PMC-690

Hand-Held Power Quality Analyzer

User Manual

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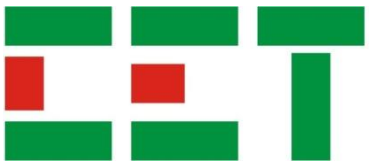

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Standards Compliance

CE

DANGER

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

CAUTION

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

DANGER

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

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

Limited warranty

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

Table of Contents

Glossary

DMD	= Present Demand
DWR	= Disturbance Waveform Recorder
FIFO	= First In First Out
Fund.	= Fundamental
GB	= Giga Byte
GPS	= Global Positioning System
HS	= High-Speed
Hn	= nth order Harmonic, integer multiple (n) of the Fundamental Frequency (50Hz or 60Hz)
IHn	= nth order Interharmonic represents all components between the (n-1)th and nth harmonic orders in RMS
HDn	= nth order Harmonic Distortion
IHDn	= nth order Interharmonic Distortion
Hn	= nth order Harmonic in RMS
IHn	= nth order Interharmonic in RMS
LCD	= Liquid Crystal Display
MB	= Mega Byte
Pred_DMD	= Predicted Demand
Plt	= Long-term Flicker
Pst	= Short-term Flicker
PQ	= Power Quality
RTC	= Real Time Clock
SDR	= Statistical Data Recorder
SOE	= Sequence of Events (PQ events)
SMTP	= Simple Mail Transfer Protocol
TH	= Total Harmonic in RMS, excluding Fundamental
THD	= Total Harmonic Distortion
TOHD	= Total Odd Harmonic Distortion
TEHD	= Total Even Harmonic Distortion
U0 / I0	= Zero Sequence Voltage / Current
U1 / I1	= Positive Sequence Voltage / Current
U2 / I2	= Negative Sequence Voltage /Current
U0 / I0 Unb	= Zero Sequence Voltage / Current Unbalance
U2 / I2 Unb	= Negative Sequence Voltage / Current Unbalance
WF	= Waveform
WFR	= Waveform Recorder
Swell	= Temporary increases in RMS value of AC voltage
Transient	=Unidirectional impulse of either polarity or a damped oscillatory wave with the first peak occurring in either polarity
$U_{rms(1/2)}$	= Half-Cycle RMS Voltage
U_{din}	= Declared input voltage - Value obtained from the declared supply voltage by a transducer ratio
U_{sr}	= Sliding Reference Voltage
$I_{half\ cycle\ rms}$	= Value of the RMS Current measured over each half period
I_{Normal}	= Normal Full-load Current
$U_{ll\ Normal}$	= Normal line-to-line Voltage
Dip Threshold	= Voltage magnitude specified for the purpose of detecting the start and end of a voltage dip
Flagged data	= For any measurement time interval in which interruptions, dips or swells occur, the measurement results of all other parameters made during this time interval are flagged

Chapter 1 Introduction

This manual explains how to use the PMC-690 Advanced Power Quality Analyzer.

This chapter provides an overview of the PMC-690 Analyzer and summarizes many of its key features.

1.1 Overview

The PMC-690 Hand-Held Power Quality Analyzer is CET's latest offer to assist engineers to diagnose the PQ events at site as it provides advanced functionality by combining Class 0.1 accuracy and advanced PQ features in a portable lightweight handheld form with a large, high-resolution, backlit, color TFT LCD display. Compliance with the standards as IEC 62053-22 Class 0.5S, IEC 61000-4-30 Class A, IEC-61000-4-15, IEC 61000-4-7 and IEC 61850. What's more, it supports 4 channels each of voltage inputs and current inputs, 512 samples/cycle waveform capture, and a large logging capacity of 16GB on-board memory with data recording in COMTRADE and PQDIF file format which is downloadable via USB port and compatible with PQ View software. With these features, the PMC-690 Power Quality Analyzer becomes the most advanced and convenient diagnostic tool at site.

Typical Applications

- PQ Check-up at HV, MV and LV Utility Substations
- Site investigation & diagnosis for PQ problems
- Industrial and Commercial
- Electrical Testing and Recording
- Fault investigation and identification
- No Load and Full Load Test
- Mains and Critical feeder Dips, Swells, Transients, Flicker & Disturbance Monitoring
- Harmonics Monitoring

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

1.2 Features

Basic Features

- 5.7'' Backlit Color LCD Display @ 640x480
- Light weight (1.16kg) - for easy transport
- Simple configuration for quick measurement setup
- Low power consumption with 8 hours battery
- PQ Insight™ for capturing Waveforms for 3-phase Voltage and Current in "Scope Mode"
- Communications - 100BaseT with RJ45 connector
- Protocol - Modbus TCP, SNTP & IEC 61850
- Industrial Grade Components
- Standard Tropicalization
- Extended Temperature Range
- Extended Warranty
- Weatherproof Carrying Case (Optional)

Power Quality Features

- IEC 61000-4-30 Class A
- IEC 61000-4-7, IEC 61000-4-15
- Transients, Dips, Swells, Interruptions, Rapid Voltage Changes (RVC) and In-rush Current monitoring
- Harmonic analysis up to 63rd
- Disturbance Waveform Recording (DWR)
- Downloadable waveform records in COMTRADE format via SD Card
- Trending and Statistical Reporting
- Up to 1024 SOE Logs
- PQ Insight™ for capturing Transient Waveforms for 3-phase Voltages and Currents in “Scope Mode”.

