PMC-53M-E

Digital Multifunction Meter

User Manual

Version: V1.0A

April 24, 2018

Standards Compliance

CE

DANGER

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

CAUTION

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

DANGER

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

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

Limited warranty

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

Table of Contents

Chapter 1 Introduction 8
1.1 Overview 8
1.2 Features 8
1.3 PMC-53M-E application in Power and Energy Management Systems 10
1.4 Getting more information 10
Chapter 2 Installation 11
2.1 Appearance 11
2.2 Unit Dimensions 12
2.3 Terminal Dimensions 12
2.4 Mounting 12
2.5 Wiring connections 13
2.5.1 3-Phase 4-Wire (3P4W) Wye Direct Connection with 3CTs 14
2.5.2 3-Phase 4-Wire (3P4W) Wye with 3PTs and 3CTs 14
2.5.3 3-Phase 3-Wire (3P3W) Direct Delta Connection with 3CTs 15
2.5.4 3-Phase 3-Wire (3P3W) Direct Delta Connection with 2CTs 15
2.5.5 3-Phase 3-Wire (3P3W) Delta with 2PTs and 3CTs 16
2.5.6 3-Phase 3-Wire (3P3W) Delta with 2PTs and 2CTs 16
2.5.7 1-Phase 3-Wire (1P3W) Direct Connection with 2CTs 17
2.5.8 1-Phase 2-Wire, Uln (1P2W-Uln) Direct Connection with 1CT 17
2.5.9 1-Phase 2-Wire, Ull (1P2W-Ull) Direct Connection with 1CT 18
2.6 Communications Wiring 18
2.7 Digital Input Wiring 19
2.8 Digital Output Wiring 19
2.9 Power Supply Wiring 19
Chapter 3 Front Panel 20
3.1 Display 20
3.1.1 LED Testing 20
3.1.2 LED Display Symbols 20
3.2 Using the Front Panel Buttons 21
3.3 Data Display 21
3.3.1 System 22
3.3.2 Phase 22
3.3.3 Energy 23
3.3.4 THD/HDx 23
3.3.5 Demand 24
3.3.6 Max./Min. 25
3.4 Setup Configuration via the Front Panel 27
3.4.1 Making Setup Changes 27
3.4.2 Setup Menu 28
3.4.3 Configuration 29
Chapter 4 Applications 32
4.1 Inputs and Outputs 32

4.1.1 Digital Inputs (Optional) 32
4.1.2 Digital Outputs (Optional) 32
4.1.3 LED Energy Pulse Output 33
4.2 Power and Energy 33
4.2.1 Basic Measurements 33
4.2.2 Energy Measurements 33
4.2.3 Demand Measurements 33
4.3 Power Quality 34
4.3.1 Phase Angles 34
4.3.2 Power Quality Parameters 34
4.4 Setpoints 36
4.5 Logging 38
4.5.1 Max./Min. Log 38
4.5.2 Peak Demand Log 38
4.5.3 SOE Log 39
4.6 Diagnostics 39
Chapter 5 Modbus Register Map 40
5.1 Basic Measurements 40
5.2 Energy Measurements 42
5.2.1 3-Phase Total Energy Measurements 42
5.2.2 Phase A (L1) Energy Measurements 42
5.2.3 Phase B (L2) Energy Measurements 42
5.2.4 Phase C (L3) Energy Measurements 42
5.3 DI Pulse Counters (Optional) 43
5.4 Harmonic Measurements 43
5.4.1 Power Quality Measurements 43
5.4.2 Current Harmonic Measurements 43
5.4.3 Voltage Harmonic Measurements 44
5.5 Demands 44
5.5.1 Present Demands 44
5.5.2 Predicted Demands 45
5.5.3 Peak Demand Log of This Month (Since Last Reset) 45
5.5.4 Peak Demand Log of Last Month (Before Last Reset) 45
5.5.5 Demand Data Structure 45
5.6 Max./Min. Log 46
5.6.1 Max. Log of This Month (Since Last Reset) 46
5.6.2 Min. Log of This Month (Since Last Reset) 46
5.6.3 Max. Log of Last Month (Before Last Reset) 47
5.6.4 Min. Log of Last Month (Before Last Reset) 48
5.6.5 Max./Min. Log Structure 49
5.7 SOE Log 49
5.8 Device Setup 52
5.8.1 Basic Setup Parameters 52
5.8.2 I/O Setup (Optional) 53

5.8.3 Communication Setup Parameters 53
5.8.4 Setpoints Setup 53
5.9 Time 54
5.10 Remote Control 55
5.11 Clear/Reset Control 55
5.12 Meter Information 57
Appendix A Technical Specifications 58
Appendix B Standards Compliance 59
Appendix C Ordering Guide 60
Contact us 61

Chapter 1 Introduction

This manual explains how to use the PMC-53M-E Digital Multifunction Meter. Throughout the manual the term “meter” generally refers to all models.

This chapter provides an overview of the PMC-53M-E meter and summarizes many of its key features.

1.1 Overview

The PMC-53M-E Digital Multifunction Meter is CET’s latest offer for the low-cost digital power/energy metering market. Housed in a standard DIN form factor measuring 96x96x88mm, it is perfectly suited for industrial, commercial and utility applications. The PMC-53M-E features quality construction, multifunction true RMS measurements and a high-contrast LED display. Compliance with the IEC 62053-22 Class 0.5S Standard, it is a cost effective replacement for analog instrumentation that is capable of displaying 3-phase measurements at once. It optionally provides four Digital Inputs for status monitoring and two Relay Outputs for control and alarm applications. The standard RS-485 port and Modbus RTU protocol support makes the PMC-53M-E a smart metering component of an intelligent, multifunction monitoring solution for any Energy Management System.

You can setup the meter through its front panel or via our free PMC Setup software. The meter is also supported by our PecStar® iEMS Integrated Energy Management System. Following is a list of typical applications for the PMC-53M-E:

- Industrial, Commercial and Utility Substation Metering
- Building, Factory and Process Automation
- Sub-metering and Cost Allocation
- Energy Management and Power Quality Monitoring

Contact CET Technical Support should you require further assistance with your application.

1.2 Features

Ease of use

- High-contrast LED display
- Intuitive user interface
- kWh/kvarh LED pulse output for accuracy testing
- LED indicator for Communications activities
- Password-protected setup via front panel or free PMC Setup software
- Easy installation with mounting clips, no tools required

Basic Measurements

- Uln, Ull per phase and Average
- Current per phase and Average with calculated Neutral
- kW, kvar, kVA, PF per phase and Total
- kWh, kvarh Import / Export / Net / Total, kVAh Total and kvarh Q1 - Q4
- Frequency
- Device Operating Time (Running Hours)
- Optional DI Pulse Counters

PQ Measurements

- Voltage and Current THD, TOHD, TEHD and Individual Harmonics up to 31st
- Current TDD, TDD Odd, TDD Even, K-Factor, Crest-Factor
- U and I Unbalance and Phase Angles
- Displacement PF

Demand

- Demands, Predicted Demands and Peak Demands for kW Total, kvar Total, kVA total and per phase Current with Timestamp for This Month (Since Last Reset) and Last Month (Before Last Reset)

Setpoints

- 9 user programmable setpoints with extensive list of monitoring parameters including Voltage, Current, Power and THD, … etc.
- Configurable thresholds, time delays and DO triggers
- Comprehensive monitoring and control based on the condition of the measured parameters and provides trigger output for different actions such as SOE Logging or DO Triggering for Alarm or Control Actions.

SOE Log

- 64 events time-stamped to ±1ms resolution
- Recording events for Setup changes, Setpoint and DI status changes as well as DO operations

Max./Min. Log

- Max./Min. Log with timestamp for real-time measurements such as Voltage, Current, In (calculated), Frequency, kW, kvar, kVA, PF, Unbalance, K-Factor, Crest-Factor and THD
- Configurable for This Month/Last Month or Since/Before Last Reset

Diagnostics

- Frequency Out-of-Range, Loss of Voltage / Current
- kW Direction per phase and Total, Possible Incorrect CT Polarity
- Incorrect U & I Phase Sequence

Optional Inputs and Outputs (Optional)

- **Digital Inputs**
  - 4 channels, volts free dry contact, 24VDC internally wetted
  - 1000Hz sampling for status monitoring with programmable debounce
  - Pulse counting with programmable weight for each channel for collecting WAGES (Water, Air, Gas, Electricity, Steam) information.
- **Digital Outputs**
  - 2 Form A mechanical relays for alarming and general purpose control
  - 5A @ 250VAC or 30VDC

Communications

- Optically isolated RS485 port at max. 38,400 bps
- Standard Modbus RTU

Real-time Clock

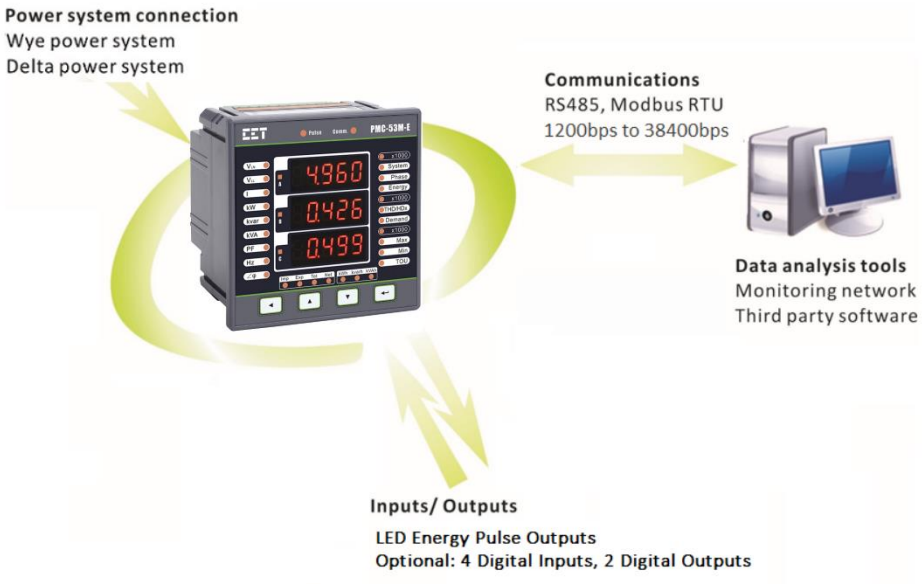
- Equipped with a battery-backed Real-Time Clock with 25ppm accuracy (<2s per day)

System Integration

- Supported by CET's PecStar® iEMS and iEEM
- Easy integration into 3rd-party Energy Management, Automation or SCADA or BMS systems via Modbus RTU

1.3 PMC-53M-E application in Power and Energy Management Systems

The PMC-53M-E can be used to monitor Wye or Delta connected power system. Modbus communications allow real-time data, DI status and other information to be transmitted across a RS485 network to an Integrated Energy Management system such as PecStar®.



1.4 Getting more information

Additional information is available from CET via the following sources:

- Visit **www.cet-global.com**
- Contact your local representative
- Contact CET directly via email at support@cet-global.com

Chapter 2 Installation

Caution

Installation of the PMC-53M-E should only be performed by qualified and competent personnel who 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

2.1 Appearance

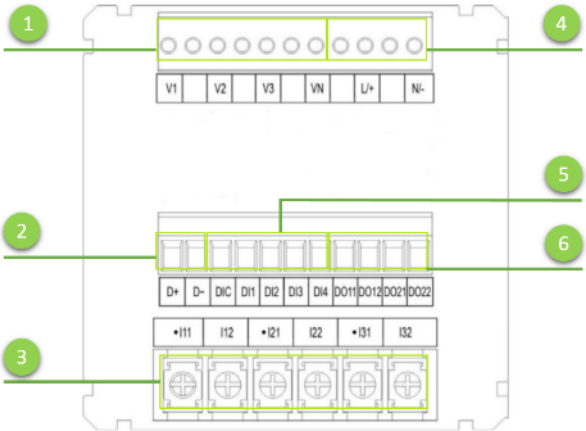


Figure 2-1 Appearance

2.2 Unit Dimensions

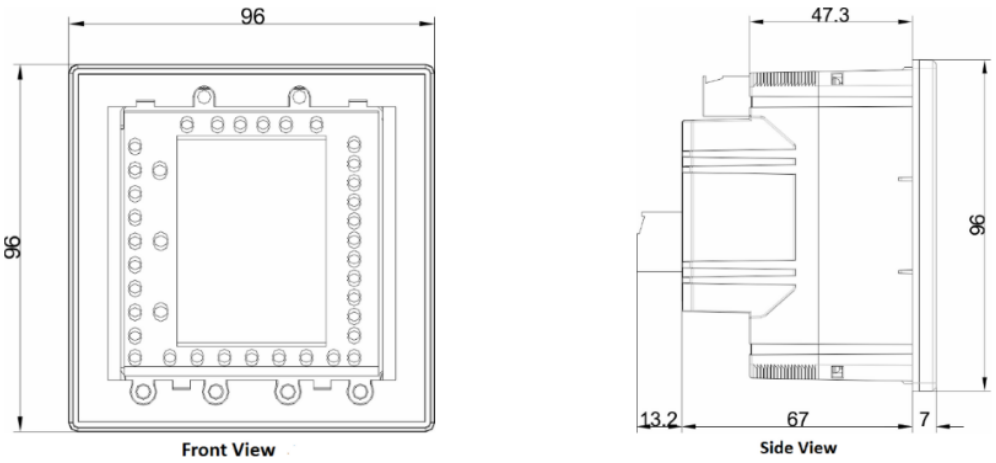


Figure 2-2 Unit Dimensions

2.3 Terminal Dimensions

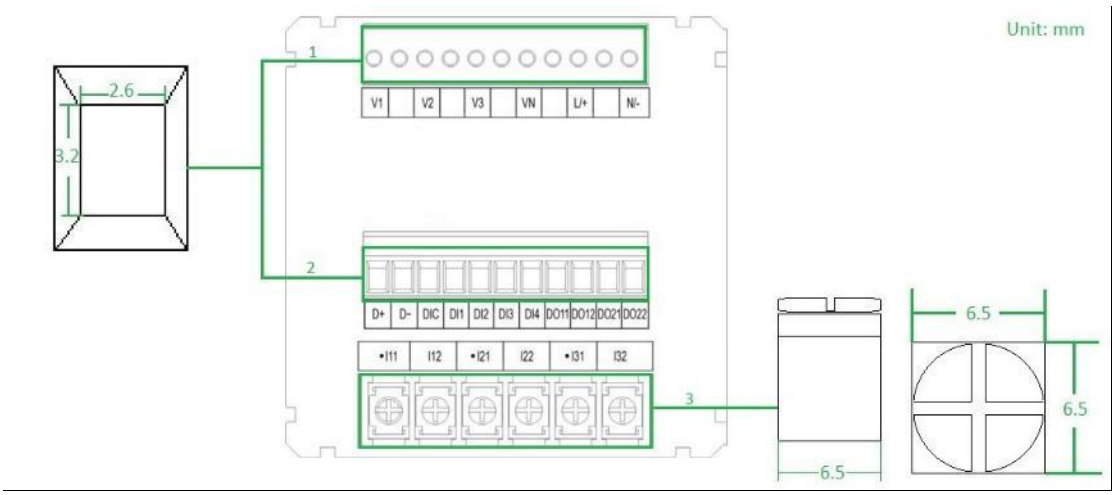


Figure 2-3 Terminal Dimensions

	Terminal	Terminal Dimensions	Wire Size	Max. Torque
1	Voltage Input	2.6mm x 3.2mm	1.5mm^2	5 kgf.cm/M3 (4.3 lb-in)
	Power Supply			
2	RS485			
	DI			
	DO			
3	Current Input	6.5mm x 6.5mm	1.0mm^2 - 2.5mm^2 (14AWG - 22AWG)	6.0 kgf.cm/M3 (5.2 lb-in)

Table 2-1 Terminal Dimensions

2.4 Mounting

The PMC-53M-E should be installed in a dry environment with no dust and kept away from heat, radiation and electrical noise source.

