

PMC-509

Multi-Circuit Multifunction Monitor

User Manual

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Ceiec Electric Technology

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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 device should only be performed by qualified, competent personnel that have the appropriate training and experience with high voltage and current devices.
- Ensure that power source is turned OFF before performing any work on the device.
- Before connecting the device to the power source, check the label on top of the device to ensure that it is equipped with the appropriate power supply.
- 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 device for primary protection functions where failure of the device can cause fire, injury or death. The device should only be used for shadow protection if needed.
- Under no circumstances should the device be connected to a power source if it is damaged.
- To prevent potential fire or shock hazard, do not expose the device to rain or moisture.
- Setup procedures must be performed only by qualified personnel familiar with the instrument and its associated electrical equipment.
- DO NOT open the device under any circumstances.

Limited warranty

- Ceiec Electric Technology (CET) offers the customer a minimum of 12-month functional warranty on the device 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 device malfunctions. CET accepts no responsibility for the suitability of the device to the application for which it was purchased.
- Failure to install, set up or operate the device according to the instructions herein will void the warranty.
- Only CET's duly authorized representative may open your device. The unit should only be opened in a fully anti-static environment. Failure to do so may damage the electronic components and will void the warranty.

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Chapter 1 Introduction

This chapter provides an overview of the PMC-509 and summarizes many of its key features.

1.1 Overview

The PMC-509 is a multi-circuit, multifunction monitor featuring quality construction, DIN rail mount and a large, easy to read LCD display. It comes with either 6 Current Inputs and 3 RTD Inputs or 9 Current Inputs. The PMC-509 also provides 4 self-excited Digital Inputs for status monitoring. Further, the SOE Log records all setup changes, Setpoint and DI events in 1ms resolution. With the standard RS-485 port and Modbus RTU protocol support, the PMC-509 becomes a vital component in any energy management systems.

The PMC-509 can be setup through its front panel or via CET's free PMC Setup software. The device is also supported by our PecStar® iEMS Integrated Energy Management System.

1.2 Features

Ease of use

- Large, backlit, easy to read LCD display
- Password-protected setup via front panel or free PMC Setup software
- Easy installation with DIN rail mounting, no tools required

MDI Software Option (Maximum Demand Indicator)

- Current and Temperature measurements
- Demands and Peak Demands with Timestamps for Current and Temperature measurements with programmable Demand Interval and No. Demand Periods
- VLN, VLL per phase

MFM Software Option (Multifunction Measurements)

- Bi-directional energy measurements
- THD for Voltages and Currents
- Frequency
- One Sub-Meter (SM) per Current Input. Every SM provides the following parameters
 - kW, kvar, kVA, PF
 - Demands and Max. Demands for Current, kW, kvar, and kVA
 - kWh Import/Export, kvarh Import/Export and kVAh
- The MFM option provides 6 Virtual Meters (VM) that can be configured as 1-phase, 2-phase or 3-phase VM. Each VM provides the following measurements:
 - kW Total, kvar Total, kVA Total and PF Total
 - Demands and Max. Demands for kW Total, kvar Total and kVA Total
 - kWh Total Import/Export, kvarh Total Import/Export and kVAh Total

Hardware Options for Current and RTD Temperature Inputs

- 6 Current Inputs + 3 RTD Inputs (Each RTD Input requires an external Pt100 temperature sensor)
- 9 Current Inputs

Digital Inputs

- 4 channels for external status monitoring
- Volts free dry contact, 24VDC internally wetted
- 1000Hz sampling

Data Recorders

- 8 Data Recorder Logs of 16 parameters each for real-time measurements, harmonics, interval energy, demand, temperatureetc.
- Recording interval from 1s to 40 days
- Configurable depths and recording offsets
- 8MB log memory

Setpoints

- 27 user programmable setpoints
- Configurable thresholds and time delays

SOE Log

- 64 events time-stamped to $\pm 1\text{ms}$ resolution
- Setup changes, Setpoint and DI events

Real-time clock

- Battery-backed real-time clock @ 6ppm or 0.5s/day
- Time can be set via front panel or communications

Communications

- Optically isolated RS485 port
- Baud rate from 1200 to 19,200bps
- Modbus RTU protocol

System Integration

- Supported by our PecStar® iEMS and PMC Setup
- Easy integration into other Automation or SCADA systems via Modbus RTU protocol

1.3 Typical Application

- MDI (Maximum Demand Indicator) for Current and Temperature measurements for Pedestal Substation
- MFM (Multifunction Measurements) option, supporting up to a maximum of three 3-phase circuits or two 3-phase circuits and 3 Temperature measurements
- Class 0.5S Revenue Metering
- Status monitoring
- Extensive logging capability with 8MB on-board memory

1.4 Acronyms

The following acronyms are used throughout this document

MDI	=	Maximum Demand Indicator
MFM	=	Multifunction Measurements
SM	=	Sub-Meters
VM	=	Virtual Meter
DR	=	Data Recorder
RTC	=	Real-time Clock

1.5 Getting more information

Additional information is available from CET via the following sources:

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

Chapter 2 Installation



Caution

Installation of the PMC-509 should only be performed by qualified, competent personnel that have the appropriate training and experience with high voltage and current devices.

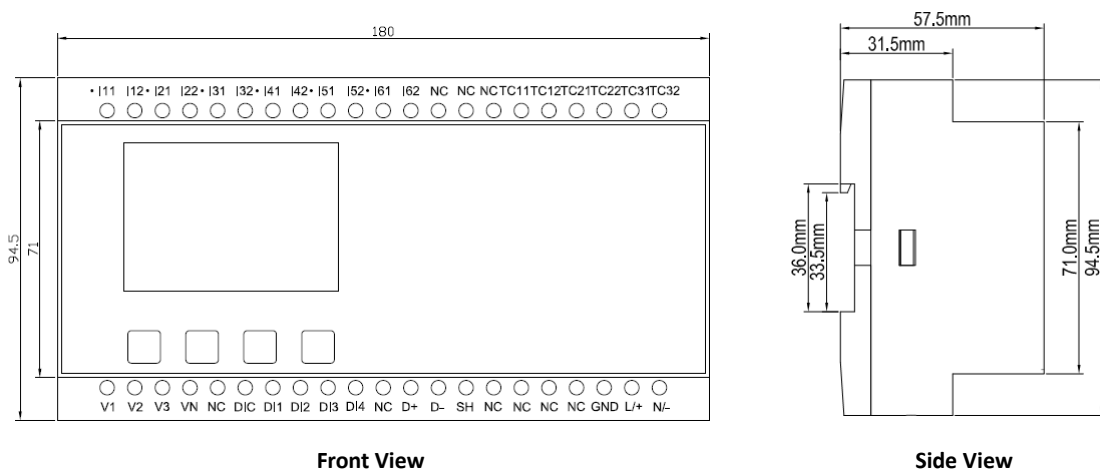
During the operation of the meter, hazardous voltages are present at the input terminals. Failure to observe precautions can result in serious or even fatal injury and equipment damage.

2.1 Appearance



Figure 2-1 Appearance

2.2 Unit Dimensions



Front View

Side View

Figure 2-2 Dimensions

2.3 Mounting

The PMC-509 should be installed in a dry environment with no dust and kept away from heat, radiation and electrical noise sources.

Installation steps:

- Before installation, make sure that the 35mm DIN-Rail is already in place
- Move the Installation clips at the back of the PMC-509, as shown in Figure 2-3, downward to the “unlock” position
- Align the top of the mounting channel at the back of the PMC-509 at an angle against the top of the DIN rail as show in Figure 2-4 below
- Rotate the bottom of the PMC-509 towards the back while applying a slight pressure to make sure that the device is completely and securely fixed on to the DIN rail
- Push the installation clip upward into the “lock” position to secure the PMC-509 on the DIN Rail

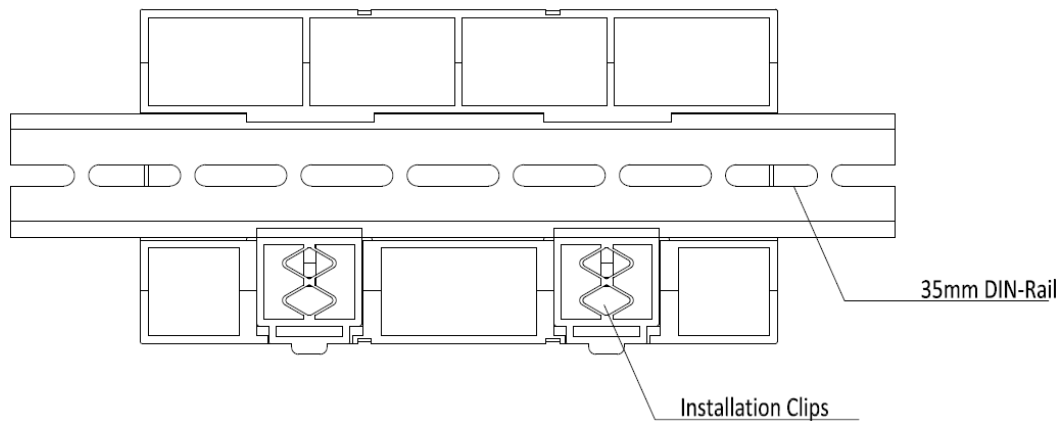


Figure 2-3 PMC-509's Installation Clips

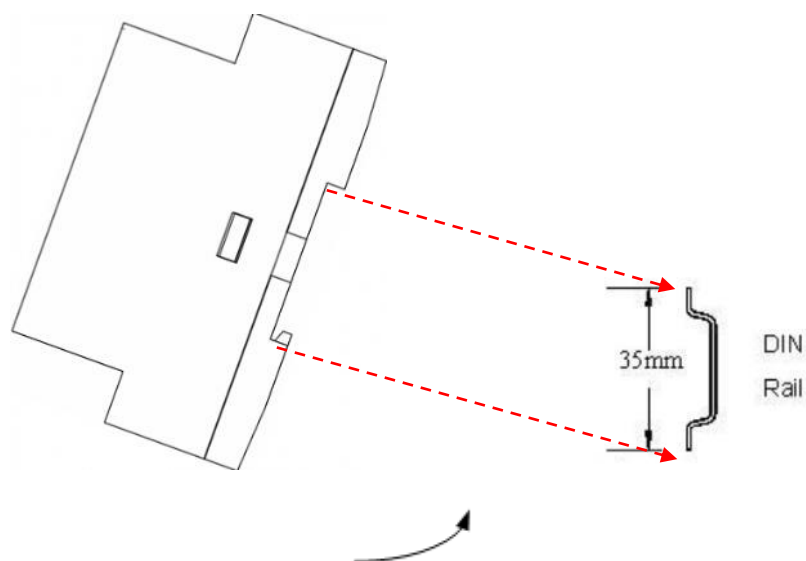


Figure 2-4 Mounting the PMC-509

2.4 Communications Wiring

The PMC-509 provides one RS485 port and supports the Modbus RTU protocol. Up to 32 devices can be connected on a RS485 bus. The overall length of the RS485 cable connecting all devices should not exceed 1200m.

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

The following figure illustrates the RS485 communications connections on the PMC-509:

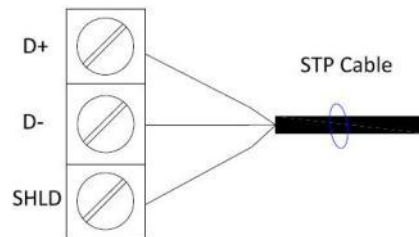


Figure 2-5 RS485 Communications Connections

2.5 Digital Input Wiring

The following figure illustrates the Digital Input connections on the PMC-509:

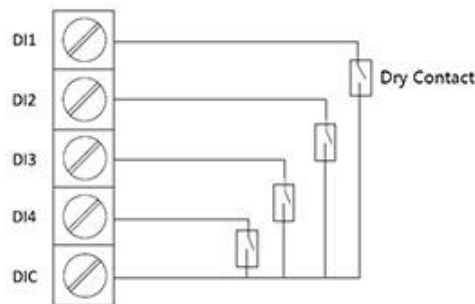


Figure 2-6 DI Connections

2.6 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. Connect the GND terminal to ground.

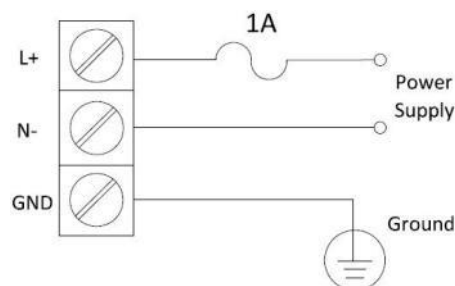


Figure 2-7 Power Supply Connections

Chapter 3 Front Panel

The PMC-509 has a large, backlit, easy to read LCD display and four buttons which allow for convenient access to various measurements as well as the configuration of the device's setup parameters. This chapter introduces the PMC-509's front panel operations.



Figure 3-1 Front Panel

3.1 Functions of buttons

Buttons	View Mode / Menu Level	Configuration via Setup or Maintenance Menu (Default password is a numeric zero "0")
<▲/▼>	Scroll to the next Measurement Category in the Main Display or the next menu item inside the Main Menu *.	Before a parameter is selected for modification, pressing this button scrolls to the next parameter in the menu. If a parameter is already selected, pressing this button moves the cursor one position to the left for a numeric parameter or scrolls to the next option in the enumerated list.
<▲>	Scroll to the next sub-page within the same Measurement Category in the Main Display or the previous menu item inside the Main Menu *.	Before a parameter is selected for modification, pressing this button scrolls to the previous parameter in the menu. If a parameter is already selected, pressing this button increments a numeric value or scrolls to the previous option in the enumerated list.
<◀>	Pressing this button enters the Main Menu while in the Main Display or the sub-menu if already inside the Main Menu *.	At the parameter configuration level, pressing this button selects the parameter for modification. After changing the parameter, pressing this button again saves the new setting into memory.
<⏮>	Pressing this button returns to the previous menu level if already inside the Main Menu *. This button is ignored at the Main Display .	At the parameter configuration level, pressing this button cancels the changes and exits the parameter configuration mode.

* Refer to Section 3.5 - Using the **Main Menu** for more information

Table 3-1 Buttons

3.2 Default Screen

The PMC-509 supports two options for **Default Screen**, **Auto Scroll** (default) and **Fixed**. The **Default Screen** can be configured under **Main Menu=>Maintenance=>Display Setup** (see Section 3.5.4). In **Auto Scroll** mode, the PMC-509's display will automatically scroll to the next screen every 4 seconds. In **Fixed** mode, the display will remain on the same screen until a button is pressed.

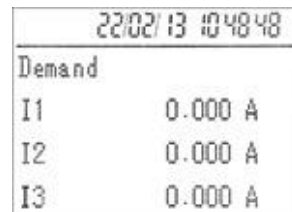
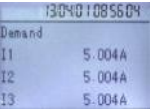
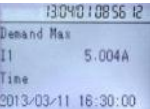
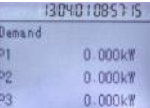


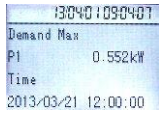
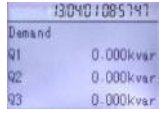
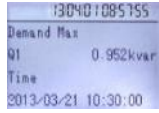
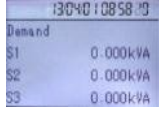
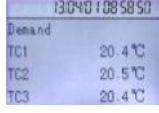
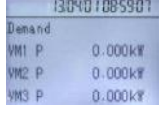
Figure 3-2 PMC-509's Main Display

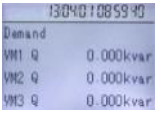
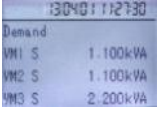
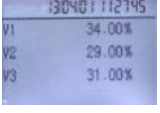
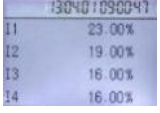
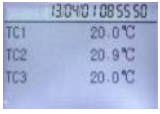
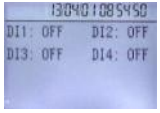
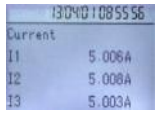
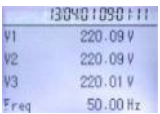
Figure 3-2 shows the PMC-509's **Main Display**, which is the first screen that appears upon power up. The **Main Display** is also the first screen that the display returns to when exiting from the **Main Menu**. If there is no front panel activity for a period longer than the **Backlight Timeout**, the LCD's backlight as well as the main parameter display area will be turned off to conserve their lifetime. Only the Date and Time at the top of the display remains. The display will come out of **Backlight Timeout** and return to normal operation as soon as any key is pressed. If the **Default Screen** is set to **Auto Scroll**, the display will first return to the **Main Display**; otherwise, the display will return to the same screen that it was on when the backlight timed out.

