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Standards Compliance



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.



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

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

Limited warranty

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

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Chapter 1 Introduction

This manual explains how to use the PMC-630E Advanced Multifunction Ethernet Meter.

This chapter provides an overview of the PMC-630E meter and summarizes many of its key features.

1.1 Overview

The PMC-630E Advanced Multifunction Ethernet Meter, based on the highly successful PMC-630 series, is CET's latest offer for the low, medium and high voltage power/energy metering market. Housed in an industry-standard DIN form factor measuring only 96mmx96mmx125 mm, the PMC-630E's compact size is perfectly suited for today's space restricting installations and for applications that require Ethernet connectivity. The PMC-630E features 4 current inputs, quality construction with metal enclosure, multifunction and revenue-accurate measurements, transient detection with waveform recording capabilities, and an easy-to-read, back-lit LCD display, capable of displaying 3-phase measurements at once. The meter comes standard with 6 Digital Inputs for status monitoring or utility pulse counting and three Relay Outputs for control or alarming applications. The standard SOE Log records all setup changes, DI and Setpoint status changes, and RO operations in 1ms resolution. With the standard RS485 port and 10/100BaseT Ethernet port supporting Modbus RTU and Modbus TCP protocols, the PMC-630E becomes a vital component of an intelligent, multifunction monitoring solution for any Power and Energy Management systems.

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, iEEM and iPQMS Systems.

Following is a list of typical applications for the PMC-630E:

- Class 0.5S Revenue Metering
- Low, medium and high voltage applications
- Utility, industrial and commercial metering
- Substation, building, industrial and factory automation
- Power quality monitoring of main incomer or critical feeder
- Waveform recording
- Extensive data logging with the 2MB on-board memory

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

1.2 Features

Ease of use

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

Basic Measurements

- VLN, VLL, Current per phase and Average
- Neutral Current (I4), measured and calculated
- Voltage and Current phase angles

- kW, kvar, kVA, PF per phase and Total
- Frequency
- kWh, kvarh Import / Export / Total / Net and kVAh
- Bi-directional energy measurements

Sliding Window Demands

- Voltage, current, power, PF, Frequency, V and I Unbalance, and THD
- Max/Min values per demand interval
- Peak Demands for This Month and Last Month

Power Quality

- Voltage and Current Unbalance based on Sequence Components
- THD, TOHD, TEHD and K-Factor
- Individual harmonics up to 31st on-board and 63rd via software
- Transient Voltage Detection at 128 samples per cycle

Log Memory

- 2MB on-board log memory
- Dynamic memory allocation for Data Recorder Logs

Waveform Recorder Log

- 2 independent groups of waveform recorders with a combined total of 6 entries
- Simultaneous capture of 3-phase Voltage and Current signals
- Programmable format from 128x5, 64x10, 32x20 to 16x40 with up to 5 pre-fault cycles
- Support FIFO recording mode

Data Recorder Log

- 16 Data Recorder Logs of 16 parameters each for real-time measurements, harmonics, interval energy, demand,etc
- Recording interval from 1s to 40 days
- Configurable depths and recording offsets

SOE Log

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

Max/Min Log

- Voltage, Current, Frequency, kW, kvar, kVA, Power Factor, Unbalance, VTHD and ITHD of This Month and Last Month

Setpoints

- 9 user programmable setpoints with extensive list of monitoring parameters
- Configurable thresholds and time delays
- WF Recording, Data Recorder and RO trigger

Digital Inputs

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

Relay Outputs

- 3 channels Form A Mechanical relays
- 8A @ 250VAC / 24VDC for RO1

- 5A @ 250VAC / 30VDC for RO2 and RO3

Real-time clock

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

Communications

Ethernet Port

- 10/100BaseT Ethernet with RJ45 connection
- Modbus RTU over TCP/IP and Modbus TCP protocols
- On-board Web Server
- Ethernet Gateway capability

RS485 Port

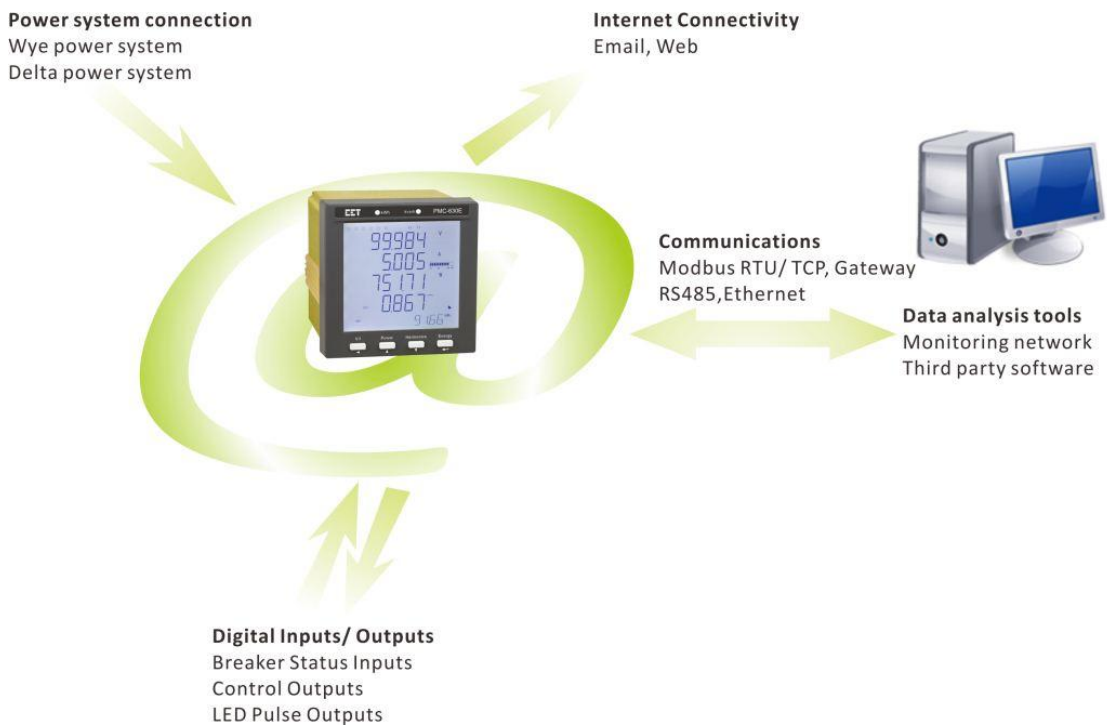
- Optically isolated
- Baud rate from 1200 to 38400bps
- Modbus RTU protocol

System Integration

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

1.3 PMC-630E's application in Power and Energy Management Systems

The PMC-630E 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, iEEM or iPQMS.



1.4 Getting more information

Additional information is available from CET via the following sources:

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

Chapter 2 Installation



Caution

Installation of the PMC-630E should only be performed by qualified, competent personnel that have the appropriate training and experience with high voltage and current devices. The meter must be installed in accordance with all local and national electrical codes.

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

2.1 Appearance

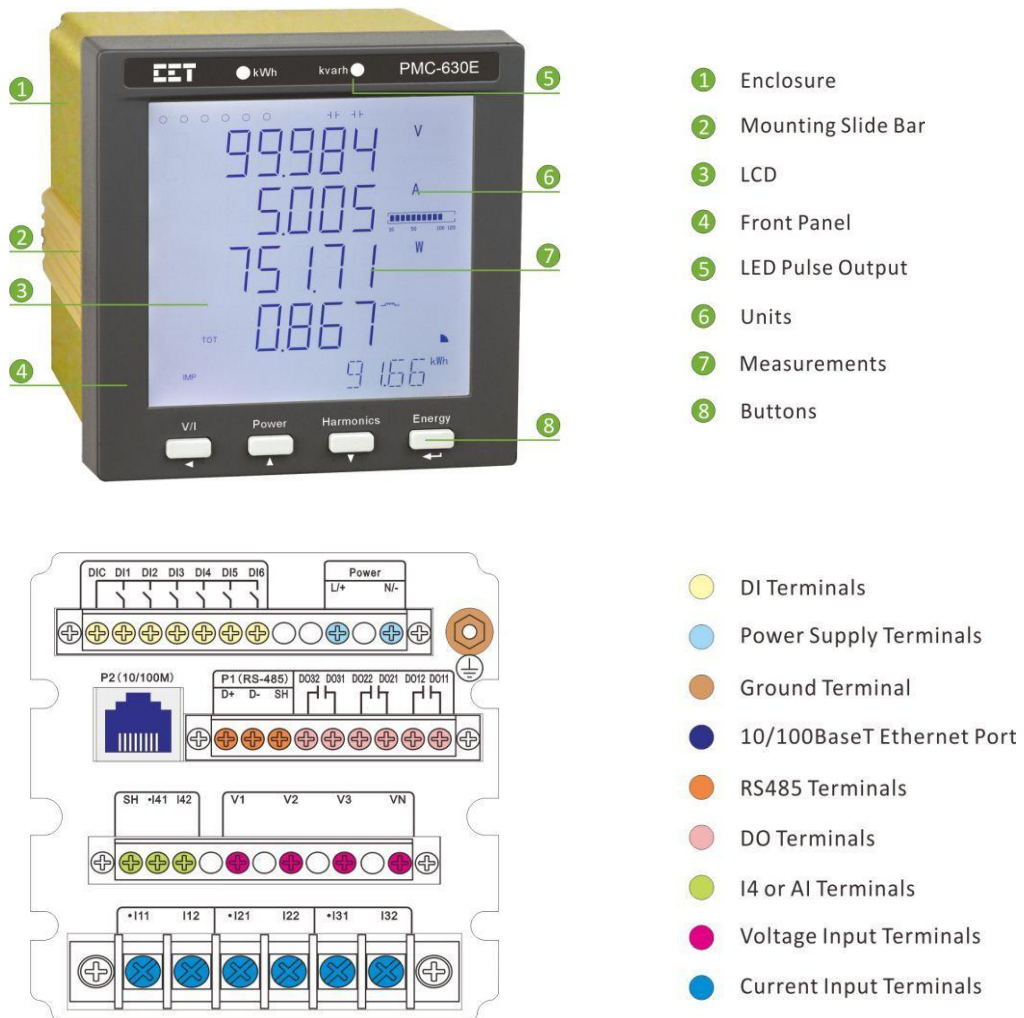


Figure 2-1 Appearance

2.2 Unit Dimensions

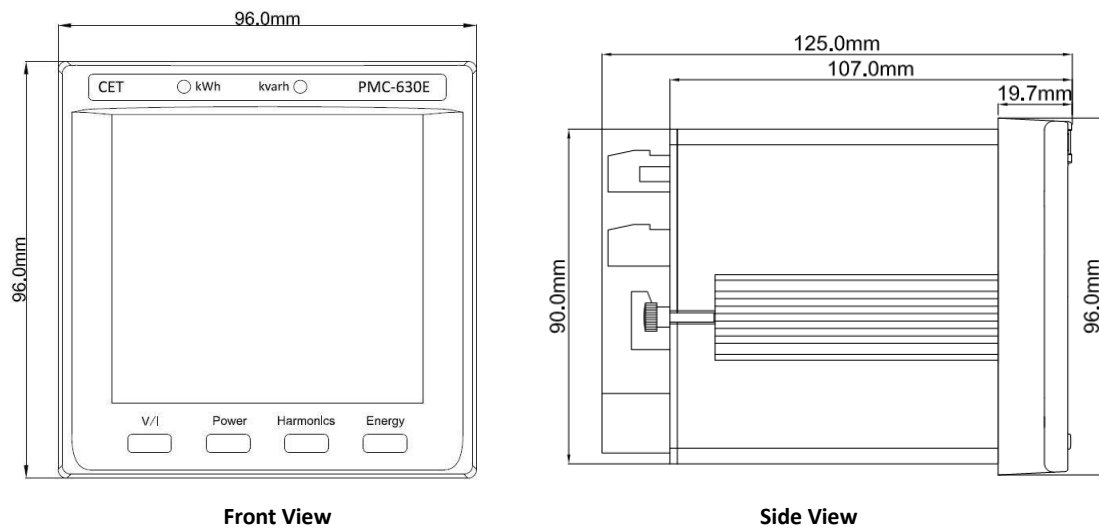


Figure 2-2 Dimensions

2.3 Mounting

The PMC-630E should be installed in a dry environment with no dust and kept away from heat, radiation and electrical noise sources.

Installation steps:

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

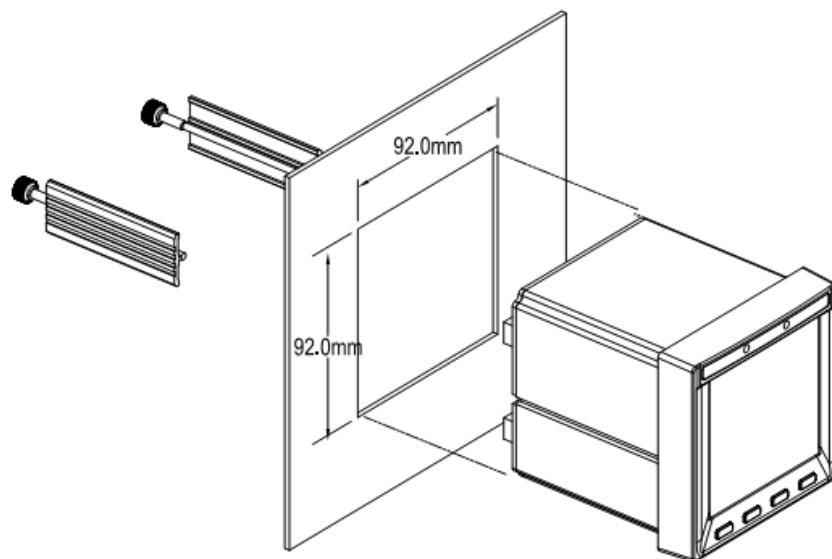


Figure 2-3 Panel Cutout

2.4 Wiring Connections

PMC-630E can satisfy almost any three phase power systems. Please read this section carefully before installation and choose the correct wiring method for your power system. The following wiring modes are supported:

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



Caution

Under no circumstances should the PT secondary be shorted.

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

2.4.1 3-phase 4-wire Wye Direct Connection

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

Set the Wiring Mode to Wye.

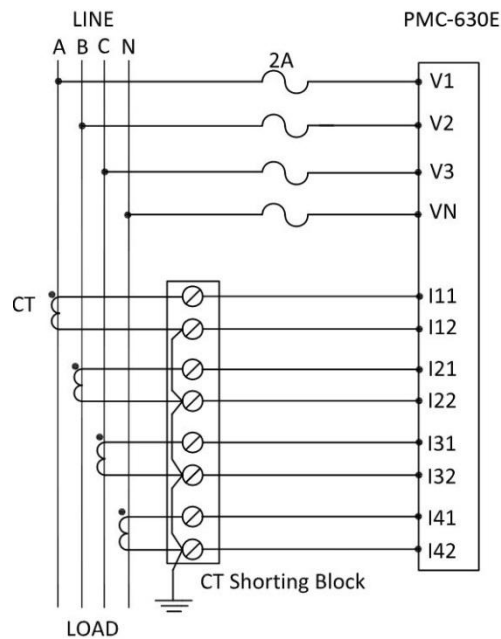


Figure 2-4 4-Wire Wye, Direct Connection

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

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

Set the Wiring Mode to Wye.

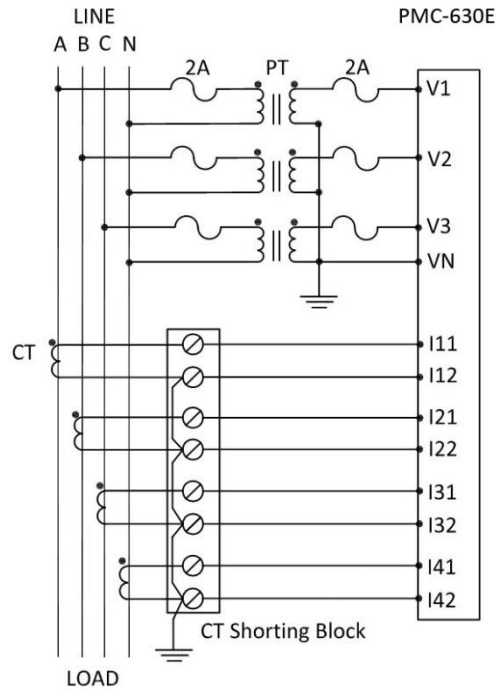


Figure 2-5 4-Wire Wye, 3PTs, 3CTs

2.4.3 3-phase 3-wire Grounded Wye Direct Connection

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

Set the Wiring Mode to Wye.