Installation steps:

- Remove the installation clips from the meter
- Fit the meter through a 92mmx92mm cutout as shown in Figure 2-4

- Re-install the installation clips and push the clips tightly against the panel to secure the meter

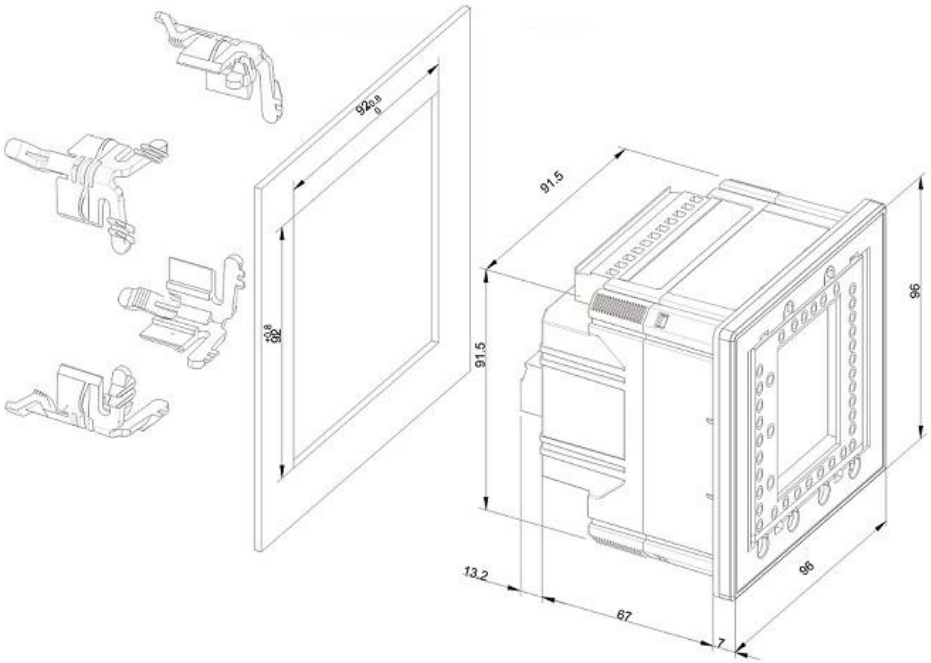


Figure 2-4 Panel Cutout Mounting

2.5 Wiring connections

PMC-53M-E 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 (3P4W) Wye Direct Connection with 3CTs
- 3-Phase 4-Wire (3P4W) Wye with 3PTs and 3CTs
- 3-Phase 3-Wire (3P3W) Direct Delta Connection With 3CTs
- 3-Phase 3-Wire (3P3W) Direct Delta Connection with 2CTs
- 3-Phase 3-Wire (3P3W) Delta with 2PTs and 3CTs
- 3-Phase 3-Wire (3P3W) Delta with 2PTs and 2CTs
- 1-Phase 3-Wire (1P3W) Direct Connection with 2CTs
- 1-Phase 2-Wire, Uln (1P2W-Uln) Direct Connection with 1CT
- 1-Phase 2-Wire, Ull (1P2W-Ull) Direct Connection with 1CT

Caution

Under no circumstances should the PT secondary be shorted.

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

2.5.1 3-Phase 4-Wire (3P4W) Wye Direct Connection with 3CTs

Please consult the serial number label to ensure that the rated system phase voltage is less than or equal to the meter's rated phase voltage input specification. Set the **Wiring Mode** to **3P4W**.

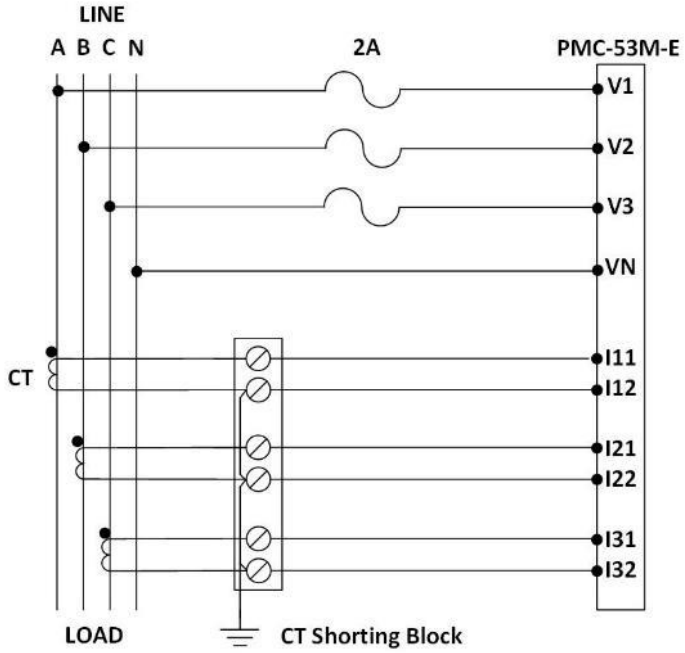


Figure 2-5 3P4W Direct Connection with 3CTs

2.5.2 3-Phase 4-Wire (3P4W) 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 rated phase voltage input specification. Set the **Wiring Mode** to **3P4W**.

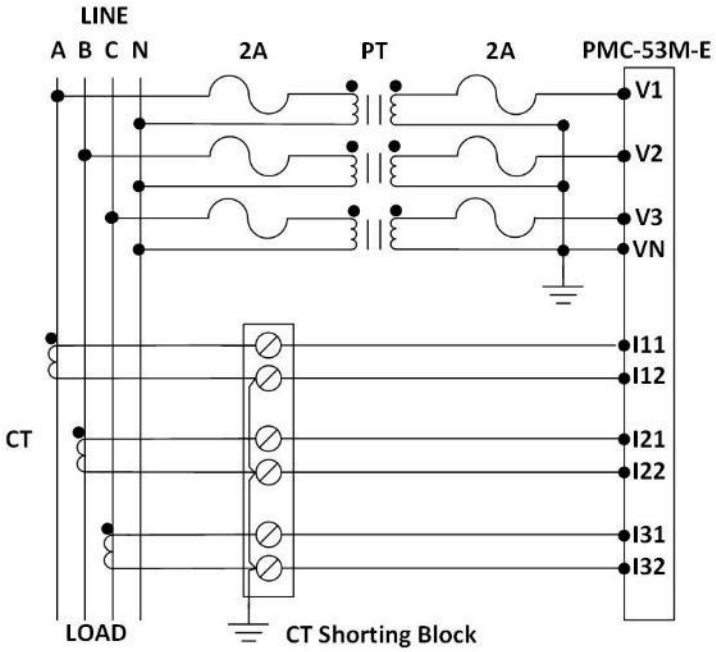


Figure 2-6 3P4W with 3PTs and 3CTs

2.5.3 3-Phase 3-Wire (3P3W) Direct Delta Connection with 3CTs

Please consult the serial number label to ensure that the rated system line voltage is less than or equal to the meter's rated line voltage input specification. Set the **Wiring Mode** to **3P3W**.

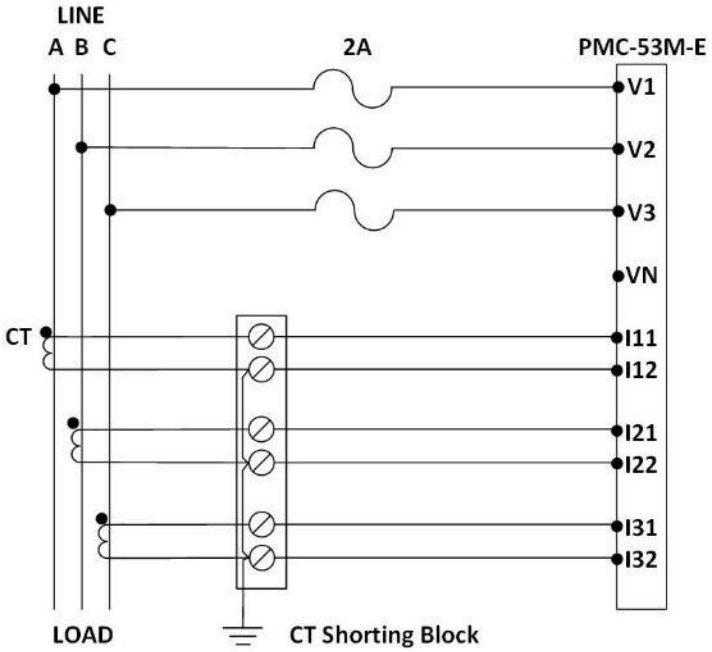


Figure 2-7 3P3W Direct Connection with 3CTs

2.5.4 3-Phase 3-Wire (3P3W) Direct Delta Connection with 2CTs

Please consult the serial number label to ensure that the rated system line voltage is less than or equal to the meter's rated line voltage input specification. Set the **Wiring Mode** to **3P3W**.

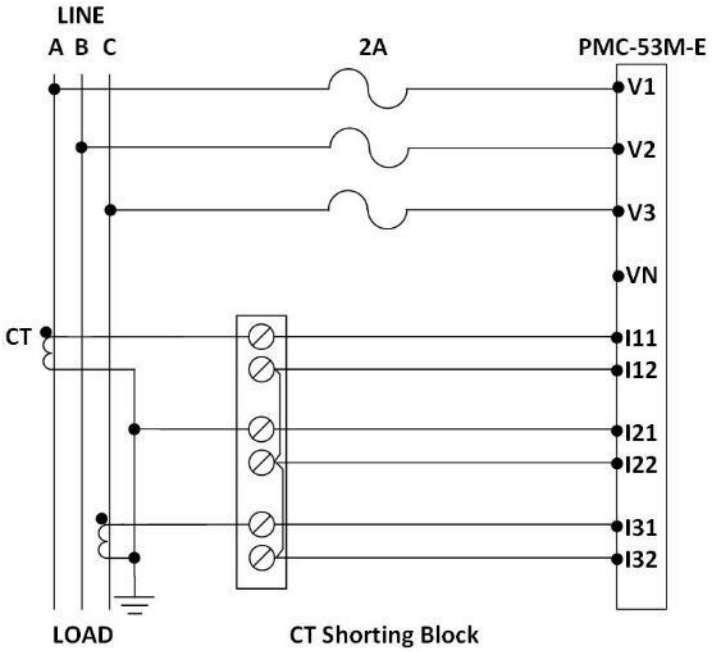


Figure 2-8 3P3W Direct Connection with 2CTs

2.5.5 3-Phase 3-Wire (3P3W) 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 rated phase voltage input specification. Set the **Wiring Mode** to **3P3W**.

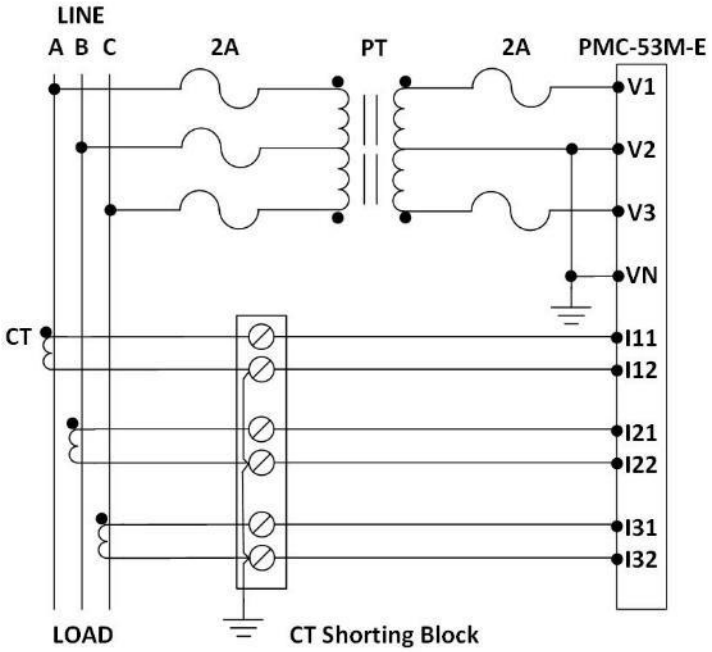


Figure 2-9 3P3W Delta with 2PTs and 3CTs

2.5.6 3-Phase 3-Wire (3P3W) 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 rated phase voltage input specification. Set the **Wiring Mode** to **3P3W**.

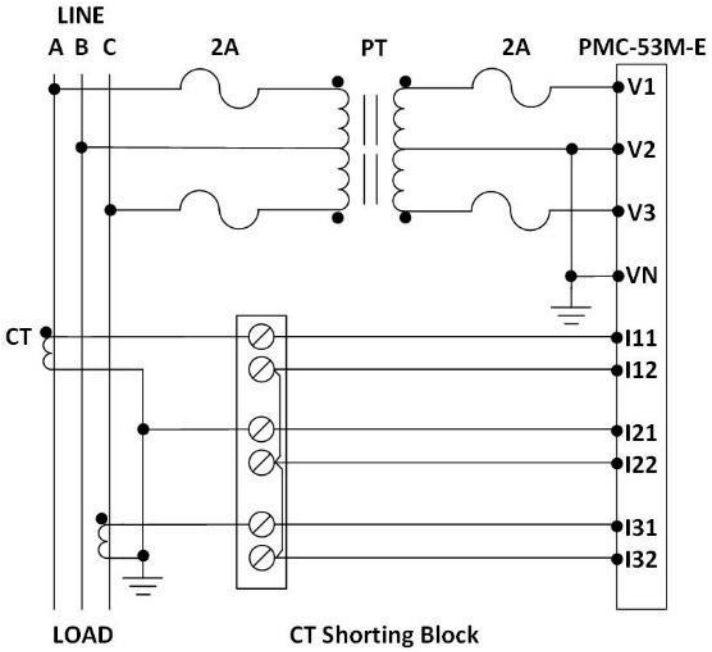


Figure 2-10 3P3W Delta with 2PTs and 2CTs

2.5.7 1-Phase 3-Wire (1P3W) Direct Connection with 2CTs

Please consult the Serial Number Label to ensure that the rated system phase voltage is less than or equal to the meter's rated phase voltage input specification. Set the Wiring Mode to **1P3W**.

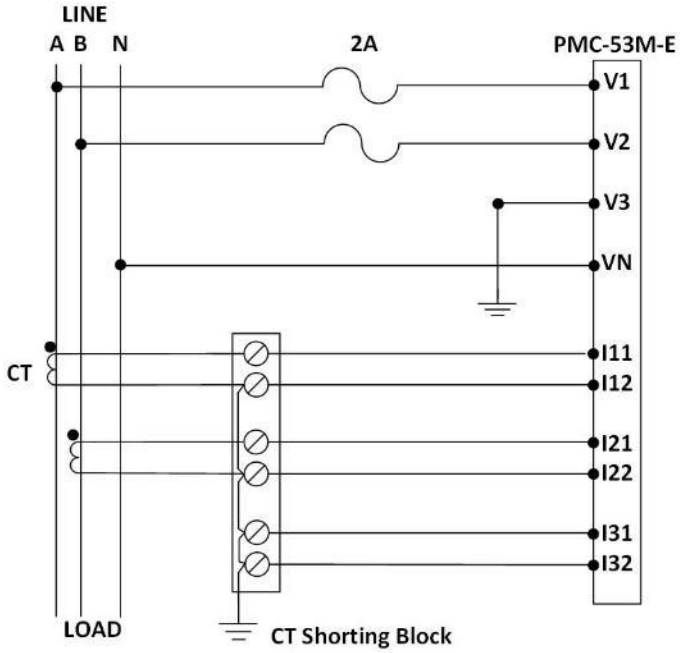


Figure 2-11 1P3W Direct Connection with 2CTs

2.5.8 1-Phase 2-Wire, Uln (1P2W-Uln) Direct Connection with 1CT

Please consult the Serial Number Label to ensure that the rated system phase voltage is less than or equal to the meter's rated phase voltage input specification. Set the **Wiring Mode** to **1P2W, L-N**.

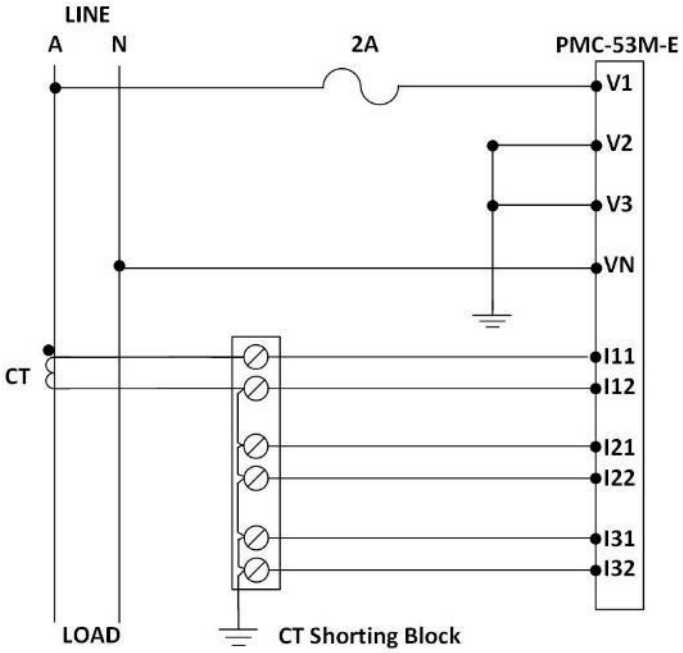


Figure 2-12 1P2W Uln Direct Connection with 1CT

2.5.9 1-Phase 2-Wire, Ull (1P2W-Ull) Direct Connection with 1CT

Please consult the Serial Number Label to ensure that the rated system line voltage is less than or equal to the meter's rated phase voltage input specification. Set the **Wiring Mode** to **1P2W, L-L**.

