Reset) with Timestamp			
	Display 54~	U12 Max. of Last Month (Before Last Reset) with Timestamp			
	Display 55~	U23 Max. of Last Month (Before Last Reset) with Timestamp			
	Display 56~	U31 Max. of Last Month (Before Last Reset) with Timestamp			
	Display 57~	Ull Avg. Max. of Last Month (Before Last Reset) with Timestamp			
	Display 58~	Frequency Max. of Last Month (Before Last Reset) with Timestamp			
	Display 59~	U Unbalance Max. of Last Month (Before Last Reset) with Timestamp			
	Display 60~	I Unbalance Max. of Last Month (Before Last Reset) with Timestamp			
<Power>	Display 1[1]	kWa	kWb	kWc	kW Total
	Display 2[1]	kvara	kvarb	kvarc	kvar Total
	Display 3[1]	kVAa	kVAb	kVAc	kVA Total

	Display 4[1]	P.F.a	P.F.b	P.F.c	P.F. Total
	Display 5[1]	dkWa	dkWb	dkWc	dkW Total
	Display 6[1]	dkvara	dkvarb	dkvarc	dkvar Total
	Display 7[1]	dkVAa	dkVAb	dkVAc	dkVA Total
	Display 8[1]	dP.F.a	dP.F.b	dP.F.c	dP.F. Total
	Display 9	kW Total	kvar Total	kVA Total	P.F. Total
	Display 10	dkW Total	dkvar Total	dkVA Total	dP.F. Total
	Display 11	kW Total Dmd	kvar Total Dmd	kVA Total Dmd	P.F. Total Dmd
	Display 12	kW Total Predicted Dmd	kvar Total Predicted Dmd	kVA Total Predicted Dmd	P.F. Total Predicted Dmd
	Display 13	kW Peak Dmd of This Month (Since Last Reset) with Timestamp			
	Display 14	kvar Peak Dmd of This Month (Since Last Reset) with Timestamp			
	Display 15	kVA Peak Dmd of This Month (Since Last Reset) with Timestamp			
	Display 16	kW Peak Dmd of Last Month (Before Last Reset) with Timestamp			
	Display 17	kvar Peak Dmd of Last Month (Before Last Reset) with Timestamp			
	Display 18	kVA Peak Dmd of Last Month (Before Last Reset) with Timestamp			
	Display 19~	kW Total Max. of This Month (Since Last Reset) with Timestamp			
	Display 20~	kvar Total Max. of This Month (Since Last Reset) with Timestamp			
	Display 21~	kVA Total Max. of This Month (Since Last Reset) with Timestamp			
	Display 22~	P.F. Total Max. of This Month (Since Last Reset) with Timestamp			
	Display 23~	kW Total Max. of Last Month (Before Last Reset) with Timestamp			
	Display 24~	kvar Total Max. of Last Month (Before Last Reset) with Timestamp			
	Display 25~	kVA Total Max. of Last Month (Before Last Reset) with Timestamp			
	Display 26~	P.F. Total Max. of Last Month (Before Last Reset) with Timestamp			
<Harmonics>	Display 1	U1 THD	U2 THD	U3 THD	Uln avg. THD
	Display 2	I1 THD	I2 THD	I3 THD	I avg. THD
	Display 3	I1 K-Factor	I2 K-Factor	I3 K-Factor	
	Display 4	U1 TEHD	U2 TEHD	U3 TEHD	Uln avg. TEHD
	Display 5	I1 TEHD	I2 TEHD	I3 TEHD	I avg. TEHD
	Display 6	U1 TOHD	U2 TOHD	U3 TOHD	Uln avg. TOHD
	Display 7	I1 TOHD	I2 TOHD	I3 TOHD	I avg. TOHD
	Display 8	U1 HD02	U2 HD02	U3 HD02	Uln avg. HD02
	Display 9	I1 HD02	I2 HD02	I3 HD02	I avg. HD02
	…	…			
	Display 66	U1 HD31	U2 HD31	U3 HD31	Uln avg. HD31
	Display 67	I1 HD31	I2 HD31	I3 HD31	I avg. HD31
	Display 68~	U1/U12 THD Max. of This Month (Since Last Reset) with Timestamp			
	Display 69~	U2/U23 THD Max. of This Month (Since Last Reset) with Timestamp			
	Display 70~	U3/U31 THD Max. of This Month (Since Last Reset) with Timestamp			
	Display 71~	I1 THD Max. of This Month (Since Last Reset) with Timestamp			
	Display 72~	I2 THD Max. of This Month (Since Last Reset) with Timestamp			
	Display 73~	I3 THD Max. of This Month (Since Last Reset) with Timestamp			
	Display 74~	I1 K-Factor Max. of This Month (Since Last Reset) with Timestamp			
	Display 75~	I2 K-Factor Max. of This Month (Since Last Reset) with Timestamp			
	Display 76~	I3 K-Factor Max. of This Month (Since Last Reset) with Timestamp			
	Display 77~	U1/U12 THD Max. of Last Month (Before Last Reset) with Timestamp			
	Display 78~	U2/U23 THD Max. of Last Month (Before Last Reset) with Timestamp			
	Display 79~	U3/U31 THD Max. of Last Month (Before Last Reset) with Timestamp			
	Display 80~	I1 THD Max. of Last Month (Before Last Reset) with Timestamp			
	Display 81~	I2 THD Max. of Last Month (Before Last Reset) with Timestamp			
	Display 82~	I3 THD Max. of Last Month (Before Last Reset) with Timestamp			
	Display 83~	I1 K-Factor Max. of Last Month (Before Last Reset) with Timestamp			
	Display 84~	I2 K-Factor Max. of Last Month (Before Last Reset) with Timestamp			
	Display 85~	I3 K-Factor Max. of Last Month (Before Last Reset) with Timestamp			
<Energy>	Display 1	kWh Import			
	Display 2	kWh Export			
	Display 3[4]~	A (T1) kWh Import			
	Display 4[4]~	B (T2) kWh Import			
	Display 5[4]~	C (T3) kWh Import			
	Display 6[4]~	D (T4) kWh Import			
	Display 7[4]~	E (T5) kWh Import			
	Display 8[4]~	F (T6) kWh Import			
	Display 9[4]~	G (T7) kWh Import			
	Display 10[4]~	H (T8) kWh Import			
	Display 11[4]~	A (T1) kWh Export			
	Display 12[4]~	B (T2) kWh Export			

	Display 13[4~]	C (T3) kWh Export
	Display 14[4~]	D (T4) kWh Export
	Display 15[4~]	E (T5) kWh Export
	Display 16[4~]	F (T6) kWh Export
	Display 17[4~]	G (T7) kWh Export
	Display 18[4~]	H (T8) kWh Export
	Display 19	kWh Net
	Display 20	kWh Total
	Display 21	kvarh Import
	Display 22	kvarh Export
	Display 23	kvarh Net
	Display 24	kvarh Total
	Display 25	kVAh

[#] Available in Firmware V1.00.05 or later
~Available in Firmware V2.00.00 or later

Table 3-4 PMC-660 Data Display Screens

Notes:

1) When the Wiring Mode is Delta or 3P3W, the screens that display per phase Line-to-Neutral Voltages, kWs, kvars, kVAs and PFs are not shown.
2) This display only appears if the meter is equipped with the I4 Current Input.
3) This display only appears if the meter is equipped with the Analog Input.
4) This display only appears if the corresponding Tariff is **Enabled**.

3.4 Setup Configuration via the Front Panel

3.4.1 Making Setup Changes

1) Entering the Passwords:

- 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. Press the **<Energy>/↵** button to enter the password. The factory default password is zero.
- Press **<V/I>/ ◄** to shift the cursor to the left by one position and press **<Power>/▲** or **<Harmonics>/▼** to increment or decrement the numeric value for the password.

2) 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.

3) Changing and saving a parameter:

- Use the **<Power>/▲**, **<Harmonics>/▼** and **<V/I>/ ◄** buttons to make modification to the selected parameter.
- For a Numeric parameter, press **<V/I>/ ◄, <Power>/▲** or **<Harmonics>/▼** to shift the cursor and increment or decrement the numeric value
- For an Enumerated parameter, press **<Power>/▲** or **<Harmonics>/▼** to scroll forward or backward in the selection list.
- After modification, press the **<Energy>/↵** button to save the new value into memory.

4) Exiting to the Setup Mode:

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

3.4.2 Setup Menu

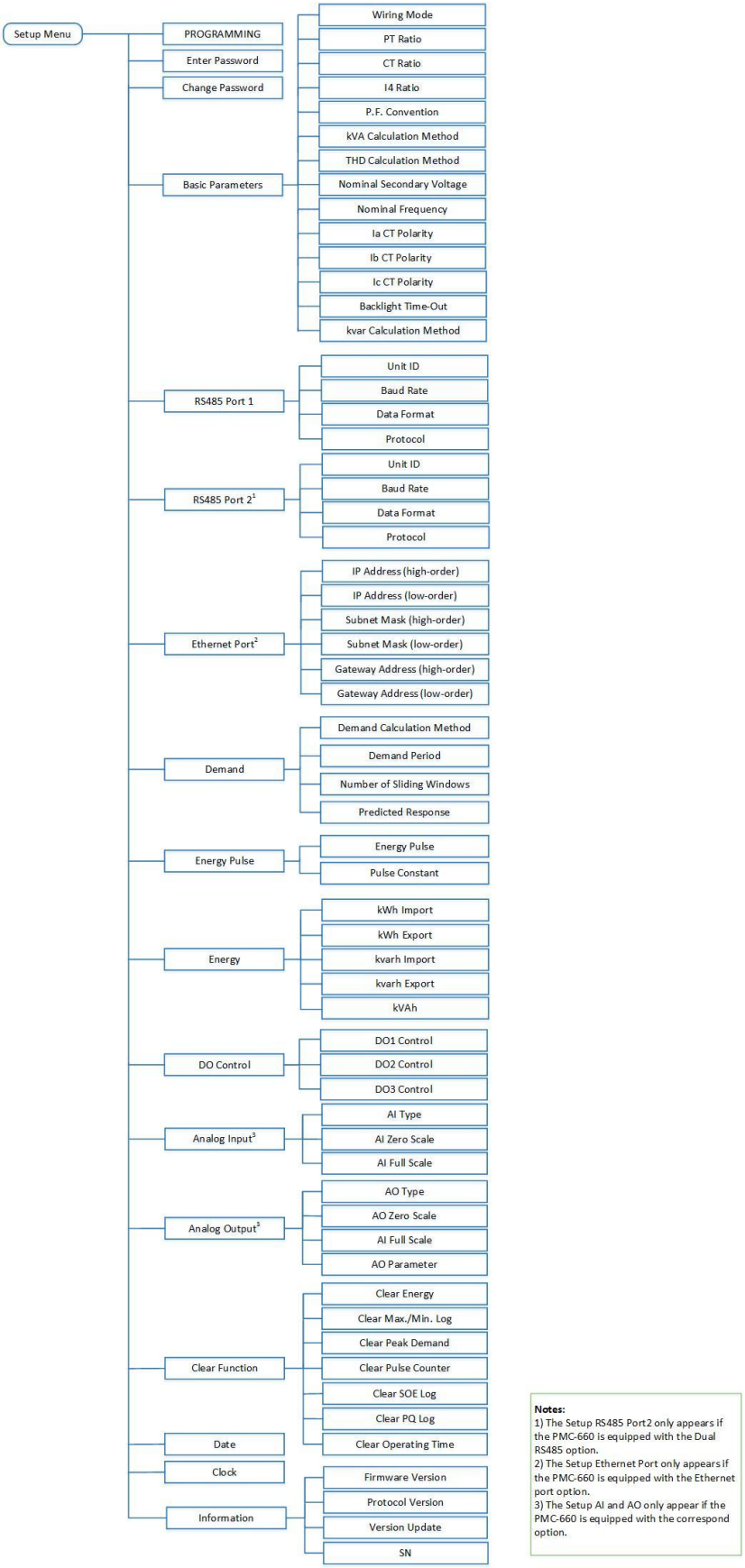


Figure 3-5 Setup Menu

3.4.3 Front Panel Setup Parameters

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

Label menu 1st 2nd	Parameters	Description	Options/Range	Default
PROGRAMMING	Programming	Setup Configuration mode	/	/
PASWORD	Password	Enter Password	0 to 9999	"0"
PAS SET		Change Password?	YES/NO	NO
NEW PAS	New Password	Change Password	0000 to 9999	"0"
SYS SET				
TYPE	Wiring Mode	Meter's Wiring Connection	WYE/DELTA/DEMO/3P3W	WYE
PT	PT Ratio[1]	PT Ratio	1.0000 to 10000.9999	1.0000
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	Ull Nominal Secondary	Ull Nominal Secondary Voltage ($Ull_{nominal}$)	100 to 700 (V)	415
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]	Backlight Time-out	0 to 60 (mins)	3
Q SET	kvarh Calculation	kvarh Calculation Method	RMS/FUND	RMS
COM1 SET				
ID1	Port 1 Modbus ID	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 Config.	Data Format	8N2/8O1/8E1/8N1/8O2/8E2	8E1
PRO	Protocol	Communication Protocol	MODBUS/EGATE	MODBUS
COM2 SET[6]				
ID2	Port 2 Modbus ID	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 Config.	Data Format	8N2/8O1/8E1/8N1/8O2/8E2	8E1
ETH SET[7]				
IPH	IP Address	IP Address (high-order)	For example: IP Address is 192.168.0.100, IP Address(high-order) is 192.168	192.168
IPL	IP Address	IP Address (low-order)	For example: IP Address is 192.168.0.100, IP Address(low-order) is 0.100	0.100
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 192.168.0.1, Gateway Address (high-order) is 192.168	192.168
GWL	Gateway Address	Gateway Address (low-order)	For example: Gateway Address is 192.168.0.1, Gateway Address (low-order) is 0.1	0.1
DMD SET				

MODE	Demand Sync. Mode	Demand Sync. Mode	SLD/SYNC	SLD
PERIOD	Sliding Window Interval	Sliding Window Interval	1 to 60 (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				
EN PULSE	Energy Pulse	Enable Energy Pulsing	YES/NO	NO
EN CONST	Pulse Constant	Pulse Constant[8]	1k/3.2k/5k/6.4k/12.8k	1k
ENGY SET				
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				
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				
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	400
FULL	Full Scale	The value that corresponds to the maximum Analog Input of 20 mA	-999,999 to 999,999	2000
AO SET				
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	999999
KEY[9]	Analog Output Parameter	The parameter to which the Analog Output is proportional	See Note 9)	Uab
CLR SET				
CLR ENGY	Clear Energy	Clear Total Energy and TOU Energy measurements	YES/NO	NO
CLR MXMN	Clear Max./Min.	Clear Max./Min. Logs of This Month (Since Last Reset)	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
CLR RT	Clear operating time	Clear device operating time	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.

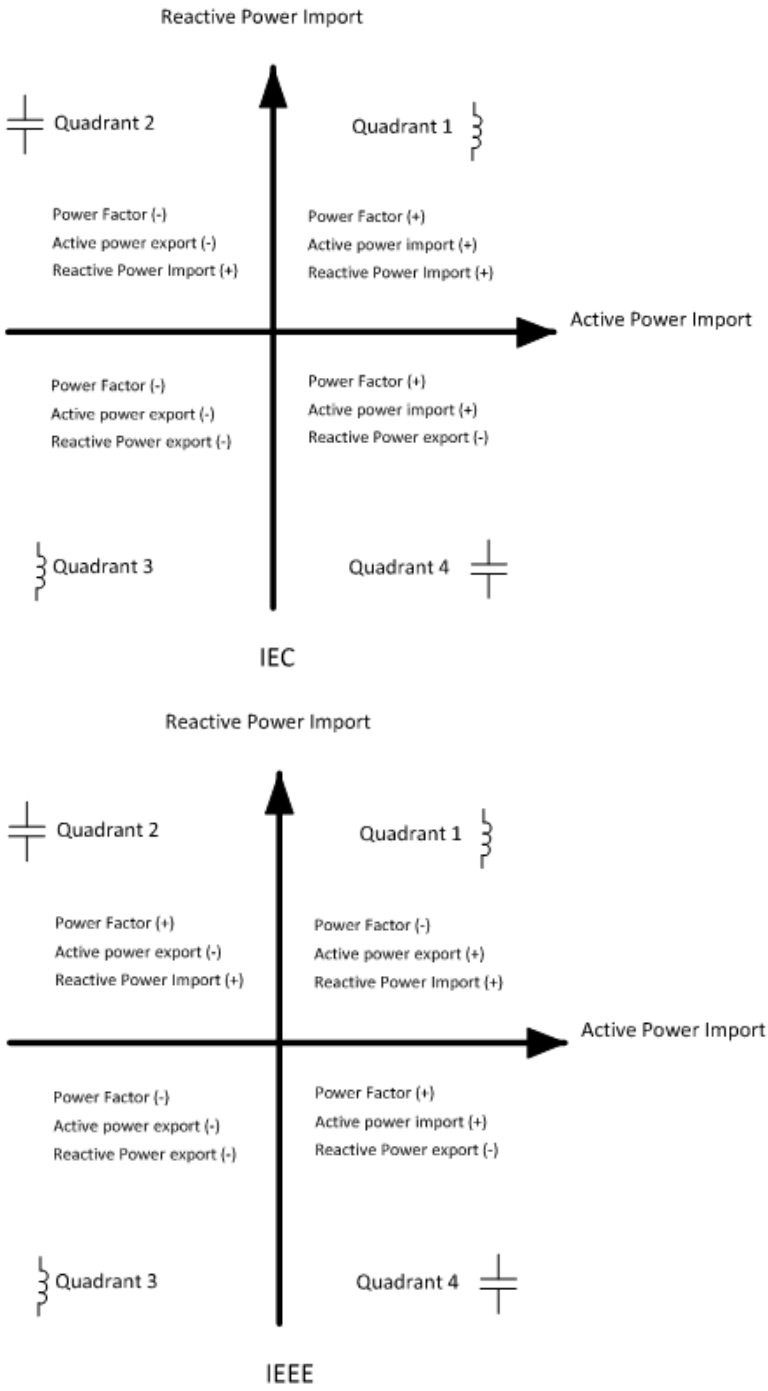


Figure 3-6 Power Factor Definitions

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 V1.00.04 or later.
6) This menu only appears if the meter is equipped with the 2[nd] RS-485 port option.
7) This menu only appears if the meter is equipped with the Ethernet port option. 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)
8) Recommended Pulse Constant settings for the different Line Voltage & Current Inputs

Line Voltage Input	Current Input	X Value	Energy Pulse Constant (X Value)
100V	1A	4	0=1000 imp/kWh 1=3200 imp/kWh 2=5000 imp/kWh 3=6400 imp/kWh 4=12800 imp/kWh
	5A	4	
380V	1A	4	
	5A	1	
690V	1A	2	
	5A	0	

Table 3-6 Pulse Constant

9) Analog Output Parameters

If **PF Total** 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	Parameter	Scale	Unit	Key	Parameter	Scale	Unit
0	Uab	x1	V	**8**	kW Total	x1	kW
1	Ubc		V	**9**	kvar Total		kvar
2	Uca		V	**10**	kVA Total		kVA
3	Ull Average		V	**11**	PF Total	x1000	-
4	Ia		A	**12**	Frequency	x1	Hz
5	Ib		A	**13**	kW Total Present Demand	x1	kW
6	Ic		A	**14**	kvar Total Present Demand		kvar
7	I Average		A	**15**	kVA Total Present Demand		kVA
				16	PF Total Present Demand		-

Table 3-7 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 with a sampling frequency of 1000Hz and programmable debounce. The PMC-660 provides the following programmable functions for its Digital Inputs:

1) **Digital Input** — The Digital Inputs are typically used for status monitoring 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) **Pulse Counting** — Pulse counting is supported with programmable pulse weight and facilitates WAGES (Water, Air, Gas, Electricity and Steam) information collection.

3) **Demand Sync Pulse** — 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) **Time Synchronization** — The Digital Inputs can be used as external time synchronization pulse. Please refer to **Section 4.8** for a detailed description.

5) **Tariff Switching** — Up to 3 Digital Inputs may be used to select to which of the 8 Tariffs the energy consumption should be accumulated. The 3 Digital Inputs (DI1 to DI3) represent 3 binary digits where Tariff 1=000, Tariff 2=001, …, Tariff 8=111 where DI1 represents the least significant digit and DI3 represents the most significant digit. The **DI1 Function** setup register must first be programmed as a **Tariff Switch** before configuring DI2 with the same function. In other words, if DI1 is configured as a **Digital Input** or **Energy Pulse Counter** and DI2 is configured as a **Tariff Switch**, the TOU will continue to function based on the TOU Schedule. This feature is available in Firmware V2.00.00 or later.