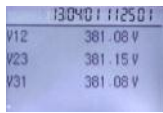
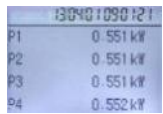
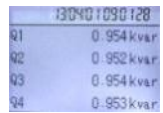
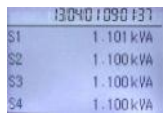
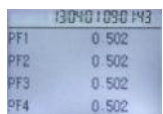
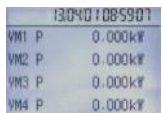
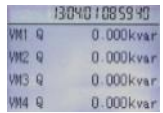
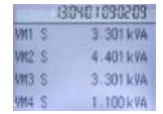
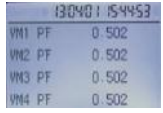
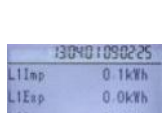
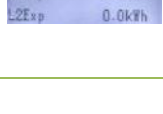
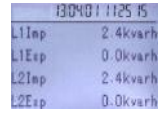
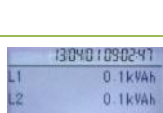
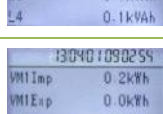
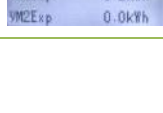
3.3 Data Display

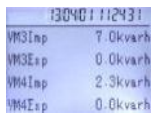
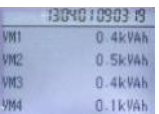
In **Auto Scroll** mode, measurements are displayed according to the order shown in the table below. The display automatically scrolls to the next screen every four seconds.

Display Screens	First Row	Second Row	Third Row	Fourth Row	Example			
1	Current	I1	I2	I3				
2	"Demand"	I4	I5	I6				
3*	(A)	I7	I8	I9				
4	Current "Demand Max" (A)	I1 to I6	"Time"	Date/Time Stamp				
5								
6								
7								
8								
9								
10*		I7 to I9						
11*								
12*								
13#	Sub-Meter kW "Demand"	P1 kW (SM1)	P2 kW (SM2)	P3 kW (SM3)				
14#		P4 kW (SM4)	P5 kW (SM5)	P6 kW (SM6)				
15#*		P7 kW (SM7)	P8 kW (SM8)	P9 kW (SM9)				

16#	Sub-Meter kW "Demand Max"	P1 kW (SM1) To P6 kW (SM6)	"Time"	Date/Time Stamp				
17#								
18#								
19#								
20#		P7 kW (SM7) P8 kW (SM8) P9 kW (SM9)						
21#								
22#*								
23#*								
24#*								
25#	Sub-Meter kvar "Demand"	Q1 kvar (SM1)	Q2 kvar (SM2)	Q3 kvar (SM3)				
26#		Q4 kvar (SM4)	Q5 kvar (SM5)	Q6 kvar (SM6)				
27#*		Q7 kvar (SM7)	Q8 kvar (SM8)	Q9 kvar (SM9)				
28#	Sub-Meter kvar "Demand Max"	Q1 kvar (SM1) To Q6 kvar (SM6)	"Time"	Date/Time Stamp				
29#								
30#								
31#								
32#		Q7 kvar (SM7) Q8 kvar (SM8) Q9 kvar (SM9)						
33#								
34#*								
35#*								
36#*								
37#	"Demand" (kVA)	S1 kVA (SM1)	S2 kVA (SM2)	S3 kVA (SM3)				
38#		S4 kVA (SM4)	S5 kVA (SM5)	S6 kVA (SM6)				
39#*		S7 kVA (SM7)	S8 kVA (SM8)	S9 kVA (SM9)				
40#	"Demand Max" (kVA)	S1 kVA (SM1) To S6 kVA (SM6)	"Time"	Date/Time Stamp				
41#								
42#								
43#								
44#		S7 kVA (SM7) S8 kVA (SM8) S9 kVA (SM9)						
45#								
46#*								
47#*								
48#*								
49	RTD "Demand"	TC1	TC2	TC3				
50	RTD "Demand Max"	TC1	"Time"	Date/Time Stamp				
51		TC2						
52		TC3						
53#	Virtual Meter kW	VM1 P	VM2 P	VM3 P				
54#	"Demand"	VM4 P	VM5 P	VM6 P				

55#	Virtual Meter kW "Demand Max"	VM1 P to VM6 P	"Time"	Date/Time Stamp	
56#					
57#					
58#					
59#					
60#					
61#	Virtual Meter kvar	VM1 Q	VM2 Q	VM3 Q	
62#	"Demand"	VM4 Q	VM5 Q	VM6 Q	
63#	Virtual Meter kvar "Demand Max"	VM1 Q to VM6 Q	"Time"	Date/Time Stamp	
64#					
65#					
66#					
67#					
68#					
69#	Virtual Meter kVA	VM1 S	VM2 S	VM3 S	
70#	"Demand"	VM4 S	VM5 S	VM6 S	
71#	Virtual Meter kVA "Demand Max"	VM1 S to VM6 S	"Time"	Date/Time Stamp	
72#					
73#					
74#					
75#					
76#					
77#	Va %THD	Vb %THD	Vc %THD		
78#	I1 %THD	I2 %THD	I3 %THD	I4 %THD	
79#	I5 %THD	I6 %THD	I7 %THD*	I8 %THD*	
80#	I9 %THD*				
81	TC1	TC2	TC3		
82	DI1 & DI2	DI3 & DI4			
83	Current	I1	I2	I3	
84		I4	I5	I6	
85#		I7	I8	I9	
86^	Va	Vb	Vc	Frequency	

87 [#]	V12	V23	V31		
88 [#]	P1 kW (SM1)	P2 kW (SM2)	P3 kW (SM3)	P4 kW (SM4)	
89 [#]	P5 kW (SM5)	P6 kW (SM6)	P7 kW (SM7)*	P8 kW (SM8)*	
90 [#]	P9 kW (SM9)*				
91 [#]	Q1 kvar (SM1)	Q2 kvar (SM2)	Q3 kvar (SM3)	Q4 kvar (SM4)	
92 [#]	Q5 kvar (SM5)	Q6 kvar (SM6)	Q7 kvar (SM7)*	Q8 kvar (SM8)*	
93 [#]	Q9 kvar (SM9)*				
94 [#]	S1 kVA (SM1)	S2 kVA (SM2)	S3 kVA (SM3)	S4 kVA (SM4)	
95 [#]	S5 kVA (SM5)	S6 kVA (SM6)	S7 kVA (SM7)*	S8 kVA (SM8)*	
96 [#]	S9 kVA (SM9)*				
97 [#]	PF1 (SM1)	PF2 (SM2)	PF3 (SM3)	PF4 (SM4)	
98 [#]	PF5 (SM5)	PF6 (SM6)	PF7 (SM7)*	PF8 (SM8)*	
99 [#]	PF9 (SM9)*				
100 [#]	VM1 P (kW)	VM2 P (kW)	VM3 P (kW)	VM4 P (kW)	
101 [#]	VM5 P (kW)	VM6 P (kW)			
102 [#]	VM1 Q (kvar)	VM2 Q (kvar)	VM3 Q (kvar)	VM4 Q (kvar)	
103 [#]	VM5 Q (kvar)	VM6 Q (kvar)			
104 [#]	VM1 S (kVA)	VM2 S (kVA)	VM3 S (kVA)	VM4 S (kVA)	
105 [#]	VM5 S (kVA)	VM6 S (kVA)			
106 [#]	VM1 PF	VM2 PF	VM3 PF	VM4 PF	
107 [#]	VM5 PF	VM6 PF			
108 [#]	L1Imp kWh (SM1)	L1Exp kWh (SM1)	L2Imp kWh (SM2)	L2Exp kWh (SM2)	
109 [#]	L3Imp kWh (SM3)	L3Exp kWh (SM3)	L4Imp kWh (SM4)	L4Exp kWh (SM4)	
110 [#]	L5Imp kWh (SM5)	L5Exp kWh (SM5)	L6Imp kWh (SM6)	L6Exp kWh (SM6)	
111 [#]	L7Imp kWh (SM7)	L7Exp kWh (SM7)	L8Imp kWh (SM8)	L8Exp kWh (SM8)	
112 [#]	L9Imp kWh (SM9)	L9Exp kWh (SM9)			
113 [#]	L1Imp kvarh (SM1)	L1Exp kvarh (SM1)	L2Imp kvarh (SM2)	L2Exp kvarh (SM2)	
114 [#]	L3Imp kvarh (SM3)	L3Exp kvarh (SM3)	L4Imp kvarh (SM4)	L4Exp kvarh (SM4)	
115 [#]	L5Imp kvarh (SM5)	L5Exp kvarh (SM5)	L6Imp kvarh (SM6)	L6Exp kvarh (SM6)	
116 [#]	L7Imp kvarh (SM7)	L7Exp kvarh (SM7)	L8Imp kvarh (SM8)	L8Exp kvarh (SM8)	
117 [#]	L9Imp kvarh (SM9)	L9Exp kvarh (SM9)			
118 [#]	L1 kVAh (SM1)	L2 kVAh (SM2)	L3 kVAh (SM3)	L4 kVAh (SM4)	
119 [#]	L5 kVAh (SM5)	L6 kVAh (SM6)	L7 kVAh (SM7)*	L8 kVAh (SM8)*	
120 [#]	L9 kVAh (SM9)*				
121 [#]	VM1 kWh Import	VM1 kWh Export	VM2 kWh Import	VM2 kWh Export	
122 [#]	VM3 kWh Import	VM3 kWh Export	VM4 kWh Import	VM4 kWh Export	
123 [#]	VM5 kWh Import	VM5 kWh Export	VM6 kWh Import	VM6 kWh Export	

124#	VM1 kvarh Import	VM1 kvarh Export	VM2 kvarh Import	VM2 kvarh Export	
125#	VM3 kvarh Import	VM3 kvarh Export	VM4 kvarh Import	VM4 kvarh Export	
126#	VM5 kvarh Import	VM5 kvarh Export	VM6 kvarh Import	VM6 kvarh Export	
127#	VM1 kVAh	VM2 kVAh	VM3 kVAh	VM4 kVAh	
128#	VM5 kVAh	VM6 kVAh			

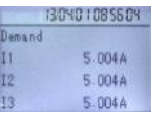
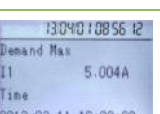
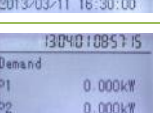
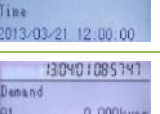
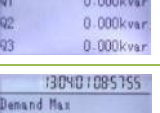
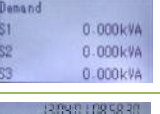
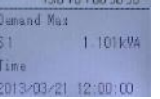
* When the Hardware Option is 6I+3RTD, the relevant parameters for SM7, SM8 and SM9 are not available. That includes Current, Current Demand, Current Demand Max, Current THD, PF, kW, kW Demand, kW Demand Max, kvar, kvar Demand, kvar Demand Max, kVA, kVA Demand, kVA Demand Max, kWh Import/Export, kvarh Import/Export, kVAh.

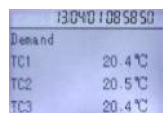
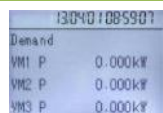
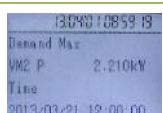
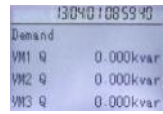
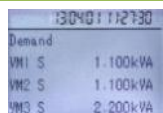
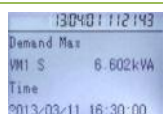
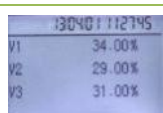
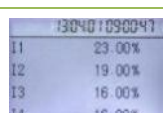
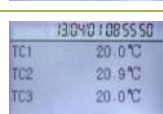
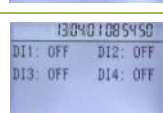
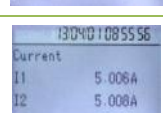
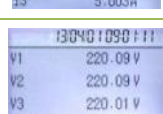
* When the Software Option is MDI, the measurements are not available.

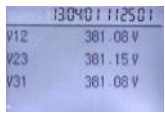
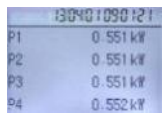
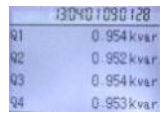
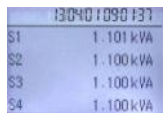
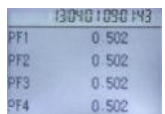
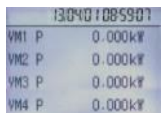
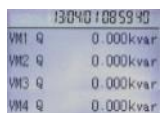
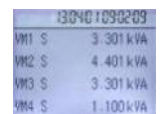
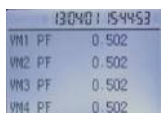
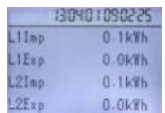
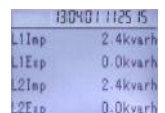
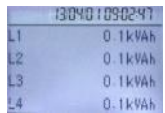
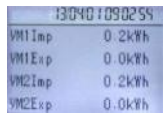
* When the Software Option is MDI, the voltage measurements are not displayed in the **Auto Scroll** display sequence. The voltage measurements can be viewed in the **MEASUREMENTS** option in the **Main Menu**.

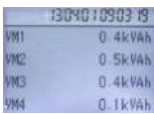
Table 3-2 PMC-509's Data Display Screens in Auto Scroll Mode

In **Fixed** mode, The screen will advance only when either <◀/▼> or <▶> is pressed. The following table illustrates the display operation in **Fixed** display mode. Pressing the <◀/▼> button anytime moves the display to the next Measurement Category. Pressing the <▶> button moves the display to the next Sub-Page within a particular Measurement Category. When the last Sub-Page is reached within a Measurement Category, pressing the <▶> button again moves the display back to the first Sub-Page of the same Measurement Category.

Button	Page	Measurement Category	Button	Sub-Page	Parameters	Sample Display
<◀/▼>	1	Current Demand	<▲>	1	I1, I2, I3	
				2	I4, I5, I6	
				3*	I7, I8, I9	
				4 - 9	I1-I6	
				10* - 12*	I7-I9	
				2#	SM kW Demand	1
	2	P4, P5, P6				
	3*	P7, P8, P9				
	4 - 9	P1 - P6				
	10* - 12*	P7 - P9				
	3#	SM kvar Demand				1 - 3
				4 - 6	Q4, Q5, Q6	
				7* - 9*	Q7, Q8, Q9	
				4 - 9	Q1 - Q6	
				10* - 12*	Q7 - Q9	
				4#	SM kVA Demand	1 - 3
	4 - 6	S4, S5, S6				
	7* - 9*	S7, S8, S9				
	4 - 9	S1 - S6				
	10* - 12*	S7 - S9				

	5	RTD Demand*		1	TC1, TC2, TC3		
				2	RTD Demand Max*		
				3			TC2
				4			TC3
	6#	VM kW Demand		1	VM1P, VM2P, VM3P		
				2	VM4P, VM5P, VM6P		
	3 - 8	VM kW Demand Max VM1P to VM6P					
	7#	VM kvar Demand		1	VM1Q, VM2Q, VM3Q		
				2	VM4Q, VM5Q, VM6Q		
	3 - 8	VM kvar Demand Max VM1Q to VM6Q					
	8#	VM kVA Demand		1	VM1S, VM2S, VM3S		
				2	VM4S, VM5S, VM6S		
	3 - 8	VM kVA Demand Max VM1S to VM6S					
	9#	Voltage THD		1	V1, V2, V3		
	10#	Current THD		1	I1, I2, I3, I4		
				2	I5, I6, I7*, I8*		
				3	I9*		
	11*	RTD Temperature		1	TC1, TC2, TC3		
	12	DI Status		1	DI1, DI2 DI3, DI4		
	13	Current		1	I1, I2, I3		
				2	I4, I5, I6		
				3*	I7, I8, I9		
	14^	Voltage & Frequency		1	V1, V2, V3, Freq		

				2	V12, V23, V31	
	15#	SM kW		1	P1, P2, P3, P4	
				2	P5, P6, P7*, P8*	
				3	P9*	
	16#	SM kvar		1	Q1, Q2, Q3, Q4	
				2	Q5, Q6, Q7*, Q8*	
				3	Q9*	
	17#	SM kVA		1	S1, S2, S3, S4	
				2	S5, S6, S7*, S8*	
				3	S9*	
	18#	SM PF		1	PF1, PF2, PF3, PF4	
				2	PF5, PF6, PF7*, PF8*	
				3	PF9*	
	19#	VM kW		1	VM1, VM2, VM3, VM4,	
				2	VM5, VM6	
	20#	VM kvar		1	VM1, VM2, VM3, VM4,	
				2	VM5, VM6	
	21#	VM kVA		2	VM1, VM2, VM3, VM4,	
					VM5, VM6	
	22#	VM PF		2	VM1, VM2, VM3, VM4,	
					VM5, VM6	
	23#	SM kWh Import/Export		1	SM1, SM2	
				2	SM3, SM4	
				3	SM5, SM6	
				4	SM7*, SM8*	
				5	SM9*	
	24#	SM kvarh Import/Export		1	SM1, SM2	
				2	SM3, SM4	
				3	SM5, SM6	
				4	SM7*, SM8*	
				5	SM9*	
	25#	SM kVAh		1	SM1, SM2, SM3, SM4	
				2	SM5, SM6, SM7*, SM8*	
				3	SM9*	
	26#	VM kWh Import/Export		1	VM1, VM2	
				2	VM3, VM4	
				3	VM5, VM6	

	27#	VM kvarh Import/Export		1	VM1, VM2		
				2	VM3, VM4		
				3	VM5, VM6		
	28#	VM kVAh		1	VM1, VM2, VM3, VM4		
				2	VM5, VM6		

* When the Hardware Option is 6I+3RTD, the relevant parameters for SM7, SM8 and SM9 are not available. That includes Current, Current Demand, Current Demand Max, Current THD, PF, kW, kW Demand, kW Demand Max, kvar, kvar Demand, kvar Demand Max, kVA, kVA Demand, kVA Demand Max, kWh Import/Export, kvarh Import/Export, kVAh.