Front Panel Display

- Real-time, Harmonic Power and Energy measurements
- SOE Log and Waveform displays
- Harmonic & Interharmonic histogram and Phasor diagrams
- Statistical Trending
- Device Log
- Device configuration
- Diagnostics

Metering

Basic Measurements (1-second update)

- 3-phase Voltage, Current, Power, PF and Phase Angles
- kWh, kvarh Import/Export/Net/Total and kVAh Total
- U4, I4, Frequency

High-speed Measurements (½ cycle update)

- 3-phase Voltages and Currents, U4, I4, Power, PF, Frequency

Demands

- 3-phase Voltage, Current, Power, PF, U4, I4, Frequency
- Predicted Demands
- Present Peak Demands, and Max. Demand of Last Time

Power Quality Metering

PQ Parameters as per IEC 61000-4-30

- Power Frequency
- Magnitude of the Supply Voltage
- Flicker
- Supply Voltage Dips and Swells
- Voltage Interruptions
- Transient Voltages
- Supply Voltage Unbalance
- Voltage Harmonics and Interharmonics
- Rapid Voltage Changes
- Measurement of Underdeviation and Overdeviation parameters

Harmonic and Interharmonic measurements

- K-Factor for Current, Crest Factor for Current and Voltage
- U and I THD, TOHD, TEHD
- U and I Individual Harmonics (%HD) from 2nd to 63rd #
- U and I Individual Interharmonics (%IHD) from 1 to 63rd #
- Harmonic kW, kvar, kVA and PF from 2nd to 63rd in RMS
- Fundamental U, I, kW, kvar, kVA, PF and Phasor
- Fundamental kWh, kvarh Import/Export/Net/Total
- Total Harmonic kWh, kvarh Import/Export/Net/Total from 2nd to 63rd

%HD and %IHD can be configured as % of Fundamental, % of U/I nominal or % of RMS

Symmetrical Components and Unbalances

- Zero, Positive and Negative Sequence Components
- U and I Unbalance based on Zero and Negative Sequence Components

Transient and Dip/Swell Recording

- Transients capture as short as 40us at 512 samples @ 50Hz for sub-cycle disturbances such as capacitor switching and resonance phenomena
- Dips and Swells detection @ 10ms (½ cycle at 50Hz)
- Trigger for WF Recorder, Disturbance Waveform Recorder, RMS Recorder and SOE Log

Rapid Voltage Changes

- Detection of a quick transition in RMS voltage between two steady state Voltage conditions

In-rush Current Monitoring

- Monitoring of the ½ cycle RMS Current and capturing of the Current waveforms associated with events such as motor starting and transformer being energized

Waveform Capture (WFC) and Waveform Recorder (WFR)

- Real-time Waveform Capture via front panel display
- Waveform Recorder with 500 entries
- Simultaneous capture of 3-phase Voltage and Current inputs
- # of Cycles x Samples/Cycles with programmable # of pre-fault cycles
  - 640x16, 320x32, 160x64
  - 80x128, 40x256, 20x512
- Extended recording for up to a maximum of 7 consecutive captures
- COMTRADE file format, downloadable via SD Card

Disturbance Waveform Recorder (DWR)

- Disturbance recording of all Voltage and Current up to 500 entries
  - Initial Fault: Up to 35 cycles @ 512 samples/cycle
  - Steady State: Up to 150 cycles @ 16 samples/cycle
    Up to 18,000 cycles @ 1 sample/cycle
  - Ending Stage: Up to 15cycles @ 512 samples/cycle

Data and Event Recorders

Log Memory

- 16GB Removable SD Card (SanDisk Extreme Class 10 @ 45MB/s)

Max/Min Recorder (MMR) Log

- 4 records (20 parameters/recorder) with timestamp
- Logging of Max./Min. values for real-time measurements such as V, I, kW, kvar, kVA, PF, Freq., Unbalance, K-factor, THD
- Two log transfer modes:
  - Manual: Max./Min. Since Last Reset/Before Last Reset
  - Automatic: Max./Min. of This Month/Last Month

Statistical Data Recorder (SDR) Log

- 5 Recorders (64 parameters/recorder)
- Recording of the Max., Min., Avg. and 95th percentile of statistical measurements including U, I, Freq., Flicker, Harmonics & Unbalances
- Recording interval from 1 to 60 minutes
- FIFO mode with configurable depth
- PQDIF file format, downloadable via the USB port

Device Log

- 1024 FIFO events time-stamped to ±1ms resolution
- On/Off events, Device events

SOE Log

- 1024 FIFO entries time-stamped to ±1ms resolution
- Transient, Dip/Swell, Interruption, Rapid Voltage Change, In-rush Current, Setpoint events

Setpoints

PQ Setpoints

- Transients
- Dips/Swells
- Rapid Voltage Changes
- In-rush Current
- Harmonics
- Trigger SOE Log, RMS Recorder, WFR or DWR