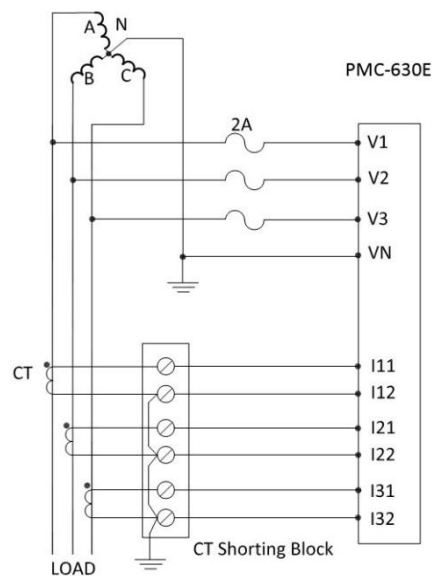


Figure 2-6 3-Wire Grounded Wye, Direct Connection

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

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

Set the Wiring Mode to Wye.

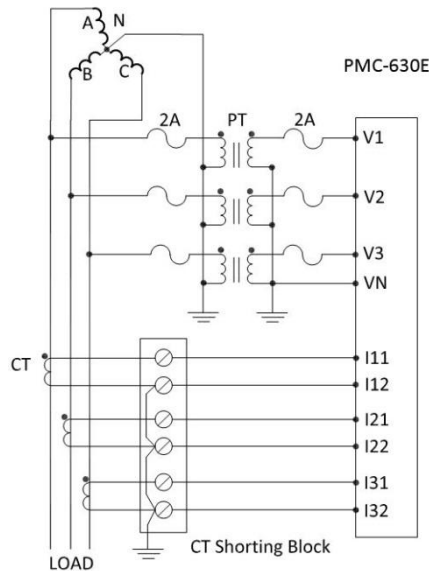


Figure 2-7 3-Wire Grounded Wye, 3PTs, 3CTs

2.4.5 3-phase 3-wire Open Delta Direct Connection

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

Set the Wiring Mode to Delta.

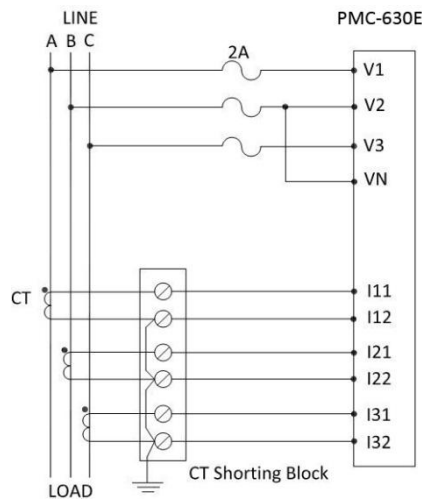


Figure 2-8 3-Wire Delta, no PTs, 3CTs

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

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

Set the Wiring Mode to Delta.

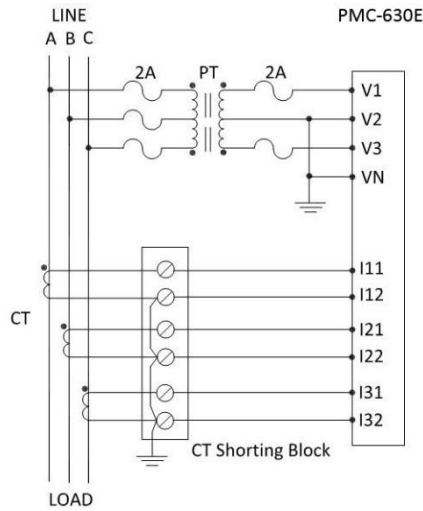


Figure 2-9 3-Wire Delta, 2PTs, 3CTs

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

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

Set the Wiring Mode to Delta.

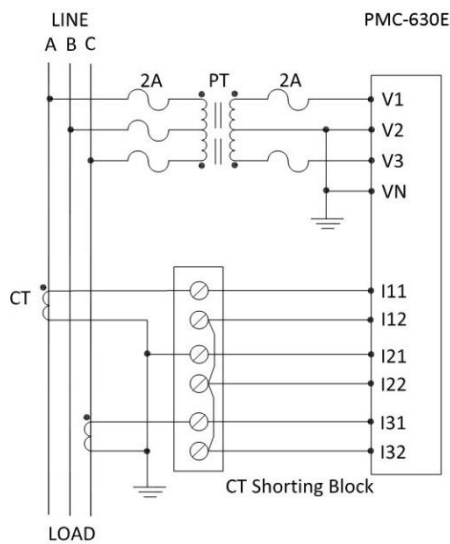


Figure 2-10 3-Wire Delta, 2PTs, 2CTs

2.5 Communications Wiring

2.5.1 RS485 Port

The PMC-630E provides one RS485 port and supports the Modbus RTU and EGATE (Ethernet Serial Gateway) protocol. Up to 32 devices can be connected on a RS485 bus. The overall length of the RS485 cable connecting all devices should not exceed 1200m.

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

The following figure illustrates the RS485 communications connections on the PMC-630E:

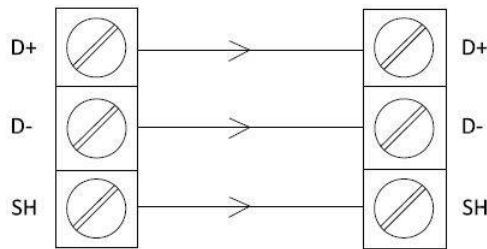


Figure 2-11 RS485 Communications Connections

2.5.2 Ethernet Port (10/100BaseT)

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

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

2.6 Digital Input Wiring

The following figure illustrates the Digital Input connections on the PMC-630E:

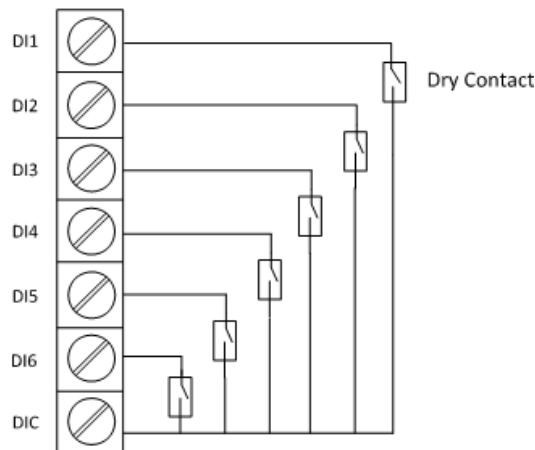


Figure 2-12 DI Connections

2.7 Digital Output Wiring

The following figure illustrates the Digital Output connections on the PMC-630E:

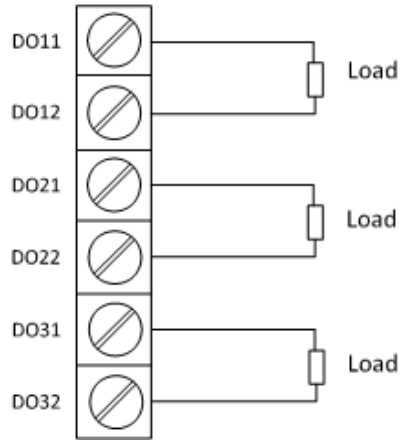


Figure 2-13 RO Connections

2.8 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.

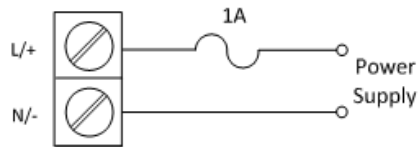


Figure 2-14 Power Supply Connections

2.9 Chassis Ground Wiring

Connect the G terminal to earth ground.

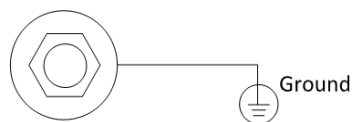


Figure 2-15 Chassis Ground connection

Chapter 3 Front Panel

The PMC-630E has a large, easy to read LCD display with backlight and four buttons for data display and meter configuration. This chapter introduces the front panel operations.



Figure 3-1 Front Panel

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

Table 3-1 Front Panel display

3.1 Display Screen Types

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

3.1.1 LCD Testing

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

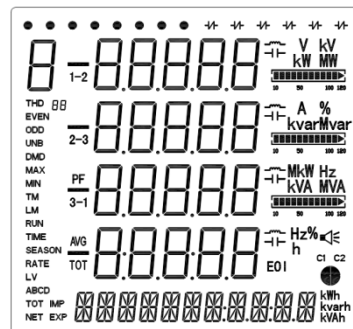


Figure 3-2 PMC-630E Full Display

3.1.2 LCD Display Areas

This section provides a description of the LCD display areas. The PMC-630E LCD display can generally be divided into 5 areas:

- A: Displays symbols for parameters such as Voltage, Current, Fundamental, Power, THD, TOHD, TEHD, 2nd to 31st Individual Harmonics, k-Factor, Unbalance, PF, Voltage Phase Angle, Current Phase Angle, Demand, ...etc.
- B: Displays the indicators for DI status and RO status
- C: Displays Measurement Units, Loading Factor and PF Quadrant indicator
- D: Displays Measurement values
- E: Displays energy information such as kWh/kvarh Imp/Exp/Net/Total and kVAh Total

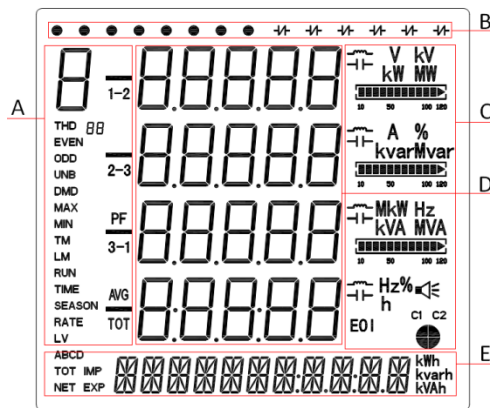


Figure 3-3 LCD Display

The following table shows the special LCD display symbols:

NO.	Label	Description			
A	8	U	I	P	Q
		Voltage	Current	kW	kvar
		S	d	t	F
		kVA	Fundamental	K-Factor	Frequency
	A	b	C		
	Phase A	Phase B	Phase C		
	1-2	1-2	PF	AVG	
BB	2-3	2-3			
	3	3-1			
	Line to Neutral	Line to Line	Power Factor	Average	
	TOT	—	PR		
	Total	Negative Symbol	Phase Angle		

	THD EVEN ODD UNB DMD MAX MIN TM LM RUN TIME SEASON RATE LV	THD	THD EVEN	THD ODD	HD 2 to THD 31
		THD	TEHD	TOHD	2 nd to 31 st Harmonics
		UNB	DMD	MAX	MIN
B		O	●	⊕	⊖
		DI Open	DI Close	RO Open	RO Close
		V kV A % Hz Units for Voltage, Current, %Harmonics Distortion and Frequency			
C	 E01	%Loading	 Inductive Load Capacitive Load	c1 c2 COM 1 Port Status COM 2 Port Status	kW MW kvarMvar kVA MVA Units for Real, Reactive and Apparent Power Alarm Symbol
		Q2 Q1 Q3 Q4 PF Quadrant – Q1 / Q2 / Q3 / Q4			
		h E01 Reserved			
E	ABCD TOT IMP NET EXP kWh kvarh kVAh	IMP kWh	EXP kWh	NET kWh	TOT kWh
		kWh Import	kWh Export	kWh Net	kWh Total
		IMP kvarh	EXP kvarh	NET kvarh	TOT kvarh
		kvarh Import	kvarh Export	kvarh Net	kvarh Total
		kVAh ABCD	Reserved		

Table 3-2 LCD Display Symbols

3.1.3 Peak Demand Display

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

- a: Peak Demand Indicator – Peak Demand of This Month / Last Month:
- b: Peak Demand value
- c: Date portion of the Peak Demand timestamp
- d: Time portion of the Peak Demand timestamp

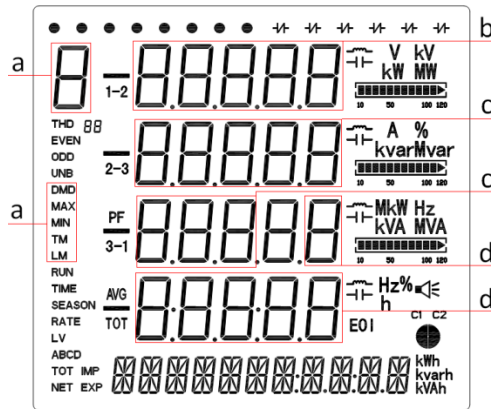


Figure 3-4 Peak Demand Display

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

Table 3-3 Peak Demand Display

3.1.4 Data Display

The following table illustrates the display screens for the different PMC-630E models.

Press Button	Display screens	First row	Second row	Third row	Fourth row
<V,I>	Display 1	VLL average	I average	ΣkW	ΣP.F.
	Display 2 ¹	Va	Vb	Vc	VLN average
	Display 3	Vab	Vbc	Vca	VLL average
	Display 4	Ia	Ib	Ic	I average
	Display 5		I4 ²		
	Display 6		I0 ³		
	Display 7			Frequency	

	Display 8		V Unbalance			
	Display 9		I Unbalance			
	Display 10	Va Angle	Vb Angle	Vc Angle		
	Display 11	Ia Angle	Ib Angle	Ic Angle		
	Display 12	Ia Demand	Ib Demand	Ic Demand		
	Display 13		I4 Demand			
	Display 14	Ia Peak Demand of This Month	YYYY.MM.DD HH:MM:SS			
	Display 15	Ib Peak Demand of This Month	YYYY.MM.DD HH:MM:SS			
	Display 16	Ic Peak Demand of This Month	YYYY.MM.DD HH:MM:SS			
	Display 17	Ia Peak Demand of Last Month	YYYY.MM.DD HH:MM:SS			
	Display 18	Ib Peak Demand of Last Month	YYYY.MM.DD HH:MM:SS			
	Display 19	Ic Peak Demand of Last Month	YYYY.MM.DD HH:MM:SS			
	<Power>	Display 1 ¹	kWa	kWb	kWc	ΣkW
		Display 2 ¹	kvara	kvarb	kvarc	Σkvar
		Display 3 ¹	kVAa	kVAb	kVAc	ΣkVA
		Display 4 ¹	P.F.a	P.F.b	P.F.c	ΣP.F.
		Display 5 ¹	dP.F.a	dP.F.b	dP.F.c	dΣP.F.
		Display 6	ΣkW	Σkvar	ΣkVA	ΣP.F.
		Display 7	ΣkW Demand	Σkvar Demand	ΣkVA Demand	ΣP.F. Demand
Display 8		kW Peak Demand of This Month	YYYY.MM.DD HH:MM:SS			
Display 9		kvar Peak Demand of This Month	YYYY.MM.DD HH:MM:SS			
Display 10		kVA Peak Demand of This Month	YYYY.MM.DD HH:MM:SS			
Display 11		kW Peak Demand	YYYY.MM.DD HH:MM:SS			

		of Last Month			
	Display 12	kvar Peak Demand of Last Month	YYYY.MM.DD HH:MM:SS		
	Display 13	kVA Peak Demand of Last Month	YYYY.MM.DD HH:MM:SS		
<Harmonics>	Display 1	Va THD	Vb THD	Vc THD	VLN avg. THD
	Display 2	Ia THD	Ib THD	Ic THD	I avg. THD
	Display 3	Ia K-Factor	Ib K-Factor	Ic K-Factor	
	Display 4	Va TEHD	Vb TEHD	Vc TEHD	VLN avg. TEHD
	Display 5	Ia TEHD	Ib TEHD	Ic TEHD	I avg. TEHD
	Display 6	Va TOHD	Vb TOHD	Vc TOHD	VLN avg. TOHD
	Display 7	Ia TOHD	Ib TOHD	Ic TOHD	I avg. TOHD
	Display 8	Va 2 nd Harmonic	Vb 2 nd Harmonic	Vc 2 nd Harmonic	VLN avg. 2 nd Harmonic
	Display 9	Ia 2 nd Harmonic	Ib 2 nd Harmonic	Ic 2 nd Harmonic	I avg. 2 nd Harmonic
				
	Display 66	Va 31 st Harmonic	Vb 31 st Harmonic	Vc 31 st Harmonic	VLN avg. 31 st Harmonic
	Display 67	Ia 31 st Harmonic	Ib 31 st Harmonic	Ic 31 st Harmonic	I avg. 31 st Harmonic
<Energy>	Display 1	kWh Import			
	Display 2	kWh Export			
	Display 3	kWh Net			
	Display 4	kWh Total			
	Display 5	kvarh Import			
	Display 6	kvarh Export			
	Display 7	kvarh Net			
	Display 8	kvarh Total			
	Display 9	kVAh			

Table 3-4 PMC-630E Data Display Screens

Notes:

- 1) When the wiring mode is Delta, the screens that display per phase line-to-neutral voltages, kW, kvars, kVAs and PFs are bypassed and do not appear.
- 2) I4 is the "measured" neutral current.
- 3) IO is the "calculated" neutral current.