The following table describes the DI's setup parameters:

Setup Parameter	Definition	Options/*Default
DIx Function	Each **DI** can be configured as a Status Input, Pulse Counter or SYNC DI. Only DI1 to DI3 can be set as **Tariff Switch**.	0=Status Input* 1=Pulse Counter 2=SYNC DI, 3=1 PPS 4=Tariff Switch
DIx Debounce	Specifies the minimum duration the **DI** must remain in the Active or Inactive state before a state change is considered to be valid.	1 to 1000 (ms) (Default=20ms)
DIx Pulse Weight	Specifies the incremental value for each received pulse. This is only used when a DI is configured as a Pulse Counter.	1* to 1,000,000

Table 4-1 DI Setup Parameters

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:

1)	**Front Panel Control**	Manually operated from the Front Panel. Please refer to the **DO SET** setup parameter in **Section 3.4.3** for a detailed description.
2)	**Remote Control**	Remotely operated over communications via our free PMC Setup software or the PecStar® iEMS Integrated Energy Management System.
3)	**Control Setpoint**	Control setpoints can be programmed to trigger DO, Data Recorder, Waveform Recorder or Alarm Email upon becoming active. Please refer to **Section 4.4** for a detailed description.
4)	**Logical Module**	Logical Module can be programmed to trigger DO, Data Recorder or Waveform Recorder upon becoming active. Please refer to **Section 4.5** for a detailed description.
5)	**Dip/Swell Setpoint**	Dip/Swell setpoint can be programmed to trigger DO, Data Recorder, Waveform Recorder or Alarm Email upon becoming active. Please refer to **Section 4.3.5** for a detailed description.
6)	**Transient Setpoint:**	Transient setpoint can be programmed to trigger DO, Data Recorder, Waveform Recorder or Alarm Email upon becoming active. Please refer to **Section 4.3.6** for a detailed description.

Since there are multiple ways to trigger 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 the highest priority and can override other applications. Remote Control, Control Setpoint, Logical Module, Dip/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 Pulse Outputs are typically used for accuracy testing. Energy pulsing can be enabled from the Front Panel through the **EN PULSE** setup parameter. The pulse constant can be configured as 1000/3200/5000/6400/12800 pulses per kWh or kvarh through the **EN CONST** setup parameters. 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 one 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 3-7.

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 which are available through the Front Panel or communications

Parameter	Phase A	Phase B	Phase C	Total	Average
Uln	●	●	●	-	●
Ull	●	●	●	-	●
Current	●	●	●	-	●
Neutral Current	-	-	-	I0 (Calculated)	I4 (Measured)
Residual Current*	-	-	-	Ir (Calculated)	-
kW	●	●	●	●	-
kvar	●	●	●	●	-
kVA	●	●	●	●	-
Power Factor	●	●	●	●	-
Frequency	●	-	-	-	-
U Fundamental	●		●		●
U Sequence*	U1 (Positive Sequence)		U2 (Negative Sequence)		U0 (Zero Sequence)

I Sequence*	I1 (Positive Sequence)	I2 (Negative Sequence)	I0 (Zero Sequence)

*Available in Firmware V2.00.00 or later

Table 4-2 Basic Measurements

4.2.2 Energy Measurements

The PMC-660 provides Energy parameters for active energy (kWh), reactive energy (kvarh) and apparent energy (kVAh) with a resolution of 0.01 and a maximum value of ±1,000,000,000.00. When the maximum value is reached, the energy registers 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/Export/Net/Total kWh Import/Export of TOU T1-8*
Reactive Energy	kvarh Import/Export/Net/Total kvarh Import/Export of TOU T1-8* kvarh of Q1/Q2/Q3/Q4
Apparent Energy	kVAh Total kVAh of TOU T1-8*

*Available in Firmware V2.00.00 or later

Table 4-3 Energy Measurement

4.2.3 Interval Energy Measurements (Firmware V2.00.00 or later)

The PMC-660 provides Interval Energy measurements of kWh Import/Export, kvar Import/Export and kVAh since Firmware V2.00.00. The Interval Energy measurements represent the amount of energy consumed during the last completed interval as defined by **EN Period**. The Interval Energy Measurements can only be retrieved through communications and are not available on the Front Panel.

The Interval Energy Period (**EN Period**) setup parameter can be programmed through communications and allows the user to specify the interval for which the real-time energy consumption should be accumulated. Please note that changing the Interval Energy Period would clear the present Interval Energy measurements.

4.2.4 High-speed Measurements

The PMC-660 provides the following high-speed measurements which are available through the Front Panel or communications.

- 3-Phase Voltage with ½ cycle update rate
- 3-Phase Current, Neutral Current (I4) and I0 with 1 cycle update rate
- 3-Phase Power and Power Factor with 1 cycle update rate

4.2.5 Demand Measurements

Demand is defined as the average power consumption over a fixed interval (usually 15 minutes) based on the sliding window method. Predicted Demand is typically used for pre-alarming and to help users reduce power consumption using a Setpoint to warn that the Demand limit may be exceeded. The PMC-660 provides the following setup parameters:

Setup Parameter	Definition	Options/*Default
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**".	0= SLD* 1=SYNC DI
Demand Period	1 to 60 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.	1 to 60 min Default=15

# of Sliding Windows	Number of Sliding Windows.	1* to 15
Self-Read Time	The **Self-Read Time** allows the user to specify the time and day of the month for the Peak Demand Self-Read operation. The **Self-Read Time** supports three 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. • A 0xFFFF value will disable the Self-Read operation and replace it with manual operation. A manual reset will cause the Peak Demand of **This Month** to be transferred to the Peak Demand of **Last Month** and then reset. The terms **This Month** and **Last Month** will become **Since Last Reset** and **Before Last Reset**.	Default=0xFFFF
Predicted Response	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.	70* to 99

Table 4-4 Demand Setup

The PMC-660 provides the following Demand parameters:

Present and Predicted Demand Parameters	
Voltage	Uan / Ubn / Ucn / Uln average
	Uab / Ubc / Uca / Ull average
Current	Ia / Ib / Ic / I average/I4[1]
Energy	kWa / kWb / kWc /kW Total
	kvara / kvarb / kvarc / kvar Total
	kVAa / kVAb / kVAc / kVA Total
Power Factor	P.F.a / P.F.b / P.F.c /P.F. Total
Frequency	FREQ
Unbalance	U / I Unbalance
THD	Uan / Ubn / Ucn THD Uab / Ubc / Uca THD
	Ia / Ib / Ic THD

Table 4-5 Demand Parameters

Notes:

1) **I4** is valid if the meter is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current)** if the meter is equipped with the AI option.

4.2.6 Max./Min. per Demand Period

The PMC-660 provides the Max./Min. value per demand period of the following measurements:

- 3-Phase Voltage and Frequency
- 3-Phase Current and Neutral Current (I4)
- 3-Phase Power and Power Factor
- Voltage and Current Unbalance
- Voltage and Current THD

All Max./Min. data can be accessed through communication.

4.3 Power Quality

4.3.1 Phase Angles

Phase analysis is used to identify the angle relationship between 3-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 PF 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°.

4.3.2 Power Quality Parameters

The PMC-660 provides the following PQ parameters:

4.3.2.1 Fundamental

The PMC-660 provides the following Fundamental Components (Displacement RMS values):

Fundamental Components			
dUan	dUbn	dUcn	dUln average
dUab	dUbc	dUca	dUll average
dIa	dIb	dIc	dI average
dkWa	dkWb	dkWc	dkW Total
dkvara	dkvarb	dkvarc	dkvar Total
dkVAa	dkVAb	dkVAc	dkVA Total
dP.F.a	dP.F.b	dP.F.c	dP.F. Total
dI4			

Table 4-6 Fundamental Components

4.3.2.2 Harmonics

The PMC-660 provides harmonic analysis for THD, TOHD, TEHD and individual harmonics up to the 63rd order. Only 31 individual harmonics are available through the Front Panel, and all 63 individual parameters are available via communications. The PMC-660 also provides Current K-Factor measurements.

4.3.2.3 K-Factor

K-Factor is defined as the weighted sum of the Harmonic Load Current according to their effects on transformer heating, as derived from ANSI/IEEE C57.110. A **K-Factor** of 1.0 indicates a linear load (no harmonics). The higher the **K-Factor**, the greater the harmonic heating effect.

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

where

I_h = h_{th} Harmonic Current in RMS

h_{max} = Highest harmonic order

The following table illustrates the Voltage and Current Harmonics measurements on the PMC-660.

	Phase A/AB	Phase B/BC	Phase C/CA
Harmonics-Voltage	THD	THD	THD
	TEHD	TEHD	TEHD
	TOHD	TOHD	TOHD
	2nd Harmonics	2nd Harmonics	2nd Harmonics
	...		
	63rd Harmonics	63rd Harmonics	63rd Harmonics
Harmonics-Current	THD	THD	THD
	TEHD	TEHD	TEHD
	TOHD	TOHD	TOHD
	K-Factor	K-Factor	K-Factor
	2nd Harmonics	2nd Harmonics	2nd Harmonics
	...		
	63rd Harmonics	63rd Harmonics	63rd Harmonics
	I4 THD/TEHD/TOHD and 2nd to 63rd Harmonics		

Table 4-7 Harmonics Measurements

4.3.3 Unbalance

The PMC-660 provides Voltage and Current Unbalance measurements. The calculation method of Voltage and Current Unbalances are listed below:

$$\text{Voltage Unbalance} = \frac{V2}{V1} \times 100\% \qquad \text{Current Unbalance} = \frac{I2}{I1} \times 100\%$$

where

V1, V2 are the Positive and Negative Sequence Components for Voltage, respectively, and
I1, I2 are the Positive and Negative Sequence Components for Current, respectively.

4.3.4 Symmetrical Components

The PMC-660 provides the Voltage and Current Symmetrical Components measurements, which can be accessed via the Front Panel or through communications.

Symmetrical Components	Positive Sequence	Negative Sequence	Zero Sequence
U	U1	U2	U0
I	I1	I2	I0

Table 4-8 Symmetrical Parameters

4.3.5 Deviation

The PMC-660 can measure deviation for Uan/Uab, Ubn/Ubc, Ucn/Uca and Frequency.

For **Voltage Deviation**, the calculation methods are listed below:

When the **Wring Mode** is **3P3W** or **Delta:**

Voltage Deviation = ((Ull – $Ull_{nominal}$) / $Ull_{nominal}$) x 100%

When the **Wring Mode** is **WYE:**

Voltage Deviation = ((Uln – ($Ull_{nominal}$÷√3)) / ($Ull_{nominal}$÷√3)) x 100%

where $Ull_{nominal}$ is the Secondary Nominal Voltage

For **Freq. Deviation**, the calculation method is listed below:

Freq. Deviation = ((f - $f_{nominal}$)/$f_{nominal}$) x 100%

where $f_{nominal}$ is the Nominal Frequency

4.3.6 Supply Voltage Dips/Swells and Interruptions

The PMC-660 supports the detection of **Supply Voltage Dips/Swells** and **Interruptions** based on 1-cycle high-speed RMS Voltage values that are updated every ½ cycle and records any detected event in the **PQ Log** with timestamp and event type. Further, the Dip/Swell and Interruption Detection can be programmed to trigger WFR, DR, DO and Alarm Email. The programming of the Dip/Swell and Interruption setpoint parameters is only supported over communications.

Parameter	Definition	Options/*Default
Dip/Swell Enable	Dip/Swell Detection Enable	0=Disabled, 1=Enabled*
Swell Limit	Specify the Swell limit	105 to 200 (x0.01**$Ull_{nominal}$**), 110*
Dip Limit	Specify the Dip limit	10 to 95 (x0.01**$Ull_{nominal}$**), 90*
Interruption Limit	Specify the Interruption limit	0 to 50 (x0.01**$Ull_{nominal}$**), 10*
Dip/Swell/Interruption Trigger	Specify what action the setpoint will take when the Dip/Swell/Interruption detection becomes active	None / DO1 to DO3 / DR1 to DR16 / WR1* to WR2 / Alarm Email

Table 4-9 Dip/Swell/Interruption Setup Parameters

For the Dip/Swell and Interruption detection to work correctly, it's critically important to set the *Ull*$_{nominal}$ parameter correctly with the nominal line-to-line voltage on the secondary (meter) side.

4.3.7 Transients

The PMC-660 provides Transient Capture capability by detecting sub-cycle voltage disturbances and records the detected event in the **PQ Log** with timestamp and event type. The programming of the Transient setpoint is only supported over communications. The Transient setpoint provides the following setup parameters:

Parameter	Definition	Options/*Default
Transient Enable	Transient Detection Enable	0=Disabled, 1=Enabled*
Transient Limit	Specify the Transient limit	5 to 500 (x0.01**Ull**$_{nominal}$), 35*
Transient Trigger	Specify what action the setpoint will take when the Transient detection becomes active	None / DO1 to DO3 / DR1 to DR16 / WR1* to WR2 / Alarm Email

Table 4-10 Transient Setpoint Setup Parameters

For the Transient detection to work correctly, it's critically important to set the *Ull*$_{nominal}$ parameter correctly with the nominal line-to-line voltage on the secondary (meter) side.

4.4 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.

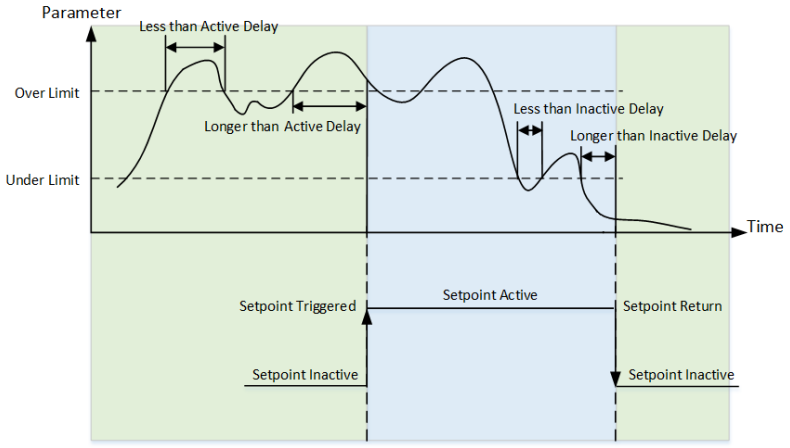


Figure 4-1 Over Setpoint

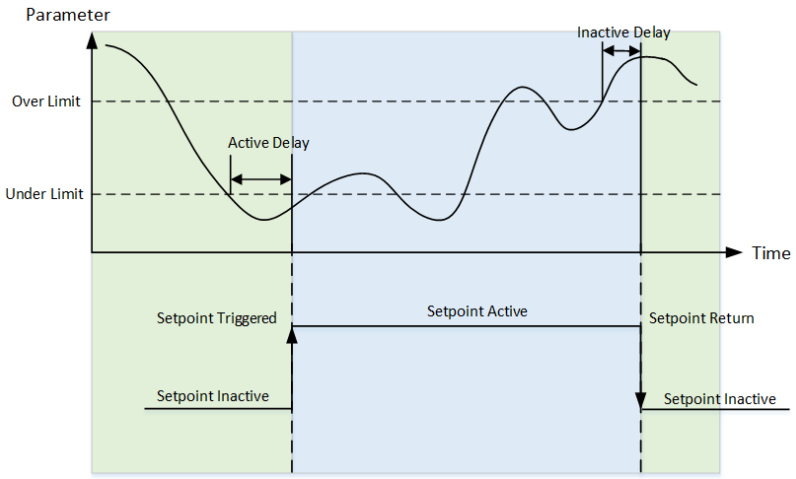


Figure 4-2 Under Setpoint

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:

Setup Parameter	Definition	Options/*Default
Setpoint Type	Disabled, Over or Under Setpoint.	0=Disabled* 1=Over Setpoint 2=Under Setpoint
Setpoint Parameter	Specify the parameter to be monitored.	See Table 4-12, 1*
Active Limit	Specify the value that the setpoint parameter must exceed for Over Setpoint to become active or for Under Setpoint to become inactive.	Default=999,999
Inactive Limit	Specify the value that the setpoint parameter must go below for Over Setpoint to become inactive or for Under Setpoint to become active.	Default=999,999
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 **Active Delay** is between 0 and 9999 seconds.	0 to 9999 s, 10*
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 **Inactive Delay** is between 0 and 9999 seconds.	0 to 9999 s, 10*
Setpoint Trigger	Specify what action a setpoint would take when it becomes active. Please refer to Table 4-13 below for a list of Setpoint Triggers.	See table 4-13, 0*

Table 4-11 Description for Setpoint Parameters

The PMC-660 provides the following Setpoint parameters, Standard Setpoint can monitor all parameters while the HS Setpoint only can monitor parameters 1 to 14.

Key	Parameter	Scale/Unit
1	Uln	x100, V
2	Ull	x100, V
3	I	x1000, A
4	I4[1]	x1000, A
5	Freq Deviation	x100, Hz
6	kW Total	kW
7	kvar Total	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 Total Present Demand	kW
17	kvar Total Present Demand	kvar
18	P.F. Present Demand	x1000
19	Total kW Predicted Demand	kW
20	Total kvar Predicted Demand	kvar
21	P.F. Predicted Demand	x1000
22	U THD	x100, %
23	U TOHD	x100, %
24	U TEHD	x100, %
25	I THD	x100, %
26	I TOHD	x100, %
27	I TEHD	x100, %
28	U Unbalance	x10, %
29	I Unbalance	x10, %
30	U 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.
32	I Residual	x1000, A
33	U2 (Negative Sequence Voltage)	x100, V
34	U0 (Zero Sequence Voltage)	x100, V

Table 4-12 Setpoint Parameters

Notes

1) **I4** is valid only if the device is equipped with the I4 Input option, and **I0 (Zero Sequence Current)** will automatically be used to if the meter is equipped with the AI option (instead of I4).

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**	WFR #1
8	DR #6	**21**	WFR #2
10	DR #7	**22**	Alarm Email
11	DR #8		

Note: Only when **DOx Mode** is set to **Remote Control/Setpoint** would setting **Setpoint Trigger** to **DOx** be valid.

Table 4-13 Setpoint Triggers

4.5 Logical Module

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

Setup Parameters	Definition	Options/*Default
Enable Logical Module	Logical Module Enable	0=Disabled*, 1=Enabled
Mode 1 to 3	Specify the type of logical evaluation to be performed	0=AND*, 1=OR, 2=NAND, 3=NOR
Source 1 to 4	Specify the source input.	See Table 4-15

Trigger 1 **Trigger 2**	Specify what action the Logical Module will take when it becomes active. **Logical Equation** = ((**Source 1** [Mode 1] **Source 2**) [Mode 2] **Source 3**) [Mode 3] **Source 4**	See Table 4-16

Table 4-14 Setpoint Parameters

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 4-15 Logical Module Sources

The PMC-660 provides the following Logical Module Triggers:

Key	Action	Key	Action
0	None	**4-19**	DR1 to DR16
1-3	DO1 to DO3	**20, 21**	WR1, WR2

Table 4-16 Logical Module Triggers

4.6 Logging

4.6.1 Max./Min. Log

The PMC-660 records the **Max. Log** and **Min. Log** of **This Month (Since Last Reset)** and **Last Month (Before Last Reset)** with timestamp for Uln, Ull, I, kW/kvar/kVA/PF Total, Frequency, Voltage and Current THD, K-Factor and Voltage and Current Unbalance. Each log includes the relevant parameter value and its timestamp. The recorded 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.

Max./Min. Parameters			
Uan	Ubn	Ucn	Uln avg
Uab	Ubc	Uca	Ull avg
Ia	Ib	Ic	I avg.
kW Total	kvar Total	kVA Total	P.F. Total
Uan/Uab THD	Ubn/Ubc THD	Ucn/Uca THD	I4
Ia THD	Ib THD	Ic THD	FREQ
Ia K-Factor	Ib K-Factor	Ic K-Factor	
Voltage Unbalance	Current Unbalance	I Residual	

Table 4-17 Max./Min. Log

The same **Self-Read Time** for the **Peak Demand Log** is used to specify the time and day of the month for the Max./Min. Self-Read operation. Please refer to **Section 4.2.5** for a complete description of the **Self-Read Time** and its operation. The Max./Min. Log of This Month (Since Last Reset) can be reset manually from the Front Panel or via communications.

4.6.2 Peak Demand Log

The PMC-660 stores the **Peak Demand** of **This Month (Since Last Reset)** and **Last Month (Before Last Reset)** with timestamp for Ia, Ib, Ic, kW Total, kvar Total and kVA Total. All Peak Demand data can be accessed through the Front Panel as well as communications. Please refer to **Section 4.2.5** for a

complete description of the **Self-Read Time** and its operation.