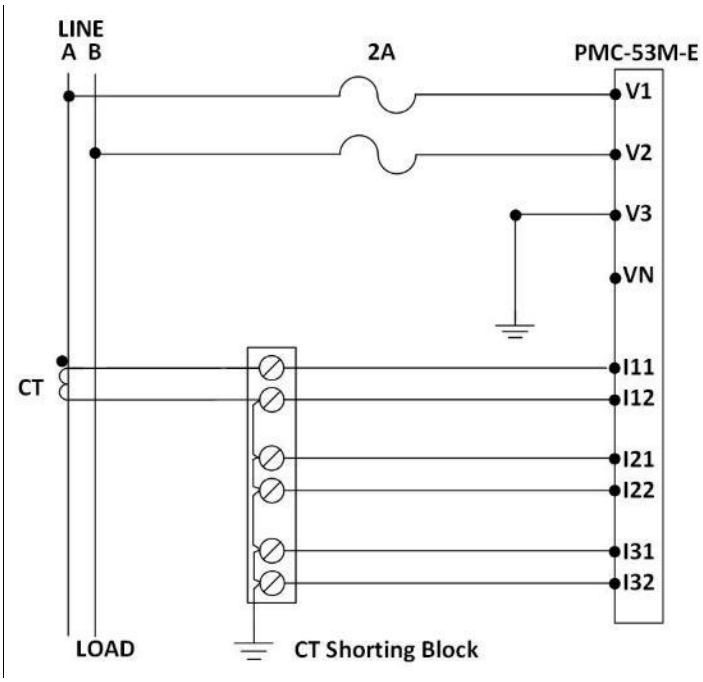


Figure 2-13 1P2W Ull Direct Connection with 1CT

2.6 Communications Wiring

The following figure illustrates the RS485 communications connections on the PMC-53M-E:

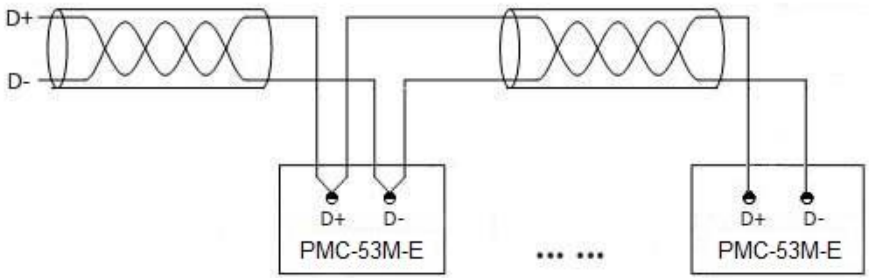


Figure 2-14 Communications Connections

The PMC-53M-E provides one standard RS485 port which supports the Modbus RTU protocol. Up to 32 devices can be connected on a RS485 bus. The overall length of the RS485 cable connecting all devices should not exceed 1200m.

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

2.7 Digital Input Wiring

The following figure illustrates the Digital Input connections on the PMC-53M-E:

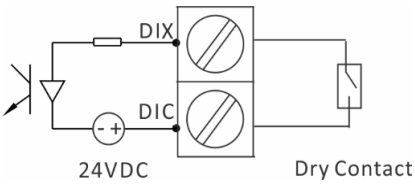


Figure 2-15 DI Connections

2.8 Digital Output Wiring

The following figure illustrates the Digital Output connections on the PMC-53M-E:

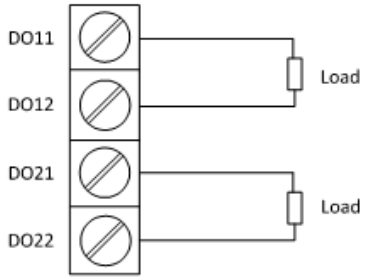


Figure 2-16 DO Connections

2.9 Power Supply Wiring

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

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

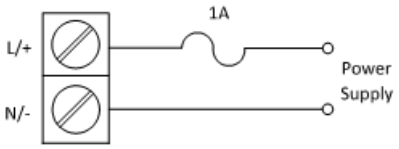
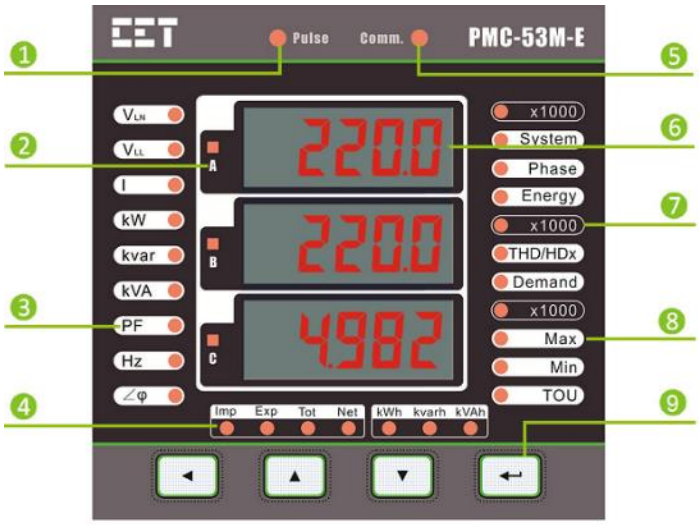


Figure 2-17 Power Supply Connections

Chapter 3 Front Panel

The PMC-53M-E has a High-contrast LED display with four buttons for data display and meter configuration. This chapter introduces the front panel operations.



1 LED Pulse Output
2 Phase Indicator
3 Parameters
4 Energy Indicators
5 Communication Indicator
6 Measurements
7 x1000 Scaling Factor
8 Measurement Menu
9 Buttons

Figure 3-1 Front Panel

3.1 Display

3.1.1 LED Testing

Pressing and holding both the <▲> and the <▼> buttons simultaneously enters the LED Testing mode. All LED segments and indicators are illuminated during testing. Releasing the buttons will immediately return to the normal display mode.

3.1.2 LED Display Symbols

The following table shows the special LED display symbols:

Label	Description					
8.	A	B	C	D	E	F
	G	H	I	J	K	L
	M	N	O	P	Q	R
	S	T	U	V	W	Y
	0	1	2	3	4	
	5	6	7	8	9	

Table 3-1 LED Display Segments

3.2 Using the Front Panel Buttons

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

Buttons	Data Display Mode	Setup Configuration Mode
<◀>	Pressing this button scrolls through the available measurements indicated by the LEDs on the left side of the Front Panel under a particular menu as indicated by the LEDs on the right side of the Front Panel**.**	• Before a parameter is selected for modification, pressing this button returns to the previous menu level if it's currently in a sub-menu. Otherwise, this button is ignored. • Once a numeric parameter is selected, pressing this button moves the cursor to the left by one position. Otherwise, this button is ignored.
<▲>	Pressing this button scrolls to the previous measurement for a particular parameter under the menu items: **<THD/HDx>**, **<Demand Max>** and **<Max>** and **<Min>**. This button is ignored for the <**System>, <Phase>, <Demand>** and <**Energy>** menu items.	• Before a parameter is selected for modification, pressing this button goes back to the last parameter in a particular menu or sub-menu. • If a parameter is already selected, pressing this button increments a numeric value or goes back to the last enumerated value in the selection list.
<▼>	Pressing this button scrolls to the next measurement for a particular parameter under the menu items: **<THD/HDx>**, **<Demand Max>** and **<Max>** and **<Min>**. This button is ignored in **<System>, <Phase>, <Demand>** and <**Energy>** Menus.	• Before a parameter is selected for modification, pressing this button advances to the next parameter in a particular menu or sub-menu. • If a parameter is already selected, pressing this button decrements a numeric value or advances to the next enumerated value in the selection list.
<↵>	Pressing this button scrolls through the different menus as indicated by the LEDs on the right side of the Front Panel: **<System>**, **<Phase>**, **<Energy>**, **<THD/HDx>**, **<Demand>**, **<Max Demand>**, **<Max>** and **<Min>**. Pressing this button for 2 seconds or more enters **Setup Configuration** mode.	• Once inside the **Setup Configuration** mode, pressing this button selects a parameter for modification or chooses whether to enter a sub-menu by selecting **YES** or **NO**. • After changing the parameter pressing this button again saves the new setting into memory. • Pressing this button for 2 seconds anywhere exits the **Setup Configuration** mode.

Table 3-2 Button Function

3.3 Data Display

There are 8 menus on the right side of the Front Panel, labeled **<System>, <Phase>, <Energy>, <THD/HDx>, <Demand>, <Max>, <Min>** and **<TOU>.** Users can scroll through those menus by pressing **<↵>.**

The following sections illustrate the available measurements for each display option. Depending on the **Wiring Mode** selected, certain measurements may not be available. For example, the per-phase Uln, Uln Average, per-phase kW, kvar, kVA and PF measurements are not available when the **Wiring Mode** is set to 3P3W or 1P2W L-L. V_{LN}

3.3.1 System

Figure 3-2 provides an example for the default Display Screen, and Table 3-3 illustrates all the Display Screens under the <**System**> menu.

Figure 3-2 System Display Example

Menu	Display Screens	1st Row	2nd Row	3rd Row
<System>	Display 1 (Default)	I avg	kW Total	PF Total
	Display 2	Uln avg[1]	Ull avg[2]	I avg
	Display 3	kW Total	kvar Total	kVA Total
	Display 4	PF Total	Frequency	
	Display 5	Inc (In Calculated)[3]		
	Display 6	DI1 Status[4]		
	Display 7	DI2 Status[4]		
	Display 8	DI3 Status[4]		
	Display 9	DI4 Status[4]		
	Display 10	DO1 Status[4]		
	Display 11	DO2 Status[4]		

Table 3-3 System Display

Notes:

1) This screen is not shown if the Wiring Mode is set to 3P3W or 1P2W L-L.
2) This screen is not shown if the Wiring Mode is set to 1P2W L-N.
3) This screen is not shown if the Wiring Mode is set to IP3W, 1P2W L-L or 1P2W L-N.
4) The DI/DO Status is not shown if the meter is not equipped with the I/O option.

3.3.2 Phase

Figure 3-3 provides an example for a **<Phase>** Display Screen, and Table 3-4 illustrates all the Display Screens under the <**Phase**> menu.

Figure 3-3 Phase Display Example

Menu	Display Screens	1st Row	2nd Row	3rd Row
<Phase>	Display 1	Ua[1,3]	Ub[1,3]	Uc[1,2,3]
	Display 2	Uab[3]	Ubc[2,3]	Uca[2,3]
	Display 3	Ia[3]	Ib[3]	Ic[2,3]
	Display 4	kWa[1,3]	kWb[1,3]	kWc[1,2,3]
	Display 5	kvara[1,3]	kvarb[1,3]	kvarc[1,2,3]
	Display 6	kVAa[1,3]	kVAb[1,3]	kVAc[1,2,3]
	Display 7	PFa[1,3]	PFb[1,3]	PFc[1,2,3]
	Display 8	Ua Angle[4]	Ub Angle[3,4]	Uc Angle[2,3,4]
	Display 9	Ia Angle	Ib Angle[3]	Ic Angle[2,3]

Table 3-4 Phase Display

Notes:

1) This screen is not shown if the Wiring Mode is set to 3P3W
2) This screen is not shown if the Wiring Mode is set to 1P3W
3) This screen is not shown if the Wiring Mode is set to 1P2W L-N or 1P2W L-L.
4) For U Angle, Ua = Uab, Ub= Ubc, Uc = Uca in 3P3W or 1P2W L-L mode.

3.3.3 Energy

Figure 3-4 provides an example of the **<Energy>** Display Screen, and Table 3-5 illustrates all the Display Screens under the <**Energy**> menu.

Figure 3-4 Energy Display Example

Menu	Display Screens	1st Row	2nd Row	3rd Row
<Energy>	Display 1	kWh Imp		
	Display 2	kWh Exp		
	Display 3	kWh Total		
	Display 4	kWh Net		
	Display 5	kvarh Imp		
	Display 6	kvarh Exp		
	Display 7	kvarh Total		
	Display 8	kvarh Net		
	Display 9	kVAh Total		

Table 3-5 Energy Display

3.3.4 THD/HDx

Figure 3-5 provides an example for a THD/HDxx Display Screen, and Table 3-6 illustrates all the Display Screens under the <**THD/HDx**> menu. Pressing <▲> and <▼> buttons to display THD, TOHD, TEHD and HD 1st to 31st for **Uln, Ull** and **I.** Pressing <◄> scrolls through Phase A, Phase B and Phase C for Voltage and Current.

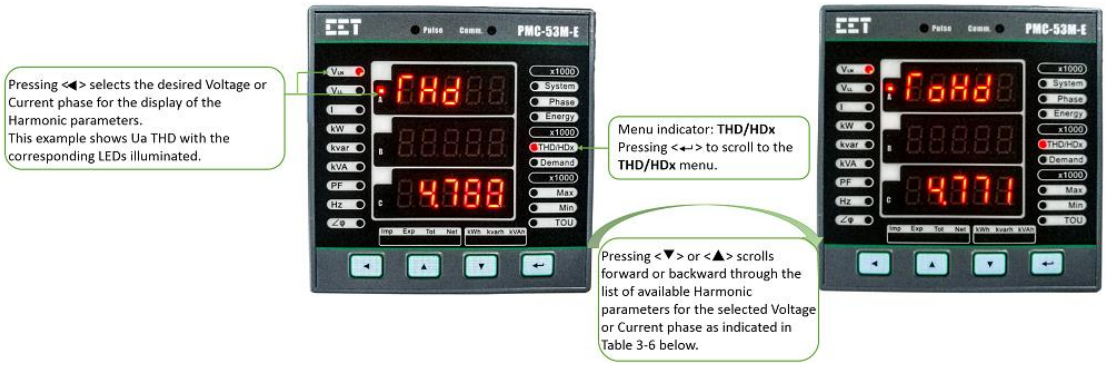


Figure 3-5 THD/HDx Display Example

Menu		Display Screens	1st Row	2nd Row	3rd Row
<THD/HDx>	<Ua/Uab>	Display 1	THD		
		Display 2	TOHD		
		Display 3	TEHD		
		Display 4	HD02		
		Display 5~32	…		
		Display 33	HD31		
	<Ub/Ubc>[2]	Display 1	THD		
		Display 2	TOHD		
		Display 3	TEHD		
		Display 4	HD02		
		Display 5~32	…		
		Display 33	HD31		
	<Uc/Uca>[2,3]	Display 1	THD		
		Display 2	TOHD		
		Display 3	TEHD		
		Display 4	HD02		
		Display 5~32	…		
		Display 33	HD31		
	<Ia>	Display 1	THD		
		Display 2	TOHD		
		Display 3	TEHD		
		Display 4	HD02		
		Display 5~32	…		
		Display 33	HD31		
	<Ib>[2]	Display 1	THD		
		Display 2	TOHD		
		Display 3	TEHD		
		Display 4	HD02		
		Display 5~32	…		
		Display 33	HD31		
	<Ic>[2,3]	Display 1	THD		
		Display 2	TOHD		
		Display 3	TEHD		
		Display 4	HD02		
		Display 5~32	…		
		Display 33	HD31		

Table 3-6 Harmonics Display

Notes:

1) This screen is not shown when the **Wiring Mode** is **1P3W**.
2) This screen is not shown when the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**.

3.3.5 Demand

Figure 3-6 provides an example of a **<Demand>** Display Screen, and Table 3-7 illustrates all the Display Screens under the <**Demand**> menu. Pressing <↵> to scroll to **<Demand>** or **<Max. Demand>** indicated by the LEDs on the right side of the Front Panel. Pressing <◄> scrolls through Phase A, Phase B and Phase C for Voltage or Current parameters. Pressing <▲> and <▼> to display complete demand

measurement information.

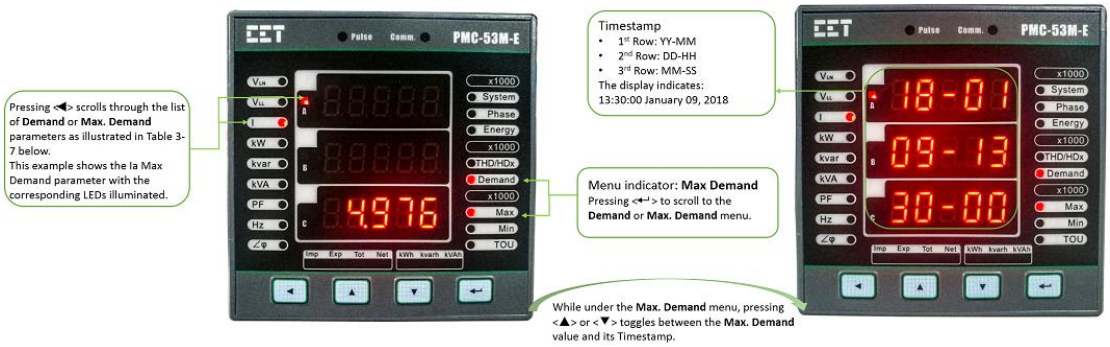


Figure 3-6 Demand Display Example

Menu		Display Screens	1st Row	2nd Row	3rd Row
<Demand>	-[1]	Display 1	Ia		
		Display 2	Ib[3]		
		Display 3	Ic[3,4]		
		Display 4	kW		
		Display 5	kvar		
		Display 6	kVA		
	<Max>[2]	Display 1	Ia		
		Display 2	Ib[3]		
		Display 3	Ic[3,4]		
		Display 4	kW		
		Display 5	kvar		
		Display 6	kVA		

Table 3-7 Demand Display

Notes:

1) Demand = Present Demand
2) Demand & Max = Max. (Peak) Demand
3) This screen is not shown when the **Wiring Mode** is**1P2W L-N** or **1P2W L-L**.
4) This screen is not shown when the **Wiring Mode** is **1P3W**.

3.3.6 Max./Min.

Figure 3-7 provides an example of a <**Max**>/<**Min**> Display Screen, and Table 3-8 illustrates all the Display Screens under the <**Max**>/<**Min**> menu. Pressing <↵> to scroll to the **<Max>** or **<Min>** menu. Pressing <◄> scrolls through Voltage, Current, kW, kvar, kVA, PF and Frequency parameters. Pressing <▲> and <▼> buttons to display complete information for each <**Max**> or <**Min**> parameter.