3.2 Setup Configuration via the Front Panel

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

seconds returns to the Data Display mode.

3.2.1 Functions of buttons

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

- <Energy>:** Pressing this button for more than three seconds toggles between Data Display mode and Setup Configuration mode. Once inside the Setup Configuration mode, pressing this button selects a parameter for modification. After changing the parameter, pressing this button again saves the new setting into memory.
- <Power>:** Before a parameter is selected for modification, pressing this button advances to the next parameter in the menu. If a parameter is already selected, pressing this button increments a numeric value or advances to the next value in the selection list.
- <Harmonics>:** Before a parameter is selected for modification, pressing this button goes back to the last parameter in the menu. If a parameter is already selected, pressing this button decrements a numeric value or goes back to the last value in the selection list.
- <V/I>:** Once a parameter is selected for modification, pressing this button moves the cursor to the left by one position if the parameter being changed is a numeric value. Otherwise, this button is ignored.

Making setup changes:

- Press the **<Energy>** button for more than 3 seconds to access Setup Configuration mode.
- Press the **<Power>** button to advance to the Password page.
- A correct password must be entered before changes are allowed. The factory default password is a numeric zero "0". Press the **<Energy>** button to select the parameter for modification. Use the **<Power>**, **<Harmonics>** and **<V/I>** buttons to enter the correct password.

Selecting a parameter to change:

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

Changing and saving a parameter:

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

Returning to the Data Display mode:

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

3.2.2 Setup Menu

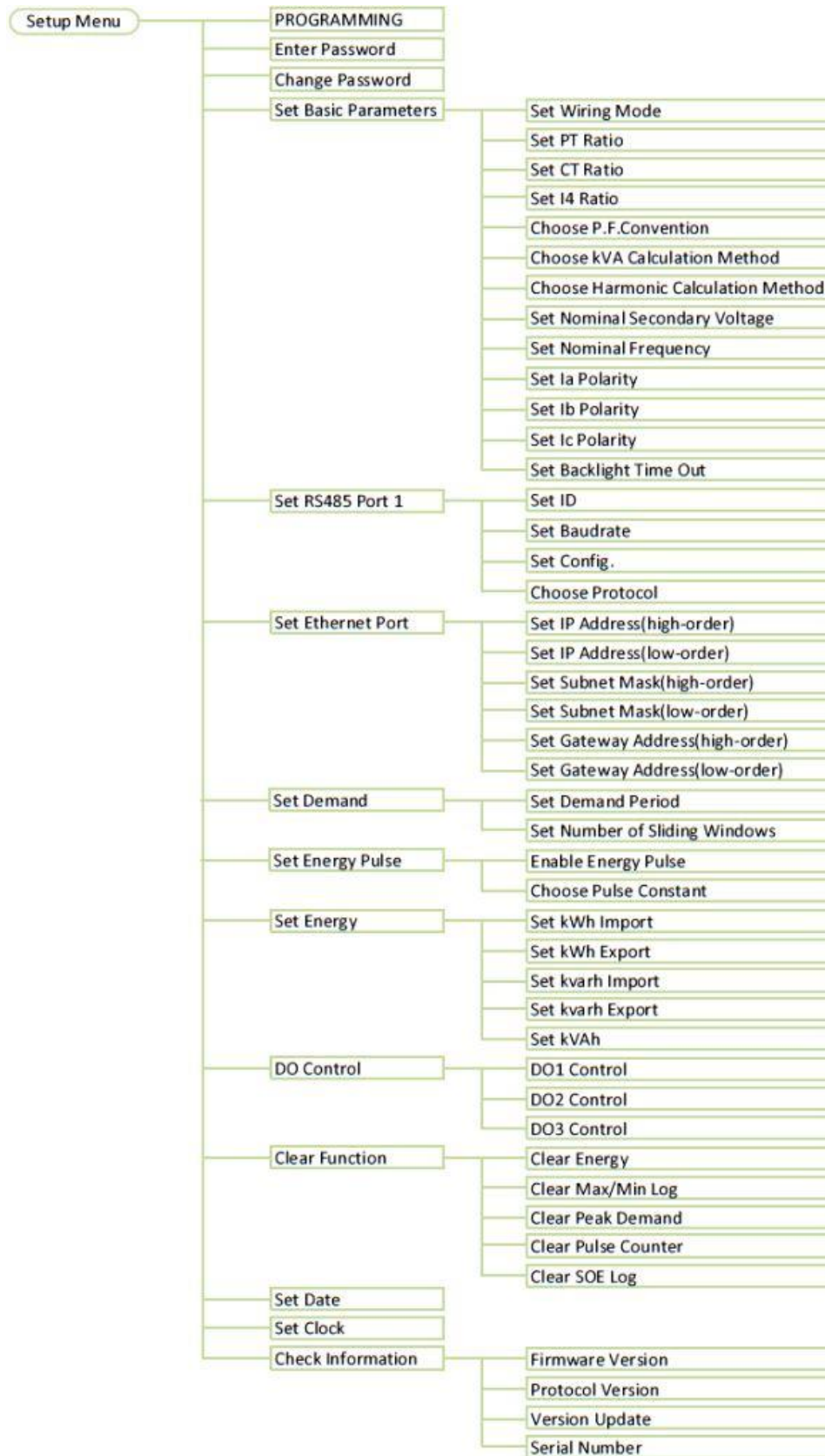


Figure 3-5 Setup Menu

3.2.3 Front Panel Setup Parameters

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

Label				
menu 1 st level 2 nd level	Parameters	Description	Options/Range	Default
PROGRAMMING		Setup Configuration mode	/	/
PASSWORD	Password	Enter Password	/	"0"
PAS SET		Change Password	YES/NO	NO
New PAS	New Password	Change Password	0000 to 9999	"0"
SYS SET		Configure System Parameters	YES/NO	NO
TYPE	Wiring Mode	The Wiring Connection of the meter	WYE/DELTA/DEMO	WYE
PT	PT Ratio ¹	PT Ratio	1 to 10,000	1
CT	CT Ratio ¹	CT Ratio	1 to 30,000 (1A) 1 to 6,000 (5A)	1
I4	I4 Ratio	I4 Ratio	1 to 10,000	1
PF SET	P.F. Convention ²	P.F. Convention	IEC/IEEE/-IEEE	IEC
KVA SET	kVA Calculation ³	kVA Calculation Method	V/S	V
HD SET	Harmonics Calculation ⁴	Harmonics Distortion Calculation Method	FUND/RMS	FUND
V NOM	VLL Nominal Secondary Voltage (VLL _{nominal})	VLL Nominal Voltage of Secondary Side	100 to 700 (V)	100
Hz NOM	Nominal Frequency (f _{nominal})	Nominal Frequency	50/60	50
I1 REV	Phase A CT	Reverse Phase A CT Polarity	YES/NO	NO
I2 REV	Phase B CT	Reverse Phase B CT Polarity	YES/NO	NO
I3 REV	Phase C CT	Reverse Phase C CT Polarity	YES/NO	NO
BLTO SET	Backlight Time-Out ⁵	Set Backlight Time-out	0 to 60 (mins)	3
COM1 SET		Configure COM1	YES/NO	NO

		Parameters		
ID1	Port 1 Address	Modbus Address	1-247	100
BAUD1	Port 1 Baudrate	Data rate in bits per second	1200/2400/4800/ 9600/19200/38400bps	9600
CONFIG1	Port 1 Configuration	Data Format	8N2/8O1/8E1/8N1/8O2/8E2	8E1
PRO	Protocol	Communication Protocol	MODBUS/EGATE ⁶	MODBUS
ETH SET ⁷		Configure Ethernet Parameters	YES/NO	NO
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		Configure Demand Parameters	YES/NO	NO
PERIOD	Sliding Window Interval	Sliding Window Interval	1 to 99 (minutes)	15
NUM	Number of Sliding Windows	Number of Sliding Windows	1 to 15	1
PULS SET		Configure Pulse Output	YES/NO	NO
EN PULSE	Energy Pulse	Enable Energy Pulsing	YES/NO	NO
EN CONST	Pulse Constant ⁸	Pulse Constant (Imp/kxh)	1k(1000) / 3.2k(3200) / 5k(5000) / 6.4k (6400) /	1k

			12.8k (12,800)	
ENGY SET	Energy Values	Preset Energy Values	YES/NO	NO
IMP kWh	kWh Import	Preset kWh Import Value	0 to 999,999,999	0
EXP kWh	kWh Export	Preset kWh Export value	0 to 999,999,999	0
IMP kvarh	kvarh Import	Preset kvarh Import Value	0 to 999,999,999	0
EXP kvarh	kvarh Export	Preset kvarh Export value	0 to 999,999,999	0
	kVAh	kVAh	Preset kVAh Value	0 to 999,999,999
DO SET	RO Control	RO Control	YES/NO	NO
DO1	RO1 Control	RO1 Control	NORMAL/ON/OFF	NORMAL
DO2	RO2 Control	RO2 Control	NORMAL/ON/OFF	NORMAL
DO3	RO3 Control	RO3 Control	NORMAL/ON/OFF	NORMAL
CLR SET		Clear Logs	YES/NO	NO
CLR ENGY	Clear Energy	Clear kWh, kvarh and kVAh	YES/NO	NO
CLR MXMN	Clear Max/Min	Clear Max/Min Logs of This Month	YES/NO	NO
CLR PDMD	Clear Demand	Clear Peak Demands of This Month	YES/NO	NO
CLR DIC	Clear Pulse Counter	Clear Pulse Counter	YES/NO	NO
CLR SOE	Clear SOE	Clear SOE Log	YES/NO	NO
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
630E	Version	Firmware Version	For example, 630E 10000 means the meter is PMC-630E 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. 120516	/
	Serial Number	Meter Serial Number	e.g. 1108040001	/

Table 3-5 Setup Parameters

Notes:

- 1) For 5A configuration, PT Ratio \times CT Ratio must be less than 1,000,000
For 1A configuration, PT Ratio \times CT Ratio must be less than 5,000,000
- 2) P.F. Convention: -IEEE is the same as IEC but with the opposite sign.

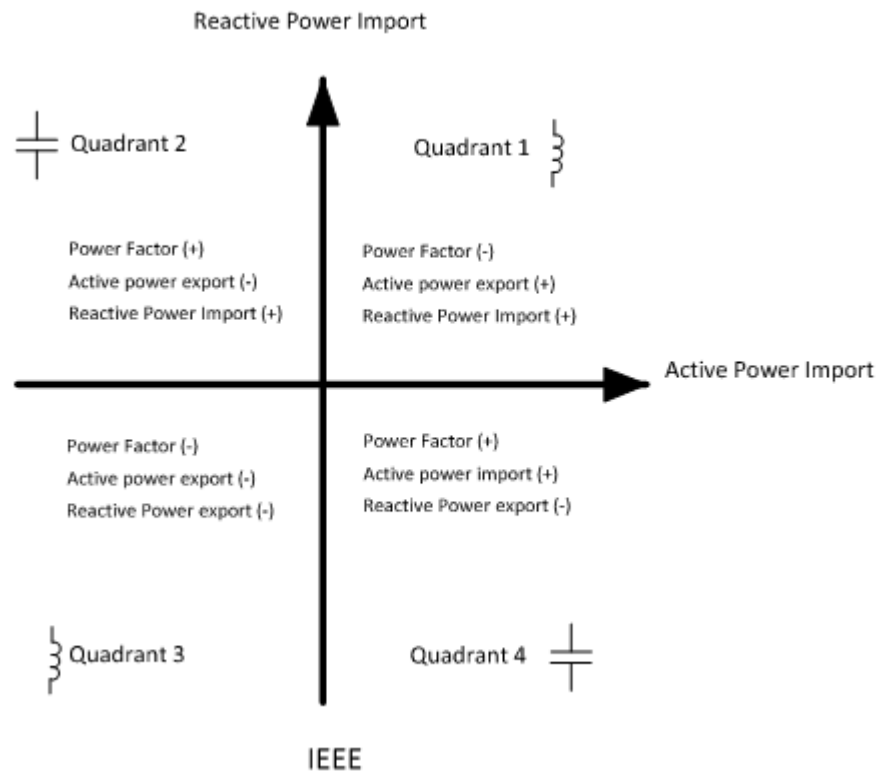
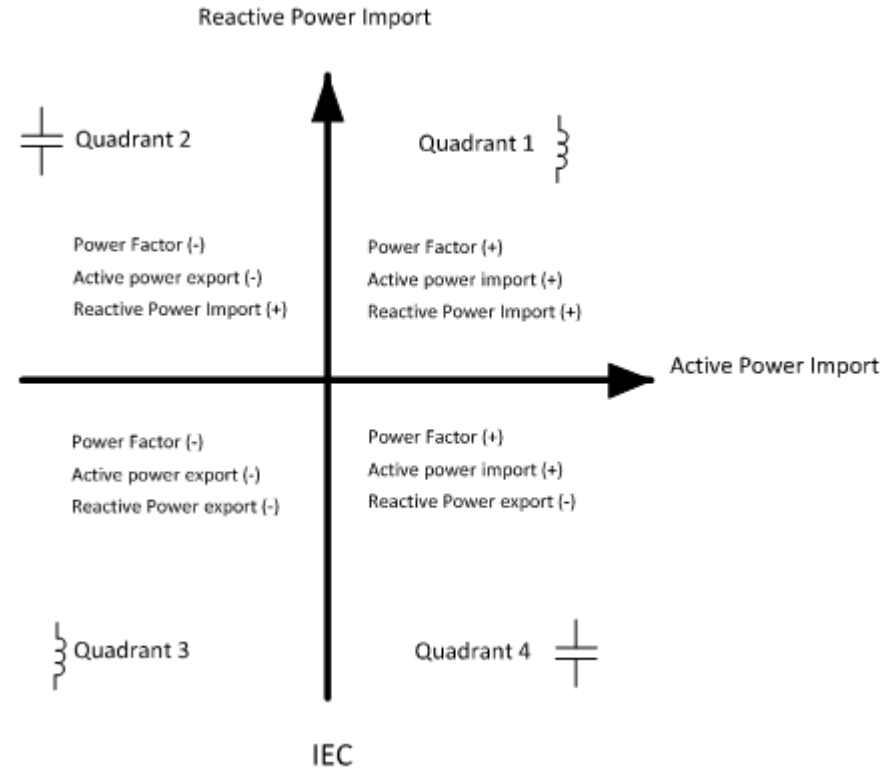


Figure 3-6 Power Factor Definitions

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 Kth Harmonic Distortion = $\frac{U_k}{U_1} \times 100\%$, U_1 is Fundamental Voltage

Current Kth Harmonic Distortion = $\frac{I_k}{I_1} \times 100\%$, I_1 is Fundamental Current

% of RMS Method:

Voltage Kth Harmonic Distortion = $\frac{U_k}{\sqrt{\sum_{K=1}^{\infty} U_K^2}} \times 100\%$

Current Kth Harmonic Distortion = $\frac{I_k}{\sqrt{\sum_{K=1}^{\infty} I_K^2}} \times 100\%$

- 5) The Backlight Time-out can be set from 0 to 60 minutes. If the value is 0, the backlight is always on.
- 6) The IP Port No. for the Ethernet Gateway function is 6000.
- 7) The PMC-630E 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) The following pulse constants are recommended for the different input ratings:

PMC-630E Configurations	Pulse Constant Options (imp/kWh, imp/kvarh)
120VLL, 1A	12800
120VLL, 5A	12800
415VLL, 1A	12800
415VLL, 5A	3200
690VLL, 1A	5000
690VLL, 5A	1000

Table 3-6 Pulse Constant

Chapter 4 Applications

4.1 Inputs and Outputs

4.1.1 Digital Inputs

The PMC-630E comes standard with six self-excited Digital Inputs that are internally wetted at 24 VDC.