When the Software Option is MDI, the measurements are not available. These measurements are only available with the MFM option.

* When the Software Option is MDI, the voltage measurements are not displayed in the **Fixed** display sequence. The voltage measurements can be viewed in the **MEASUREMENTS** option in the **Main Menu**.

Table 3-3 PMC-509's Data Display Screens in Fixed Mode

3.4 PMC-509's Menu Tree

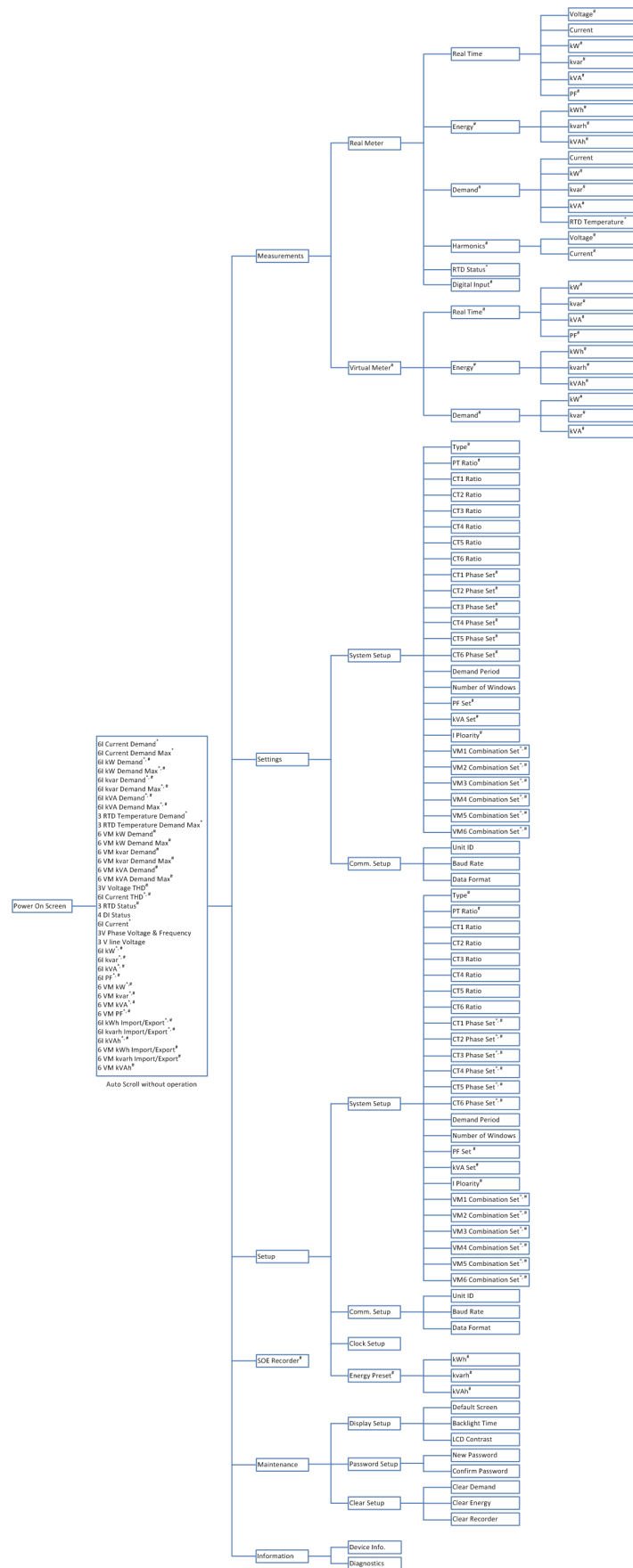


Figure 3-3 PMC-509's Menu Tree

3.5 Using the Main Menu

Pressing the <  > button in the **Main Display** enters PMC-509's **Main Menu** as illustrated in Figure 3-4.



Figure 3-4 PMC-509's Main Menu

There are six options in the **Main Menu**:

MEASUREMENTS	View real-time parameters of SM (Sub-Meters) and VM (Virtual Meters)
SETTINGS	View Setup parameters
SETUP	Configure Setup parameters
SOE RECORD (MFM only)	View SOE Records
MAINTENANCE	Configure Display, Change Password, Clear Operations
INFORMATION	View Device Information

The following Sections describe front panel navigation within each option.

3.5.1 MEASUREMENTS

From the **Main Menu**, scroll to the **MEASUREMENTS** option and then press the <  > button to enter its sub-menu.

Sub-Menu	Category	Group	Parameters
REAL METER (Sub-Meters)	Real Time	Voltage	Va, Vb, Vc, Frequency, Vab, Vbc, Vca
		Current	I1, I2, I3, I4, I5, I6, I7*, I8*, I9*
		kW^	P1, P2, P3, P4, P5, P6, P7*, P8*, P9*
		kvar^	Q1, Q2, Q3, Q4, Q5, Q6, Q7*, Q8*, Q9*
		kVA^	S1, S2, S3, S4, S5, S6, S7*, S8*, S9*
		PF^	PF1, PF2, PF3, PF4, PF5, PF6, PF7*, PF8*, PF9*
	Energy^	kWh Import/Export	SM1 / 2 / 3 / 4 / 5 / 6 / 7* / 8* / 9*
		kvarh Import/Export	SM1 / 2 / 3 / 4 / 5 / 6 / 7* / 8* / 9*
		kVAh	SM1 / 2 / 3 / 4 / 5 / 6 / 7* / 8* / 9*
	Demand	Current Demand	I1, I2, I3, I4, I5, I6, I7*, I8*, I9*
		Current Demand Max.	I1, I2, I3, I4, I5, I6, I7*, I8*, I9*
		SM kW Demand^	P1, P2, P3, P4, P5, P6, P7*, P8*, P9*
		SM kW Demand Max^	P1, P2, P3, P4, P5, P6, P7*, P8*, P9*
		SM kvar Demand^	Q1, Q2, Q3, Q4, Q5, Q6, Q7*, Q8*, Q9*
		SM kvar Demand Max^	Q1, Q2, Q3, Q4, Q5, Q6, Q7*, Q8*, Q9*
		SM kVA Demand^	S1, S2, S3, S4, S5, S6, S7*, S8*, S9*
		SM kVA Demand Max^	S1, S2, S3, S4, S5, S6, S7*, S8*, S9*
		RTD Demand#	TC1, TC2, TC3
		RTD Demand Max#	TC1, TC2, TC3

	Harmonics [^]	Voltage THD	Va, Vb, Vc
		Current THD	I1, I2, I3, I4, I5, I6, I7*, I8*, I9*
	RTD [#]		TC1, TC2, TC3
	DI Status		DI1, DI2, DI3, DI4
VIRTUAL METER [^]	Real Time	VM kW	P1, P2, P3, P4, P5, P6
		VM kvar	Q1, Q2, Q3, Q4, Q5, Q6
		VM kVA	S1, S2, S3, S4, S5, S6
		VM PF	PF1, PF2, PF3, PF4, PF5, PF6
	Energy	VM kWh Import/Export	VM1 / 2 / 3 / 4 / 5 / 6
		VM kvarh Import/Export	VM 1 / 2 / 3 / 4 / 5 / 6
		VM kVAh Total	VM 1 / 2 / 3 / 4 / 5 / 6
	Demand	VM kW Demand	P1, P2, P3, P4, P5, P6
		VM kW Demand Max.	P1, P2, P3, P4, P5, P6
		VM kvar Demand	Q1, Q2, Q3, Q4, Q5, Q6
		VM kvar Demand Max.	Q1, Q2, Q3, Q4, Q5, Q6
		VM kVA Demand	S1, S2, S3, S4, S5, S6
		VM kVA Demand Max.	S1, S2, S3, S4, S5, S6

[^] When the Hardware Option is 6I+3RTD, the relevant parameters for SM7, SM8 and SM9 are not available. That includes Current, Current Demand, Current Demand Max, Current THD, PF, kW, kW Demand, kW Demand Max, kvar, kvar Demand, kvar Demand Max, kVA, kVA Demand, kVA Demand Max, kWh Import/Export, kvarh Import/Export, kVAh.

[#] When the Software Option is MDI, the measurements are not available. These measurements are only available with the MFM option.

^{*} RTD and RTD Demand will only appear when the **Hardware Option** is 6I+3RTD.

Table 3-4 MEASUREMENTS

3.5.2 SETTINGS and SETUP

From the **Main Menu**, scroll to the **SETTINGS or SETUP** option and then press the <  > button to enter its sub-menu. The **SETTINGS** option only allows the viewing of the Setup parameters. To configure the Setup parameters, the **SETUP** option should be used.

The user is required to enter a password before making configuration changes to the device with the **SETUP** option. The default password is "0" (numeric zero).

Sub-Menu	Setup Parameters	Description (Range/Options)	6I+3RTD	9I
			Default	
System Setup	Type	Wiring Connection (WYE/DELTA/DEMO)	WYE	
	PT Ratio	PT Ratio (1~ to 2200)	1	
	CT1 Ratio	Set Sub-Meter's CT Ratio 1~ to 6000 (5A input) 1~ to 30000 (1A input)	320	80
	CT2 Ratio		320	80
	CT4 Ratio		320	80
	CT4 Ratio		80	80
	CT5 Ratio		80	80
	CT6 Ratio		80	80
	CT7 Ratio*		80	80
	CT8 Ratio*		80	80
	CT9 Ratio*		80	80
	CT1 Phase	Set Sub-Meter's Current's Relationship with Voltage	Va	

	CT2 Phase	(Va/Vb/Vc)	Vb	
	CT3 Phase		Vc	
	CT4 Phase		Va	
	CT5 Phase		Vb	
	CT6 Phase		Vc	
	CT7 Phase *		Va	
	CT8 Phase*		Vb	
	CT9 Phase *		Vc	
	DMD Period	Sliding Window Interval (1 to 99 minutes)	10	
	Num of Windows	Number of Sliding Windows (1 to 15)	1	
	PF Set [#]	P.F. Convention (IEC/IEEE/-IEEE)	IEC	
	kVA Set [#]	kVA Calculation Method (Vector/Scalar)	Vector	
	I Polarity [#]	Set Current Polarity (Normal/Reverse)	Normal	
	VM1 Set [#]	Virtual Meter Configuration Bit 0 = SM1 (I1) Bit 1 = SM2 (I2) Bit 2 = SM3 (I3) Bit 3 = SM4 (I4) Bit 4 = SM5 (I5) Bit 5 = SM6 (I6) Bit 6 = SM7 (I7) [#] Bit 7 = SM8 (I8) [#] Bit 8 = SM9 (I9) [#] Bits 9 to 15 = Reserved	000111111	111111111
	VM2 Set [#]		000000111	000000111
	VM3 Set [#]		000111000	000111000
	VM4 Set [#]		000000000	111000000
	VM5 Set [#]		000000000	000000000
	VM6 Set [#]		000000000	000000000
Comm. Setup	Unit	Modbus Address (1 to 247)	100	101
	Baudrate	Data rate in bits per second (bps) (1200/2400/4800/9600/19200)	9600	
	Data Format	Data Format (8N2/8O1/8E1/8N1/8O2/8E2)	8E1	
Clock Setup [^]	Date Format	Data Format of date (YYYY/MM/DD, DD/MM/YYYY, MM/DD/YYYY)	YYYY/MM/DD	
	Date	Set Date	20YY/MM/DD	
	Clock	Set Time	HH:MM:SS	
Energy Preset [^]	kWh	Preset kWh Import/Export	SM1/2/3/4/5/6/7*/8*/9* VM1/2/3/4/5/6/7*/8*/9*	
	kvarh	Preset kvarh Import/Export		
	kVAh	Preset kVAh		

^{*}Default

^{*}When the **Hardware Option** is 6I+3RTD, these Setup parameters are not available.

[#]When the **Software option** is MDI, these Setup parameters are not available.

[^]These sub-menus are only available in the **SETUP** option and not the **SETTINGS** option.

Table 3-5 Setup Parameters

3.5.3 SOE RECORD (MFM Version)

From the **Main Menu**, scroll to the **SOE RECORD** option and then press the <  > button to enter its sub-menu. The SOE Records with time stamp will appear, if any.



```

13/04/01 11:28:27
01.PANEL SETUP
13/04/01 08:56:40:794
02.RTD3 OPENED
13/03/22 17:16:20:003
  
```

3.5.4 MAINTENANCE

From the **Main Menu**, scroll to the **MAINTENANCE** option and then press the <  > button to enter its sub-menu. A password is required before entering this option. The default password is "0" (numeric zero).

Sub-Menu	Parameters	Description	Range/Options
Display Setup	Default Screen	Default display mode	Auto Scroll~/Fixed
	Backlight Timeout	In minutes	0-60 (default=3)
	LCD Contrast	The higher the value the darker the display	0-9 (default=5)
Password Setup	New Password	Change Password	0000-9999 (default=0000)
	Confirm Password		
Clear Setup	Clear Max. Demand Log	Clear Maximum Demands	Yes/No~
	Clear Energy	Clear Energy Counters	
	Clear SOE*	Clear SOE Log	

~Default

*When the **Hardware Option** is 6I+3RTD, these Setup parameters are not available.

Table 3-6 Maintenance

3.5.5 INFORMATION

From the **Main Menu**, scroll to the **INFORMATION** option and then press the <  > button to enter its sub-menu.

Sub-Menu	Parameters	Description	Note/Option
Device Info	Hardware	Basic Function	3V+6I+3RTD 3V+9I
	Type	Software Function	FULL FUNC (MFM) MDI
	Firmware	Firmware Version	e.g. VA.02.11
	Protocol	Protocol Version	e.g. VB.3
	Update	Date of the latest firmware update	e.g. 11.07.09
	SN	Serial Number	e.g.1108471895

Table 3-7 Information

Chapter 4 Applications

4.1 Inputs

4.1.1 Digital Inputs (MFM Version)

The PMC-509 comes standard with four self-excited Digital Inputs that are internally wetted at 24 VDC.

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

4.1.2 RTD Inputs

The PMC-509 provides three optional RTD Temperature Inputs that can accept the Pt100 sensor as described in Appendix C for temperature measurements. The outputs of the Pt100 sensor are connected to the RTD Inputs of the PMC-509 if so equipped.

The Temperature Input provides accurate temperature monitoring/alarming and is mainly used for measuring the temperature for neutral conductor, transformer, enclosure's ambient temperature or other equipment that requires temperature monitoring. Please refer to Section 4.4.2 for a complete description of the Temperature Setpoint operations.

4.2 Energy Measurements (MFM Version)

The PMC-509 provides bi-directional energy measurements such as active energy (kWh Import/Export), reactive energy (kvarh Import/Export) and apparent energy (kVAh) with a resolution of 0.1 and a maximum value of $\pm 99,999,999.9$ for each Sub-Meter and Virtual Meter. When the maximum value is reached, it will automatically roll over to zero.

The energy values can be reset manually or preset to user-defined values through the front panel or via communications. Please refer to Section 3.5.4 for more details on how to reset the Energy counters and Section 3.5.2 on how to pre-set them from the Front Panel.

For a complete list of available Energy Measurements, please refer to Section 3.5.1 for more details.

4.3 Demand Measurements

Demand is defined as the average power consumption over a fixed interval (usually 10 or 15 minutes). The PMC-509 supports the sliding window demand calculation and has the following Setup parameters:

# of Sliding Windows:	1-15 (default = 1)
Demand Period:	1, 2, 3, 5, 10, 15, 30, 60 minutes. For example, if the # of Sliding Windows is set as 1 and the Demand Period is 10, the demand cycle will be $1 \times 10 = 10\text{min}$.