The Peak Demand 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 Logs of This Month (Since Last Reset) and Last Month (Before Last Reset)	
kW Total	Ia
kVA Total	Ib
kvar Total	Ic

Table 4-18 Peak Demand Measurements

4.6.3 Interval Energy Recorder (IER) Log

The PMC-660 provides an Interval Energy Recorder 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 IER is only supported over communications. The IER provides the following setup parameters:

Setup Parameter	Value/Option	Default
Recording Mode	0=Disabled, 1=Stop-When-Full, 2=First-In-First-Out	2
Recording Depth	0 to 65535 (entry)	5760
Recording Interval	0=5mins, 1=10mins, 2=15mins, 3=30mins, 4=60mins	2
Start Time	20YY/MM/DD, HH:MM:SS	
Number of Parameters	0 to 5	5
Parameter 1 to 5	kWh Import/Export, kvarh Import/Export and kVAh	

Table 4-19 IER Setup Parameters

The IER is only operational when the values of **Recording Mode**, **Recording Depth**, **Start Time** and **Number of Parameters** are all non-zero. When the present time meets or exceeds the "**Start Time**", the IER will start to record.

4.6.4 Waveform Recorder (WFR) Log

The PMC-660 provides 2 independent groups of Waveform Recorders (**WFR**) with a combined total of 32 entries. Each WFR can simultaneously capture 3-phase Voltage and Current signals at a maximum resolution of 256 samples per cycles. The WFR can be triggered by Setpoints, Dip/Swell and Transient Detection or manually through communications. The manual trigger command has a higher priority. When the WFR is already in progress, other WFR commands will be ignored until the current recording has completed. The WFR Log has a capacity of 32 entries organized in a First-In-First-Out basis, with the newest WFR 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 WFR is only supported over communications. The WFR provides the following setup parameters:

Setup Parameters	Value/Option	Default	
		WFR 1	WFR 2
Recording Depth	0 to 32	10	20
# of Samples	0=16, 1=32, 2=64, 3=128, 4=256	4	2
Number of Cycle	320/160/80/40/20	20	80
Pre-fault Cycles	0 to 10 Cycles	4	6

Table 4-20 WFR Setup Parameters

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.

The WFR logs can be retrieved via communications by our PecStar® iEMS or our free PMC Setup Software for display.

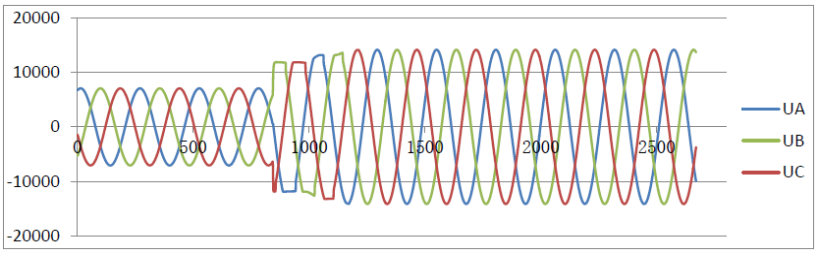


Figure 4-3 WFR Log displayed in PecStar®

4.6.5 PQ Log

The PMC-660's **PQ Log** can store up to 1000 PQ events such as Dips/Swells and Transients. 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.

4.6.6 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.

4.6.7 Data Recorder (DR) Log

The PMC-660 comes equipped with 4MB of memory and provides 4 High-Speed Data Recorders (**HS DR**) as well as 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:

Setup Parameters	Value/Option	Default
Trigger Mode	0=Disabled / 1=Triggered by Timer / 2=Triggered by Setpoint	See **Appendix B**
Recording Mode	0=Stop-When-Full / 1=First-In-First-Out	
Recording Depth	1 to 65535 (entry)	
Recording Interval	0 to 3456000 seconds for Standard Data Recorder 0 to 60 cycles for High-Speed Data Recorder	
Offset Time	0 to 43,200 seconds, 0 indicates no offset If the **Trigger Mode** is set to **Triggered by Setpoint**, the **Offset Time** will be disregarded.	
Number of Parameters	0 to 16	
Parameter 1 to 16	0 to 329 for Standard Data Recorder 0 to 28 for High-Speed Data Recorder Please see refer to **Appendix A** for more information.	

Table 4-21 DR Setup Parameters

The DR 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 5.8.9**).

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** should be set to zero.

4.7 Time of Use (TOU)

TOU is used for electricity pricing that varies depending on the time of day, day of week, and season. The TOU system allows the user to configure an electricity price schedule inside the PMC-660 and accumulate energy consumption into different TOU tariffs based on the time of consumption. TOU programming is only supported through communications. This feature is available in Firmware V2.00.00 or later.

The TOU feature on PMC-660 supports two TOU schedules, which can be switched at a pre-defined time. Each TOU schedule supports:

- Up to 12 seasons
- 90 Holidays or Alternate Days
- 20 Daily Profiles, each with 12 Periods in 15-minute interval
- 8 Tariffs

Instead of using the TOU schedule to switch between Tariffs, the PMC-660 supports Tariff switching based on the status of DI1 to DI3.

The 3 Digital Inputs (DI1, DI2 and DI3) represent 3 binary digits where Tariff 1=000, Tariff 2=001, Tariff 3=010, …Tariff 7=110 and Tariff 8=111 where DI1 represents the least significant digit and DI3 represents the most significant digit. As soon as DI1, DI2 and/or DI3 are configured as **Tariff Switches**, the current **TOU Tariff** will be determined by the status of the DIs, and the TOU Schedule will be ignored. The **DI1 Function** setup register must first be programmed as a **Tariff Switch** before configuring DI2 and DI3 with the same function. In other words, if DI1 is configured as a **Digital Input** or **Energy Pulse Counter**, and DI2 is configured as a **Tariff Switch**, the TOU will continue to function based on the TOU Schedule. The number of Tariffs supported depends on how many DIs are programmed as a Tariff Switch as indicated in the following table.

Tariff	DI Function		
	DI1 = Tariff Switch	DI2 & DI1 = Tariff Switch	DI3, DI2 & DI1 = Tariff Switch
T1	DI1 (0=T1)	DI2 + DI1 (00=T1)	DI3 + DI2 + DI1 (000=T1)
T2	DI1 (1=T2)	DI2 + DI1 (01=T2)	DI3 + DI2 + DI1 (001=T2)
T3	Not Available	DI2 + DI1 (10=T3)	DI3 + DI2 + DI1 (010=T3)
T4	Not Available	DI2 + DI1 (11=T4)	DI3 + DI2 + DI1 (011=T4)
T5	Not Available	Not Available	DI3 + DI2 + DI1 (100=T5)
T6	Not Available	Not Available	DI3 + DI2 + DI1 (101=T6)
T7	Not Available	Not Available	DI3 + DI2 + DI1 (110=T7)
T8	Not Available	Not Available	DI3 + DI2 + DI1 (111=T8)

Table 4-22 DIs and the Number of Tariffs Setup

Each TOU schedule has the following setup parameters and can only be programmed via communications:

Setup Parameters	Definition	Options
Daily Profile #	Specify a daily rate schedule which can be divided into a maximum of 12 periods in 15-min intervals. Up to 20 Daily Profiles can be programmed for each TOU schedule.	1 to 20, the first period starts at 00:00 and the last period ends at 24:00.
Season #	A year can be divided into a maximum of 12 seasons. Each season is specified with a Start Date and ends with the next season's Start Date.	1 to 12, starts from January 1st
Alternate Days #	A day can be defined as an Alternate Day, such as May 1st. Each Alternate Day is assigned a Daily Profile.	1 to 90.
Day Types	Specify the day type of the week. Each day of a week can be assigned a day type such as Weekday1, Weekday2, Weekday3 and Alternate Days. The Alternate Day has the highest priority.	Weekday1, Weekday2, Weekday3 and Alternate Days
Switching Time	Specify when to switch from one TOU schedule to another. Writing 0xFFFFFFFF to this parameter disables switching between TOU schedules.	Format: YYYYMMDDHH Default=0xFFFFFFFF

Table 4-23 TOU Setup Parameters

For each of the 8 Tariff Rates, the PMC-660 provides the following Energy measurements: kWh Import/Export, kvarh Import/Export, kVAh.

T1-T8's kWh Import/Export are available through the Front Panel and via communications, and T1-T8's kvarh Import/Export and kVAh are only available via communications.

4.8 Time Synchronization

The PMC-660 provides timestamps for all recorded data, so the clock needs to be configured properly for event 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.

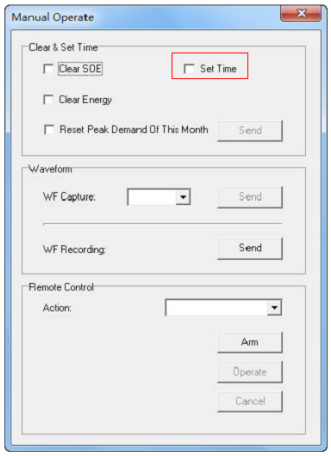


Figure 4-4 Set Time via PMC Setup

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 of

synchronization interval is 60 minutes.

3) **SNTP server** can be used to synchronize the PMC-660's clock through its Ethernet port providing that the network where the PMC-660 resides has access 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/*Default
SNTP Enable	Disabled*/Enabled
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, 60*
IP Address of Time Server	Set the IP address of your Time Server

Table 4-24 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 5.8.1** 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, 4=Tariff Switch*
DI Debounce	0 and 1000 (ms), Default = 20 (ms)
DI Pulse Weight	1 and 1,000,000 (x0.001), Default = 1 (0.001)

*Available in Firmware V2.00.00 or later, and only DI1 to DI3 can be set as Tariff Switch.

Table 4-25 DI Setup Parameters

Please also refer to Figure 2-15 for the time synchronization wiring diagram.

4.9 On-board Web Server

The PMC-660's 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 4-5. 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.

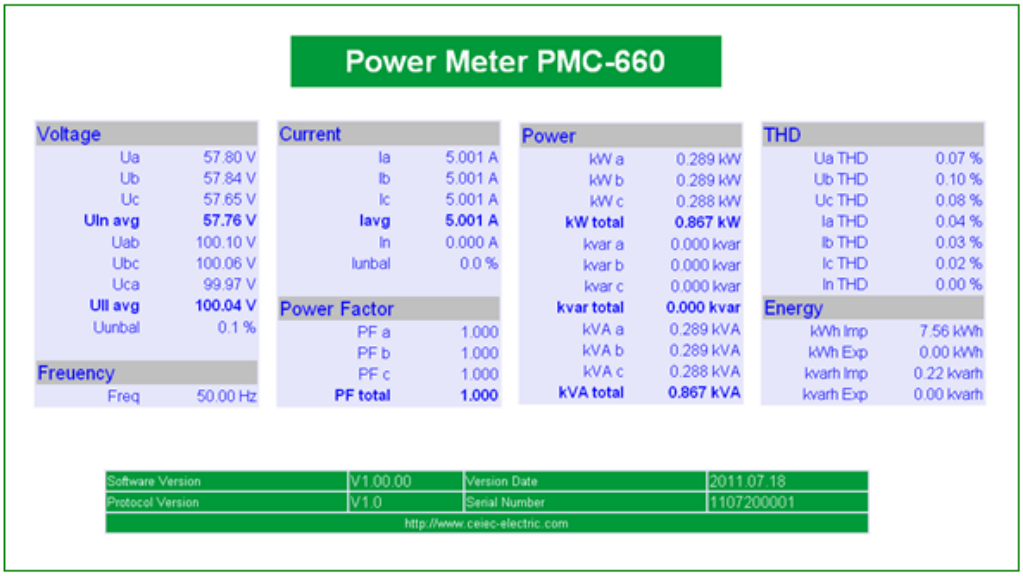


Figure 4-5 PMC-660's Web Page

4.10 Meter Email

The PMC-660 supports the SMTP and ESMTP protocols and can be configured to send alarm messages via email, which may be triggered by Setpoint, Dip/Swell and Transient Detection.

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 is up to 35 characters long.
Logon Password	Set the logon password to send an email using the Source Email account. This string is up to 19 characters long.
Destination Email Address	Destination email address that appears in the "To" field of the email. This string is up to 35 characters long.
Test Email	Send a "test email" to the destination email address.

Table 4-26 Email Setup Parameters

4.11 Ethernet Gateway

The PMC-660's Ethernet port together with its RS485 port can be used as an Ethernet Gateway (EGATE) to allow communications between a Modbus Master on the Ethernet network and a network of serial devices connected to the PMC-660's RS485 port as shown in Figure 4-6 below.

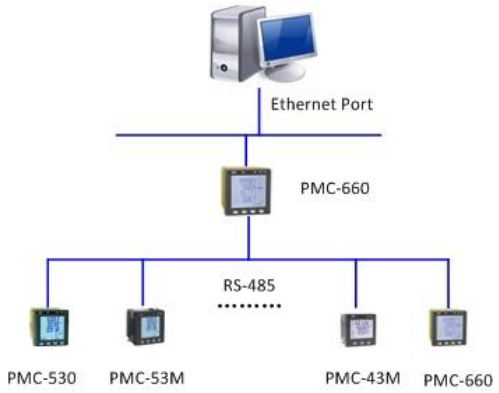


Figure 4-6 Topological Graph

To use the PMC-660 as an Ethernet Gateway, the following parameters should be configured via the 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 (cannot be configured) as the IP Port No. to connect to PMC-660's Ethernet Gateway with your software
4) Please refer to Section 3.4.3 for more information

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

Chapter 5 Modbus Register Map

This chapter provides a complete description of the Modbus register map (**Protocol Version 1.6**) for the PMC-660 to facilitate the development of 3rd party communications driver for accessing information on the PMC-660. For a complete Modbus Protocol Specification, please visit http://www.modbus.org. 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)

The following table provides a description of the different data formats used for the Modbus registers. The PMC-660 uses the **Big Endian** byte ordering system.

Format	Description
UINT16/INT16	Unsigned/Signed 16-bit Integer
UINT32/INT32	Unsigned/Signed 32-bit Integer
Float	IEEE 754 32-bit Single Precision Floating Point Number

5.1 Basic Measurements

Register	Property	Description	Format	Scale	Unit
0000	RO	Uan[1]	Float	x1	V
0002	RO	Ubn[1]	Float		
0004	RO	Ucn[1]	Float		
0006	RO	Uln average[1]	Float		
0008	RO	Uab	Float		
0010	RO	Ubc	Float		
0012	RO	Uca	Float		
0014	RO	Ull average	Float		
0016	RO	Ia	Float	x1	A
0018	RO	Ib	Float		
0020	RO	Ic	Float		
0022	RO	I average	Float		
0024	RO	kWa[1]	Float	x1	W
0026	RO	kWb[1]	Float		
0028	RO	kWc[1]	Float		
0030	RO	kW Total	Float		
0032	RO	kvara[1]	Float	x1	var
0034	RO	kvarb[1]	Float		
0036	RO	kvarc[1]	Float		
0038	RO	kvar Total	Float		
0040	RO	kVAa[1]	Float	x1	VA
0042	RO	kVAb[1]	Float		
0044	RO	kVAc[1]	Float		
0046	RO	kVA Total	Float		
0048	RO	P.F.a[1]	Float	x1	-
0050	RO	P.F.b[1]	Float		
0052	RO	P.F.c[1]	Float		
0054	RO	P.F. Total	Float		
0056	RO	FREQ	Float	x1	Hz
0058	RO	I4 Measured	Float	x1	A
0060	RO	I0 (Calculated Neutral Current)[#]	Float	x1	A
0062~0069		Reserved			
0070	RO	U Unbalance	UINT16	×10	%
0071	RO	I Unbalance	UINT16		
0072	RO	Uan (Wye)/Uab (Delta/3P3W) Deviation	INT16	x100	%
0073	RO	Ubn (Wye)/Ubc (Delta/3P3W) Deviation	INT16		
0074	RO	Ucn (Wye)/Uca (Delta/3P3W) Deviation	INT16		
0075	RO	FREQ Deviation	INT16	x100	Hz

0076	RO	Uan (Wye)/Uab (Delta/3P3W) Angle	UINT16	x100	°
0077	RO	Ubn (Wye)/Ubc (Delta/3P3W) Angle	UINT16		
0078	RO	Ucn (Wye)/Uca (Delta/3P3W) Angle	UINT16		
0079	RO	Ia Angle	UINT16	x100	°
0080	RO	Ib Angle	UINT16		
0081	RO	Ic Angle	UINT16		
0082	RO	AI	Float		
0084	RO	AO	UINT16	x100	mA
0085	RO	DI Status[2]	UINT16		
0086	RO	DO Status[3]	UINT16		
0087	RO	Alarm Status[4]	UINT32		
0089	RO	SOE Pointer[5]	UINT32		
0091	RO	PQ Log Pointer[5]	UINT32		
0093	RO	WFR Log #1 Pointer[5]	UINT32		
0095	RO	WFR Log #2 Pointer[5]	UINT32		
0097	RO	IER Log Pointer[5]	UINT32		
0099	RO	DR #1 Pointer (HS)[5]	UINT32		
0101	RO	DR #2 Pointer (HS)[5]	UINT32		
0103	RO	DR #3 Pointer (HS)[5]	UINT32		
0105	RO	DR #4 Pointer (HS)[5]	UINT32		
0107	RO	DR #5 Pointer (Standard)[5]	UINT32		
…		…			
0129	RO	DR #16 Pointer (Standard)[5]	UINT32		
0131	RO	Total Memory Size[6]	UINT32	x1	kB
0133	RO	Available Memory[6]	UINT32	x1	kB
0135	RO	Device Operating Time[7~]	UINT32	x0.1	Hour
0137	RO	I Residual[8~]	Float	x1	A
0139	RO	U1~ (Positive Sequence Voltage)	Float	x1	V
0141	RO	U2~ (Negative Sequence Voltage)	Float		
0143	RO	U0~ (Zero Sequence Voltage)	Float		
0145	RO	I1~ (Positive Sequence Current)	Float	x1	A
0147	RO	I2~ (Negative Sequence Current)	Float		
0149	RO	I0~ (Zero Sequence Current)	Float		

Available in Firmware version V1.00.05 or later

~Available in Firmware V2.00.00 or later

Table 5-1 Basic Measurements

Notes:

1) When the **Wiring Mode** is **Delta** or **3P3W**, the per phase line-to-neutral Voltages, kWs, kvars, kVAs and P.F.s have no meaning, and their registers are reserved.

2) 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).

3) 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).

4) The **Alarm Status** register, the bit values indicates the various Alarm states with "1" meaning Active and "0" meaning Inactive. The following table illustrates the details of the **Alarm Status** 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 Status Register (0087)

5) The range of the SOE/PQ/WFR/IER/DR Log Pointer is between 0 and 0xFFFFFFFFH. The pointer is incremented for every new log generated and will roll over to 0 if its current value is 0xFFFFFFFFH. A value of zero indicates that the specific Log does not contain any record. If a **Clear SOE Log/PQ Log/WFR Log/IER Log/DR Log** is performed from the Front Panel or via communications, its corresponding **Log Pointer** will be reset to zero. Use the following equation to determine the latest log location:

   Latest Log Location = Modulo [**Log Pointer / Log Depth**]

   Where **Log Depth** = 512 for **SOE Log**, 1000 for **PQ Log**, **WFR Recording Depth** for **WFR Log**, **IER Recording Depth** for **IER Log** and **DR Recording Depth** for **DR Log**.

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

7) The **Device Operating Time** means the accumulated Operating Time (or Running Hours) whenever any per-phase Current has exceeded the **Current On Threshold** (Register 6200). The **Device Operating Time** data is stored in non-volatile memory and will not suffer any loss in the event of a power failure.

8) **I Residual** register is meaningful only if the meter is equipped with the I4 option.