Digital Inputs on the PMC-630E can be used in the following applications:

- 1) Digital Inputs are typically used for monitoring external status which can help prevent equipment damage, improve maintenance, and track security breaches. The real-time statuses of the Digital Inputs are available on the front panel LCD Display as well as through communications. Changes in Digital Input status are stored as events in the SOE Log in 1 ms resolution.
- 2) Digital Inputs can be used for pulse counting to collect WAGES (Water, Air, Gas, Electricity and Steam) information. The DI Pulse Counter information is available via communications. Pulse Counters can be reset from the front panel or via communications.

There are 3 setup parameters:

DI Function: 0 = Digital Input; **1 = Pulse Counter**

DI Debounce: Between 0 and 1000 (ms). The default value is 20 (ms).

DI Pulse Weight: Between 1 and 1,000,000 (x0.001). The default value is 1 (0.001).

4.1.2 Digital Outputs

The PMC-630E 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-630E can be used in the following applications:

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

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

Control Setpoint: Control setpoints can be programmed to trigger RO, Data Recorder or Waveform Recorder upon becoming active. Please refer to Section 4.4 for a detailed description.

Transient Setpoint: Transient setpoint can be programmed to trigger RO, Data Recorder and Waveform Recorder upon becoming active. Please refer to Section 4.6.3 for a detailed description.

Since there are so many ways to utilize the Digital Outputs on the PMC-630E, a prioritized scheme has been developed to avoid conflicts between different applications. In general, Front Panel Control has a higher priority and can override the other applications. Remote Control, Control Setpoints 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-630E comes standard with two front panel LED Pulse Outputs for kWh and kvarh pulsing. Energy pulsing can be enabled from the front panel through the **EN PULSE** setup parameter. Energy Pulse Outputs are typically used for accuracy testing. The pulse constant can be configured as 1000/3200/5000/6400/12800 imp/kxh. The pulse width is fixed at 80ms.

4.2 Power and Energy

4.2.1 Basic Measurements

The PMC-630E provides the following basic measurements with 1 second update rate:

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

4.2.2 Phase Angle

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

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

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

4.2.3 Energy

Basic energy parameters include active energy (kWh), reactive energy (kvarh) and apparent energy (kVAh) with a resolution of 0.01 and a maximum value of ±999,999,999.99. When the maximum value is reached, it will automatically roll over to zero.

The energy can be reset manually or preset to user-defined values through the front panel or via communications.

The PMC-630E provides the following energy measurements:

Active Energy	kWh Import	kWh Export	kWh Net	kWh Total
Reactive Energy	kvarh Import	kvarh Export	kvarh Net	kvarh Total
Apparent Energy	kVAh Total			

Table 4-1 Energy Measurements

4.2.4 Demands

Demand is defined as the average power consumption over a fixed interval (usually 15 minutes). The PMC-630E supports the sliding window demand calculation and has the following setup parameters:

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

The PMC-630E provides the following Demand parameters:

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

Table 4-2 Demand Parameters

Note:

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

4.2.5 Max/Min per Demand Period

The PMC-630E calculated the max/min value per demand period of the following measurements:

- 1) 3-phase Voltage and Frequency
- 2) 3-phase Current and Neutral Current (I4)
- 3) 3-phase Power and Power Factor
- 4) Voltage and Current Unbalance
- 5) Voltage and Current THD


All Max/Min data can be accessed through communication.

4.2.6 Peak Demand of This Month and Last Month

The PMC-630E calculated 3-phase Current, Σ kWh, Σ kvar and Σ kVA peak demand of This Month and Last Month. All Max/Min data can be accessed through communication.

4.3 Setpoints

The PMC- PMC-630E comes standard with 9 user programmable setpoints which provide extensive control by allowing a user to initiate an action in response to a specific condition. Typical setpoint applications include alarming, fault detection and power quality monitoring.

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

Setpoint Type:

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

1) Setpoint Parameter:

Specify the parameter to be monitored. Table 4-3 below provides a list of Setpoint Parameters.

2) Setpoint Active Limit :

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

3) Setpoint Inactive Limit:

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

4) Setpoint Active Delay:

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

5) Setpoint Inactive Delay:

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

6) Setpoint Trigger 1 and Setpoint Trigger 2:

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

The PMC-630E provides the following Setpoint Parameters:

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

Table 4-3 Setpoint Parameters

The PMC-630E provides the following Setpoint Triggers:

Key	Action	Key	Action
0	None	11	DR 8
1	RO1	12	DR 9
2	RO2	13	DR 10
3	RO3	14	DR 11
4	DR 1	15	DR 12
5	DR 2	16	DR 13
6	DR 3	17	DR 14
7	DR 4	18	DR 15
8	DR 5	19	DR 16
8	DR 6	20	WR 1
10	DR 7	21	WR 2

Table 4-4 Setpoint Triggers

4.4 Logging

4.4.1 Peak Demand Log

The PMC-630E stores the peak demand data of **This Month** and **Last Month** with timestamp for Ia, Ib, Ic, ΣkW , $\Sigma kvar$, and ΣkVA . All of the peak demand data can be accessed through front panel LCD as well as communications.

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

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

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

The PMC-630E provides the following Peak Demand parameters:

Peak Demand of This Month	Peak Demand of Last Month
ΣkW Peak Demand of This Month	ΣkW Peak Demand of Last Month
$\Sigma kvar$ Peak Demand of This Month	$\Sigma kvar$ Peak Demand of Last Month
ΣkVA Peak Demand of This Month	ΣkVA Peak Demand of Last Month
Ia Peak Demand of This Month	Ia Peak Demand of Last Month
Ib Peak Demand of This Month	Ib Peak Demand of Last Month
Ic Peak Demand of This Month	Ic Peak Demand of Last Month

Table 4-5 Peak Demand Measurements

4.4.2 Max/Min Log

The PMC-630E records the minimum and maximum data of **This Month** and **Last Month** with timestamp for VLN, VLL, I, ΣkW , $\Sigma kvar$, ΣkVA , $\Sigma P.F.$, frequency, THD, K-Factor, and Unbalance. The Max/Min data is stored in the device's non-volatile memory and will not suffer any loss in the event of power failure. All maximum and minimum data can be accessed through communications.

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

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

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

The PMC-630E provides the following Max/Min parameters:

Max/Min Value of This Month		Max/Min Value of Last Month	
Va max	Va min	Va max	Va min
Vb max	Vb min	Vb max	Vb min
Vc max	Vc min	Vc max	Vc min
VLN avg. max	VLN avg. min	VLN avg. max	VLN avg. min
Vab max	Vab min	Vab max	Vab min
Vbc max	Vbc min	Vbc max	Vbc min
Vca max	Vca min	Vca max	Vca min
VLL avg. max	VLL avg. min	VLL avg. max	VLL avg. min
Ia max	Ia min	Ia max	Ia min
Ib max	Ib min	Ib max	Ib min
Ic max	Ic min	Ic max	Ic min
I avg. max	I avg. min	I avg. max	I avg. min
I4 max	I4 min	I4 max	I4 min
$\sum kW$ max	$\sum kW$ min	$\sum kW$ max	$\sum kW$ min
$\sum kvar$ max	$\sum kvar$ min	$\sum kvar$ max	$\sum kvar$ min
$\sum kVA$ max	$\sum kVA$ min	$\sum kVA$ max	$\sum kVA$ min
$\sum P.F.$ max	$\sum P.F.$ min	$\sum P.F.$ max	$\sum P.F.$ min
FREQ max	FREQ min	FREQ max	FREQ min
Va THD max	Va THD min	Va THD max	Va THD min
Vb THD max	Vb THD min	Vb THD max	Vb THD min
Vc THD max	Vc THD min	Vc THD max	Vc THD min
Ia THD max	Ia THD min	Ia THD max	Ia THD min
Ib THD max	Ib THD min	Ib THD max	Ib THD min
Ic THD max	Ic THD min	Ic THD max	Ic THD min
Ia K-Factor max	Ia K-Factor min	Ia K-Factor max	Ia K-Factor min
Ib K-Factor max	Ib K-Factor min	Ib K-Factor max	Ib K-Factor min
Ic K-Factor max	Ic K-Factor min	Ic K-Factor max	Ic K-Factor min
Voltage Unbalance max	Voltage Unbalance min	Voltage Unbalance max	Voltage Unbalance min
Current Unbalance max	Current Unbalance min	Current Unbalance max	Current Unbalance min

Table 4-6 Max/Min Measurements

4.4.3 Data Recorder (DR) Log

The PMC-630E comes equipped with 2MB of log memory and provides 16 Data Recorders (DR) capable of recording 16 parameters each. The recorded data is stored in the device's non-volatile memory and will not suffer any loss in the event of power failure.

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

- 1) **Triggered Mode:** 0=Disabled / 1=Triggered by Timer / 2=Triggered by Setpoint
- 2) **Recording Mode:** 0=Stop-When-Full / 1= First-In-First-Out
- 3) **Recording Depth:** 0 to 65535 (entries)

- 4) **Recording Interval:** 1 to 3456000 seconds
- 5) **Recording Offset:** 1 to 43200 seconds
- 6) **Number of Parameters:** 0 to 16
- 7) **Parameter 1 to 16:** 0 to 322 for Standard Data Recorder

Please see refer to **Appendix A** for more information.

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

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

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.

4.4.4 Energy Log

The PMC-630E provides an Energy Log capable of recording the interval energy consumption for kWh/kvarh Import/Export and kVAh. If the users wish to record the accumulative energy values instead of the interval energy consumption, the Data Recorder function should be used in the PMC-630E. The recorded data is stored in the device’s non-volatile memory and will not suffer any loss in the event of power failure.

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

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

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

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

The PMC-630E Energy Log can record the following parameters:

Parameters	kWh Import	kWh Export	kvarh Import	kvarh Export	kVAh
-------------------	------------	------------	--------------	--------------	------

Table 4-7 Energy Log Parameters

4.4.5 Waveform Recorder Log

The PMC-630E provides 2 independent groups of waveform recorders (**WFR**) with a combined total of 6 entries. Each Waveform Recorder Log can simultaneously capture 3-phase Voltage and Current signals at a maximum resolution of 128 samples per cycles. Waveform Recorder on the PMC-630E can be triggered by Setpoints, Transient Detection or manually through communications. The

manual trigger command has a higher priority. When Waveform Recorder is already in progress, other Waveform Recorder commands will be ignored until the current recording has completed. The 2 Waveform Recorder Logs have a combined capacity of 6 entries organized in a first-in-first-out basis, with the newest waveform log replacing the oldest one. The waveform data is stored in the device's non-volatile memory and will not suffer any loss in the event of power failure.

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

- 1) **Recording Depth:** 0 to 6 (entry)
- 2) **# of Samples:** 16 / 32 / 64 / 128 (samples)
- 3) **Number of Cycle:** 40 / 20 / 10 / 5 (cycles)
- 4) **Pre-fault Cycle:** 0 to 5 (cycles)

The total capacity of WFR 1 and WFR 2 is 6. The valid formats (# of samples/cycle x # of cycles) of WFR include 16x40, 32x20, 64x10 and 128x5.

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

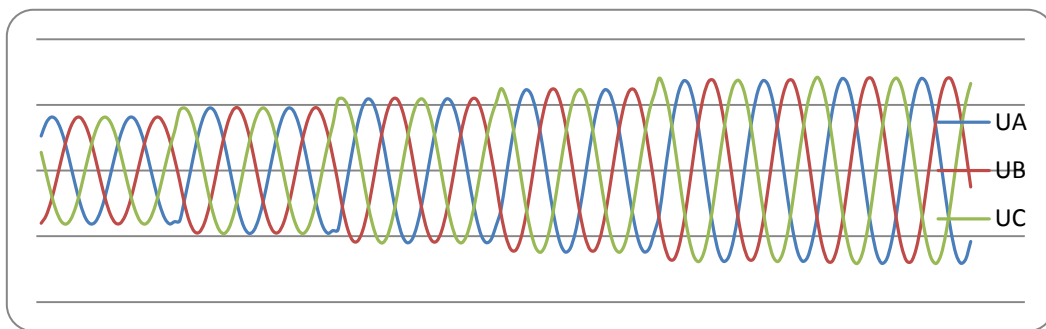


Figure 4-1 Waveform Recording displayed in PecStar®

4.4.6 SOE Log

The PMC-630E's SOE Log can store up to 64 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 64 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.

4.5 Power Quality

4.5.1 Harmonics

The PMC-630E provides on-board harmonics analysis for THD, TOHD, TEHD, K-factor and Individual Harmonics up to the 31st order. All harmonics parameters are available through communications, and individual harmonics from 2nd to 31st are available through the front panel LCD display.

There are two ways to calculate the individual harmonic distortion:

% of Fundamental Method:

$$\text{Voltage } K^{\text{th}} \text{ Harmonic Distortion} = \frac{U_k}{U_1} \times 100\% \quad , \text{ where } U_1 \text{ is the Fundamental Voltage}$$

$$\text{Current } K^{\text{th}} \text{ Harmonic Distortion} = \frac{I_k}{I_1} \times 100\% \quad , \text{ where } I_1 \text{ is the Fundamental Current}$$

% of RMS Method:

$$\text{Voltage } K^{\text{th}} \text{ Harmonic Distortion} = \frac{U_k}{\sqrt{\sum_{K=1}^{\infty} U_K^2}} \times 100\%$$

$$\text{Current } K^{\text{th}} \text{ Harmonic Distortion} = \frac{I_k}{\sqrt{\sum_{K=1}^{\infty} I_K^2}} \times 100\%$$

The PMC-630E provides the following Harmonic measurements:

	Phase A	Phase B	Phase C	Phase N	
Harmonics-Voltage	THD	THD	THD	/	
	TEHD	TEHD	TEHD	/	
	TOHD	TOHD	TOHD	/	
	2 nd Harmonics	2 nd Harmonics	2 nd Harmonics	/	
				/
	31 st Harmonics	31 st Harmonics	31 st Harmonics	/	
Harmonics-Current	THD	THD	THD	THD	
	TEHD	TEHD	TEHD	TEHD	
	TOHD	TOHD	TOHD	TOHD	
	K-Factor	K-Factor	K-Factor	K-Factor	
	2 nd Harmonics	2 nd Harmonics	2 nd Harmonics	2 nd Harmonics	
				
	31 st Harmonics	31 st Harmonics	31 st Harmonics	31 st Harmonics	
	dPFa	dPFb	dPFc	/	
	K Factor	K Factor	K Factor	/	

Table 4-8 Harmonics Measurements

The calculation method of K-Factor is listed below:

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

- I_h = RMS current at the h_{th} harmonic
- h_{\max} = the highest harmonic order number
- h = the harmonic order number

4.5.2 Unbalance

The PMC-630E can measure Voltage and Current Unbalances based on Sequence Components. The calculation method of Voltage and Current Unbalances is listed below:

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

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

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

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

4.5.3 Transient Setpoint

The PMC-630E provides Transient Capture capability for detecting voltage disturbances. The programming of the Transient setpoint is only supported over communications. The Transient setpoint provides the following setup parameters:

- | | |
|----------------------------------|--|
| 1) Transient Enable: | Disabled / Enable |
| 2) Transient Limit: | 0.05xVLL _{nominal} to 5.00xVLL _{nominal} |
| 3) Transient Trigger 1/2: | WR 1 |

4.6 On-board Web Server

The PMC-630E'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-630E currently comes with only one web page as displayed in Figure 4-2. The PMC-630E's web server supports simultaneous access from two web clients.