The PMC-509 provides an extensive list of Demand and Maximum Demand parameters. Please refer to Section 3.5.1 for more details.

4.4 Setpoints

4.4.1 Control Setpoints

The PMC-509 comes standard with 27 user programmable control setpoints which provide extensive control by allowing a user to initiate an action in response to a specific condition. Typical setpoint applications include alarming, demand control, fault detection and power quality monitoring.

The setpoints can be programmed over communications and have the following setup parameters:

1) **Setpoint Type:**

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

2) **Setpoint Parameter:**

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

3) **Setpoint Active Limit :**

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

4) **Setpoint Inactive Limit:**

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

5) **Setpoint Active Delay:**

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

6) **Setpoint Inactive Delay:**

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

7) **Setpoint Trigger:**

Specify what action the setpoint will take when it becomes active. These actions include No Trigger and Trigger Data Recorder X.

The PMC-509 provides the following Setpoint Parameters:

Key	Parameter	Scale/Unit
0	None	/
1	Frequency*	x100, Hz
2	VLN	x100, V
3	VLL	x100, V
4	V THD*	x100, %
5	SM1 Current	x1000, A
6	SM2 Current	x1000, A
7	SM3 Current	x1000, A
8	SM4 Current	x1000, A
9	SM5 Current	x1000, A
10	SM6 Current	x1000, A
11	SM7 Current	x1000, A
12	SM8 Current	x1000, A

13	SM9 Current	x1000, A
14	SM1 Current THD*	x100, %
15	SM2 Current THD*	x100, %
16	SM3 Current THD*	x100, %
17	SM4 Current THD*	x100, %
18	SM5 Current THD*	x100, %
19	SM6 Current THD*	x100, %
20	SM7 Current THD*	x100, %
21	SM8 Current THD*	x100, %
22	SM9 Current THD*	x100, %
23	SM1 kW*	x1000, kW
24	SM2 kW*	x1000, kW
25	SM3 kW*	x1000, kW
26	SM4 kW*	x1000, kW
27	SM5 kW*	x1000, kW
28	SM6 kW*	x1000, kW
29	SM7 kW*	x1000, kW
30	SM8 kW*	x1000, kW
31	SM9 kW*	x1000, kW
32	SM1 kvar*	x1000, kvar
33	SM2 kvar*	x1000, kvar
34	SM3 kvar*	x1000, kvar
35	SM4 kvar*	x1000, kvar
36	SM5 kvar*	x1000, kvar
37	SM6 kvar*	x1000, kvar
38	SM7 kvar*	x1000, kvar
39	SM8 kvar*	x1000, kvar
40	SM9 kvar*	x1000, kvar
41	SM1 kVA*	x1000, kVA
42	SM2 kVA*	x1000, kVA
43	SM3 kVA*	x1000, kVA
44	SM4 kVA*	x1000, kVA
45	SM5 kVA*	x1000, kVA
46	SM6 kVA*	x1000, kVA
47	SM7 kVA*	x1000, kVA
48	SM8 kVA*	x1000, kVA
49	SM9 kVA*	x1000, kVA
50	SM1 PF*	x1000
51	SM2 PF*	x1000
52	SM3 PF*	x1000
53	SM4 PF*	x1000
54	SM5 PF*	x1000
55	SM6 PF*	x1000
56	SM7 PF*	x1000
57	SM8 PF*	x1000
58	SM9 PF	x1000
59	VM1 $\sum$ kW*	x1000, kW
60	VM2 $\sum$ kW*	x1000, kW
61	VM3 $\sum$ kW*	x1000, kW
62	VM4 $\sum$ kW*	x1000, kW
63	VM5 $\sum$ kvar*	x1000, kvar
64	VM6 $\sum$ kvar*	x1000, kvar
65	VM1 $\sum$ kvar*	x1000, kvar
66	VM2 $\sum$ kvar*	x1000, kvar
67	VM3 $\sum$ kvar*	x1000, kvar
68	VM4 $\sum$ kvar*	x1000, kvar
69	VM5 $\sum$ kvar*	x1000, kvar
70	VM6 $\sum$ kvar*	x1000, kvar
71	VM1 $\sum$ kVA*	x1000, kVA
72	VM2 $\sum$ kVA*	x1000, kVA
73	VM3 $\sum$ kVA*	x1000, kVA
74	VM4 $\sum$ kVA*	x1000, kVA
75	VM5 $\sum$ kVA*	x1000, kVA
76	VM6 $\sum$ kVA*	x1000, kVA
77	VM1 $\sum$ PF*	x1000
78	VM2 $\sum$ PF*	x1000
79	VM3 $\sum$ PF*	x1000

80	VM4 Σ PF*	x1000
81	VM5 Σ PF*	x1000
82	VM6 Σ PF*	x1000
83	RTD1 Temperature [#]	×10, °C
84	RTD2 Temperature [#]	×10, °C
85	RTD3 Temperature [#]	×10, °C

* When the Software Option is MDI, the measurements are not available.

[#] When the Hardware Option is 9I, the measurements are not available.

Table 4-3 Setpoint Parameters

4.4.2 Temperature Setpoint

The Temperature Setpoint can be used to monitor equipment temperature and provide alarming and control capability if the temperature measurement exceeds a pre-determined level.

The following table illustrates the operational behavior of the Temperature ALARM Setpoint.

Temperature Setpoint	ALARM
Mode	ON/OFF
ALARM Setpoint Limit	55 to 140 (°C)
Action/Release Delay	0.0 to 400 (x0.1s)
Action	1) Temperature $\geq$ ALARM Setpoint Limit 2) The ALARM Setpoint becomes active when the Temperature measurement has exceeded the ALARM Setpoint Limit for a duration longer than the Action Delay time. 3) When ALARM is active, an SOE event would be generated
Release	1) Temperature $< 0.8 \times$ ALARM Setpoint Limit. 2) The ALARM becomes inactive when the Temperature measurement is less than $0.8 \times$ ALARM Setpoint Limit for a duration longer than the Release Delay time. 3) An SOE event would be generated when the ALARM becomes inactive

Table 4-4 Temperature ALARM Setpoint

4.5 Logging

4.5.1 Max Demand Log

The PMC-509 provides an extensive list of Maximum Demand parameters with timestamp since the last reset. Please refer to Section 3.5.1 for more details.

The Maximum Demand can be reset manually from the front panel or via communications. Please refer to Section 3.5.4 for more details on how to reset the Maximum Demand from the Front Panel.

4.5.2 Data Recorder (DR) Log

The PMC-509 comes equipped with 8MB of memory and provides up to 8 Data Recorders (**DR**) capable of recording 16 parameters each. The recorded data is stored in the device's non-volatile memory and will not suffer any loss in the event of a power failure.

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

- 1) **Triggered Mode:** 0=Disabled / 1=Triggered by Timer / 2=Triggered by Setpoint

- | | |
|---------------------------------|--|
| 2) Recording Depth: | 0 to 65535 (entry) |
| 3) Recording Interval: | 1 to 3456000 seconds |
| 4) Recording Offset: | 0 to 43200 seconds |
| 5) Number of Parameters: | 0 to 16 |
| 6) Parameter 1 to 16: | 0 to 115 (Please see Appendix A DR Parameters) |

The Data Recorder Log is only operational when the values of **Triggered 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 programmed value of the **Recording Offset** parameter should be less than that of the **Recording Interval** parameter.

4.5.3 SOE Log (MFM Version)

The PMC-509's SOE Log can store up to 64 events such as power-on, power-off, setpoint actions, Digital Input status changes and setup changes in its non-volatile memory. Each event record includes the event classification, its relevant parameter values and a timestamp in 1ms resolution.

The SOE Log can be displayed from the Front Panel (as shown below) or retrieved via communications (see Section 3.5.3 for details). If there are more than 64 events, the newest event will replace the oldest event on a first-in-first-out basis. The SOE Log can be reset from the Front Panel or via communications. Please refer to Section 3.5.4 for more details on how to reset the SOE Log from the Front Panel.



4.6 Harmonics (MFM Version)

The PMC-509 provides THD parameters in percentage of fundamental for its Voltage and Current Inputs. Please refer to Section 3.5.1 for more details.

4.7 Sub-Meters (MFM Version)

The PMC-509 supports six (6I + 3RTD Hardware Option) or nine (9I Hardware Option) Sub-Meters (SM1 to SM9). Each Sub-Meter (SM) is coupled with a Current Input and a **CTx Phase Setup Register**, which is used to associate each Current Input with a particular Voltage Input (Va, Vb or Vc) for its power calculation. For example, SMx is associated with Ix Current Input and **CTx Phase Setup Register**, where $1 \leq x \leq 9$. Each SM provides the following parameters: Current, ITHD, kW, kvar, kVA,

PF, Current Demand, kW Demand, kvar Demand, kVA Demand, Current Demand Max., kW Demand Max., kvar Demand Max., kVA Demand Max., kWh Import/Export, kvarh Import/Export and kVAh. Please refer to Section 3.5.1 for more details.

4.8 Virtual Meters (MFM Version)

The PMC-509 supports up to six Virtual Meters, VM1 to VM6, which can be used to arbitrarily aggregate the total value from any of the six or nine individual Sub-Meters, depending on the Hardware Option. SM1 to SM9 represents the nine Sub-Meters as described in Section 4.7 above.

Each VM provides the following parameters as the aggregate value of the individual Sub-Meters: kW, kvar, kVA, PF, kW Demand, kvar Demand, kVA Demand, kW Demand Max., kvar Demand Max., kVA Demand Max., kWh Import/Export and kvarh Import/Export. Please refer to Section 3.5.1 for more details.

4.8.1 Virtual Meter Configuration

The configuration of the Virtual Meter is achieved via the **VMx Set** Setup Register where $1 \leq x \leq 6$. Bit 0 to Bit 8 of each of the **VM1 Set** to **VM6 Set** Setup Registers represent SM1 to SM9, respectively. Setting a particular bit of **VMx Set** to 1 includes the associated SMs in the VMx's aggregation of the relevant power and energy parameters from all the specified SMs. The Virtual Meter configuration is supported from the Front Panel as well as via communications. Please refer to Section 3.5.2 for more details on how to configure the Virtual Meters from the Front Panel. The following table provides an explanation for the default VM setup for the 6I+3RTD and the 9I Hardware Options according to Section 3.5.2 above.

VM	SM	VMx Set Value	Bits									
			9-15	8	7	6	5	4	3	2	1	0
1	SM1-SM6	0x003F	Reserved	0	0	0	1	1	1	1	1	1
2	SM1-SM3	0x0007		0	0	0	0	0	0	1	1	1
3	SM4-SM6	0x0038		0	0	0	1	1	1	0	0	0
4	None	0x0000		0	0	0	0	0	0	0	0	0
5	None	0x0000		0	0	0	0	0	0	0	0	0
6	None	0x0000		0	0	0	0	0	0	0	0	0

Table 4-5 Virtual Meters' Default Settings for the 6I+3RTD Hardware Option

VM	SM	VMx Set Value	Bits									
			9-15	8	7	6	5	4	3	2	1	0
1	SM1-SM9	0x01FF	Reserved	1	1	1	1	1	1	1	1	1
2	SM1-SM3	0x0007		0	0	0	0	0	0	1	1	1
3	SM4-SM6	0x0038		0	0	0	1	1	1	0	0	0
4	SM7-SM9	0x01C0		1	1	1	0	0	0	0	0	0
5	None	0x0000		0	0	0	0	0	0	0	0	0
6	None	0x0000		0	0	0	0	0	0	0	0	0

Table 4-6 Virtual Meters' Default Settings for the 9I Hardware Option

Chapter 5 Modbus Register Map

This chapter provides a complete description of the Modbus register mapping (**Protocol Version V1.0**) for the PMC-509 Multi-circuit, Multifunction Monitor to facilitate the development of 3rd party communications driver for accessing information on the PMC-509. The PMC-509 supports the following Modbus functions:

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

The register addresses are listed as **Offset addresses without the Modbus Address Prefix, 4 for Holding Registers and 0 for Coil Registers**. Therefore, it's not necessary to subtract 400001 for Holding Registers or 000001 for Coil Registers to obtain the starting address number. For a complete Modbus Protocol Specification, please visit <http://www.modbus.org>.

Read General Reference Packet Structure (Function Code 0x14)

Read Reference Request Packet (Master Station to PMC-509)		Read Reference Response Packet (PMC-509 to Master Station)	
Slave Address	1 Byte	Slave Address	1 Byte
Function Code (0x14)	1 Byte	Function Code (0x14)	1 Byte
Byte Count	1 Byte	Byte Count	1 Byte (NxN ₀ +2)
Sub-Req X, Reference Type (0x06)	1 Byte	Sub-Req X, Byte Count	1 Byte (NxN ₀ +1)
Sub-Req X, File Number	2 Bytes	Sub-Req X, Reference Type (0x06)	1 Byte
Sub-Req X, Start Address	2 Bytes	Sub-Req X, Register Data	NxN ₀ Bytes
Sub-Req X, Register Count	2 Bytes	Sub-Req X+1.....	
Sub-Req X+1.....			
Error Check (CRC)	2 Bytes	Error Check (CRC)	2 Bytes

Notes:

- 1) Modbus function code 0x14 is used to access the Data Recorder Log.
- 2) Start Address = Modulo [(Log #X Pointer -1)/ Log #X Depth].
- 3) In the Request Packet, the **File Number** parameter is used to reference which log to read:
 - a) For Data Recorder Logs 1 to 8, **File Number** = 1 to 8
- 4) In the Response Packet, **N** represents the number of logs returned, and **N₀** is the length of a single log:
 - a) For Data Recorder, **N₀** = n*4+6 where n is the number of parameters for a particular Data Recorder

5.1 Basic Measurements

Offset Addresses	Property	Description	Format	Scale/Unit
0000	RO	Va	UINT32	×100, V ²
0002	RO	Vb	UINT32	×100, V
0004	RO	Vc	UINT32	×100, V
0006	RO	Vab	UINT32	×100, V
0008	RO	Vbc	UINT32	×100, V
0010	RO	Vca	UINT32	×100, V
0012	RO	FREQ	UINT16	×100, Hz
0013	RO	SM1 Current	UINT32	×1000, A
0015	RO	SM1 kW ¹	INT32	×1000, kW
0017	RO	SM1 kvar ¹	INT32	×1000, kvar
0019	RO	SM1 kVA ¹	UINT32	×1000, kVA
0021	RO	SM1 PF ¹	INT16	×1000
0022	RO	SM2 Current	UINT32	×1000, A
0024	RO	SM2 kW ¹	INT32	×1000, kW
0026	RO	SM2 kvar ¹	INT32	×1000, kvar
0028	RO	SM2 kVA ¹	UINT32	×1000, kVA

0030	RO	SM2 PF ¹	INT16	×1000
.....				
0058	RO	SM6 Current	UINT32	×1000, A
0060	RO	SM6 kW ¹	INT32	×1000, kW
0062	RO	SM6 kvar ¹	INT32	×1000, kvar
0064	RO	SM6 kVA ¹	UINT32	×1000, kVA
0066	RO	SM6 PF ¹	INT16	×1000
0067	RO	SM7 Current ³	UINT32	×1000, A
0069	RO	SM7 kW ^{1,3}	INT32	×1000, kW
0071	RO	SM7 kvar ^{1,3}	INT32	×1000, kvar
0073	RO	SM7 kVA ^{1,3}	UINT32	×1000, kVA
0075	RO	SM7 PF ^{1,3}	INT16	×1000
0076	RO	SM8 Current ³	UINT32	×1000, A
0078	RO	SM8 kW ^{1,3}	INT32	×1000, kW
0080	RO	SM8 kvar ^{1,3}	INT32	×1000, kvar
0082	RO	SM8 kVA ^{1,3}	UINT32	×1000, kVA
0084	RO	SM8 PF ^{1,3}	INT16	×1000
0085	RO	SM9 Current ³	UINT32	×1000, A
0087	RO	SM9 kW ^{1,3}	INT32	×1000, kW
0089	RO	SM9 kvar ^{1,3}	INT32	×1000, kvar
0091	RO	SM9 kVA ^{1,3}	UINT32	×1000, kVA
0093	RO	SM9 PF ^{1,3}	INT16	×1000
0094	RO	RTD1 Temperature ⁴	INT16	×10, °C
0095	RO	RTD2 Temperature ⁴	INT16	×10, °C
0096	RO	RTD3 Temperature ⁴	INT16	×10, °C
0097	RO	Alarm 1 ⁵	UINT16	
0098	RO	Alarm 2 ⁵	UINT16	
0099	RO	DI Status ^{1,6}	UNIT16	
0100	RO	SOE Pointer ^{1,7}	UINT32	
0102	RO	DR #1 Pointer	UINT32	
0104	RO	DR #2 Pointer	UINT32	
0106	RO	DR #3 Pointer	UINT32	
0108	RO	DR #4 Pointer	UINT32	
0110	RO	DR #5 Pointer	UINT32	
0112	RO	DR #6 Pointer	UINT32	
0114	RO	DR #7 Pointer	UINT32	
0116	RO	DR #8 Pointer	UINT32	
0118-0119		Reserved		
120	RO	VM1 $\sum$ kW ¹	INT32	×1000, kW
122	RO	VM1 $\sum$ kvar ¹	INT32	×1000, kvar
124	RO	VM1 $\sum$ kVA ¹	UINT32	×1000, kVA
126	RO	VM1 $\sum$ PF ¹	INT16	×1000
127	RO	VM2 $\sum$ kW ¹	INT32	×1000, kW
129	RO	VM2 $\sum$ kvar ¹	INT32	×1000, kvar
131	RO	VM2 $\sum$ kVA ¹	UINT32	×1000, kVA
133	RO	VM2 $\sum$ PF ¹	INT16	×1000
.....				
155	RO	VM6 $\sum$ kW ¹	INT32	×1000, kW
157	RO	VM6 $\sum$ kvar ¹	INT32	×1000, kvar
159	RO	VM6 $\sum$ kVA ¹	UINT32	×1000, kVA
161	RO	VM6 $\sum$ PF ¹	INT16	×1000

Table 5-1 Basic Measurements

Notes:

- 1) When the **Software Option** is MDI, the kW, kvars, kVAs and PFs of the SMs and VMs as well as the SOE Pointer are reserved.
- 2) “×100, V” indicates the value returned in the register is 100 times the actual engineering value with the unit V (voltage). For example, if a register contains a value 22003, the actual value is 22003/100=220.03V.
- 3) When the **Hardware Option** is 6I+3RTD, all registers of SM7, SM8 and SM9 are reserved.
- 4) When the **Hardware Option** is 9I, all registers associated with RTD1, RTD2 and RTD3 are reserved.

