

# **PMC-512-D**

## **DC Multi-Circuit Power Monitor**

### **User Manual**

### **Version: V1.0**

**December 6, 2018**



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## Standards Compliance



**DANGER**

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



**CAUTION**

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



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

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

### **Limited warranty**

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

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## Glossary

CET	= CET Electric Technology
AI	= Analog Input
DI	= Digital Input
DMD	= Demand
DO	= Digital Output
FIFO	= First In First Out
LED	= Light Emitting Diode
MB	= Mega Byte
PDU	= Power Distribution Unit
RTC	= Real Time Clock
SM	= Sub Meter
SOE	= Sequence of Events

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## Chapter 1 Introduction

This manual explains how to use the PMC-512-D DC Multi-Circuit Power Monitor.

This chapter provides an overview of the PMC-512-D and summarizes many of its key features.

### 1.1 Overview

The PMC-512-D Multi-Circuit Power Monitor is CET's latest offer for Data Center, Telecom Base Station, Renewable Energy, Commercial Building and Industrial Automation applications that require Direct Current (DC) multi-circuit monitoring. Housed in compact DIN Rail Mountable enclosure, the PMC-512-D is perfectly suited for applications that have high density metering requirements. The PMC-512-D features quality construction with multifunction and high-accuracy measurements, one Mains Input and up to 12 Branch Circuit Inputs. The PMC-512-D comes standard with 13 Digital Inputs for status monitoring, one Relay Output for control or alarming as well as one Analogue Input for temperature measurement or other analogue input applications. The standard SOE Log records all setup changes, alarms and DI/DO operations in 1ms resolution. With dual RS-485 as standard feature supporting Modbus RTU, the PMC-512-D can easily be deployed in a centralized monitoring and control system such as CET's PecStar® iEMS, for a DC Power Distribution Network.

#### Typical Applications

- Data Center DC Power Monitoring
- Photovoltaic DC Distribution Boards
- Telecom Base Station DC PDUs
- Other DC Power Distribution Applications

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

### 1.2 Features

#### Ease of use

- Status LEDs - Run, Pulse and Comm. Activities
- Self-Diagnostic function
- Password-protected setup via the Front Panel (Future)
- Compact, DIN Rail Mount for easy installation

#### Measurements

##### Mains Measurements

- **Option A (Mains Current Type = Incomer Current):**
  - Voltage
  - Current, %Loading, Power and Energy
  - Present Demand, Peak Demand for This Month and Last Month,
- **Option B (Mains Current Type = Residual Current):**
  - Voltage
  - Residual Current

**SM 1-12 Measurements (12 Branch Circuits Inputs)**

- Current, %Loading, Power, and Energy
- Present Demand, Peak Demand for This Month and Last Month

**Logs**

**Data Recording**

- 4MB Log Memory
- Up to 60 parameters @ min. 1-min recording interval for a max. 5,000 logs with timestamps
- 24 Monthly Energy Logs – kWh for Mains and each SM

**SOE Log**

- 512 FIFO events time-stamped to  $\pm 1$ ms resolution
- DI/DO changes, Alarms, Setup changes, Self-Diagnosis

**Alarming**

- 4 Alarm Levels for Current and AI
- 2 Alarm Levels for Voltage and Residual Current
- Status Input Alarm
- Programmable Digital Output Trigger
- Facilitate the comprehensive monitoring and alarming for Mains & 12 Sub-Meters.

**Inputs and Outputs**

- 13xDI, external excitation @ 48VDC or 240VDC
- 1xDO, mechanical relay output @ 250VAC/5A or 30VDC/5A
- 1xAI (0-20mA or 4-20mA)
- LED Energy Pulse Output

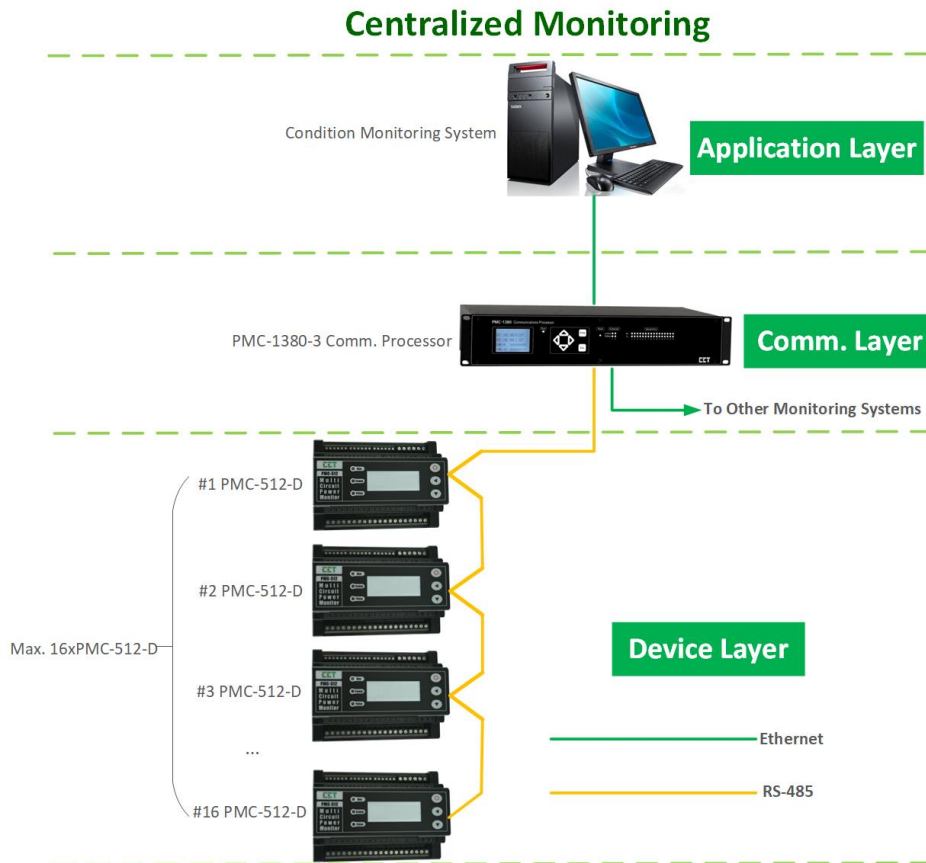
**Communications**

- 2xRS-485, Modbus RTU protocol
- Baud rate @ 1,200 to 57,600bps

## System Integration

The PMC-512-D is supported by CET's PecStar iEMS. In addition, it can be easily integrated into other 3rd party Automation, Energy Management or SCADA systems because of its support of multiple communication ports and the Modbus RTU protocol.

### 1.3 PMC-512-D' application in Monitoring Management Systems



### 1.4 Getting more information

Additional information is available from CET via the following sources:

- Visit [www.cet-global.com](http://www.cet-global.com)
- Contact your local representative
- Contact CET directly via email @ [support@cet-global.com](mailto:support@cet-global.com)

## Chapter 2 Installation



### Caution

Installation of the PMC-512-D should only be performed by qualified, competent personnel that have the appropriate training and experience with high voltage and current devices. The device must be installed in accordance with all local and national electrical codes.

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

## 2.1 Appearance

### 2.1.1 Main Unit

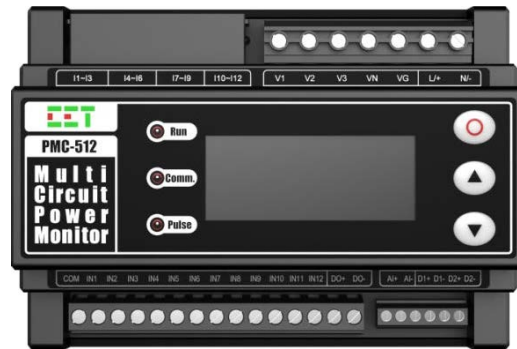


Figure 2-1 Main Unit

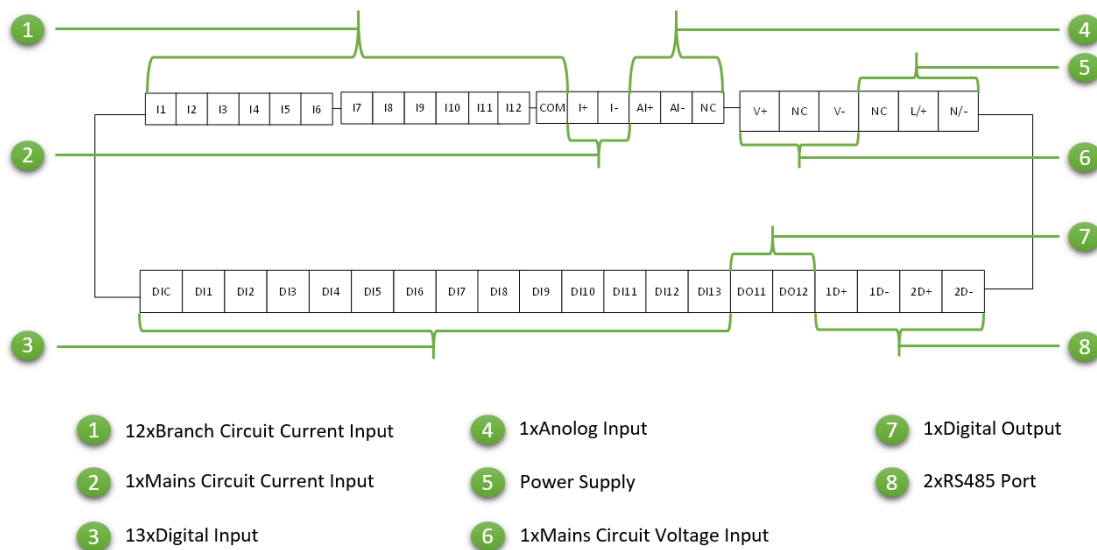


Figure 2-2 Main Unit Terminal Diagram

2.1.2 CTs

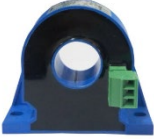




Category	Model	Appearance
Branch Circuit Hall Effect Solid-Core CT (with Current Output)	PMC-DCT-50A-25mA-A PMC-DCT-100A-50mA-A PMC-DCT-200A-100mA-A	
Mains Circuit Hall Effect Split-Core CT (with Voltage Output)	PMC-DCT-200A-4V-A	
	PMC-DCT-400A-4V-A PMC-DCT-600A-4V-A	
	PMC-DCT-800A-4V-A PMC-DCT-1000A-4V-A PMC-DCT-2000A-4V-A	
Mains Hall Effect DC Residual CT (with Voltage Output)	PMC-DCT-50mA-5V-A	

Table 2-1 CTs' Appearances

2.1.3 Switching Power Supplies

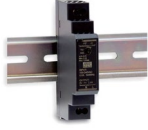
Model	Output	Appearance
PMC-DP-240V	±12V	
PMC-DP-48V	±12V	

Table 2-2 Switching Power Supplies' Appearance

2.2 Unit Dimensions

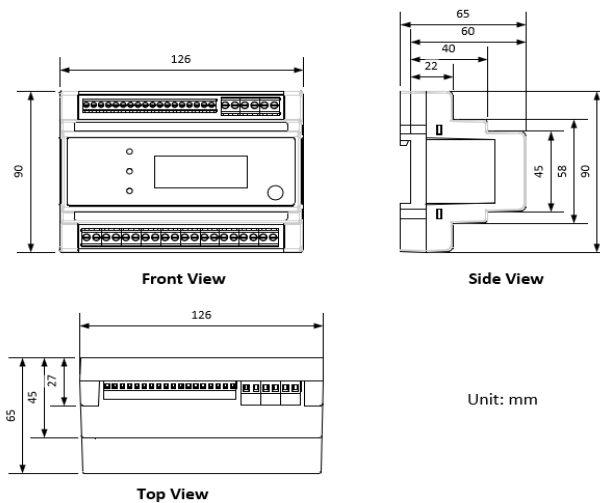


Figure 2-3 Main Unit Dimensions

## 2.3 Overall Setup

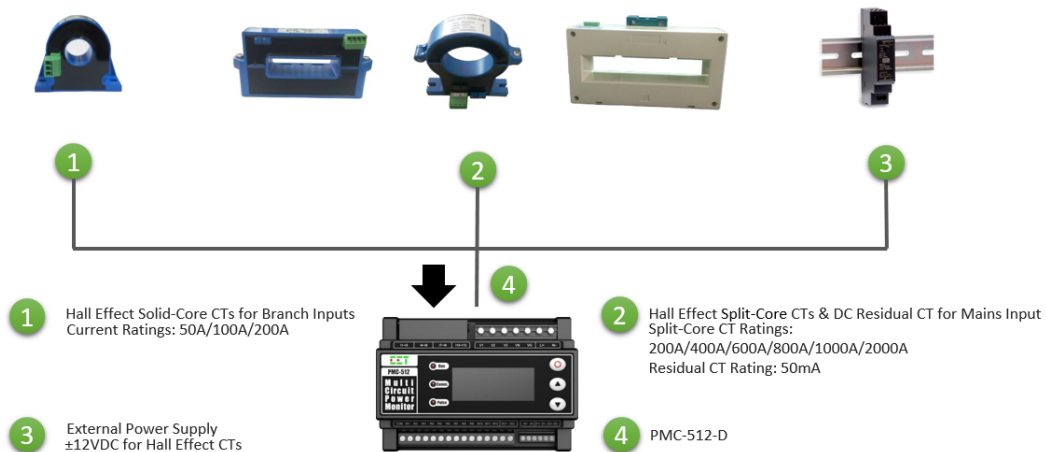


Figure 2-4 Overall Setup

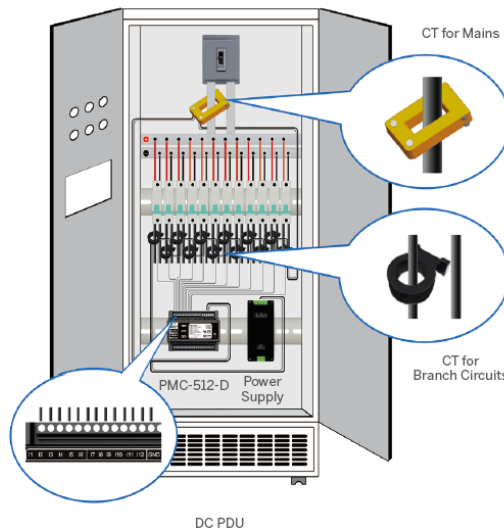


Figure 2-5 Overall Installation

## 2.4 Mounting

The PMC-512-D should be installed in a dry environment without dust and kept away from heat, radiation and electrical noise sources. The PMC-512-D is usually installed inside the PDU cabinet. Please reserve enough room for other accessories and make it convenient for future maintenance.

### 2.4.1 Mounting PMC-512-D with 35mm DIN Rail

Installation steps:

- Pre-drill the mounting holes for the DIN rail and ensure it is already in place before installation.
- Move the installation clips at the back of the PMC-512-D downward to the “unlock” position.
- Align the top of the mounting channel at the back of the PMC-512-D at an angle against the top of the DIN rail as shown in figure below.
- Rotate the bottom of the PMC-512-D towards the back while applying a slight pressure to ensure that the device is completely and securely fixed on to the DIN rail.
- Push the installation clips upward to the “lock” position to secure the PMC-512-D on to the DIN rail.

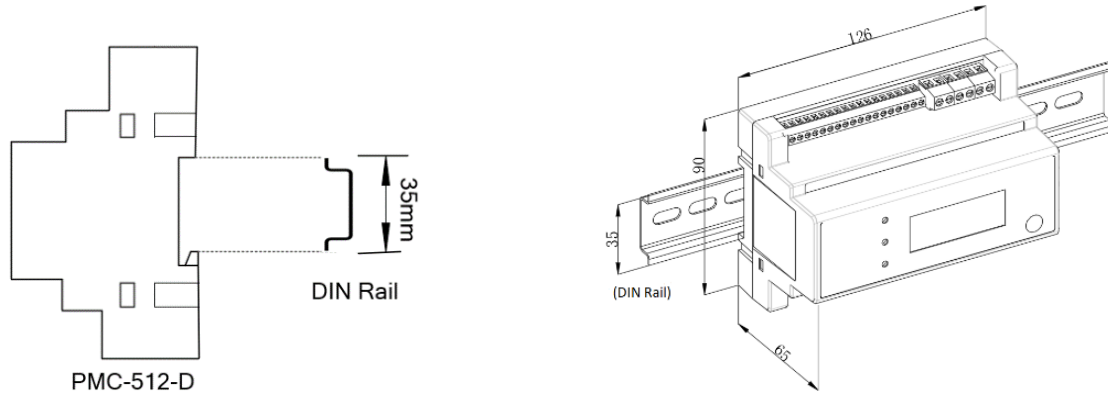


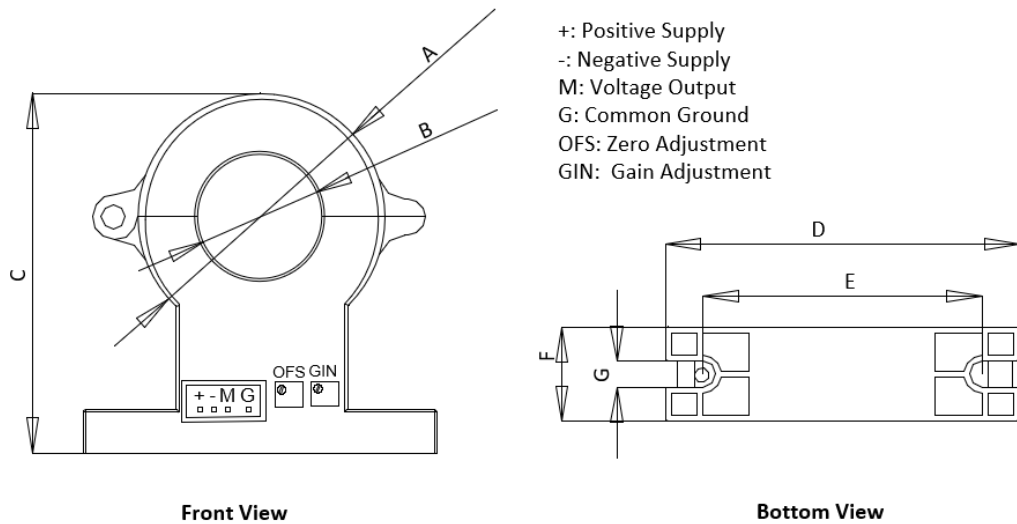
Figure 2-6 Mounting Main Unit

### 2.4.2 CTs Dimensions and Terminal Definitions

There are multiple types of CTs available for the Mains Input, or DC Residual Current Input and Branch Inputs. It's extremely important for the users to understand that the Hall Effect Split-Core CTs and DC Residual CT for the Mains Input have a Voltage Output while the Hall Effect CTs for the Branch Circuits have a Current Output. Caution should be exercised during the installation of the Hall Effect CTs for the Mains and Branch Inputs. Using incorrect CTs for the Mains and Branch Inputs may cause permanent damage to the PMC-512-D. Please refer to **Appendix C** for their complete specifications and select the appropriate CTs for your applications.

The following figures describe the dimensions for the various CTs and the definitions for their terminals.