To view the PMC-630E's on-board Web Page:

- 1) Make sure that the web client computer and the PMC-630E are in the same subnet.
- 2) Enter the IP Address of the PMC-630E in the Address input box of the Internet Explorer and then press <Enter>.
- 3) The PMC-630E's web page appears as follows.

Chapter 5 Modbus Register Map

This chapter provides a complete description of the Modbus register map (**Protocol Versions 1.0** and above) for the PMC-630E Multifunction Ethernet to facilitate the development of 3rd party communications driver for accessing information on the PMC-630E.

The PMC-630E supports the following Modbus functions:

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

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

Read General Reference Packet Structure (Function Code 0x14)

Read Reference Request Packet (Master Station to PMC-630E)		Read Reference Response Packet (PMC-630E to Master Station)	
Slave Address	1 Byte	Slave Address	1 Byte
Function Code (0x14)	1 Byte	Function Code (0x14)	1 Byte
Byte Count	1 Byte	Byte Count	1 Byte ($N \times N_0 + 2$)
Sub-Req X, Reference Type (0x06)	1 Byte	Sub-Res X, Byte Count	1 Byte ($N \times N_0 + 1$)
Sub-Req X, File Number	2 Bytes	Sub-Res X, Reference Type (0x06)	1 Byte
Sub-Req X, Start Address	2 Bytes	Sub-Res X, Register Data	$N \times N_0$ Bytes
Sub-Req X, Register Count	2 Bytes	Sub-Res X+1.....	
Sub-Req X+1.....			
Error Check (CRC)	2 Byte	Error Check (CRC)	2 Bytes

Notes:

- 1) Modbus function code 0x14 is used to access the Data Recorder Log, Energy Log and Waveform Recorder Log.
- 2) Start Address = [Log #X Pointer / Log #X Depth].
- 3) In the Request Packet, the **File Number** parameter is used to reference which log to read:
 - a) For Data Recorder Logs 1 to 16, **File Number** = 1 to 16
 - b) For Energy Log, **File Number** = 17
 - c) For Waveform Recorder Log, **File Number** = 18 to 23
- 4) In the Response Packet, **N** represents the number of logs returned, and **N₀** is the length of a single log:
 - a) For Data Recorder, **N₀** = $n \times 4 + 8$ where n is the number of parameters for a particular Data Recorder
 - b) For Energy Log, **N₀** = $n \times 4 + 8$ where n is the number of parameters for the Energy Log
 - c) For Waveform Recorder Log, **N₀** = 2

5.1 Data Register

5.1.1 Basic Measurements

Register	Property	Description	Format	Scale/Unit
0000	RO	Va ¹	Float	V
0002	RO	Vb ¹	Float	V
0004	RO	Vc ¹	Float	V
0006	RO	VLN average ¹	Float	V
0008	RO	Vab	Float	V
0010	RO	Vbc	Float	V
0012	RO	Vca	Float	V
0014	RO	VLL average	Float	V
0016	RO	Ia	Float	A
0018	RO	Ib	Float	A
0020	RO	Ic	Float	A
0022	RO	I average	Float	A
0024	RO	kWa ¹	Float	W
0026	RO	kWb ¹	Float	W
0028	RO	kWc ¹	Float	W
0030	RO	∑kW	Float	W
0032	RO	kvara ¹	Float	var
0034	RO	kvarb ¹	Float	var
0036	RO	kvarc ¹	Float	var
0038	RO	∑kvar	Float	var
0040	RO	kVAa ¹	Float	VA
0042	RO	kVAb ¹	Float	VA
0044	RO	kVAc ¹	Float	VA
0046	RO	∑kVA	Float	VA
0048	RO	P.F.a ¹	Float	-
0050	RO	P.F.b ¹	Float	-
0052	RO	P.F.c ¹	Float	-
0054	RO	∑P.F.	Float	-
0056	RO	FREQ	Float	Hz
0058	RO	I4 (Measured Neutral Current)	Float	A
0060	RO	I0 (Calculated Neutral Current)	Float	A
0062 - 0069		Reserved		
0070	RO	Voltage Unbalance	UINT16	×1000
0071	RO	Current Unbalance	UINT16	×1000
0072-0075		Reserved		
0076	RO	Va Angle	UINT16	× 100, °
0077	RO	Vb Angle	UINT16	× 100, °
0078	RO	Vc Angle	UINT16	× 100, °

0079	RO	Ia Angle	UINT16	x 100, °
0080	RO	Ib Angle	UINT16	x 100, °
0081	RO	Ic Angle	UINT16	x 100, °
0082-0084		Reserved		
0085	RO	DI Status ²	UINT16	
0086	RO	RO Status ³	UINT16	
0087	RO	Alarm ⁴	UINT32	
0089	RO	SOE Pointer ⁵	UINT32	
0091		Reserved	UINT32	
0093	RO	WFR Log #1 Pointer ⁶	UINT32	
0095	RO	WFR Log #2 Pointer ⁶	UINT32	
0097	RO	Energy Log Pointer ⁷	UINT32	
0099	RO	DR #1 Pointer (Standard) ⁸	UINT32	
0101	RO	DR #2 Pointer (Standard) ⁸	UINT32	
0103	RO	DR #3 Pointer (Standard) ⁸	UINT32	
0105	RO	DR #4 Pointer (Standard) ⁸	UINT32	
0107	RO	DR #5 Pointer (Standard) ⁸	UINT32	
.....			
0129	RO	DR #16 Pointer (Standard) ⁸	UINT32	
0131	RO	Total Memory Size ⁹	UINT32	kB
0133	RO	Available Memory ⁹	UINT32	kB

Table 5-1 Basic Measurements

Notes:

- 1) When the **Wiring Mode** is Delta, the per phase line-to-neutral voltages, kW, kvars, kVAs and PFs 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 **RO Status** register, the bit values of B0 to B2 represent the states of RO1 to RO3, respectively, with “1” meaning active (closed) and “0” meaning inactive (open).
- 4) The Alarm register indicates the various alarm states with a bit value of 1 meaning active and 0 meaning inactive. The following table illustrates the details of the Alarm register.

Bit	Alarm Event	Bit	Alarm Event
B0	Setpoint #1 (Standard)	B5	Setpoint #6 (Standard)
B1	Setpoint #2 (Standard)	B6	Setpoint #7 (Standard)
B2	Setpoint #3 (Standard)	B7	Setpoint #8 (Standard)
B3	Setpoint #4 (Standard)	B8	Setpoint #9 (Standard)
B4	Setpoint #5 (Standard)	B9-B31	Reserved

Table 5-2 Alarm Register (0087)

- 5) The range of the **SOE Pointer** is between 0 and 0xFFFFFFFF. The **SOE Pointer** is incremented by one for every event generated and will roll over to 0 if its current value is 0xFFFFFFFF. Since the **SOE Pointer** is a 32-bit value and the SOE Log capacity is relatively small with only

64 events in the PMC-630E, an assumption has been made that the **SOE Pointer** will never roll over. If a **CLR SOE** is performed from the front panel or via communications, the **SOE Pointer** will be reset to zero and then immediately incremented by one with a new "Clear SOE via Front Panel" or "Clear SOE via Communications" event. Therefore, any 3rd party software should assume that a **CLR SOE** action has been performed if it sees the **SOE Pointer** rolling over to one or to a value that is smaller than its own pointer. In this case, the new **SOE Pointer** also indicates the number of events in the SOE Log if it is less than 64. Otherwise, there will always be 64 events in the SOE Log.

- 6) The PMC-630E has two Waveform Recorders (**WFR #1 and WFR #2**). Each **WFR** has a Pointer that indicates its current logging position. The range of the **WFR Pointer** is between 0 and 0xFFFFFFFF. The **WFR Pointer** is incremented by one for every WFR log generated and will roll over to 0 if its current value is 0xFFFFFFFF. A value of zero indicates that the device does not contain any WFR Log. The total depth of **WFR #1** and **WFR #2** is 6 records. Since the **WFR Pointers** are 32-bit values, an assumption has been made that these pointers will never roll over. If a **Clear WFR** is performed via communications, the **WFR Pointers** will be reset to zero.

To determine the latest WFR log location:

WFR #1's latest log location = Modulo [**WFR #1 Pointer**/ **WFR #1 Depth**]

WFR #2's latest log location = Modulo [**WFR #2 Pointer**/ **WFR #2 Depth**]

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

To determine the latest Energy Log location:

Energy Log's latest log location = Modulo [**Energy Log Pointer**/ **Energy Log Depth**]

- 8) The PMC-630E has sixteen Data Recorders (**DR #1 / 2 /... / 16**). Each **DR** has a Pointer that indicates its current logging position. The range of the **DR Pointer** is between 0 and 0xFFFFFFFF. The **DR Pointer** is incremented by one for every DR log generated and will roll over to 0 if its current value is 0xFFFFFFFF. A value of zero indicates that the device does not contain any DR Log. If a **Clear DR** is performed via communications, the **DR Pointer** will be reset to zero.

To determine the latest DR #X log location (X=1 to 16):

DR #X's latest log location = Modulo [**DR #X Pointer**/ **DR #X Depth**]

- 9) The Total Memory Size of the PMC-630E is 2MB (2048kB). Used Memory = 2048kB - Available Memory.

5.1.2 Energy Measurements

The Energy registers have a maximum value of 999,999,999 and will roll over to zero automatically when it is reached.

Register	Property	Description	Format	Unit
0200	RW	kWh Import	UINT32	kWh
0202	RW	kWh Export	UINT32	kWh
0204	RO	kWh Net	INT32	kWh
0206	RO	kWh Total	UINT32	kWh
0208	RW	kvarh Import	UINT32	kvarh
0210	RW	kvarh Export	UINT32	kvarh
0212	RO	kvarh Net	INT32	kvarh
0214	RO	kvarh Total	UINT32	kvarh
0216	RW	kVAh	UINT32	kVAh

Table 5-3 Energy Measurements

5.1.3 Pulse Counter

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

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

Table 5-4 Pulse Counter

5.1.4 Harmonic Measurements

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

Register	Property	Description	Format	Scale/Unit
0450	RO	dPFa ¹	Float	
0452	RO	dPFb ¹	Float	
0454	RO	dPFc ¹	Float	
0456	RO	dPF Total ¹	Float	
0458	RO	Ia K Factor	UINT16	×10
0459	RO	Ib K Factor	UINT16	×10
0460	RO	Ic K Factor	UINT16	×10
0461	RO	Va THD	UINT16	×10000
0462	RO	Vb THD	UINT16	×10000
0463	RO	Vc THD	UINT16	×10000
0464	RO	Ia THD	UINT16	×10000
0465	RO	Ib THD	UINT16	×10000
0466	RO	Ic THD	UINT16	×10000

0467	RO	I4 Measured THD ²	UINT16	×10000
0468	RO	Va TOHD	UINT16	×10000
0469	RO	Vb TOHD	UINT16	×10000
0470	RO	Vc TOHD	UINT16	×10000
0471	RO	Ia TOHD	UINT16	×10000
0472	RO	Ib TOHD	UINT16	×10000
0473	RO	Ic TOHD	UINT16	×10000
0474	RO	I4 Measured TOHD ²	UINT16	×10000
0475	RO	Va TEHD	UINT16	×10000
0476	RO	Vb TEHD	UINT16	×10000
0477	RO	Vc TEHD	UINT16	×10000
0478	RO	Ia TEHD	UINT16	×10000
0479	RO	Ib TEHD	UINT16	×10000
0480	RO	Ic TEHD	UINT16	×10000
0481	RO	I4 Measured TEHD ²	UINT16	×10000
0482	RO	Va 2 nd Harmonic	UINT16	×10000
0483	RO	Vb 2 nd Harmonic	UINT16	×10000
0484	RO	Vc 2 nd Harmonic	UINT16	×10000
0485	RO	Ia 2 nd Harmonic	UINT16	×10000
0486	RO	Ib 2 nd Harmonic	UINT16	×10000
0487	RO	Ic 2 nd Harmonic	UINT16	×10000
0488	RO	I4 Measured 2 nd Harmonic ²	UINT16	×10000
.....		.....		×10000
0685	RO	Va 31 st Harmonic	UINT16	×10000
0686	RO	Vb 31 st Harmonic	UINT16	×10000
0687	RO	Vc 31 st Harmonic	UINT16	×10000
0688	RO	Ia 31 st Harmonic	UINT16	×10000
0689	RO	Ib 31 st Harmonic	UINT16	×10000
0690	RO	Ic 31 st Harmonic	UINT16	×10000
0691	RO	I4 Measured 31 st Harmonic ²	UINT16	×10000

Table 5-5 Harmonics Measurements

Notes:

- 1) When the **Wiring Mode** is Delta, the dPFs have no meaning, and their registers are reserved.
- 2) Registers of I4 harmonics are valid only if the device is equipped with the I4 Input. Otherwise, it is reserved.

5.1.5 Present Demand

Register	Property	Description	Format	Scale/Unit
1000	RO	Va Demand	INT32	x100, V
1002	RO	Vb Demand	INT32	x100, V
1004	RO	Vc Demand	INT32	x100, V
1006	RO	VLN average Demand	INT32	x100, V
1008	RO	Vab Demand	INT32	x100, V
1010	RO	Vbc Demand	INT32	x100, V
1012	RO	Vca Demand	INT32	x100, V
1014	RO	VLL average Demand	INT32	x100, V
1016	RO	Ia Demand	INT32	x1000, A
1018	RO	Ib Demand	INT32	x1000, A
1020	RO	Ic Demand	INT32	x1000, A
1022	RO	I average Demand	INT32	x1000, A
1024	RO	I4 Demand ¹	INT32	x1000, A
1026	RO	kWa Demand	INT32	W
1028	RO	kWb Demand	INT32	W
1030	RO	kWc Demand	INT32	W
1032	RO	ΣkW Demand	INT32	W
1034	RO	kvara Demand	INT32	var
1036	RO	kvarb Demand	INT32	var
1038	RO	kvarc Demand	INT32	var
1040	RO	Σkvar Demand	INT32	var
1042	RO	kVAa Demand	INT32	VA
1044	RO	kVAb Demand	INT32	VA
1046	RO	kVAc Demand	INT32	VA
1048	RO	ΣkVA Demand	INT32	VA
1050	RO	P.F.a Demand	INT32	x1000
1052	RO	P.F.b Demand	INT32	x1000
1054	RO	P.F.c Demand	INT32	x1000
1056	RO	ΣP.F. Demand	INT32	x1000
1058	RO	FREQ Demand	INT32	x100, Hz
1060	RO	V Unbalance Demand	INT32	x1000
1062	RO	I Unbalance Demand	INT32	x1000
1064	RO	Va THD Demand	INT32	x10000
1066	RO	Vb THD Demand	INT32	x10000
1068	RO	Vc THD Demand	INT32	x10000
1070	RO	Ia THD Demand	INT32	x10000
1072	RO	Ib THD Demand	INT32	x10000
1074	RO	Ic THD Demand	INT32	x10000

Table 5-6 Present Demand

Note:

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

5.1.6 Max/Min Value per Demand Period

Register	Property	Description	Format	Scale/Unit
1400	RO	Va max	INT32	x100, V
1402	RO	Vb max	INT32	x100, V
1404	RO	Vc max	INT32	x100, V
1406	RO	VLN average max	INT32	x100, V
1408	RO	Vab max	INT32	x100, V
1410	RO	Vbc max	INT32	x100, V
1412	RO	Vca max	INT32	x100, V
1414	RO	VLL average max	INT32	x100, V
1416	RO	Ia max	INT32	x1000, A
1418	RO	Ib max	INT32	x1000, A
1420	RO	Ic max	INT32	x1000, A
1422	RO	I average max	INT32	x1000, A
1424	RO	I4 max ¹	INT32	x1000, A
1426	RO	kWa max	INT32	W
1428	RO	kWb max	INT32	W
1430	RO	kWc max	INT32	W
1432	RO	$\sum kW$ max	INT32	W
1434	RO	kvara max	INT32	var
1436	RO	kvarb max	INT32	var
1438	RO	kvarc max	INT32	var
1440	RO	$\sum kvar$ max	INT32	var
1442	RO	kVAa max	INT32	VA
1444	RO	kVAb max	INT32	VA
1446	RO	kVAc max	INT32	VA
1448	RO	$\sum kVA$ max	INT32	VA
1450	RO	P.F.a max	INT32	x1000
1452	RO	P.F.b max	INT32	x1000
1454	RO	P.F.c max	INT32	x1000
1456	RO	$\sum P.F.$ max	INT32	x1000
1458	RO	FREQ max	INT32	x100, Hz
1460	RO	V Unbalance max	INT32	x1000
1462	RO	I Unbalance max	INT32	x1000
1464	RO	Va THD max	INT32	x10000
1466	RO	Vb THD max	INT32	x10000
1468	RO	Vc THD max	INT32	x10000
1470	RO	Ia THD max	INT32	x10000
1472	RO	Ib THD max	INT32	x10000
1474	RO	Ic THD max	INT32	x10000
Register	Property	Description	Format	Scale/Unit
1600	RO	Va min	INT32	x100, V
1602	RO	Vb min	INT32	x100, V
1604	RO	Vc min	INT32	x100, V
1606	RO	VLN average min	INT32	x100, V
1608	RO	Vab min	INT32	x100, V
1610	RO	Vbc min	INT32	x100, V

1612	RO	Vca min	INT32	x100, V
1614	RO	VLL average min	INT32	x100, V
1616	RO	Ia min	INT32	x1000, A
1618	RO	Ib min	INT32	x1000, A
1620	RO	Ic min	INT32	x1000, A
1622	RO	I average min	INT32	x1000, A
1624	RO	I4 min ¹	INT32	x1000, A
1626	RO	kW _a min	INT32	W
1628	RO	kW _b min	INT32	W
1630	RO	kW _c min	INT32	W
1632	RO	∑kW min	INT32	W
1634	RO	kvar _a min	INT32	var
1636	RO	kvar _b min	INT32	var
1638	RO	kvar _c min	INT32	var
1640	RO	∑kvar min	INT32	var
1642	RO	kVA _a min	INT32	VA
1644	RO	kVA _b min	INT32	VA
1646	RO	kVA _c min	INT32	VA
1648	RO	∑kVA min	INT32	VA
1650	RO	P.F.a min	INT32	x1000
1652	RO	P.F.b min	INT32	x1000
1654	RO	P.F.c min	INT32	x1000
1656	RO	∑P.F. min	INT32	x1000
1658	RO	FREQ min	INT32	x100, Hz
1660	RO	V Unbalance min	INT32	x1000
1662	RO	I Unbalance min	INT32	x1000
1664	RO	V _a THD min	INT32	x10000
1666	RO	V _b THD min	INT32	x10000
1668	RO	V _c THD min	INT32	x10000
1670	RO	I _a THD min	INT32	x10000
1672	RO	I _b THD min	INT32	x10000
1674	RO	I _c THD min	INT32	x10000

Table 5-7 Max/Min Value per Demand Period

Note:

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

5.1.7 Peak Demand Log

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

Register	Property	Description	Format	Scale/Unit
1800-1805	RO	∑kW Peak Demand of This Month	See Section 5.11.1 Peak Demand Data Structure	W
1806-1811	RO	∑kvar Peak Demand of This Month		var
1812-1817	RO	∑kVA Peak Demand of This Month		VA
1818-1823	RO	I _a Peak Demand of This Month		x1000, A

1824-1829	RO	Ib Peak Demand of This Month		x1000, A
1830-1835	RO	Ic Peak Demand of This Month		x1000, A
Register	Property	Description	Format	Scale/Unit
1850-1855	RO	Σ kW Peak Demand of Last Month	See Section 5.11.1 Peak Demand Data Structure	W
1856-1861	RO	Σ kvar Peak Demand of Last Month		var
1862-1867	RO	Σ kVA Peak Demand of Last Month		VA
1868-1873	RO	Ia Peak Demand of Last Month		x1000, A
1874-1879	RO	Ib Peak Demand of Last Month		x1000, A
1880-1885	RO	Ic Peak Demand of Last Month		x1000, A

Table 5-8 Peak Demand

5.1.8 Max/Min Log

5.1.8.1 Max Log of This Month

Register	Property	Description	Format	Scale/Unit
2000-2005	RO	Va max	See Section 5.11.2 Max/Min Data Structure	x100, V
2006-2011	RO	Vb max		x100, V
2012-2017	RO	Vc max		x100, V
2018-2023	RO	VLN average max		x100, V
2024-2029	RO	Vab max		x100, V
2030-2035	RO	Vbc max		x100, V
2036-2041	RO	Vca max		x100, V
2042-2047	RO	VLL average max		x100, V
2048-2053	RO	Ia max		x1000, A
2054-2059	RO	Ib max		x1000, A
2060-2065	RO	Ic max		x1000, A
2066-2071	RO	I average max		x1000, A
2072-2077	RO	I4 max ¹		x1000, A
2078-2083	RO	Σ kW max		W
2084-2089	RO	Σ kvar max		var
2090-2095	RO	Σ kVA max		VA
2096-2101	RO	Σ P.F. max		x1000
2102-2107	RO	FREQ max		x100, Hz
2108-2113	RO	Va THD max		x10000
2114-2119	RO	Vb THD max		x10000
2120-2125	RO	Vc THD max		x10000
2126-2131	RO	Ia THD max		x10000
2132-2137	RO	Ib THD max		x10000
2138-2143	RO	Ic THD max		x10000
2144-2149	RO	Ia K-Factor max		x10
2150-2155	RO	Ib K-Factor max		x10
2156-2161	RO	Ic K-Factor max		x10
2162-2167	RO	V Unbalance max		x1000
2168-2173	RO	I Unbalance max		x1000

Table 5-9 Max Log of This Month

Note:

- 1) Registers 2072-2077 are valid only if the device is equipped with the I4 Current Input. Otherwise, they are reserved.

5.1.8.2 Min Log of This Month

Register	Property	Description	Format	Scale/Unit
2300-2305	RO	Va min	See Section 5.11.2 Max/Min Data Structure	x100, V
2306-2311	RO	Vb min		x100, V
2312-2317	RO	Vc min		x100, V
2318-2323	RO	VLN average min		x100, V
2324-2329	RO	Vab min		x100, V
2330-2335	RO	Vbc min		x100, V
2336-2341	RO	Vca min		x100, V
2342-2347	RO	VLL average min		x100, V
2348-2353	RO	Ia min		x1000, A
2354-2359	RO	Ib min		x1000, A
2360-2365	RO	Ic min		x1000, A
2366-2371	RO	I average min		x1000, A
2372-2377	RO	I4 min ¹		x1000, A
2378-2383	RO	∑kW min		W
2384-2389	RO	∑kvar min		var
2390-2395	RO	∑kVA min		VA
2396-2401	RO	∑P.F. min		x1000
2402-2407	RO	FREQ min		x100, Hz
2408-2413	RO	Va THD min		x10000
2414-2419	RO	Vb THD min		x10000
2420-2425	RO	Vc THD min		x10000
2426-2431	RO	Ia THD min		x10000
2432-2437	RO	Ib THD min		x10000
2438-2443	RO	Ic THD min		x10000
2444-2449	RO	Ia K-Factor min		x10
2450-2455	RO	Ib K-Factor min		x10
2456-2461	RO	Ic K-Factor min		x10
2462-2467	RO	V Unbalance min		x1000
2468-2473	RO	I Unbalance min		x1000

Table 5-10 Min Log of This Month

Note:

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

5.1.8.3 Max Log of Last Month

Register	Property	Description	Format	Scale/Unit
2600-2605	RO	Va max	See Section 5.11.2 Max/Min Data Structure	x100, V
2606-2611	RO	Vb max		x100, V
2612-2617	RO	Vc max		x100, V
2618-2623	RO	VLN average max		x100, V
2624-2629	RO	Vab max		x100, V
2630-2635	RO	Vbc max		x100, V
2636-2641	RO	Vca max		x100, V
2642-2647	RO	VLL average max		x100, V
2648-2653	RO	Ia max		x1000, A
2654-2659	RO	Ib max		x1000, A
2660-2665	RO	Ic max		x1000, A
2666-2671	RO	I average max		x1000, A
2672-2677	RO	I4 max ¹		x1000, A
2678-2683	RO	Σ kW max		W
2684-2689	RO	Σ kvar max		var
2690-2695	RO	Σ kVA max		VA
2696-2701	RO	Σ P.F. max		x1000
2702-2707	RO	FREQ max		x100, Hz
2708-2713	RO	Va THD max		x10000
2714-2719	RO	Vb THD max		x10000
2720-2725	RO	Vc THD max		x10000
2726-2731	RO	Ia THD max		x10000
2732-2737	RO	Ib THD max		x10000
2738-2743	RO	Ic THD max		x10000
2744-2749	RO	Ia K-Factor max		x10
2750-2755	RO	Ib K-Factor max		x10
2756-2761	RO	Ic K-Factor max		x10
2762-2767	RO	V Unbalance min		x1000
2768-2773	RO	I Unbalance min	x1000	

Table 5-11 Max Log of Last Month

Note:

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

5.1.8.4 Min Log of Last Month

Register	Property	Description	Format	Scale/Unit
2900-2905	RO	Va min	See Section 5.11.2 Max/Min Data Structure	x100, V
2906-2911	RO	Vb min		x100, V
2912-2917	RO	Vc min		x100, V
2918-2923	RO	VLN average min		x100, V

2924-2929	RO	Vab min	x100, V
2930-2935	RO	Vbc min	x100, V
2936-2941	RO	Vca min	x100, V
2942-2947	RO	VLL average min	x100, V
2948-2953	RO	Ia min	x1000, A
2954-2959	RO	Ib min	x1000, A
2960-2965	RO	Ic min	x1000, A
2966-2971	RO	I average min	x1000, A
2972-2977	RO	I4 min ¹	x1000, A
2978-2983	RO	ΣkW min	W
2984-2989	RO	Σkvar min	var
2990-2995	RO	ΣkVA min	VA
2996-3001	RO	ΣP.F. min	x1000
3002-3007	RO	FREQ min	x100, Hz
3008-3013	RO	Va THD min	x10000
3014-3019	RO	Vb THD min	x10000
3020-3025	RO	Vc THD min	x10000
3026-3031	RO	Ia THD min	x10000
3032-3037	RO	Ib THD min	x10000
3038-3043	RO	Ic THD min	x10000
3044-3049	RO	Ia K-Factor min	x10
3050-3055	RO	Ib K-Factor min	x10
3056-3061	RO	Ic K-Factor min	x10
3062-3067	RO	V Unbalance min	x1000
3068-3073	RO	I Unbalance min	x1000

Table 5-12 Min Log of Last Month

Note:

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

5.2 Setup Register

5.2.1 Basic Setup Parameters

Register	Property	Description	Format	Range/Options
6000	RW	PT Ratio ¹	UINT16	1* to 10000
6001	RW	CT Ratio ¹	UINT16	1* to 6000 (5A input) 1* to 30000 (1A input)
6002	RW	I4 Ratio	UINT16	1* to 10000
6003	RW	Wiring Mode	UINT16	0=WYE* 1=DELTA 2=DEMO
6004	RW	VLL Nominal Secondary (VLL _{nominal})	UINT16	100V* to 700V (VLL)

6005	RW	Nominal Frequency (f_{nominal})	UINT16	0=50Hz* 1=60Hz
6006	RW	Port 1 Protocol	UINT16	0=Modbus* 1= EGATE
6007	RW	Port 1 Unit ID	UINT16	1 to 247 (Default = 100)
6008	RW	Port 1 Baud rate	UINT16	0=1200 1=2400 2=4800 3=9600* 4=19200 5=38400
6009	RW	Port 1 Configuration	UINT16	0=8N2 1=8O1 2=8E1* 3=8N1 4=8O2 5=8E2
6010	RW	IP Address	UINT32	E.g. if the IP Address is "192.168.0.100", write "0xC0A80064" to this register (Default=192.168.0.100)
6012	RW	Subnet Mask	UINT32	E.g. if the Subnet Mask is "255.255.255.0", write "0xFFFFFFFF" to this register (Default=255.255.255.0)
6014	RW	Gateway Address	UINT32	E.g. if the Gateway Address is "192.168.0.1", write "0XC0A80001" to this register (Default=192.168.0.1)
6016	RW	Power Factor Convention	UINT16	0=IEC* 1=IEEE 2=-IEEE
6017	RW	kVA Calculation	UINT16	0=Vector* 1=Scalar
6018	RW	Demand Period	UINT16	1 to 60 (minutes) (Default = 15)
6019	RW	Number of Sliding Windows	UINT16	1* to 15
6020	RW	DI1 Function	UINT16	0=Digital Input* 1=Pulse Counter
6021	RW	DI2 Function	UINT16	
6022	RW	DI3 Function	UINT16	
6023	RW	DI4 Function	UINT16	
6024	RW	DI5 Function	UINT16	

6025	RW	DI6 Function	UINT16	
6026	RW	DI1 Debounce	UINT16	1 to 1000 (ms) (Default=20ms)
6027	RW	DI2 Debounce	UINT16	
6028	RW	DI3 Debounce	UINT16	
6029	RW	DI4 Debounce	UINT16	
6030	RW	DI5 Debounce	UINT16	
6031	RW	DI6 Debounce	UINT16	
6032	RW	DI1 Pulse Weight	UINT16	1* to 1000000 (x0.001)
6034	RW	DI2 Pulse Weight	UINT16	
6036	RW	DI3 Pulse Weight	UINT16	
6038	RW	DI4 Pulse Weight	UINT16	
6040	RW	DI5 Pulse Weight	UINT16	
6042	RW	DI6 Pulse Weight	UINT16	
6044	RW	RO1 Function	UINT16	0=Relay Output* Others Reserved
6045	RW	RO2 Function	UINT16	
6046	RW	RO3 Function	UINT16	
6047-6050		Reserved		
6052	RW	Ia Polarity	UINT16	0=Normal* 1=Reverse
6053	RW	Ib Polarity	UINT16	
6054	RW	Ic Polarity	UINT16	
6055	RW	Harmonic Calculation	UINT16	0=Fundamental 1=RMS*
6056	RW	Enable Energy Pulse	UINT16	0=Disabled* 1=Enabled
6057	RW	Pulse Constant	UINT16	0=1000 imp/kxh* 1=3200 imp/kxh 2=5000 imp/kxh 3=6400 imp/kxh 4=12800 imp/kxh
6058	RW	Peak Demand Log & Max/Min Log Self-Read Time ²	UINT16	0*
6059	RW	Transient Enable	UINT16	0=Disabled* 1=Enabled
6060	RW	Transient Limit ³	UINT16	5-500 (x0.01 VLL _{nominal}) (Default=50)
6061	RW	Backlight Time-out ⁴	UINT16	0 to 60 (minutes) (Default=3)

* Default

Table 5-13 Basic Setup Parameters

Notes:

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

- 2) Self-Read Time is applied to Peak Demand Log and Max/Min Log.
There are two types of Self-Read Time. The value 0 indicates that the transfer will happen at 00:00 of the first day of every month. A non-zero value indicates that the transfer will happen at a specific time based on the formula $[Hour+Day*100]$ where $0 \leq Hour \leq 23$ and $1 \leq Day \leq 28$. For example, the value 1512 means that the Peak Demand of Current Month will be transferred to the Peak Demand of Last Month register at 12:00pm on the 15th day of each month.
- 3) The Transient Capture function triggers WFR1 by default. It is highly recommended that WFR2 be used for other Waveform Recording functions.
- 4) The Backlight Time-out can be set from 0 to 60 minutes. A zero (0) value indicates that the backlight time-out is disabled.