Control Setpoints

- 24 Control Setpoints and 16 High-Speed Setpoints
- Extensive monitoring sources
- Configurable thresholds and time delays
- Trigger SOE Log, RMS Recorder, WFR or DWR

Communications

Ethernet Port

- 100BaseT TCP/IP Ethernet Ports with RJ45 connector
- Simultaneous connection for 10xModbus TCP and 12xIEC61580 clients
- Protocols
  - Modbus TCP
  - IEC61850
  - SMTP

- Firmware upgrade via Ethernet port

SD Card

- 16GB Capacity
- Removable SD Card for easy data transfer to PC
- Solid State technology that is immune from mechanical breakdown

USB Port

- For Data transfer to USB storage device
- User friendly interface for transferring data/waveform through USB port

Time Synchronization

- Battery-backed real-time clock @ 6ppm(≤ 0.5s/day)
- Time Sync. via Modbus SNTP

1.3 Getting more information

Additional information is available from CET via the following sources:

- Visit www.cet-global.com
- Contact your local representative
- Contact CET directly via email or telephone

Chapter 2 Installation

Caution

Installation of the PMC-690 should only be performed by qualified, competent personnel that have the appropriate training and experience with high voltage and current devices. The meter must be installed in accordance with all local and national electrical codes.

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

2.1 Appearance

1 Voltage Input Terminals
2 Front Panel
3 Power Input
4 Battery Charging Indicator
5 TFT LCD Display
6 CT Clamp Inputs
7 SD Card
8 USB Port
9 Ethernet Port
10 Earthing Terminal
11 Buttons

Figure 2-1 Appearance

2.2 Unit Dimensions

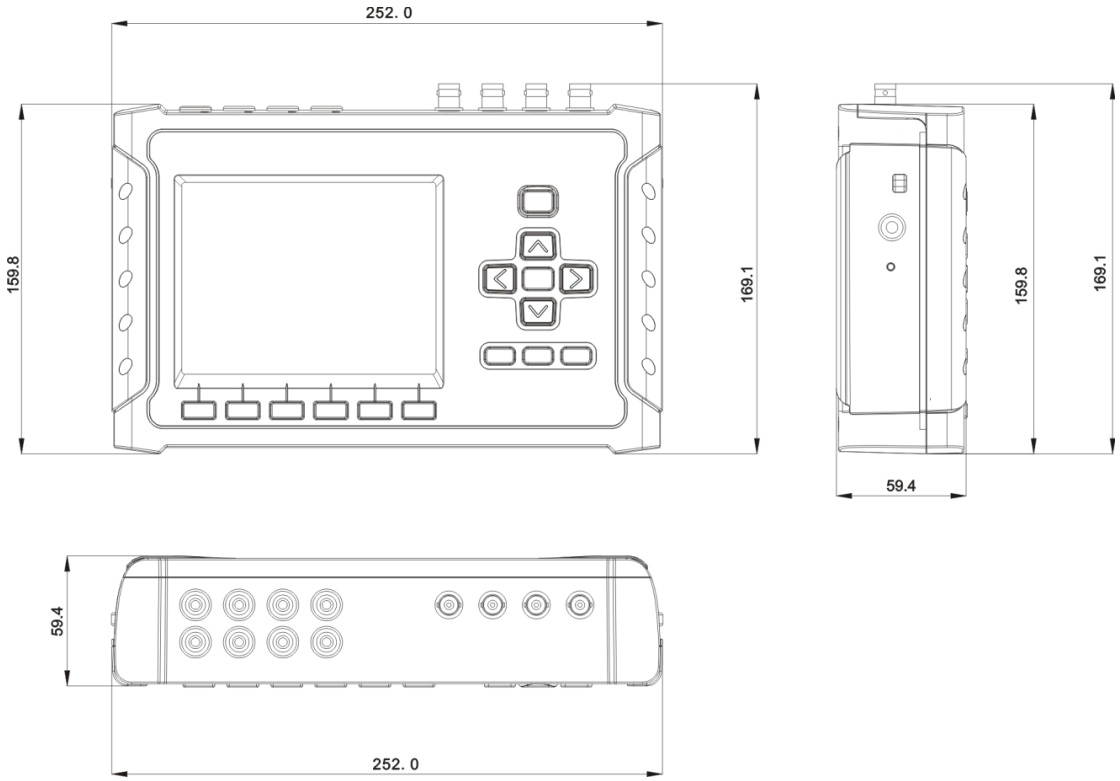


Figure 2-2 Unit Dimensions

2.3 Wiring Connections

Please read this section carefully before installation and choose the correct wiring method for your power system. The following wiring modes are supported:

- Single-Phase Connection
- 3-Phase 3-Wire Delta Connection
- 3-Phase 4-Wire 2.5E-2PT Connection
- 3-Phase 4-Wire Wye Connection

Caution

Under no circumstances should the PT secondary be shorted.

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

2.3.1 Single-Phase Connection

Please consult the serial number label to ensure that the Voltage and Current input is less than or equal to the meter's input specification.