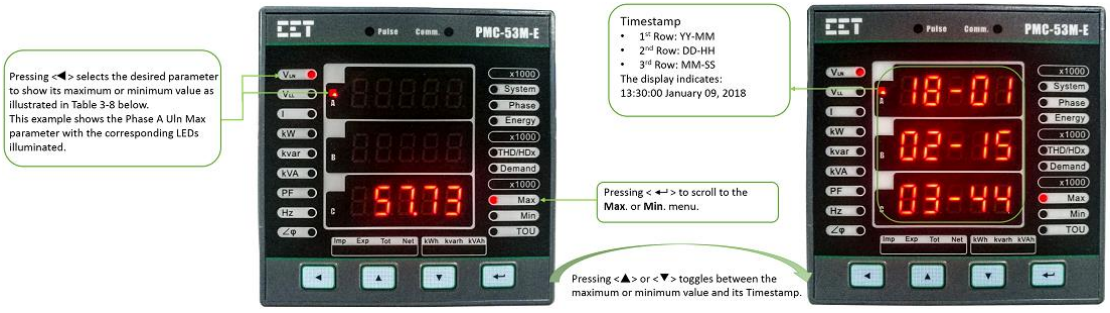


Figure 3-7 Max./Min. Display Example

Menu	Display Screens	1st Row	2nd Row	3rd Row
<Max> / <Min>	Display 1	Ua		
	Display 2	Ub[1]		
	Display 3	Uc[1,2]		

	Display 4	Uln avg
	Display 5	Uab
	Display 6	Ubc
	Display 7	Uca
	Display 8	Ull avg
	Display 9	Ia
	Display 10	Ib[1]
	Display 11	Ic[1,2]
	Display 12	I avg
	Display 13	kWa
	Display 14	kWb[1]
	Display 15	kWc[1,2]
	Display 16	kW Total
	Display 17	kvara
	Display 18	kvarb[1]
	Display 19	kvarc[1,2]
	Display 20	kvar Total
	Display 21	kVAa
	Display 22	kVAb[1]
	Display 23	kVAc[1,2]
	Display 24	kVA Total
	Display 25	PFa
	Display 26	PFb[1]
	Display 27	PFc[1,2]
	Display 28	PF Total
	Display 29	Frequency

Table 3-8 Max./Min. Display

Notes:

1) This screen is not shown when the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**.
2) This screen is not shown when the **Wiring Mode** is **1P3W**.

3.4 Setup Configuration via the Front Panel

3.4.1 Making Setup Changes

1) Entering the Password:

- Press **<↵>** for two seconds to enter **Setup Configuration** mode, and the LED displays **PROG**.
- Press <▼> advance to the Password page.
- A correct password must be entered before changes are allowed. Press **<↵>** to enter the password. The factory default password is "0000".
- Press< ◀> to shift the cursor to the left by one position and press <▲> or <▼> to increment or decrement the numeric value for the password.
- When the password has been entered, press **<↵>** to save the password. If the entered password is correct, changes will be allowed. Press <▲ > or < ▼ > to scroll through the list of sub-menus. Once the desired sub-menu is reached, press **<↵>** to select it and then choose **YES** to enter the sub-menu. When finished, press <◀> to return to the main menu.

2) Selecting a parameter to change:

- Press <▲> or <▼> to scroll to the desired parameter.
- Press **<↵>** to select a parameter. Once a parameter has been selected, its value will blink.

3) Changing and saving a setup parameter:

- For a Numeric parameter, press <◀> to shift the cursor to the left by one position or <▲> or <▼> to increment or decrement the numeric value
- For an Enumerated parameter, press <▲> or <▼> to scroll through the enumerated list.
- After modification, press **<↵>** to save the change into memory.
- Repeat step 3) until all setup parameters have been changed.

4) Exiting the Setup Mode

- Press **<↵>** for two seconds to return to the **Display Mode**.
- Also, the **Setup Mode** will be automatically exited if there is a period of inactivity of 5 minutes or longer.

3.4.2 Setup Menu

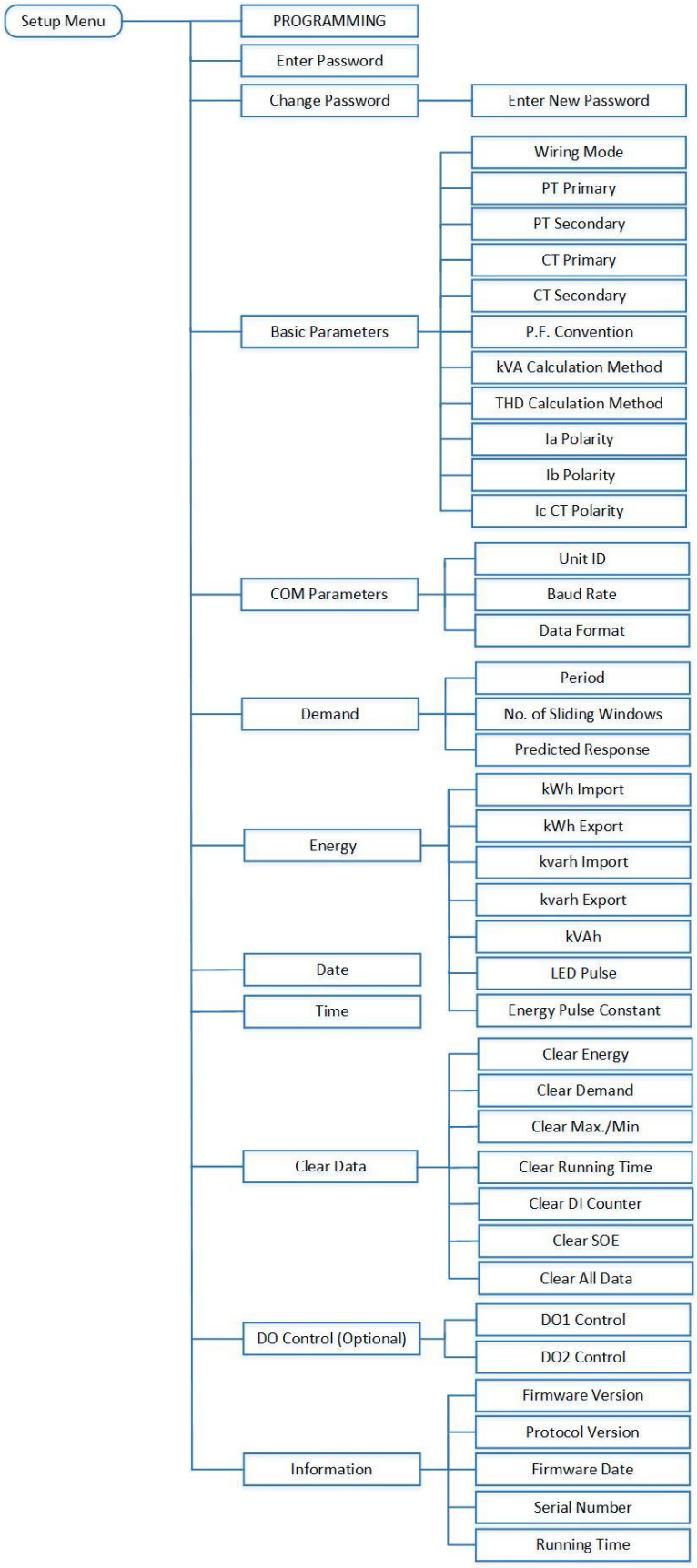


Figure 3-2 Setup Menu

3.4.3 Configuration

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

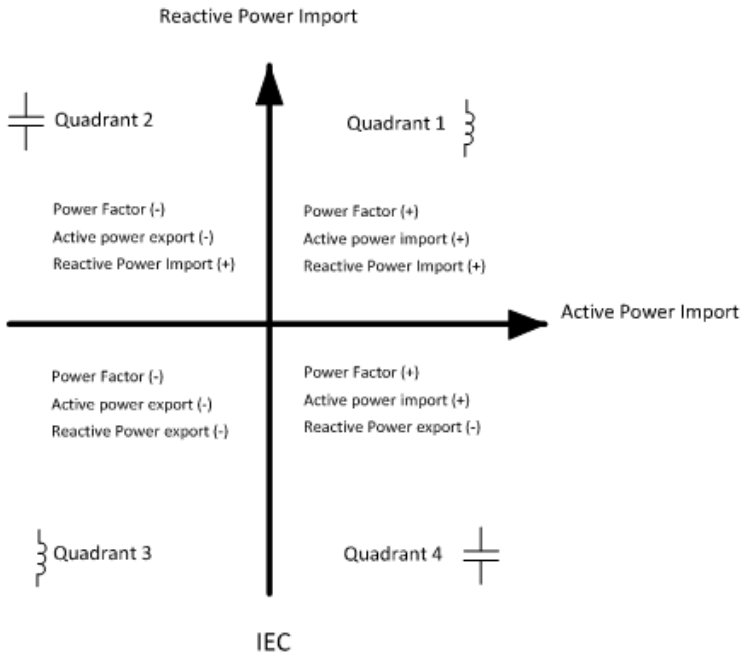
Label Menu Main	Label Menu Sub	Parameters	Description	Range	Default
PROG		Programming	Setup Configuration	/	/
PASS		Password	Enter Password	0 to 9999	0
PASS SET			Enter Sub Menu to change password?	YES/NO	NO
	NEW PASS	New Password	Change Password	0000 to 9999	"0"
PARA			Enter sub menu to set basic parameters?	YES/NO	NO
	TYPE	Wiring Mode	Meter's Wiring Connection	DEMO/1P3W/ 1P2W L-N/1P2W L-L/ /3P3W/3P4W	3P4W
	PT1	PT Primary[1]	PT Primary Voltage	1 to 1,000,000V	100V
	PT2	PT Secondary [1]	PT Secondary Voltage	1 to 690V	100V
	CT1	CT Primary	CT Primary Current	1 to 30,000A	5A
	CT2	CT Secondary	CT Secondary Current	1 to 5A	5A
	PF SET	P.F. Convention[2]	PF Convention	IEC/IEEE/-IEEE	IEC
	kVA SET	kVA Calculation[3]	kVA Calculation Method	V/S (V=Vector, S=Scalar)	V
	THD SET	THD Calculation	Select between % of Fundamental or % of RMS	THDf/THDr	THDf
	CT A REV	Phase A CT	Reverse Phase A CT Polarity	YES/NO	NO
	CT B REV	Phase B CT	Reverse Phase B CT Polarity	YES/NO	NO
	CT C REV	Phase C CT	Reverse Phase C CT Polarity	YES/NO	NO
COM SET			Enter sub menu to set Comm. parameters?	YES/NO	NO
	ID	Meter Address	Unit ID	1-247	100
	BD	Baud rate	Data rate in bits per second	1200/2400 /4800/9600/ 19200bps	9600
	CFG	Comm. Port Configuration	Data Format	8N2/8O1/8E1/ 8N1/ 8O2/ 8E2	8E1
DMD SET					
	PRD	Period	Demand Interval	1 to 60 (min)	15
	NUM	No. of Windows	Number of Sliding Windows	1 to 15	1
	PRED RESP	Predicted Resp.	Predicted Response	70 to 99 (%)	70
ENGY SET		Preset Energy Values	Enter sub menu to preset Energy Values	YES/NO	NO
	kWh Imp	kWh Import	Preset kWh Import Value	0 to 99,999,999.9	
	kWh Exp	kWh Export	Preset kWh Export Value	0 to 99,999,999.9	
	kvarh Imp	kvarh Import	Preset kvarh Import Value	0 to 99,999,999.9	
	kvarh Exp	kvarh Export	Preset kvarh Export Value	0 to 99,999,999.9	
	kVAh	kVAh	Preset kVAh Value	0 to 99,999,999.9	
	ENGY PULS	Energy Pulsing	Enable kWh or kvarh LED Energy Pulsing	NO/kWh/ kvarh	kWh
	ENGY CNST	Pulse Constant	Pulse Constant	1000/3200	1000
DATE		Date	Enter the Current Date	YYYY-MM-DD	/
TIM		Clock	Enter the Current Time	HH:MM:SS	/
DATA CLR			Enter sub menu to clear data	YES/NO	NO
	ENGY	Energy	Clear the 3-Ø Total and Per-Phase Energy registers	YES/NO	NO
	DMD	Demand	Clear Peak Demand of This Month (Since Last Reset)	YES/NO	NO

MA/MN	Max./Min. Logs	Clear Max./Min. Log of This Month (Since Last Reset)	YES/NO	NO
RUN TIM	Run Time	Clear Device Operating Time	YES/NO	NO
PULSE	DI Counter	Clear DI Counters	YES/NO	NO
SOE	SOE	Clear SOE logs	YES/NO	NO
ALL DATA	All data	Clear All of the above	YES/NO	NO
DO CTRL[5]				
DO1	DO1 Control	DO1 Control	ON/OFF/NRM	NRM
DO2	DO2 Control	DO2 Control		NRM
INFO		View Device Information (Read Only)	YES/NO	NO
FW VER	Firmware Version	Firmware Version	e.g. 1.00.00 means V1.00.00	/
PROT VER	Protocol Version	Protocol Version	e.g. 2.1 means V2.1	/
UPDT	Update Date	Firmware Update Date	e.g. 20160603	/
SN	Serial Number	Serial Number	e.g. 1506005094	/
RUN TIME	Device operating time	Run Hours	Hrs	/

Table 3-9 Setup Parameters

Notes:

1) The value of [PT Primary/PT Secondary] cannot exceed 10000.
2) Power Factor Convention



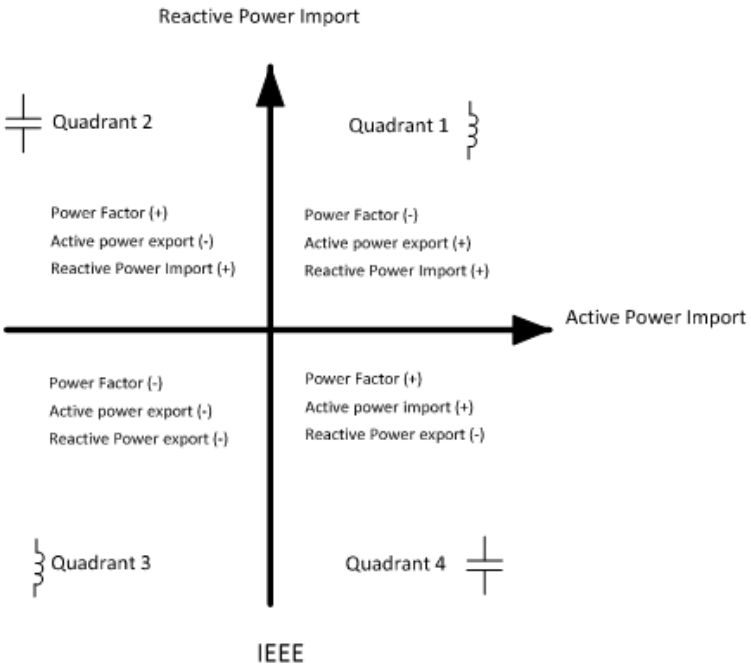


Figure 3-3 P.F. Convention

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 THD:

THDf (based on Fundamental): $THD = \frac{\sqrt{\sum_{n=2}^{\infty} I_n^{2}}}{I_1} \times 100\%$

where I_n represents the RMS value for the n^{th} harmonic and I_1 represents the RMS value of the Fundamental harmonic.

THDr (based on RMS): $THD = \frac{\sqrt{\sum_{n=2}^{\infty} I_n^{2}}}{\sqrt{\sum_{n=1}^{\infty} I_n^{2}}} \times 100\%$

where I_n represents the RMS value for the n^{th} harmonic.

5) This menu only appears if the meter is equipped with the corresponding options.

Chapter 4 Applications

4.1 Inputs and Outputs

4.1.1 Digital Inputs (Optional)

The PMC-53M-E comes optionally with four self-excited Digital Inputs that are internally wetted at 24 VDC with a sampling frequency of 1000Hz and programmable debounce. The PMC-53M-E provides the following programmable functions for its digital inputs:

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

2) **Pulse Counting** — Pulse counting is supported with programmable pulse weight and facilitates WAGES (Water, Air, Gas, Electricity and Steam) information collection.

The following table describes the DI's setup parameters:

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

Table 4-1 DI Setup Parameters

4.1.2 Digital Outputs (Optional)

The PMC-53M-E comes optionally with two Form A Electrometrical Relays. Digital Outputs are normally used for setpoint alarming, load control, or remote control applications.

Digital Outputs on the PMC-53M-E can be used in the following applications:

1) **Front Panel Control** — Manually operated from the front panel. Please refer to the **DO Control** setup parameter in Section 3.4.3 for a detailed description.

2) **Remote Control** — Remotely operated over communications via our free PMC Setup software or PecStar® iEMS Integrated Energy Management System.

3) **Control Setpoint** — Control Setpoints can be programmed to trigger DO action upon becoming active. Please refer to Section 4.4 for a detailed description.

Since there are multiple ways to trigger the Digital Outputs on the PMC-53M-E, a prioritized scheme has been developed to avoid conflicts between different applications. In general, Front Panel Control has the highest priority and can override other control schemes. Remote Control and Control 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 LED Energy Pulse Output

The PMC-53M-E comes standard with one front panel LED Pulse Output for energy pulsing. Energy Pulse Outputs are typically used for accuracy testing. Energy Pulsing via the front panel LED can be enabled from the front panel through the **ENGY PULS** setup parameter. The pulse constant can be configured as 1000/3200 pulses per kWh or kvarh through the **ENGY CNST** setup parameter.