5.2.2 Clear/Reset Register

Register	Property	Description	Format	Note
6400	WO	Manual WFR Log #1 Trigger	UINT16	Writing "0xFF00" triggers the respective Waveform Recorder
6401	WO	Manual WFR Log #2 Trigger	UINT16	
6402	WO	Clear DR #1 (Standard)	UINT16	Writing "0xFF00" to the register clears the respective DR Log
6403	WO	Clear DR #2 (Standard)	UINT16	
6404	WO	Clear DR #3 (Standard)	UINT16	
6405	WO	Clear DR #4 (Standard)	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	Writing "0xFF00" to the register clears the respective WFR Log
6419	WO	Clear WFR Log #2	UINT16	
6420	WO	Clear Energy Log	UINT16	Writing "0xFF00" to the register clears the Energy Log
6421		Reserved		
6422	WO	Clear SOE Log	UINT16	Writing "0xFF00" to the register clears the SOE Log
6423	WO	Clear Energy	UINT16	Writing "0xFF00" to the register clears all energy registers
6424	WO	Clear Max/Min Log of This Month	UINT16	Writing "0xFF00" to the register clears the Max/Min Log of This Month
6425	WO	Clear Peak Demand Log of This Month	UINT16	Writing "0xFF00" to the register clears the Peak

				Demand Log of This Month
6426	WO	Clear Counter #1 (DI1)	UINT16	Writing "0xFF00" to the register clears the respective DI Counter register
6427	WO	Clear Counter #2 (DI2)	UINT16	
.....	WO	.....	UINT16	
6430	WO	Clear Counter #5 (DI5)	UINT16	
6431	WO	Clear Counter #6 (DI6)	UINT16	
6432-6436		Reserved	UINT16	
6437	WO	Clear all Logs ¹	UINT16	Writing "0xFF00" to the register clears all of the above

Table 5-14 SOE Log

Notes:

- 1) Writing "0xFF00" to the register clears all logs, including Data Recorder, Waveform Recorder, Energy Log, SOE Log, Max/Min Log of This Month, Peak Demand of This Month, DI Counters and Energy registers.

5.3 Setpoint Setup Parameters

5.3.1 Setpoint Setup Registers

Register	Property	Description	Format
6600-6609	RW	Setpoint #1 (Standard)	See Section 5.3.2 Setpoint Setup Register Structure
6610-6619	RW	Setpoint #2 (Standard)	
6620-6629	RW	Setpoint #3 (Standard)	
6630-6639	RW	Setpoint #4 (Standard)	
6640-6649	RW	Setpoint #5 (Standard)	
6650-6659	RW	Setpoint #6 (Standard)	
6660-6669	RW	Setpoint #7 (Standard)	
6670-6679	RW	Setpoint #8 (Standard)	
6680-6689	RW	Setpoint #9 (Standard)	

Table 5-15 Setpoints

5.3.2 Setpoint Setup Data Structure

Offset	Property	Description	Format	Range/Options
+0	RW	Standard Setpoint	Type	UINT16 0=Disabled* 1=Over Setpoint 2=Under Setpoint
+1	RW		Parameter ¹	UINT16 1* to 26
+2	RW		Active Limit	INT32 Default=5000
+4	RW		Inactive Limit	INT32 Default=1000
+6	RW		Active Delay	UINT16 0* to 9999 (second) (Default=1)
+7	RW		Inactive Delay	UINT16 0* to 9999 (second) (Default=1)

+8	RW		Trigger 1 ²	UINT16	0 to 21 (Default=1)
+9	RW		Trigger 2 ²	UINT16	0 to 21 (Default=2)

* Default

Table 5-16 Setpoint Setup Register Structure

Notes:

- 1) “**Parameter**” specifies the parameter to be monitored. Table 5-17 below provides a list of Setpoint Parameters.

Key	Parameter	Scale/Unit
1	VLN	x100, V
2	VLL	x100, V
3	I	x1000, A
4	I4	x1000, A
5	Freq	x100, Hz
6	ΣkW	kW
7	Σkvar	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	Reserved	/
16	ΣkW Demand	kW
17	Σkvar Demand	kvar
18	P.F. Demand	x1000
19	V THD	x10000
20	V TOHD	x10000
21	V TEHD	x10000
22	I THD	x10000
23	I TOHD	x10000
22	I TEHD	x10000
25	Voltage Unbalance	x1000
26	Current Unbalance	x1000

Table 5-17 Setpoint Parameters

- 2) “**Trigger**” specifies what action the setpoint will take when it becomes active. Table 5-18 below provides a list of Setpoint Triggers.

Key	Action	Key	Action
0	None	11	DR #8
1	RO1	12	DR #9
2	RO2	13	DR #10

3	RO3	14	DR #11
4	DR #1	15	DR #12
5	DR #2	16	DR #13
6	DR #3	17	DR #14
7	DR #4	18	DR #15
8	DR #5	19	DR #16
8	DR #6	20	WR #1
10	DR #7	21	WR #2

Table 5-18 Setpoint Triggers

5.4 Data Recorder Log Setup Parameters

5.4.1 Data Recorder Log Setup Registers

Register	Property	Description	Format
7000-7022	RW	Data Recorder #1(Standard)	See Section 5.4.2 Standard Data Recorder Setup Data Structure
7023-7045	RW	Data Recorder #2 (Standard)	
7046-7068	RW	Data Recorder #3 (Standard)	
7069-7091	RW	Data Recorder #4 (Standard)	
7092-7114	RW	Data Recorder #5 (Standard)	
7115-7137	RW	Data Recorder #6 (Standard)	
7138-7160	RW	Data Recorder #7 (Standard)	
7161-7183	RW	Data Recorder #8 (Standard)	
7184-7206	RW	Data Recorder #9 (Standard)	
7207-7229	RW	Data Recorder #10 (Standard)	
7230-7252	RW	Data Recorder #11 (Standard)	
7253-7275	RW	Data Recorder #12 (Standard)	
7276-7298	RW	Data Recorder #13 (Standard)	
7299-7321	RW	Data Recorder #14 (Standard)	
7322-7344	RW	Data Recorder #15 (Standard)	
7345-7367	RW	Data Recorder #16 (Standard)	
7368	RO	DR #1 Record Size (Bytes)	UINT16
7369	RO	DR #2 Record Size (Bytes)	UINT16
7370	RO	DR #3 Record Size (Bytes)	UINT16
7371	RO	DR #4 Record Size (Bytes)	UINT16
7372	RO	DR #5 Record Size (Bytes)	UINT16
7373	RO	DR #6 Record Size (Bytes)	UINT16
7374	RO	DR #7 Record Size (Bytes)	UINT16
7375	RO	DR #8 Record Size (Bytes)	UINT16
7376	RO	DR #9 Record Size (Bytes)	UINT16
7377	RO	DR #10 Record Size (Bytes)	UINT16
7378	RO	DR #11 Record Size (Bytes)	UINT16
7379	RO	DR #12 Record Size (Bytes)	UINT16
7380	RO	DR #13 Record Size (Bytes)	UINT16
7381	RO	DR #14 Record Size (Bytes)	UINT16

7382	RO	DR #15 Record Size (Bytes)	UINT16
7383	RO	DR #16 Record Size (Bytes)	UINT16

Table 5-19 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.

5.4.2 Standard Data Recorder Setup Data Structure

Offset	Property	Description	Format	Range/Options
+0	RW	Triggered Mode ¹	UINT16	0=Disabled* 1=Triggered by Timer 2=Triggered by Setpoint
+1	RW	Recording Mode	UINT16	0=Stop-When-Full* 1=First-In-First-Out
+2	RW	Recording Depth ²	UINT16	0 to 65535 (Default=5760)
+3	RW	Recording Interval	UINT32	1 to 3456000 (seconds) (Default=900)
+5	RW	Recording Offset ³	UINT16	0* to 43200 (seconds)
+6	RW	Number of Parameters ⁴	UINT16	0* to 16
+7	RW	Parameter 1	UINT16	0* to 322
+8	RW	Parameter 2	UINT16	0* to 322
+9	RW	Parameter 3	UINT16	0* to 322
+10	RW	Parameter 4	UINT16	0* to 322
+11	RW	Parameter 5	UINT16	0* to 322
+12	RW	Parameter 6	UINT16	0* to 322
+13	RW	Parameter 7	UINT16	0* to 322
+14	RW	Parameter 8	UINT16	0* to 322
+15	RW	Parameter 9	UINT16	0* to 322
+16	RW	Parameter 10	UINT16	0* to 322
+17	RW	Parameter 11	UINT16	0* to 322
+18	RW	Parameter 12	UINT16	0* to 322
+19	RW	Parameter 13	UINT16	0* to 322
+20	RW	Parameter 14	UINT16	0* to 322
+21	RW	Parameter 15	UINT16	0* to 322
+22	RW	Parameter 16	UINT16	0* to 322

* Default

Table 5-20 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.

5.5 Energy Log

Register	Property	Description		Format	Note
7700	RW	Recording Mode		UINT16	0*=Disabled 1=Stop-When-Full 2= First-In-First-Out
7701	RW	Recording Depth ¹		UINT16	0 to 65535 (Default=5760)
7702	RW	Recording Interval		UINT16	0=5mins 1=10mins 2=15mins* 3=30mins 4=60mins
7703	RW	Start Time ²	High-order Byte: Year	UINT16	0-99 (Year-2000)
			Low-order Byte: Month			1 to 12
7704	RW		High-order Byte: Day	UINT16	1 to 31
			Low-order Byte: Hour		0 to 23
7705	RW		High-order Byte: Minute	UINT16	0 to 59
			Low-order Byte: Second		0 to 59
7706	RW	Number of Parameters		UINT16	0 to 5*
7707	RW	Parameter 1		UINT16	0=kWh Import* 1=kWh Export 2=kvarh Import 3=kvarh Export 4=kVAh
7708	RW	Parameter 2		UINT16	0=kWh Import 1=kWh Export*

				2=kvarh Import 3=kvarh Export 4=kVAh
7709	RW	Parameter 3	UINT16	0=kWh Import 1=kWh Export 2=kvarh Import* 3=kvarh Export 4=kVAh
7710	RW	Parameter 4	UINT16	0=kWh Import 1=kWh Export 2=kvarh Import 3=kvarh Export* 4=kVAh
7711	RW	Parameter 5	UINT16	0=kWh Import 1=kWh Export 2=kvarh Import 3=kvarh Export 4=kVAh*
7712	RO	Record Size ³	UINT16	Unit: Bytes

* Default

Table 5-21 Energy Log

Notes:

- 1) If **Recording Depth** is set to **0**, the Energy Log is disabled.
- 2) When the current time meets or exceeds the **Start Time**, the Interval Energy Log starts to record.
- 3) **Record Size** (Bytes) = **Number of Parameters** x 4 + 8.

Energy Log Size = **Recording Depth** x **Record Size**. The Log Size is rounded up to the nearest kB.
- 4) Modifying **Recording Depth**, **Recording Interval**, **Start Time**, **Number of Parameters** and **Parameter 1 to 5** will clear the Energy Log and reset the **Energy Log Pointer** to 0.

5.6 Waveform Recorder Log Setup Parameters

The PMC-630E provides 2 independent groups of waveform recorders (**WFR**) with a combined total of 6 entries. Each Waveform Recorder Log can simultaneously capture 3-phase voltage and current signals at a maximum resolution of 128 samples per cycles.

Register	Property	Description		Format
7600	RW	WFR Log 1	Recording Depth ¹	0* to 6
7601	RW		# of Samples ²	0= 16 1=32 2=64 3*=128

7602	RW	WFR Log 2	Number of Cycles ²	40/20/10/5 (Default=5)
7603	RW		Pre-fault Cycles ³	0* to 5
7604	RW		Recording Depth ¹	0* to 6
7605	RW		# of Samples ²	0= 16 1=32 2=64 3*=128
7606	RW		Number of Cycles ²	40/20/10/5 (Default=5)
7607	RW		Pre-fault Cycles ³	0* to 5

Table 5-22 Waveform Recorder Log

Notes:

- 1) The total capacity of **WFR 1** and **WFR 2** is 6, i.e. **WFR Log 1 Recording Depth + WFR Log 2 Recording Depth <= 6**
- 2) The valid WFR formats (# of samples/cycle x # of cycles) include 16x40, 32x20, 64x10, and 128x5.
- 3) **WFR Log Size = (Number of Samples x Number of Cycles x 2 + 10) x Recording Depth.** The Log Size is rounded up to the nearest kB.
- 4) Modifying the Setup Parameters of WFRx will clear the WFRx Log and reset WFRx Pointer will be reset to "0".

5.7 SOE Log

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

$$\text{Register Address} = 10000 + \text{Modulo}((\text{SOE Pointer}-1) / 64) \times 8$$

Register	Property	Description	Format
10000 – 10007	RO	Event 1	See Section 5.11.6 SOE Log Data Structure
10008 – 10015	RO	Event 2	
10016 – 10023	RO	Event 3	
10024 – 10031	RO	Event 4	
10032 – 10039	RO	Event 5	
10040 -10047	RO	Event 6	
10048 – 10055	RO	Event 7	
10056 – 10063	RO	Event 8	
10064 – 10071	RO	Event 9	
10072 – 10079	RO	Event 10	
10080 – 10087	RO	Event 11	
10088 - 10195	RO	Event 12	

.....			
14088 -4095	RO	Event 64	

Table 5-23 SOE Log

5.8 Time

There are two sets of Time registers supported by the PMC-630E - Year/Month/Day/Hour/Minute/Second (Register # 9000 to 9002) and UNIX Time (Register # 9004). When sending time to the PMC-630E over Modbus communications, care should be taken to only write one of the two Time register sets. All registers within a Time register set must be written in a single transaction. If registers 9000 to 9004 are being written to at the same time, both Time register sets will be updated to reflect the new time specified in the UNIX Time register set (9004) and the time specified in registers 9000-9002 will be ignored. Writing to the Millisecond register (9003) is optional during a Time Set operation. When broadcasting time, the function code must be set to 0x10 (Pre-set Multiple Registers). Incorrect date or time values will be rejected by the meter.

Register	Property	Description	Format	Note
9000	RW	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
9001	RW	High-order Byte: Day	UINT16	1 to 31
		Low-order Byte: Hour		0 to 23
9002	RW	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
9003	RW	Millisecond	UINT16	0 to 999
9004	RW	UNIX Time	UINT32	(946684800 to 4102444800) This time shows the number of seconds from 00:00:00 January 1, 2000 to 23:59:59 December 31, 2099

Table 5-24 Time Registers

5.9 RO Control

The RO Control registers are implemented as “Write-Only” Modbus Coil Registers (0XXXXX) and can be controlled with the Force Single Coil command (Function Code 0x05). The PMC-630E does not support the Read Coils command (Function Code 0x01) because RO Control registers are “Write-Only”. Register 0086 (RO Status) should be read instead to determine the current RO status.

The PMC-630E adopts the ARM before EXECUTE operation for the remote control of its Digital Outputs. Before executing an OPEN or CLOSE command on a Digital Output, it must be “Armed” first. This is achieved by writing the value 0xFF00 to the appropriate register to “Arm” a particular RO operation. The RO 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 RO1 Close	UINT16	Writing "0xFF00"
9101	WO	Execute RO1 Close	UINT16	Writing "0xFF00"
9102	WO	Arm RO1 Open	UINT16	Writing "0xFF00"
9103	WO	Execute RO1 Open	UINT16	Writing "0xFF00"
9104	WO	Arm RO2 Close	UINT16	Writing "0xFF00"
9105	WO	Execute RO2 Close	UINT16	Writing "0xFF00"
9106	WO	Arm RO2 Open	UINT16	Writing "0xFF00"
9107	WO	Execute RO2 Open	UINT16	Writing "0xFF00"
9108	WO	Arm RO3 Close	UINT16	Writing "0xFF00"
9109	WO	Execute RO3 Close	UINT16	Writing "0xFF00"
9110	WO	Arm RO3 Open	UINT16	Writing "0xFF00"
9111	WO	Execute RO3 Open	UINT16	Writing "0xFF00"

Table 5-25 RO Control

5.10 Meter Information

Register	Property	Description	Format	Note
9800 - 9819	RO	Meter Model ¹	UINT16	
9820	RO	Firmware Version	UINT16	e.g. 10000 shows the version is V1.00.00
9821	RO	Protocol Version	UINT16	e.g. 10 shows the version is V1.0
9822	RO	Firmware Update Date: Year-2000	UINT16	e.g.100110means January 10,2010
9823	RO	Firmware Update Date: Month	UINT16	
9824	RO	Firmware Update Date: Day	UINT16	
9825-9826	RO	Serial Number: XX(Year-2000) - XX(Month) - XX(Lot Number) - XXXX(Meter Number)	UINT32	e.g. 1001030100 means that this meter was the 100 th meter manufactured in Lot 3 of January, 2010
9827-9828		Reserved	UINT16	
9829	RO	Feature Code	UINT16	B3B2B1B0: 0000: 1xRS485+1xEthernet+6DI+3RO Other: Reserved
				B5B4: 00: 5A I4 CT 01: 1A I4 CT 10: Reserved 11: Reserved

				Other bits are reserved.
9830	RO	Current configuration	UINT16	0=1 (A) 1=5 (A)
9831	RO	Voltage configuration	UINT16	0=120 (V) 1=415 (V) 2=690 (V)

Table 5-26 Meter Information

Note:

- 1) The Meter Model appears in registers 9800 to 9819 and contains the ASCII encoding of the string “PMC-630E” as shown in the following table.