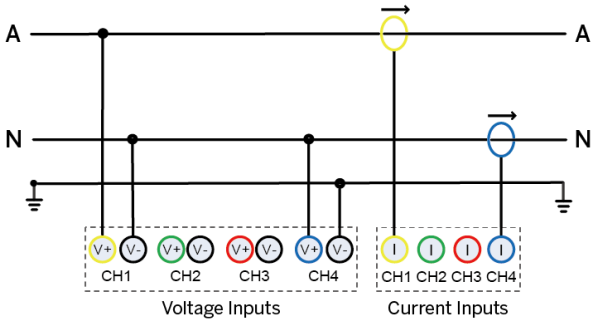


Figure 2-3 Single-Phase 2-Wire Connection

2.3.2 3-Phase 3-Wire Delta Connection

Please consult the serial number label to ensure that the Voltage and Current input is less than or equal to the meter's input specification.

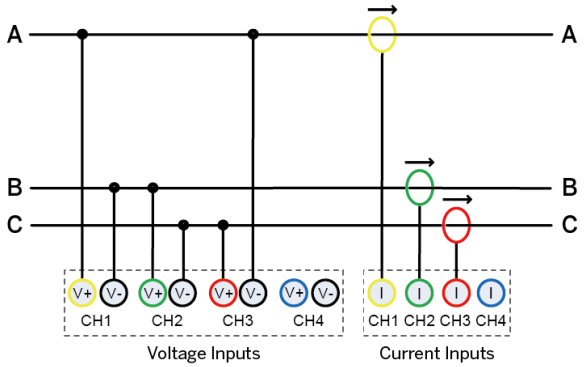


Figure 2-4 3-Phase 3-Wire Delta Connection

2.3.3 3-Phase 4-Wire 2.5E-2PT Connection

Please consult the serial number label to ensure that the Voltage and Current input is less than or equal to the meter's input specification.

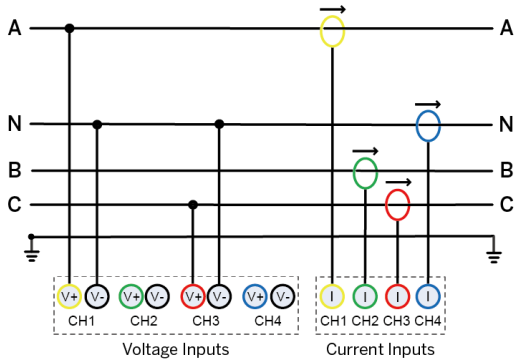


Figure 2-5 3-Phase 4-Wire 2.5E-2PT Connection

2.3.4 3-Phase 4-Wire Wye Connection

Please consult the serial number label to ensure that the Voltage and Current input is less than or equal to the meter's input specification.

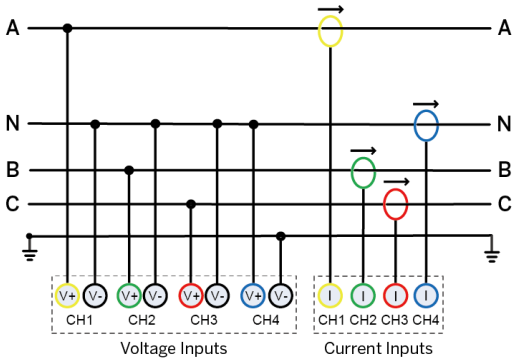


Figure 2-6 3-Phase 4-Wire Wye Connection

2.4 Ethernet Port (100BaseT)

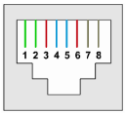
RJ45 Connector	Pin	Meaning
	1	Transmit Data+
	2	Transmit Data-
	3	Receive Data+
	4,5,7,8	NC
	6	Receive Data-

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

2.5 Chassis Ground Wiring

Connect the Earthing Terminal to earth ground.

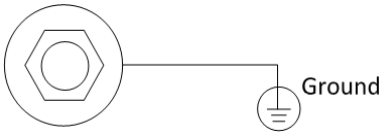


Figure 2-7 Chassis Ground connection

Chapter 3 Front Panel Interface

The PMC-690 is equipped with a stunning, 640x480, TFT Color, LCD Display. The following figure illustrates PMC-690's Main Display, which is the first screen shown upon device power on.

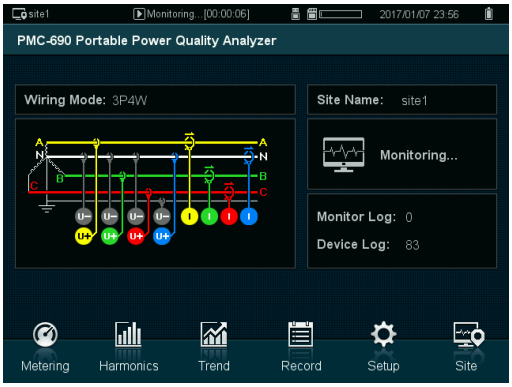


Figure 3-1 Main Display

3.1 Using the Front Panel Buttons

Figure 3-2 Front Panel User Interface

There are fifteen buttons on the front panel: ⏻, **<Enter>**, **<Esc>**, **<Start/Stop>**, **<Save Screen>**, <▲>, <▼>, <◀>, <▶> and six shortcut buttons.