#### 2.4.2.1 200A Mains Hall Effect Split-Core CT (PMC-DCT-200A-4V-A)

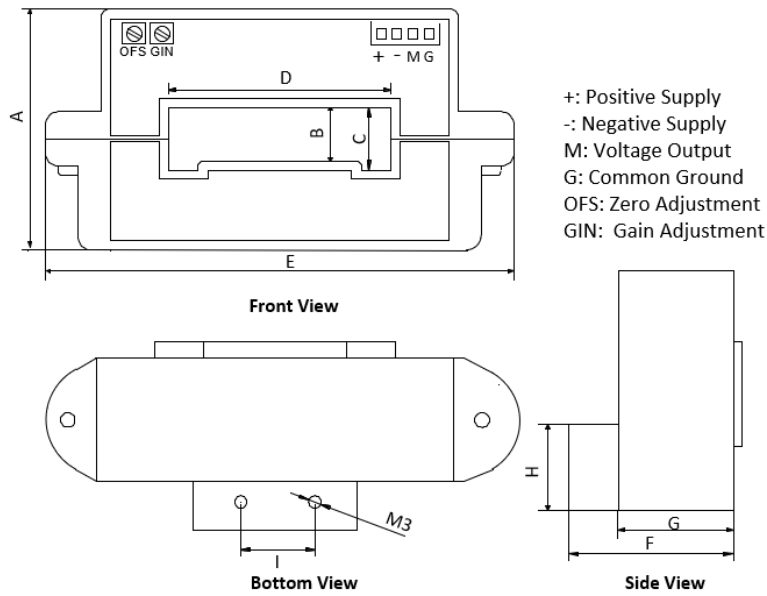


Model	A	B	C	D	E	F	G
PMC-DCT-200A-4V-A	Ø58	Ø35	84	78	66	16	4.5

Unit: mm

Figure 2-7 PMC-DCT-200A-4V-A Dimensions

2.4.2.2 400A/600A Mains Hall Effect Split-Core CTs (PMC-DCT-400A-4V-A & PMC-DCT-600A-4V-A)

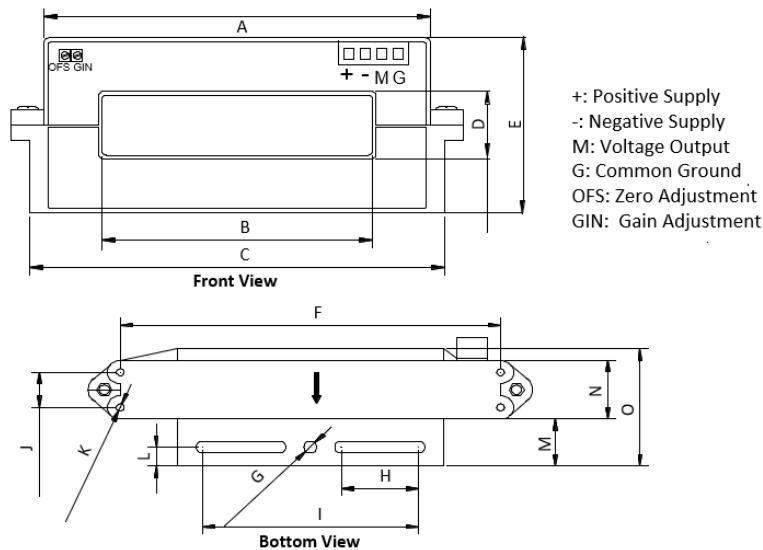


Model	A	B	C	D	E	F	G	H	I
PMC-DCT-400A-4V-A	48.5	13	15	42	92	31.5	21.5	16	15
PMC-DCT-600A-4V-A	48.5	13	15	42	92	31.5	21.5	16	15

Unit: mm

Figure 2-8 PMC-DCT-400A-4V-A & PMC-DCT-600A-4V-A CTs Dimensions

2.4.2.3 800A Mains Hall Effect Split-Core CT (PMC-DCT-800A-4V-A)

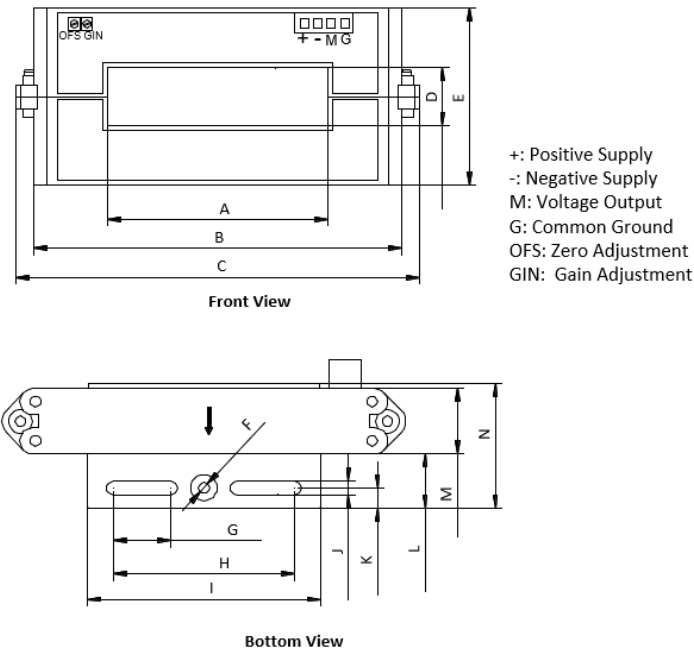


Model	A	B	C	D	E	F	G	H
PMC-DCT-800A-4V-A	108	64	120	16	62	110	Ø5.5	10
Model	I	J	K	L	M	N	O	
PMC-DCT-800A-4V-A	44	15.5	4-Ø2.2	8	20	25	46	

Unit: mm

Figure 2-9 PMC-DCT-800A-4V-A Dimension

2.4.2.4 1000A/2000A Mains Hall Effect Split-Core CTs (PMC-DCT-1000A-4V-A & PMC-DCT-2000A-4V-A)

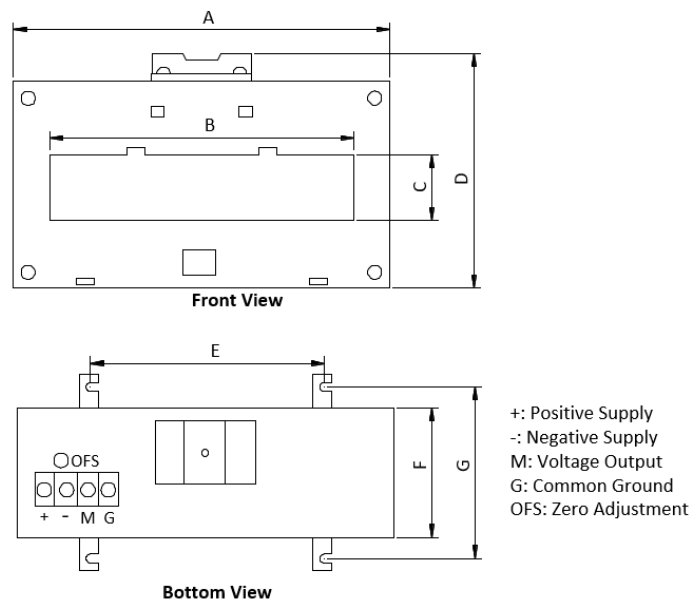


Model	A	B	C	D	E	F	G
PMC-DCT-1000A-4V-A	99.5	155	169	42	86	M4.5	30
PMC-DCT-2000A-4V-A	99.5	155	169	42	86	M4.5	30
Model	H	I	J	K	L	M	N
PMC-DCT-1000A-4V-A	84.5	105	5.5	8	20	25	46.5
PMC-DCT-2000A-4V-A	84.5	105	5.5	8	20	25	46.5

Unit: mm

Figure 2-10 PMC-DCT-1000A-4V-A & PMC-DCT-2000A-4V-A Dimensions

2.4.2.5 50mA Mains Hall Effect DC Residual CT (PMC-DCT-50mA-5V-A)

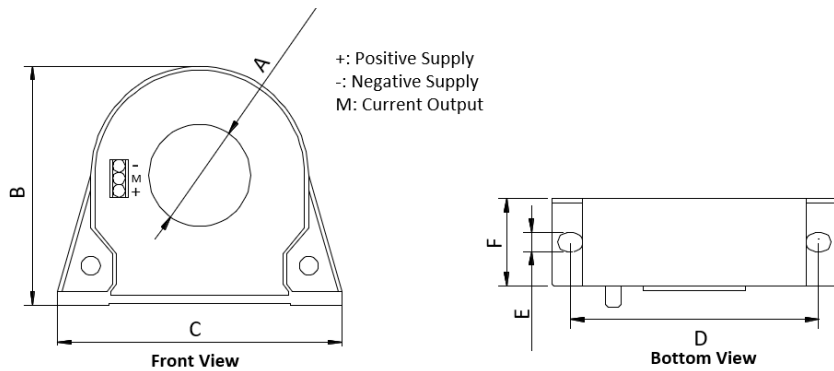


Model	A	B	C	D	E	F	G
PMC-DCT-50mA-5V-A	225	182	38	135	140	50	74

Unit: mm

Figure 2-11 PMC-DCT-50mA-5V-A Dimensions

2.4.2.6 50A/100A/200A Branch Hall Effect Solid-Core CTs



Model	A	B	C	D	E	F
PMC-DCT-50A-25mA-A	Ø20	58	68	58	4.0	20
PMC-DCT-100A-50mA-A	Ø20	58	68	58	4.0	20
PMC-DCT-200A-100mA-A	Ø25	69.5	80	68	5.0	22

Unit: mm

Figure 2-12 Branch Circuit Hall Effect CT Dimensions

2.4.3 Switching Power Supply

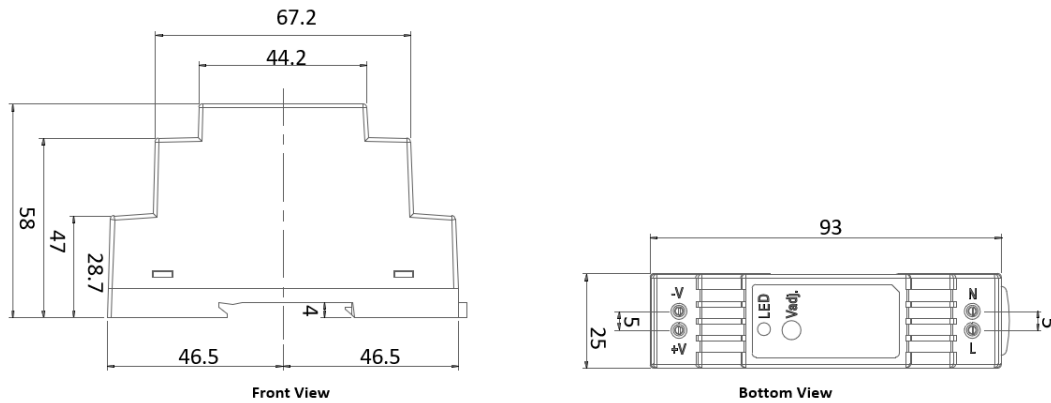


Figure 2-13 Switching Power Supply Dimensions

2.5 Wiring Connections

2.5.1 PMC-512-D Wiring

Figure 2-14 illustrates how to wire the PMC-512-D with multiple Hall Effect CTs to the Mains and Branch Inputs. Following are some tips before pre-installation.

- a) Ensure that all incoming DC power and other power sources are turned OFF before performing any work on the meter.
- b) Before connecting the meter to the power source, check the Serial Number label on the meter to ensure that it is equipped with the appropriate power supply as well as the correct Voltage and Current Input specifications for your application.
- c) Confirm that the CT's Primary and Secondary ratings are correct before installation.
- d) Please keep in mind that:
  - i. The Hall Effect Split-Core CTs and DC Residual CT for the Mains Circuit have a Voltage Output.

- ii. The Hall Effect CTs for the Branch Circuits have a Current Output.
- iii. Caution should be exercised during the installation of Hall Effect CTs for the Mains and Branch Inputs. Using incorrect CTs for the Mains and Branch Inputs may cause permanent damage to the PCM-512-D.
- e) Please refer to **Sections 2.5.2-2.5.5** to wire the Hall Effect CTs and their power supply to work with the PCM-512-D for monitoring the Mains & Branch Circuits and the Residual Current.

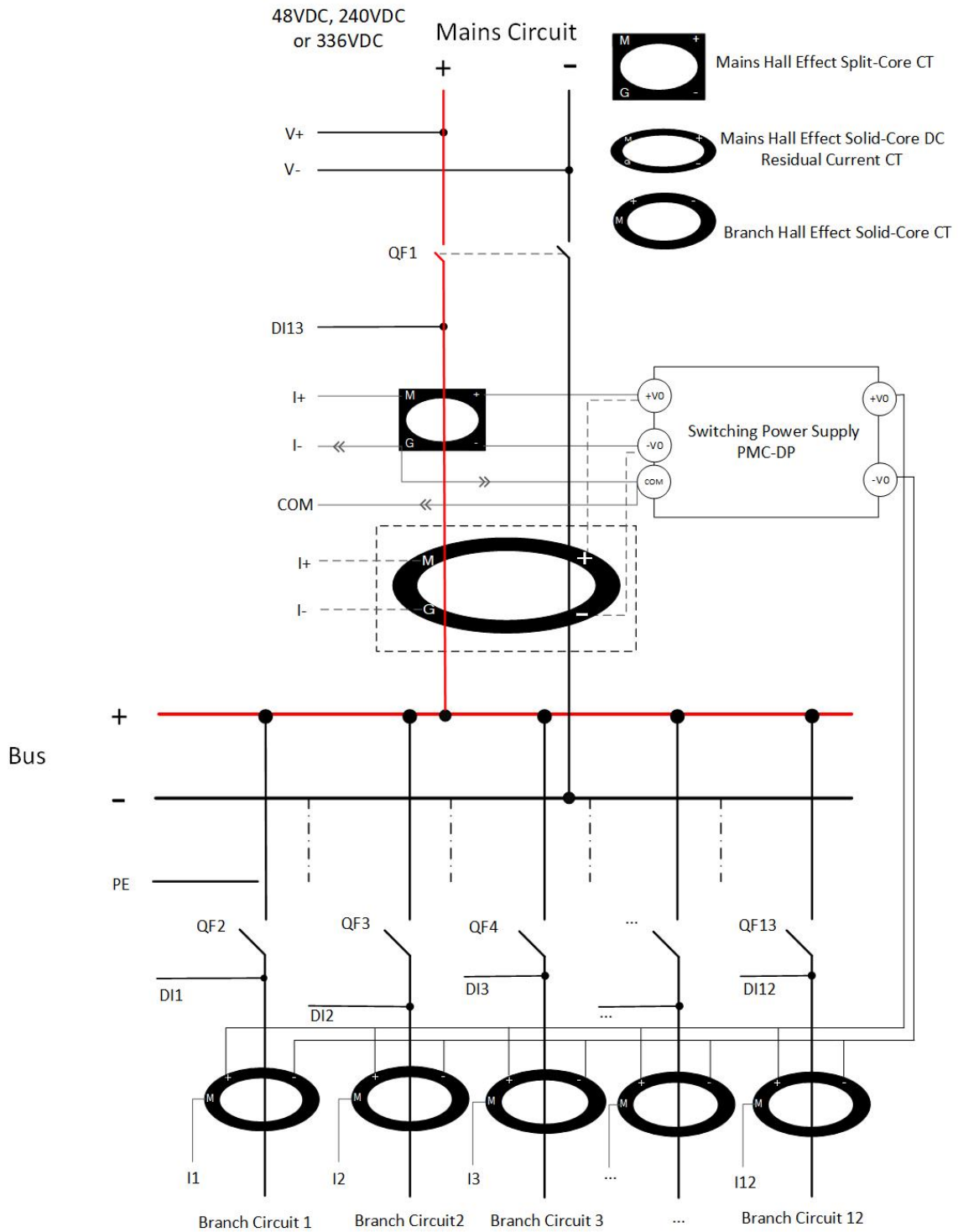
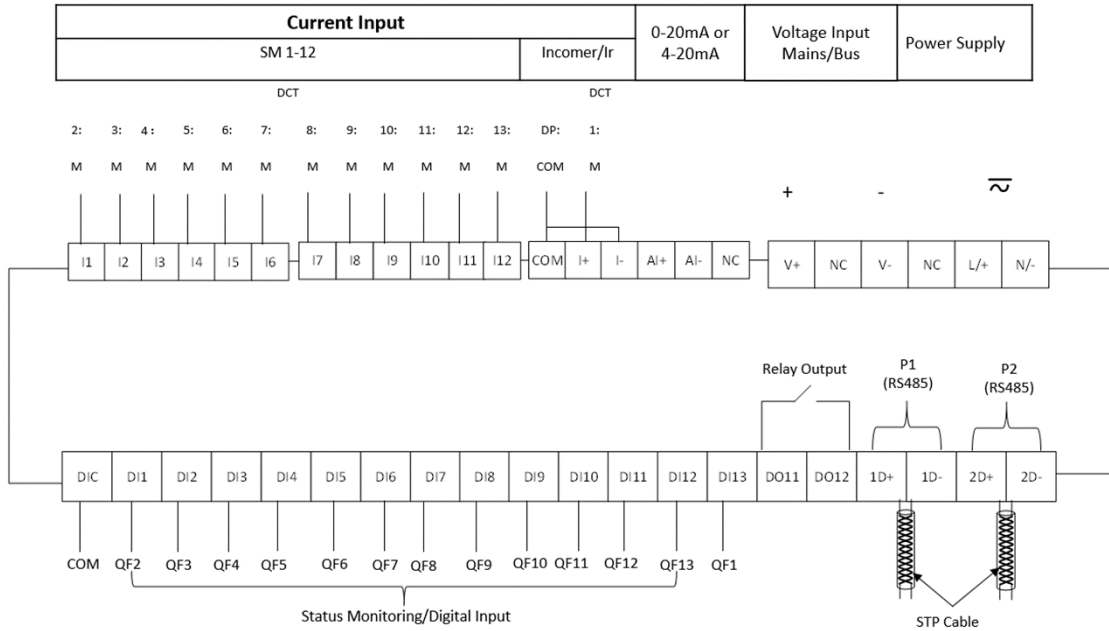


Figure 2-14 Typical Application

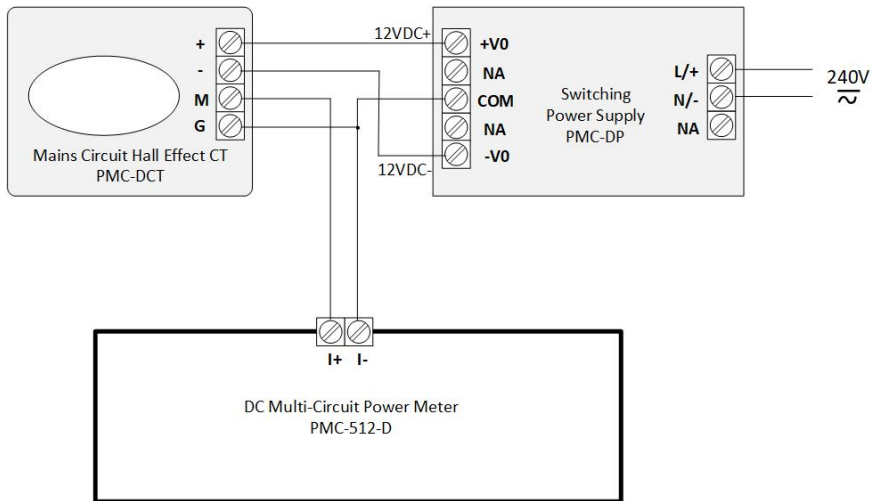
**Notes:**

- a) The Mains Input can be used to measure the Mains Current or the Mains Residual Current by using the appropriate CT. The wiring connections for the Mains CT and Residual CT are the same.
- b) It is important to determine the total load requirement from all the CTs to ensure that the capacity of the power supply is sufficient.



**Figure 2-15 Terminal Connection**

**2.5.2 Mains Hall Effect CT Wiring**



**Figure 2-16 Wiring for Mains Hall Effect CT**

**Note:**

- 1. It is important to wire the G terminal on the CT to the COM Terminal on the Power Supply and the I- Terminal on the PMC-512-D.

### 2.5.3 Residual Current Hall Effect CT Wiring

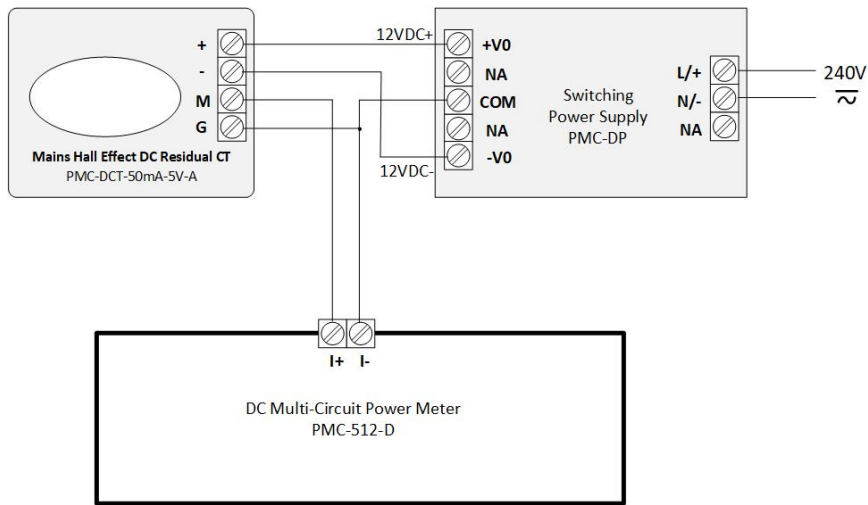


Figure 2-17 Wiring for Residual Current Hall Effect CT

**Note:**

1. It is important to wire the G terminal on the CT to the COM Terminal on the Power Supply and the I- Terminal on the PMC-512-D.