5.2 Energy Measurements

5.2.1 Total Energy Measurements

The Energy registers have a maximum value of 1,000,000,000 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	Scale	Unit
0200	RW	kWh Import	UINT32	x1	kWh
0202	RW	kWh Export	UINT32		
0204	RO	kWh Net	INT32		
0206	RO	kWh Total	UINT32		
0208	RW	kvarh Import	UINT32	x1	kvarh
0210	RW	kvarh Export	UINT32		
0212	RO	kvarh Net	INT32		
0214	RO	kvarh Total	UINT32		
0216	RW	kVAh	UINT32	x1	kVAh
0218	RW	kvarh Q1	UINT32	x1	kvarh
0220	RW	kvarh Q2	UINT32		
0222	RW	kvarh Q3	UINT32		
0224	RW	kvarh Q4	UINT32		
0226	RO	kWh Import Fractional	Float	x1	W·s
0228	RO	kWh Export Fractional	Float		
0230	RO	kWh Net Fractional	Float		
0232	RO	kWh Total Fractional	Float		
0234	RO	kvarh Import Fractional	Float	x1	var·s
0236	RO	kvarh Export Fractional	Float		
0238	RO	kvarh Net Fractional	Float		
0240	RO	kvarh Total Fractional	Float		
0242	RO	kVAh Fractional	Float	x1	VA·s
0244	RO	kvarh Q1 Fractional	Float	x1	var·s
0246	RO	kvarh Q2 Fractional	Float		
0248	RO	kvarh Q3 Fractional	Float		
0250	RO	kvarh Q4 Fractional	Float		

Table 5-3 Energy Measurements

5.2.2 TOU Energy Measurements

Register	Property	Description	Format	Scale	Unit
4000	RW	kWh Import of T1	UINT32	x1	kWh
4002	RW	kWh Export of T1	UINT32		
4004	RW	kvarh Import of T1	UINT32		kvarh
4006	RW	kvarh Export of T1	UINT32		
4008	RW	kVAh of T1	UINT32		kVAh

4010	RW	kWh Import of T2	UINT32		kWh
4012	RW	kWh Export of T2	UINT32		
4014	RW	kvarh Import of T2	UINT32		kvarh
4016	RW	kvarh Export of T2	UINT32		
4018	RW	kVAh of T2	UINT32		kVAh
4020	RW	kWh Import of T3	UINT32		kWh
4022	RW	kWh Export of T3	UINT32		
4024	RW	kvarh Import of T3	UINT32		kvarh
4026	RW	kvarh Export of T3	UINT32		
4028	RW	kVAh of T3	UINT32		kVAh
4030	RW	kWh Import of T4	UINT32		kWh
4032	RW	kWh Export of T4	UINT32		
4034	RW	kvarh Import of T4	UINT32		kvarh
4036	RW	kvarh Export of T4	UINT32		
4038	RW	kVAh of T4	UINT32		kVAh
4040	RW	kWh Import of T5	UINT32		kWh
4042	RW	kWh Export of T5	UINT32		
4044	RW	kvarh Import of T5	UINT32		kvarh
4046	RW	kvarh Export of T5	UINT32		
4048	RW	kVAh of T5	UINT32		kVAh
4050	RW	kWh Import of T6	UINT32		kWh
4052	RW	kWh Export of T6	UINT32		
4054	RW	kvarh Import of T6	UINT32		kvarh
4056	RW	kvarh Export of T6	UINT32		
4058	RW	kVAh of T6	UINT32		kVAh
4060	RW	kWh Import of T7	UINT32		kWh
4062	RW	kWh Export of T7	UINT32		
4064	RW	kvarh Import of T7	UINT32		kvarh
4066	RW	kvarh Export of T7	UINT32		
4068	RW	kVAh of T7	UINT32		kVAh
4070	RW	kWh Import of T8	UINT32		kWh
4072	RW	kWh Export of T8	UINT32		
4074	RW	kvarh Import of T8	UINT32		kvarh
4076	RW	kvarh Export of T8	UINT32		
4078	RW	kVAh of T8	UINT32		kVAh
4080~4099	RW	Reserved			
4100	RO	kWh Import of T1	Float		W.s
4102	RO	kWh Export of T1	Float		
4104	RO	kvarh Import of T1	Float		var.s
4106	RO	kvarh Export of T1	Float		
4108	RO	kVAh of T1	Float		VA.s
4110	RO	kWh Import of T2	Float		W.s
4112	RO	kWh Export of T2	Float		
4114	RO	kvarh Import of T2	Float		var.s
4116	RO	kvarh Export of T2	Float		
4118	RO	kVAh of T2	Float		VA.s
4120	RO	kWh Import of T3	Float		W.s
4122	RO	kWh Export of T3	Float		
4124	RO	kvarh Import of T3	Float		var.s
4126	RO	kvarh Export of T3	Float		
4128	RO	kVAh of T3	Float	x1	VA.s
4130	RO	kWh Import of T4	Float		W.s
4132	RO	kWh Export of T4	Float		
4134	RO	kvarh Import of T4	Float		var.s
4136	RO	kvarh Export of T4	Float		
4138	RO	kVAh of T4	Float		VA.s
4140	RO	kWh Import of T5	Float		W.s
4142	RO	kWh Export of T5	Float		
4144	RO	kvarh Import of T5	Float		var.s
4146	RO	kvarh Export of T5	Float		
4148	RO	kVAh of T5	Float		VA.s
4150	RO	kWh Import of T6	Float		W.s
4152	RO	kWh Export of T6	Float		
4154	RO	kvarh Import of T6	Float		var.s
4156	RO	kvarh Export of T6	Float		

4158	RO	kVAh of T6	Float		VA.s
4160	RO	kWh Import of T7	Float		W.s
4162	RO	kWh Export of T7	Float		
4164	RO	kvarh Import of T7	Float		var.s
4166	RO	kvarh Export of T7	Float		
4168	RO	kVAh of T7	Float		VA.s
4170	RO	kWh Import of T8	Float		W.s
4172	RO	kWh Export of T8	Float		
4174	RO	kvarh Import of T8	Float		var.s
4176	RO	kvarh Export of T8	Float		
4178	RO	kVAh of T8	Float		VA.s

Table 5-4 TOU Energy Measurements

5.2.3 Interval Energy Measurements

Register	Property	Description	Format	Scale	Unit
4500	RO	kWh Import	INT32	x0.01	kWh
4502	RO	kWh Export	INT32		
4504	RO	kvarh Import	INT32		kvarh
4506	RO	kvarh Export	INT32		
4508	RO	kVAh	INT32		kVAh

Table 5-5 Interval Energy Measurements

5.3 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	Scale	Unit
0350	RW	DI1 Pulse Counter	UINT32	x1000	-
0352	RW	DI2 Pulse Counter	UINT32		
0354	RW	DI3 Pulse Counter	UINT32		
0356	RW	DI4 Pulse Counter	UINT32		
0358	RW	DI5 Pulse Counter	UINT32		
0360	RW	DI6 Pulse Counter	UINT32		

Table 5-6 Pulse Counter

5.4 Harmonic Measurements

5.4.1 Fundamental (Displacement) Measurements

Register	Property	Description	Format	Scale	Unit
0400	RO	dUan[1]	Float	x1	V
0402	RO	dUbn[1]	Float		
0404	RO	dUcn[1]	Float		
0406	RO	dUln average[1]	Float		
0408	RO	dUab[2]	Float		
0410	RO	dUbc[2]	Float		
0412	RO	dUca[2]	Float		
0414	RO	dUll average[2]	Float		
0416	RO	dIa	Float		A
0418	RO	dIb	Float		
0420	RO	dIc	Float		
0422	RO	dI average	Float		
0424	RO	dI4[3]	Float		
0426	RO	dkWa[1]	Float		W
0428	RO	dkWb[1]	Float		
0430	RO	dkWc[1]	Float		
0432	RO	dkW Total	Float		
0434	RO	dkvara[1]	Float		var
0436	RO	dkvarb[1]	Float		
0438	RO	dkvarc[1]	Float		
0440	RO	dkvar Total	Float		
0442	RO	dkVAa[1]	Float		VA
0444	RO	dkVAb[1]	Float		

0446	RO	dkVAc[1]	Float		
0448	RO	dkVA Total	Float		
0450	RO	dP.F.a[1]	Float		-
0452	RO	dP.F.b[1]	Float		
0454	RO	dP.F.c[1]	Float		
0456	RO	dP.F. Total	Float		

Table 5-7 Fundamental Measurements

Notes:

1) When the **Wiring Mode** is **Delta** or **3P3W**, the fundamental components of per phase line-to-neutral Voltages, kWs, kvars, kVAs and P.F.s 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) **I4** is valid only if the device is equipped with I4 option. Otherwise, it is reserved.

5.4.2 Harmonic Measurements

The Harmonics data (Individual Harmonics, THD, TOHD and TEHD) returned is 100 times the actual value. For example, if the register contains a value of 1031, the actual harmonic value is 10.31. The K Factor data 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		
0460	RO	Ic K-Factor	UINT16		
0461	RO	Uan (WYE)/Uab (Delta/3P3W) THD	UINT16	x100	%
0462	RO	Ubn (WYE)/Ubc (Delta/3P3W) THD	UINT16		
0463	RO	Ucn (WYE)/Uca (Delta/3P3W) THD	UINT16		
0464	RO	Ia THD	UINT16		
0465	RO	Ib THD	UINT16		
0466	RO	Ic THD	UINT16		
0467	RO	I4 THD[1]	UINT16		
0468	RO	Uan (WYE)/Uab (Delta/3P3W) TOHD	UINT16		
0469	RO	Ubn (WYE)/Ubc (Delta/3P3W) TOHD	UINT16		
0470	RO	Ucn (WYE)/Uca (Delta/3P3W) TOHD	UINT16		
0471	RO	Ia TOHD	UINT16		
0472	RO	Ib TOHD	UINT16		
0473	RO	Ic TOHD	UINT16		
0474	RO	I4 TOHD[1]	UINT16		
0475	RO	Uan (WYE)/Uab (Delta/3P3W) TEHD	UINT16		
0476	RO	Ubn (WYE)/Ubc (Delta/3P3W) TEHD	UINT16		
0477	RO	Ucn (WYE)/Uca (Delta/3P3W) TEHD	UINT16		
0478	RO	Ia TEHD	UINT16		
0479	RO	Ib TEHD	UINT16		
0480	RO	Ic TEHD	UINT16		
0481	RO	I4 TEHD[1]	UINT16		
0482	RO	Uan (WYE)/Uab (Delta/3P3W) 2nd Harmonic	UINT16		
0483	RO	Ubn (WYE)/Ubc (Delta/3P3W) 2nd Harmonic	UINT16		
0484	RO	Ucn (WYE)/Uca (Delta/3P3W) 2nd Harmonic	UINT16		
0485	RO	Ia 2nd Harmonic	UINT16		
0486	RO	Ib 2nd Harmonic	UINT16		
0487	RO	Ic 2nd Harmonic	UINT16		
0488	RO	I4 2nd Harmonic[1]	UINT16		
...		...			
0909	RO	Uan (WYE)/Uab (Delta/3P3W) 63rd Harmonic	UINT16		
0910	RO	Ubn (WYE)/Ubc (Delta/3P3W) 63rd Harmonic	UINT16		
0911	RO	Ucn (WYE)/Uca (Delta/3P3W) 63rd Harmonic	UINT16		
0912	RO	Ia 63rd Harmonic	UINT16		
0913	RO	Ib 63rd Harmonic	UINT16		
0914	RO	Ic 63rd Harmonic	UINT16		
0915	RO	I4 63rd Harmonic[1]	UINT16		

Table 5-8 Harmonics Measurements

Notes:

1) **I4 THD/TOHD/TEHD** and **Individual Harmonic** Registers are valid only if the device is equipped with the I4 option.

Otherwise, they are reserved.

5.5 High-speed Measurements

Register	Property	Description	Format	Scale	Unit
0930	RO	Uan[1]	Float	x1	V
0932	RO	Ubn[1]	Float		
0934	RO	Ucn[1]	Float		
0936	RO	Uln average[1]	Float		
0938	RO	Uab	Float		
0940	RO	Ubc	Float		
0942	RO	Uca	Float		
0944	RO	Ull average	Float		
0946	RO	Ia	Float		A
0948	RO	Ib	Float		
0950	RO	Ic	Float		
0952	RO	I average	Float		
0954	RO	I4[2]	Float		
0956	RO	kWa[1]	Float		W
0958	RO	kWb[1]	Float		
0960	RO	kWc[1]	Float		
0962	RO	kW Total	Float		
0964	RO	kvara[1]	Float		var
0966	RO	kvarb[1]	Float		
0968	RO	kvarc[1]	Float		
0970	RO	kvar Total	Float		
0972	RO	kVAa[1]	Float		VA
0974	RO	kVAb[1]	Float		
0976	RO	kVAc[1]	Float		
0978	RO	kVA Total	Float		
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. Total	Float		
0988	RO	I0*	Float		A

*Available in Firmware version V1.00.05 or later

Table 5-9 High-speed Measurements

Notes:

1) When the **Wiring Mode** is **Delta** or **3P3W**, the per phase line-to-neutral Voltages, kWs, kvars, kVAs and P.F.s have no meaning, and their registers are reserved.

2) **I4** is valid only if the device is equipped with the I4 option. Otherwise, it is reserved.

3) The high-speed measurements update Voltage @ ½ cycle and 3-phase Current, Neutral Current (I4) and I0 @ 1 cycle.

5.6 Demand Measurements

5.6.1 Present Demand

Register	Property	Description	Format	Scale	Unit
1000	RO	Uan	INT32	x100	V
1002	RO	Ubn	INT32		
1004	RO	Ucn	INT32		
1006	RO	Uln average	INT32		
1008	RO	Uab	INT32		
1010	RO	Ubc	INT32		
1012	RO	Uca	INT32		
1014	RO	Ull average	INT32		
1016	RO	Ia	INT32	x1000	A
1018	RO	Ib	INT32		
1020	RO	Ic	INT32		
1022	RO	I average	INT32		
1024	RO	I4[1]	INT32		
1026	RO	kWa	INT32	x1	W
1028	RO	kWb	INT32		
1030	RO	kWc	INT32		
1032	RO	kW Total	INT32		

1034	RO	kvara	INT32	x1	var
1036	RO	kvarb	INT32		
1038	RO	kvarc	INT32		
1040	RO	kvar Total	INT32		
1042	RO	kVAa	INT32	x1	VA
1044	RO	kVAb	INT32		
1046	RO	kVAc	INT32		
1048	RO	kVA Total	INT32		
1050	RO	P.F.a	INT32	x1000	-
1052	RO	P.F.b	INT32		
1054	RO	P.F.c	INT32		
1056	RO	P.F. Total	INT32		
1058	RO	FREQ	INT32	x100	Hz
1060	RO	U Unbalance	INT32	x10	%
1062	RO	I Unbalance	INT32		
1064	RO	Uan (WYE)/Uab (Delta/3P3W) THD	INT32	x100	%
1066	RO	Ubn (WYE)/Ubc (Delta/3P3W) THD	INT32		
1068	RO	Ucn (WYE)/Uca (Delta/3P3W) THD	INT32		
1070	RO	Ia THD	INT32		
1072	RO	Ib THD	INT32		
1074	RO	Ic THD	INT32		

Table 5-10 Present Demand

Notes:

1) **I4 Present Demand** is valid only if the device is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current) Present Demand** if the meter is equipped with the AI option.

5.6.2 Predicted Demand

Register	Property	Description	Format	Scale	Unit
1200	RO	Uan	INT32	x100	V
1202	RO	Ubn	INT32		
1204	RO	Ucn	INT32		
1206	RO	Uln average	INT32		
1208	RO	Uab	INT32		
1210	RO	Ubc	INT32		
1212	RO	Uca	INT32		
1214	RO	Ull average	INT32		
1216	RO	Ia	INT32	x1000	A
1218	RO	Ib	INT32		
1220	RO	Ic	INT32		
1222	RO	I average	INT32		
1224	RO	I4[1]	INT32		
1226	RO	kWa	INT32	x1	W
1228	RO	kWb	INT32		
1230	RO	kWc	INT32		
1232	RO	kW Total	INT32		
1234	RO	kvara	INT32	x1	var
1236	RO	kvarb	INT32		
1238	RO	kvarc	INT32		
1240	RO	kvar Total	INT32		
1242	RO	kVAa	INT32	x1	VA
1244	RO	kVAb	INT32		
1246	RO	kVAc	INT32		
1248	RO	kVA Total	INT32		
1250	RO	P.F.a	INT32	x1000	-
1252	RO	P.F.b	INT32		
1254	RO	P.F.c	INT32		
1256	RO	P.F. Total	INT32		
1258	RO	FREQ	INT32	x100	Hz
1260	RO	U Unbalance	INT32	x10	%
1262	RO	I Unbalance	INT32		
1264	RO	Uan (WYE)/Uab (Delta/3P3W) THD	INT32	x100	%
1266	RO	Ubn (WYE)/Ubc (Delta/3P3W) THD	INT32		
1268	RO	Ucn (WYE)/Uca (Delta/3P3W) THD	INT32		
1270	RO	Ia THD	INT32		

1272	RO	Ib THD	INT32		
1274	RO	Ic THD	INT32		

Table 5-11 Predicted Demand

Notes:

1) **I4 Predicted Demand** is valid only if the device is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current) Predicted Demand** if the meter is equipped with the AI option.

5.6.3 Max./Min. per Demand Period

Register	Property	Description	Format	Scale	Unit
1400	RO	Uan Max.	INT32	x100	V
1402	RO	Ubn Max.	INT32		
1404	RO	Ucn Max.	INT32		
1406	RO	Uln average Max.	INT32		
1408	RO	Uab Max.	INT32		
1410	RO	Ubc Max.	INT32		
1412	RO	Uca Max.	INT32		
1414	RO	Ull average Max.	INT32		
1416	RO	Ia Max.	INT32	x1000	A
1418	RO	Ib Max.	INT32		
1420	RO	Ic Max.	INT32		
1422	RO	I average Max.	INT32		
1424	RO	I4 Max.[1]	INT32		
1426	RO	kWa Max.	INT32	x1	W
1428	RO	kWb Max.	INT32		
1430	RO	kWc Max.	INT32		
1432	RO	kW Total Max.	INT32		
1434	RO	kvara Max.	INT32	x1	var
1436	RO	kvarb Max.	INT32		
1438	RO	kvarc Max.	INT32		
1440	RO	kvar Total Max.	INT32		
1442	RO	kVAa Max.	INT32	x1	VA
1444	RO	kVAb Max.	INT32		
1446	RO	kVAc Max.	INT32		
1448	RO	kVA Total Max.	INT32		
1450	RO	P.F.a Max.	INT32	x1000	-
1452	RO	P.F.b Max.	INT32		
1454	RO	P.F.c Max.	INT32		
1456	RO	P.F. Total Max.	INT32		
1458	RO	FREQ Max.	INT32	x100	Hz
1460	RO	U Unbalance Max.	INT32	x10	%
1462	RO	I Unbalance Max.	INT32		
1464	RO	Uan (WYE)/Uab (Delta/3P3W) THD Max.	INT32	x100	%
1466	RO	Ubn (WYE)/Ubc (Delta/3P3W) THD Max.	INT32		
1468	RO	Ucn (WYE)/Uca (Delta/3P3W) THD Max.	INT32		
1470	RO	Ia THD Max.	INT32		
1472	RO	Ib THD Max.	INT32		
1474	RO	Ic THD Max.	INT32		
1476~1598		Reserved			
1600	RO	Uan Min.	INT32	x100	V
1602	RO	Ubn Min.	INT32		
1604	RO	Ucn Min.	INT32		
1606	RO	Uln average Min.	INT32		
1608	RO	Uab Min.	INT32		
1610	RO	Ubc Min.	INT32		
1612	RO	Uca Min.	INT32		
1614	RO	Ull average Min.	INT32		
1616	RO	Ia Min.	INT32	x1000	A
1618	RO	Ib Min.	INT32		
1620	RO	Ic Min.	INT32		
1622	RO	I average Min.	INT32		
1624	RO	I4 Min.[1]	INT32		
1626	RO	kWa Min.	INT32	x1	W
1628	RO	kWb Min.	INT32		
1630	RO	kWc Min.	INT32		
1632	RO	kW Total Min.	INT32		

1634	RO	kvara Min.	INT32	x1	var
1636	RO	kvarb Min.	INT32		
1638	RO	kvarc Min.	INT32		
1640	RO	kvar Total Min.	INT32		
1642	RO	kVAa Min.	INT32	x1	VA
1644	RO	kVAb Min.	INT32		
1646	RO	kVAc Min.	INT32		
1648	RO	kVA Total Min.	INT32		
1650	RO	P.F.a Min.	INT32	x1000	-
1652	RO	P.F.b Min.	INT32		
1654	RO	P.F.c Min.	INT32		
1656	RO	P.F. Total Min.	INT32		
1658	RO	FREQ Min.	INT32	x100	Hz
1660	RO	U Unbalance Min.	INT32	x10	%
1662	RO	I Unbalance Min.	INT32		
1664	RO	Uan (WYE)/Uab (Delta/3P3W) THD Min.	INT32	x100	%
1666	RO	Ubn (WYE)/Ubc (Delta/3P3W) THD Min.	INT32		
1668	RO	Ucn (WYE)/Uca (Delta/3P3W) THD Min.	INT32		
1670	RO	Ia THD Min.	INT32		
1672	RO	Ib THD Min.	INT32		
1674	RO	Ic THD Min.	INT32		

Table 5-12 Max./Min. Value per Demand Period

Notes:

1) **I4 Max./Min. Value per Demands** Period is valid only if the device is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current) Demand** if the meter is equipped with the AI option.