- 5) The Alarm register indicates the various alarm states with a bit value of 1 meaning active and 0 meaning inactive. The following table illustrates the details of the Alarm 1 and Alarm 2 register.

Bit	Alarm 1 Event	Bit	Alarm 1 Event
B0	Setpoint #1	B8	Setpoint #9
B1	Setpoint #2	B9	Setpoint #10
B2	Setpoint #3	B10	Setpoint #11
B3	Setpoint #4	B11	Setpoint #12
B4	Setpoint #5	B12	Setpoint #13
B5	Setpoint #6	B13	Setpoint #14
B6	Setpoint #7	B14	Setpoint #15
B7	Setpoint #8	B15	Setpoint #16

Table 5-2 Alarm 1 Register (0097)

Bit	Alarm 1 Event	Bit	Alarm 1 Event
B0	Setpoint #17	B6	Setpoint #23
B1	Setpoint #18	B7	Setpoint #24
B2	Setpoint #19	B8	Setpoint #25
B3	Setpoint #20	B9	Setpoint #26
B4	Setpoint #21	B10	Setpoint #27
B5	Setpoint #22	B11-B15	Reserved

Table 5-3 Alarm 2 Register (0098)

- 6) For the **DI Status** register, the bit values of B0 to B3 represent the states of DI1 to DI4, respectively, with “1” meaning active (closed) and “0” meaning inactive (open).
- 7) The range of the **SOE Pointer** is between 0 and 0xFFFFFFFF. The **SOE Pointer** is incremented by one for every event generated and will roll over to 0 if its current value is 0xFFFFFFFF. Since the **SOE Pointer** is a 32-bit value and the SOE Log capacity is relatively small with only 64 events in the PMC-509, an assumption has been made that the **SOE pointer** will never roll over. If a **Clear SOE** is performed from the front panel or via communications, the **SOE Pointer** will be reset to zero and then immediately incremented by one with a new “Clear SOE via Front Panel” or “Clear SOE via Communications” event. Therefore, any 3rd party software should assume that a **Clear SOE** action has been performed if it sees the **SOE Pointer** rolling over to one or to a value that is smaller than its own pointer. In this case, the new **SOE Pointer** also indicates the number of events in the SOE Log if it is less than 64. Otherwise, there will always be 64 events in the SOE Log.

5.2 Energy Measurements (MFM Version)

The Energy registers have a maximum/minimum value of $\pm 99,999,999.9$ and will roll over to zero automatically when it is reached.

Offset Addresses	Property	Description	Format	Scale/Unit
0300	RW	SM1 kWh Import	UINT32	x10, kWh
0302	RW	SM2 kWh Import	UINT32	x10, kWh
0304	RW	SM3 kWh Import	UINT32	x10, kWh
0306	RW	SM4 kWh Import	UINT32	x10, kWh
0308	RW	SM5 kWh Import	UINT32	x10, kWh
0310	RW	SM6 kWh Import	UINT32	x10, kWh
0312	RW	SM7 kWh Import ¹	UINT32	x10, kWh
0314	RW	SM8 kWh Import ¹	UINT32	x10, kWh
0316	RW	SM9 kWh Import ¹	UINT32	x10, kWh
0318	RW	SM1 kvarh Import	UINT32	x10, kvarh
0320	RW	SM2 kvarh Import	UINT32	x10, kvarh
0322	RW	SM3 kvarh Import	UINT32	x10, kvarh
0324	RW	SM4 kvarh Import	UINT32	x10, kvarh

0326	RW	SM5 kvarh Import	UINT32	x10, kvarh
0328	RW	SM6 kvarh Import	UINT32	x10, kvarh
0330	RW	SM7 kvarh Import ¹	UINT32	x10, kvarh
0332	RW	SM8 kvarh Import ¹	UINT32	x10, kvarh
0334	RW	SM9 kvarh Import ¹	UINT32	x10, kvarh
0336	RW	SM1 kWh Export	UINT32	x10, kWh
0338	RW	SM2 kWh Export	UINT32	x10, kWh
0340	RW	SM3 kWh Export	UINT32	x10, kWh
0342	RW	SM4 kWh Export	UINT32	x10, kWh
0344	RW	SM5 kWh Export	UINT32	x10, kWh
0346	RW	SM6 kWh Export	UINT32	x10, kWh
0348	RW	SM7 kWh Export ¹	UINT32	x10, kWh
0350	RW	SM8 kWh Export ¹	UINT32	x10, kWh
0352	RW	SM9 kWh Export ¹	UINT32	x10, kWh
0354	RW	SM1 kvarh Export	UINT32	x10, kvarh
0356	RW	SM2 kvarh Export	UINT32	x10, kvarh
0358	RW	SM3 kvarh Export	UINT32	x10, kvarh
0360	RW	SM4 kvarh Export	UINT32	x10, kvarh
0362	RW	SM5 kvarh Export	UINT32	x10, kvarh
0364	RW	SM6 kvarh Export	UINT32	x10, kvarh
0366	RW	SM7 kvarh Export ¹	UINT32	x10, kvarh
0368	RW	SM8 kvarh Export ¹	UINT32	x10, kvarh
0370	RW	SM9 kvarh Export ¹	UINT32	x10, kvarh
0372	RW	SM1 kVAh	UINT32	x10, kVAh
0374	RW	SM2 kVAh	UINT32	x10, kVAh
0376	RW	SM3 kVAh	UINT32	x10, kVAh
0378	RW	SM4 kVAh	UINT32	x10, kVAh
0380	RW	SM5 kVAh	UINT32	x10, kVAh
0382	RW	SM6 kVAh	UINT32	x10, kVAh
0384	RW	SM7 kVAh ¹	UINT32	x10, kVAh
0386	RW	SM8 kVAh ¹	UINT32	x10, kVAh
0388	RW	SM9 kVAh ¹	UINT32	x10, kVAh
0390	RW	VM1 kWh Import	UINT32	x10, kWh
0392	RW	VM2 kWh Import	UINT32	x10, kWh
0394	RW	VM3 kWh Import	UINT32	x10, kWh
0396	RW	VM4 kWh Import	UINT32	x10, kWh
0398	RW	VM5 kWh Import	UINT32	x10, kWh
0400	RW	VM6 kWh Import	UINT32	x10, kWh
0402	RW	VM1 kvarh Import	UINT32	x10, kvarh
0404	RW	VM2 kvarh Import	UINT32	x10, kvarh
0406	RW	VM3 kvarh Import	UINT32	x10, kvarh
0408	RW	VM4 kvarh Import	UINT32	x10, kvarh
0410	RW	VM5 kvarh Import	UINT32	x10, kvarh
0412	RW	VM6 kvarh Import	UINT32	x10, kvarh
0414	RW	VM1 kWh Export	UINT32	x10, kWh
0416	RW	VM2 kWh Export	UINT32	x10, kWh
0418	RW	VM3 kWh Export	UINT32	x10, kWh
0420	RW	VM4 kWh Export	UINT32	x10, kWh
0422	RW	VM5 kWh Export	UINT32	x10, kWh
0424	RW	VM6 kWh Export	UINT32	x10, kWh
0426	RW	VM1 kvarh Export	UINT32	x10, kvarh
0428	RW	VM2 kvarh Export	UINT32	x10, kvarh
0430	RW	VM3 kvarh Export	UINT32	x10, kvarh
0432	RW	VM4 kvarh Export	UINT32	x10, kvarh
0434	RW	VM5 kvarh Export	UINT32	x10, kvarh
0436	RW	VM6 kvarh Export	UINT32	x10, kvarh
0438	RW	VM1 kVAh	UINT32	x10, kVAh
0440	RW	VM2 kVAh	UINT32	x10, kVAh
0442	RW	VM3 kVAh	UINT32	x10, kVAh
0444	RW	VM4 kVAh	UINT32	x10, kVAh
0446	RW	VM5 kVAh	UINT32	x10, kVAh
0448	RW	VM6 kVAh	UINT32	x10, kVAh

Table 5-4 Energy Measurements

Notes:

- 1) When the **Hardware Option** is 6I+3RTD, all registers of SM7, SM8 and SM9 are reserved.

5.3 Harmonic Measurements (MFM Version)

The Harmonics data (THD) returned is 10000 times the actual value. For example, if the register contains a value of 1031, the actual harmonic value is 10.31% (0.1031).

Offset Addresses	Property	Description	Format	Scale/Unit
0700	RO	Va THD	UINT16	×10000
0701	RO	Vb THD	UINT16	×10000
0702	RO	Vc THD	UINT16	×10000
0703	RO	SM1 Current THD	UINT16	×10000
0704	RO	SM2 Current THD	UINT16	×10000
0705	RO	SM3 Current THD	UINT16	×10000
0706	RO	SM4 Current THD	UINT16	×10000
0707	RO	SM5 Current THD	UINT16	×10000
0708	RO	SM6 Current THD	UINT16	×10000
0709	RO	SM7 Current THD ¹	UINT16	×10000
0710	RO	SM8 Current THD ¹	UINT16	×10000
0711	RO	SM9 Current THD ¹	UINT16	×10000

Table 5-5 Harmonics Measurements

Notes:

- 1) When the **Hardware Option** is 6I+3RTD, all registers of SM7, SM8 and SM9 are reserved.

5.4 Demand

5.4.1 Real-time Demand

Offset Addresses	Property	Description	Format	Scale/Unit
1000	RO	SM1 Current Demand	INT32	×1000, A
1002	RO	SM1 kW Demand ^{1, 2}	INT32	×1000, kW
1004	RO	SM1 kvar Demand ^{1, 2}	INT32	×1000, kvar
1006	RO	SM1 kVA Demand ^{1, 2}	INT32	×1000, kVA
1008	RO	SM2 Current Demand	INT32	×1000, A
1010	RO	SM2 kW Demand ^{1, 2}	INT32	×1000, kW
1012	RO	SM2 kvar Demand ^{1, 2}	INT32	×1000, kvar
1014	RO	SM2 kVA Demand ^{1, 2}	INT32	×1000, kVA
1016	RO	SM3 Current Demand	INT32	×1000, A
1018	RO	SM3 kW Demand ^{1, 2}	INT32	×1000, kW
1020	RO	SM3 kvar Demand ^{1, 2}	INT32	×1000, kvar
1022	RO	SM3 kVA Demand ^{1, 2}	INT32	×1000, kVA
1024	RO	SM4 Current Demand	INT32	×1000, A
1026	RO	SM4 kW Demand ^{1, 2}	INT32	×1000, kW
1028	RO	SM4 kvar Demand ^{1, 2}	INT32	×1000, kvar
1030	RO	SM4 kVA Demand ^{1, 2}	INT32	×1000, kVA
1032	RO	SM5 Current Demand	INT32	×1000, A
1034	RO	SM5 kW Demand ^{1, 2}	INT32	×1000, kW
1036	RO	SM5 kvar Demand ^{1, 2}	INT32	×1000, kvar
1038	RO	SM5 kVA Demand ^{1, 2}	INT32	×1000, kVA
1040	RO	SM6 Current Demand	INT32	×1000, A
1042	RO	SM6 kW Demand ^{1, 2}	INT32	×1000, kW
1044	RO	SM6 kvar Demand ^{1, 2}	INT32	×1000, kvar
1046	RO	SM6 kVA Demand ^{1, 2}	INT32	×1000, kVA
1048	RO	SM7 Current Demand ³	INT32	×1000, A
1050	RO	SM7 kW Demand ^{1, 2, 3}	INT32	×1000, kW
1052	RO	SM7 kvar Demand ^{1, 2, 3}	INT32	×1000, kvar
1054	RO	SM7 kVA Demand ^{1, 2, 3}	INT32	×1000, kVA
1056	RO	SM8 Current Demand ³	INT32	×1000, A

1058	RO	SM8 kW Demand ^{1, 2, 3}	INT32	x1000, kW
1060	RO	SM8 kvar Demand ^{1, 2, 3}	INT32	x1000, kvar
1062	RO	SM8 kVA Demand ^{1, 2, 3}	INT32	x1000, kVA
1064	RO	SM9 Current Demand ³	INT32	x1000, A
1066	RO	SM9 kW Demand ^{1, 2, 3}	INT32	x1000, kW
1068	RO	SM9 kvar Demand ^{1, 2, 3}	INT32	x1000, kvar
1070	RO	SM9 kVA Demand ^{1, 2, 3}	INT32	x1000, kVA
1072	RO	RTD1 Temperature Demand ⁴	INT32	x10, °C
1074	RO	RTD2 Temperature Demand ⁴	INT32	x10, °C
1076	RO	RTD3 Temperature Demand ⁴	INT32	x10, °C
1078	RO	VM1 Σ kW Demand ^{1, 2}	INT32	x1000, kW
1080	RO	VM1 Σ kvar Demand ^{1, 2}	INT32	x1000, kvar
1082	RO	VM1 Σ kVA Demand ^{1, 2}	UINT32	x1000, kVA
1084	RO	VM2 Σ kW Demand ^{1, 2}	INT32	x1000, kW
1086	RO	VM2 Σ kvar Demand ^{1, 2}	INT32	x1000, kvar
1088	RO	VM2 Σ kVA Demand ^{1, 2}	UINT32	x1000, kVA
1090	RO	VM3 Σ kW Demand ^{1, 2}	INT32	x1000, kW
1092	RO	VM3 Σ kvar Demand ^{1, 2}	INT32	x1000, kvar
1094	RO	VM3 Σ kVA Demand ^{1, 2}	UINT32	x1000, kVA
1096	RO	VM4 Σ kW Demand ^{1, 2}	INT32	x1000, kW
1098	RO	VM4 Σ kvar Demand ^{1, 2}	INT32	x1000, kvar
1100	RO	VM4 Σ kVA Demand ^{1, 2}	UINT32	x1000, kVA
1102	RO	VM5 Σ kW Demand ^{1, 2}	INT32	x1000, kW
1104	RO	VM5 Σ kvar Demand ^{1, 2}	INT32	x1000, kvar
1106	RO	VM5 Σ kVA Demand ^{1, 2}	UINT32	x1000, kVA
1108	RO	VM6 Σ kW Demand ^{1, 2}	INT32	x1000, kW
1110	RO	VM6 Σ kvar Demand ^{1, 2}	INT32	x1000, kvar
1112	RO	VM6 Σ kVA Demand ^{1, 2}	UINT32	x1000, kVA

Table 5-6 Real-time Demand

Notes:

- 1) When the **Software Option** is MDI, the Demands for kW, kvar and kVA of the SMs and VMs are reserved.
- 2) The PMC-509 only supports Import (positive) Demands.
- 3) When the **Hardware Option** is 6I+3RTD, all registers of SM7, SM8 and SM9 are reserved.
- 4) When the **Hardware Option** is 9I, all registers associated with RTD1, RTD2 and RTD3 are reserved.