### 2.5.4 Branch Circuits Hall Effect CT Wiring

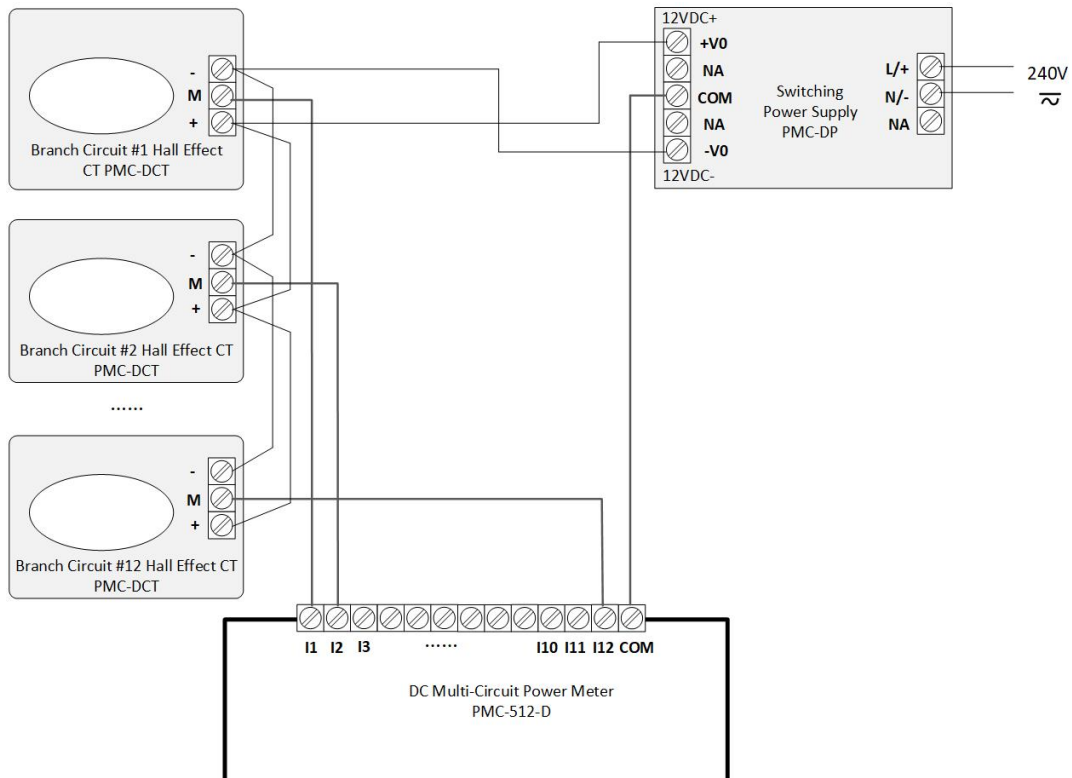


Figure 2-18 Wiring for Branch Circuits Hall Effect CT

**Note:**

1. It is important to wire the COM Terminal on the Power Supply and the counterpart on the PMC-512-D.

### 2.5.5 Mains & Branch Circuits Hall Effect CT wiring (sharing the same PMC-DP)

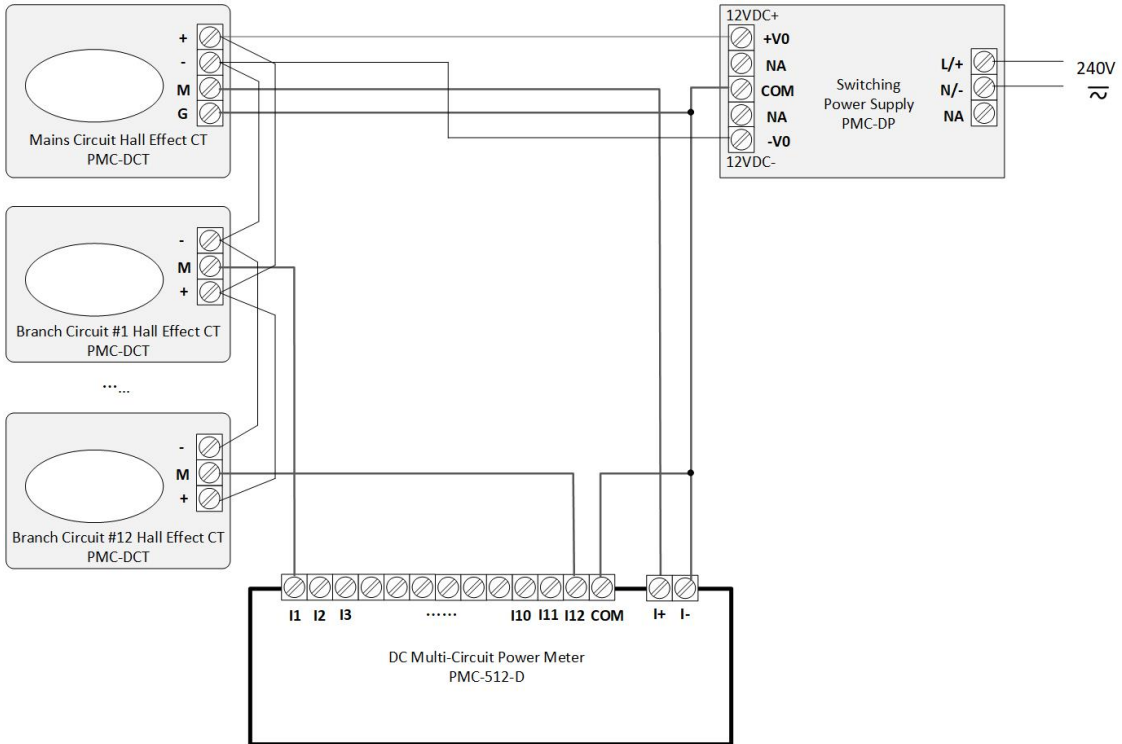


Figure 2-19 Mains & Branch Circuits Hall Effect CT wiring (sharing the same PMC-DP)

**Note:**

1. It is important to wire the G Terminal on the Hall Effect CT for the Mains Input, the COM Terminal on the Power Supply, the I- Terminal and the COM Terminal on the PMC-512-D.

### 2.5.6 Communications Wiring

The PMC-512-D provides two RS485 ports that support 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 optical isolation and surge protection should be used.

The following figure illustrates the RS485 wiring for the PMC-512-D:

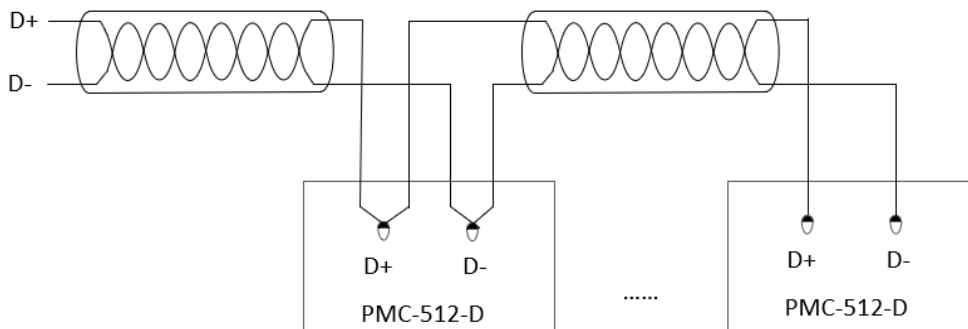


Figure 2-20 RS485 Connections on PMC-512-D

### 2.5.7 Digital Input Wiring

The following figure illustrates the Digital Input connections on the PMC-512-D. Please be informed that there are two versions of the PMC-512-D with different voltage ratings for its Voltage Inputs, Power Supply and Digital Inputs. Please refer to the Ordering Guide in **Appendix F** for more details.

- a) PMC-512-DX43AE is designed for 48VDC system.
- b) PMC-512-DX52BE is designed for 240/336VDC system.

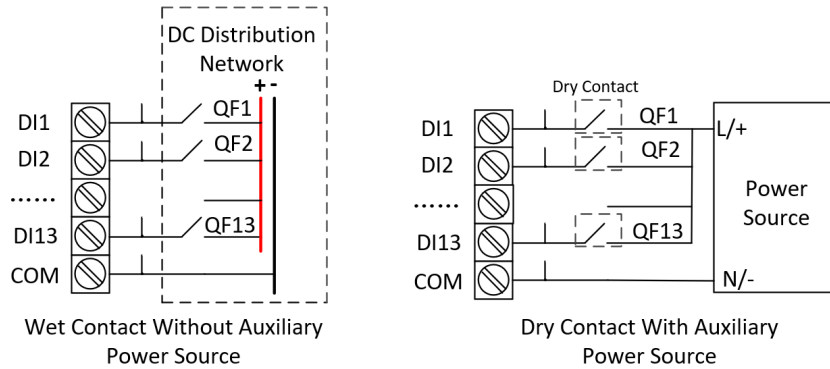


Figure 2-21 DI Connections

### 2.5.8 Analog Input Wiring

The following figure illustrates the Analog Input connections on the PMC-512-D:

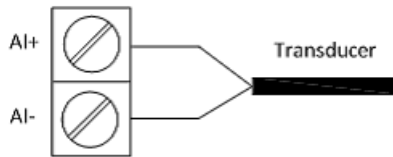


Figure 2-22 AI Connections

### 2.5.9 Digital Output Wiring

The following figure illustrates the Digital Output connections on the PMC-512-D:

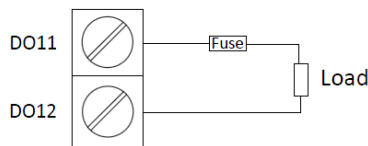


Figure 2-23 DO Connections

### 2.5.10 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.

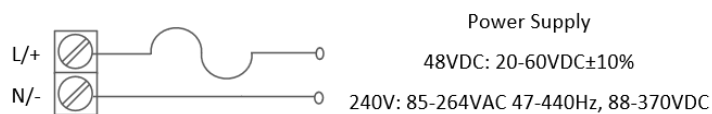


Figure 2-24 Power Supply Wiring

## Chapter 3 User Interface

The following figures illustrate the two versions of the PMC-512-D. The Transducer Version provides three LED indicators and one Reset button. The LCD Version (available in the future) has an easy to read LCD display and three buttons for both data display and setup configuration purposes.



Figure 3-1 Front Panel of PMC-512-D Transducer Version



Figure 3-2 Front Panel of PMC-512-D LCD Version

### 3.1 Front Panel LED Indicators

There are three LED indicators on the PMC-512-D's Front Panel as described in the following table.

LED Indicator	Color	Status	Description
Run	Green	Blinking once per second	System is running normally
	Red	Blinking once per 0.5s	Alarm Active
		Solid On	Abnormal Diagnostics
Comm.	Green	Blinking	Receiving data or Transmitting data
		Off	No Communication
Pulse	Red	Pulsing based on the rate of Energy Consumption	Energy Pulse Output

Table 3-1 Front Panel LED Indicators

### 3.2 Front Panel Buttons

#### 3.2.1 PMC-512-D Transducer Version

There is a <sup>Comm.</sup>Reset button on the Front Panel of the PMC-512-D Transducer Version (No LCD), such as PMC-512-DX43AE, for resetting the Communication parameters or all Setup parameters to factory default.

Button	Reset Comm. Parameters	Reset All Setup Parameters
Comm. Reset	i. Press this button for 5 seconds when the device is running. ii. All the LED indicators will blink for 5 times.	i. Power off the PMC-512-D. ii. Holding down this button for 5 seconds after the device has been powered up. iii. All the LED indicators will blink for 10 times.

Table 3-2 Reset Mechanism for the PMC-512-D's Transducer Version

#### 3.2.2 Buttons on LCD PMC-512-D (Future)

There are three buttons on the right-hand side of the PMC-512-D LCD Version, <O>, <◀> and <▼>. Their functions are described below.

Button	Auto-Scroll Mode	Main Menu	Setup Configuration Mode
<O>	Pressing this button momentarily enters the <b>Main Menu</b>	<ul style="list-style-type: none"> <li>Pressing this button enters the highlighted sub-menu.</li> <li>Pressing this button at the <b>Setup</b> menu enters the <b>Setup Configuration Mode</b>.</li> <li>Holding this button for 2s returns to the <b>Auto-Scroll</b> mode from the <b>Main Menu</b> or returns to the previous menu level from inside a sub-menu.</li> </ul>	<ul style="list-style-type: none"> <li>While inside the <b>Setup</b> menu, pressing this button enters the sub-menu.</li> <li>While inside a sub-menu, pressing this button enters the next sub-menu or selects a parameter to modify.</li> <li>After the parameter has been modified, pressing this button saves the changes.</li> <li>Holding this button for 2s returns to the previous menu level.</li> </ul>
<◀>	Pressing this button scrolls through the following <b>Parameter Categories</b> if the respective option has been enabled in the <b>Auto Scroll</b> setup under the <b>Maintenance</b> menu: <ul style="list-style-type: none"> <li>SM1-12</li> <li>AI</li> </ul>	<ul style="list-style-type: none"> <li>Pressing this button inside the <b>Metering</b> sub-menu scrolls through the following <b>Parameter Categories</b>:                             <ul style="list-style-type: none"> <li>I1-I12 for 12 SMs</li> <li>AI</li> </ul> </li> <li>Pressing this button inside the <b>Alarm Status</b> sub-menu scrolls through the following <b>Alarm Categories</b>:                             <ul style="list-style-type: none"> <li>U/I for Mains Circuit</li> <li>I1-I12 for 12 SMs</li> <li>AI</li> <li>DI1 to DI13</li> </ul> </li> <li>While inside other sub-menus, pressing this button scrolls to the previous item.</li> </ul>	<ul style="list-style-type: none"> <li>While inside the <b>Setup</b> menu or a sub-menu, pressing this button scrolls to the previous menu item or setup parameter.</li> <li>After a setup parameter has been selected, pressing this button moves the cursor one position to the left if it is a numeric value. Once the cursor has reached the left most digit, pressing this button again will move the cursor to the right most digit. This button is ignored if the selected parameter is an enumerated value.</li> </ul>
<▼>	Pressing this button scrolls to the next parameter in a certain <b>Parameter Category</b> .	<ul style="list-style-type: none"> <li>Pressing this button scrolls to the next sub-menu, the next parameter in a certain <b>Parameter Category</b> inside the <b>Metering</b> sub-menu or the next alarm parameter in a certain <b>Alarm Category</b> inside the <b>Alarm status</b> sub-menu.</li> </ul>	<ul style="list-style-type: none"> <li>While inside the <b>Setup</b> menu or a sub-menu, pressing this button scrolls to the next menu item or setup parameter.</li> <li>After a setup parameter has been selected, pressing this button increments the selected digit if it is a numeric value or scrolls through the selection list if it is an enumerated value.</li> </ul>

Table 3-3 Button Descriptions on LCD PMC-512D

### 3.3 Data Display (Optional with the Future LCD Version)

The PMC-512-D’s LCD display defaults to the **Auto-Scroll** display mode where measurements in each of the selected **Parameter Categories** illustrated in **Table 3-4** below are automatically scrolled through at a fixed 5-second interval. If the user wishes to see all the available parameters, one can manually do so by pressing the <O> button to enter the **Main Menu** and then selecting one of the following sub-menus for the desired information. The available sub-menus are: **Metering, Alarm status, DI/DO Status, Event Log, Setup, Maintenance, and Information**. The following sections describe the available information for each of the sub-menus in detail.

#### 3.3.1 Auto-Scroll

The **Parameter Categories** and their measurements are listed in the table below, and all of them are **Enabled** in **Auto-Scroll Mode** by default. Please refer to **Auto-Scroll Setup** in **Section 3.4.4 Maintenance** about how to enable or disable the display of a certain of **SMs** or **AI** in **Auto-Scroll**.

Parameter Categories	Measurements			
Mains Circuit	U			
	I*/I $\tilde{r}$	%Loading <sup>1</sup>	P <sup>1</sup>	kWh <sup>1</sup>
SMx (x=1-12)	I	%Loading	P	kWh
AI	AI Scaled		AI Raw	

\*I stands for the Mains Current when working with the Mains Circuit Hall Effect CT.

$\tilde{r}$ I stands for the Residual Current when working with the DC Residual Hall Effect CT.

Note:

- 1) When the Mains Current Type is Residual Current, the %Loading, P, and kWh are not available.

**Table 3-4 Auto-Scroll Display Pages**

#### 3.3.2 Metering

The following table illustrates the available measurements under the **Metering** sub-menu.

Parameter Categories	Measurements			
Mains Circuit	U			
	I*/I $\tilde{r}$	%Loading <sup>1</sup>	P <sup>1</sup>	kWh <sup>1</sup>
SMx (x=1-12)	I	%Loading	P	kWh
AI	AI Scaled		AI Raw	

\*I stands for the Mains Current when working with the Mains Circuit Hall Effect CT.

$\tilde{r}$ I stands for the Residual Current when working with the DC Residual Hall Effect CT.

Note:

- 1) When the Mains Current Type is Residual Current, %Loading, P, and kWh are not available.

**Table 3-5 Metering Display Pages**

#### 3.3.3 Alarm Status

Menu	Alarm Categories	Measurements	
Alarm Status	Mains Circuit	U Alarm	I*/I $\tilde{r}$ Alarm
	SMx (x=1-12)	I Alarm	
	AI	AI Alarm	
	Dlx (x=1-13)	Dlx (x=1 to 13) Open/Closed Alarm	

\*I stands for the Mains Current when working with the Mains Circuit Hall Effect CT.

$\tilde{r}$ I stands for the Residual Current when working with the DC Residual Hall Effect CT.

**Table 3-6 Alarm Status Pages**

### 3.3.4 DI/DO Status

Menu	Sub-Menu	Measurements
DI/DO Status	DI (1-13)	Dlx (x=1 to 13)
	DO	DO

Table 3-7 DI/DO Status Display Pages

### 3.3.5 SOE Log

The PMC-512-D supports the display of the SOE Log with its relevant parameter values and its timestamp. The users can scroll through the SOE Log by pressing <◀> or <▼>.

Two examples of SOE Log Display:



Figure 3-3 Examples of Event Log Display

### 3.3.6 Information

Menu	Parameters	Description
Info		Meter Information
	Firmware	Firmware Version
	Modbus	Modbus Protocol Version
	Ver. Date	Firmware Version Date
	S/N	Serial Number
Diagnostics		
	AD	A/D Diagnostics
	FRAM	FRAM Diagnostics
	FLASH	FLASH Diagnostics
	Setup Param.	Setup Parameters Diagnostics

Table 3-8 Information Display Pages

## 3.4 Setup and Maintenance via the Front Panel (Optional with the future LCD Version)

### 3.4.1 Making Setup Changes

#### 1) Entering the Password:

- Press <O> to enter the **Main Menu**.
- Press <▼> to advance to the **Setup** menu.
- A correct password must be entered before changes are allowed. The factory default password is "0000" (four zeros).
- Press <◀> to shift the cursor to the left and <▼> to increment the numeric value for the password.
- When the password has been entered, pressing <O> will enter the **Setup** sub-menu if the password is correct (otherwise, the device will respond "Incorrect Password").

#### 2) Selecting a parameter to change:

- Press <▼> to scroll to the desired sub-menu or parameter.
- Press <O> to select the sub-menu or parameter for configuration.
- Hold <O> for 2 seconds to return to the previous menu level.
- Repeat Step 2 until all the desired setup parameters have been selected.

**3) Changing and saving a setup parameter:**

- For a numeric parameter, press <◀> to shift the cursor to the left by one position or <▼> to increment the numeric value.
- For an enumerated parameter, press <◀> or <▼> to scroll backward and forward in the selection list.
- After modification, press <O> to save the change into memory or hold <O> for 2 seconds to exit the currently selected parameter without change.
- Repeat steps 2) and 3) if necessary.

**4) Exiting the Setup Configuration Mode**

- Hold <O> for 2 seconds to return to the **Main Menu**.
- Also, the **Setup Configuration Mode** will be automatically exited if there is a period of inactivity of 5 minutes or longer.