4.2 Power and Energy

4.2.1 Basic Measurements

The PMC-53M-E provides the following basic measurements which are available through the LED display or communications.

Parameter	Phase A	Phase B	Phase C	Total	Average
Uln	●	●	●	-	●
Ull	●	●	●	-	●
Current	●	●	●	-	●
Neutral Current	-	-	-	In (Calculated)	-
kW	●	●	●	●	-
kvar	●	●	●	●	-
kVA	●	●	●	●	-
Power Factor	●	●	●	●	-
Frequency	●	-	-	-	-

Table 4-2 Basic Measurements

4.2.2 Energy Measurements

The PMC-53M-E provides Energy parameters for active energy (kWh), reactive energy (kvarh) and apparent energy (kVAh) with a resolution of 0.1k and a maximum value of ±100,000,000.0. When the maximum value is reached, the energy registers will automatically roll over to zero. The energy can be reset manually or preset to user-defined values through the front panel or via communications.

The PMC-53M-E provides the following energy measurements:

3-Phase Energy	kWh Import/Export/Net/Total
	kvarh Import/Export/Net/Total kvarh of Q1/Q2/Q3/Q4
	kVAh Total
Per-Phase Energy (Phase A/B/C):	kWh Import/Export/Net/Total
	kvarh Import/Export/Net/Total kvarh of Q1/Q2/Q3/Q4
	kVAh

Table 4-3 Energy Measurement

4.2.3 Demand Measurements

Demand is defined as the average power consumption over a fixed interval (usually 15 minutes) based on the sliding window method. The PMC-53M-E provides Present Demand and Predicted Demand for Ia, Ib, Ic, kW Total, kvar Total and kVA Total. Predicted Demand is typically used for pre-alarming and to help users reduce power consumption using a Setpoint to warn that the Demand limit may be exceeded.

The PMC-53M-E provides the following setup parameters which can be programmed via the Front Panel or via communication:

Setup Parameter	Definition	Options
Demand Period	1 to 60 minutes. For example, if the **# of Sliding Windows** is set as 1 and the **Demand Period** is 15, the demand cycle will be 1×15=15min.	1 to 60 min Default=15
# of Sliding Windows	Number of Sliding Windows.	1 to 15 Default=1
Self-Read Time	The **Self-Read Time** allows the user to specify the time and day of the month for the Peak Demand Self-Read operation. The **Self-Read Time** supports three options: • A zero value means that the Self-Read will take place at 00:00 of the first day of each month. • A non-zero value means that the Self-Read will take place at a specific time and day based on the formula: Self-Read Time = Day * 100 + Hour where 0 ≤ Hour ≤ 23 and 1 ≤ Day ≤ 28. For example, the value 1512 means that the Self-Read will take place at 12:00pm on the 15th day of each month. • A 0xFFFF value will disable the Self-Read operation and replace it with manual operation. A manual reset will cause the Max. Demand of **This Month** to be transferred to the Max. Demand of **Last Month** and then reset. The terms **This Month** and **Last Month** will become **Since Last Reset** and **Before Last Reset**.	Default=0xFFFF
Predicted Response	The Predicated Response shows the speed of the predicted demand output. A value between 70 and 99 is recommended for a reasonably fast response. Specify a higher value for higher sensitivity.	70 to 99 Default=70

Table 4-4 Demand Setup

4.3 Power Quality

4.3.1 Phase Angles

Phase analysis is used to identify the angle relationship between 3-phase Voltages and Currents.

For WYE connected systems, the per phase difference of the Current and Voltage angles should correspond to the per phase PF. For example, if the PF is 0.5 Lag and the Voltage phase angles are 0.0°, 240.0° and 120.0°, the Current phase angles should have the values of -60.0°, 180.0° and 60.0°.

4.3.2 Power Quality Parameters

The PMC-53M-E provides the following PQ parameters:

4.3.2.1 Harmonics

The PMC-53M-E provides harmonic analysis for THD, TOHD, TEHD and individual harmonics up to the 31st order. All harmonic parameters are available on the front panel and through communications. In addition, the PMC-53M-E also provides TDD, K-factor and Crest-factor measurements for current.

4.3.2.2 TDD

Total Demand Distortion (TDD) is defined as the ratio of the root mean square (rms) of the harmonic current to the root mean square value of the rated or maximum demand fundamental current.

TDD of the current I is calculated by the formula below:

$$TDD = \frac{\sqrt{\sum_{h=1}^{h=\infty} (I_h)^2}}{I_L}$$

where

I_L = maximum demand of fundamental current

h = harmonic order (1, 2, 3, 4, etc.)

I_h = rms load current at the harmonic order h

4.3.2.3 K-Factor

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

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

where

I_h = h_{th} Harmonic Current in RMS

h_{max} = Highest harmonic order

4.3.2.4 Crest Factor

Crest Factor is defined as the **Peak to Average Ratio (PAR)**, and its calculation is illustrated below:

$$C = \frac{|X|_{peak}}{X_{rms}}$$

where

$|X|_{peak}$ = Peak amplitude of the waveform

X_{rms} = RMS value

The following table illustrates the available Voltage and Current Harmonics measurements on the PMC-53M-E. Please note that THD and Individual Harmonics measurements up to the 31st are available on both the front panel and communications but the TDD, K-Factor and Crest Factor measurements are only available via communications.

	Phase A/AB	Phase B/BC	Phase C/CA
Harmonic-Voltage	THD	THD	THD
	TEHD	TEHD	TEHD
	TOHD	TOHD	TOHD
	2nd Harmonic	2nd Harmonic	2nd Harmonic
	…		
	31st Harmonic	31st Harmonic	31st Harmonic
Harmonic-Current	THD	THD	THD
	TEHD	TEHD	TEHD
	TOHD	TOHD	TOHD
	TDD	TDD	TDD
	TEDD	TEDD	TEDD
	TODD	TODD	TODD
	K-factor	K-factor	K-factor
	Crest-factor	Crest-factor	Crest-factor
	2nd Harmonic	2nd Harmonic	2nd Harmonic
	…		
	31st Harmonic	31st Harmonic	31st Harmonic

Table 4-5 Harmonic Measurements

4.3.3 Unbalance

The PMC-53M-E provides Voltage and Current Unbalance measurements. The calculation method of Voltage and Current Unbalances are listed below:

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

where

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

and

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

The Voltage and Current Unbalance measurements are only available via communications.

4.4 Setpoints

The PMC-53M-E 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.

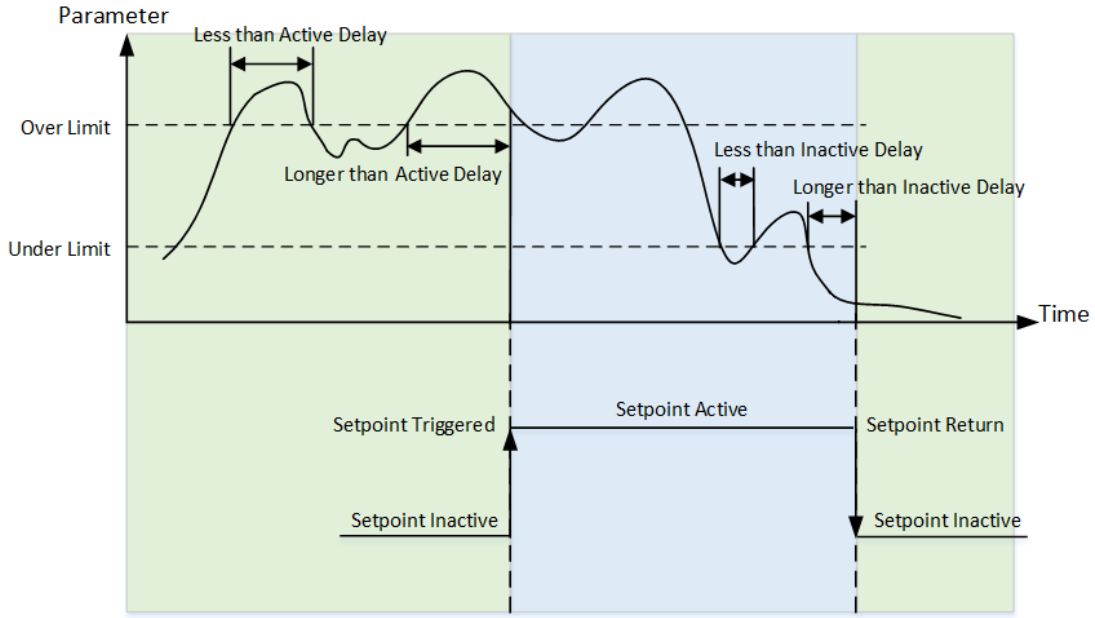


Figure 4-1 Over Setpoint

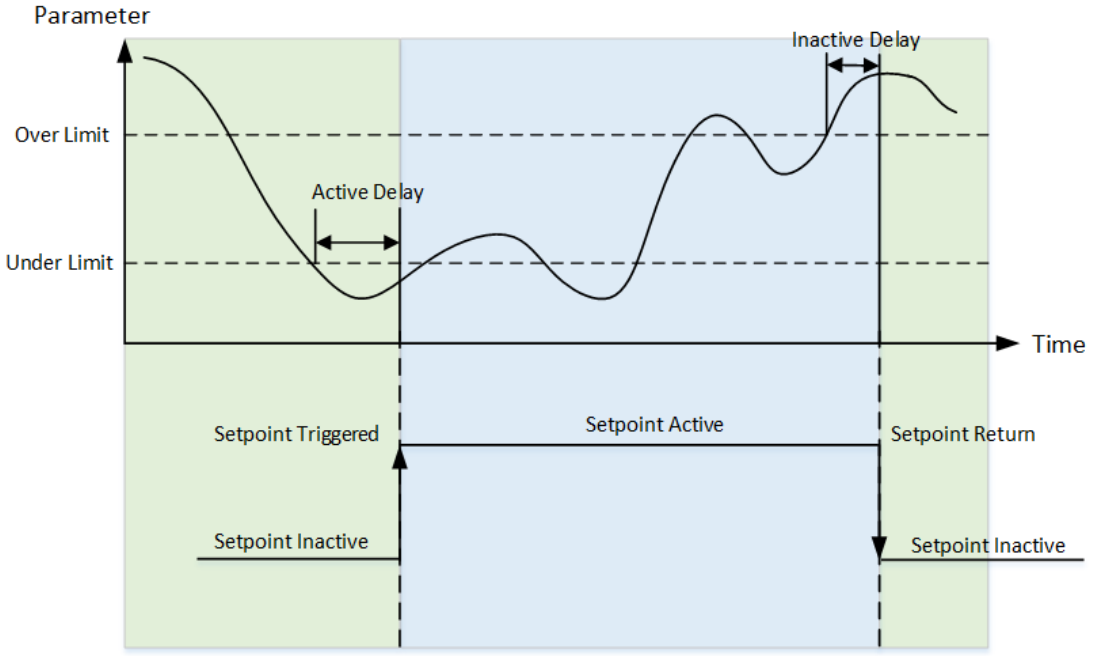


Figure 4-2 Under Setpoint

Setpoints can be programmed via the Front Panel or through communications and have the following setup parameters:

Setup Parameter	Definition	Options/Default*
Setpoint Type	Disabled, Over or Under Setpoint.	0=Disabled* 1=Over Setpoint 2=Under Setpoint
Setpoint Parameter	Specify the parameter to be monitored.	See Table 4-7 0*
Over Limit	Specify the value that the setpoint parameter must exceed for Over Setpoint to become active or for Under Setpoint to become inactive.	0*
Under Limit	Specify the value that the setpoint parameter must go below for Over Setpoint to become inactive or for Under Setpoint to become active.	0*
Active Delay	Specify the minimum duration that the setpoint condition must be met before the setpoint becomes active. An event will be generated and stored in the SOE Log. The range of the **Active Delay** is between 0 and 9999 seconds.	0 to 9999s Default=10
Inactive Delay	Specify the minimum duration that the setpoint return condition must be met before the setpoint becomes inactive. An event will be generated and stored in the SOE Log. The range of the **Inactive Delay** is between 0 and 9999 seconds.	0 to 9999 Default=10
Setpoint Trigger	Specify what action a setpoint would take when it becomes active.	See table 4-8 0*

Table 4-6 Description for Setpoint Parameters

Key	Parameter	Scale	Unit
0	None	-	
1	Uln (Any Phase Voltage)	x1	V
2	Ull (Any Line Voltage)		
3	Current (Any Phase Current)		A
4	In (Calculated)		
5	Frequency		Hz
6	kW Total		W
7	kvar Total		var
8	kVA Total		VA
9	PF Total		-

10	kW Total Present Demand		W
11	kvar Total Present Demand		var
12	kVA Total Present Demand		VA
13	kW Total Predicted Demand		W
14	kvar Total Predicted Demand		var
15	kVA Total Predicted Demand		VA
16	Voltage THD		100%
17	Voltage TOHD		100%
18	Voltage TEHD		100%
19	Current THD		100%
20	Current TOHD		100%
21	Current TEHD		100%
22	Voltage Unbalance		100%
23	Current Unbalance		100%
24	Phase Reversal[1]		

Table 4-7 Setpoint Parameters

Note:

1) When the **Setpoint Parameter** is set to **Phase Reversal**, the **Setpoint Type** must be set to **1 (Over Setpoint)**, and there is no need to set **Over Limit** and **Under Limit**. Please be informed that the Phase Reversal Setpoint assumes that the phase sequencing is based on **Positive** or **Clockwise** rotation (ABC).

Key	Action
0	None
1	DO1 Closed
2	DO2 Closed

Table 4-8 Setpoint Triggers

4.5 Logging

4.5.1 Max./Min. Log

The PMC-53M-E records the **Max. Log** and **Min. Log** of **This Month (Since Last Reset)** and **Last Month (Before Last Reset)** with timestamp for 44 parameters. Each log includes the relevant parameter value and its timestamp. The recorded data is stored in non-volatile memory and will not suffer any loss in the event of a power failure. The PMC-53M-E's Max./Min. Log records the following parameters:

Max./Min. Parameters					
Ia	Ib	Ic	I avg	Uan	Ubn
Ucn	Uln avg	Uab	Ubc	Uca	Ull avg
kWa	kWb	kWc	kW Total	kvara	kvarb
kvarc	kvar Total	kVAa	kVAb	kVAc	kVA Total
PFa	PFb	PFc	PF Total	Frequency	In (Calculated)
Ia THD	Ib THD	Ic THD	Uan/Uab THD	Ubn/Ubc THD	Ucn/Uca THD
Ia K-Factor	Ib K-Factor	Ic K-Factor	Ia Crest-factor	Ib Crest-factor	Ic Crest-factor
U Unbal.	I Unbal.				

Table 4-9 Max./Min. Log

The same **Self-Read Time** for the Peak Demand Log is used to specify the time and day of the month for the Max./Min. Self-Read operation. Please refer to **Section 4.2.3** for a complete description of the **Self-Read Time** and its operation. The Max./Min. Log of This Month (Since Last Reset) can be reset manually from the front panel or via communications.

4.5.2 Peak Demand Log

The PMC-53M-E records the **Peak Demand** of **This Month (Since Last Reset)** and **Last Month (Before Last Reset)** with timestamp for Ia, Ib, Ic, kW Total, kvar Total and kVA. All Peak Demand information can be accessed through the front panel as well as communications. Please refer to **Section 4.2.3** for a complete description of the **Self-Read Time** and its operation.

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

Table 4-10 Peak Demand Log

4.5.3 SOE Log

The PMC-53M-E's SOE Log can store up to 64 events such as Power-on, Power-off, Digital Input status changes, Digital Output status changes, Setup changes and Setpoint events in its non-volatile memory. Each event record includes the event classification, its relevant parameter values and a timestamp in ±1 ms 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 First-In-First-Out basis. The SOE Log can be reset from the front panel or via communications.

4.6 Diagnostics

The PMC-53M-E provides wiring error detection for 3P4W and 3P3W wiring modes, which allow users to check for possible problems especially during the initial commissioning stage. The following wiring errors may be detected:

- Frequency Out-of-Range
- Voltage / Current Phase Loss
- Incorrect Voltage and Current Phase Sequence
- kW Direction per phase and Total
- Possible Incorrect CT Polarity

Please note the above detection is based on the assumptions below:

- The Voltage and Current Phase Sequence are consistent
- kW is kW Import, which means the kW is over 0
- The wiring is correct
- 3P4W wiring mode supports all detections
- 3P3W wiring mode does not support the detection of Voltage Phase Loss, kW Direction per phase and CT Polarity

The Diagnostic register (0101) indicates the status of the wiring error detection with a bit value of 1 meaning active and 0 meaning inactive which are illustrated in table below:

Bit	Event
B00	Summary Bit (Set if any other bit is set)
B01	Frequency is out of range (45 to 65Hz) (3P4W or 3P3W)
B02	Any phase voltage < 10% of PT Primary (Register 6000) (3P4W only)
B03	Any phase current < 10% of CT Primary (Register 6004) (3P4W or 3P3W)
B04~05	Reserved
B06	Voltage Phase Reversal (3P4W only)
B07	Current Phase Reversal (3P4W or 3P3W)
B08	Negative kW Total may be abnormal (3P4W or 3P3W)
B09	Negative kWa may be abnormal (3P4W only)
B10	Negative kWb may be abnormal (3P4W only)
B11	Negative kWc may be abnormal (3P4W only)
B12	CTa polarity may be reversed (3P4W only)
B13	CTb polarity may be reversed (3P4W only)
B14	CTc polarity may be reversed (3P4W only)
B15	Reserved

Table 4-11 Wiring Diagnostic Register

Chapter 5 Modbus Register Map

This chapter provides a complete description of the Modbus register map (**Protocol Version 1.0**) for the PMC-53M-E to facilitate the development of 3rd party communications driver for accessing information on the PMC-53M-E. For a complete Modbus Protocol Specification, please visit http://**www.modbus.org**. The PMC-53M-E 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)

The following table provides a description of the different data formats used for the Modbus registers. The PMC-53M-E uses the Big Endian byte ordering system.