5.4.2 Maximum Demand

Offset Addresses	Property	Description	Format	Scale/Unit
1400	RO	SM1 Current Demand Max	See Section 5.11.1 Max Demand Data Structure	x1000, A
1405	RO	SM2 Current Demand Max		x1000, A
1410	RO	SM3 Current Demand Max		x1000, A
1415	RO	SM4 Current Demand Max		x1000, A
1420	RO	SM5 Current Demand Max		x1000, A
1425	RO	SM6 Current Demand Max		x1000, A
1430	RO	SM7 Current Demand Max ¹		x1000, A
1435	RO	SM8 Current Demand Max ¹		x1000, A
1440	RO	SM9 Current Demand Max ¹		x1000, A
1445	RO	RTD1 Demand Max ²		x10, °C
1450	RO	RTD2 Demand Max ²		x10, °C
1455	RO	RTD3 Demand Max ²		x10, °C
1460	RO	VM1 Σ kW Demand Max ³		x1000, kW
1465	RO	VM1 Σ kvar Demand Max ³		x1000, kvar
1470	RO	VM1 Σ kVA Demand Max ³		x1000, kVA
1475	RO	VM2 Σ kW Demand Max ³		x1000, kW
1480	RO	VM2 Σ kvar Demand Max ³		x1000, kvar
1485	RO	VM2 Σ kVA Demand Max ³		x1000, kVA
1490	RO	VM3 Σ kW Demand Max ³		x1000, kW
1495	RO	VM3 Σ kvar Demand Max ³		x1000, kvar
1500	RO	VM3 Σ kVA Demand Max ³		x1000, kVA
1505	RO	VM4 Σ kW Demand Max ³		x1000, kW

1510	RO	VM4 Σ kvar Demand Max ³	×1000, kvar
1515	RO	VM4 Σ kVA Demand Max ³	×1000, kVA
1520	RO	VM5 Σ kW Demand Max ³	×1000, kW
1525	RO	VM5 Σ kvar Demand Max ³	×1000, kvar
1530	RO	VM5 Σ kVA Demand Max ³	×1000, kVA
1535	RO	VM6 Σ kW Demand Max ³	×1000, kW
1540	RO	VM6 Σ kvar Demand Max ³	×1000, kvar
1545	RO	VM6 Σ kVA Demand Max ³	×1000, kVA
1550	RO	SM1 kW Demand Max ³	×1000, kW
1555	RO	SM1 kvar Demand Max ³	×1000, kvar
1560	RO	SM1 kVA Demand Max ³	×1000, kVA
1565	RO	SM2 kW Demand Max ³	×1000, kW
1570	RO	SM2 kvar Demand Max ³	×1000, kvar
1575	RO	SM2 kVA Demand Max ³	×1000, kVA
1580	RO	SM3 kW Demand Max ³	×1000, kW
1585	RO	SM3 kvar Demand Max ³	×1000, kvar
1590	RO	SM3 kVA Demand Max ³	×1000, kVA
1595	RO	SM4 kW Demand Max ³	×1000, kW
1600	RO	SM4 kvar Demand Max ³	×1000, kvar
1605	RO	SM4 kVA Demand Max ³	×1000, kVA
1610	RO	SM5 kW Demand Max ³	×1000, kW
1615	RO	SM5 kvar Demand Max ³	×1000, kvar
1620	RO	SM5 kVA Demand Max ³	×1000, kVA
1625	RO	SM6 kW Demand Max ³	×1000, kW
1630	RO	SM6 kvar Demand Max ³	×1000, kvar
1635	RO	SM6 kVA Demand Max ³	×1000, kVA
1640	RO	SM7 kW Demand Max ^{1,3}	×1000, kW
1645	RO	SM7 kvar Demand Max ^{1,3}	×1000, kvar
1650	RO	SM7 kVA Demand Max ^{1,3}	×1000, kVA
1655	RO	SM8 kW Demand Max ^{1,3}	×1000, kW
1660	RO	SM8 kvar Demand Max ^{1,3}	×1000, kvar
1665	RO	SM8 kVA Demand Max ^{1,3}	×1000, kVA
1670	RO	SM9 kW Demand Max ^{1,3}	×1000, kW
1675	RO	SM9 kvar Demand Max ^{1,3}	×1000, kvar
1680	RO	SM9 kVA Demand Max ^{1,3}	×1000, kVA

Table 5-7 Max Demand

Notes:

- 1) When the **Hardware Option** is 6I+3RTD, all registers of SM7, SM8 and SM9 are reserved.
- 2) When the **Hardware Option** is 9I, all registers associated with RTD1, RTD2 and RTD3 are reserved.
- 3) When the **Software Option** is MDI, the Maximum Demands for kW, kvar, kVA of the SMs and VMs are reserved.

5.5 Setup Parameters

Offset Addresses	Property	Description	Format	Range/Options
6000	RW	Unit ID	UINT16	1 to 247 (6I+3RTD: Default = 100) (9I: Default = 101)
6001	RW	Baud rate	UINT16	0=1200 1=2400 2=4800 3=9600* 4=19200
6002	RW	Comm. Config.	UINT16	0=8N2 1=8O1 2=8E1* 3=8N1 4=8O2 5=8E2
6003	RW	RTD1 Type ^{1,2}	UINT16	0=Reserved 1*= Pt100
6004	RW	RTD2 Type ^{1,2}	UINT16	
6005	RW	RTD3 Type ^{1,2}	UINT16	

6006	RW	Demand Period	UINT16	1 to 99 (min) (Default = 10min)
6007	RW	Number of Sliding Windows	UINT16	1* to 15
6008	RW	Power Factor Convention ^{3,9}	UINT16	0=IEC* 1=IEEE 2=-IEEE
6009	RW	kVA Calculation ^{4,9}	UINT16	0=Vector* 1=Scalar
6010	RW	PT Ratio ^{5,9}	UINT16	1* to 2200
6011	RW	Wiring Mode ⁶	UINT16	0=WYE* 1=DELTA 2=DEMO
6012	RW	SM1 CT Ratio ⁵	UINT16	Range: 1 to 6000 (5A input) 1 to 30000 (1A input) Defaults: 6I+3RTD: SM1-3 CT Ratio = 320 SM4-6 CT Ratio = 80 9I: SM1-9 CT Ratio = 80
6013	RW	SM2 CT Ratio ⁵	UINT16	
6014	RW	SM3 CT Ratio ⁵	UINT16	
6015	RW	SM4 CT Ratio ⁵	UINT16	
6016	RW	SM5 CT Ratio ⁵	UINT16	
6017	RW	SM6 CT Ratio ⁵	UINT16	
6018	RW	SM7 CT Ratio ⁵	UINT16	
6019	RW	SM8 CT Ratio ⁵	UINT16	
6020	RW	SM9 CT Ratio ⁵	UINT16	
6021	RW	SM1 phase Set ⁹	UINT16	0=None,1*=VA,2=VB,3=VC
6022	RW	SM2 phase Set ⁹	UINT16	0=None,1=VA,2*=VB,3=VC
6023	RW	SM3 phase Set ⁹	UINT16	0=None,1=VA,2=VB,3*=VC
6024	RW	SM4 phase Set ⁹	UINT16	0=None,1*=VA,2=VB,3=VC
6025	RW	SM5 phase Set ⁹	UINT16	0=None,1=VA,2*=VB,3=VC
6026	RW	SM6 phase Set ⁹	UINT16	0=None,1=VA,2=VB,3*=VC
6027	WO	SM7 phase Set ⁹	UINT16	0=None,1*=VA,2=VB,3=VC
6028	RW	SM8 phase Set ⁹	UINT16	0=None,1=VA,2*=VB,3=VC
6029	WO	SM9 phase Set ⁹	UINT16	0=None,1=VA,2=VB,3*=VC
6030	RW	SM CT Polarity ⁷	UINT16	0=Normal*,1=Reverse
6031	RW	VM1 Set ⁸	UINT16	See Section 4.8.1 for a complete description of the VMx Set Setup Registers
6032	RW	VM2 Set ⁸	UINT16	
6033	RW	VM3 Set ⁸	UINT16	
6034	RW	VM4 Set ⁸	UINT16	
6035	RW	VM5 Set ⁸	UINT16	
6036	RW	VM6 Set ⁸	UINT16	
6037-6049	RW	Reserved		
6050-6058	RW	Setpoint #1	Setpoint Data Structure	See Section 5.11.2 Control Setpoint Data Structure
6059-6067	RW	Setpoint #2		
6068-6076	RW	Setpoint #3		
6077-6085	RW	Setpoint #4		
6086-6094	RW	Setpoint #5		
6095-6103	RW	Setpoint #6		
6104-6112	RW	Setpoint #7		
6113-6121	RW	Setpoint #8		
6122-6130	RW	Setpoint #9		
6131-6139	RW	Setpoint #10		
6140-6148	RW	Setpoint #11		
6149-6157	RW	Setpoint #12		
6158-6166	RW	Setpoint #13		
6167-6175	RW	Setpoint #14		
6176-6184	RW	Setpoint #15		
6185-6193	RW	Setpoint #16		
6194-6202	RW	Setpoint #17		
6203-6211	RW	Setpoint #18		
6212-6220	RW	Setpoint #19		
6221-6229	RW	Setpoint #20		
6230-6238	RW	Setpoint #21		
6239-6247	RW	Setpoint #22		
6248-6256	RW	Setpoint #23		
6257-6265	RW	Setpoint #24		
6266-6274	RW	Setpoint #25		
6275-6283	RW	Setpoint #26		
6284-6292	RW	Setpoint #27		

* Default

Table 5-8 Setup Parameters

Notes:

- 1) When the **Hardware Option** is 9I, all Setup Registers associated with RTD1, RTD2 and RTD3 are reserved.
- 2) When the RTD Type is set as 0 (reserved), the RTD Inputs will not detect if a sensor is connected.
- 3) Power Factor Convention

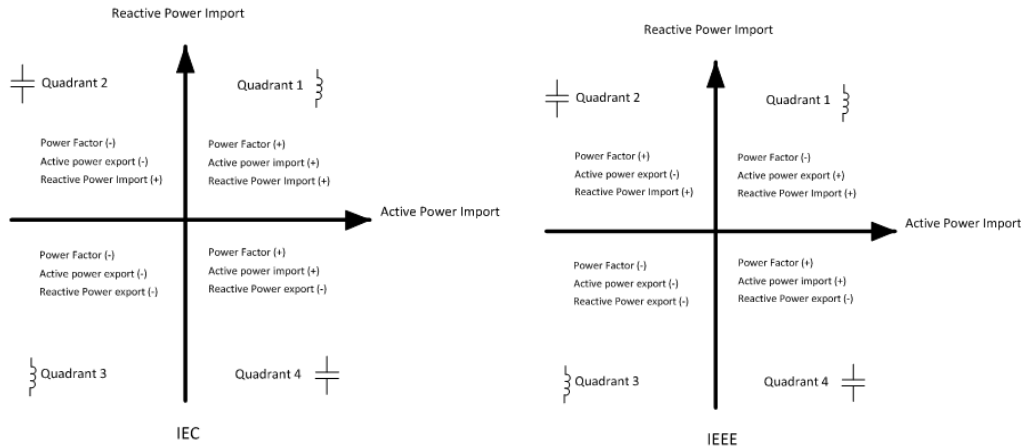


Figure 5-1 P.F. Convention

- 4) There are two ways to calculate kVA:

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

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

- 5) PT Ratio × CT Ratio × Rated Phase Voltage Input × Rated Current input × √3 must be less than 790,000,000.
- 6) When the **Wiring Mode** is Delta, the per phase line-to-neutral voltages have no meaning, and their registers are reserved.
- 7) The following table illustrates the bit map of the SM CT Polarity register. The bit value of 0 means the Polarity is Normal while the bit value of 1 means the Polarity is Reverse.

B15-B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Reserved	SM9	SM8	SM7	SM6	SM5	SM4	SM3	SM2	SM1

Table 5-9 SM Current Polarity Register (6030)

- 8) When the **Software Option** is MDI, the Power Factor Convention, PT Ratio, and all setup registers associated with SMs and VMs are reserved.

5.6 Maintenance Registers

Offset Addresses	Property	Description	Format	Note
6500	RW	Backlight Time-out ¹	UINT16	0 to 60 (min) (Default=3min)
6501	RW	LCD Contrast	UINT16	0 to 9 (Default=5)
6502	RW	Default Screen ²	UINT16	0=Auto Scroll 1=Fixed Display
6503	RW	Date Format	UINT16	0=YY/MM/DD 1=DD/MM/YY 2=MM/DD/YY
6504-6509	RW	Reserved		
6510	WO	Clear Energy	UINT16	Writing "0xFF00" to the register clears all energy registers
6511	WO	Clear Max Demand Log	UINT16	Writing "0xFF00" to the register clears the Max Demand Log
6512	WO	Clear SOE	UINT16	Writing "0xFF00" to the register clears the SOE Log

6513	WO	Clear DR #1	UINT16	Writing "0xFF00" to the register clears the respective Data Recorder
6514	WO	Clear DR #2	UINT16	
6515	WO	Clear DR #3	UINT16	
6516	WO	Clear DR #4	UINT16	
6517	WO	Clear DR #5	UINT16	
6518	WO	Clear DR #6	UINT16	
6519	WO	Clear DR #7	UINT16	
6520	WO	Clear DR #8	UINT16	

Table 5-11 Maintenance Registers

Notes:

- 1) The Backlight Time-out can be set from 0 to 60 minutes. A zero (0) value indicates that the backlight time-out is disabled.
- 2) When the **Default Screen** is **Auto Scroll**, the display will automatically scroll to the next measurement page every 4 seconds. When the **Default Screen** is **Fixed**, automatic scrolling is disabled.

5.7 Data Recorder Setup Parameters

5.7.1 Data Recorder Setup Parameters

Offset Addresses	Property	Description	Format
7000-7022	RW	Data Recorder #1	See Section 5.11.3 DR Setup Parameters Data Structure
7023-7045	RW	Data Recorder #2	
7046-7068	RW	Data Recorder #3	
7069-7091	RW	Data Recorder #4	
7092-7114	RW	Data Recorder #5	
7115-7137	RW	Data Recorder #6	
7138-7160	RW	Data Recorder #7	
7161-7183	RW	Data Recorder #8	

Table 5-12 Data Recorder Setup Parameters

5.7.2 Data Recorder Setup Data Structure

Offset	Property	Description	Format	Range/Options
+0	RW	Triggered Mode ^{1,6}	UINT16	0=Disabled 1=Triggered by Timer 2=Triggered by Setpoint
+1	RW	Recording Depth ^{2,6}	UINT16	0 to 65535
+2	RW	Recording Interval ⁶	UINT32	1 to 345600 (seconds)
+4	RW	Recording Offset ^{3,6}	UINT32	0 to 43200 (seconds)
+6	RW	Number of Parameters ^{4,6}	UINT16	0 to 16
+7	RW	Parameter 1 ⁵	UINT16	0 to 115
+8	RW	Parameter 2 ⁵	UINT16	0 to 115
+9	RW	Parameter 3 ⁵	UINT16	0 to 115
+10	RW	Parameter 4 ⁵	UINT16	0 to 115
+11	RW	Parameter 5 ⁵	UINT16	0 to 115
+12	RW	Parameter 6 ⁵	UINT16	0 to 115
+13	RW	Parameter 7 ⁵	UINT16	0 to 115
+14	RW	Parameter 8 ⁵	UINT16	0 to 115
+15	RW	Parameter 9 ⁵	UINT16	0 to 115
+16	RW	Parameter 10 ⁵	UINT16	0 to 115
+17	RW	Parameter 11 ⁵	UINT16	0 to 115
+18	RW	Parameter 12 ⁵	UINT16	0 to 115
+19	RW	Parameter 13 ⁵	UINT16	0 to 115
+20	RW	Parameter 14 ⁵	UINT16	0 to 115
+21	RW	Parameter 15 ⁵	UINT16	0 to 115
+22	RW	Parameter 16 ⁵	UINT16	0 to 115

Table 5-13 DR Setup Parameters Data Structure

Notes:

- 1) The Data Recorder can be triggered by Setpoints (**Triggered by Setpoint**), or on a time basis

using the meter clock (**Triggered by Timer**).

For **Triggered by Setpoint**, the Data Recorder starts recording when the setpoint becomes active and stops when the Setpoint becomes inactive.