### 3.4.2 Setup Menu

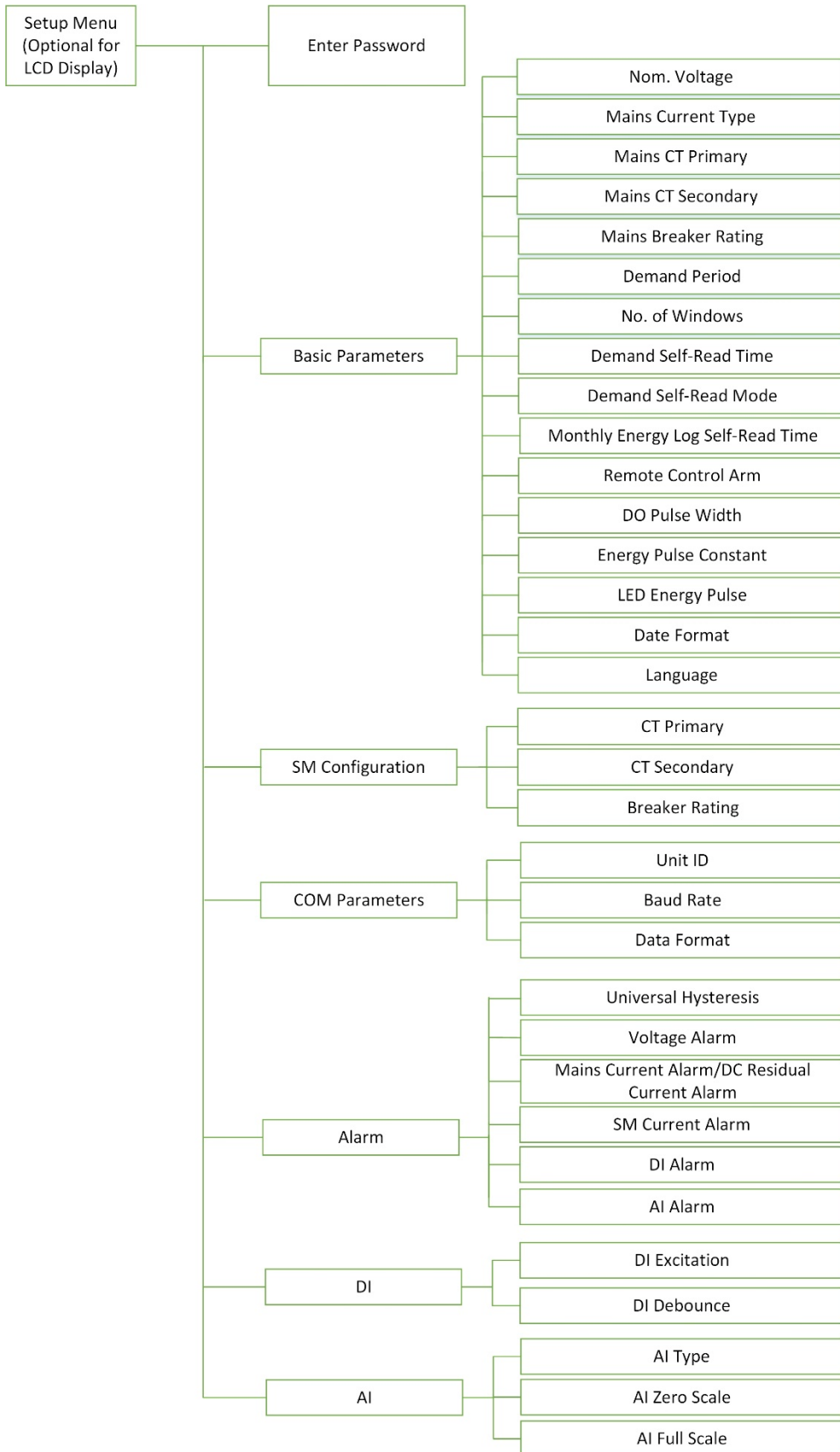


Figure 3-4 Setup Menu

### 3.4.3 Configuration

The **Setup Configuration Mode** provides access to the following setup parameters:

Label			Description	Range	Default
1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>			
Setup					
Basic					
	Nom. Voltage		Nominal Voltage	48 V/240 V/336 V	240 V
	Mains Current Type		Mains Current Type	Incomer/Residual	Incomer
	Mains CT Primary		Mains CT Primary <sup>1</sup>	1 to 3,000 A/mA <sup>1</sup>	400 A/mA <sup>1</sup>
	Mains CT Secondary		Mains CT Secondary	0.1-5.0 V	4 V
	Mains Breaker Rating		Mains Breaker Rating	1 to 3,000 A	250 A
	Dmd Period		Demand Interval	1 to 60 min	15
	No. of Windows		Number of Sliding Windows	1 to 15	1
	Dmd S.R. Time		Self-Read Time for Demand	See Note 2)	0
	Dmd S.R. Mode		Self-Read Mode for Demand	Auto/Manual	Auto
	Mthly Energy Log S.R. Time		Self-Read Time for Monthly Energy Log	See Note 2)	0
	R.C. Arm		Enable Arm before Execute Remote Control	Enabled/Disabled	Enabled
	DO Pulse Width		Specifies the Pulse Width for which the relay output will be active when a remote control command is received to activate it. The DO is in Latched mode if it's set to zero.	0.0 ~600.0 s	0 s
	EN Pulse CNST		LED Energy Pulse Constant	1/10/100/400/1000/3200 imp/kWh	400
	LED EN Pulse		Specifies which kWh will be enabled as the LED Energy Pulse	0 to 14 <sup>3</sup>	0 (Disabled)
	Date Format		Set Date Format	YYYY/MM/DD MM/DD/YYYY DD/MM/YYYY	YYYY/MM/DD
	Language		System language	EN/SC/TC	EN
SM Config.					
	CT Primary		SMx (x=1-12) CT Primary	1 to 3000 A	100 A
	CT Secondary		SMx (x=1-12) CT Secondary	1 to 100 mA	50 mA
	Breaker Rating		SMx (x=1-12) Breaker Rating	1 to 3,000 A	250 A
Comm.					
	COM1 Unit ID		COM1 Modbus Address	1 to 254	100
	COM1 Baud Rate		COM1 Data rate in bits per COM1 second	1200/2400/4800/9600 19200/38400/57600	38400
	COM1 Config		COM1 Data Format	8N2/8O1/8E1/8N1	8E1
	COM2 Unit ID		COM2 Modbus Address	1 to 254	100
	COM2 Baud Rate		COM2 Data rate in bps	1200/2400/4800/9600/ 19200/38400/57600	9600
	COM2 Config		COM2 Data Format	8N2/8O1/8E1/8N1	8E1
Alarm					
Global Alarm					
	Uni. Hys.		Universal Hysteresis	0 to 10%	2%
	ON/OFF Threshold		Current ON Threshold	0 to 10%	5%
	ON Time		Current ON Delay	0 to 9999(s)	10s
	OFF Time		Current OFF Delay	0 to 9999(s)	30s
Voltage Alarm					
	H Limit		U H Alarm Limit	0~300.0V	0
	H Delay		U H Alarm Delay	0~9999s	0
	L Limit		U L Alarm Limit	0~300.0V	0
	L Delay		U L Alarm Delay	0~9999s	0
	Trigger		U Alarm Trigger	None/DO/Alarm LED/DO & Alarm LED	None
Mains Current Alarm <sup>4</sup>					
	HH Threshold		Current HH Alarm Threshold	0 to 100 (%) <sup>5</sup>	80%
	HH Delay		Current HH Alarm Delay	0 to 9999 (s)	10s
	H Threshold		Current H Alarm Threshold	0 to 100 (%) <sup>5</sup>	60%

H Delay	Current H Alarm Delay	0 to 9999 (s)	10S
L Threshold	Current L Alarm Threshold	0 to 100 (%) <sup>5</sup>	0
L Delay	Current L Alarm Delay	0 to 9999 (s)	0
LL Threshold	Current LL Alarm Threshold	0 to 100 (%) <sup>5</sup>	0
LL Delay	Current LL Alarm Delay	0 to 9999 (s)	0
Trigger	Current Alarm Trigger	None/DO/Alarm LED/DO & Alarm LED	None
<b>DC Residual Current Alarm<sup>4</sup></b>			
HH Threshold	Current HH Alarm Threshold	0 to 1000 (mA)	0
HH Delay	Current HH Alarm Delay	0 to 9999 (s)	0
H Threshold	Current H Alarm Threshold	0 to 1000 (mA)	0
H Delay	Current H Alarm Delay	0 to 9999 (S)	0
Trigger	Current Alarm Trigger	None/DO/Alarm LED/RO & Alarm LED	None
<b>SM Current Alarm</b>			
Enable 1-6	Select SMs 1-6 to be included in Current Alarm	1-6 □□□□□□	Off
Enable 7-12	Select SMs 7-12 to be included in Current Alarm	7-12 □□□□□□	Off
HH Threshold (%)	SM Current HH Alarm Threshold	0 to 100%	80%
HH Delay	SM Current HH Alarm Time Delay	0 to 9999 (s)	10 s
H Threshold (%)	SM Current H Alarm Threshold	0 to 100%, 0%	60%
H Delay	SM Current H Alarm Time Delay	0 to 9999(s), 0s	10 s
L Threshold (%)	SM Current L Alarm Limit	0 to 100%	0
L Delay	SM Current L Alarm Time Delay	0 to 9999(s)	0 s
LL Threshold (%)	SM Current LL Alarm Threshold	0 to 100%	0
LL Delay	SM Current LL Alarm Time Delay	0 to 9999(s)	0 s
Trigger	SM Current Alarm Trigger	None/DO/Alarm LED/RO & Alarm LED	None
<b>DIx Alarm(X=1-13)</b>			
Active Mode	Decide whether & when the alarm should active	Disabled/ Close/ Open	Disabled
Active Delay	Active Delay	0~9999 (s)	0
Trigger	DI Alarm Trigger	None/DO/Alarm LED/DO & Alarm LED	None
<b>AI Alarm</b>			
Alarm Mode	Set/Enable Alarm Level(s)	HH H L LL □□□□	Off
HH Limit	AI HH Alarm Threshold	-999999 to 999999	0
HH Delay	AI HH Alarm Delay	0 to 9999 (s)	10 s
H Limit	AI H Alarm Threshold	-999999 to 999999	0
H Delay	AI H Alarm Delay	0 to 9999 (s)	10 s
L Limit	AI L Alarm Threshold	-999999 to 999999	0
L Delay	AI L Alarm Delay	0 to 9999 (s)	10 s
LL Limit	AI LL Alarm Threshold	-999999 to 999999	0
Trigger	AI Alarm Trigger	None/DO/Alarm LED/DO & Alarm LED	None
<b>DI Setup (x=1-13)</b>			
DIx Excitation <sup>5</sup>	Excitation Voltage	0=220VDC* 1=220VAC, 2=110VDC 3=110VAC, 4=48VDC 5=48VDC	DC220V
DIx Debo.	Debounce Time	1 to 9999 (ms)	40 ms
<b>Analog Input</b>			
Type	Select between 0-20mA or 4-20mA input	4-20 mA / 0-20 mA	4-20 mA
Zero Scale	The value that corresponds to the minimum Analog Input of 0 or 4 mA	-999,999 to 999,999	400
Full Scale	The value that corresponds to the maximum Analog Input of 20 mA	-999,999 to 999,999	2000

**Table 3-9 Setup Parameters**

**Notes:**

- 1) The unit of **Mains CT Primary** is variable, which is A or mA, and depends on whether the **Mains Current Type** is **Incomer** or **Residual**.
- 2) The **Dmd S.R. Time** and **Mthly Energy Log S.R Time** support the following two options:
  - a. A zero value means that the Self-Read will take place at 00:00 of the first day of each month.
  - b. 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  $0 \leq \text{Hour} \leq 23$  and  $1 \leq \text{Day} \leq 28$ . For example, the value 1512 means that the Self-Read will take place at 12:00pm on the 15th day of each month.
- 3) The **LED Energy Pulse Modes** are listed in the table below:

Value	Parameter	Value	Parameter	Value	Parameter
0	Disabled	5	SM4 kWh	10	SM9 kWh
1	Mains kWh	6	SM5 kWh	11	SM10 kWh
2	SM1 kWh	7	SM6 kWh	12	SM11 kWh
3	SM2 kWh	8	SM7 kWh	13	SM12 kWh
4	SM3 kWh	9	SM8 kWh		

**Table 3-10 LED Energy Pulse Modes**

- 4) Since the **Mains Current Type** can be configured as **Incomer** or **Residual**, the **Current Alarm** settings should be configured accordingly. When **Incomer** is selected as the **Mains Current Type**, the **Mains Current Alarm** settings would be used for alarming, and vice versa.
- 5) The available options for DIx Excitation would depend on the PMC-512-D Model. The 48VDC and -48VDC options are only available for the hardware that is only equipped with 48VDC DI while the 220VDC, 220VDC, 110VDC and 110VAC options are available for the 240VDC (max.336VDC) DI.

**3.4.4 Maintenance**

Parameters	Descriptions	Range	Default
Clock Setup	Time and Date	YYYY/MM/DD hh:mm:ss	-
Password Setup	Set New Password	-	-
BLTO	Backlight Time Out <sup>1</sup>	0 to 60 min.	5
Contrast	LCD Contrast	0 to 9	5
Auto-Scroll	Auto Scroll Setup <sup>2</sup>	See Note 2)	
Clear Energy	Clear all Energy registers	Yes/No	No
Clear Max Demands	Clear Peak Demand Log of This Month (Since Last Reset)	Yes/No	No
Clear All Demands	Clear all Demand Logs	Yes/No	No
Clear SOE	Clear SOE Logs	Yes/No	No
Clear DR Log	Clear DR Logs	Yes/No	No
Clear All Data	Clear All of the above	Yes/No	No
Factory Reset	Reset factory default settings	Yes/No	No

**Table 3-11 Maintenance Parameters**

**Notes:**

- 1) If **BLTO** is set to 0, the Backlight Time Out is disabled, which means that the Backlight will always be on.
- 2) **Auto-Scroll** Setup allows users to select which **SM** and whether **Analog Input** would be displayed in **Auto-Scroll Mode**. For Example, if the PMC-512-D is used for monitoring 9 branch circuits with SM1 to SM9, the remaining three SMs can be disabled in the **Auto-Scroll Mode** to prevent unnecessary information from being displayed. The **Parameter Categories** and their measurements are listed in the table below, and all of them are **Enabled** in **Auto-Scroll Mode** by default. The **Parameter Category Mains Circuit** is always shown and cannot be disabled in **Auto-Scroll** mode.

Parameter Categories	Measurements			
<b>Mains Circuit</b>	U			
	I*/I <sub>r</sub> ~	%Loading <sup>1</sup>	P <sup>1</sup>	kWh <sup>1</sup>
<b>SMx (x=1-12)</b>	I <sub>x</sub>	%Loading <sub>x</sub>	P <sub>x</sub>	kWh <sub>x</sub>
<b>AI</b>	AI Scaled		AI Raw	

\*I stands for the Mains Current when working with Mains Circuit Hall Effect CT.  
~I<sub>r</sub> stands for the Residual Current when working with DC Residual Hall Effect CT.

**Note:**

- 1) When the **Mains Current Type** is **Residual Current**, %Loading, P, and kWh are not available.

**Table 3-12 Auto-Scroll Display Pages**

## Chapter 4 Applications

### 4.1 Inputs and Outputs

#### 4.1.1 Digital Inputs

The PMC-512-D is equipped with 13 Wet Contact **Digital Inputs (DIs)** that are used for breaker status monitoring. Changes in Digital Input status are stored as events in the SOE Log at 1 ms resolution. Each DI has the following setup parameters:

Setup Parameter	Definition	Options/Default*
<b>DIx Excitation<sup>1</sup></b> (Reg. # 6100)	Specifies the voltage excitation level.	0 = 220VDC* 1= 220VAC, 2 = 110VDC 3= 110VAC, 4= 48VDC 5= -48VDC
<b>DIx Debounce</b> (Reg. # 6101~6113)	Specifies the minimum duration the <b>DI</b> must remain in the Active or Inactive state before a DI state change is considered to be valid.	1 to 9999 (ms) 40ms*

**Table 4-1 Definition for DI Parameters**

**Note:**

- The available options for **DI Excitation** would depend on the PMC-512-D model. The 48VDC and -48VDC options are only available for the hardware that are equipped with 48VDC DI while the 220VDC, 220VAC, 110VDC and 110VAC options are available for the 240VDC (max. 336VDC) DI.

#### 4.1.2 Analog Input

The PMC-512-D comes standard with an Analog Input which can be programmed as 0mA to 20mA or 4mA to 20mA input. There are 3 setup parameters:

Setup Parameter	Definition	Options/Default*
<b>AI Type</b> (Reg. # 6050)	Select between 0-20mA or 4-20mA input.	0 = 4 -20 mA* 1 = 0 -20 mA
<b>AI Zero</b> (Reg. # 6051)	This value corresponds to the minimum Analog Input of 4 mA (for 4-20mA input) and has a range of -999,999 to +999,999.	-999,999 to +999,999 400*
<b>AI Full</b> (Reg. # 6053)	This value corresponds to the maximum Analog Input of 20 mA and has a range of -999,999 to +999,999.	-999,999 to +999,999 2000*

**Table 4-2 AI Setup Parameters**

For example, to measure the oil temperature of a transformer, connect the outputs of the temperature sensor to the AI terminals of the PMC-512-D. The temperature sensor outputs 4mA when the temperature is -25°C and 20mA when the temperature is 100°C. As such, the Type parameter should be programmed as 4-20mA. The AI FULL parameter should be programmed with the value 100, and the AI ZERO parameter should be programmed with the value -25. Therefore, when the output of the sensor is 20mA, the reading will be 100.00°C. When the output is 4mA, the reading will be -25.00°C. When the output is 12mA, the reading will be  $(100^{\circ}\text{C} - (-25^{\circ}\text{C})) \times (12\text{mA} - 4\text{mA}) / (20\text{mA} - 4\text{mA}) + (-25^{\circ}\text{C}) = 37.50^{\circ}\text{C}$ .

#### 4.1.3 Energy Pulse Outputs

The PMC-512-D comes standard with one Front Panel LED Pulse Output for kWh pulsing. Energy pulsing mode can be programmed from the Front Panel or through communications via the LED EN Pulse setup parameter. Energy Pulse Outputs are typically used for accuracy testing. The pulse constant can be configured as 1/10/100/400/1000/3200 imp/kWh.

## 4.2 Power, Energy and Demand

### 4.2.1 Basic Measurements

The PMC-512-D provides the following basic measurements that can be accessed via the communication:

Parameter	Description	Mains Current Type = Incomer	Mains Current Type = Residual
U	Mains Voltage	●	●
I	Mains Current	●	○
I <sub>r</sub>	Residual Current	○	●
%Loading	Mains Loading rate	●	○
P	Mains Power	●	○
kWh	Mains Energy	●	○
I1-I12	SM1-12 Current	●	●
%Loading1-12	SM1-12 %Loading	●	●
P1-P12	SM1-12 Power	●	●
kWh1-12	SM1-12 Energy	●	●
AI	Analog Input	●	●

Table 4-4 Basic Measurements

### 4.2.2 Energy Measurements

The PMC-512-D's Energy measurements include Mains Energy (if the **Mains Current Type = Incomer**) and SM 1-12 Energy at a resolution of 0.01kWh and a maximum value of 999,999.99kWh. When the maximum value is reached, it will automatically roll over to zero.

The energy can be reset manually via the Front Panel or through communications.

### 4.2.3 Demands

Demand is defined as the average power consumption over a fixed interval (usually 15 minutes) based on the sliding window method. The PMC-512-D provides the Current and kW Total Present Demand of Mains and Branch Circuits as well as the Current and kW total Peak Demand of Mains and Branch Circuits for **This Month (Since Last Reset)** and **Last Month (Before Last Reset)**. Please note that the kW total Present and Peak Demand for the Mains Circuit are not available if the **Mains Current Type** is **Residual Current**. The Present Demand and Peak Demand data can be retrieved via Communications and, its Setup Parameters are available via the Front Panel and through communications.

The PMC-512-D provides the following Demand setup parameters:

Parameter	Definition	Options
<b>Demand Period</b> (Reg. # 6006)	1 to 60 minutes. For example, if the <b># of Sliding Windows</b> is set as 1 and the <b>Demand Period</b> is 15, the demand cycle will be 1×15=15min.	1 to 60 minutes Default=15
<b># of Sliding Windows</b> (Reg. # 6007)	Number of Sliding Windows.	1 to 15 Default=1
<b>Self-Read Time</b> (Reg. # 6008)	The <b>Self-Read Time</b> allows the user to specify the time and day of the month for the Peak Demand Self-Read operation. The <b>Self-Read Time</b> supports three options: <ul style="list-style-type: none"> <li>• A zero value means that the Self-Read will take place at 00:00 of the first day of each month.</li> <li>• 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.</li> <li>• A 0xFFFF value will disable the Self-Read operation and replace it with manual operation. A manual reset will cause the Max. Demand of <b>This Month</b> to be transferred to</li> </ul>	Default=0xFFFF

	the Max. Demand of <b>Last Month</b> and then reset. The terms <b>This Month</b> and <b>Last Month</b> will become <b>Since Last Reset</b> and <b>Before Last Reset</b> .	
<b>Self-Read Mode</b> (Reg. # 6009)	<ul style="list-style-type: none"> <li>• 0=Auto</li> <li>• 1=Manual</li> </ul>	Default = 0

**Table 4-5 Demand Setup**

### 4.3 Alarm Setpoints

The PMC-512-D provides powerful alarming functions for the Mains Meter, 12 Sub-Meters as well as different parameters. Each Alarm Type has an independent enable switch, which allows the alarms for Mains Meter, SM and other parameters to be enabled individually as needed. The alarms may also be disabled by setting their respective alarm thresholds to 0.