Buttons	Description
<▲>	Pressing <▲> moves up the cursor or increments a numeric value if a parameter is already selected.
<▼>	Pressing <▼> moves down the cursor or decrements a numeric value if a parameter is already selected.
<◀>	Pressing <◀> moves the cursor to the left.
<▶>	Pressing <▶> moves the cursor to the right.
⏻	Pressing ⏻ starts the device. When the device is running, long press this button to force a shutdown.
<Enter>	Pressing this button enters to next menu or enters to a value.
<Esc>	Pressing this button returns to the previous level or cancels the value.
<Start/Stop>	Pressing this button enters to monitoring page and starts or stops monitoring.
<Save Screen>	Pressing this button captures present page and saves it to the SD card.

Table 3-1 Description of Button in Front Panel

3.2 Menu Tree

The following figure illustrates menu tree of the Front Panel:

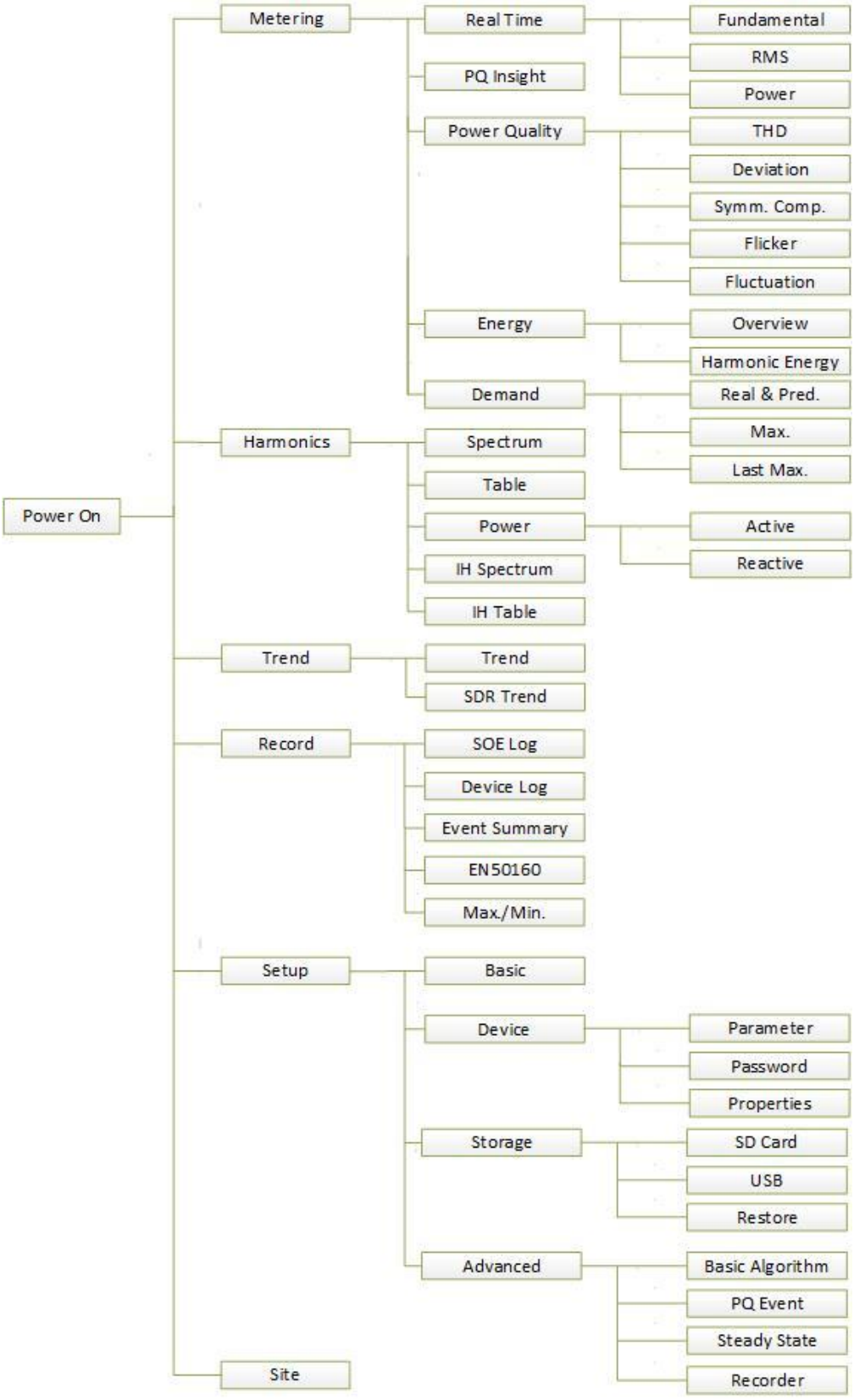
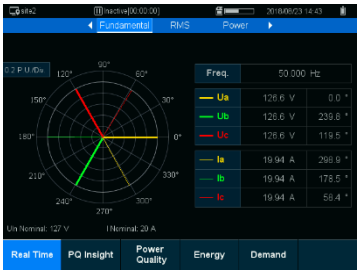
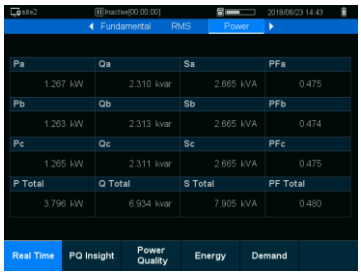
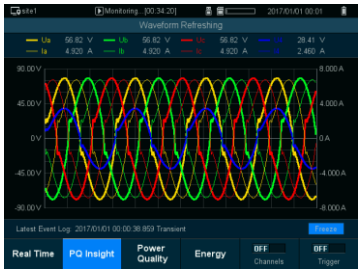
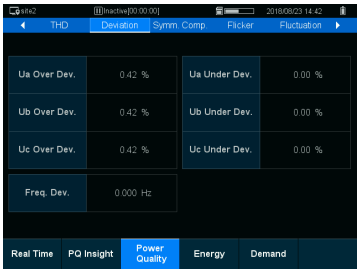
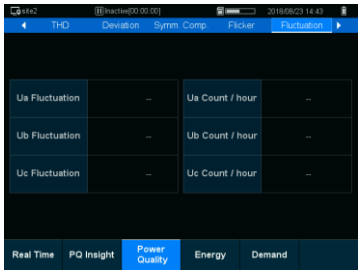