5.6.4 Peak Demand Log of This Month (Since Last Reset)

Register	Property	Description	Format	Scale	Unit
1800~1805	RO	kW Total	See Section 5.6.6 Demand Data Structure	x1	W
1806~1811	RO	kvar Total			var
1812~1817	RO	kVA Total			VA
1818~1823	RO	Ia		x1000	A
1824~1829	RO	Ib			
1830~1835	RO	Ic			

Table 5-13 Peak Demand Log of This Month (Since Last Reset)

5.6.5 Peak Demand Log of Last Month (Before Last Reset)

Register	Property	Description	Format	Scale	Unit
1850~1855	RO	kW Total	See Section 5.6.6 Demand Data Structure	x1	W
1856~1861	RO	kvar Total			var
1862~1867	RO	kVA Total			VA
1868~1873	RO	Ia		x1000	A
1874~1879	RO	Ib			
1880~1885	RO	Ic			

Table 5-14 Peak Demand Log of Last Month (Before Last Reset)

5.6.6 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

Table 5-15 Demand Data Structure

5.7 Log Register

5.7.1 Max./Min. Log

5.7.1.1 Max. Log of This Month (Since Last Reset)

Register	Property	Description	Format	Scale	Unit
2000~2005	RO	Uan	See Section 5.7.1.5 Max./Min. Log Data Structure	x100	V
2006~2011	RO	Ubn			
2012~2017	RO	Ucn			
2018~2023	RO	Uln average			
2024~2029	RO	Uab			
2030~2035	RO	Ubc			
2036~2041	RO	Uca			
2042~2047	RO	Ull average			
2048~2053	RO	Ia		x1000	A
2054~2059	RO	Ib			
2060~2065	RO	Ic			
2066~2071	RO	I average			
2072~2077	RO	I4[1]			
2078~2083	RO	kW Total		x1	W
2084~2089	RO	kvar Total			var
2090~2095	RO	kVA Total			VA
2096~2101	RO	P.F. Total		x1000	-
2102~2107	RO	FREQ		x100	Hz
2108~2113	RO	Uan (WYE)/Uab (Delta/3P3W) THD		x100	%
2114~2119	RO	Ubn (WYE)/Ubc (Delta/3P3W) THD			
2120~2125	RO	Ucn (WYE)/Uca (Delta/3P3W) THD			
2126~2131	RO	Ia THD			
2132~2137	RO	Ib THD			
2138~2143	RO	Ic THD			
2144~2149	RO	Ia K-Factor		x10	-
2150~2155	RO	Ib K-Factor			
2156~2161	RO	Ic K-Factor			
2162~2167	RO	U Unbalance		x10	%
2168~2173	RO	I Unbalance			
2174~2179	RO	I Residual		x1000	A

Table 5-16 Max. Log of This Month (Since Last Reset)

Notes:

1) **I4** is valid only if the device is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current)** if the meter is equipped with the AI option.

5.7.1.2 Min. Log of This Month (Since Last Reset)

Register	Property	Description	Format	Scale	Unit
2300~2305	RO	Uan	See Section 5.7.1.5 Max./Min. Log Data Structure	x100	V
2306~2311	RO	Ubn			
2312~2317	RO	Ucn			
2318~2323	RO	Uln average			
2324~2329	RO	Uab			
2330~2335	RO	Ubc			
2336~2341	RO	Uca			
2342~2347	RO	Ull average			
2348~2353	RO	Ia		x1000	A
2354~2359	RO	Ib			
2360~2365	RO	Ic			
2366~2371	RO	I average			
2372~2377	RO	I4[1]			
2378~2383	RO	kW Total		x1	W
2384~2389	RO	kvar Total			var
2390~2395	RO	kVA Total			VA
2396~2401	RO	P.F. Total		x1000	-
2402~2407	RO	FREQ		x100	Hz
2408~2413	RO	Uan (WYE)/Uab (Delta/3P3W) THD		x100	%
2414~2419	RO	Ubn (WYE)/Ubc (Delta/3P3W) THD			
2420~2425	RO	Ucn (WYE)/Uca (Delta/3P3W) THD			
2426~2431	RO	Ia THD			
2432~2437	RO	Ib THD			
2438~2443	RO	Ic THD			

2444~2449	RO	Ia K-Factor		x10	-
2450~2455	RO	Ib K-Factor			
2456~2461	RO	Ic K-Factor			
2462~2467	RO	U Unbalance		x10	%
2468~2473	RO	I Unbalance			
2474~2479	RO	I Residual		x1000	A

Table 5-17 Min. Log of This Month (Since Last Reset)

Notes:

1) **I4** is valid only if the device is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current)** if the meter is equipped with the AI option.

5.7.1.3 Max. Log of Last Month (Before Last Reset)

Register	Property	Description	Format	Scale	Unit
2600~2605	RO	Uan	See Section 5.7.1.5 Max./Min. Log Data Structure	x100	V
2606~2611	RO	Ubn			
2612~2617	RO	Ucn			
2618~2623	RO	Uln average			
2624~2629	RO	Uab			
2630~2635	RO	Ubc			
2636~2641	RO	Uca			
2642~2647	RO	Ull average			
2648~2653	RO	Ia		x1000	A
2654~2659	RO	Ib			
2660~2665	RO	Ic			
2666~2671	RO	I average			
2672~2677	RO	I4[1]			
2678~2683	RO	kW Total		x1	W
2684~2689	RO	kvar Total			var
2690~2695	RO	kVA Total			VA
2696~2701	RO	P.F. Total		x1000	-
2702~2707	RO	FREQ		x100	Hz
2708~2713	RO	Uan (WYE)/Uab (Delta/3P3W) THD		x100	%
2714~2719	RO	Ubn (WYE)/Ubc (Delta/3P3W) THD			
2720~2725	RO	Ucn (WYE)/Uca (Delta/3P3W) THD			
2726~2731	RO	Ia THD			
2732~2737	RO	Ib THD			
2738~2743	RO	Ic THD			
2744~2749	RO	Ia K-Factor		x10	-
2750~2755	RO	Ib K-Factor			
2756~2761	RO	Ic K-Factor			
2762~2767	RO	U Unbalance		x10	%
2768~2773	RO	I Unbalance			
2774~2779	RO	I Residual		x1000	A

Table 5-18 Max. Log of Last Month (Before Last Reset)

Notes:

1) **I4** is valid only if the device is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current)** if the meter is equipped with the AI option.

5.7.1.4 Min Log of Last Month (Before Last Reset)

Register	Property	Description	Format	Scale	Unit
2900~2905	RO	Uan	See Section 5.7.1.5 Max./Min. Log Data Structure	x100	V
2906~2911	RO	Ubn			
2912~2917	RO	Ucn			
2918~2923	RO	Uln average			
2924~2929	RO	Uab			
2930~2935	RO	Ubc			
2936~2941	RO	Uca			
2942~2947	RO	Ull average			
2948~2953	RO	Ia		x1000	A
2954~2959	RO	Ib			
2960~2965	RO	Ic			
2966~2971	RO	I average			
2972~2977	RO	I4[1]			

2978~2983	RO	kW Total		x1	W
2984~2989	RO	kvar Total			var
2990~2995	RO	kVA Total			VA
2996~3001	RO	P.F. Total		x1000	-
3002~3007	RO	FREQ		x100	Hz
3008~3013	RO	Uan (WYE)/Uab (Delta/3P3W) THD		x100	%
3014~3019	RO	Ubn (WYE)/Ubc (Delta/3P3W) THD			
3020~3025	RO	Ucn (WYE)/Uca (Delta/3P3W) THD			
3026~3031	RO	Ia THD			
3032~3037	RO	Ib THD			
3038~3043	RO	Ic THD			
3044~3049	RO	Ia K-Factor		x10	-
3050~3055	RO	Ib K-Factor			
3056~3061	RO	Ic K-Factor			
3062~3067	RO	U Unbalance		x10	%
3068~3073	RO	I Unbalance			
3074~3079	RO	I Residual		x1000	A

Table 5-19 Min. Log of Last Month (Before Last Reset)

Notes:

1) **I4** is valid only if the device is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current)** if the meter is equipped with the AI option.

5.7.1.5 Max./Min. Log 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 5-20 Max./Min. Log Data Structure

5.7.2 SOE Log

The **SOE Pointer** points to the location 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 Note 1) 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	
...		...	
14088~14095	RO	Event 512	

Table 5-21 SOE Log

Notes:

1) SOE Log Data Structure

Offset	Properties	Description	Format	Note
+0	RO	Reserved	UINT16	-
+1	RO	High-order Byte: Event Classification	UINT16	See Appendix C
		Low-order Byte: Sub-Classification		See Appendix C

+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 5-22 SOE Log Data Structure

5.8 Log Data Format

5.8.1 Read General Reference Packet Structure (Function Code 0x14)

Modbus function code 0x14 is used to access to the Energy Log, PQ Log, Data Recorder Log and Waveform Recorder Log. The table below list the file format.

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 Bytes

Read Reference Response Packet (PMC-660 to Master Station)	
Salve Address	1 Byte
Function Code (0x14)	1 Byte
Byte Count	1 Byte (N$\times N_0$+2)
Sub-Res X, Byte Count	1 Byte (N$\times N_0$+1)
Sub-Res X, Reference Type (0x06)	1 Byte
Sub-Res X, Register Data	N$\times N_0$ Bytes
Sub-Res X+1…	
Error Check (CRC)	2 Bytes

Table 5-23 Read Reference/ Response Request Packet

1) Start Address = [**Log #X Pointer** / **Log #X Depth**].
2) In the Request Packet, the **File Number** parameter is used to reference which log to read:
   a) For Energy Log, **File Number** = 17
   b) For PQ Log, **File Number** = 18
   c) For Data Recorder Logs 1 to 16, **File Number** = 1 to 16
   d) For Waveform Recorder Log, **File Number** = 19 to 50
3) In the Response Packet, **N** represents the number of logs returned, and $\mathbf{N_0}$ is the length of a single log:
   e) For Energy Log, $\mathbf{N_0}$ = n*4+8 where n is the number of parameters for the Energy Log
   f) For Data Recorder, $\mathbf{N_0}$ = n*4+8 where n is the number of parameters for a particular Data Recorder
   g) For PQ Log, $\mathbf{N_0}$ = 16
   h) For Waveform Recorder Log, $\mathbf{N_0}$ = 2

5.8.2 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 5-24 Energy Log Data Structure

Note:

1) Please refer to **Section 5.8.1 Read General Reference Packet Structure** for how to retrieve the energy log.

5.8.3 PQ Log Data Structure

Offset	Property	Description	Format
0 to 7	RO	PQ Log 1	See Note 1) 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 5-25 PQ Log

Notes:

1) PQ Log Data Structure

Offset	Property	Description	Format	Note
+0	RO	PQ Log Location	UINT16	/
+1	RO	High-order Byte: Classification	UINT16	See Note 2)
		Low-order Byte: Sub-Classification[2]		
+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#	RO	Event Value 1	INT32	See Note 2)
+8#	RO	Event Value 2	INT32	
+10#	RO	Event Value 3	INT32	
+12#	RO	Event Value 4	INT32	
+14#	RO	Event Value 5	INT32	

Available in Firmware V1.00.04 or later

Table 5-26 PQ Log Data Structure

2) The table below lists the PQ Log Classifications:

PQ Log Classification	Sub-Classification	Description	Event Value, Unit, Scale, Option
7. Transient	1	Transient Triggered	**Event Value 1**: Maximum of Transient (%), x100 **Event Value 2**: Duration (us) **Event Value 3:** Maximum Uan/Uab Transient (%), x100 **Event Value 4**: Maximum Ubn/Ubc Transient (%), x100 **Event Value 5**: Maximum Ucn/Uca Transient (%), x100
8. Dip/Swell	1	Swell Starts	**Event Value 1:** Trigger Phase • 0 = Uan/Uab • 1 = Ubn/Ubc • 2 = Ucn/Uca **Event Value 3 to 5:** Reserved
	2	Swell Ends	When the **Wiring Mode** is **WYE**: **Event Value 1**: Maximum %Residual Uln, x100 **Event Value 2**: Duration (us) **Event Value 3**: %Residual $Uan_{max}/Uln_{nominal}$, x100 **Event Value 4**: %Residual $Ubn_{max}/Uln_{nominal}$, x100 **Event Value 5**: %Residual $Ucn_{max}/Uln_{nominal}$, x100 Where $Uln_{nominal} = (Ull_{nominal} \div \sqrt{3})$ When the **Wiring Mode** is **3P3W** or **Delta**: **Event Value 1**: Maximum %Residual Ull, x100 **Event Value 2**: Duration (us) **Event Value 3**: %Residual $Uab_{max}/Ull_{nominal}$, x100 **Event Value 4**: %Residual $Ubc_{max}/Ull_{nominal}$, x100 **Event Value 5**: %Residual $Uca_{max}/Ull_{nominal}$, x100
	3	Dip Starts	See **PQ Log Classification** 8 => **Sub-Classification** 1
	4	Dip Ends	When the **Wiring Mode** is **WYE**: **Event Value 1**: Minimum %Residual Uln, x100 **Event Value 2**: Duration (us) **Event Value 3**: %Residual $Uan_{min}/Uln_{nominal}$, x100 **Event Value 4**: %Residual $Ubn_{min}/Uln_{nominal}$, x100 **Event Value 5**: %Residual $Ucn_{min}/Uln_{nominal}$, x100

			Where $Uln_{nominal}$ = ($Ull_{nominal}$÷V3) When the **Wiring Mode** is **3P3W** or **Delta**: **Event Value 1**: Maximum %Residual Ull, x100 **Event Value 2**: Duration (us) **Event Value 3**: %Residual $Uab_{min}/Ull_{nominal}$, x100 **Event Value 4**: %Residual $Ubc_{min}/Ull_{nominal}$, x100 **Event Value 5**: %Residual $Uca_{min}/Ull_{nominal}$, x100
	5	Interruption Starts	See **PQ Log Classification** 8 => **Sub-Classification** 1
	6	Interruption Ends	See **PQ Log Classification** 8 => **Sub-Classification** 4

Table 5-27 PQ Classifications

5.8.4 Data Recorder 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=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 5-28 DR-LOG Data Structure

Notes:

1) Please refer to **Section 5.8.1 Read General Reference Packet Structure** for how to retrieve the DR log.

5.8.5 Waveform Recorder Log 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=Dip/Swell 4=Transient
+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	Uan/Uab sample value (1 to N#)	UINT16	x10, V
+N+5 to 2N+4	RO	Ubn/Ubc sample value (1 to N#)	UINT16	x10, V
+2N+5 to 3N+4	RO	Ucn/Uca 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 5-29 WFR Data Structure

Notes:

1) Please refer to **Section 5.8.1 Read General Reference Packet Structure** for how to retrieve the WFR log.

5.9 Device Setup

5.9.1 Basic Setup

Register	Property	Description	Format	Range	Default
5999	RW	PT Ratio-Fraction[1]	UINT16	0 to 9999	0
6000	RW	PT Ratio-Integer[1]	UINT16	1 to 10000	1
6001	RW	CT Ratio[1]	UINT16	1 to 6,000 (5A input) 1 to 30,000 (1A input)	1
6002	RW	I4 Ratio	UINT16	1 to 10,000	1
6003	RW	Wiring Mode	UINT16	0=WYE, 1=DELTA 2=DEMO, 3=3P3W	0
6004	RW	Ull Nominal Secondary Voltage ($Ull_{nominal}$)	UINT16	100V to 700V (Ull)	415
6005	RW	Nominal Frequency ($f_{nominal}$)	UINT16	0=50Hz, 1=60Hz	0
6006	RW	Port 1 Protocol	UINT16	0=Modbus, 1=EGATE	0
6007	RW	Port 1 Unit ID	UINT16	1 to 247	100
6008	RW	Port 1 Baud rate	UINT16	0=1200, 1=2400 2=4800, 3=9600 4=19200, 5=38400	3
6009	RW	Port 1 Configuration	UINT16	0=8N2, 1=8O1, 2=8E1 3=8N1, 4=8O2, 5=8E2	2
6010	RW	Port 2 Unit ID	UINT16	1 to 247	101
6011	RW	Port 2 Baud rate	UINT16	0=1200, 1=2400 2=4800, 3=9600 4=19200, 5=38400	3
6012	RW	Port 2 Configuration	UINT16	0=8N2, 1=8O1, 2=8E1 3=8N1, 4=8O2, 5=8E2	2
6013	RW	IP Address[2]	UINT32	See Notes 2)	
6015	RW	Subnet Mask[2]	UINT32		
6017	RW	Gateway Address[2]	UINT32		
6019	RW	Power Factor Convention	UINT16	0=IEC, 1=IEEE, 2=-IEEE	0
6020	RW	kVA Calculation	UINT16	0=Vector, 1=Scalar	0
6021	RW	Demand Sync.	UINT16	0= SLD, 1=SYNC DI	0
6022	RW	Demand Period~	UINT16	1 to 60 (minutes)	15
6023	RW	Number of Sliding Windows	UINT16	1 to 15	1
6024	RW	Predicted Response[3]	UINT16	70 to 99	70
6025	RW	DI1 Function	UINT16	0=Digital Input 1=Pulse Counter 2=SYNC DI, 3=PPS 4=Tariff Switch[4#]	0
6026	RW	DI2 Function	UINT16		
6027	RW	DI3 Function	UINT16		
6028	RW	DI4 Function	UINT16	0=Digital Input 1=Pulse Counter 2=SYNC DI, 3=PPS	0
6029	RW	DI5 Function	UINT16		
6030	RW	DI6 Function	UINT16		
6031	RW	DI1 Debounce	UINT16	1 to 1000 (ms)	20
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	UINT32	1 to 1,000,000	1
6039	RW	DI2 Pulse Weight	UINT32		
6041	RW	DI3 Pulse Weight	UINT32		
6043	RW	DI4 Pulse Weight	UINT32		
6045	RW	DI5 Pulse Weight	UINT32		
6047	RW	DI6 Pulse Weight	UINT32		
6049	RW	DO1 Function	UINT16	0= Remote Control/Setpoint 1=kWh Import 2=kWh Export 3=kvarh Import 4=kvarh Export 5=kWh Total	0
6050	RW	DO2 Function	UINT16		
6051	RW	DO3 Function	UINT16		

				6=kvarh Total	
6052	RW	DO1 Pulse Width	UINT16	0 to 999 (x0.1s) 0=Latch Mode	0
6053	RW	DO2 Pulse Width	UINT16		
6054	RW	DO3 Pulse Width	UINT16		
6055	RW	AI Type	UINT16	0=4-20mA, 1=0-20mA	0
6056	RW	AI Zero scale	INT32	-999,999 to +999,999	400
6058	RW	AI Full scale	INT32	-999,999 to +999,999	2000
6060	RW	AO Key[5]	UINT16	0 ~16	0 (Uab)
6061	RW	AO Type	UINT16	0=4-20mA, 1=0-20mA	0
6062	RW	AO Zero scale	INT32	-999,999 to +999,999	0
6064	RW	AO Full scale	INT32	-999,999 to +999,999	+999,999
6066	RW	Ia Polarity	UINT16	0=Normal 1=Reverse	0
6067	RW	Ib Polarity	UINT16		
6068	RW	Ic Polarity	UINT16		
6069	RW	Harmonic Calculation	UINT16	0=Fundamental, 1=RMS	0
6070	RW	Enable Energy Pulse	UINT16	0=Disabled, 1=Enabled	0
6071	RW	Pulse Constant[6]~	UINT16	0 to 4	0
6072	RW	Self-Read Time[7]	UINT16	See Notes 7)	65535
6073	RW	Dip/Swell Enable	UINT16	0=Disabled, 1=Enabled	1
6074	RW	Swell Limit	UINT16	105 to 200, ($x0.01Ull_{nominal}$)	110
6075	RW	Dip Limit	UINT16	10 to 95, ($x0.01Ull_{nominal}$)	90
6076	RW	Dip/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	21
6077	RW	Dip/Swell Trigger 2	UINT16		0
6078	RW	SNTP Enable[8]	UINT16	0=Disabled 1=Enabled	0
6079	RW	Time Zone[9]	UINT16	0 to 32	26
6080	RW	SNTP Sync. Interval[10]	UINT16	10 to 1440 (min)	60
6081	RW	IP Address of Time Server	UINT32	If IP address is 192.168.8.94, write "0xC0A8085E" to this register	0.0.0.0
6083	RW	SMTP IP Port	UINT16	0 to 65535	25
6084	RW	IP Address of SMTP Server	UINT32	If address is 191.0.0.6, write "0XBF000006" to this register	0.0.0.0
6086~6121	RW	Source Email	UINT16	See Note (11)	0
6122~6141	RW	Logon Password	UINT16	See Note (12)	0
6142~6177	RW	Destination Email	UINT16	See Note (13)	0
6178	RW	Transient Enable	UINT16	0=Disabled, 1=Enabled	1
6179	RW	Transient Limit	UINT16	5 to 500 ($x0.01\ Ull_{nominal}$)	35
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	20
6181	RW	Transient Trigger 2	UINT16		0
6182	RW	Email Language	UINT16	0=English	0
6183	RW	Backlight Time-out[14]	UINT16	0 to 60 (mins)	3
6184	RW	Interruption Limit~	UINT16	0 to 50 (x0.01Un)	10
6185	RW	Arm before Execute#	UINT16	0=Disabled 1=Enabled	0
6186	RW	kvarh Type#	UINT16	0=RMS kvarh 1=Fundamental kvarh	0
6187	RW	EN Period[15,#]	UINT16	5 to 60min	60
6188	WO	Send Test Email	UINT16	Writing "0xFF00" to the Register sends a test Email to the specified Destination Email address.	
6189~6199	WO	Reserved	UINT16		
6200	RW	Current On Threshold#	UINT16	1 to 1000 (x0.001In)	1

~The ranges of parameters are changed in Firmware V1.00.05 or later.
Available in Firmware V2.00.00 or later

Table 5-30 Basic Setup Parameters

Notes:

1) PT Ratio= PT Ratio-Integer Part + (PT Ratio-Decimal Part/10000)

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

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

2) The last Octet of the **IP Address, Subnet Mask** and **Gateway** can neither be "0000 0000" nor "1111 1111".