- 2) If the “**Recording Depth**” is set to “**0**”, the Data Recorder will be disabled.
- 3) The **Recording Offset** parameter can be used to delay the recording by a fixed time from the **Recording Interval**. For example, if the **Recording Interval** parameter is set to 3600 (hourly) and the **Recording Offset** parameter is set to 300 (5 minutes), the recording will take place at 5 minutes after the hour every hour, i.e. 00:05, 01:05, 02:05...etc. The programmed value of the **Recording Offset** parameter should be less than that of the **Recording Interval** parameter.
- 4) If the “**Number of parameters**” is set to “**0**”, the Data Recorder will be disabled.
- 5) The Data Recorder can record any one of the 116 parameters documented in **Appendix A Data Recorder Parameters**.
- 6) Modifying “**Recording Mode**”, “**Recording Depth**”, “**Recording Interval**”, “**Recording Offset**”, “**Number of Parameters**” and “**Parameters 1 to 16**” will clear the DRx Log.
- 7) The number of Data Recorder is a dynamic variable, but the sum of all space can’t exceed 8M.

5.8 SOE Log (MFM Version)

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

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

Offset Addresses	Property	Description	Format
10000-10007	RO	Event 1	See Section 5.11.4 SOE LOG Data Structure
10008-10015	RO	Event 2	
10016-10023	RO	Event 3	
10024-10031	RO	Event 4	
10032-10039	RO	Event 5	
10040-10047	RO	Event 6	
10048-10055	RO	Event 7	
10056-10063	RO	Event 8	
10064-10071	RO	Event 9	
10072-10079	RO	Event 10	
10080-10087	RO	Event 11	
10088-10095	RO	Event 12	
.....			
10504-10511	RO	Event 64	

Table 5-14 SOE Log

5.9 Time

There are two sets of Time registers supported by the PMC-509 - Year/Month/Day/Hour/Minute/Second (Registers # 60000 to 60002 for 6-digit addressing and Registers # 9000 to 9002 for 5-digit addressing) and UNIX Time (Registers # 60004 to 60005 for 6-digit addressing and Registers # 9004 to 9005 for 5-digit addressing). When sending time to the PMC-509 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 (9000 to 9004 for 5-digit addressing) 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 (9004) where the time specified in registers 60000 to 60003 (9000-9003 for 5-digit addressing) will be ignored. Writing to the Millisecond register 60003 (9003 for 5-digit addressing) 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.

Offset Addresses		Property	Description	Format	Note
6-digit	5-digit				
60000	9000	RW	High-order Byte: Year	UINT16	0-99 (Year-2000)
			Low-order Byte: Month		1 to 12
60001	9001	RW	High-order Byte: Day	UINT16	1 to 31
			Low-order Byte: Hour		0 to 23
60002	9002	RW	High-order Byte: Minute	UINT16	0 to 59
			Low-order Byte: Second		0 to 59
60003	9003	RW	Millisecond	UINT16	0 to 999
60004-60005	9004-9005	RW	UNIX Time	UINT32	(0 to 4102444799) This time shows the number of seconds since 00:00:00 January 1, 1970

Table 5-15 Time Registers

5.10 Meter Information

Offset Address		Property	Description	Format	Note
6-digit	5-digit				
60200-60219	9800-9819	RO	Meter model ¹	UINT16	See Table 5-17
60220	9820	RO	Firmware Version	UINT16	e.g. 10000 means V1.00.00
60221	9821	RO	Protocol Version	UINT16	e.g. 20 means V2.0
60222	9822	RO	Firmware Update Date: Year-2000	UINT16	e.g. 080110 means January 10, 2008
60223	9823	RO	Firmware Update Date: Month	UINT16	
60224	9824	RO	Firmware Update Date: Day	UINT16	
60225	9825	RO	Serial Number: XX(Year-2000) - XX(Month) - XX(Lot Number) - XXXX(Meter Number)	UINT32	e.g. 0908471895 means that this meter was the 1895 th meter manufactured in Lot 47 of August 2009
60227-60228	9827-9828	RO	Reserved	UINT16	
60229	9829	RO	Feature Number	UINT16	0=3V+6I+3RTD 1=3V+9I

Table 5-16 Device Information

Note:

- 1) The Meter Model appears in registers with offset addresses 60200 to 60219 (or 9800 to 9819 for 5-digit addressing) and contains the ASCII encoding of the string “PMC-509” as shown in the following table.

Offset Address		Value(Hex)	ASCII
6-digit	5-digit		
60200	9800	0x50	P
60201	9801	0x4D	M
60202	9802	0x43	C
60203	9803	0x2D	-
60204	9804	0x35	5
60205	9805	0x30	0
60206	9806	0x39	9
60207-60219	9807-9819	0x20	Null

Table 5-17 ASCII Encoding of “PMC-509”

5.11 Data Format

5.11.1 Max Demand Data Structure

Offset	Property	Description	Format	Note
+0	RO	High-order Byte: Max Demand	INT32	/
+1	RO	Low-order Byte: Max Demand	INT32	/
+2	RO	High-order Byte: Year	UINT16	1 to 99 (Year-2000)
		Low-order Byte: Month		1 to 12
+3	RO	High-order Byte: Day	UINT16	1 to 28/29/30/31
		Low-order Byte: Hour		0 to 23
+4	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59

Table 5-18 Max Demand Data Structure

5.11.2 Control Setpoint Data Structure

Offset	Property	Description	Format	Range/Options
+0	RW	Type	UINT16	0*=Disabled 1=Over Setpoint 2=Under Setpoint
+1	RW	Parameter ¹	UINT16	0* to 85
+2	RW	Active Limit	UINT32	
+4	RW	Inactive Limit	UINT32	
+6	RW	Active Delay	UINT16	0* to 9999 (second)
+7	RW	Inactive Delay	UINT16	0* to 9999 (second)
+8	RW	Trigger ²	UINT16	0 to 8

* Default

Table 5-19 Setpoint Data Structure

Notes:

- 1) “**Parameter**” specifies the parameter to be monitored. Table 5-20 below provides a list of Setpoint Parameters.

Key	Parameter	Scale/Unit
0	None	/
1	Frequency	x100, Hz
2	VLN	x100, V
3	VLL	x100, V
4	V THD*	x100, %
5	SM1 Current	x1000, A
6	SM2 Current	x1000, A
7	SM3 Current	x1000, A
8	SM4 Current	x1000, A
9	SM5 Current	x1000, A
10	SM6 Current	x1000, A
11	SM7 Current	x1000, A
12	SM8 Current	x1000, A
13	SM9 Current	x1000, A
14	SM1 Current THD*	x100, %
15	SM2 Current THD*	x100, %
16	SM3 Current THD*	x100, %
17	SM4 Current THD*	x100, %
18	SM5 Current THD*	x100, %
19	SM6 Current THD*	x100, %
20	SM7 Current THD*	x100, %
21	SM8 Current THD*	x100, %
22	SM9 Current THD*	x100, %
23	SM1 kW*	x1000, kW
24	SM2 kW*	x1000, kW
25	SM3 kW*	x1000, kW
26	SM4 kW*	x1000, kW
27	SM5 kW*	x1000, kW

28	SM6 kW*	x1000, kW
29	SM7 kW*	x1000, kW
30	SM8 kW*	x1000, kW
31	SM9 kW*	x1000, kW
32	SM1 kvar*	x1000, kvar
33	SM2 kvar*	x1000, kvar
34	SM3 kvar*	x1000, kvar
35	SM4 kvar*	x1000, kvar
36	SM5 kvar*	x1000, kvar
37	SM6 kvar*	x1000, kvar
38	SM7 kvar*	x1000, kvar
39	SM8 kvar*	x1000, kvar
40	SM9 kvar*	x1000, kvar
41	SM1 kVA*	x1000, kVA
42	SM2 kVA*	x1000, kVA
43	SM3 kVA*	x1000, kVA
44	SM4 kVA*	x1000, kVA
45	SM5 kVA*	x1000, kVA
46	SM6 kVA*	x1000, kVA
47	SM7 kVA*	x1000, kVA
48	SM8 kVA*	x1000, kVA
49	SM9 kVA*	x1000, kVA
50	SM1 PF*	x1000
51	SM2 PF*	x1000
52	SM3 PF*	x1000
53	SM4 PF*	x1000
54	SM5 PF*	x1000
55	SM6 PF*	x1000
56	SM7 PF*	x1000
57	SM8 PF*	x1000
58	SM9 PF	x1000
59	VM1 $\sum$ kW*	x1000, kW
60	VM2 $\sum$ kW*	x1000, kW
61	VM3 $\sum$ kW*	x1000, kW
62	VM4 $\sum$ kW*	x1000, kW
63	VM5 $\sum$ kvar*	x1000, kvar
64	VM6 $\sum$ kvar*	x1000, kvar
65	VM1 $\sum$ kvar*	x1000, kvar
66	VM2 $\sum$ kvar*	x1000, kvar
67	VM3 $\sum$ kvar*	x1000, kvar
68	VM4 $\sum$ kvar*	x1000, kvar
69	VM5 $\sum$ kvar*	x1000, kvar
70	VM6 $\sum$ kvar*	x1000, kvar
71	VM1 $\sum$ kVA*	x1000, kVA
72	VM2 $\sum$ kVA*	x1000, kVA
73	VM3 $\sum$ kVA*	x1000, kVA
74	VM4 $\sum$ kVA*	x1000, kVA
75	VM5 $\sum$ kVA*	x1000, kVA
76	VM6 $\sum$ kVA*	x1000, kVA
77	VM1 $\sum$ PF*	x1000
78	VM2 $\sum$ PF*	x1000
79	VM3 $\sum$ PF*	x1000
80	VM4 $\sum$ PF*	x1000
81	VM5 $\sum$ PF*	x1000
82	VM6 $\sum$ PF*	x1000
83	RTD1 Temperature#	x10, °C
84	RTD1 Temperature#	x10, °C
85	RTD1 Temperature#	x10, °C

* When the Software Option is MDI, voltage THDs, current THDs and all power measurements are reserved and therefore should not be used for setpoint monitoring.

When the Hardware Option is 9I, all parameters associated with RTDx have no meanings and therefore should not be used for setpoint monitoring.

Table 5-20 Setpoint Parameters

- 2) “Trigger” specifies what action the setpoint will take when it becomes active. Table 5-21 below provides a list of Setpoint Triggers.

Key	Action	Key	Action
0	None	5	Data Recorder #5
1	Data Recorder #1	6	Data Recorder #6
2	Data Recorder #2	7	Data Recorder #7
3	Data Recorder #3	8	Data Recorder #8
4	Data Recorder #4		

Table 5-21 Setpoint Triggers

5.11.3 Data Recorder Log Data Structure

Offset	Property	Description	Format	Note
+0	RO	Parameter 1	INT32	/
+2	RO	Parameter 2	INT32	/
.....	RO		INT32	/
Nx2	RO	Parameter N (N=1 to 16)	INT32	/
Nx2+1	RO	High-order Byte: Year	UINT16	1 to 99 (Year-2000)
		Low-order Byte: Month		1 to 12
Nx2+2	RO	High-order Byte: Day	UINT16	1 to 28/29/30/31
		Low-order Byte: Hour		0 to 23
Nx2+3	RO	High-order Byte: Minute	UINT16	0 to 59
		Low-order Byte: Second		0 to 59

Table 5-22 DR Data Structure

5.11.4 SOE Log Data Structure

Offset	Properties	Description
+0	RO	Reserved
+1	RO	High-order Byte: Event Classification ¹
		Low-order Byte: Sub-Classification ¹
+2	RO	High-order Byte: Year (Year-2000)
		Low-order Byte: Month (0 to 12)
+3	RO	High-order Byte: Day (0 to 31)
		Low-order Byte: Hour (0 to 23)
+4	RO	High-order Byte: Minute (0 to 59)
		Low-order Byte: Second (0 to 59)
+5	RO	Millisecond (0 to 999)
+6	RO	Event Value High-order Word
+7	RO	Event Value Low-order Word

Table 5-23 SOE LOG Data Structure

Notes:

- 1) Please see **Appendix B - Event Classification** for more information.

Appendix A - Data Recorder Parameters

Key	Parameters	Scale/Unit	Key	Parameters	Scale/Unit
0	None	/	1	Frequency	×100, Hz
2	RTD1 Temperature	×10, °C	3	RTD2 Temperature	×10, °C
4	RTD3 Temperature	×10, °C	5	Va	×100, V
6	Vb	×100, V	7	Vc	×100, V
8	Vab	×100, V	9	Vbc	×100, V
10	Vca	×100, V	11	SM1 Current	×1000, A
12	SM2 Current	×1000, A	13	SM3 Current	×1000, A
14	SM4 Current	×1000, A	15	SM5 Current	×1000, A
16	SM6 Current	×1000, A	17	SM7 Current	×1000, A
18	SM8 Current	×1000, A	19	SM9 Current	×1000, A
20	SM1 kW	×1000, kW	21	SM2 kW	×1000, kW
22	SM3 kW	×1000, kW	23	SM4 kW	×1000, kW
24	SM5 kW	×1000, kW	25	SM6 kW	×1000, kW
26	SM7 kW	×1000, kW	27	SM8 kW	×1000, kW
28	SM9 kW	×1000, kW	29	SM1 kvar	×1000, kvar
30	SM2 kvar	×1000, kvar	31	SM3 kvar	×1000, kvar
32	SM4 kvar	×1000, kvar	33	SM5 kvar	×1000, kvar
34	SM6 kvar	×1000, kvar	35	SM7 kvar	×1000, kvar
36	SM8 kvar	×1000, kvar	37	SM9 kvar	×1000, kvar
38	SM1 kVA	×1000, kVA	39	SM2 kVA	×1000, kVA
40	SM3 kVA	×1000, kVA	41	SM4 kVA	×1000, kVA
42	SM5 kVA	×1000, kVA	43	SM6 kVA	×1000, kVA
44	SM7 kVA	×1000, kVA	45	SM8 kVA	×1000, kVA
46	SM9 kVA	×1000, kVA	47	SM1 PF	×1000
48	SM2 PF	×1000	49	SM3 PF	×1000
50	SM4 PF	×1000	51	SM5 PF	×1000
52	SM6 PF	×1000	53	SM7 PF	×1000
54	SM8 PF	×1000	55	SM9 PF	×1000
56	SM1 kWh Import	×10, kWh	57	SM2 kWh Import	×10, kWh
58	SM3 kWh Import	×10, kWh	59	SM4 kWh Import	×10, kWh
60	SM5 kWh Import	×10, kWh	61	SM6 kWh Import	×10, kWh
62	SM7 kWh Import	×10, kWh	63	SM8 kWh Import	×10, kWh
64	SM9 kWh Import	×10, kWh	65	SM1 kWh Export	×10, kWh
66	SM2 kWh Export	×10, kWh	67	SM3 kWh Export	×10, kWh
68	SM4 kWh Export	×10, kWh	69	SM5 kWh Export	×10, kWh
70	SM6 kWh Export	×10, kWh	71	SM7 kWh Export	×10, kWh
72	SM8 kWh Export	×10, kWh	73	SM9 kWh Export	×10, kWh
74	SM1 kvarh Import	×10, kvarh	75	SM2 kvarh Import	×10, kvarh
76	SM3 kvarh Import	×10, kvarh	77	SM4 kvarh Import	×10, kvarh
78	SM5 kvarh Import	×10, kvarh	79	SM6 kvarh Import	×10, kvarh
80	SM7 kvarh Import	×10, kvarh	81	SM8 kvarh Import	×10, kvarh
82	SM9 kvarh Import	×10, kvarh	83	SM1 kvarh Export	×10, kvarh
84	SM2 kvarh Export	×10, kvarh	85	SM3 kvarh Export	×10, kvarh
86	SM4 kvarh Export	×10, kvarh	87	SM5 kvarh Export	×10, kvarh
88	SM6 kvarh Export	×10, kvarh	89	SM7 kvarh Export	×10, kvarh
90	SM8 kvarh Export	×10, kvarh	91	SM9 kvarh Export	×10, kvarh
92	SM1 Current Demand	×1000, A	93	SM2 Current Demand	×1000, A
94	SM3 Current Demand	×1000, A	95	SM4 Current Demand	×1000, A
96	SM5 Current Demand	×1000, A	97	SM6 Current Demand	×1000, A
98	SM7 Current Demand	×1000, A	99	SM8 Current Demand	×1000, A
100	SM9 Current Demand	×1000, A	101	RTD1 Temperature Demand	×10, °C
102	RTD2 Temperature Demand	×10, °C	103	RTD3 Temperature Demand	×10, °C
104	Va THD	×100, %	105	Vb THD	×100, %
106	Vc THD	×100, %	107	SM1 Current THD	×100, %
108	SM2 Current THD	×100, %	109	SM3 Current THD	×100, %
110	SM4 Current THD	×100, %	111	SM5 Current THD	×100, %
112	SM6 Current THD	×100, %	113	SM7 Current THD	×100, %
114	SM8 Current THD	×100, %	115	SM9 Current THD	×100, %