Figure 3-3 Menu Tree

3.3 Front Panel User Interface

The following table provides an overview of this display hierarchy.

Category	Topics	Pages
Metering	Real Time	  
	PQ Insight	
	Power Quality	   

<table>
<tr><td rowspan="4">Harmonics</td><td></td><td colspan="2"> 
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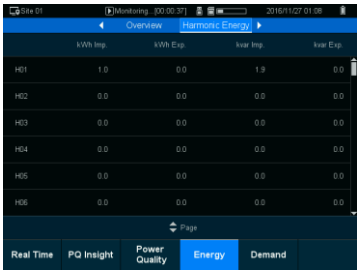
</td><td> 
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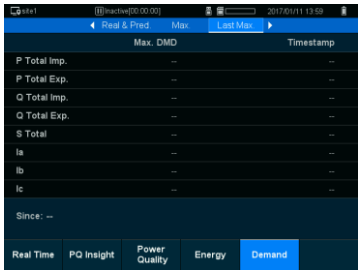
<tr><td colspan="2"> 
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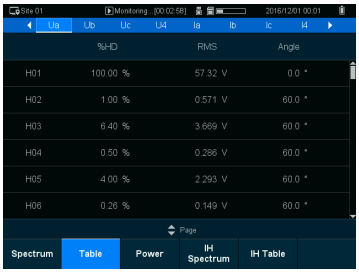
</td><td> 
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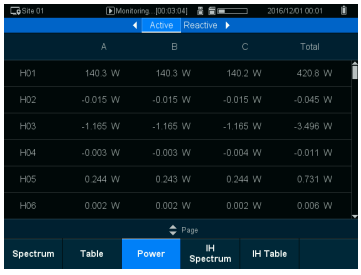
<tr><td>Power</td><td colspan="2"> 
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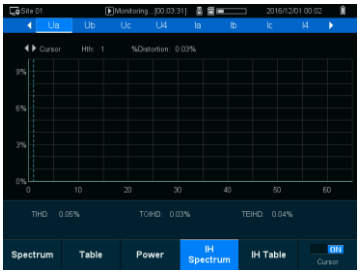