#### 4.3.1 Alarm Status

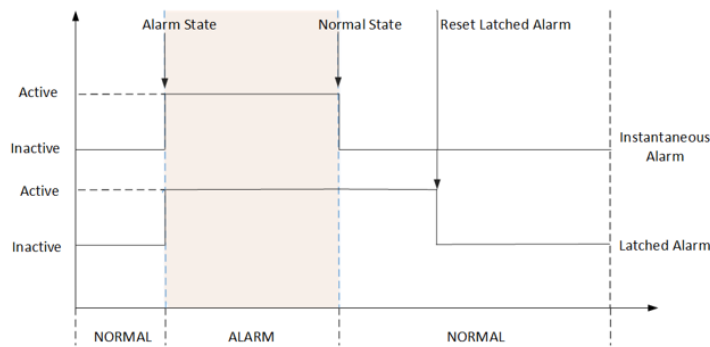
The PMC-512-D supports both the Instantaneous Alarm and Latched Alarm, which are defined below.

##### Instantaneous Alarm

The status of an Instantaneous Alarm becomes ALARM when the alarm condition is met and is automatically reset to NORMAL when the alarm condition is no longer met. Instantaneous Alarm cannot be reset manually.

##### Latched Alarm

On the other hand, the status of a Latched Alarm becomes ALARM when the alarm condition is met and will remain in the ALARM state even after the alarm condition is no longer met. The Latched Alarm must be reset manually. However, the Latched Alarm cannot be reset while the alarm condition remains.



**Figure 4-1 Alarm Status**

#### 4.3.2 Universal Hysteresis and Current ON/OFF Status

The Universal Hysteresis, Current ON Threshold, Current ON Delay and Current OFF Delay are global parameters that are valid for all relevant alarms.

Parameters	Description	Range	Default Value
Universal Hysteresis	The hysteresis rate for calculating the Return Threshold for all Alarms.	0 to 10%	2%
Current ON Threshold	The ON Threshold that applies to all Current channels for switching from the OFF to ON state.	0 to 10%	5%
Current ON Delay	The minimum duration that the Current of a particular channel must exceed the ON Threshold before the Status would switch from OFF to ON.	0 to 9999 (s)	10 s

Current OFF Delay	The minimum duration that the Current of a particular channel must fall below the OFF Threshold before the Status would switch from ON to OFF.	0 to 9999 (s)	30 s
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**Table 4-6 Global Parameters**

The Universal Hysteresis is a global parameter that is used to prevent measurement fluctuation around the threshold point from causing an alarm to fluctuate between the Active and Inactive states.

The PMC-512-D provides the ON/OFF status for each Current channel to indicate whether the channel is ON (Loaded) or OFF (No Load). If the channel status is OFF, it means that the channel has no load which would prevent the Low and Low-Low alarms from activating.

The following figures illustrate the logic diagram of the Current ON/OFF status, respectively.

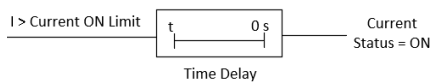
Where

$$\text{Current ON Limit} = \text{Breaker Rating} \times \text{Current ON Threshold}$$

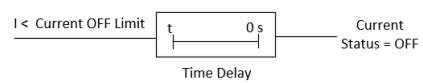
$$\text{Current OFF Threshold} = \text{Current ON Threshold} \times (1 - \text{Universal Hysteresis})$$

$$\text{Current OFF Limit} = \text{Breaker Rating} \times \text{Current OFF Threshold}$$

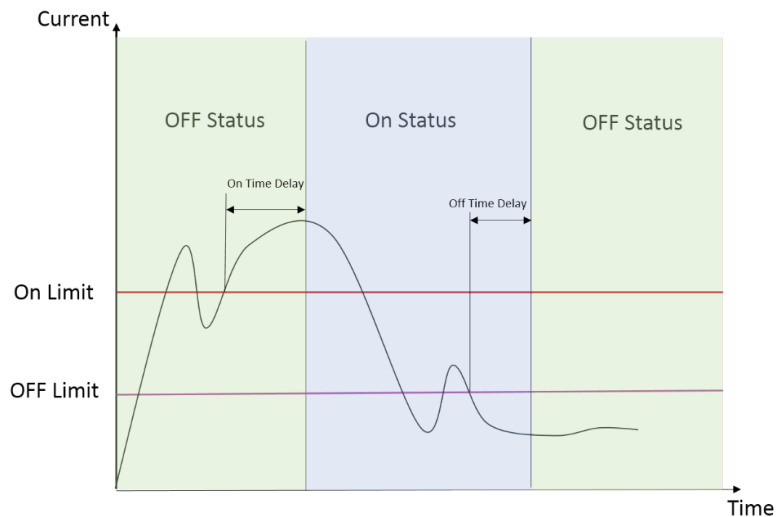
**It should be noted that the absolute value of the Current ON/OFF Limit is calculated based on the Breaker Rating parameters. Therefore, it's critical to set the Breaker Rating correctly for the Mains and each Branch Circuit for the Current Alarms to work properly.**



**Figure 4-2 Current ON Logic Diagram**



**Figure 4-3 Current OFF Logic Diagram**



**Figure 4-4 Current ON/OFF Status**

### 4.3.3 Voltage Alarms and ON/OFF Status

PMC-512-D provides the **Voltage ON/OFF** status as well as two Voltage Alarm levels (High and Low) for the Mains Circuit. The Voltage H/L Alarms will only be evaluated if it's determined that the **Voltage** status is **ON**.

It should be noted that the **absolute value** of the **Voltage ON/OFF Threshold** is calculated based on the **Nominal Voltage** parameter. **Therefore, it's critical to set the Nominal Voltage correctly for the Voltage ON/OFF to work properly.**

$$\text{Voltage Alarm ON Limit} = \text{Nominal Voltage} \times 5.0\%$$

$$\text{Voltage Alarm OFF Limit} = \text{Voltage ON Limit} \times (1 - \text{Universal Hysteresis})$$

The following figures illustrate the logic diagram of the Voltage Alarm ON/OFF status, respectively.

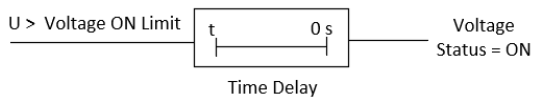


Figure 4-5 Voltage ON Logic Diagram

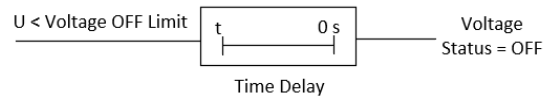


Figure 4-6 Voltage OFF Logic Diagram

The following table illustrates the Voltage Alarm parameters.

Parameters	Description	Range/Default
Voltage H Alarm Limit	Voltage H Alarm Limit	0* <sup>1</sup> to 300V
Voltage H Alarm Time Delay	Voltage H Alarm Time Delay	0* to 9999(s)
Voltage L Alarm Limit	VLN H Alarm Limit	0* to 300V
Voltage L Alarm Time Delay	VLN H Alarm Time Delay	0* to 9999(s)
Voltage Alarm Trigger	VLN Alarm Trigger	0* <sup>2</sup> = Disabled Bit 0 = RO Bit 1= Alarm Indicator Bits 2-15=Reserved

Table 4-7 Voltage Alarm Parameters

**Notes:**

- 1) 0 means this Alarm Channel is disabled.
- 2) 0 means the Alarm Trigger is disabled.

The logic diagram of Voltage H Alarm is illustrated in Figure 4-7.

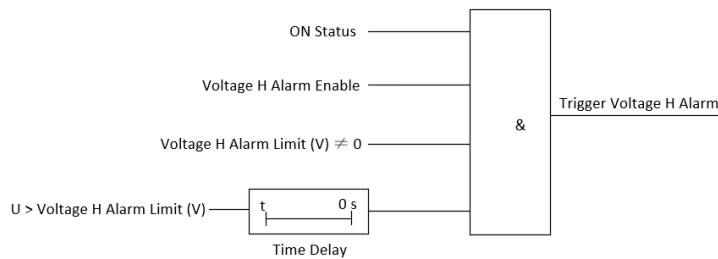


Figure 4-7 Voltage H Alarm Logic Diagram

The logic diagram of Voltage L Alarm is illustrated in Figure 4-8.

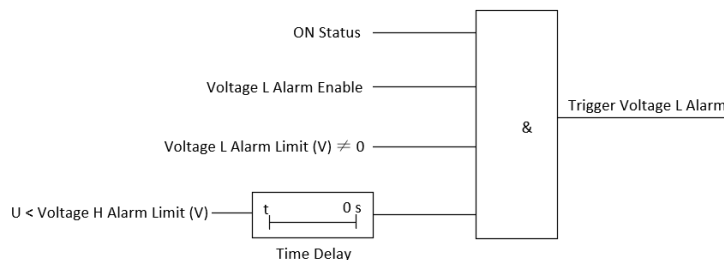


Figure 4-8 Voltage L Alarm Logic Diagram

### 4.3.4 Mains Current Alarms

PMC-512-D provides four Current alarm levels (High-High, High, Low, Low-Low) for the Mains Current. The **Current Alarms** will only be evaluated if it's determined that the **Current ON** status is true for the Mains Meter. The Mains Current Alarms will only be evaluated if the **Mains Current Type** is **Incomer**.

The following table illustrates the Mains Current Alarms parameters.

Parameters	Description	Range/Default
Current HH Alarm Threshold (%)	Mains Current HH Alarm Threshold	0* to 100%
Current HH Alarm Time Delay	Mains Current HH Alarm Time Delay	0 to 9999(s), 10s*
Current H Alarm Threshold (%)	Mains Current H Alarm Threshold	0 to 100%, 0%*
Current H Alarm Time Delay	Mains Current H Alarm Time Delay	0 to 9999(s), 0s*
Current L Alarm Threshold (%)	Mains Current L Alarm Threshold	0* to 100%
Current L Alarm Time Delay	Mains Current L Alarm Time Delay	0* to 9999(s)
Current LL Alarm Threshold (%)	Mains Current LL Alarm Threshold	0* to 100%
Current LL Alarm Time Delay	Mains Current LL Alarm Time Delay	0* to 9999(s)
Current Alarm Trigger	Mains Current Alarm Trigger	0*=Disabled, Bit 0=DO Bit 1=Alarm LED Bits 2-15=Reserved

**Table 4-8 Current Alarm Parameters**

For High and High-High Alarms, which are conceptually similar to Over Setpoint:

$$\text{Return Threshold} = \text{Alarm Threshold} \times (1 - \text{Universal Hysteresis})$$

For Low and Low-Low Alarms, which are conceptually similar to Under Setpoint:

$$\text{Return Threshold} = \text{Alarm Threshold} \times (1 + \text{Universal Hysteresis})$$

The following logic diagrams illustrates the different levels of Current Alarms.

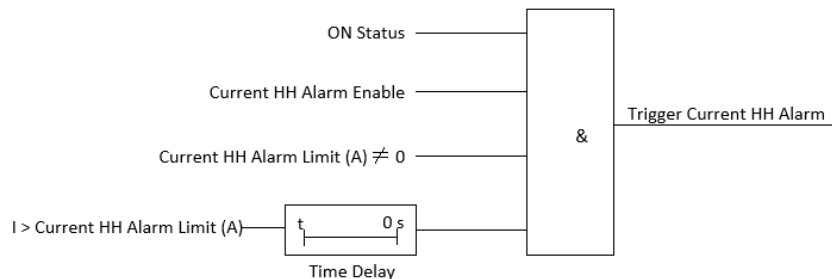
Where

$$\text{Current Alarm Limit} = \text{Mains' Breaker Rating} \times \text{Alarm Threshold} (\%)$$

$$\text{Current Return Limit} = \text{Mains' Breaker Rating} \times \text{Return Threshold} (\%)$$

**It should be noted that the absolute value of the Current Alarm Limit is calculated based on the Breaker Rating parameters. Therefore, it's critical to set the Breaker Rating correctly for the Current Alarms to work properly.**

Current HH Alarm:



**Figure 4-9 Current HH Alarm Logic Diagram**

Current H Alarm:

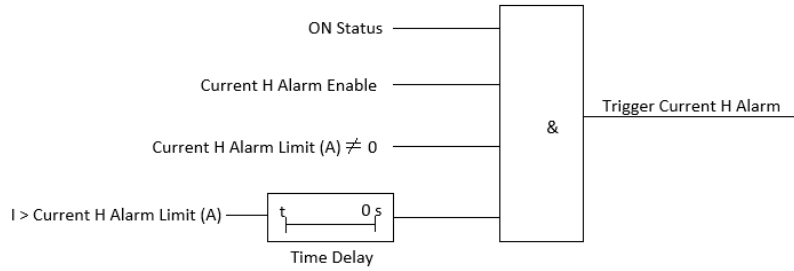


Figure 4-10 Current H Alarm Logic Diagram

Current L Alarm:

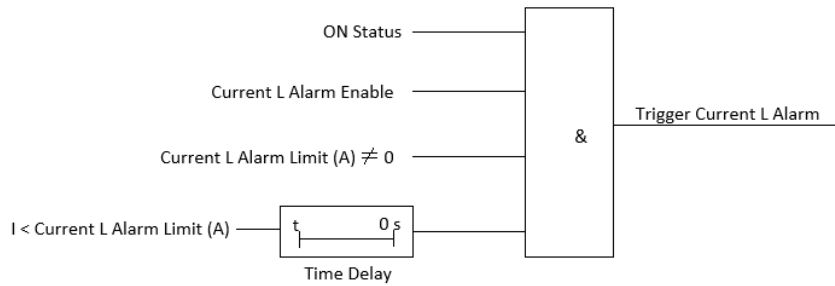


Figure 4-11 Current L Alarm Logic Diagram

Current LL Alarm

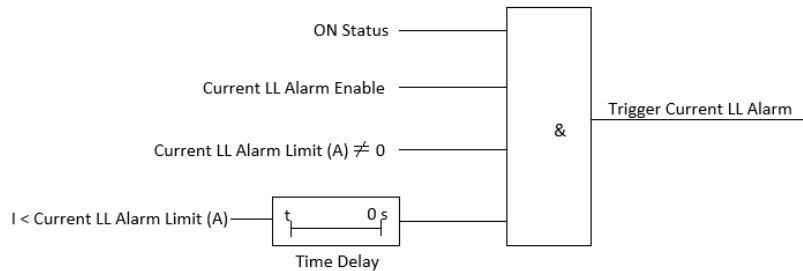


Figure 4-12 Current LL Alarm Logic Diagram

#### 4.3.5 DC Residual Current Alarm

When the **Mains Current Type** is **Residual**, the PMC-512-D provides 2 alarm levels (High-High, High) for the **Residual Current Alarm**. If the **Mains Current Type** is **Incomer**, the **Residual Current Alarm** is disabled.

The following table illustrates the Residual Current Alarm parameters.

Parameters	Description	Range/Default
Current H Alarm Limit	Residual Current HH Alarm Limit	0* <sup>1</sup> to 1000 mA
Current H Alarm Time Delay	Residual Current HH Alarm Time Delay	0* to 9999 (s)
Current HH Alarm Limit	Residual Current H Alarm Limit	0* <sup>1</sup> to 1000 mA
Current HH Alarm Time Delay	Residual Current H Alarm Time Delay	0* <sup>1</sup> to 9999 (s)
Current Alarm Trigger	Residual Current Alarm Trigger	0* <sup>2</sup> =Disabled, Bit 0=DO Bit 1=Alarm LED Bits 2-15=Reserved

Table 4-9 Current Alarm Parameters

**Notes:**

- 1) 0 means this Alarm Channel is disabled.
- 2) 0 means the Alarm Trigger is disabled.

For High and High-High Alarms, which are conceptually similar to Over Setpoint:

$$\text{Return Limit} = \text{Alarm Limit} \times (1 - \text{Universal Hysteresis})$$

Residual Current H Alarm:

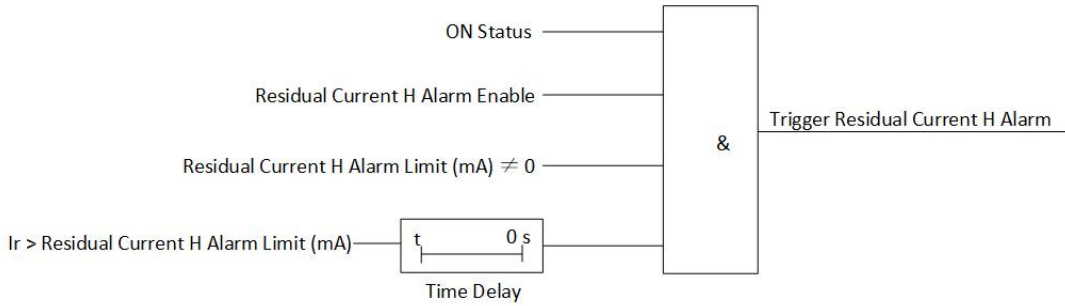


Figure 4-13 Current H Alarm Logic Diagram

Residual Current HH Alarm:

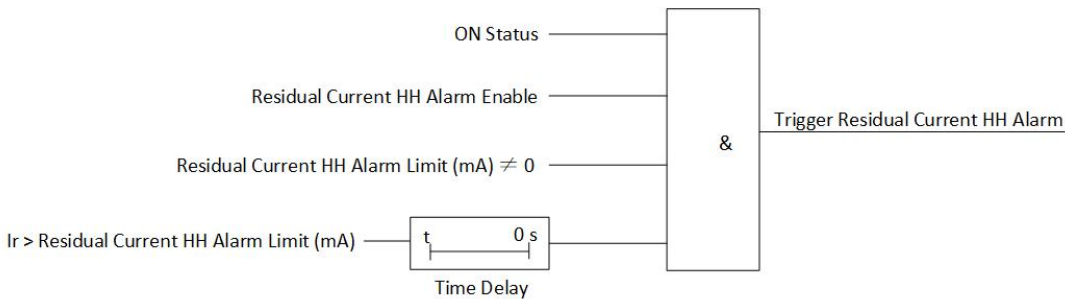


Figure 4-14 Current HH Alarm Logic Diagram

### 4.3.6 SM Current Alarm

PMC-512-D also provides four Current alarm levels (High-High, High, Low, Low-Low) for each SM Current. The SM Current Alarms will only be evaluated if it's determined that the respective **SM Current ON** status is true. The **SM Current Alarm Enable** register provides the ability to individually enable the Current Alarm for each SM. The **Alarm Threshold** and **Time Delay** settings would apply to all SMs that are enabled for **SM Current Alarm**.

The following table illustrates the **SM Current Alarm** setup parameters.

Parameters	Description	Range/Default
Current Alarm Enable	Enable SM1-12 for Current Alarm	0*-0x0FFF <sup>1</sup>
Current HH Alarm Threshold (%)	SM Current HH Alarm Threshold	0 <sup>2</sup> to 100%, 80%*
Current HH Alarm Time Delay	SM Current HH Alarm Time Delay	0 to 9999 (s), 10s*
Current H Alarm Threshold (%)	SM Current H Alarm Threshold	0 <sup>2</sup> to 100%, 60%*
Current H Alarm Time Delay	SM Current H Alarm Time Delay	0 to 9999(s), 10s*
Current L Alarm Threshold (%)	SM Current L Alarm Limit	0* <sup>2</sup> to 100%
Current L Alarm Time Delay	SM Current L Alarm Time Delay	0* to 9999(s)
Current LL Alarm Threshold (%)	SM Current LL Alarm Threshold	0* <sup>2</sup> to 100%
Current LL Alarm Time Delay	SM Current LL Alarm Time Delay	0* to 9999(s)
Current Alarm Trigger	SM Current Alarm Trigger	0* <sup>3</sup> =Disabled, Bit 0=DO Bit 1=Alarm LED Bits 2-15=Reserved

Table 4-10 Current Alarm Parameters

**Notes:**

- 1) Bits 0 to 11 represent the **SM Current Alarm Enable** for SM1 to 12 respectively, with the bit value "0" meaning Disabled and "1" meaning Enabled. For example, 0x003F means SM1 to 6 are enabled for **Current Alarm** and SM7 to 12 are disabled.
- 2) 0 means this Alarm Channel is disabled.
- 3) 0 means the Current Alarm Trigger is disabled.

For High and High-High Alarms, which are conceptually similar to Over Setpoint:

***Return Threshold = Alarm Threshold x (1 – Universal Hysteresis)***

For Low and Low-Low Alarms, which are conceptually similar to Under Setpoint:

***Return Threshold = Alarm Threshold x (1 + Universal Hysteresis)***

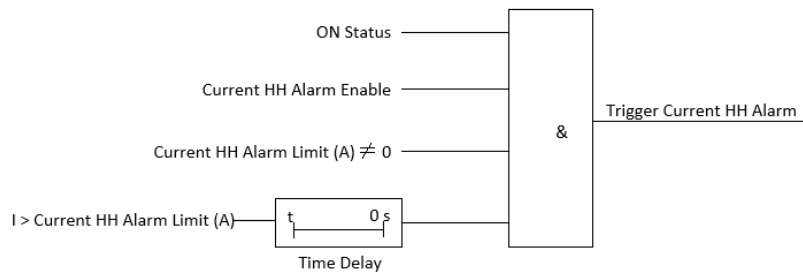
The following logic diagrams illustrates the different levels of Current Alarms.