If the IP Address is "192.168.8.97", write "0xC0A80861" to this register. The default values for the **IP Address, Subnet Mask** and **Gateway Address** are 192.168.0.100, 255.255.255.0 and 192.168.0.1, respectively.

3) 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.

4) The 3 Digital Inputs (DI1, DI2 and DI3) represent 3 binary digits where Tariff 1=000, Tariff 2=001, Tariff 3= 010, …Tariff 7=110 and Tariff 8=111 where DI1 represents the least significant digit and DI3 represents the most significant digit. As soon as DI1, DI2 and/or DI3 are configured as **Tariff Switches**, the current **TOU Tariff** will be determined by the status of the DIs, and the TOU Schedule will be ignored. The **DI1 Function** setup register must first be programmed as a **Tariff Switch** before configuring DI2 and DI3 with the same function. In other words, if DI1 is configured as a **Digital Input** or **Energy Pulse Counter**, and DI2 is configured as a **Tariff Switch**, the TOU will continue to function based on the TOU Schedule. The number of Tariffs supported depends on how many DIs are programmed as a Tariff Switch as indicated in the following table.

Tariff	DI Function		
	DI1 = Tariff Switch	DI2 & DI1 = Tariff Switch	DI3, DI2 & DI1 = Tariff Switch
T1	DI1 (0=T1)	DI2 + DI1 (00=T1)	DI3 + DI2 + DI1 (000=T1)
T2	DI1 (1=T2)	DI2 + DI1 (01=T2)	DI3 + DI2 + DI1 (001=T2)
T3	Not Available	DI2 + DI1 (10=T3)	DI3 + DI2 + DI1 (010=T3)
T4	Not Available	DI2 + DI1 (11=T4)	DI3 + DI2 + DI1 (011=T4)
T5	Not Available	Not Available	DI3 + DI2 + DI1 (100=T5)
T6	Not Available	Not Available	DI3 + DI2 + DI1 (101=T6)
T7	Not Available	Not Available	DI3 + DI2 + DI1 (110=T7)
T8	Not Available	Not Available	DI3 + DI2 + DI1 (111=T8)

Table 5-31 DIs and the Number of Tariffs Setup

5) Analog Output Parameters

If **PF Total** 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	Parameter	Scale	Unit	Key	Parameter	Scale	Unit
0	Uab	x1	V	**8**	kW Total	x1	kW
1	Ubc		V	**9**	kvar Total		kvar
2	Uca		V	**10**	kVA Total		kVA
3	Ull Average		V	**11**	PF Total	x1000	-
4	Ia		A	**12**	Frequency	x1	Hz
5	Ib		A	**13**	kW Total Present Demand	x1	kW
6	Ic		A	**14**	kvar Total Present Demand		kvar
7	I Average		A	**15**	kVA Total Present Demand		kVA
				16	PF Total Present Demand		-

Table 5-32 Analog Output Parameters

6) Recommended Pulse Constant settings for the different Line Voltage & Current Inputs

Voltage Input	Current Input	X Value	Energy Pulse Constant (X Value)
100V	1A	4	0=1000 imp/kWh 1=3200 imp/kWh 2=5000 imp/kWh 3=6400 imp/kWh 4=12800 imp/kWh
	5A	4	
380V	1A	4	
	5A	1	
690V	1A	2	
	5A	0	

Table 5-33 Pulse Constant

7) The **Self-Read Time** applies to both the Peak Demand Log as well as the Max./Min. Log and supports the following three 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 x 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.
- A 0xFFFF value means the automatic self-read operation is disabled and the log will be transferred manually.

8) If the PMC-660 is not equipped with the Ethernet Port, SNTP is disabled.

9) 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 5-34 Time Zones

10) The SNTP Sync. Interval should be set between 10 and 1440 minutes.

11) 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 sender@domain.com, set the registers as" 0073 0065 006E 0064 0065 0072 0040 0064 006F 006D 0061 0069 006E 002E 0063 006F 006D 0000".

12) 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"

13) 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 receiver@domain.com, so set the registers as" 0072 0065 0063 0065 0069 0076 0065 0072 0040 0064 006F 006D 0061 0069 006E 002E 0063 006F 006D 0000".

14) 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.

15) The Interval Energy will be reset once the **EN Period** is changed.

5.9.2 Setpoint Setup

5.9.2.1 Setpoint Setup Registers

Register	Property	Description	Format
6600~6609	RW	Setpoint #1 (Standard)	See Section 5.9.2.2 Setpoint Setup Data 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 5-35 Setpoints Setup

5.9.2.2 Setpoint Setup Data Structure

Offset	Property	Description		Format	Range	Default
+0	RW	Standard	Type	UINT16	0=Disabled	0

		Setpoint			1=Over Setpoint 2=Under Setpoint	
+1	RW		Paramenter[1]	UINT16	1 to 34	1
+2	RW		Active Limit	INT32	-	999,999
+4	RW		Inactive Limit	INT32	-	999,999
+6	RW		Active Delay	UINT16	0 to 9999 s	10
+7	RW		Inactive Delay	UINT16	0 to 9999 s	10
+8	RW		Trigger 1[2]	UINT16	0 to 22	0
+9	RW		Trigger 2[2]	UINT16	0 to 22	0
+0	RW	High-speed Setpoint	Type	UINT16	0=Disabled 1=Over Setpoint 2=Under Setpoint	0
+1	RW		Paramenter[1]	UINT16	1 to 14	1
+2	RW		Active Limit	INT32	-	999,999
+4	RW		Inactive Limit	INT32	-	999,999
+6	RW		Active Delay	UINT16	0 to 9999 s	10
+7	RW		Inactive Delay	UINT16	0 to 9999 s	10
+8	RW		Trigger 1[2]	UINT16	0 to 22	0
+9	RW		Trigger 2[2]	UINT16	0 to 22	0

Table 5-36 Setpoint Setup Register Structure

Notes:

1) "**Parameter**" specifies the parameter to be monitored. The Table 5-37 below provides a list of Setpoint Parameters, Standard Setpoint can monitor all parameters while the HS Setpoint only can monitor 1 to 14.

Key	Parameter	Scale/Unit
1	Uln	x100, V
2	Ull	
3	I	x1000, A
4	I4[2]	
5	Frequency Deviation	x100, Hz
6	kW Total	x1, kW
7	kvar Total	x1, 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	x1, /
16	kW Total Present Demand	x1, kW
17	kvar Total Present Demand	x1, kvar
18	P.F. Present Demand	x1000
19	kW Total Predicted Demand	x1, kW
20	kvar Total Predicted Demand	x1, kvar
21	P.F. Predicted Demand	x1000
22	U THD	x100, %
23	U TOHD	
24	U TEHD	
25	I THD	
26	I TOHD	
27	I TEHD	
28	U Unbalance	x10, %
29	I Unbalance	
30	U 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.
32	I Residual	x1000, A
33	U2 (Negative Sequence Voltage)	x100, V
34	U0 (Zero Sequence Voltage)	

Table 5-37 Setpoint Parameters

2) The **I4** is valid only if the device is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current)** if the meter is equipped with the AI option.

3) **Trigger 1/2** specifies what action the Setpoint will take when it becomes active. Table 5-38 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**	WFR #1
8	DR #6	**21**	WFR #2
10	DR #7	**22**	Alarm Email
11	DR #8		

Table 5-38 Setpoint Triggers

5.9.3 Logical Module Setup

5.9.3.1 Logical Module Setup Registers

Register	Property	Description	Format
6840~6849	RW	Logical Module #1	See Section 5.9.3.2 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 5-39 Logical Modules

5.9.3.2 Logical Module Setup Data Structure

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

Table 5-40 Logical Module Data Structure

Notes:

1) The Logical Modules can have up to 4 Source inputs. Table 5-41 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 5-41 Logical Module Sources

2) **Trigger 1/2** specifies what action the Logical Module will take when it becomes active. Table 5-42 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**	WFR #1
10	DR #7	**21**	WFR #2

Table 5-42 Logical Module Triggers

5.9.4 Data Recorder Setup

5.9.4.1 Data Recorder Setup Registers

Register	Property	Description	Format
7000~7022	RW	Data Recorder #1 (High-Speed)	See Section 5.9.4.2 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 5.9.4.3 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	Data Recorder #1 Record Size (Bytes)	UINT16
7369	RO	Data Recorder #2 Record Size (Bytes)	UINT16
7370~7381	RO	…	
7382	RO	Data Recorder #15 Record Size (Bytes)	UINT16
7383	RO	Data Recorder #16 Record Size (Bytes)	UINT16

Table 5-43 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.

5.9.4.2 High-speed Data Recorder Setup Data Structure

Offset	Property	Description	Format	Range
+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)
+5	RW	Recording Offset[4]	UINT16	0
+6	RW	Number of Parameters[5]	UINT16	0 to 16
+7	RW	Parameter 1	UINT16	Please refer to Appendices A and B for a complete list of the Data Recorder Parameters and the default configuration for each DR, respectively.
+8	RW	Parameter 2	UINT16	
+9	RW	Parameter 3	UINT16	
+10	RW	Parameter 4	UINT16	
+11	RW	Parameter 5	UINT16	
+12	RW	Parameter 6	UINT16	
+13	RW	Parameter 7	UINT16	
+14	RW	Parameter 8	UINT16	
+15	RW	Parameter 9	UINT16	
+16	RW	Parameter 10	UINT16	
+17	RW	Parameter 11	UINT16	
+18	RW	Parameter 12	UINT16	
+19	RW	Parameter 13	UINT16	
+20	RW	Parameter 14	UINT16	
+21	RW	Parameter 15	UINT16	
+22	RW	Parameter 16	UINT16	

Table 5-44 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** should be set to zero for **High-Speed Data Recorder**.

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".

5.9.4.3 Standard Data Recorder Setup Data Structure

Offset	Property	Description	Format	Range
+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
+3	RW	Recording Interval	UINT32	1 to 3456000 (seconds)
+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	Please refer to Appendices A and B for a complete list of the Data Recorder Parameters and the default configuration for each DR, respectively.
+8	RW	Parameter 2	UINT16	
+9	RW	Parameter 3	UINT16	
+10	RW	Parameter 4	UINT16	
+11	RW	Parameter 5	UINT16	
+12	RW	Parameter 6	UINT16	
+13	RW	Parameter 7	UINT16	
+14	RW	Parameter 8	UINT16	
+15	RW	Parameter 9	UINT16	
+16	RW	Parameter 10	UINT16	
+17	RW	Parameter 11	UINT16	
+18	RW	Parameter 12	UINT16	
+19	RW	Parameter 13	UINT16	
+20	RW	Parameter 14	UINT16	
+21	RW	Parameter 15	UINT16	
+22	RW	Parameter 16	UINT16	

Table 5-45 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".

5.9.5 Interval Energy Recorder Setup Registers

Register	Property	Description		Format	Range	Default
7700	RW	Recording Mode		UINT16	0=Disabled 1=Stop-When-Full 2= First-In-First-Out	2
7701	RW	Recording Depth[1]		UINT16	0 to 65535	5760
7702	RW	Recording Interval		UINT16	0=5mins, 1=10mins 2=15mins, 3=30mins 4=60mins	2
7703	RW	Start Time[2]	High-order Byte: Year	UINT16	0-99 (Year-2000)	10

			Low-order Byte: Month		1 to 12	10
7704	RW		High-order Byte: Day	UINT16	1 to 31	14
			Low-order Byte: Hour		0 to 23	14
7705	RW		High-order Byte: Minute	UINT16	0 to 59	46
			Low-order Byte: Second		0 to 59	00
7706	RW	Number of Parameters		UINT16	0 to 5	5
7707	RW	Parameter 1		UINT16	0=kWh Import 1=kWh Export 2=kvarh Import 3=kvarh Export 4=kVAh	0
7708	RW	Parameter 2		UINT16		1
7709	RW	Parameter 3		UINT16		2
7710	RW	Parameter 4		UINT16		3
7711	RW	Parameter 5		UINT16		4
7712	RO	Record Size[3]		UINT16	Unit: Bytes	28

Table 5-46 Interval Energy Recorder Setup Registers

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 Recorder** 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 **Parameters 1 to 5** will clear the Energy Log and reset the **Energy Log Pointer** to "0".

5.9.6 Waveform Recorder (WFR) Setup

The PMC-660 provides 2 independent groups of WFR with a combined total of 32 entries. Each WFR can simultaneously capture 3-phase Voltage and Current signals at a maximum resolution of 256 samples per cycles.

Register	Property	Description		Format	Range	Default
7600	RW	**WFR Log 1**	Recording Depth[1]	UINT16	0 to 32	10
7601	RW		# of Samples[2]	UINT16	0= 16, 1=32, 2=64 3=128, 4=256	4
7602	RW		Number of Cycles[2]	UINT16	320/160/80/40/20	20
7603	RW		Pre-fault Cycles[3]	UINT16	0 to 10	4
7604	RW	**WFR Log 2**	Recording Depth[1]	UINT16	0 to 32	20
7605	RW		# of Samples[2]	UINT16	0= 16, 1=32, 2=64 3=128, 4=256	2
7606	RW		Number of Cycles[2]	UINT16	320/160/80/40/20	80
7607	RW		Pre-fault Cycles[3]	UINT16	0 to 10	6

Table 5-47 Waveform Recorder Setup Parameters

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".

5.9.7 TOU Setup

5.9.7.1 Basic

Register	Property	Description	Format	Range/Option
16000	RO	Current Tariff[1]	UINT16	0=T1, 1=T2, 2=T3, 3=T4 4=T5, 5=T6, 6=T7, 7=T8
16001	RO	Current Season	UINT16	0 to 11 (Season #1 to #12)

16002	RO	Current Period	UINT16	0 to 11 (Period #1 to #12)
16003	RO	Current Daily Profile No.	UINT16	0 to 19 (Daily Profile #1 to #20)
16004	RO	Current Day Type	UINT16	0=Weekday1 1=Weekday2 2=Weekday3 3= Alternate Day
16005	RO	Current TOU No.	UINT16	0=TOU #1, 1=TOU #2
16006	RW	TOU Switch Time	UINT32	See Note (1)
16008	WO	Switch TOU Manually	UINT16	Write 0xFF00 to manually switch the TOU schedules
16009	RW	Sunday Setup	UINT16	0=Weekday1* 1=Weekday2 2=Weekday3
16010	RW	Monday Setup	UINT16	
16011	RW	Tuesday Setup	UINT16	
16012	RW	Wednesday Setup	UINT16	
16013	RW	Thursday Setup	UINT16	
16014	RW	Friday Setup	UINT16	
16015	RW	Saturday Setup	UINT16	

Table 5-48 TOU Basic Setup

Notes:

1) If DI1 is not programmed as a **Tariff Switch**, the TOU will function based on the TOU Schedule. If at least one DI (DI1) is programmed as a **Tariff Switch**, the TOU Schedule will no longer be used and the Tariff switching will be based on the status of the DIs.

2) The following table illustrates the data structure for the TOU Switch Time. For example, 0x1003140C indicates a switch time of 12:00pm on March 20th, 2016. Writing 0xFFFFFFFF to this register disables the switching between TOU Schedule.

Byte 3	Byte 2	Byte 1	Byte 0
Year-2000 (0-37)	Month (1-12)	Day (1-31)	Hour (00-23)

Table 5-49 TOU Switch Time Format

5.9.7.2 Season

The PMC-660 has two sets of Season setup parameters, one for each TOU. The Base Addresses for the two sets are 16100 and 17100, respectively, where the Register Address = Base Address + Offset. For example, the register address for TOU #1's Season #2's Start Date is 17100+4 = 17104.

Offset	Property	Description	Format	Range/Note
0	RW	Season #1: Start Date	UINT16	0x0101
1	RW	Season #1: Weekday#1 Daily Profile	UINT16	0 to 19
2	RW	Season #1: Weekday#2 Daily Profile	UINT16	
3	RW	Season #1: Weekday#3 Daily Profile	UINT16	
4	RW	Season #2: Start Date	UINT16	High-order Byte: Month Low-order Byte: Day
5	RW	Season #2: Weekday#1 Daily Profile	UINT16	0 to 19
6	RW	Season #2: Weekday#2 Daily Profile	UINT16	
7	RW	Season #2: Weekday#3 Daily Profile	UINT16	
8	RW	Season #3: Start Date	UINT16	See Season #2: Start Date
9	RW	Season #3: Weekday#1 Daily Profile	UINT16	0 to 19
10	RW	Season #3: Weekday#2 Daily Profile	UINT16	
11	RW	Season #3: Weekday#3 Daily Profile	UINT16	
12	RW	Season #4: Start Date	UINT16	See Season #2: Start Date
13	RW	Season #4: Weekday#1 Daily Profile	UINT16	0 to 19
14	RW	Season #4: Weekday#2 Daily Profile	UINT16	
15	RW	Season #4: Weekday#3 Daily Profile	UINT16	
16	RW	Season #5: Start Date	UINT16	See Season #2: Start Date
17	RW	Season #5: Weekday#1 Daily Profile	UINT16	0 to 19
18	RW	Season #5: Weekday#2 Daily Profile	UINT16	
19	RW	Season #5: Weekday#3 Daily Profile	UINT16	
20	RW	Season #6: Start Date	UINT16	See Season #2: Start Date
21	RW	Season #6: Weekday#1 Daily Profile	UINT16	0 to 19
22	RW	Season #6: Weekday#2 Daily Profile	UINT16	
23	RW	Season #6: Weekday#3 Daily Profile	UINT16	
24	RW	Season #7: Start Date	UINT16	See Season #2: Start Date

25	RW	Season #7: Weekday#1 Daily Profile	UINT16	0 to 19
26	RW	Season #7: Weekday#2 Daily Profile	UINT16	
27	RW	Season #7: Weekday#3 Daily Profile	UINT16	
28	RW	Season #8: Start Date	UINT16	See Season #2: Start Date
29	RW	Season #8: Weekday#1 Daily Profile	UINT16	0 to 19
30	RW	Season #8: Weekday#2 Daily Profile	UINT16	
31	RW	Season #8: Weekday#3 Daily Profile	UINT16	
32	RW	Season #9: Start Date	UINT16	See Season #2: Start Date
33	RW	Season #9: Weekday#1 Daily Profile	UINT16	0 to 19
34	RW	Season #9: Weekday#2 Daily Profile	UINT16	
35	RW	Season #9: Weekday#3 Daily Profile	UINT16	
36	RW	Season #10: Start Date	UINT16	See Season #2: Start Date
37	RW	Season #10: Weekday#1 Daily Profile	UINT16	0 to 19
38	RW	Season #10: Weekday#2 Daily Profile	UINT16	
39	RW	Season #10: Weekday#3 Daily Profile	UINT16	
40	RW	Season #11: Start Date	UINT16	See Season #2: Start Date
41	RW	Season #11: Weekday#1 Daily Profile	UINT16	0 to 19
42	RW	Season #11: Weekday#2 Daily Profile	UINT16	
43	RW	Season #11: Weekday#3 Daily Profile	UINT16	
44	RW	Season #12: Start Date	UINT16	See Season #2: Start Date
45	RW	Season #12: Weekday#1 Daily Profile	UINT16	0 to 19
46	RW	Season #12: Weekday#2 Daily Profile	UINT16	
47	RW	Season #12: Weekday#3 Daily Profile	UINT16	

Table 5-50 Season Setup

Notes:

1) **Start Date** for Season #1 is Jan. 1st and cannot be modified.

2) Setting a Season's **Start Date** as 0xFFFF terminates the TOU's Season settings. All subsequent Seasons' setup parameters will be ignored since the previous Season's duration is from its **Start Date** to the end of the year.

3) The **Start Date** of a particular Season must be later than the previous Season's.

5.9.7.3 Daily Profile

The PMC-660 has two sets of Daily Profile setup parameters, one for each TOU.