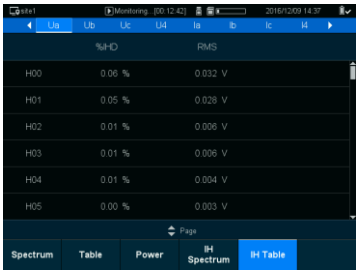
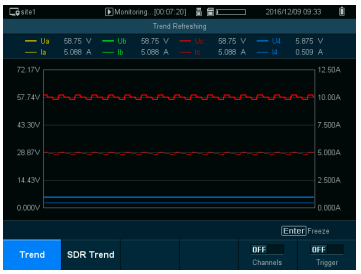
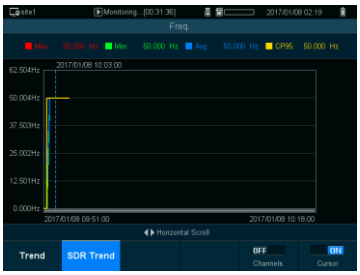
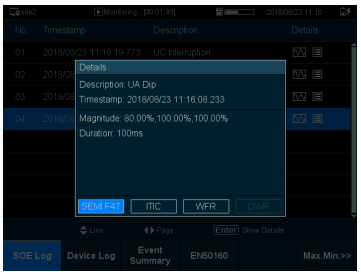
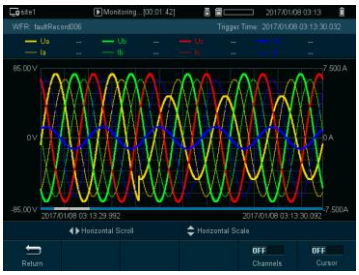
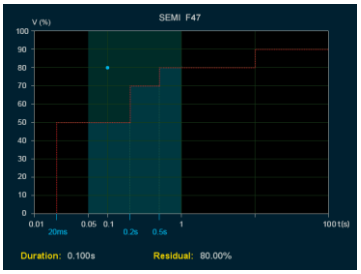
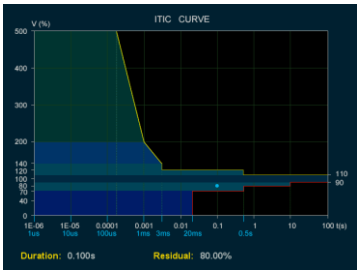
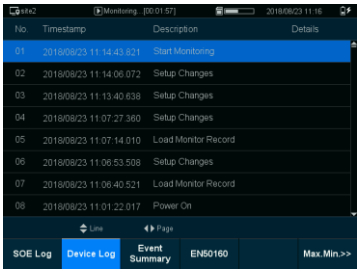
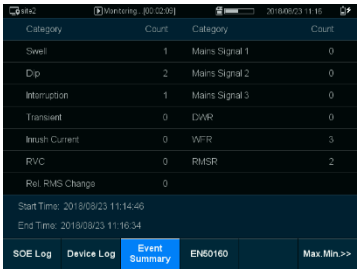
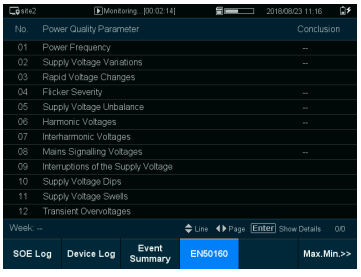
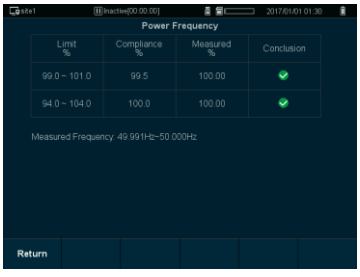
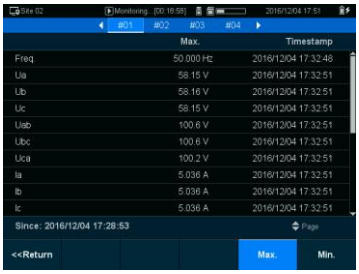
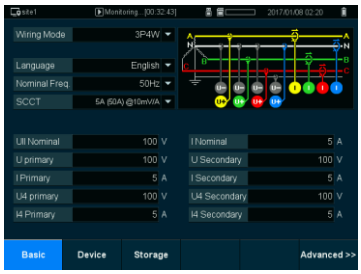
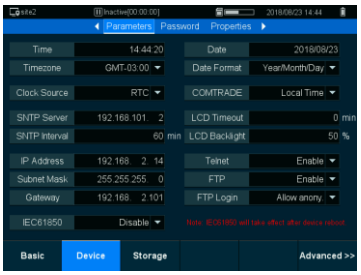
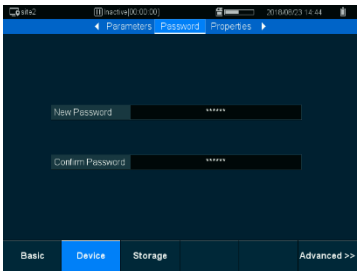
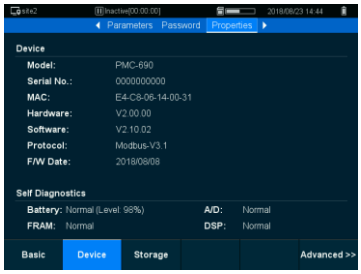
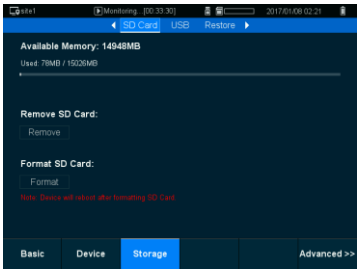
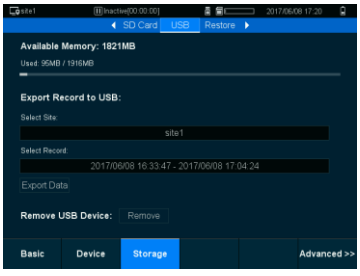
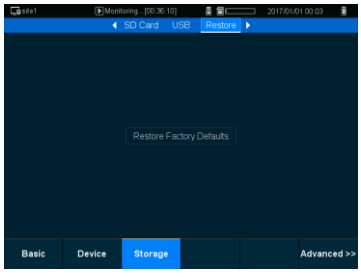
	IH Spectrum / IH Table		
Trend	Trend/SDR Trend		
Record	SOE Log		
			