Where

***SMx Current Alarm Limit = SMx's Breaker Rating x Alarm Threshold (%)***

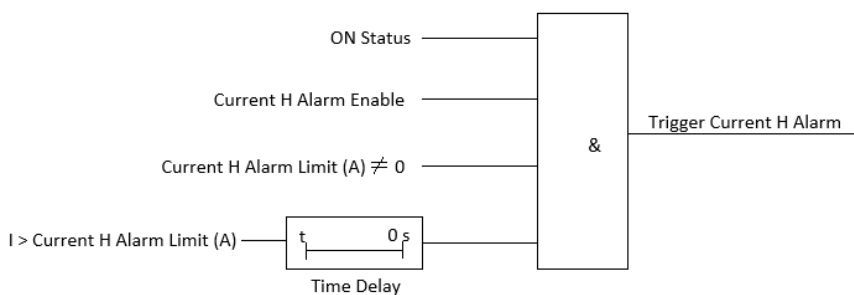
***It should be noted that the absolute value of the Current Alarm Limit is calculated based on the Breaker Rating parameters. Therefore, it's critical to set the Breaker Rating correctly for each SM Current for the Current Alarms to work properly.***

Current HH Alarm:



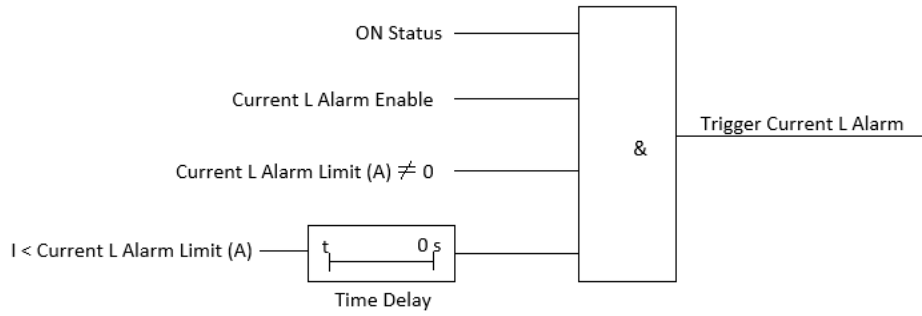
**Figure 4-15 Current HH Alarm Logic Diagram**

Current H Alarm:



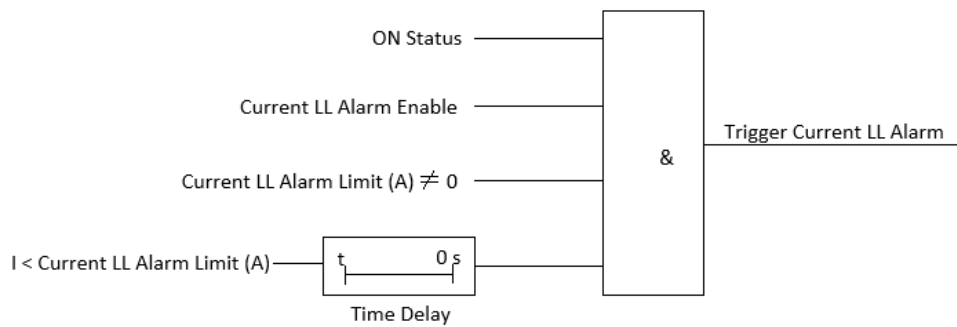
**Figure 4-16 Current H Alarm Logic Diagram**

Current L Alarm:



**Figure 4-17 Current L Alarm Logic Diagram**

Current LL Alarm



**Figure 4-18 Current LL Alarm Logic Diagram**

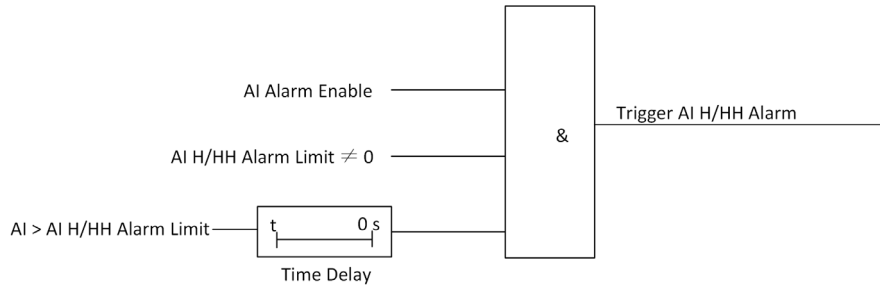
### 4.3.7 AI Alarm

PMC-512-D provides four AI Alarm Levels (High-High, High, Low, Low-Low). The following table illustrates the AI Alarm parameters.

Parameters	Range	Default
AI Alarm Enable (Reg. # 6484)	0* = Disable Bit0=HH Bit1=H Bit2=L Bit3=LL	0
AI HH Alarm Threshold (Reg. # 6485)	-999999 to 999999	0
AI HH Alarm Time Delay (Reg. # 6487)	0 to 9999 (s)	10 s
AI H Alarm Threshold (Reg. # 6488)	-999999 to 999999	0
AI H Alarm Time Delay (Reg. # 6490)	0 to 9999(s)	10 s
AI L Alarm Threshold (Reg. # 6491)	-999999 to 999999	0
AI L Alarm Time Delay (Reg. # 6493)	0 to 9999(s)	10 s
AI LL Alarm Threshold (Reg. # 6494)	-999999 to 999999	0
AI LL Alarm Time Delay (Reg. # 6496)	0 to 9999(s)	10s
AI Alarm Trigger (Reg. # 6497)	0*=Disabled Bit 0=DO, Bit 1=Alarm LED Bits 2-15=Reserved	0

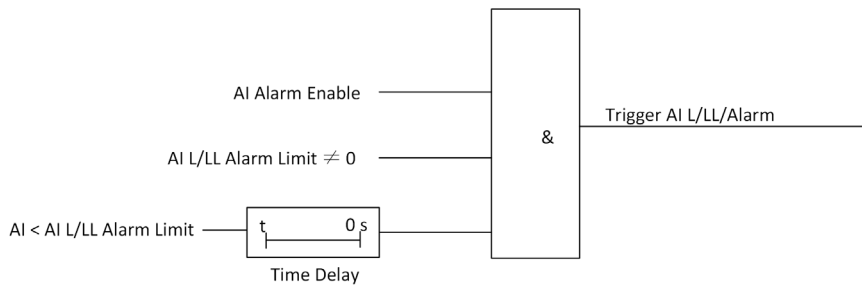
**Table 4-11 AI Alarm Parameters**

The logic diagram of AI H/HH Alarm is illustrated in Figure 4-19.



**Figure 4-19 AI H Alarm Logic Diagram**

The logic diagram of AI L/LL Alarm is illustrated in Figure 4-20.



**Figure 4-20 AI L Alarm Logic Diagram**

### 4.3.8 DI Alarm

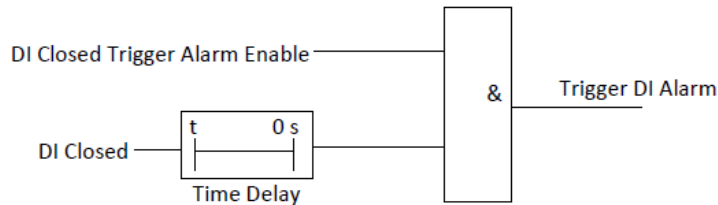
The following table illustrates the DI Alarm parameters.

Parameters	Description	Default
Dlx Alarm Type	0=Disabled 1=DI1 Closed Trigger; 2=DI1 Open Trigger	0
Dlx Alarm Time Delay	0 to 9999 (s)	0 s
Dlx Alarm Trigger	0* = Disabled Bit 0 = DO, Bit 1 = Alarm LED Bit 2-15=Reserved	0

x indicates 1 to 13

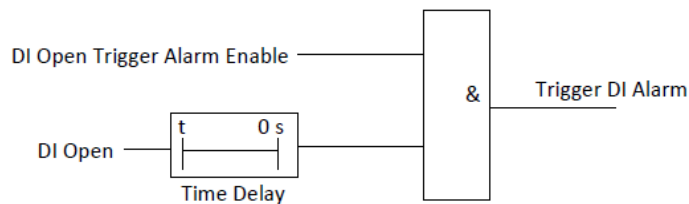
**Table 4-12 DI Alarm Parameters**

The logic diagram of DI Closed Alarm is illustrated in Figure 4-21.



**Figure 4-21 DI Closed Alarm Logic Diagram**

The logic diagram of DI Open Alarm is illustrated in Figure 4-22.



**Figure 4-22 DI Open Alarm Logic Diagram**

## 4.4 Data Logging

### 4.4.1 Peak Demand Log

The PMC-512-D records the **Peak Demand of This Month (Since Last Reset)** and **Last Month (Before Last Reset)** with timestamp for Current, kW Total for Mains Meter and SMs. All Peak Demand information can be accessed through communications. Please refer to **Section 4.2.3** for a complete description of the **Self-Read Time** and its operation. The **Peak Demand Log of This Month (Since Last Reset)** and all the **Peak Demand** can be reset individually through the Front Panel or via communications.

### 4.4.2 Monthly Energy Log

The PMC-512-D stores monthly energy data of the Mains Meter and SMs for the present month and the last 24 months. The **Monthly Energy Log Self-Read Time** setup parameter allows the user to specify the time and day of the month for the Recorder's Self-Read operation via communications. The Monthly Energy Log is stored in the meter's non-volatile memory and will not suffer any loss in the event of power failure, and they are stored on a First-In-First-Out basis where the newest log will overwrite the oldest.

The **Monthly Energy Log Self-Read Time** supports two options:

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

The Monthly Energy Log can be reset manually through the Front Panel or via communications.

### 4.4.3 SOE Recorder

The PMC-512-D's **SOE Log** can store up to 512 events such as Power-On, Power-Off, Alarms, Relay actions, Digital Input status changes, Diagnostics and Setup changes in non-volatile memory. Each event includes a cause, its relevant parameter values and a timestamp in 1ms resolution.

All events can be retrieved through the Front Panel or via communications. If there are more than 512 events, the newest event will replace the oldest event on a FIFO basis. The SOE Log can be reset through the Front Panel or via communications.

### 4.4.4 Data Recorder Log

The PMC-512-D provides one Data Recorder capable of recording a maximum of 60 parameters. Up to 5,000 Data Recorder Logs can be stored in the device's non-volatile memory and will not suffer any loss in the event of a power failure.

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

Setup Parameters	Value/Option	Default
Trigger Mode	0=Disabled / 1=Triggered by Timer	0
Recording Mode	0=Stop-When-Full / 1=First-In-First-Out	0
Recording Depth	1 to 5000 (entry)	5000
Recording Interval	60 to 345,600 seconds	60 s
Offset Time	0 to 43,200 seconds, 0 indicates no offset.	0
Number of Parameters	0 to 60	0
Parameter 1 to 60	See Appendix B	0

Table 4-13 Setup Parameters for Data Recorder

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

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

## Chapter 5 Modbus Register Map

This chapter provides a complete description of the Modbus register map (**Protocol Version 2.0**) for the PMC-512-D to facilitate the development of 3<sup>rd</sup> party Modbus RTU communications driver for accessing information on the PMC-512-D.

The PMC-512-D supports the following Modbus functions:

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

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

### 5.1 Status Register

#### 5.1.1 General Status

Register	Property	Description	Format	Note
0000	RO	DI Status <sup>1</sup>	Bitmap	
0001	RO	DO Status <sup>2</sup>	Bitmap	
0002	RO	Diagnostics <sup>3</sup>	Bitmap	
0004	RO	SOE Pointer <sup>4</sup>	UINT32	
0006~0007	RO	Reserved	UINT32	
0008	RO	DR Log Pointer <sup>5</sup>	UINT32	
0010	RO	Monthly Energy Log Pointer <sup>5</sup>	UINT32	
0012	RO	General Alarm Status	UINT16	0=Normal, 1=Alarm

**Table 5-1 General Status**

#### Notes:

- 1) For the **DI Status** register, the bit values of Bit0 to Bit12 represent the state of DI1 to DI13, respectively, with “1” meaning active (closed) and “0” meaning inactive (open).
- 2) For the **DO Status** register, the bit value of Bit0 represent the states of DO, with “1” meaning active (closed) and “0” meaning inactive (open). The remaining bits are reserved.
- 3) The **Diagnostics** register indicates the various system statuses with a bit value of 0 meaning normal and 1 meaning fault. The following table illustrates the details of the Diagnostics register.

Bit	Alarm Event
Bit 0	NVRAM Fault
Bit 1	Flash Fault
Bit 2	A/D Chips Fault
Bit 3	Internal Power Supply Fault
Bit 4	System Parameters Error
Bit 5	Internal Parameters Error
Bit 6-31	Reserved

**Table 5-2 Diagnostics Register (Reg. # 0002)**

- 4) The range of the **SOE Pointer** is between 0 and 0xFFFFFFFFH. The **SOE Pointer** is incremented by one for every event generated and will roll over to 0 if its current value is 0xFFFFFFFFH. The **SOE Log capacity** is relatively small with only 512 events in the PMC-512-D, and it can be reset to zero and then immediately incremented by one with a new “Clear SOE via Communications” event. When the number of events is larger than 512, only the latest 512 events will be stored.
- 5) The range of the **DR Log/Monthly Log Pointer** is between 0 and 0xFFFFFFFFH. The pointers point to the current logging position and are incremented by one for every new record generated and will roll over to 0 if its current value is 0xFFFFFFFFH. Use the following equation to determine the latest log location:  
 Latest Log Location = Modulo [SOE Pointer/Log Depth]  
 Where Log Depth = 512 for SOE Log and DR’s Recording Depth for the DR Log.

### 5.1.2 Instantaneous Alarm

Register	Property	Description	Format	Note
0030	RO	Alarm#1 Status	Bitmap	
0031	RO	Alarm#2 Status	Bitmap	
0032	RO	Alarm#3 Status	Bitmap	
0033	RO	Alarm#4 Status	Bitmap	
0034	RO	Alarm#5 Status	Bitmap	

**Table 5-3 Instantaneous Alarm**

**Note:**

- For the Alarm #x Status register, each bit values of B0 to B11 represent different alarms, with “1” meaning active (Alarm) and “0” meaning inactive (Normal).

Bit	Bit 2	Bit 1	Bit 0
Status	Mains Current HH Alarm	Mains Current L Alarm	Mains Current H Alarm
Bit	Bit 5	Bit 4	Bit 3
Status	Residual Current HH Alarm	Residual Current H Alarm	Mains Current LL Alarm
Bit	Bit 8	Bit 7	Bit 6
Status	AI H Alarm	Voltage L Alarm	Voltage H Alarm
Bit	Bit 11	Bit 10	Bit 9
Status	AI LL Alarm	AI HH Alarm	AI L Alarm

**Table 5-4 Alarm#1 Status (Register 0030)**

Bit	Bit 3	Bit 2	Bit 1	Bit 0
Status	SM1 I-LL Alarm	SM1 I-HH Alarm	SM1 I-L Alarm	SM1 I-H Alarm
Bit	Bit 7	Bit 6	Bit 5	Bit 4
Status	SM2 I-LL Alarm	SM2 I-HH Alarm	SM2 I-L Alarm	SM2 I-H Alarm
Bit	Bit 11	Bit 10	Bit 9	Bit 8
Status	SM3 I-LL Alarm	SM3 I-HH Alarm	SM3 I-L Alarm	SM3 I-H Alarm
Bit	Bit 15	Bit 14	Bit 13	Bit 12
Status	SM4 I-LL Alarm	SM4 I-HH Alarm	SM4 I-L Alarm	SM4 I-H Alarm

**Table 5-5 Alarm#2 Status (Register 0031)**

Bit	Bit 3	Bit 2	Bit 1	Bit 0
Status	SM5 I-LL Alarm	SM5 I-HH Alarm	SM5 I-L Alarm	SM5 I-H Alarm
Bit	Bit 7	Bit 6	Bit 5	Bit 4
Status	SM6 I-LL Alarm	SM6 I-HH Alarm	SM6 I-L Alarm	SM6 I-H Alarm
Bit	Bit 11	Bit 10	Bit 9	Bit 8
Status	SM7 I-LL Alarm	SM7 I-HH Alarm	SM7 I-L Alarm	SM7 I-H Alarm
Bit	Bit 15	Bit 14	Bit 13	Bit 12
Status	SM8 I-LL Alarm	SM8 I-HH Alarm	SM8 I-L Alarm	SM8 I-H Alarm

**Table 5-6 Alarm#3 Status (Register 0032)**

Bit	Bit 3	Bit 2	Bit 1	Bit 0
Status	SM9 I-LL Alarm	SM9 I-HH Alarm	SM9 I-L Alarm	SM9 I-H Alarm
Bit	Bit 7	Bit 6	Bit 5	Bit 4
Status	SM10 I-LL Alarm	SM10 I-HH Alarm	SM10 I-L Alarm	SM10 I-H Alarm
Bit	Bit 11	Bit 10	Bit 9	Bit 8
Status	SM11 I-LL Alarm	SM11 I-HH Alarm	SM11 I-L Alarm	SM11 I-H Alarm
Bit	Bit 15	Bit 14	Bit 13	Bit 12
Status	SM12 I-LL Alarm	SM12 I-HH Alarm	SM12 I-L Alarm	SM12 I-H Alarm

**Table 5-7 Alarm#4 Status (Register 0033)**

Bit	Bit 3	Bit 2	Bit 1	Bit 0
Status	DI4 Alarm	DI3 Alarm	DI2 Alarm	DI1 Alarm
Bit	Bit 7	Bit 6	Bit 5	Bit 4
Status	DI8 Alarm	DI7 Alarm	DI5 Alarm	DI5 Alarm
Bit	Bit 11	Bit 10	Bit 9	Bit 8
Status	DI12 Alarm	DI11 Alarm	DI10 Alarm	DI9 Alarm
Bit	Bit 15	Bit 14	Bit 13	Bit 12
Status	Reserved	Reserved	Reserved	DI13 Alarm

**Table 5-8 Alarm#5 Status (Register 0034)**

### 5.1.3 Latched Alarm

Register	Property	Description	Format	Note
0130	RO	Alarm#1 Status	Bitmap	
0131	RO	Alarm#2 Status	Bitmap	
0132	RO	Alarm#3 Status	Bitmap	
0133	RO	Alarm#4 Status	Bitmap	
0134	RO	Alarm#5 Status	Bitmap	
0134~0145	RO	Reserved	Bitmap	

**Table 5-9 Latch Alarm**

**Note:**

- For the **Alarm #x Status** register, each bit values of B0 to B15 represent different alarms, with “1” meaning active (closed) and “0” meaning inactive (open).