Register	Property	Description	Format
16200~16223	RW	Daily Profile #1	See Table 5-53 Daily Profile Data Structure
16224~16247	RW	Daily Profile #2	
16248~16271	RW	Daily Profile #3	
16272~16295	RW	Daily Profile #4	
16296~16319	RW	Daily Profile #5	
16320~16343	RW	Daily Profile #6	
16344~16367	RW	Daily Profile #7	
16368~16391	RW	Daily Profile #8	
16392~16415	RW	Daily Profile #9	
16416~16439	RW	Daily Profile #10	
16440~16463	RW	Daily Profile #11	
16464~16487	RW	Daily Profile #12	
16488~16511	RW	Daily Profile #13	
16512~16535	RW	Daily Profile #14	
16536~16559	RW	Daily Profile #15	
16560~16583	RW	Daily Profile #16	
16584~16607	RW	Daily Profile #17	
16608~16631	RW	Daily Profile #18	
16632~16655	RW	Daily Profile #19	
16656~16679	RW	Daily Profile #20	

Table 5-51 TOU #1's Daily Profile Setup

Register	Property	Description	Format
17200~17223	RW	Daily Profile #1	See Table 5-53 Daily Profile Data Structure
17224~17247	RW	Daily Profile #2	
17248~17271	RW	Daily Profile #3	
17272~17295	RW	Daily Profile #4	
17296~17319	RW	Daily Profile #5	
17320~17343	RW	Daily Profile #6	
17344~17367	RW	Daily Profile #7	

17368~17391	RW	Daily Profile #8	
17392~17415	RW	Daily Profile #9	
17416~17439	RW	Daily Profile #10	
17440~17463	RW	Daily Profile #11	
17464~17487	RW	Daily Profile #12	
17488~17511	RW	Daily Profile #13	
17512~17535	RW	Daily Profile #14	
17536~17559	RW	Daily Profile #15	
17560~17583	RW	Daily Profile #16	
17584~17607	RW	Daily Profile #17	
17608~17631	RW	Daily Profile #18	
17632~17655	RW	Daily Profile #19	
17656~17679	RW	Daily Profile #20	

Table 5-52 TOU #2's Daily Profile Setup

Offset	Property	Description		Format	Note
+0	RW	Period #1 Start Time		UINT16	0x0000
+1	RW	Period #1 Tariff		UINT16	0=T1, …, 7=T8
+2	RW	Period #2 Start Time	High-order Byte: Hour	UINT16	0 ≤ Hour < 24
			Low-order Byte: Min		Min = 0, 15, 30, 45
+3	RW	Period #2 Tariff		UINT16	0=T1, …, 7=T8
+4	RW	Period #3 Start Time		UINT16	See Period #2 Start Time
+5	RW	Period #3 Tariff		UINT16	0=T1, …, 7=T8
+6	RW	Period #4 Start Time		UINT16	See Period #2 Start Time
+7	RW	Period #4 Tariff		UINT16	0=T1, …, 7=T8
+8	RW	Period #5 Start Time		UINT16	See Period #2 Start Time
+9	RW	Period #5 Tariff		UINT16	0=T1, …, 7=T8
+10	RW	Period #6 Start Time		UINT16	See Period #2 Start Time
+11	RW	Period #6 Tariff		UINT16	0=T1, …, 7=T8
+12	RW	Period #7 Start Time		UINT16	See Period #2 Start Time
+13	RW	Period #7 Tariff		UINT16	0=T1, …, 7=T8
+14	RW	Period #8 Start Time		UINT16	See Period #2 Start Time
+15	RW	Period #8 Tariff		UINT16	0=T1, …, 7=T8
+16	RW	Period #9 Start Time		UINT16	See Period #2 Start Time
+17	RW	Period #9 Tariff		UINT16	0=T1, …, 7=T8
+18	RW	Period #10 Start Time		UINT16	See Period #2 Start Time
+19	RW	Period #10 Tariff		UINT16	0=T1, …, 7=T8
+20	RW	Period #11 Start Time		UINT16	See Period #2 Start Time
+21	RW	Period #11 Tariff		UINT16	0=T1, …, 7=T8
+22	RW	Period #12 Start Time		UINT16	See Period #2 Start Time
+23	RW	Period #12 Tariff		UINT16	0=T1, …, 7=T8

Table 5-53 Daily Profile Data Structure

Notes:

1) **Daily Profile #1's Period #1 Start Time** is always 00:00 and cannot be modified.

2) Setting a Period's **Start Time** as 0xFFFF terminates the Daily Profile's settings. All later Daily Profile' setup parameters will be ignored**,** and the previous Period's duration is from its **Start Time** to the end of the day.

3) The minimum interval of a period is 15 minutes.

4) The **Start Time** of a particular Period must be later than the previous Period's.

5.9.7.4 Alternate Days

Each Alternate Day is assigned a Daily Profile and has a higher priority than Season. If a particular date is set as an Alternate Day, its assigned Daily Profile will override the "normal" Daily Profile for this day according the TOU settings.

The PMC-660 has two sets of Alternate Days setup parameters, one for each TOU. The Base Addresses for the two sets are 16700 and 17700, respectively, where the Register Address = Base Address + Offset. For example, the register address for TOU #2's Alternative Day #2's Date is 17700+3 = 17703.

Offset	Property	Description	Format	Note
0	RW	Alternate Day #1 Date[1]	UINT32	Table 5-55
2	RW	Alternate Day #1 Daily Profile	UINT16	0 to 19

3	RW	Alternate Day #2 Date[1]	UINT32	Table 5-55
5	RW	Alternate Day #2 Daily Profile	UINT16	0 to 19
6	RW	Alternate Day #3 Date[1]	UINT32	Table 5-55
8	RW	Alternate Day #3 Daily Profile	UINT16	0 to 19
9	RW	Alternate Day #4 Date[1]	UINT32	Table 5-55
11	RW	Alternate Day #4 Daily Profile	UINT16	0 to 19
12	RW	Alternate Day #5 Date[1]	UINT32	Table 5-55
14	RW	Alternate Day #5 Daily Profile	UINT16	0 to 19
15	RW	Alternate Day #6 Date[1]	UINT32	Table 5-55
17	RW	Alternate Day #6 Daily Profile	UINT16	0 to 19
18	RW	Alternate Day #7 Date[1]	UINT32	Table 5-55
19	RW	Alternate Day #7 Daily Profile	UINT16	0 to 19
21	RW	Alternate Day #8 Date[1]	UINT32	Table 5-55
22	RW	Alternate Day #8 Daily Profile	UINT16	0 to 19
24	RW	Alternate Day #9 Date[1]	UINT32	Table 5-55
25	RW	Alternate Day #9 Daily Profile	UINT16	0 to 19
27	RW	Alternate Day #10 Date[1]	UINT32	Table 5-55
29	RW	Alternate Day #10 Daily Profile	UINT16	0 to 19
…		…		Table 5-55
…		…		0 to 19
240	RW	Alternate Day #81 Date[1]	UINT32	Table 5-55
162	RW	Alternate Day #81 Daily Profile	UINT16	0 to 19
243	RW	Alternate Day #82 Date[1]	UINT32	Table 5-55
245	RW	Alternate Day #82 Daily Profile	UINT16	0 to 19
246	RW	Alternate Day #83 Date[1]	UINT32	Table 5-55
248	RW	Alternate Day #83 Daily Profile	UINT16	0 to 19
249	RW	Alternate Day #84 Date[1]	UINT32	Table 5-55
251	RW	Alternate Day #84 Daily Profile	UINT16	0 to 19
252	RW	Alternate Day #85 Date[1]	UINT32	Table 5-55
254	RW	Alternate Day #85 Daily Profile	UINT16	0 to 19
255	RW	Alternate Day #86 Date[1]	UINT32	Table 5-55
256	RW	Alternate Day #86 Daily Profile	UINT16	0 to 19
258	RW	Alternate Day #87 Date[1]	UINT32	Table 5-55
260	RW	Alternate Day #87 Daily Profile	UINT16	0 to 19
261	RW	Alternate Day #88 Date[1]	UINT32	Table 5-55
263	RW	Alternate Day #88 Daily Profile	UINT16	0 to 19
264	RW	Alternate Day #89 Date[1]	UINT32	Table 5-55
266	RW	Alternate Day #89 Daily Profile	UINT16	0 to 19
267	RW	Alternate Day #90 Date[1]	UINT32	Table 5-55
269	RW	Alternate Day #90 Daily Profile	UINT16	0 to 19

Table 5-54 Alternate Days Setup

Notes:

1) The following table illustrates the data structure of the Date register:

Byte 3	Byte 2	Byte 1	Byte 0
Reserved	Year-2000 (0-37)	Month (1-12)	Day (1-31)

Table 5-55 Date Format

When the Year and/or Month are set as **0xFF**, it means the Alternate Day is repetitive by year and/or month, i.e. the same day of every year or every month is an Alternate Day.

5.9.8 DO Control

The DO Control registers are implemented as both "Write-Only" Modbus Coil Registers (0XXXXX) and Modbus Holding Registers (4XXXXX), which can be controlled with the Force Single Coil command (Function Code 0x05) or the Preset Multiple Hold Registers (Function Code 0x10). The PMC-660 does not support the Read Coils command (Function Code 0x01) because DO Control registers are "Write-Only". The DO Status register 0098 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 if this function is enabled through the **Arm Before Execute Enable** Setup register (6185) since Firmware V2.00.00, which is disabled by default. 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" to the register to perform the described action.
9101	WO	Execute DO1 Close	UINT16	
9102	WO	Arm DO1 Open	UINT16	
9103	WO	Execute DO1 Open	UINT16	
9104	WO	Arm DO2 Close	UINT16	
9105	WO	Execute DO2 Close	UINT16	
9106	WO	Arm DO2 Open	UINT16	
9107	WO	Execute DO2 Open	UINT16	
9108	WO	Arm DO3 Close	UINT16	
9109	WO	Execute DO3 Close	UINT16	
9110	WO	Arm DO3 Open	UINT16	
9111	WO	Execute DO3 Open	UINT16	

Table 5-56 DO Control

5.9.9 Clear/Reset Control

Register	Property	Description	Format	Note
6400	WO	Manual WFR Log #1 Trigger	UINT16	Writing "0xFF00" to the register to execute the described action.
6401	WO	Manual WFR Log #2 Trigger	UINT16	
6402	WO	Clear DR #1 (High-Speed)	UINT16	
6403	WO	Clear DR #2 (High-Speed)	UINT16	
6404	WO	Clear DR #3 (High-Speed)	UINT16	
6405	WO	Clear DR #4 (High-Speed)	UINT16	
6406	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	
6419	WO	Clear WFR Log #2	UINT16	
6420	WO	Clear Energy Log	UINT16	
6421	WO	Clear PQ Log	UINT16	
6422	WO	Clear SOE Log	UINT16	
6423	WO	Clear Total Energy and TOU Energy	UINT16	
6424	WO	Clear Max./Min. Log of This Month (Since Last Reset)	UINT16	
6425	WO	Clear Peak Demand Log of This Month (Since Last Reset)	UINT16	
6426	WO	Clear Counter #1 (DI1)	UINT16	
6427	WO	Clear Counter #2 (DI2)	UINT16	
…	WO	…	UINT16	
6430	WO	Clear Counter #5 (DI5)	UINT16	
6431	WO	Clear Counter #6 (DI6)	UINT16	
6432	WO	Clear Device Operating Time[#]	UINT16	
6433~6436	WO	Reserved	UINT16	
6437	WO	Clear all Logs[1]	UINT16	Writing "0xFF00" to the register clears all of the above

[#]Available in Firmware V2.00.00 or later

Table 5-57 Clear/Reset Registers

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 (Since Last Reset), Peak Demand of This Month (Since Last Reset), DI Counters, Energy Registers and Device Operating Time.

5.10 Time

There are two sets of Time registers supported by the PMC-660 – Year / Month / Day / Hour / Minute / Second (Registers # 60000 to 60002) and UNIX Time (Register # 60004). 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 60000 to 60004 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 (60004) and the time specified in registers 60000-60002 will be ignored. Writing to the Millisecond register (60003) 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. In addition, attempting to write a Time value less than Jan 1, 2000 00:00:00 will be rejected.

Register		Property	Description	Format	Note
60000	9000	RW	High-order Byte: Year	UINT16	0-37 (Year-2000)
			Low-order Byte: Month		1 to 12
60001	9001	RW	High-order Byte: Day	UINT16	1 to 31
			Low-order Byte: Hour		0 to 23
60002	9002	RW	High-order Byte: Minute	UINT16	0 to 59
			Low-order Byte: Second		0 to 59
60003	9003	RW	Millisecond	UINT16	0 to 999
60004 ~ 60005	9004 ~ 9005	RW	UNIX Time	UINT32	0x386D4380 to 0x 7FE8177F The corresponding time is 2000.01.01 00:00:00 to 2037.12.31 23:59:59 (GMT 0:00 Time Zone)

Table 5-58 Time Registers

5.11 Meter Information

Register		Property	Description	Format	Note
60200 ~ 60219	9800 ~ 9819	RO	Meter model[1]	UINT16	See Note 1)
60220	9820	RO	Firmware Version	UINT16	e.g. 10000 shows the version is V1.00.00
60221	9821	RO	Protocol Version	UINT16	e.g. 10 shows the version is V1.0
60222	9822	RO	Firmware Update Date: Year-2000	UINT16	e.g. 140110 means January 10, 2014
60223	9823	RO	Firmware Update Date: Month	UINT16	
60224	9824	RO	Firmware Update Date: Day	UINT16	
60225	9825	RO	Serial Number	UINT32	e.g. 1601030100 means the 100th PMC-660 that was manufactured on January 3rd, 2016
60227	9827	RO	Reserved	UINT16	
60228	9828	RO	Reserved	UINT16	
60229	9829	RO	Feature Code	UINT16	B3B2B1B0: • 0000: 2xRS485+6xDI+3xDO • 0001: 1xRS485+1xEthernet +6xDI+3xDO • 0010: 2xRS485+6xDI+2xDO+1xAO • 0011: 1xRS485+1xEthernet +6xDI+2xDO+1xAO • Other: Reserved

					B5B4: • 00: 5A I4 CT • 01: 1A I4 CT • 10: Analog Input • 11: Reserved
					Other bits are reserved.
60230	9830	RO	Current configuration	UINT16	0=5 (A) 3-Phase CT 1=1 (A) 3-Phase CT
60231	9831	RO	Voltage configuration	UINT16	0=120 (V) , 1=415 (V) 2=690 (V) 3=690 (V) 3P3W Open Delta

Table 5-59 Meter Information

Notes:

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 5-60 ASCII Encoding of "PMC-660"

Appendix A - Data Recorder Parameter

Key	Parameters	Scale/Unit	Key	Parameters	Scale/Unit
0	Uan	x100, V	**1**	Ubn	x100, V
2	Ucn	x100, V	**3**	Uln average	x100, V
4	Uab	x100, V	**5**	Ubc	x100, V
6	Uca	x100, V	**7**	Ull 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 Total	W	**17**	kvara	var
18	kvarb	var	**19**	kvarc	var
20	kvar Total	var	**21**	kVAa	VA
22	kVAb	VA	**23**	kVAc	VA
24	kVA Total	VA	**25**	P.F.a	x1000
26	P.F.b	x1000	**27**	P.F.c	x1000
28	P.F. Total	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	U Unbalance	x10, %	**37**	I Unbalance	x10, %
38	Ia K-factor	x10	**39**	Ib K-factor	x10
40	Ic K-factor	x10	**41**	Uan THD	x100, %
42	Ubn THD	x100, %	**43**	Ucn THD	x100, %
44	Uan TOHD	x100, %	**45**	Ubn TOHD	x100, %
46	Ucn TOHD	x100, %	**47**	Uan TEHD	x100, %
48	Ubn TEHD	x100, %	**49**	Ucn TEHD	x100, %
50	Ia THD	x100, %	**51**	Ib THD	x100, %
52	Ic THD	x100, %	**53**	Ia TOHD	x100, %
54	Ib TOHD	x100, %	**55**	Ic TOHD	x100, %
56	Ia TEHD	x100, %	**57**	Ib TEHD	x100, %
58	Ic TEHD	x100, %	**59**	Uan 2nd Harmonic	x100, %
60	Ubn 2nd Harmonic	x100, %	**61**	Ucn 2nd Harmonic	x100, %
62	Uan 3rd Harmonic	x100, %	**63**	Ubn 3rd Harmonic	x100, %
64	Ucn 3rd Harmonic	x100, %	**65**	Uan 4th Harmonic	x100, %
66	Ubn 4th Harmonic	x100, %	**67**	Ucn 4th Harmonic	x100, %
68	Uan 5th Harmonic	x100, %	**69**	Ubn 5th Harmonic	x100, %
70	Ucn 5th Harmonic	x100, %	**71**	Uan 6th Harmonic	x100, %
72	Ubn 6th Harmonic	x100, %	**73**	Ucn 6th Harmonic	x100, %
74	Uan 7th Harmonic	x100, %	**75**	Ubn 7th Harmonic	x100, %
76	Ucn 7th Harmonic	x100, %	**77**	Uan 8th Harmonic	x100, %
78	Ubn 8th Harmonic	x100, %	**79**	Ucn 8th Harmonic	x100, %
80	Uan 9th Harmonic	x100, %	**81**	Ubn 9th Harmonic	x100, %
81	Ucn 9th Harmonic	x100, %	**83**	Uan 10th Harmonic	x100, %
84	Ubn 10th Harmonic	x100, %	**85**	Ucn 10th Harmonic	x100, %
86	Uan 11th Harmonic	x100, %	**87**	Ubn 11th Harmonic	x100, %
88	Ucn 11th Harmonic	x100, %	**89**	Uan 12th Harmonic	x100, %
90	Ubn 12th Harmonic	x100, %	**91**	Ucn 12th Harmonic	x100, %
92	Uan 13th Harmonic	x100, %	**93**	Ubn 13th Harmonic	x100, %
94	Ucn 13th Harmonic	x100, %	**95**	Uan 14th Harmonic	x100, %
96	Ubn 14th Harmonic	x100, %	**97**	Ucn 14th Harmonic	x100, %
98	Uan 15th Harmonic	x100, %	**99**	Ubn 15th Harmonic	x100, %
100	Ucn 15th Harmonic	x100, %	**101**	Uan 16th Harmonic	x100, %
102	Ubn 16th Harmonic	x100, %	**103**	Ucn 16th Harmonic	x100, %
104	Uan 17th Harmonic	x100, %	**105**	Ubn 17th Harmonic	x100, %
106	Ucn 17th Harmonic	x100, %	**107**	Uan 18th Harmonic	x100, %
108	Ubn 18th Harmonic	x100, %	**109**	Ucn 18th Harmonic	x100, %
110	Uan 19th Harmonic	x100, %	**111**	Ubn 19th Harmonic	x100, %
112	Ucn 19th Harmonic	x100, %	**113**	Uan 20th Harmonic	x100, %
114	Ubn 20th Harmonic	x100, %	**115**	Ucn 20th Harmonic	x100, %
116	Uan 21st Harmonic	x100, %	**117**	Ubn 21st Harmonic	x100, %
118	Ucn 21st Harmonic	x100, %	**119**	Uan 22nd Harmonic	x100, %
120	Ubn 22nd Harmonic	x100, %	**121**	Ucn 22nd Harmonic	x100, %
122	Uan 23rd Harmonic	x100, %	**123**	Ubn 23rd Harmonic	x100, %
124	Ucn 23rd Harmonic	x100, %	**125**	Uan 24th Harmonic	x100, %
126	Ubn 24th Harmonic	x100, %	**127**	Ucn 24th Harmonic	x100, %
128	Uan 25th Harmonic	x100, %	**129**	Ubn 25th Harmonic	x100, %
130	Ucn 25th Harmonic	x100, %	**131**	Ia 2nd Harmonic	x100, %
132	Ib 2nd Harmonic	x100, %	**133**	Ic 2nd Harmonic	x100, %
134	Ia 3rd Harmonic	x100, %	**135**	Ib 3rd Harmonic	x100, %
136	Ic 3rd Harmonic	x100, %	**137**	Ia 4th Harmonic	x100, %
138	Ib 4th Harmonic	x100, %	**139**	Ic 4th Harmonic	x100, %
140	Ia 5th Harmonic	x100, %	**141**	Ib 5th Harmonic	x100, %
142	Ic 5th Harmonic	x100, %	**143**	Ia 6th Harmonic	x100, %
144	Ib 6th Harmonic	x100, %	**145**	Ic 6th Harmonic	x100, %
146	Ia 7th Harmonic	x100, %	**147**	Ib 7th Harmonic	x100, %
148	Ic 7th Harmonic	x100, %	**149**	Ia 8th Harmonic	x100, %
150	Ib 8th Harmonic	x100, %	**151**	Ic 8th Harmonic	x100, %
152	Ia 9th Harmonic	x100, %	**153**	Ib 9th Harmonic	x100, %
154	Ic 9th Harmonic	x100, %	**155**	Ia 10th Harmonic	x100, %
156	Ib 10th Harmonic	x100, %	**157**	Ic 10th Harmonic	x100, %