Appendix B - Event Classification

Event Classification	Sub-Classification	Event Value Scale/Option	Description
1	1	1/0	DI1 Close/DI1 Open
	2	1/0	DI2 Close/DI2 Open
	3	1/0	DI3 Close/DI3 Open
	4	1/0	DI4 Close/DI4 Open
2	1	Trigger Value (x100)	Over Frequency Setpoint Active
	2		Over VLN Setpoint Active
	3		Over VLL Setpoint Active
	4	Trigger Value (x10000)	Over Voltage THD Setpoint Active
	5	Trigger Value (x1000)	Over SM1 Current Setpoint Active
	6		Over SM2 Current Setpoint Active
	7		Over SM3 Current Setpoint Active
	8		Over SM4 Current Setpoint Active
	9		Over SM5 Current Setpoint Active
	10		Over SM6 Current Setpoint Active
	11		Over SM7 Current Setpoint Active
	12		Over SM8 Current Setpoint Active
	13		Over SM9 Current Setpoint Active
	14	Trigger Value (x10000)	Over SM1 Current THD Setpoint Active
	15		Over SM2 Current THD Setpoint Active
	16		Over SM3 Current THD Setpoint Active
	17		Over SM4 Current THD Setpoint Active
	18		Over SM5 Current THD Setpoint Active
	19		Over SM6 Current THD Setpoint Active
	20		Over SM7 Current THD Setpoint Active
	21		Over SM8 Current THD Setpoint Active
	22		Over SM9 Current THD Setpoint Active
	23	Trigger Value (x1000)	Over SM1 kW Setpoint Active
	24		Over SM2 kW Setpoint Active
	25		Over SM3 kW Setpoint Active
	26		Over SM4 kW Setpoint Active
	27		Over SM5 kW Setpoint Active
	28		Over SM6 kW Setpoint Active
	29		Over SM7 kW Setpoint Active
	30		Over SM8 kW Setpoint Active
	31		Over SM9 kW Setpoint Active
	32	Trigger Value (x1000)	Over SM1 kvar Setpoint Active
	33		Over SM2 kvar Setpoint Active
	34		Over SM3 kvar Setpoint Active
	35		Over SM4 kvar Setpoint Active
	36		Over SM5 kvar Setpoint Active
	37		Over SM6 kvar Setpoint Active
	38		Over SM7 kvar Setpoint Active
	39		Over SM8 kvar Setpoint Active
	40		Over SM9 kvar Setpoint Active
	41	Trigger Value (x1000)	Over SM1 kVA Setpoint Active
	42		Over SM2 kVA Setpoint Active
	43		Over SM3 kVA Setpoint Active
	44		Over SM4 kVA Setpoint Active
	45		Over SM5 kVA Setpoint Active
	46		Over SM6 kVA Setpoint Active
	47		Over SM7 kVA Setpoint Active
	48		Over SM8 kVA Setpoint Active
	49		Over SM9 kVA Setpoint Active
	50	Trigger Value (x1000)	Over SM1 PF Setpoint Active
	51		Over SM2 PF Setpoint Active
	52		Over SM3 PF Setpoint Active
	53		Over SM4 PF Setpoint Active
	54		Over SM5 PF Setpoint Active
	55		Over SM6 PF Setpoint Active
	56		Over SM7 PF Setpoint Active
	57		Over SM8 PF Setpoint Active

	58		Over SM9 PF Setpoint Active
	59	Trigger Value (x1000)	Over VM1 Σ kW Setpoint Active
	60		Over VM2 Σ kW Setpoint Active
	61		Over VM3 Σ kW Setpoint Active
	62		Over VM4 Σ kW Setpoint Active
	63		Over VM5 Σ kW Setpoint Active
	64		Over VM6 Σ kW Setpoint Active
	65	Trigger Value (x1000)	Over VM1 Σ kvar Setpoint Active
	66		Over VM2 Σ kvar Setpoint Active
	67		Over VM3 Σ kvar Setpoint Active
	68		Over VM4 Σ kvar Setpoint Active
	69		Over VM5 Σ kvar Setpoint Active
	70		Over VM6 Σ kvar Setpoint Active
	71	Trigger Value (x1000)	Over VM1 Σ kVA Setpoint Active
	72		Over VM2 Σ kVA Setpoint Active
	73		Over VM3 Σ kVA Setpoint Active
	74		Over VM4 Σ kVA Setpoint Active
	75		Over VM5 Σ kVA Setpoint Active
	76		Over VM6 Σ kVA Setpoint Active
	77	Trigger Value (x1000)	Over VM1 Σ PF Setpoint Active
	78		Over VM2 Σ PF Setpoint Active
	79		Over VM3 Σ PF Setpoint Active
	80		Over VM4 Σ PF Setpoint Active
	81		Over VM5 Σ PF Setpoint Active
	82		Over VM6 Σ PF Setpoint Active
	83	Trigger Value (x10)	Over RTD1 Temperature Setpoint Active
	84		Over RTD2 Temperature Setpoint Active
	85		Over RTD3 Temperature Setpoint Active
2	86	Trigger Value (x100)	Over Frequency Setpoint Return
	87		Over VLN Setpoint Return
	88		Over VLL Setpoint Return
	89	Trigger Value (x10000)	Over Voltage THD Setpoint Return
	90	Trigger Value (x1000)	Over SM1 to SM9 Current Setpoint Return
	91	Trigger Value (x10000)	Over SM1 to SM9 Current THD Setpoint Return
	92	Trigger Value (x1000)	Over SM1 to SM9 kW Setpoint Return
	93		Over SM1 to SM9 kvar Setpoint Return
	94		Over SM1 to SM9 kVA Setpoint Return
	95		Over SM1 to SM9 PF Setpoint Return
	96		Over VM1 to VM6 Σ kW Setpoint Return
	97		Over VM1 to VM6 Σ kvar Setpoint Return
	98		Over VM1 to VM6 Σ kVA Setpoint Return
	99		Over VM1 to VM6 Σ PF Setpoint Return
	100	Trigger Value (x10)	Over RTD1 to RTD3 Temperature Setpoint Active
	101	Trigger Value (x100)	Under Frequency Setpoint Active
	102		Under VLN Setpoint Active
	103		Under VLL Setpoint Active
	104	Trigger Value (x10000)	Under Voltage THD Setpoint Active
	105	Trigger Value (x1000)	Under SM1 Current Setpoint Active
	106		Under SM2 Current Setpoint Active
	107		Under SM3 Current Setpoint Active
	108		Under SM4 Current Setpoint Active
	109		Under SM5 Current Setpoint Active
	110		Under SM6 Current Setpoint Active
	111		Under SM7 Current Setpoint Active
	112		Under SM8 Current Setpoint Active
	113		Under SM9 Current Setpoint Active
	114	Trigger Value (x10000)	Under SM1 Current THD Setpoint Active
	115		Under SM2 Current THD Setpoint Active
	116		Under SM3 Current THD Setpoint Active
	117		Under SM4 Current THD Setpoint Active
	118		Under SM5 Current THD Setpoint Active
	119		Under SM6 Current THD Setpoint Active
	120		Under SM7 Current THD Setpoint Active

	121		Under SM8 Current THD Setpoint Active
	122		Under SM9 Current THD Setpoint Active
	123	Trigger Value (x1000)	Under SM1 kW Setpoint Active
	124		Under SM2 kW Setpoint Active
	125		Under SM3 kW Setpoint Active
	126		Under SM4 kW Setpoint Active
	127		Under SM5 kW Setpoint Active
	128		Under SM6 kW Setpoint Active
	129		Under SM7 kW Setpoint Active
	130		Under SM8 kW Setpoint Active
	131		Under SM9 kW Setpoint Active
	132	Trigger Value (x1000)	Under SM1 kvar Setpoint Active
	133		Under SM2 kvar Setpoint Active
	134		Under SM3 kvar Setpoint Active
	135		Under SM4 kvar Setpoint Active
	136		Under SM5 kvar Setpoint Active
	137		Under SM6 kvar Setpoint Active
	138		Under SM7 kvar Setpoint Active
	139		Under SM8 kvar Setpoint Active
	140		Under SM9 kvar Setpoint Active
	141	Trigger Value (x1000)	Under SM1 kVA Setpoint Active
	142		Under SM2 kVA Setpoint Active
	143		Under SM3 kVA Setpoint Active
	144		Under SM4 kVA Setpoint Active
	145		Under SM5 kVA Setpoint Active
	146		Under SM6 kVA Setpoint Active
	147		Under SM7 kVA Setpoint Active
	148		Under SM8 kVA Setpoint Active
	149		Under SM9 kVA Setpoint Active
	150	Trigger Value (x1000)	Under SM1 PF Setpoint Active
	151		Under SM2 PF Setpoint Active
	152		Under SM3 PF Setpoint Active
	153		Under SM4 PF Setpoint Active
	154		Under SM5 PF Setpoint Active
	155		Under SM6 PF Setpoint Active
	156		Under SM7 PF Setpoint Active
	157		Under SM8 PF Setpoint Active
	158		Under SM9 PF Setpoint Active
	159	Trigger Value (x1000)	Under VM1 Σ kW Setpoint Active
	160		Under VM2 Σ kW Setpoint Active
	161		Under VM3 Σ kW Setpoint Active
	162		Under VM4 Σ kW Setpoint Active
	163		Under VM5 Σ kW Setpoint Active
	164		Under VM6 Σ kW Setpoint Active
	165	Trigger Value (x1000)	Under VM1 Σ kvar Setpoint Active
	166		Under VM2 Σ kvar Setpoint Active
	167		Under VM3 Σ kvar Setpoint Active
	168		Under VM4 Σ kvar Setpoint Active
	169		Under VM5 Σ kvar Setpoint Active
	170		Under VM6 Σ kvar Setpoint Active
	171	Trigger Value (x1000)	Under VM1 Σ kVA Setpoint Active
	172		Under VM2 Σ kVA Setpoint Active
	173		Under VM3 Σ kVA Setpoint Active
	174		Under VM4 Σ kVA Setpoint Active
	175		Under VM5 Σ kVA Setpoint Active
	176		Under VM6 Σ kVA Setpoint Active
	177	Trigger Value (x1000)	Under VM1 Σ PF Setpoint Active
	178		Under VM2 Σ PF Setpoint Active
	179		Under VM3 Σ PF Setpoint Active
	180		Under VM4 Σ PF Setpoint Active
	181		Under VM5 Σ PF Setpoint Active
	182		Under VM6 Σ PF Setpoint Active
	183	Trigger Value (x10)	Under RTD1 Temperature Setpoint Active
	184		Under RTD2 Temperature Setpoint Active
	185		Under RTD3 Temperature Setpoint Active
	186	Trigger Value (x100)	Under Frequency Setpoint Return
	187		Under VLN Setpoint Return

	188		Under VLL Setpoint Return
	189	Trigger Value (x10000)	Under Voltage THD Setpoint Return
	190	Trigger Value (x1000)	Under SM1 to SM9 Current Setpoint Return
	191	Trigger Value (x10000)	Under SM1 to SM9 Current THD Setpoint Return
	192	Trigger Value (x1000)	Under SM1 to SM9 kW Setpoint Return
	193		Under SM1 to SM9 kvar Setpoint Return
	194		Under SM1 to SM9 kVA Setpoint Return
	195		Under SM1 to SM9 PF Setpoint Return
	196		Under VM1 to VM6 Σ kW Setpoint Return
	197		Under VM1 to VM6 Σ kvar Setpoint Return
	198		Under VM1 to VM6 Σ kVA Setpoint Return
	199		Under VM1 to VM6 Σ PF Setpoint Return
	200	Trigger Value (x10)	Under RTD1 to RTD3 Temperature Setpoint Active
3	1	0	Power On
	2	0	Power Down
	3	0	Setup Changes via Front Panel
	4	0	Setup Changes via Communications
	5	0/1/2	RTD opened
	6	(RTD1/2/3)	RTD shorted

Appendix C - Temperature Sensor



Hoop Model	Diameter Range of Hoop	Weight
PMC-DN-30	18 to 32mm	<=58g
PMC-DN-50	27 to 51mm	<=62g
PMC-DN-55	33 to 57mm	<=64g
PMC-DN-60	40 to 63mm	<=66g
Technical Specification		
Material	Platinum resistor Pt100	
Work Range	-40°C to 200°C	
Accuracy	$\pm(0.30+0.005 t)$	
Line Length	3000mm	
Protective Tube Length	30mm	

Appendix D - Technical Specification

Power Supply (L+, N-, GND)	
Standard	95-250VAC/DC, $\pm 10\%$, 47-440Hz
Burden	3W
Voltage Inputs (V1, V2, V3, VN)	
Standard (Un)	240VLN/415VLL
Range	10% to 120% Un
PT Ratio	1-2200
Overload	1.2xUn continuous, 1.6xUn for 10s
Burden	<0.5VA @ 240V
Current Inputs (I11, I12, ... I91, I92)	
Standard (In/Imax)	5A / 6A
Optional (In/Imax)	1A / 1.2A
Range	0.1% In to 120% In
CT Ratio	1-6,000 (5A), 1-30,000 (1A)
Overload	1.2xIn continuous, 10xIn for 1s
Burden	<0.25VA @ 5A
RTD Temperature Input (TC1, TC2, TC3)	
Type	2-wire Pt100
Range	-40 °C to 200 °C
Digital Inputs (DI1 to DI4, DICOM)	
Type	Dry contact, 24VDC internally wetted
Sampling	1000Hz
Debounce	1ms minimum
Environmental conditions	
Operating temp	-25°C to +70°C
Storage temp	-40°C to +85°C
Humidity	5% to 95% non-condensing
Atmospheric pressure	70 kPa to 106 kPa
Mechanical Characteristics	
Installation	Standard DIN-Rail Mount
Unit Dimensions	180x94.5x57.5mm
IP Rating	52
Shipping Weight	0.7kg
Shipping Dimensions	222x136x100mm

Appendix E - Standards Compliance

Safety Requirements		
CE LVD 2006 / 95 / EC		EN61010-1-1-2001
Insulation Dielectric test: 2kV @ 1 minute Insulation resistance: >100MΩ Impulse voltage: 5kV, 1.2/50μs		IEC 60255-5-2000
Electromagnetic Compatibility CE EMC Directive 2004 / 108 / EC (EN 61326: 2006)		
Immunity Tests		
Electrostatic discharge		IEC 61000-4-2:2008 Level IV
Radiated fields		IEC 61000-4-3:2008 (10 V/m)
Fast transients		IEC 61000-4-4:2004 Level IV
Surges		IEC 61000-4-5:2005 Level V
Conducted disturbances		IEC 61000-4-6:2008 Level III
Magnetic Fields		IEC 61000-4-8:2009 Level IV
Oscillatory waves		IEC 61000-4-12:2006 Level III
Electromagnetic Emission		IEC 60255-25: 2000
Emission Tests		
Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment		EN 55011: 2009 (CISPR 11)
Limits and methods of measurement of radio disturbance characteristics of information technology equipment		EN 55022: 2006+A1: 2007 (CISPR 22)
Limits for harmonic current emissions for equipment with rated current ≤16 A		EN 61000-3-2: 2006+A1: 2009
Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤16 A		EN 61000-3-3: 2006
Emission standard for residential, commercial and light-industrial environments		EN 61000-6-3: 2007
Electromagnetic Emission Tests for Measuring Relays and Protection Equipment		IEC 60255-25: 2000
Mechanical Tests		
Vibration Test	Response	IEC 60255-21-1 Level I
	Endurance	IEC 60255-21-1 Level I
Shock Test	Response	IEC 60255-21-2 Level I
	Endurance	IEC 60255-21-2 Level I
Bump Test		IEC 60255-21-2 Level I



Appendix F - Ordering Guide



Ceiec

Electric

Technology

Version 20130115

Product Code		Description	
PMC-509 Maximum Current Demand Indicator			
Software Function			
A		MDI	
B*		Multifunction Meter	
Basic Function			
A		3U+ 6I + 3RTD	
B		3U+ 9I	
Input Current (I1, I2, I3, I4, I5, I6)			
1		1A	
5		5A	
Input Voltage (V1, V2, V3)			
3		277/480VAC(WYE), 415VAC(Delta)	
Power Supply			
2		95-250VAC/DC, 47-440Hz	
System Frequency			
5		50Hz	
6		60Hz	
IO			
A		4DI	
Interface Language			
E		English	
PMC-509	-	A	A
		5	3
		2	5
		A	E
PMC-509-AA5325AE (Standard Model)			

*Additional charges apply

*Additional charges apply

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