Bit	Bit 2	Bit 1	Bit 0
Status	Mains Current HH Alarm	Mains Current L Alarm	Mains Current H Alarm
Bit	Bit 5	Bit 4	Bit 3
Status	Residual Current HH Alarm	Residual Current H Alarm	Mains Current LL Alarm
Bit	Bit 8	Bit 7	Bit 6
Status	AI H Alarm	Voltage L Alarm	Voltage H Alarm
Bit	Bit 11	Bit 10	Bit 9
Status	AI LL Alarm	AI HH Alarm	AI L Alarm

**Table 5-10 Alarm#1 Status (Register 0130)**

Bit	Bit 3	Bit 2	Bit 1	Bit 0
Status	SM1 I-LL Alarm	SM1 I-HH Alarm	SM1 I-L Alarm	SM1 I-H Alarm
Bit	Bit 7	Bit 6	Bit 5	Bit 4
Status	SM2 I-LL Alarm	SM2 I-HH Alarm	SM2 I-L Alarm	SM2 I-H Alarm
Bit	Bit 11	Bit 10	Bit 9	Bit 8
Status	SM3 I-LL Alarm	SM3 I-HH Alarm	SM3 I-L Alarm	SM3 I-H Alarm
Bit	Bit 15	Bit 14	Bit 13	Bit 12
Status	SM4 I-LL Alarm	SM4 I-HH Alarm	SM4 I-L Alarm	SM4 I-H Alarm

**Table 5-11 Alarm#2 Status (Register 0131)**

Bit	Bit 3	Bit 2	Bit 1	Bit 0
Status	SM5 I-LL Alarm	SM5 I-HH Alarm	SM5 I-L Alarm	SM5 I-H Alarm
Bit	Bit 7	Bit 6	Bit 5	Bit 4
Status	SM6 I-LL Alarm	SM6 I-HH Alarm	SM6 I-L Alarm	SM6 I-H Alarm
Bit	Bit 11	Bit 10	Bit 9	Bit 8
Status	SM7 I-LL Alarm	SM7 I-HH Alarm	SM7 I-L Alarm	SM7 I-H Alarm
Bit	Bit 15	Bit 14	Bit 13	Bit 12
Status	SM8 I-LL Alarm	SM8 I-HH Alarm	SM8 I-L Alarm	SM8 I-H Alarm

**Table 5-12 Alarm#3 Status (Register 0132)**

Bit	Bit 3	Bit 2	Bit 1	Bit 0
Status	SM9 I-LL Alarm	SM9 I-HH Alarm	SM9 I-L Alarm	SM9 I-H Alarm
Bit	Bit 7	Bit 6	Bit 5	Bit 4
Status	SM10 I-LL Alarm	SM10 I-HH Alarm	SM10 I-L Alarm	SM10 I-H Alarm
Bit	Bit 11	Bit 10	Bit 9	Bit 8
Status	SM11 I-LL Alarm	SM11 I-HH Alarm	SM11 I-L Alarm	SM11 I-H Alarm
Bit	Bit 15	Bit 14	Bit 13	Bit 12
Status	SM12 I-LL Alarm	SM12 I-HH Alarm	SM12 I-L Alarm	SM12 I-H Alarm

**Table 5-13 Alarm#4 Status (Register 0133)**

Bit	Bit 3	Bit 2	Bit 1	Bit 0
Status	DI4 Alarm	DI3 Alarm	DI2 Alarm	DI1 Alarm
Bit	Bit 7	Bit 6	Bit 5	Bit 4
Status	DI8 Alarm	DI7 Alarm	DI5 Alarm	DI5 Alarm
Bit	Bit 11	Bit 10	Bit 9	Bit 8
Status	DI12 Alarm	DI11 Alarm	DI10 Alarm	DI9 Alarm
Bit	Bit 15	Bit 14	Bit 13	Bit 12
Status	Reserved	Reserved	Reserved	DI13 Alarm

**Table 5-14 Alarm#5 Status (Register 0134)**

## 5.2 Basic Measurements

Register	Property	Description	Format	Scale	Unit	
0500	RO	Channel Polarity	UINT32	x1	Bit 0: Voltage Bit 1: Mains I Bit 2: SM1 I ... Bit 13: SM12 I Others: Reserved 0=Normal 1=Reverse	
0502~0503	RO	Reserved	FP32			
0504	RO	U	FP32		V	
0506	RO	Mains Current <sup>1</sup>	FP32		A	
0508	RO	Residual Current <sup>2</sup>	FP32		mA	
0510~0511	RO	Reserved	FP32			
0512	RO	SM1 Current	FP32		A	
0514	RO	SM2 Current	FP32			
...		...	FP32			
0532	RO	SM11 Current	FP32			
0534	RO	SM12 Current	FP32			
0536~0539	RO	Reserved	FP32			
0540		Mains kW	FP32		W	
0542	RO	SM1 kW	FP32		W	
0544	RO	SM2 kW	FP32			
0546	RO	SM3 kW	FP32			
...		...	FP32			
0564	RO	SM12 kW	FP32			
0566~0569	RO	Reserved				
0570	RO	Mains %Loading <sup>3</sup>	FP32		-	
0572	RO	SM1 %Loading <sup>3</sup>	FP32			
0574	RO	SM 2 %Loading <sup>3</sup>	FP32			
...		...	FP32			
0594	RO	SM12 %Loading <sup>3</sup>	FP32			
0596~0601	RO	Reserved	FP32			
0602	RO	AI Raw	UINT16		x0.01	mA
0603	RO	AI Scaled	FP32			

Table 5-15 Real-time Measurements

**Notes:**

- 1) When **Mains Current Type** is **Residual**, this register is invalid.
- 2) When **Mains Current Type** is **Incomer**, this register is invalid.
- 3) For example, the return value 0.001 means the %Loading = 0.1%.

## 5.3 Energy Measurements

Register	Property	Description	Format	Scale	Unit
2000	RO	Mains kWh	INT32	x0.01	kWh
2002	RO	SM1 kWh	INT32		
2004	RO	SM2 kWh	INT32		
2006	RO	SM3 kWh	INT32		
2008	RO	SM4 kWh	INT32		
2010	RO	SM5 kWh	INT32		
2012	RO	SM6 kWh	INT32		
2014	RO	SM7 kWh	INT32		
2016	RO	SM8 kWh	INT32		
2018	RO	SM9 kWh	INT32		
2020	RO	SM10 kWh	INT32		
2022	RO	SM11 kWh	INT32		
2024	RO	SM12 kWh	INT32		

Table 5-16 Energy Measurements

## 5.4 Monthly Energy Log

Register	Property	Description	Format	Scale	Unit
2700	RW	Month <sup>1</sup>	UINT16		0* to 24

2701	RO	High-order Byte: Year (0-99) Low-order Byte: Month (1-12)	UINT16	Time Stamp (20YY/MM/DD HH:MM:SS)	
2702	RO	High-order Byte: Day (1-31) Low-order Byte: Hour (0-23)	UINT16		
2703	RO	High-order Byte: Minute (0-59) Low-order Byte: Second (0-59)	UINT16		
2704	RO	Millisecond	UINT16	x0.01	kWh
2705	RO	Mains kWh	INT32		
2707	RO	SM1 kWh	INT32		
2709	RO	SM2 kWh	INT32		
2711	RO	SM3 kWh	INT32		
2713	RO	SM4 kWh	INT32		
2715	RO	SM5 kWh	INT32		
2717	RO	SM6 kWh	INT32		
2719	RO	SM7 kWh	INT32		
2721	RO	SM8 kWh	INT32		
2723	RO	SM9 kWh	INT32		
2725	RO	SM10 kWh	INT32		
2727	RO	SM11 kWh	INT32		
2729	RO	SM12 kWh	INT32		

**Table 5-17 Monthly Energy Log**

**Notes:**

1. This Register represents the Month when it is read. To read the Monthly Energy Log, this register must be first written to indicate the PMC-512-D which log to load from memory. The range of this register is from 0 to 24, which represents the **Present Month** and the **Last 24 Months**.
2. For each Monthly Energy Log, the time stamp shows the exact Self-Read time (20YY/MM/DD/HH:MM:SS) when the log was recorded. For the monthly Energy Log of the Present Month, the time stamp shows the current time of the meter because the present month is not yet over.
3. The Monthly Energy Log for this Month can be modified, but the Monthly Energy Log for the last 24 months are Read Only.

**5.5 Demands**

**5.5.1 Present Demands**

Register	Property	Description	Format	Scale	Unit
3500	RO	Mains Current Demand*	FP32	x1	A
3502	RO	SM1 Current Demand	FP32		
3504	RO	SM2 Current Demand	FP32		
3506	RO	SM3 Current Demand	FP32		
3508	RO	SM4 Current Demand	FP32		
3510	RO	SM5 Current Demand	FP32		
3512	RO	SM6 Current Demand	FP32		
3514	RO	SM7 Current Demand	FP32		
3516	RO	SM8 Current Demand	FP32		
3518	RO	SM9 Current Demand	FP32		
3520	RO	SM10 Current Demand	FP32		
3522	RO	SM11 Current Demand	FP32		
3524	RO	SM12 Current Demand	FP32		
3526	RO	Mains kW Demand*	FP32		W
3528	RO	SM1 kW Demand	FP32		
3530	RO	SM2 kW Demand	FP32		
3532	RO	SM3 kW Demand	FP32		
3534	RO	SM4 kW Demand	FP32		
3536	RO	SM5 kW Demand	FP32		
3538	RO	SM6 kW Demand	FP32		
3540	RO	SM7 kW Demand	FP32		
3542	RO	SM8 kW Demand	FP32		
3544	RO	SM9 kW Demand	FP32		
3546	RO	SM10 kW Demand	FP32		
3548	RO	SM11 kW Demand	FP32		
3550	RO	SM12 kW Demand	FP32		

\*When Mains Current Type is Residual, this register is invalid

**Table 5-18 Present Demand Measurements**

**5.5.2 Peak Demand Log of This Month (Since Last Reset)**

Register	Property	Description	Format	Scale	Unit
4000	RO	Mains Current Demand*	FP32	x1	A
4002	RO	Timestamp	UINT32		s
4004	RO	SM1 Current Demand	FP32	x1	A
4006	RO	Timestamp	UINT32		s
4008	RO	SM2 Current Demand	FP32	x1	A
4010	RO	Timestamp	UINT32		s
...		...			
4048	RO	SM12 Current Demand	FP32	x1	A
4050	RO	Timestamp	UINT32		s
4052	RO	Mains kW Demand*	FP32	x1	A
4054	RO	Timestamp	UINT32		s
4056	RO	SM1 kW Demand	FP32	x1	W
4058	RO	Timestamp	UINT32		s
4060	RO	SM2 kW Demand	FP32	x1	W
4062	RO	Timestamp	UINT32		s
...		...			
4100	RO	SM12 kW Demand	FP32	x1	W
4102	RO	Timestamp	UINT32		s

\*When Mains Current Type is Residual, this register is invalid

**Table 5-19 Peak Demand Log of This Month (Since Last Reset)**

**5.5.3 Peak Demand Log of Last Month (Before Last Reset)**

Register	Property	Description	Format	Scale	Unit
4104	RO	Mains Current Demand*	FP32	x1	A
4106	RO	Timestamp	UINT32		s
4108	RO	SM1 Current Demand	FP32	x1	A
4110	RO	Timestamp	UINT32		s
4112	RO	SM2 Current Demand	FP32	x1	A
4114	RO	Timestamp	UINT32		s
...		...			
4152	RO	SM12 Current Demand	FP32	x1	A
4154	RO	Timestamp	UINT32		s
4156	RO	Mains kW Demand*	FP32	x1	A
4158	RO	Timestamp	UINT32		s
4160	RO	SM1 kW Demand	FP32	x1	W
4162	RO	Timestamp	UINT32		s
4164	RO	SM2 kW Demand	FP32	x1	W
4166	RO	Timestamp	UINT32		s
...		...			
4204	RO	SM12 kW Demand	FP32	x1	W
4206	RO	Timestamp	UINT32		s

\*When Mains Current Type is Residual, this register is invalid

**Table 5-20 Peak Demand Log of Last Month (Before Last Reset)**

**5.6 Log Register**

**5.6.1 SOE Log**

Register	Property	Description	Format
10000-10008	RO	Event 1	See Appendix A SOE Log Data Structure
10009-10017	RO	Event 2	
10018-10026	RO	Event 3	
10027-10035	RO	Event 4	
....		....	
14599~14607	RO	Event 512	

**Table 5-21 SOE Log**

Offset	Property	Description	Format	Range/Note
+0	RO	High-order Byte: Event Classification	UINT16	See Appendix A
		Low-order Byte: Sub-Classification		See Appendix A
+1	RO	High-order Byte: Year	UINT16	0-99 (Year-2000)
		Low-order Byte: Month		1 to 12
+2	RO	High-order Byte: Day	UINT16	1 to 31
		Low-order Byte: Hour		0 to 23
+3	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59
+4	RO	Millisecond	UINT16	0 to 999
+5	RO	High-order Byte: Reserved	UINT16	
	RO	Low-order Byte: Status	UINT16	
+6	RO	Event Value High Word	INT16	
+7	RO	Event Value Low Word	INT16	
+8	RO	Channel No.	UINT16	

Table 5-22 SOE Log Data Structure

### 5.6.2 Data Recorder Log

Register	Property	Description	Format
21000	RW	DR Log x Index	UINT32
21002	RO	High-order Byte: Year (0-99)	UINT16
		Low-order Byte: Month (1-12)	
21003	RO	High-order Byte: Day (1-31)	UINT16
		Low-order Byte: Hour (0-23)	
21004	RO	High-order Byte: Minute (0-59)	UINT16
		Low-order Byte: Second (0-59)	
21005	RO	Millisecond	UINT16
21006	RO	Parameter #1	FP32
21008	RO	Parameter #2	
...		...	
21124	RO	Parameter #60	

Table 5-23 DR Log

**Notes:**

- 1) Writing “n” to the **DR Log X Index** register will load the Log Record at pointer position “n” into the DR Log X Buffer from the device’s memory.
- 2) Writing an index value that points to a Log Record that is either already expired or has not been generated yet to the **DR Log X Index** register will generate an exception response with the Illegal Data Value error code (0x03) as defined by the Modbus protocol.

### 5.7 Device Setup

#### 5.7.1 Basic Setup Parameters

Register	Property	Description	Format	Range, Default*
6000	RW	Nominal Voltage	UINT16	1 to 400 V, 240*
6001	RW	Mains Current Type	UINT16	0*= Incomer 1= Residual
6002	RW	Mains CT Primary <sup>1</sup>	UINT16	1 to 3000A/mA, 400*
6003	RW	Mains CT Secondary	UINT16	1 to 50V (x0.1), 40*
6004	RW	Mains Breaker Rating	UINT16	1 to 3000A, 250*
6005	RW	Reserved	UINT16	
6006	RW	Demand Period	UINT16	1 to 60 mins, 15*
6007	RW	Number of Sliding Windows	UINT16	1* to 15
6008	RW	Demand Log Self-Read Time <sup>2</sup>	UINT16	0*
6009	RW	Demand Log Self-Read Mode	UINT16	0=Auto*, 1=Manual
6010	RW	Monthly Energy Log Self-Read Time <sup>2</sup>	UINT16	0*
6011	RW	Reserved		
6012	RW	Arm before Execute	UINT16	0=Disabled*, 1=Enabled
6013	RW	DO Pulse Width		0* to 6000 (x0.1s)
6014	RW	Energy Pulse Constant	UINT16	0=1 imp/kWh, 1=10 imp/kWh 2=100imp/kWh,3=400imp/kW*

				4=1000 imp/kWh 5=3200 imp/kWh 0* to 13
6015	RW	LED EN Pulse Mode <sup>3</sup>	UINT16	
6016	RW	Date Format	UINT16	0=YYYY/MM/DD* 1=MM/DD/YYYY 2=DD/MM/YYYY
6017	RW	Demo	UINT16	0=Disabled*, 1=Enabled

**Table 5-24 Basic Setup**

**Notes:**

- The unit of Mains CT Primary is A for Mains Current or mA for Residual Current.
- The Demand Log's and Monthly Energy Log's **Self-Read Time** support the following two options:
  - A zero value means that the Self-Read will take place at 00:00 of the first day of each month.
  - A non-zero value means that the Self-Read will take place at a specific time and day based on the formula: Self-Read Time = (Day 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.
- The **LED Energy Pulse Modes** are listed in the table below:

Value	Parameter	Value	Parameter	Value	Parameter
0	Disabled	5	SM4 kWh	10	SM9 kWh
1	Mains kWh	6	SM5 kWh	11	SM10 kWh
2	SM1 kWh	7	SM6 kWh	12	SM11 kWh
3	SM2 kWh	8	SM7 kWh	13	SM12 kWh
4	SM3 kWh	9	SM8 kWh		

**Table 5-25 LED Energy Pulse Modes**

**5.7.2 AI Setup**

Register	Property	Description	Format	Range, Default*
6050	RW	AI Type	UINT16	0=4~20mA*, 1=0~20mA
6051	RW	AI Zero Scale	INT32	-999,999 to +999,999 400*
6053	RW	AI Full Scale	INT32	-999,999 to +999,999 2000*

**Table 5-26 AI Setup**

**5.7.3 DI Setup**

Register	Property	Description	Format	Range, Default*
6100	RW	DI Excitation <sup>1</sup>	UINT16	0 = 220VDC* 1=220VAC, 2 =110VDC 3=110VAC, 4=48VDC 5=-48VDC
6101	RW	DI1 Debounce <sup>2</sup>	UINT16	1 to 9999 ms, 40*
6102	RW	DI2 Debounce <sup>2</sup>	UINT16	
6103	RW	DI3 Debounce <sup>2</sup>	UINT16	
...	RW	...	UINT16	
6112	RW	DI12 Debounce <sup>2</sup>	UINT16	
6113	RW	DI13 Debounce <sup>2</sup>	UINT16	

**Table 5-27 AI Setup**

**Notes:**

- For the model that supports 48VDC for DI, the DI Excitation can only be ±48V (such as PMC-512-DX43AE). For the model that supports 240VDC for DI, the DI Excitation option are 110VAC, 110VDC, 220VAC or 220VDC (such as PMC-512-DX43BE).
- The DI Excitation must be set correctly for the DI Debounce to work.

**5.7.4 Communication Setup Parameters**

Register	Property	Description	Format	Range, Default*
6200	RW	COM1 Unit ID	UINT16	1 to 254, 100*
6201	RW	COM1 Baud Rate	UINT16	0=1200, 1=2400, 2=4800, 3=9600, 4=19200, 5=38400*, 6=57600
6202	RW	COM1 Comm. Config.	UINT16	1=8O1, 2=8E1*, 3=8N1
6203	RW	COM2 Unit ID	UINT16	1 to 254, 100*
6204	RW	COM2 Baud Rate	UINT16	0=1200, 1=2400, 2=4800, 3=9600*, 4=19200, 5=38400, 6=57600
6205	RW	COM2 Comm. Config.	UINT16	1=8O1, 2=8E1*, 3=8N1

**Table 5-28 Communication Setup**

5.7.5 Alarm Setup

Register	Property	Description	Format	Range/Default*
6400	RW	Universal Hysteresis <sup>1</sup>	UINT16	0 to 100 (x0.1%), 20*
6401	RW	Current ON Threshold <sup>2</sup>	UINT16	0 to 100 (x0.1%), 50*
6402	RW	Current ON Time Delay	UINT16	0 to 9999 (s), 10s*
6403	RW	Current OFF Time Delay	UINT16	0 to 9999 (s), 30s*
6404~ 6409	RW	Reserved		
6410	RW	Voltage H Alarm Limit <sup>2</sup>	UINT16	0* to 5000V (x0.1)
6411	RW	Voltage H Alarm Time Delay	UINT16	0* to 9999 (s)
6412	RW	Voltage L Alarm Limit <sup>2</sup>	UINT16	0* to 5000V (x0.1)
6413	RW	Voltage L Alarm Time Delay	UINT16	0* to 9999 (s)
6414	RW	Voltage Alarm Trigger	UINT16	0* to 0x0003
6415	RW	Mains Current H Alarm Threshold (%) <sup>2, 3</sup>	UINT16	0 to 1000 (x0.1), 600*
6416	RW	Mains Current H Alarm Time Delay	UINT16	0 to 9999 (s), 10*
6417	RW	Mains Current HH Alarm Threshold (%) <sup>2, 3</sup>	UINT16	0 to 1000 (x0.1), 800*
6418	RW	Mains Current HH Alarm Time Delay	UINT16	0* to 9999 (s), 10
6419	RW	Mains Current L Alarm Threshold (%) <sup>2, 3</sup>	UINT16	0* to 1000 (x0.1)
6420	RW	Mains Current L Alarm Time Delay	UINT16	0* to 9999 (s)
6421	RW	Mains Current LL Alarm Threshold (%) <sup>2</sup>	UINT16	0* to 1000 (x0.1)
6422	RW	Mains Current LL Alarm Time Delay	UINT16	0* to 9999 (s)
6423	RW	Mains Current H Alarm Trigger	UINT16	0* to 0x0003
6424	RW	Residual Current H Alarm Threshold <sup>24</sup>	Bitmap	0* to 10000mA (x0.1)
6425	RW	Residual Current H Alarm Time Delay	UINT16	0* to 9999 (s)
6426	RW	Residual Current HH Alarm Threshold <sup>24</sup>	Bitmap	0* to 10000mA (x0.1)
6427	RW	Residual Current HH Alarm Time Delay	UINT16	0* to 9999 (s)
6428	RW	Residual Current H Alarm Trigger	UINT16	0* to 0x0003
6429~ 6433		Reserved		
6434	RW	SM Current Alarm Channel Enable	UINT16	0* to 0x0FFF <sup>5</sup> 0 = Disabled 1 = Enabled
6435	RW	SM I-H Alarm Threshold <sup>2</sup>	UINT16	0 to 1000 (x0.1), 600*
6436	RW	SM I-H Alarm Time Delay	UINT16	0 to 9999 (s), 10*
6437	RW	SM I-HH Alarm Threshold <sup>2</sup>	UINT16	0 to 1000 (x0.1), 800*
6438	RW	SM I-HH Alarm Time Delay	UINT16	0 to 9999 (s), 10*
6439	RW	SM I-L Alarm Threshold <sup>2</sup>	UINT16	0* to 1000 (x0.1)
6440	RW	SM I-L Alarm Time Delay	UINT16	0* to 9999 (s)
6441	RW	SM I-LL Alarm Threshold <sup>2</sup>	UINT16	0* to 1000 (x0.1)
6442	RW	SM I-LL Alarm Time Delay	UINT16	0* to 9999 (s)
6443	RW	Circuit I Alarm Trigger	UINT16	0* to 0x0003
6444	RW	Reserved	Bitmap	
6445	RW	DI1 Alarm Configuration	UINT16	0 = Disabled* 1 = DI1 Closed Trigger 2 = DI1 Open Trigger
6446	RW	DI1 Alarm Time Delay	UINT16	0* to 9999 (s)
6447	RW	DI1 Alarm Trigger	UNIT16	0* to 0x0003
...	RW	...	UINT16	...
6481	RW	DI13 Alarm Configuration	UINT16	0 = Disabled* 1 = DI12 Closed Trigger 2 = DI12 Open Trigger
6482	RW	DI123 Alarm Time Delay	UINT16	0* to 9999 (s)
6483	RW	DI13 Alarm Trigger	UINT16	0* to 0x0003
6484	RW	AI Alarm Enable	UINT16	0x00* to 0x0F See Notes 6)
6485	RW	AI HH Alarm Threshold <sup>2</sup>	INT32	-999,999 to 999,999, 0*
6487	RW	AI HH Alarm Time Delay	UINT16	0 to 9999 (s), 10*
6488	RW	AI H Alarm Threshold <sup>2</sup>	INT32	-999,999 to 999,999, 0*
6490	RW	AI H Alarm Time Delay	UINT16	0* to 9999 (s)
6491	RW	AI L Alarm Threshold <sup>2</sup>	INT32	-999,999 to 999,999, 10*
6493	RW	AI L Alarm Time Delay	UINT16	0* to 9999 (s)
6494	RW	AI LL Alarm Threshold <sup>2</sup>	INT32	-999,999 to 999,999,

				0*
6496	RW	AI LL Alarm Time Delay	UINT16	0 to 9999 (s), 10*
6497	RW	AI Alarm Trigger	UINT16	0* to 0x0003

**Table 5-29 Alarm Setup Parameters**

**Notes:**

1) The calculation method for the **Universal Hysteresis** is listed below:

$$\text{Universal Hysteresis} = \frac{|\text{Alarm Threshold} - \text{Alarm Return Threshold}|}{\text{Alarm Threshold}} \times \%$$

- 2) If the **Threshold/Limit** is set to 0, the corresponding channel alarm is disabled.
- 3) The **Incomer Current Alarm** is invalid when the **Mains Current Type** is **Residual**.
- 4) The **Residual Current Alarm** is invalid when the **Mains Current Type** is **Incomer**.
- 5) Bits 0 to 11 represent the **SM Current Alarm Enable** for SM1 to 12 respectively, with the bit value “0” meaning Disabled and “1” meaning Enabled. For example, 0x003F means SM1 to 6 are enabled for **Current Alarm** and SM7 to 12 are disabled.
- 6) 0x03 stands for 2 bits (BIN). Bit 0 and 1 represents RO trigger enable and Alarm LED enable respectively. For every bit, 0=Alarm Disabled and 1=Alarm Enabled. For example, 0x03 means that both RO trigger and Alarm LED are enabled for **AI Alarm**.