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

5.1 Basic Measurements

Register	Property	Description	Format	Scale	Unit
0000	RO	Uan	Float	x1	V
0002	RO	Ubn	Float		
0004	RO	Ucn	Float		
0006	RO	Uln Average	Float		
0008	RO	Uab	Float		
0010	RO	Ubc	Float		
0012	RO	Uca	Float		
0014	RO	Ull Average	Float		
0016	RO	Ia	Float		A
0018	RO	Ib	Float		
0020	RO	Ic	Float		
0022	RO	I Average	Float		
0024	RO	kWa	Float		W
0026	RO	kWb	Float		
0028	RO	kWc	Float		
0030	RO	kW Total	Float		
0032	RO	kvara	Float		var
0034	RO	kvarb	Float		
0036	RO	kvarc	Float		
0038	RO	kvar Total	Float		
0040	RO	kVAa	Float		VA
0042	RO	kVAb	Float		
0044	RO	kVAc	Float		
0046	RO	kVA Total	Float		
0048	RO	PFa	Float		-
0050	RO	PFb	Float		-
0052	RO	PFc	Float		-
0054	RO	PF Total	Float		-
0056	RO	Frequency	Float		Hz
0058	RO	Uan/Uab (3P3W) Angle	Float		°
0060	RO	Ubn/Ubc (3P3W) Angle	Float		°
0062	RO	Ucn/Uca (3P3W) Angle	Float		°
0064	RO	Ia Angle	Float		°
0066	RO	Ib Angle	Float		°
0068	RO	Ic Angle	Float		°
0070	RO	In (Calculated)	Float		A
0072	RO	Reserved	Float		
0074	RO	Displacement PFa	Float		-
0076	RO	Displacement PFb	Float		-

0078	RO	Displacement PFc	Float		-
0080	RO	Displacement PF Total	Float		-
0082~0094	RO	Reserved	Float		-
0096	RO	DI Status[1,2]	UINT16		-
0097	RO	Reserved	UINT16		-
0098	RO	DO Status[1,3]	UINT16		-
0099	RO	Reserved	UINT16		-
0100	RO	Setpoint Status[4]	UINT16		-
0101	RO	Wiring Diagnostic Status[5]	UINT16		-
0102	RO	SOE Log Pointer[6]	UINT32		-
0104	RO	Device Operating Time[7]	UINT32	x0.1	0.1Hour

Table 5-1 Basic Measurements

Notes:

1) DO Status and DI Status are only meaningful if the meter is equipped with the corresponding option.

2) For the **DI Status** register, the bit values of B0 to B3 represent the states of DI1 to DI4, respectively, with "1" meaning Active (Closed) and "0" meaning Inactive (Open).

3) For the **DO Status** register, the bit values of B0 to B1 represent the states of DO1 to DO2, respectively, with "1" meaning Active (Closed) and "0" meaning Inactive (Open).

4) For the **Setpoint Status** register, the bit values indicate the various Setpoint states with "1" meaning Active and "0" meaning Inactive. The following table illustrates the details of the **Alarm Status** register.

Bit15	**Bit14**	**Bit13**	**Bit12**	**Bit11**	**Bit10**	**Bit9**	**Bit8**
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Setpoint9
Bit7	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
Setpoint8	Setpoint7	Setpoint6	Setpoint5	Setpoint4	Setpoint3	Setpoint2	Setpoint1

Table 5-2 Alarm Status Register

5) The following table illustrates the Wiring Diagnostic Status with 0 meaning Normal and 1 meaning Abnormal:

Bit	Event
B00	Summary Bit (Set if any other bit is set)
B01	Frequency is out of range (45 to 65Hz) (3P4W or 3P3W)
B02	Any phase voltage < 10% of PT Primary (Register 6000) (3P4W only)
B03	Any phase current < 10% of CT Primary (Register 6004) (3P4W or 3P3W)
B04~05	Reserved
B06	Voltage Phase Reversal (3P4W only)
B07	Current Phase Reversal (3P4W or 3P3W)
B08	Negative kW Total may be abnormal (3P4W or 3P3W)
B09	Negative kWa may be abnormal (3P4W only)
B10	Negative kWb may be abnormal (3P4W only)
B11	Negative kWc may be abnormal (3P4W only)
B12	CTa polarity may be reversed (3P4W only)
B13	CTb polarity may be reversed (3P4W only)
B14	CTc polarity may be reversed (3P4W only)
B15	Reserved

Table 5-3 Wiring Diagnostic Status Register

6) The PMC-53M-E has one SOE Log. The SOE log has a Log Pointer that indicates its current logging position. The range of the **Log Pointer** is between 0 and 0xFFFFFFFF, and it is incremented by one for every new log generated and will roll over to 0 if its current value is 0xFFFFFFFF. A value of zero indicates that the SOE does not contain any Log. If a **Clear Log** is performed via communications, its **Log Pointer** will be reset to zero. Therefore, any 3rd party software should assume that a Clear Log action has been performed if it sees the SOE Log Pointer rolling over to zero or to a value that is smaller than its own pointer.

   Use the following equation to determine the latest log location:

   Latest Log Location = Modulo [**SOE Log Pointer** / **SOE Log Depth (fixed at 64)**]

7) The **Device Operating Time** means the accumulated Operating Time whenever any per-phase Current exceeds 2% of $I_{nominal}$ (5A), which is 100mA. The Device Operating Time data is stored in

non-volatile memory and will not suffer any loss in the event of a power failure.

5.2 Energy Measurements

The Energy registers have a maximum value of 1,000,000,000 and will roll over to zero automatically when it is reached. The actual energy value is 0.1 times of the register value.

5.2.1 3-Phase Total Energy Measurements

Register	Property	Description	Format	Scale	Unit
0500	RW	kWh Import	INT32	x0.1	kWh
0502	RW	kWh Export	INT32		
0504	RO	kWh Net	INT32		
0506	RO	kWh Total	INT32		
0508	RW	kvarh Import	INT32		kvarh
0510	RW	kvarh Export	INT32		
0512	RO	kvarh Net	INT32		
0514	RO	kvarh Total	INT32		
0516	RW	kVAh	INT32		kVAh
0518	RW	kvarh Q1	INT32		kvarh
0520	RW	kvarh Q2	INT32		
0522	RW	kvarh Q3	INT32		
0524	RW	kvarh Q4	INT32		

Table 5-4 3-phase Total Energy Measurements

5.2.2 Phase A (L1) Energy Measurements

Register	Property	Description	Format	Scale	Unit
0620	RW	kWh Import	INT32	x0.1	kWh
0622	RW	kWh Export	INT32		
0624	RO	kWh Net	INT32		
0626	RO	kWh Total	INT32		
0628	RW	kvarh Import	INT32		kvarh
0630	RW	kvarh Export	INT32		
0632	RO	kvarh Net	INT32		
0634	RO	kvarh Total	INT32		
0636	RW	kVAh	INT32		kVAh
0638	RW	kvarh Q1	INT32		kWh
0640	RW	kvarh Q2	INT32		
0642	RW	kvarh Q3	INT32		
0644	RW	kvarh Q4	INT32		

Table 5-5 Phase A Energy Measurements

5.2.3 Phase B (L2) Energy Measurements

Register	Property	Description	Format	Scale	Unit
0740	RW	kWh Import	INT32	x0.1	kWh
0742	RW	kWh Export	INT32		
0744	RO	kWh Net	INT32		
0746	RO	kWh Total	INT32		
0748	RW	kvarh Import	INT32		kvarh
0750	RW	kvarh Export	INT32		
0752	RO	kvarh Net	INT32		
0754	RO	kvarh Total	INT32		
0756	RW	kVAh	INT32		kVAh
0758	RW	kvarh Q1	INT32		kvarh
0760	RW	kvarh Q2	INT32		
0762	RW	kvarh Q3	INT32		
0764	RW	kvarh Q4	INT32		

Table 5-6 Phase B Energy Measurements

5.2.4 Phase C (L3) Energy Measurements

Register	Property	Description	Format	Scale	Unit
0860	RW	kWh Import	INT32	x0.1	kWh

0862	RW	kWh Export	INT32		
0864	RO	kWh Net	INT32		
0866	RO	kWh Total	INT32		
0868	RW	kvarh Import	INT32		kvarh
0870	RW	kvarh Export	INT32		
0872	RO	kvarh Net	INT32		
0874	RO	kvarh Total	INT32		
0876	RW	kVAh	INT32		kVAh
0878	RW	kvarh Q1	INT32		kvarh
0880	RW	kvarh Q2	INT32		
0882	RW	kvarh Q3	INT32		
0884	RW	kvarh Q4	INT32		

Table 5-7 Phase C Energy Measurements

5.3 DI Pulse Counters (Optional)

Register	Property	Description	Format	Range/Unit
1200	RW	DI1 Pulse Counter	UINT32	0 to 1,000,000,000 DI Pulse Counter= Pulse Counter x DI Pulse Weight
1202	RW	DI2 Pulse Counter	UINT32	
1204	RW	DI3 Pulse Counter	UINT32	
1206	RW	DI4 Pulse Counter	UINT32	
1208~1210	RW	Reserved	UINT32	

Table 5-8 DI Pulse Counter

5.4 Harmonic Measurements

5.4.1 Power Quality Measurements

Register	Property	Description	Format	Scale	Unit
1300	RO	Ia TDD	Float	x1	-
1302	RO	Ib TDD	Float		
1304	RO	Ic TDD	Float		
1306	RO	Ia TDD Odd	Float		
1308	RO	Ib TDD Odd	Float		
1310	RO	Ic TDD Odd	Float		
1312	RO	Ia TDD Even	Float		
1314	RO	Ib TDD Even	Float		
1316	RO	Ic TDD Even	Float		
1318	RO	Ia K-factor	Float		
1320	RO	Ib K-factor	Float		
1322	RO	Ic K-factor	Float		
1324	RO	Ia Crest-factor	Float		
1326	RO	Ib Crest-factor	Float		
1328	RO	Ic Crest-factor	Float		
1330	RO	Voltage Unbalance	Float		
1332	RO	Current Unbalance	Float		

Table 5-9 Power Quality Measurements

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Ib/Ic TDD/TDD Odd/TDD Even/K-factor/Crest-factor have no meaning, and their registers are reserved.

2) When the **Wiring Mode** is **1P3W,** the Ic TDD/TDD Odd/TDD Even/K-factor/Crest-factor have no meaning, and their registers are reserved.

5.4.2 Current Harmonic Measurements

Register	Property	Description	Format	Scale	Unit
1400	RO	Ia THD	Float	x1	-
1402	RO	Ib THD	Float		
1404	RO	Ic THD	Float		
1406	RO	Ia TOHD	Float		
1408	RO	Ib TOHD	Float		
1410	RO	Ic TOHD	Float		
1412	RO	Ia TEHD	Float		
1414	RO	Ib TEHD	Float		

1416	RO	Ic TEHD	Float		
1418	RO	Ia HD02	Float		
1420	RO	Ib HD02	Float		
1422	RO	Ic HD02	Float		
1424~1590	RO	…	Float		
1592	RO	Ia HD31	Float		
1594	RO	Ib HD31	Float		
1596	RO	Ic HD31	Float		

Table 5-10 Current Harmonic Measurements

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Ib/Ic THD/TOHD/TEHD/HD*xx* have no meaning, and their registers are reserved.
2) When the **Wiring Mode** is **1P3W**, the Ic THD/TOHD/TEHD/HD*xx* have no meaning, and their registers are reserved.

5.4.3 Voltage Harmonic Measurements

Register	Property	Description	Format	Scale	Unit
1600	RO	Uan/Uab THD	Float	x1	-
1602	RO	Ubn/Ubc THD	Float		
1604	RO	Ucn/Uca THD	Float		
1606	RO	Uan/Uab TOHD	Float		
1608	RO	Ubn/Ubc TOHD	Float		
1610	RO	Ucn/Uca TOHD	Float		
1612	RO	Uan/Uab TEHD	Float		
1614	RO	Ubn/Ubc TEHD	Float		
1616	RO	Ucn/Uca TEHD	Float		
1618	RO	Uan/Uab HD02	Float		
1620	RO	Ubn/Ubc HD02	Float		
1622	RO	Ucn/Uca HD02	Float		
1624~1790	RO	…	Float		
1792	RO	Uan/Uab HD31	Float		
1794	RO	Ubn/Ubc HD31	Float		
1796	RO	Ucn/Uca HD31	Float		

Table 5-11 Voltage Harmonic Measurements

Notes:

1) When the **Wiring Mode** is **3P3W** or **1P2W L-L**, the phase A/B/C Voltage THD/TOHD/TEHD/HD*xx* mean phase AB/BC/CA Voltage THD/TOHD/TEHD/HD*xx*.
2) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Ubn/Ucn THD/TOHD/TEHD/HD*xx* have no meaning, and their registers are reserved.
3) When the **Wiring Mode** is **1P3W**, the Ucn THD/TOHD/TEHD/HD*xx* have no meaning, and their registers are reserved.

5.5 Demands

5.5.1 Present Demands

Register	Property	Description	Format	Scale	Unit
3000	RO	Ia	Float	x1	A
3002	RO	Ib	Float		
3004	RO	Ic	Float		
3006	RO	kW Total	Float	x1	W
3008	RO	kvar Total	Float	x1	var
3010	RO	kVA Total	Float	x1	VA

Table 5-12 Present Demand Measurements

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Ib/Ic Present Demand have no meaning, and their registers are reserved.
2) When the **Wiring Mode** is **1P3W**, the Ic Present Demand has no meaning, and its register is reserved.

5.5.2 Predicted Demands

Register	Property	Description	Format	Scale	Unit
3200	RO	Ia	Float	x1	A
3202	RO	Ib	Float		
3204	RO	Ic	Float		
3206	RO	kW Total	Float	x1	W
3208	RO	kvar Total	Float	x1	var
3210	RO	kVA Total	Float	x1	VA

Table 5-13 Predicted Demand Measurements

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Ib/Ic Predicted Demand have no meaning, and their registers are reserved.
2) When the **Wiring Mode** is **1P3W**, the Ic Predicted Demand has no meaning, and its register is reserved.

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

Register	Property	Description	Format	Scale	Unit
3400~3405	RO	Ia	See Section 5.5.5 Demand Data Structure	x1	A
3406~3411	RO	Ib			
3412~3417	RO	Ic			
3418~3423	RO	kW Total			W
3424~3429	RO	kvar Total			var
3430~3435	RO	kVA Total			VA

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

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Ib/Ic Peak Demand of This Month (Since Last Reset) registers have no meaning, and their registers are reserved.
2) When the **Wiring Mode** is **1P3W**, the Ic Peak Demand of This Month (Since Last Reset) and its register is reserved.

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

Register	Property	Description	Format	Scale	Unit
3600~3605	RO	Ia	See Section 5.5.5 Demand Data Structure	x1	A
3606~3611	RO	Ib			
3612~3617	RO	Ic			
3618~3623	RO	kW Total			W
3624~3629	RO	kvar Total			var
3630~3635	RO	kVA Total			VA

Table 5-15 Peak Demand Log of Last Month (Before Last Reset)

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Ib/Ic Peak Demand of Last Month (Before Last Reset) registers have no meaning, and their registers are reserved.
2) When the **Wiring Mode** is **1P3W**, the Ic Peak Demand of Last Month (Before Last Reset) has no meaning, and its register is reserved.

5.5.5 Demand Data Structure

Offset		Description
+0	High	Year - 2000
	Low	Month
+1	High	Day
	Low	Hour
+2	High	Minute
	Low	Second
+3	-	Millisecond
+4~+5	-	Peak Demand Value

Table 5-16 Demand Data Structure

5.6 Max./Min. Log

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

Register	Property	Description	Format	Scale	Unit
4000~4005	RO	Uan	See 5.6.5 Max./Min. Log Structure	x1	V
4006~4011	RO	Ubn			
4012~4017	RO	Ucn			
4018~4023	RO	Uln Average			
4024~4029	RO	Uab			
4030~4035	RO	Ubc			
4036~4041	RO	Uca			
4042~4047	RO	Ull Average			
4048~4053	RO	Ia		x1	A
4054~4059	RO	Ib			
4060~4065	RO	Ic			
4066~4071	RO	I Average			
4072~4077	RO	kWa		x1	W
4078~4083	RO	kWb			
4084~4089	RO	kWc			
4090~4095	RO	kW Total			
4096~4101	RO	kvara		x1	var
4102~4107	RO	kvarb			
4108~4113	RO	kvarc			
4114~4119	RO	kvar Total			
4120~4125	RO	kVAa		x1	VA
4126~4131	RO	kVAb			
4132~4137	RO	kVAc			
4138~4143	RO	kVA Total			
4144~4149	RO	PFa		x1	-
4150~4155	RO	PFb			
4156~4161	RO	PFc			
4162~4167	RO	PF Total			
4168~4173	RO	Frequency		x1	Hz
4174~4179	RO	In (Calculated)		x1	A
4180~4185	RO	Uan/Uab THD		x1	-
4186~4191	RO	Ubn/Ubc THD			
4192~4197	RO	Ucn/Uca THD			
4198~4203	RO	Ia THD			
4204~4209	RO	Ib THD			
4210~4215	RO	Ic THD			
4216~4221	RO	Ia K-factor			
4222~4227	RO	Ib K-factor			
4228~4233	RO	Ic K-factor			
4234~4239	RO	Ia Crest-factor			
4240~4245	RO	Ib Crest-factor			
4246~4251	RO	Ic Crest-factor			
4252~4257	RO	Voltage Unbalance			
4258~4263	RO	Current Unbalance			

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

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Phase B and Phase C Max. measurements of This Month (Since Last Reset) have no meaning, and their registers are reserved.