158	Ia 11th Harmonic	x100, %	**159**	Ib 11th Harmonic	x100, %
160	Ic 11th Harmonic	x100, %	**161**	Ia 12th Harmonic	x100, %
162	Ib 12th Harmonic	x100, %	**163**	Ic 12th Harmonic	x100, %
164	Ia 13th Harmonic	x100, %	**165**	Ib 13th Harmonic	x100, %
166	Ic 13th Harmonic	x100, %	**167**	Ia 14th Harmonic	x100, %
168	Ib 14th Harmonic	x100, %	**169**	Ic 14th Harmonic	x100, %
170	Ia 15th Harmonic	x100, %	**171**	Ib 15th Harmonic	x100, %
172	Ic 15th Harmonic	x100, %	**173**	Ia 16th Harmonic	x100, %
174	Ib 16th Harmonic	x100, %	**175**	Ic 16th Harmonic	x100, %
176	Ia 17th Harmonic	x100, %	**177**	Ib 17th Harmonic	x100, %
178	Ic 17th Harmonic	x100, %	**179**	Ia 18th Harmonic	x100, %
180	Ib 18th Harmonic	x100, %	**181**	Ic 18th Harmonic	x100, %
182	Ia 19th Harmonic	x100, %	**183**	Ib 19th Harmonic	x100, %
184	Ic 19th Harmonic	x100, %	**185**	Ia 20th Harmonic	x100, %
186	Ib 20th Harmonic	x100, %	**187**	Ic 20th Harmonic	x100, %
188	Ia 21st Harmonic	x100, %	**189**	Ib 21st Harmonic	x100, %
190	Ic 21st Harmonic	x100, %	**191**	Ia 22nd Harmonic	x100, %
192	Ib 22nd Harmonic	x100, %	**193**	Ic 22nd Harmonic	x100, %
194	Ia 23rd Harmonic	x100, %	**195**	Ib 23rd Harmonic	x100, %
196	Ic 23rd Harmonic	x100, %	**197**	Ia 24th Harmonic	x100, %
198	Ib 24th Harmonic	x100, %	**199**	Ic 24th Harmonic	x100, %
200	Ia 25th Harmonic	x100, %	**201**	Ib 25th Harmonic	x100, %
202	Ic 25th Harmonic	x100, %	**203**	Uan Demand	x100, V
204	Ubn Demand	x100, V	**205**	Ucn Demand	x100, V
206	Uln avg. Demand	x100, V	**207**	Uab Demand	x100, V
208	Ubc Demand	x100, V	**209**	Uca Demand	x100, V
210	Ull 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 Total Demand	W
220	kvara Demand	var	**221**	kvarb Demand	var
222	kvarc Demand	var	**223**	kvar Total Demand	var
224	kVAa Demand	VA	**225**	kVAb Demand	VA
226	kVAc Demand	VA	**227**	kVA Total Demand	VA
228	P.F.a Demand	x1000	**229**	P.F.b Demand	x1000
230	P.F.c Demand	x1000	**231**	P.F. Total Demand	x1000
232	Freq. Demand	x100, Hz	**233**	U Unbalance Demand	x10, %
234	I Unbalance Demand	x10, %	**235**	Uan THD Demand	x100, %
236	Ubn THD Demand	x100, %	**237**	Ucn THD Demand	x100, %
238	Ia THD Demand	x100, %	**239**	Ib THD Demand	x100, %
240	Ic THD Demand	x100, %	**241**	Uan max per Demand Period	x100, V
242	Ubn max per Demand Period	x100, V	**243**	Ucn max per Demand Period	x100, V
244	Uln avg. max Per Demand Period	x100, V	**245**	Uab max per Demand Period	x100, V
246	Ubc max per Demand Period	x100, V	**247**	Uca max per Demand Period	x100, V
248	Ull 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 Total 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 Total 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 Total 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. Total max per Demand Period	x1000
270	Freq. max per Demand Period	x100, Hz	**271**	U Unbalance max Per Demand Period	x10, %
272	I Unbalance max Per Demand Period	x10, %	**273**	Uan THD max per Demand Period	x100, %
274	Ubn THD max per Demand Period	x100, %	**275**	Ucn THD max per Demand Period	x100, %
276	Ia THD max per Demand Period	x100, %	**277**	Ib THD max per Demand Period	x100, %
278	Ic THD max per Demand Period	x100, %	**279**	Uan min per Demand Period	x100, V
280	Ubn min per Demand Period	x100, V	**281**	Ucn min per Demand Period	x100, V

282	Uln avg. min Per Demand Period	x100, V	**283**	Uab min per Demand Period	x100, V
284	Ubc min per Demand Period	x100, V	**285**	Uca min per Demand Period	x100, V
286	Ull 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 Total 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 Total 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 Total 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. Total min per Demand Period	x1000
308	Freq. min Per Demand Period	x100, Hz	**309**	U Unbalance min per Demand Period	x10, %
310	I Unbalance per Demand Period	x10, %	**311**	Uan THD min per Demand Period	x100, %
312	Ubn THD min per Demand Period	x100, %	**313**	Ucn THD min per Demand Period	x100, %
314	Ia THD min per Demand Period	x100, %	**315**	Ib THD min per Demand Period	x100, %
316	Ic THD min per Demand Period	x100, %	**317**	dUan/dUab	x100, V
318	dUbn/dUbc	x100, V	**319**	dUcn/dUca	x100, V
320	dIa	x1000, A	**321**	dIb	x1000, A
322	dIc	x1000, A	**323**	kWh Import*,#	kWh
324	kWh Export*,#	kWh	**325**	kWh Total *,#	kWh
326	kvarh Import*,#	kvarh	**327**	kvarh Export*,#	kvarh
328	kvarh Total*,#	kvarh	**329~**	I Residual	x1000, A

^ **I4** is valid only if the device is equipped with the I4 option, and it will be automatically changed to **I0 (Zero Sequence Current)** if the meter is equipped with the AI option.

* Parameters # 323 to 328 are accumulative energy values.

Available in Firmware V1.00.04 or later

~ Available in Firmware V2.00.00 or later

Appendix B - Data Recorder Default Settings

Parameter	DR 1 (HS)	DR 2 (HS)	DR 3 (HS)	DR 4 (HS)
Trigger Mode	Disabled	Disabled	Disabled	Disabled
Recording Mode	Stop-When-Full	Stop-When-Full	Stop-When-Full	Stop-When-Full
Recording Depth	0	0	0	0
Recording Interval	2	2	2	2
Recording Offset	0	0	0	0
Number of Parameters	0	0	0	0
Parameter 1~16	Null	Null	Null	Null
Parameter	**DR 5**	**DR 6**	**DR 7**	**DR 8**
Trigger Mode	Triggered by Timer	Triggered by Timer	Triggered by Timer	Triggered by Timer
Recording Mode	First-In-First-Out	First-In-First-Out	First-In-First-Out	First-In-First-Out
Recording Depth	3360	1440	1440	1440
Recording Interval	900	900	900	900
Recording Offset	0	0	0	0
No. of Parameters	6	15	16	6
Parameter 1	kWh Import	Uab	Uan	Uan THD
Parameter 2	kWh Export	Ubc	Ubn	Ubn THD
Parameter 3	kWh Total	Uca	Ucn	Ucn THD
Parameter 4	kvarh Import	Ull avg	Uln avg	Ia THD
Parameter 5	kvarh Export	Ia	kWa	Ib THD
Parameter 6	kvarh Total	Ib	kWb	Ic THD
Parameter 7	Null	Ic	kWc	Null
Parameter 8	Null	I avg	kvara	Null
Parameter 9	Null	kW Total	kvarb	Null
Parameter 10	Null	kvar Total	kvarc	Null
Parameter 11	Null	kVA Total	kVAa	Null
Parameter 12	Null	P.F. Total	kVAb	Null
Parameter 13	Null	Freq	kVAc	Null
Parameter 14	Null	U Unbalance	P.F.a	Null
Parameter 15	Null	I Unbalance	P.F.b	Null
Parameter 16	Null	Null	P.F.c	Null
Parameter	**DR 9**	**DR 10**	**DR 11**	**DR 12**
Trigger Mode	Triggered by Timer	Triggered by Timer	Triggered by Timer	Triggered by Timer
Recording Mode	First-In-First-Out	First-In-First-Out	First-In-First-Out	First-In-First-Out
Recording Depth	1440	1440	1440	1440
Recording Interval	900	900	900	900
Recording Offset	0	0	0	0
No. of Parameters	15	16	6	15
Parameter 1	Uab Demand	Uan Demand	Uan THD Demand	Uab max per Demand Period
Parameter 2	Ubc Demand	Ubn Demand	Ubn THD Demand	Ubc max per Demand Period
Parameter 3	Uca Demand	Ucn Demand	Ucn THD Demand	Uca max per Demand Period
Parameter 4	Ull avg Demand	Uln avg Demand	Ia THD Demand	Ull avg max per Demand Period
Parameter 5	Ia Demand	kWa Demand	Ib THD Demand	Ia max per Demand Period
Parameter 6	Ib Demand	kWb Demand	Ic THD Demand	Ib max per Demand Period
Parameter 7	Ic Demand	kWc Demand	Null	Ic max per Demand Period
Parameter 8	I avg Demand	kvara Demand	Null	I avg max per Demand Period
Parameter 9	kW Total Demand	kvarb Demand	Null	kW Total max per Demand Period
Parameter 10	kvar Total Demand	kvarc Demand	Null	kvar Total max per Demand Period
Parameter 11	kVA Total Demand	kVAa Demand	Null	kVA Total max per Demand Period
Parameter 12	P.F. Total Demand	kVAb Demand	Null	P.F. Total max per Demand Period
Parameter 13	Freq Demand	kVAc Demand	Null	Freq max per Demand Period
Parameter 14	U Unbalance Demand	P.F.a Demand	Null	U Unbalance max per Demand Period
Parameter 15	I Unbalance Demand	P.F.b Demand	Null	I Unbalance max per Demand Period
Parameter 16	Null	P.F.c Demand	Null	Null
Parameter	**DR 13**	**DR 14**	**DR 15**	**DR 16**
Trigger Mode	Triggered by Timer	Triggered by Timer	Triggered by Timer	Triggered by Timer
Recording Mode	First-In-First-Out	First-In-First-Out	First-In-First-Out	First-In-First-Out
Recording Depth	1440	1440	1440	1440
Recording Interval	900	900	900	900
Recording Offset	0	0	0	0
No. of Parameters	16	12	15	16
Parameter 1	Uan max per Demand Period	Uan THD max per Demand Period	Uab min per Demand Period	Uan min per Demand Period

Parameter 2	Ubn max per Demand Period	Ubn THD max per Demand Period	Ubc min per Demand Period	Ubn min per Demand Period
Parameter 3	Ucn max per Demand Period	Ucn THD max per Demand Period	Uca min per Demand Period	Ucn min per Demand Period
Parameter 4	Uln avg max per Demand Period	Ia THD max per Demand Period	Ull avg min per Demand Period	Uln avg min per Demand Period
Parameter 5	kWa max per Demand Period	Ib THD max per Demand Period	Ia min per Demand Period	kWa min per Demand Period
Parameter 6	kWb max per Demand Period	Ic THD max per Demand Period	Ib min per Demand Period	kWb min per Demand Period
Parameter 7	kWc max per Demand Period	Uan THD min per Demand Period	Ic min per Demand Period	kWc min per Demand Period
Parameter 8	kvara max per Demand Period	Ubn THD min per Demand Period	I avg min per Demand Period	kvara min per Demand Period
Parameter 9	kvarb max per Demand Period	Ucn THD min per Demand Period	kW Total min per Demand Period	kvarb min per Demand Period
Parameter 10	kvarc max per Demand Period	Ia THD min per Demand Period	kvar Total min per Demand Period	kvarc min per Demand Period
Parameter 11	kVAa max per Demand Period	Ib THD min per Demand Period	kVA Total min per Demand Period	kVAa min per Demand Period
Parameter 12	kVAb max per Demand Period	Ic THD min per Demand Period	P.F. Total min per Demand Period	kVAb min per Demand Period
Parameter 13	kVAc max per Demand Period	Null	Freq min per Demand Period	kVAc min per Demand Period
Parameter 14	P.F.a max per Demand Period	Null	U Unbalance min per Demand Period	P.F.a min per Demand Period
Parameter 15	P.F.b max per Demand Period	Null	I Unbalance min per Demand Period	P.F.b min per Demand Period
Parameter 16	P.F.c max per Demand Period	Null	Null	P.F.c min per Demand Period

Appendix C – SOE 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 Dip/swell
	8	1 / 0	DO2 Operated/Released by Dip/swell
	9	1 / 0	DO3 Operated/Released by Dip/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 Uln Setpoint Active
	2	Trigger Value (x100)	Over Ull 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 Total Setpoint Active
	7	Trigger Value	Over kvar Total Setpoint Active
	8	Trigger Value (x1000)	Over P.F. Total 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 Total Demand Setpoint Active
	17	Trigger Value	Over kvar Total Demand Setpoint Active
	18	Trigger Value (x1000)	Over P.F. Total Demand Setpoint Active
	19	Trigger Value	Over kW Total Predicted Setpoint Active
	20	Trigger Value	Over kvar Total Predicted Setpoint Active
	21	Trigger Value (x1000)	Over P.F. Total 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
	32	Trigger Value (x1000)	Over I Residual Setpoint Active
	33	Trigger Value (x100)	Over U2 (Negative Sequence Voltage) Setpoint Active
	34	Trigger Value (x100)	Over U0 (Zero Sequence Voltage) Setpoint Active
	46	Return Value (x100)	Over Uln Setpoint Return
	47	Return Value (x100)	Over Ull 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 Total Setpoint Return
	52	Return Value	Over kvar Total Setpoint Return
	53	Return Value (x1000)	Over P.F. Total 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 Total Demand Setpoint Return
	62	Return Value	Over kvar Total Demand Setpoint Return
	63	Return Value (x1000)	Over P.F. Total Demand Setpoint Return
	64	Return Value	Over kW Total Predicted Setpoint Return
	65	Return Value	Over kvar Total Predicted Setpoint Return
	66	Return Value (x1000)	Over P.F. Total 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
	77	Return Value (x1000)	Over I Residual Setpoint Return
	78	Return Value (x100)	Over U2 (Negative Sequence Voltage) Setpoint Return
	79	Return Value (x100)	Over U0 (Zero Sequence Voltage) Setpoint Return
	91	Trigger Value (x100)	Under Uln Setpoint Active
	92	Trigger Value (x100)	Under Ull 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 Total Setpoint Active
	97	Trigger Value	Under kvar Total Setpoint Active
	98	Trigger Value (x1000)	Under P.F. Total 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 Total Demand Setpoint Active
	107	Trigger Value	Under kvar Total Demand Setpoint Active
	108	Trigger Value (x1000)	Under P.F. Total Demand Setpoint Active
	109	Trigger Value	Under kW Total Predicted Setpoint Active
	110	Trigger Value	Under kvar Total Predicted Setpoint Active
	111	Trigger Value (x1000)	Under P.F. Total 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
	122	Trigger Value (x1000)	Under I Residual Setpoint Active
	123	Trigger Value (x100)	Under U2 (Negative Sequence Voltage) Setpoint Active
	124	Trigger Value (x100)	Under U0 (Zero Sequence Voltage) Setpoint Active
	136	Return Value (x100)	Under Uln Setpoint Return
	137	Return Value (x100)	Under Ull Setpoint Return
	138	Return Value (x1000)	Under Current Setpoint Return
	139	Return Value (x1000)	Under I4 Setpoint Return
	140	Return Value (x100)	Under Freq. Deviation Setpoint Return
	141	Return Value	Under kW Total Setpoint Return
	142	Return Value	Under kvar Total Setpoint Return
	143	Return Value (x1000)	Under P.F. Total 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 Total Demand Setpoint Return
	152	Return Value	Under kvar Total Demand Setpoint Return
	153	Return Value (x1000)	Under P.F. Total Demand Setpoint Return
	154	Return Value	Under kW Total Predicted Setpoint Return
	155	Return Value	Under kvar Total Predicted Setpoint Return
	156	Return Value (x1000)	Under P.F. Total 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
	167	Return Value (x1000)	Under I Residual Setpoint Return
	168	Return Value (x100)	Under U2 (Negative Sequence Voltage) Setpoint Return
	169	Return Value (x100)	Under U0 (Zero Sequence Voltage) Setpoint Return
4	1	0	Battery Voltage Low
	2	0	Power Supply of CPU Fault
	3	0	A/D Fault
	4	0	FRAM 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
	11	0	TOU 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 (Since Last Reset) via Front Panel
	13	0	Clear Peak Demand of This Month (Since Last Reset) 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 (Since Last Reset) via Communications
	23	0	Clear Peak Demand of This Month (Since Last Reset) via Communications
	24	0	Clear Device Operating Time via Front Panel
	25	0	Clear Device Operating Time via Communications
	26	0	Preset Energy Values via Front Panel
	27	0	Preset Energy Values 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 Dip/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 Dip/Swell
	7	0	High Speed Data Recorder Triggered by Dip/Swell
	8	Setpoint # X (X = 1 to 24)	Alarm Email Triggered by Setpoint # X
	9	0	Alarm Email Triggered by Dip/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
	14	1~4	TOU Schedule Switch [7]

The event values of **Switch TOU Schedule** are illustrated in the table below:

Record Value	Description
1	Schedule Switch from TOU 1 to TOU 2 manually
2	Schedule Switch from TOU 2 to TOU 1 manually
3	Schedule Switch from TOU 1 to TOU 2 based on the pre-defined **Switching Time**
4	Schedule Switch from TOU 2 to TOU 1 based on the pre-defined **Switching Time**

Appendix D - 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	<6W
Digital Inputs (DI1, DI2, DI3, DI4, DI5, DI6, DIC)	
Type	Dry contact, 24VDC internally wetted
Sampling	1000Hz
Hysteresis	1-1,000ms programmable
Digital Outputs (DO11, DO12, DO21, DO22, DO31, DO32)	
Type	Form A Mechanical Relay
Loading	8A@250VAC/24VDC for DO1 5A@250VAC/30VDC for DO2 and DO3
LED Pulse Outputs (kWh, kvarh)	
Type	Optical
Pulse Constant	1000/3200/5000/6400/12800 imp/kxh
Analog Input (I41, I42)	
Type	0-20mA / 4-20 mA
Overload	24 mA maximum
Analog Output (AO+, AO-)	
Type	0-20mA / 4-20 mA
Loading	500 Ω maximum
Overload	24 mA maximum
Terminal Dimensions	
Power Supply	0.5N·m
Voltage Input	0.5N·m
Current Input	1.8N·m
I/O, RS485, I4 Input	0.5N·m
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%	0.001V
Current	±0.1%	0.001A
I4 Measured	±0.1%	0.001A
Ir Calculated	±0.1% F.S.	0.001A
kW, kvar, kVA	±0.2%	0.001k
kWh, kVAh	IEC 62053-22 Class 0.2S	0.01kXh
kvarh	IEC 62053-24 Class 0.5S	0.01kvarh
P.F.	±0.2%	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 E - Standards Compliance

Safety Requirements	
LVD Directive 2014 / 35 / EU	EN61010-1: 2010 EN61010-2-030: 2010
Electrical safety in low voltage distribution systems up to 1000Vac and 1500 Vdc	IEC 61557-12: 2008 (PMD)
Insulation AC Voltage: 4kV @ 1 minute Insulation resistance: >100MΩ Impulse Voltage: 6kV, 1.2/50µs	IEC 62052-11: 2003
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: 2010 Level III
Fast Transients	IEC 61000-4-4: 2012 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
Voltage Dips and Interruptions	IEC 61000-4-11: 2004 Level III
Oscillatory waves	IEC 61000-4-12: 2006 Level III
Radio Disturbances	CISPR 22:2006, Level B
Emission Tests	
Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment	EN 55011: 2009 + A1: 2010 (CISPR 11)
Limits and methods of measurement of radio disturbance characteristics of information technology equipment	EN 55022: 2010+AC: 2011 (CISPR 22)
Limits for harmonic current emissions for equipment with rated current ≤16 A	EN 61000-3-2: 2006+A1: 2009+A2:2009
Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤16 A	EN 61000-3-3: 2008
Emission standard for residential, commercial and light-industrial environments	EN 61000-6-4: 2007+A1: 2011
Testing and measurement techniques - Ring wave immunity test.	EN 61000-4-12: 2006
Mechanical Tests	
Spring Hammer Test	IEC 62052-11: 2003
Vibration Test	IEC 62052-11: 2003
Shock Test	IEC 62052-11: 2003

Appendix F – Ordering Guide

CET Electric Technology

Version 20180315

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
Display Language	
E	English

PMC-660	-	A	5	3	2	5	A	X	B	E	PMC-660-A5325AXBE (Standard Model)

* Additional charges apply

I4 is not available with AI Option "A"

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