**5.7.6 SM Setup Parameters**

Register	Property	Description	Format	Range, Default*
6600	WO	SM CT Primary (Bulk)	UINT16	1 to 3000A
6601	WO	SM CT Secondary (Bulk)	UINT16	1 to 100mA
6602	WO	SM Breaker Rating (Bulk)	UINT16	1 to 3000A
6603	RW	SM1 CT Primary	UINT16	1 to 3000 (A), 100*
6604	RW	SM1 CT Secondary	UINT16	1 to 100 (mA), 50*
6605	RW	SM1 Breaker Rating	UINT16	0 to 3000A, 63*
6606	RW	SM2 CT Primary	UINT16	1 to 3000 (A), 100*
6607	RW	SM2 CT Secondary	UINT16	1 to 100 (mA), 50*
6608	RW	SM2 Breaker Rating	UINT16	0 to 3000A, 63*
6609	RW	SM3 CT Primary	UINT16	1 to 3000 (A), 100*
6610	RW	SM3 CT Secondary	UINT16	1 to 100 (mA), 50*
6611	RW	SM3 Breaker Rating	UINT16	0 to 3000A, 63*
6612	RW	SM4 CT Primary	UINT16	1 to 3000 (A), 100*
6613	RW	SM4 CT Secondary	UINT16	1 to 100 (mA), 50*
6614	RW	SM4 Breaker Rating	UINT16	0 to 3000A, 63*
6615	RW	SM5 CT Primary	UINT16	1 to 3000 (A), 100*
6616	RW	SM5 CT Secondary	UINT16	1 to 100 (mA), 50*
6617	RW	SM5 Breaker Rating	UINT16	0 to 3000A, 63*
6618	RW	SM6 CT Primary	UINT16	1 to 3000 (A), 100*
6619	RW	SM6 CT Secondary	UINT16	1 to 100 (mA), 50*
6620	RW	SM6 Breaker Rating	UINT16	0 to 3000A, 63*
6621	RW	SM7 CT Primary	UINT16	1 to 3000 (A), 100*
6622	RW	SM7 CT Secondary	UINT16	1 to 100 (mA), 50*
6623	RW	SM7 Breaker Rating	UINT16	0 to 3000A, 63*
6624	RW	SM8 CT Primary	UINT16	1 to 3000 (A), 100*
6625	RW	SM8 CT Secondary	UINT16	1 to 100 (mA), 50*
6626	RW	SM8 Breaker Rating	UINT16	0 to 3000A, 63*
6627	RW	SM9 CT Primary	UINT16	1 to 3000 (A), 100*
6628	RW	SM9 CT Secondary	UINT16	1 to 100 (mA), 50*
6629	RW	SM9 Breaker Rating	UINT16	0 to 3000A, 63*
6630	RW	SM10 CT Primary	UINT16	1 to 3000 (A), 100*
6631	RW	SM10 CT Secondary	UINT16	1 to 100 (mA), 50*
6632	RW	SM10 Breaker Rating	UINT16	0 to 3000A, 63*
6633	RW	SM11 CT Primary	UINT16	1 to 3000 (A), 100*
6634	RW	SM11 CT Secondary	UINT16	1 to 100 (mA), 50*
6635	RW	SM11 Breaker Rating	UINT16	0 to 3000A, 63*
6636	RW	SM12 CT Primary	UINT16	1 to 3000 (A), 100*
6637	RW	SM12 CT Secondary	UINT16	1 to 100 (mA), 50*
6638	RW	SM12 Breaker Rating	UINT16	0 to 3000A, 63*

**Table 5-30 SM Setup Parameters**

### 5.7.7 Data Recorder Setup

Register	Property	Description	Format	Range, Default*
6900	RW	Trigger Mode	UINT16	0=Disabled, 1=Enabled
6901	RW	Recording Mode	UINT16	0*=Stop-When-Full 1=First-In-First-Out
6902	RW	Recording Depth	UINT16	0 to 5000
6903	RW	Recording Interval	UINT32	60 to 345600s, 600*
6905	RW	Recording Offset <sup>1</sup>	UINT16	0* to 43200s
6906	RW	Parameters Number	UINT16	0* to 60
6907	RW	Parameter1	UINT16	Please refer to Appendix B for a complete list of the Data Recorder Parameters.
6908	RW	Parameter2	UINT16	
6909	RW	Parameter3	UINT16	
...		...	UINT16	
6966	RW	Parameter60	UINT16	

**Table 5-31 DR Parameter Setup**

**Note:**

1. Recording Offset < Recording Interval.

### 5.8 Time Registers

There are two sets of Time registers supported by the PMC-PMC-512-D – Year / Month / Day / Hour / Minute / Second (Registers # 60000 to 60002) and UNIX Time (Register # 60004). When sending time to the PMC-512-D 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	UINT16	0-37 (Year-2000) 1 to 12
		High-order Byte: Year Low-order Byte: Month		
60001	9001	RW	UINT16	1 to 31 0 to 23
		High-order Byte: Day Low-order Byte: Hour		
60002	9002	RW	UINT16	0 to 59 0 to 59
		High-order Byte: Minute Low-order Byte: Second		
60003	9003	RW	UINT16	0 to 999
60004 ~ 60005	9004 ~ 9005	RW	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 5-32 Time Registers**

### 5.9 Clear/Reset Control

Register	Property	Description	Format	Note
9600	WO	Clear All Latched Alarms	UINT16	Writing “0xFF00” to the register executes the described action
9601	WO	Clear SOE Log	UINT16	
9602	WO	Clear Energy <sup>1</sup>	UINT16	
9603	WO	Clear Peak Demand of This Month (Since Last Reset) <sup>1</sup>	UINT16	Writing “0xFF00” to the register executes the described action
9604	WO	Clear DR Log	UINT16	
9605	WO	Clear All <sup>2</sup>	UINT16	
9606	WO	Reset to Default	UINT16	
9607	WO	Clear Monthly Energy Log	UINT16	

9608	WO	Hall Zero Setting	UINT16
9609	WO	Reset Hall Zero Parameters	UINT16

**Table 5-33 Clear/Reset Control Setup**

**Notes:**

- 1) The following table provides a detailed description of the different values that can be written to the **Clear Energy** and **Clear Peak Demand of This Month (Since Last Reset)** registers to clear the different Energy and Peak Demand registers for Mains Meter and SMs. Writing “0xA AFF” to clear all the **Energy** and **Peak Demand of This Month (Since Last Reset) log** for all channels.

Key	Clear Register Values		Description
	High Order	Low Order	
1	0xAA (Mains and SMs)	0x00	Clear Mains (0x0000)
		0x01	Clear SM1(0x0001)
		...	...
		0x11	Clear SM11 (0x0011)
		0x12	Clear SM12 (0x0012)

**Table 5-34 Clear Energy and Peak Demand Register Values**

- 2) Writing “0xFFFF” to the register clears **Energy Measurements, Peak Demand Log of This Month (Since Last Rest), Peak Demand Log of Last Month (Before Last Reset), SOE Log** and **DR Log** that are listed in Section 5.3 to 5.6.

**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-512-D does not support the Read Coils command (Function Code 0x01) because DO Control registers are “Write-Only”.

The PMC-512-D 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 (6014), 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 DO Close	UINT16	Writing “0xFF00” to the register to perform the described action.
9101	WO	Execute DO Close	UINT16	
9102	WO	Arm DO Open	UINT16	
9103	WO	Execute DO Open	UINT16	

**Table 5-35 DO Control**

**5.11 Meter Information**

Register	Property	Description	Format	Note
60200 ~ 60219	9800 ~ 9819	RO	Meter model	UINT16 See Note 1)
60220	9820	RO	Firmware Version	UINT16 e.g. 10000 shows the version is V1.00.00
60221	9821	RO	Modbus Version	UINT16 e.g. 10 shows the version is V1.0

60222	9822	RO	Firmware Update Date: Year-2000	UINT16	e.g. 160110 means January 10, 2016
60223	9823	RO	Firmware Update Date: Month	UINT16	
60224	9824	RO	Firmware Update Date: Day	UINT16	
60225	9825	RO	Serial Number: High-Order Byte	UINT16	e.g. 1701030100 means it is the 100 <sup>th</sup> device that are produced in January 3, 2017
60026	9826	RO	Serial Number: Low-Order Byte	UINT16	
60227	9827	RO	Reserved	UINT16	
60228	9828	RO	Reserved	UINT16	
60229	9829	RO	Bit0: Input Voltage	UINT32	0=-48V 1=240/336VDC
			Bit1: Power Supply		0=20 to 60VDC 1=88 to 370VDC
			Bit2: DI Excitation		0=48VDC 1=240VDC
60231	9831	RO	Hardware Version	UINT16	e.g. 10 shows the version is V1.0

**Table 5-36 Meter Information**

**Note:**

- The Meter Model appears in registers 9800 to 9819 (60200 to 60219) and contains the ASCII encoding of the string “PMC-512-D” as shown in the following table.

Register		Value (Hex)	ASCII
60200	9800	0x50	P
60201	9801	0x4D	M
60202	9802	0x43	C
60203	9803	0x2D	-
60204	9804	0x35	5
60205	9805	0x31	1
60206	9806	0x32	2
60207	9807	0x2D	-
60208	9808	0x44	D
60209-60219	9809-9819	0x20	<Null>

**Table 5-37 ASCII Encoding of “PMC-512-D”**

**Appendix A - SOE Event Classification**

Event Classification	Sub-Classification	Channel	Event Value	DPI	Description	
0	1	--	--	2/1	DI1 Close/DI1 Open	
	2	--	--	2/1	DI2 Close/DI2 Open	
	3	--	--	2/1	DI3 Close/DI3 Open	
	4	--	--	2/1	DI4 Close/DI4 Open	
	5	--	--	2/1	DI5 Close/DI5 Open	
	6	--	--	2/1	DI6 Close/DI6 Open	
	7	--	--	2/1	DI7 Close/DI7 Open	
	8	--	--	2/1	DI8 Close/DI8 Open	
	9	--	--	2/1	DI9 Close/DI9 Open	
	10	--	--	2/1	DI10 Close/DI10 Open	
	11	--	--	2/1	DI11 Close/DI11 Open	
	12	--	--	2/1	DI12 Close/DI12 Open	
	13	--	--	2/1	DI13 Close/DI13 Open	
1	1	--	--	2/1	DO Operated/Released by Remote Control	
	2	--	--	2/1	DO Operated/Released by Setpoint	
2	1	Alarm Channel <sup>1</sup>	Trigger Value (x1000)		Current HH Alarm Active	
	2				Current H Alarm Active	
	3				Current L Alarm Active	
	4				Current LL Alarm Active	
	5				Voltage H Alarm Active	
	6				Voltage L Alarm Active	
	7			Trigger Value (x100)		Mains Current HH Alarm Active
	8					Mains Current LL Alarm Active
	9					Mains Current H Alarm Active
	10					Mains Current L Alarm Active
	11			Trigger Value (x1000)		Residual Current HH Alarm Active
	12					Residual Current H Alarm Active
	13-14	Reserved				
	15	Alarm Channel <sup>1</sup>	Trigger Value (x1000)		AI HH Alarm Active	
	16				AI H Alarm Active	
17				AI L Alarm Active		
18				AI LL Alarm Active		
19			DI Status	DI Alarm Active		
3	1	Alarm Channel <sup>1</sup>	Method: Front Panel		Power On	
	2				Power Off	
	3				Set Time	
	4				Set System Parameters	
	5				Set Communication Parameters	
	6				Set AI Parameters	
	7				Set DI Parameters	
	8				Set Alarm Parameters	
	9				Set SM Parameters	
	10				Set DR Parameters	
	11				Set Calibration Parameters	
	12				Reset Alarm	
	13				Clear Energy	
	14				Clear Historic Energy	
	15				Clear Present Max Demand Logs	
	16				Clear All Demand Logs	
	17				Clear SOE	
	18				Clear DR Logs	
	19				Clear All Recorder	
	20				Load Factory Default Configuration	
	21				Load Communication Default Configuration	
	22				Preset Energy	
	23				Set First Power On	
	24				Hall Calibration	
	25				Recover Hall Calibration	

4	1			First Power On
	2			A/D Fault
	3			Internal Power Fault
	4			FRAM Fault
	5			FLASH Fault
	6			System Parameters Fault
	7			Internal Parameters Fault

**Note:**

The following table provides a detailed description of the Channel Number.

Channel Number	Description
0	Invalid
1	I1
2	I2
...	...
11	I11
12	I12
13	DI1
14	DI2
...	...
24	D112
25	D113

## Appendix B - Data Recorder Parameters

### 1) SMs Group Structure

Offset	Description
+0	Current
+1	kW
+2	%Loading
+3	Current Demand
+4	kW total Demand
+5	kWh

### SMs Real-time and Demand Measurement

Key	Description	Key	Description
1~6	SM1	37~42	SM7
7~12	SM2	43~48	SM8
13~18	SM3	49~54	SM9
19~24	SM4	55~60	SM10
25~30	SM5	61~66	SM11
31~36	SM6	67~72	SM12

### 2) Mains Current and Voltage Real-time Measurement

Key	Description
73	Voltage
74	Mains Current
75	Residual Current
76	Reserved
77	kW
78	%Loading
79	Current Demand
80	kW Total Demand
81	kWh

### 3) AI Measurement

Key	Description
82	AI

**Appendix C - Technical Specifications**

<b>Voltage Inputs</b>	
Standard	240V
Optional	48VDC
Range	
240V	0-400VDC (RMS), 0.05xUn-Umax
48VDC	0-60VDC (RMS), 0.05xUn-Umax
Burden	<0.05VA @240VDC
Overload	1.2xUn continuous, 2xUn for 10s
<b>Current Inputs</b>	
<b>Mains Circuit Hall Effect Split-Core CTs</b>	
In	200A/400A/600A/800A/1000A/2000A
Range	0.5% to 120% In
Overload	1.2xIn continuous, 2xIn for 10s
Starting Current	0.15%In
Nominal Output	±4VDC
<b>Mains Hall Effect Solid-Core DC Residual CT</b>	
In	50mA
Range	0.5% to 100% In
Overload	1.2xIn continuous, 2xIn for 10s
Starting Current	0.15%In
Nominal Output	±5VDC
<b>Branch Circuit Hall Effect Solid-Core CTs</b>	
In	50A/100A/200A
Range	0.5% to 100% In
Overload	1.2xIn continuous, 2xIn for 10s
Starting Current	0.15%In
Burden	<0.15W
Output	
In=50A	0 to 25mA
In=100A	0 to 50mA
In=200A	0 to 100mA
<b>Power Supply (L+, N-, GND)</b>	
Standard (240V)	85-264VAC, 88-370VDC, 47-440Hz
Optional (48VDC)	20-60VDC
Burden	<0.1W
<b>Digital Inputs (13xDI)</b>	
Type	48VDC or 240VDC External Excitation
<b>Digital Outputs</b>	
Type	Normally Open
Loading	5A @ 250VAC or 30VDC
<b>Analog Inputs</b>	
Type	0-20 mA or 4-20 mA
Overload	500Ω
<b>Installation Torque</b>	
Current Input, AI	0.2 N.m
Others	0.4 N.m
<b>Environmental Conditions</b>	
Operating Temp.	-25°C to 70°C
Storage Temp.	-40°C to 85°C
Humidity	5% to 98% non-condensing
Atmospheric Pressure	70 kPa to 106 kPa
Altitude	≤3,000m
<b>Mechanical Characteristics</b>	
Unit Dimensions	126x90x65 mm


**Appendix D - Accuracy Specifications**

Parameters	Accuracy	Resolution
Voltage	±0.5%	0.01V
Current	±0.5%	0.001A
Residual Current	±1.0%	0.01mA
kW	±0.5%	0.001kW
kWh	Class 0.5 (Main Unit) Class 1.0 (including Hall Effect CT)	0.01kWh
Analog Input	±0.5%	-

## Appendix E - Standards Compliance

Safety Requirements		
CE LVD 2014 / 35 / EU		EN 61010-1: 2010, EN 61010-2-030: 2010
Electrical safety in low voltage distribution systems up to 1000VAC and 1500 VDC		IEC 61557-12: 2008
Insulation	Dielectric test:	2kV @ 1 minute
	Insulation resistance:	>100MΩ
	Impulse voltage:	6kV, 1.2/50μs
IEC 60255-5-2000		
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: 2012
Surges		EN 61000-4-5: 2006
Conducted Disturbances		EN 61000-4-6: 2009
Magnetic Fields		EN 61000-4-8: 2010
Oscillatory Waves		EN 61000-4-12: 2006
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 residential, commercial and light-industrial environments		EN 61000-6-4: 2007+A1: 2011
Electromagnetic Emission Tests for Measuring Relays and Protection Equipment		EN 61000-4-12: 2006
Mechanical Tests		
Vibration Test	Response	IEC 62052-11: 1988 Level I
	Endurance	IEC 62052-11: 1988 Level I
Shock Test	Response	IEC 62052-11: 1988 Level I
	Endurance	IEC 62052-11: 1988 Level I
Bump Test		IEC 62052-11: 1988 Level I

## Appendix F - Ordering Guide

 <b>CET Electric Technology</b>		<i>Version 20181116</i>
Product Code	Description	
<b>PMC-512 DC Multi-Circuit Power Monitor</b>		
↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓	<b>Basic Function</b>	
	D	DC Multi-Circuit Power Monitor with Mains Circuit V & I, 12 Branch Circuits, 13xDI, 1xDO, 1xAI and 2xRS485
	<b>Display Screen</b>	
	X	None
	L	LCD
	<b>Voltage Input</b>	
	4	48VDC
	5	240VDC (max. 336VDC)
	<b>Power Supply</b>	
	2	88V~264VAC, 47-440Hz or 88~370VDC
	3	20-60VDC
	<b>DI</b>	
A	13xDI, 48VDC External Excitation <sup>1</sup>	
B	13xDI, 240VDC External Excitation <sup>2</sup>	
<b>Display Language</b>		
E	English	
<b>PMC-512</b>	-	<b>PMC-512-DX43AE (Standard Model)</b>

- 1) 13xDI, 48VDC External Excitation can only be paired with Input Voltage Input Option 4 only.
- 2) 13xDI, 240VDC External Excitation can only be paired with Input Voltage Input Option 5 only.
- 3) Please refer to PMC-512-D Accessories for the Hall-Effect sensor and Power Supply option.

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