2) When the **Wiring Mode** is **1P3W**, the Phase C Max. measurements of This Month (Since Last Reset) have no meaning, and their registers are reserved.

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

Register	Property	Description	Format	Scale	Unit
4300~4305	RO	Uan	See 5.6.5 Max./Min. Log Structure	x1	V
4306~4311	RO	Ubn			
4312~4317	RO	Ucn			
4318~4323	RO	Uln Average			
4324~4329	RO	Uab			

4330~4335	RO	Ubc			
4336~4341	RO	Uca			
4342~4347	RO	Ull Average			
4348~4353	RO	Ia		x1	A
4354~4359	RO	Ib			
4360~4365	RO	Ic			
4366~4371	RO	I Average			
4372~4377	RO	kWa		x1	W
4378~4383	RO	kWb			
4384~4389	RO	kWc			
4390~4395	RO	kW Total			
4396~4401	RO	kvara		x1	var
4402~4407	RO	kvarb			
4408~4413	RO	kvarc			
4414~4419	RO	kvar Total			
4420~4425	RO	kVAa		x1	VA
4426~4431	RO	kVAb			
4432~4437	RO	kVAc			
4438~4443	RO	kVA Total			
4444~4449	RO	PFa		x1	-
4450~4455	RO	PFb			
4456~4461	RO	PFc			
4462~4467	RO	PF Total			
4468~4473	RO	Frequency		x1	Hz
4474~4479	RO	In (Calculated)		x1	A
4480~4485	RO	Uan/Uab THD		x1	-
4486~4491	RO	Ubn/Ubc THD			
4492~4497	RO	Ucn/Uca THD			
4498~4503	RO	Ia THD			
4504~4509	RO	Ib THD			
4510~4515	RO	Ic THD			
4516~4521	RO	Ia K-factor			
4522~4527	RO	Ib K-factor			
4528~4533	RO	Ic K-factor			
4534~4539	RO	Ia Crest-factor			
4540~4545	RO	Ib Crest-factor			
4546~4551	RO	Ic Crest-factor			
4552~4557	RO	Voltage Unbalance			
4558~4563	RO	Current Unbalance			

Table 5-18 Min. Log of This Month (Since Last Reset)

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Phase B and Phase C Min. measurements of This Month (Since Last Reset) have no meaning, and their registers are reserved.

2) When the **Wiring Mode** is **1P3W**, the Phase C Min. measurements of This Month (Since Last Reset) have no meaning, and their registers are reserved.

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

Register	Property	Description	Format	Scale	Unit
4600~4605	RO	Uan	See 5.6.5 Max./Min. Log Structure	x1	V
4606~4611	RO	Ubn			
4612~4617	RO	Ucn			
4618~4623	RO	Uln Average			
4624~4629	RO	Uab			
4630~4635	RO	Ubc			
4636~4641	RO	Uca			
4642~4647	RO	Ull Average			
4648~4653	RO	Ia		x1	A
4654~4659	RO	Ib			
4660~4665	RO	Ic			
4666~4671	RO	I Average			
4672~4677	RO	kWa		x1	W
4678~4683	RO	kWb			
4684~4689	RO	kWc			

4690~4695	RO	kW Total			
4696~4701	RO	kvara		x1	var
4702~4707	RO	kvarb			
4708~4713	RO	kvarc			
4714~4719	RO	kvar Total			
4720~4725	RO	kVAa		x1	VA
4726~4731	RO	kVAb			
4732~4737	RO	kVAc			
4738~4743	RO	kVA Total			
4744~4749	RO	PFa		x1	-
4750~4755	RO	PFb			
4756~4761	RO	PFc			
4762~4767	RO	PF Total			
4768~4773	RO	Frequency		x1	Hz
4774~4779	RO	In (Calculated)		x1	-
4780~4785	RO	Uan/Uab THD			
4786~4791	RO	Ubn/Ubc THD			
4792~4797	RO	Ucn/Uca THD			
4798~4803	RO	Ia THD			
4804~4809	RO	Ib THD			
4810~4815	RO	Ic THD			
4816~4821	RO	Ia K-factor			
4822~4827	RO	Ib K-factor			
4828~4833	RO	Ic K-factor			
4834~4839	RO	Ia Crest-factor			
4840~4845	RO	Ib Crest-factor			
4846~4851	RO	Ic Crest-factor			
4852~4857	RO	Voltage Unbalance			
4858~4863	RO	Current Unbalance			

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

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Phase B and Phase C Max. measurements of Last Month (Before Last Reset) have no meaning, and their registers are reserved.

2) When the **Wiring Mode** is **1P3W**, the Phase C Max. measurements of Last Month (Before Last Reset) have no meaning, and their registers are reserved.

5.6.4 Min. Log of Last Month (Before Last Reset)

Register	Property	Description	Format	Scale	Unit
4900~4905	RO	Uan	See 5.6.5 Max./Min. Log Structure	x1	V
4906~4911	RO	Ubn			
4912~4917	RO	Ucn			
4918~4923	RO	Uln Average			
4924~4929	RO	Uab			
4930~4935	RO	Ubc			
4936~4941	RO	Uca			
4942~4947	RO	Ull Average			
4948~4953	RO	Ia		x1	A
4954~4959	RO	Ib			
4960~4965	RO	Ic			
4966~4971	RO	I Average			
4972~4977	RO	kWa		x1	W
4978~4983	RO	kWb			
4984~4989	RO	kWc			
4990~4995	RO	kW Total			
4996~5001	RO	kvara		x1	var
5002~5007	RO	kvarb			
5008~5013	RO	kvarc			
5014~5019	RO	kvar Total			
5020~5025	RO	kVAa		x1	VA
5026~5031	RO	kVAb			
5032~5037	RO	kVAc			
5038~5043	RO	kVA Total			
5044~5049	RO	PFa		x1	-

5050~5055	RO	PFb			
5056~5061	RO	PFc			
5062~5067	RO	PF Total			
5068~5073	RO	Frequency		x1	Hz
5074~5079	RO	In (Calculated)		x1	A
5080~5085	RO	Uan/Uab THD		x1	-
5086~5091	RO	Ubn/Ubc THD			
5092~5097	RO	Ucn/Uca THD			
5098~5103	RO	Ia THD			
5104~5109	RO	Ib THD			
5110~5115	RO	Ic THD			
5116~5121	RO	Ia K-factor			
5122~5127	RO	Ib K-factor			
5128~5133	RO	Ic K-factor			
5134~5139	RO	Ia Crest-factor			
5140~5145	RO	Ib Crest-factor			
5146~5151	RO	Ic Crest-factor			
5152~5157	RO	Voltage Unbalance			
5158~5163	RO	Current Unbalance			

Table 5-20 Min. Log of Last Month (Before Last Reset)

Notes:

1) When the **Wiring Mode** is **1P2W L-N** or **1P2W L-L**, the Phase B and Phase C Min. measurements of Last Month (Before Last Reset) have no meaning, and their registers are reserved.
2) When the **Wiring Mode** is **1P3W**, the Phase C Min. measurements of Last Month (Before Last Reset) have no meaning, and their registers are reserved.

5.6.5 Max./Min. Log Structure

Offset		Description
+0	High	Year - 2000
	Low	Month
+1	High	Day
	Low	Hour
+2	High	Minute
	Low	Second
+3	-	Millisecond
+4~+5	-	Max./Min. Value

Table 5-21 Max./Min. Structure

5.7 SOE Log

The SOE Log 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 Log Pointer value: Register Address = 10000 + Modulo(SOE Log Pointer-1/64)*8

Register	Property	Description	Format
10000~10007	RO	Event 1	See Table 5-23 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	
10088~10095	RO	Event 12	
...		...	
10504~10511	RO	Event 64	

Table 5-22 SOE Log

Notes:

1) SOE Log Data Structure

Offset	Property	Description	Unit
+0	RO	High-order Byte: Event Classification	See Table 5-24 SOE Classification
	RO	Low-order Byte: Sub-Classification	
+1	RO	Record Time: Year	0-99 (Year-2000)
	RO	Record Time: Month	1 to 12
+2	RO	Record Time: Day	1 to 31
	RO	Record Time: Hour	0 to 23
+3	RO	Record Time: Minute	0 to 59
	RO	Record Time: Second	0 to 59
+4	RO	Record Time: Millisecond	0 to 999
+5	RO	High-order Byte: Reserved	-
	RO	Low-order Byte: Status[2]	-
+6 to +7	RO	Event Value[2]	-

Table 5-23 SOE Log Data Structure

2) SOE Classification

Event Classification	Sub-Classification	Status	Event Value	Description
1=DI Changes	1	1 / 0		DI1 Inactive / DI1 Active
	2	1 / 0		DI2 Inactive / DI2 Active
	3	1 / 0		DI3 Inactive / DI3 Active
	4	1 / 0		DI4 Inactive / DI4 Active
2=DO Changes	1	1 / 0		DO1 Operated/Released by Remote Control
	2	1 / 0		DO2 Operated/Released by Remote Control
	3~10			Reserved
	11	1 / 0		DO1 Operated/Released by Setpoint
	12	1 / 0		DO2 Operated/Released by Setpoint
	13~20			Reserved
	21	1 / 0		DO1 Operated/Released by Front Panel
	22	1 / 0		DO2 Operated/Released by Front Panel
	23~24	1 / 0		Reserved
3=Setpoint	1	1 / 0	Trigger Value / Return Value	Over Uln Setpoint Active/Return
	2	1 / 0		Over Ull Setpoint Active/Return
	3	1 / 0		Over Current Setpoint Active/Return
	4	1 / 0		Over In (calculated) Setpoint Active/Return
	5	1 / 0		Over Frequency Setpoint Active/Return
	6	1 / 0		Over kW Total Setpoint Active/Return
	7	1 / 0		Over kvar Total Setpoint Active/Return
	8	1 / 0		Over kVA Total Setpoint Active/Return
	9	1 / 0		Over PF Total Setpoint Active/Return
	10	1 / 0		Over kW Total Present Demand Setpoint Active/Return
	11	1 / 0		Over kvar Total Present Demand Setpoint Active/Return
	12	1 / 0		Over kVA Total Present Demand Setpoint Active/Return
	13	1 / 0		Over kW Total Predicted Demand Setpoint Active/Return
	14	1 / 0		Over kvar Total Predicted Demand Setpoint Active/Return
	15	1 / 0		Over kVA Total Predicted Demand Setpoint Active/Return
	16	1 / 0		Over Voltage THD Setpoint Active/Return
	17	1 / 0		Over Voltage TOHD Setpoint Active/Return
	18	1 / 0		Over Voltage TEHD Setpoint Active/Return
	19	1 / 0		Over Current THD Setpoint Active/Return
	20	1 / 0		Over Current TOHD Setpoint Active/Return
	21	1 / 0		Over Current TEHD Setpoint Active/Return
	22	1 / 0		Over Voltage Unbalance Setpoint Active/Return
	23	1 / 0		Over Current Unbalance Setpoint Active/Return
	24	1 / 0		Reversal Phase Setpoint Active/Return

	25~40			Reserved
	41	1 / 0		Under Uln Setpoint Active/Return
	42	1 / 0		Under Ull Setpoint Active/Return
	43	1 / 0		Under Current Setpoint Active/Return
	44	1 / 0		Under In (calculated) Setpoint Active/Return
	45	1 / 0		Under Frequency Setpoint Active/Return
	46	1 / 0		Under kW Total Setpoint Active/Return
	47	1 / 0		Under kvar Total Setpoint Active/Return
	48	1 / 0		Under kVA Total Setpoint Active/Return
	49	1 / 0		Under PF Total Setpoint Active/Return
	50	1 / 0		Under kW Total Present Demand Setpoint Active/Return
	51	1 / 0		Under kvar Total Present Demand Setpoint Active/Return
	52	1 / 0		Under kVA Total Present Demand Setpoint Active/Return
	53	1 / 0		Under kW Total Predicted Demand Setpoint Active/Return
	54	1 / 0		Under kvar Total Predicted Demand Setpoint Active/Return
	55	1 / 0		Under kVA Total Predicted Demand Setpoint Active/Return
	56	1 / 0		Under Voltage THD Setpoint Active/Return
	57	1 / 0		Under Voltage TOHD Setpoint Active/Return
	58	1 / 0		Under Voltage TEHD Setpoint Active/Return
	59	1 / 0		Under Current THD Setpoint Active/Return
	60	1 / 0		Under Current TOHD Setpoint Active/Return
	61	1 / 0		Under Current TEHD Setpoint Active/Return
	62	1 / 0		Under Voltage Unbalance Setpoint Active/Return
	63	1 / 0		Under Current Unbalance Setpoint Active/Return
4=Self-diagnosis	1	1	0	System Parameter Fault
	2	1	0	Internal Parameter Fault
	3			Reserved
	4	1	0	Memory Fault
5=Operations	1	0	0	Power On
	2	0	0	Power Off
	3	0	0	Clear 3-Ø Total and Per-Phase Energy Registers via Front Panel
	4	0	0	Reserved
	5	0	0	Clear Peak Demand Log of This Month (Since Last Reset) via the Front Panel
	6	0	0	Reserved
	7	0	0	Clear Present Max./Min. via Front Panel
	8	0	0	Reserved
	9	0	0	Clear All Data via Front Panel[3]
	10	0	0	Clear SOE Log via Front Panel
	11	0	x=1 to 4	Clear DIx Pulse Counter via Front Panel
	12	0	0	Clear All Pulse Counter via Front Panel
	13	0	0	Clear Device Operating Time via Front Panel
	14	0	0	Set Clock via Front Panel
	15	0	0	Setup Changed via Front Panel
	16~29	0		Reserved
	30	0	0	Clear 3-Ø Total and Per-Phase Energy Registers via Communication
	31			Reserved
	32			Reserved
	33	0	0	Clear Peak Demand of This Month (Since Last Reset) via Communication
	34	0	0	Clear All Demand Registers via Communication
	35	0	0	Clear Max./Min. Logs of This Month (Since Last Reset) via Communication
	36	0	0	Clear All Max./Min. Logs via Communication

	37	0	0	Clear All Data via Communication[3]
	38	0	0	Clear SOE Log via Communication
	39	0	x=1 to 4	Clear DIx Pulse Counter via Communication
	40	0	0	Clear All DI Pulse Counters via Communication
	41	0	0	Clear Device Operating Time via Communication
	42	0	0	Reserved
	43	0	0	Setup Changes via Communication
	44	0	0	Preset Energy Value via Communication

Table 5-24 SOE Event Classification

3) **Clear All Data via Front Panel** or **Communication** means to clear 3-Phase Total Energy registers, Phase A/B/C Energy registers, All Peak Demands, All Max./Min. Logs, Device Operating Time, SOE Log and All DI Pulse Counters.

5.8 Device Setup

5.8.1 Basic Setup Parameters

Register	Property	Description	Format	Range, Default*
6000	RW	PT Primary[1]	UINT32	1 to 1,000,000 V, 100*
6002	RW	PT Secondary	UINT32	1 to 690V, 100*
6004	RW	CT Primary	UINT32	1 to 30,000A, 5*
6006	RW	CT Secondary	UINT32	1 to 5A*
6008~6018	RW	Reserved	UINT32	
6020	RW	Wiring Mode	UINT16	0=DEMO, 1=1P2W L-N, 2=1P2W L-L, 3=1P3W 4=3P3W, 5=3P4W*
6021	RW	PF Convention	UINT16	0=IEC*, 1=IEEE, 2=-IEEE
6022	RW	kVA Calculation	UINT16	0=Vector*, 1=Scalar
6023	RW	Ia Polarity	UINT16	0=Normal*, 1=Reverse
6024	RW	Ib Polarity	UINT16	
6025	RW	Ic Polarity	UINT16	
6026~6027	RW	Reserved	UINT16	
6028	RW	THD Calculation[2]	UINT16	0= THDf*, 1= THDr
6029	RW	Demand Period	UINT16	1 to 60 (minutes), 15*
6030	RW	Number of Sliding Windows	UINT16	1* to 15
6031	RW	Predicted Response	UINT16	70* to 99
6032	RW	Arm before Execute	UINT16	0=Disabled*, 1=Enabled
6033	RW	Self-Read Time[3]	UINT16	Default=0xFFFF (Manual Reset)
6034	RW	Reserved	UINT16	
6035	RW	Energy Pulse Constant	UINT16	0=1000 imp/kxh* 1=3200 imp/kxh
6036	RW	LED Energy Pulse	UINT16	0=Disabled 1=kWh Total Energy Pulse* 2=kvarh Total Energy Pulse
6037~6040	RW	Reserved	UINT16	

Table 5-25 Basic Setup Parameters

Notes:

1) The value of [PT Primary/PT Secondary] cannot exceeds 10000.