Register	Value(Hex)	ANSII
9800	0x50	P
9801	0x4D	M
9802	0x43	C
9803	0x2D	-
9804	0x36	6
9805	0x63	3
9806	0x33	0
9807	0x45	E
9808-9819	0x20	<Space>

Table 5-27 ASCII Encoding of “PMC-630E”

5.11 Data Format

5.11.1 Peak Demand Data Structure

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

Table5-28 DMD-LOG Data Structure

5.11.2 Max/Min Data Structure

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

+4	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+5	RO	Millisecond	UINT16	0 to 999

Table 5-29 Max-Min-LOG Data Structure

5.11.3 Data Recorder Data Structure

Offset	Property	Description	Format	Note
+0	RO	Parameter 1	INT32	/
+2	RO	Parameter 2	INT32	/
.....	RO	.....	INT32	/
+2N	RO	Parameter N (N=1 to 16)	INT32	/
+2N+1	RO	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
+2N+2	RO	High-order Byte: Day	UINT16	1 to 31
		Low-order Byte: Hour		0 to 23
+2N+3	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+2N+4	RO	Millisecond	UINT16	0 to 999

Table 5-30 DR-LOG Data Structure

5.11.4 Energy Log Data Structure

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

Table 5-31 Energy Log Data Structure

5.11.5 Waveform Recorder Setup Data Structure

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

Primary Voltage Value = Voltage Data × PT Ratio ÷ 10

Primary Current Value = Current Data × CT Ratio ÷ 1000

Offset	Property	Description	Format	Note
+0	RO	Trigger Mode	UINT16	0=Disabled*

				1=Manual 2=Setpoint 3=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	Va sample value (1 to N [#])	UINT16	x10, V
+N+5 to 2N+4	RO	Vb sample value (1 to N [#])	UINT16	x10, V
+2N+5 to 3N+4	RO	Vc sample value (1 to N [#])	UINT16	x10, V
3N+5 to 4N+4	RO	Ia sample value (1 to N [#])	UINT16	x1000, A
+4N+5 to 5N+4	RO	Ib sample value (1 to N [#])	UINT16	x1000, A
+5N+5 to 6N+4	RO	Ic sample value (1 to N [#])	UINT16	x1000, A

[#]N=# of Samples

Table 5-32 WFR Data Structure

5.11.6 SOE Log Data Structure

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

Table 5-33 SOE Log Data Structure

Revision History

Revision	Date	Description
1.0A	20130703	First Edition

Appendix A - Data Recorder Parameter

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

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

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

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

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

* Parameters # 318 to 322 are accumulative energy values.

Appendix B - Event Classification

Event Classification	Sub-Classification	Event Value Scale/Option	Description
1	1	1/0	DI1 Close/DI1 Open
	2	1/0	DI2 Close/DI2 Open
	3	1/0	DI3 Close/DI3 Open
	4	1/0	DI4 Close/DI4 Open
	5	1/0	DI5 Close/DI5 Open
	6	1/0	DI6 Close/DI6 Open
2	1	1/0	RO1 Operated/Released by Remote Control
	2	1/0	RO2 Operated/Released by Remote Control
	3	1/0	RO3 Operated/Released by Remote Control
	4	1/0	RO1 Operated/Released by Setpoint
	5	1/0	RO2 Operated/Released by Setpoint
	6	1/0	RO3 Operated/Released by Setpoint
3	1	Trigger Value (x100)	Over VLN Setpoint Active
	2	Trigger Value (x100)	Over VLL Setpoint Active
	3	Trigger Value (x1000)	Over Current Setpoint Active
	4	Trigger Value (x1000)	Over I4 Setpoint Active
	5	Trigger Value (x100)	Over Freq. Setpoint Active
	6	Trigger Value	Over Σ kW Setpoint Active
	7	Trigger Value	Over Σ kvar Setpoint Active
	8	Trigger Value (x1000)	Over Σ P.F. Setpoint Active
	9	1	DI1 Close Setpoint Active
	10	1	DI2 Close Setpoint Active
	11	1	DI3 Close Setpoint Active
	12	1	DI4 Close Setpoint Active
	13	1	DI5 Close Setpoint Active
	14	1	DI6 Close Setpoint Active
	15	Reserved	
	16	Trigger Value	Over Σ kW Demand Setpoint Active
	17	Trigger Value	Over Σ kvar Demand Setpoint Active
	18	Trigger Value (x1000)	Over Σ P.F. Demand Setpoint Active
	19	Trigger Value (x100)	Over Voltage THD Setpoint Active
	20	Trigger Value	Over Voltage TOHD Setpoint Active

		(x100)	
21	Trigger Value (x100)		Over Voltage TEHD Setpoint Active
22	Trigger Value (x100)		Over Current THD Setpoint Active
23	Trigger Value (x100)		Over Current TOHD Setpoint Active
24	Trigger Value (x100)		Over Current TEHD Setpoint Active
25	Trigger Value (x10)		Over Voltage Unbalance Setpoint Active
26	Trigger Value (x10)		Over Current Unbalance Setpoint Active
46	Return Value (x100)		Over VLN Setpoint Return
47	Return Value (x100)		Over VLL Setpoint Return
48	Return Value (x1000)		Over Current Setpoint Return
49	Return Value (x1000)		Over I4 Setpoint Return
50	Return Value (x100)		Over Freq. Setpoint Return
51	Return Value		Over $\sum kW$ Setpoint Return
52	Return Value		Over $\sum kvar$ Setpoint Return
53	Return Value (x1000)		Over $\sum P.F.$ Setpoint Return
54	0		DI1 Close Setpoint Return
55	0		DI2 Close Setpoint Return
56	0		DI3 Close Setpoint Return
57	0		DI4 Close Setpoint Return
58	0		DI5 Close Setpoint Return
59	0		DI6 Close Setpoint Return
60	Reserved		
61	Return Value		Over $\sum kW$ Demand Setpoint Return
62	Return Value		Over $\sum kvar$ Demand Setpoint Return
63	Return Value (x1000)		Over $\sum P.F.$ Demand Setpoint Return
64	Reserved		
65	Reserved		
66	Reserved		
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	Reserved	
73	Reserved	
74	Reserved	
75	Reserved	
76	Reserved	
91	Trigger Value (x100)	Under VLN Setpoint Active
92	Trigger Value (x100)	Under VLL Setpoint Active
93	Trigger Value (x1000)	Under Current Setpoint Active
94	Trigger Value (x1000)	Under I4 Setpoint Active
95	Trigger Value (x100)	Under Freq. Setpoint Active
96	Trigger Value	Under Σ kW Setpoint Active
97	Trigger Value	Under Σ kvar Setpoint Active
98	Trigger Value (x1000)	Under Σ P.F. Setpoint Active
99	0	DI1 Open Setpoint Active
100	0	DI2 Open Setpoint Active
101	0	DI3 Open Setpoint Active
102	0	DI4 Open Setpoint Active
103	0	DI5 Open Setpoint Active
104	0	DI6 Open Setpoint Active
105	Reserved	
106	Trigger Value	Under Σ kW Demand Setpoint Active
107	Trigger Value	Under Σ kvar Demand Setpoint Active
108	Trigger Value (x1000)	Under Σ P.F. Demand Setpoint Active
109	Trigger Value (x100)	Under Voltage THD Setpoint Active
110	Trigger Value (x100)	Under Voltage TOHD Setpoint Active
111	Trigger Value	Under Voltage TEHD Setpoint Active

		(x100)	
112	Trigger Value (x100)		Under Current THD Setpoint Active
113	Trigger Value (x100)		Under Current TOHD Setpoint Active
114	Trigger Value (x100)		Under Current TEHD Setpoint Active
115	Trigger Value (x10)		Under Voltage Unbalance Setpoint Active
116	Trigger Value (x10)		Under Current Unbalance Setpoint Active
117	Reserved		
118	Reserved		
119	Reserved		
120	Reserved		
121	Reserved		
136	Return Value (x100)		Under VLN Setpoint Return
137	Return Value (x100)		Under VLL Setpoint Return
138	Return Value (x1000)		Under Current Setpoint Return
139	Return Value (x1000)		Under I4 Setpoint Return
140	Reserved		
141	Return Value		Under Σ kW Setpoint Return
142	Return Value		Under Σ kvar Setpoint Return
143	Return Value (x1000)		Under Σ P.F. Setpoint Return
144	1		DI1 Open Setpoint Return
145	1		DI2 Open Setpoint Return
146	1		DI3 Open Setpoint Return
147	1		DI4 Open Setpoint Return
148	1		DI5 Open Setpoint Return
149	1		DI6 Open Setpoint Return
150	Reserved		
151	Return Value		Under Σ kW Demand Setpoint Return
152	Return Value		Under Σ kvar Demand Setpoint Return
153	Return Value (x1000)		Under Σ P.F. Demand Setpoint Return
154	Reserved		
155	Reserved		
156	Reserved		

	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	Reserved	
	166	0	Under Phase Reversal Setpoint Return
4	1	0	Battery Voltage Low
	2	0	Power Supply of CPU Fault
	3	0	A/D Fault
	4	0	NVRAM Fault
	5	0	System Parameter Fault
	6	0	Calibration Parameter Fault
	7	0	Setpoint Parameter Fault
	8	0	Data Recorder Parameter Fault
	9	0	Waveform Recorder Parameter Fault
	10	0	Energy Log Parameter Fault
5	1	0	Power On
	2	0	Power Off
	3	0	Set Clock via Front Panel
	4	0	Setup Changes via Front Panel
	5	0	Clear DI Counter via Front Panel
	6	0	Clear SOE via Front Panel
	7	0	Reserved
	8	0	Clear Energy via Front Panel
	9	0	Clear Data Recorder Log via Front Panel
	10	0	Clear Waveform Recorder Log via Front Panel
	11	0	Clear Energy Log via Front Panel
	12	0	Clear Max/Min Log of This Month via Front Panel
	13	0	Clear Peak Demand of This Month via Front Panel
	14	0	Setup Changes via Communications
	15	0	Clear DI Counter via Communications

	16	0	Clear SOE via Communications
	17	0	Clear Max/Min Log of Last Month via Communications
	18	0	Clear Energy via Communications
	19	0	Clear Data Recorder Log via Communications
	20	0	Clear Waveform Recorder Log via Communications
	21	0	Clear Energy Log via Communications
	22	0	Clear Max/Min Log of This Month via Communications
	23	0	Clear Peak Demand of This Month via Communications
	24	0	Clear Peak Demand of Last Month via Communications
6	1	0	WF Recorder Triggered by Remote Control
	2	Setpoint # X (X = 1 to 9)	WF Recorder Triggered by Setpoint # X
	3	Setpoint # X (X = 1 to 9)	Data Recorder Triggered by Setpoint # X
	4	0	WF Recorder Triggered by Transient

Appendix C - Technical Specifications

Voltage Inputs (V1, V2, V3, VN)	
Standard (Un)	240VLN/415VLL
Optional (Un)	69VLN/120VLL, 400VLN/690VLL
Range	10% to 120% Un
PT Ratio	1-10000
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/I _{max})	5A / 10A
Optional (In/I _{max})	1A / 2A
Range	0.1% In to 200% In
CT Ratio	1-6,000 (5A), 1-30,000 (1A)
Overload	2xIn continuous, 20xIn for 1s
Burden	<0.25VA @ 5A
Power Supply (L+, N-)	
Standard	95-415VAC/DC ± 10%, 47-440Hz
Burden	< 6W
Digital Inputs (DI1, DI2, DI3, DI4, DI5, DI6, DIC)	
Type	Dry contact, 24VDC internally wetted
Sampling	1000Hz
Debounce	1-1,000ms programmable
Relay Outputs (DO11, DO12, DO21, DO22, DO31, DO32)	
Type	Form A Mechanical Relay
Loading	8A@250VAC / 8A@24VDC, 5A@30VDC for RO1 5A@250VAC / 5A@30VDC for RO2 and RO3
Front Panel Pulse Outputs (kWh, kvarh)	
Type	LED
Isolation	Optical
Pulse Constant	1000/3200/5000/6400/12800 imp/kxh
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	92x92mm (3.62"x3.62")
Unit Dimensions	96x96x125mm (3.78"x3.78"x4.92")
Shipping Dimensions	170x145x155mm (6.69"x5.71"x6.10")
Shipping Weight	1.0kg
IP Rating	52

Accuracy


Parameters	Accuracy	Resolution
Voltage	±0.2% reading	0.01V
Current	±0.2% reading + 0.05%FS	0.001A
I4 Measured	±0.2% reading + 0.05% F.S.	0.001A
I4 Calculated	0.5% F.S.	0.001A
kW, kVA	IEC 62053-22 Class 0.5S	0.001k
kWh, kVAh	IEC 62053-22 Class 0.5S	0.01kXh
kvar, kvarh	IEC 62053-23 Class 2	0.001k / 0.01kvarh
P.F.	IEC 62053-22 Class 0.5S	0.001
Frequency	±0.02 Hz	0.01Hz
Harmonics	IEC 61000-4-7 Class B	0.01%
K-Factor	IEC 61000-4-7 Class B	0.1
Phase angles	±1°	0.1°

Appendix D - Standards Compliance

Safety Requirements		
LVD Directive 2006 / 95 / EC		EN61010-1-1-2001
Insulation		IEC 60255-5-2000
Dielectric test		2kV @ 1 minute
Insulation resistance		>100MΩ
Impulse voltage		5kV, 1.2/50μs
Electromagnetic Compatibility EMC Directive 2004 / 108 / EC (EN 61326: 2006)		
Immunity Tests		
Electrostatic discharge		IEC 61000-4-2: 2008 Level III
Radiated fields		IEC 61000-4-3: 2010 Level III
Fast transients		IEC 61000-4-4: 2011 Level IV
Surges		IEC 61000-4-5: 2005 Level II
Conducted disturbances		IEC 61000-4-6: 2008 Level II
Magnetic Fields		IEC 61000-4-8: 2009 Level IV
Voltage Dips and Interruptions		IEC 61000-4-11: 2004 Class III
Oscillatory waves		IEC 61000-4-12: 2006 Level III
Emission Tests		
Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment		EN 55011: 2009 (CISPR 11) + A1: 2011
Limits and methods of measurement of radio disturbance characteristics of information technology equipment		EN 55022: 2010 (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 61000-6-3: 2007
Electromagnetic Emission Tests for Measuring Relays and Protection Equipment		IEC 60255-25: 2000
Mechanical Tests		
Vibration Test	Response	IEC 60255-21-1:1998 Level I
	Endurance	IEC 60255-21-1:1998 Level I
Shock Test	Response	IEC 60255-21-2:1998 Level I
	Endurance	IEC 60255-21-2:1998 Level I
Bump Test		IEC 60255-21-2:1998 Level I



Appendix E - Ordering Guide

 Ceiec Electric Technology		Version 20130508	
Product Code	Description		
PMC-630E Advanced Multifunction Ethernet Meter			
Basic Function			
Class 0.5S Compliant, 3-Phase Metering, Demands, Peak Demands, Min/Max Log, 9 Setpoints, Ind. Har to 31st, 16 Data Recorders and WF Recording and 2MB Log Memory			
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			
A	6 DI + 3 RO		
AI / AO			
X	None		
Communications			
D	1 10/100BaseT Ethernet port + 1 RS-485 port		
Display Language			
E	English		
PMC-630E	-	A 5 3 2 5 A X D E	PMC-630E-A5325AXDE (Standard Model)

* Additional charges apply

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