2) There are two ways to calculate THD:

THDf (based on Fundamental): $\mathrm{THD} = \frac{\sqrt{\sum_{n=2}^{\infty} I_n^{\,2}}}{I_1} \times 100\%$

where I_n represents the RMS value for the n^{th} harmonic and I_1 represents the RMS value of the Fundamental harmonic.

THDr (based on RMS): $$\mathrm{THD} = \frac{\sqrt{\sum_{n=2}^{\infty} I_n^{\,2}}}{\sqrt{\sum_{n=1}^{\infty} I_n^{\,2}}} \times 100\%$$

where I_n represents the RMS value for the n^{th} harmonic.

3) The **Self-Read Time** applies to both the Peak Demand Log as well as the Max./Min. Log and supports the following three options:
   - A zero value means that the Self-Read will take place at 00:00 of the first day of each month.
   - A non-zero value means that the Self-Read will take place at a specific time and day based on the formula: Self-Read Time = (Day x 100 + Hour) where 0 ≤ Hour ≤ 23 and 1 ≤ Day ≤ 28. For example, the value 1512 means that the Self-Read will take place at 12:00pm on the 15th day of each month.
   - A 0xFFFF value means the automatic self-read operation is disabled and the log will be transferred manually.

5.8.2 I/O Setup (Optional)

Register	Property	Description	Format	Range, Default*
6200	RW	DI1 Function	UINT16	0 = Digital Input* 1=Pulse Counting
6201	RW	DI2 Function	UINT16	
6202	RW	DI3 Function	UINT16	
6203	RW	DI4 Function	UINT16	
6204~6207		Reserved		
6208	RW	DI1 Debounce	UINT16	1 to 9999 ms, 20*
6209	RW	DI2 Debounce	UINT16	
6210	RW	DI3 Debounce	UINT16	
6211	RW	DI4 Debounce	UINT16	
6212~6215		Reserved		
6216	RW	DI1 Pulse Weight	UINT32	1* to 1,000,000
6218	RW	DI2 Pulse Weight	UINT32	
6220	RW	DI3 Pulse Weight	UINT32	
6222	RW	DI4 Pulse Weight	UINT32	
6224~6235	RW	Reserved	UINT16	-
6236	RW	DO1 Pulse Width	UINT16	0 to 6000 (x0.1s), 10* (0 = Latch Mode)
6237	RW	DO2 Pulse Width	UINT16	

Table 5-26 I/O Setup Parameters

Notes:

1) The DI/DO Setup registers are available only when the PMC-53M-E is equipped corresponding options.

5.8.3 Communication Setup Parameters

Register	Property	Description	Format	Range, Default*
6400	RW	Port1 Protocol	UINT16	0=Modbus RTU*
6401	RW	Port1 Unit ID	UINT16	1 to 247, 100*
6402	RW	Port1 Baud Rate[1]	UINT16	0=1200, 1=2400, 2=4800, 3=9600*, 4=19200, 5=38400
6403	RW	Port1 Comm. Config.	UINT16	0=8N2, 1=8O1,2=8E1* 3=8N1, 4=8O2, 5=8E2

Table 5-27 Communication Setup

Notes:

1) If the **Baud Rate** is set to an invalid value, it will default to 9600bps automatically.

5.8.4 Setpoints Setup

Register	Property	Description		Format	Range, Default*
6500	RW	Setpoint #1	Setpoint Type	UINT16	0=Disabled* 1=Over Setpoint 2=Under Setpoint

6501	RW		Parameters[1]	UINT16	0* to 24
6502	RW		Over Limit[2]	Float	0*
6504	RW		Under Limit[2]	Float	0*
6506	RW		Active Delay	UINT16	0 to 9999 s, 10*
6507	RW		Inactive Delay	UINT16	0 to 9999 s, 10*
6508	RW		Trigger Action 1[3]	UINT16	0* to 2
6509	RW		Trigger Action 2[3]	UINT16	
…		…			…
6580	RW	Setpoint #9	Setpoint Type	UINT32	0=Disabled* 1=Over Setpoint 2=Under Setpoint
6581	RW		Parameter[1]	UINT16	0* to 24
6582	RW		Over Limit	Float	0*
6584	RW		Under Limit	Float	0*
6586	RW		Active Delay	UINT16	0 to 9999 s, 10*
6587	RW		Inactive Delay	UINT16	0 to 9999 s, 10*
6588	RW		Trigger Action 1[2]	UINT16	0* to 2
6589	RW		Trigger Action 2[2]	UINT16	

Table 5-28 Setpoint Setup Parameters

Notes:

1) The PMC-53M-E provides the following setpoint parameters:

Key	Parameter	Key	Parameter	Key	Parameter
0	None	9	PF Total	18	Voltage TEHD
1	Uln (Any Phase Voltage)	10	kW Total Present Demand	19	Current THD
2	Ull (Any Line Voltage)	11	kvar Total Present Demand	20	Current TOHD
3	Current (Any Phase Current)	12	kVA Total Present Demand	21	Current TEHD
4	In (Calculated)	13	kW Total Predicted Demand	22	Voltage Unbalance
5	Frequency	14	kvar Total Predicted Demand	23	Current Unbalance
6	kW Total	15	kVA Total Predicted Demand	24	Phase Reversal[4]
7	kvar Total	16	Voltage THD		
8	kVA Total	17	Voltage TOHD		

Table 5-29 Setpoint Parameters

2) For Over Setpoint, the setpoint parameter must exceed the **Over Limit** to become active and go below the **Under Limit** to become inactive.

   For Under Setpoint, the setpoint parameter must go below the **Under Limit** to become active and exceed the **Over Limit** to become inactive.

3) The PMC-53M-E provides the following Setpoint Triggers:

Key	Action
0	None
1	DO1 Closed
2	DO2 Closed

Table 5-30 Setpoint Triggers

4) When the **Setpoint Parameter** is set to **Phase Reversal**, the **Setpoint Type** must be set to **1 (Over Setpoint)**, and there is no need to set **Over Limit** and **Under Limit**. Please be informed that the Phase Reversal Setpoint assumes that the phase sequencing is based on **Positive** or **Clockwise** rotation (ABC).

5.9 Time

There are two sets of Time registers supported by the PMC-53M-E – Year / Month / Day / Hour / Minute / Second (Registers # 60000 to 60002) and UNIX Time (Register # 60004). When sending time to the PMC-53M-E over Modbus communications, care should be taken to only write one of the two Time register sets. All registers within a Time register set must be written in a single transaction. If registers 60000 to 60004 are being written to at the same time, both Time register sets will be updated to reflect the new time specified in the UNIX Time register set (60004) and the time specified in registers 60000-60002 will be ignored. Writing to the Millisecond register (60003) is optional during a Time Set operation. When broadcasting time, the function code must be set to 0x10 (Pre-set Multiple Registers). Incorrect

date or time values will be rejected by the meter. In addition, attempting to write a Time value less than Jan 1, 2000 00:00:00 will be rejected.

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

Table 5-31 Time Registers

5.10 Remote Control

The DO Control registers are implemented as both "Write-Only" Modbus Coil Registers (0XXXXX) and Modbus Holding Registers (4XXXXX), which can be controlled with the Force Single Coil command (Function Code 0x05) or the Preset Multiple Hold Registers (Function Code 0x10). The PMC-53M-E does not support the Read Coils command (Function Code 0x01) because DO Control registers are "Write-Only". The DO Status register 0098 should be read instead to determine the current DO status.

The PMC-53M-E adopts the ARM before EXECUTE operation for the remote control of its Digital Outputs if this function is enabled through the **Arm Before Execute Enable** Setup register (6032), which is disabled by default. Before executing an OPEN or CLOSE command on a Digital Output, it must be "Armed" first. This is achieved by writing the value 0xFF00 to the appropriate register to "Arm" a particular DO operation. The DO will be "Disarmed" automatically if an "Execute" command is not received within 15 seconds after it has been "Armed". If an "Execute" command is received without first having received an "Arm" command, the meter ignores the "Execute" command and returns the 0x04 exception code.

Register	Property	Description	Format	Note
9100	WO	Arm DO1 Close	UINT16	Writing "0xFF00" to the register to perform the described action.
9101	WO	Execute DO1 Close	UINT16	
9102	WO	Arm DO1 Open	UINT16	
9103	WO	Execute DO1 Open	UINT16	
9104	WO	Arm DO2 Close	UINT16	
9105	WO	Execute DO2 Close	UINT16	
9106	WO	Arm DO2 Open	UINT16	
9107	WO	Execute DO2 Open	UINT16	

Table 5-32 DO Control

5.11 Clear/Reset Control

Register	Property	Description	Format	Note
9600	WO	Reserved	UINT16	Writing "0xFF00" to the register to execute the described action.
9601	WO	Clear 3-Ø Total and Per-Phase Energy Registers[1]		
9602	WO	Reserved		
9603	WO	Clear Peak Demand of This Month (Since Last Reset)[1]		
9604	WO	Clear All Demand Registers[2]		
9605	WO	Clear Max/Min Logs of This Month (Since Last Reset)[3]		
9606	WO	Clear All Max./Min. Log[4]		
9607	WO	Clear Device Operating Time		

9608	WO	Clear All Data[5]		
9609	WO	Clear SOE Log		
9610	WO	Clear DI1 Pulse Counter		
9611	WO	Clear DI2 Pulse Counter		
9612	WO	Clear DI3 Pulse Counter		
9613	WO	Clear DI4 Pulse Counter		
9614~9617	WO	Reserved		
9618	WO	Clear All Pulse Counters		

Table 5-33 Clear Control

Notes:

1) Writing 0xFF00 to the **Clear Peak Demand of This Month** register to clear Peak Demand Log of This Month (Since Last Reset) when the **Self-Read Time** register is set for automatic Self-Read operation. The Peak Demand of Last Month will not be cleared. If the **Self-Read Time** register is set for manual operation with a register value of 0xFFFF, the Peak Demand of This Month (Since Last Reset) will be transferred to the Peak Demand of Last Month (Before Last Reset) and then cleared.
2) Writing 0xFF00 to the **Clear All Demand** register to clear all Demand registers and logs, including Real-time Present Demand, Peak Demand Log of This Month (Since Last Reset) and Last Month (Before Last Reset).
3) Writing 0xFF00 to the **Clear Max./Min. Log of This Month** register to clear the Max./Min. log of This Month (Since Last Reset) when the **Self-Read Time** register is set for automatic Self-Read operation. The Max./Min. log of Last Month will not be cleared. If the **Self-Read Time** register is set for manual operation with a register value of 0xFFFF, the Max./Min. log of This Month (Since Last Reset) will be transferred to the Max./Min. log of Last Month (Before Last Reset) and then cleared.
4) Writing 0xFF00 to the **Clear All Max./Min. Log** register to clear both the Max./Min Log of This Month (Since Last Reset) and the Max./Min. Log of Last Month (Before Last Reset).
5) Writing 0xFF00 to the **Clear All Data** register to perform the Clear operation for the actions specified in registers # 9601 to #9607, registers # 9609 to # 9613 and register # 9618.

5.12 Meter Information

Register		Property	Description	Format	Note
60200~60219	9800~9819	RO	Meter model[1]	UINT16	See Note 1)
60220	9820	RO	Firmware Version	UINT16	e.g. 10000 shows the version is V1.00.00
60221	9821	RO	Protocol Version	UINT16	e.g. 10 shows the version is V1.0
60222	9822	RO	Firmware Update Date: Year-2000	UINT16	e.g. 140110 means January 10, 2014
60223	9823	RO	Firmware Update Date: Month	UINT16	
60224	9824	RO	Firmware Update Date: Day	UINT16	
60225	9825	RO	Serial Number	UINT32	e.g. 1701030100 means the 100th PMC-53M-E that was manufactured on January 3rd, 2017
60227	9827	RO	Reserved	UINT16	
60228	9828	RO	Reserved	UINT16	
60229	9829	RO	Feature Code	UINT16	Bit 6 to Bit 0: Reserved Bit 7 (DIDO): 0=4xDI + 2 x DO 1=None Bit 8 to Bit 15: Reserved

Table 5-34 Meter Information

Notes:

1) The Meter Model appears from registers 60200 to 60219 and contains the ASCII encoding of the string “PMC-53M-E” as shown in the following table.

Register	Value(Hex)	ASCII
60200	0x50	P
60201	0x4D	M
60202	0x43	C
60203	0x2D	-
60204	0x35	5
60205	0x33	3
60206	0x4D	M
60207	0x2D	-
60208	0x45	E
60209-60219	0x20	Null

Table 5-35 ASCII Encoding of “PMC-53M-E”

Appendix A Technical Specifications

Voltage Inputs (V1, V2, V3, VN)	
Un	400Uln/690Ull
Range	10V to 1.2xUn
Overload	1.2xUn continuous, 2xUn for 1s
Burden	<0.02VA per phase
Measurement Category	CAT III up to 600VLL
Frequency	45-65Hz
Current Inputs (I11, I12, I21, I22, I31, I32)	
In	5A (5A/1A Auto-Scale)
Range	0.1% to 200% In
Starting Current	0.1% In
Overload	2xIn continuous, 20xIn for 1s
Measurement Category	CAT III up to 600VLL
Burden	<0.15VA per phase
Power Supply (L+, N-, GND)	
Standard	95-250VAC/DC, ±10%, 47-440Hz
Burden	<2W
Overvoltage Category	CAT III up to 300V
Optional Digital Inputs (DI1, DI2, DI3, DI4, DIC)	
Type	Dry contact, 24VDC Internally Wetted
Sampling	1000Hz
Hysteresis	40ms minimum
Optional Digital Outputs (DO11, DO12, DO21, DO22)	
Type	Form A Mechanical Relay
Loading	5A @ 250VAC or 30VDC
Installation Torque	
Voltage / Current Inputs	1.3 N.m
Power Supply, RS485, I/O	0.5 N.m
Environmental Conditions	
Operating Temp.	-25°C to 70°C
Storage Temp.	-40°C to 85°C
Humidity	5% to 95% non-condensing
Atmospheric Pressure	70 kPa to 106 kPa
Mechanical Characteristics	
Panel Cutout	92x92 mm (3.62”x3.62”)
Unit Dimensions	96x96x88 mm
IP Rating	65

Accuracy

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

Appendix B Standards Compliance

Safety Requirements	
CE LVD 2014 / 35 / EU	EN61010-1: 2010, EN61010-2-030: 2010
Electrical safety in low voltage distribution systems up to 1000Vac and 1500 Vdc	IEC 61557-12: 2008 (PMD)
Insulation AC Voltage: 2kV @ 1 minute Impulse voltage: 6kV, 1.2/50μs	IEC 62052-11: 2003
Electromagnetic Compatibility CE EMC Directive 2014 / 30 / EU (EN 61326: 2013)	
Immunity Tests	
Electrostatic discharge	EN 61000-4-2: 2009
Radiated fields	EN 61000-4-3: 2006+A1: 2008+A2: 2010
Fast transients	EN 61000-4-4: 2004+A1: 2010
Surges	EN 61000-4-5: 2006
Conducted disturbances	EN 61000-4-6: 2009
Magnetic Fields	EN 61000-4-8: 2010
V Dips, Interruptions & Variations	EN 61000-4-11:2004
Oscillatory waves	EN 61000-4-12: 2006
Radio Disturbances	CISPR 22:2006, Level B
Emission Tests	
Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment	EN 55011: 2009 + A1: 2010 (CISPR 11)
Limits and methods of measurement of radio disturbance characteristics of information technology equipment	EN 55022: 2010+AC: 2011 (CISPR 22)
Limits for harmonic current emissions for equipment with rated current ≤16 A	EN 61000-3-2: 2014
Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤16 A	EN 61000-3-3: 2013
Emission standard for industrial environments	EN 61000-6-4: 2007+A1: 2011
Testing and measurement techniques - Ring wave immunity test.	EN 61000-4-12: 2006
Mechanical Tests	
Spring Hammer Test	IEC 62052-11: 2003
Vibration Test	IEC 62052-11: 2003
Shock Test	IEC 62052-11: 2003

Appendix C Ordering Guide

CET Electric Technology

Version 20171128

Product Code	Description
PMC-53M-E DIN96 Intelligent Multifunction Meter	
Basic Funciton	
E	Multifunction Measurements, LED Display
Input Current	
5	5A/1A Auto-Scaling (Class 0.5S for 5A and Class 1 for 1A)
Input Voltage	
9	400VLN/690VLL
Power Supply	
2	95-250 VAC/DC, 47-440Hz
Frequency	
5	45Hz-65Hz
I/O	
X	None
B*	4xDI+2xDO
Communications	
A	1xRS-485
Language	
E	English

PMC-53M	-	E	-	5	9	2	5	X	A	E	**PMC-53M-E-5925XAE (Standard Model)**

* Additional charges apply

Contact us

CET Inc.
8/F, Westside, Building 201, Terra Industrial & Tradepark,
Che Gong Miao, Shenzhen, Guangdong, P.R.China 518040
Tel: +86.755.8341.5187
Fax: +86.755.8341.0291
Email: support@cet-global.com
Web: **www.cet-global.com**