	Device Log / Event Summary		
	EN50160		

	Max./Min.	 
Setup	Basic	
	Device	  
	Storage	  

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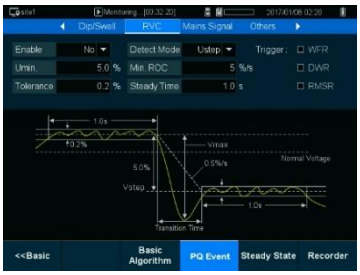
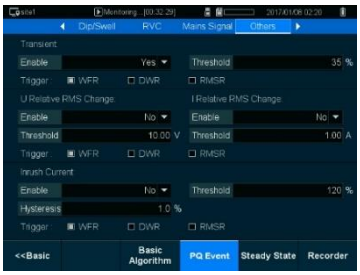
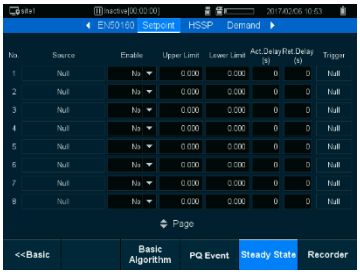
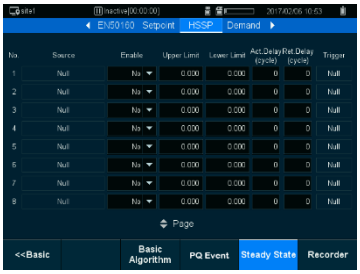
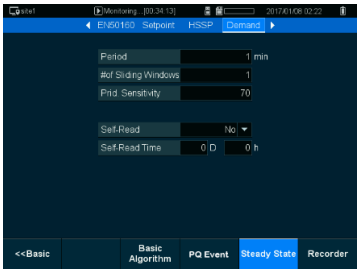
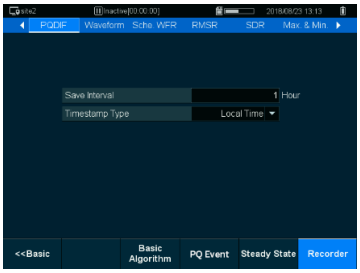
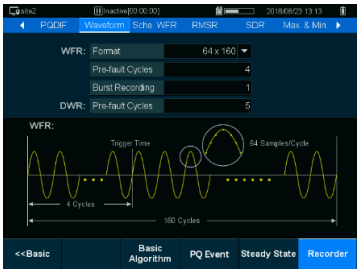
		 Dip/Swell RVC Mains Signal Others Enable Detect Mode Ustep Trigger: WFR Umin. Min. ROC DWR Tolerance Steady Time RMSR <<Basic Basic Algorithm PQ Event Steady State Recorder	 Dip/Swell RVC Mains Signal Others Enable Freq. Threshold Mains Signal 1 1000.0 Hz 5.0 % Mains Signal 2 2000.0 Hz 5.0 % Mains Signal 3 3000.0 Hz 5.0 % <<Basic Basic Algorithm PQ Event Steady State Recorder
		 Dip/Swell RVC Mains Signal Others Transient Enable Yes Threshold 35 % Trigger: WFR DWR RMSR U Relative RMS Change I Relative RMS Change Inrush Current Hysteresis 1.0 % <<Basic Basic Algorithm PQ Event Steady State Recorder	 EN50160 Setpoint HSSP Demand Voltage Level Low First Day Of Week Sunday Wide Tolerance Wide +ve Limit Wide -ve Limit Narrow Tolerance Narrow +ve Limit Narrow -ve Limit Tolerance Limit Voltage Harmonics <<Basic Basic Algorithm PQ Event Steady State Recorder
		 EN50160 Setpoint HSSP Demand Page <<Basic Basic Algorithm PQ Event Steady State Recorder	 EN50160 Setpoint HSSP Demand Page <<Basic Basic Algorithm PQ Event Steady State Recorder
		 EN50160 Setpoint HSSP Demand Period 1 min #of Sliding Windows 1 Prld. Sensitivity 70 Self-Read No Self-Read Time 0 D 0 h <<Basic Basic Algorithm PQ Event Steady State Recorder	 PQDIF Waveform Sche. WFR RMSR SDR Max. & Min. Save Interval 1 Hour Timestamp Type Local Time <<Basic Basic Algorithm PQ Event Steady State Recorder
		 PQDIF Waveform Sche. WFR RMSR SDR Max. & Min. WFR: Format 64 x 160 Pre-fault Cycles 4 Burst Recording 1 DWR: Pre-fault Cycles 5 WFR: Trigger Time 64 Samples/Cycle 4 Cycles 160 Cycles <<Basic Basic Algorithm PQ Event Steady State Recorder	 PQDIF Waveform Sche. WFR RMSR SDR Max. & Min. Enable No Start Date 2000/01/01 Start Time 00:00:00 Record Interval 1 Hour Depth 100 64 Samples/Cycle 4 Cycles 160 Cycles <<Basic Basic Algorithm PQ Event Steady State Recorder

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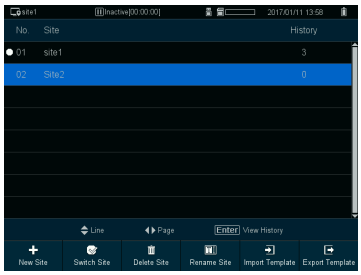
<tr><td>-</td><td colspan="2"> 
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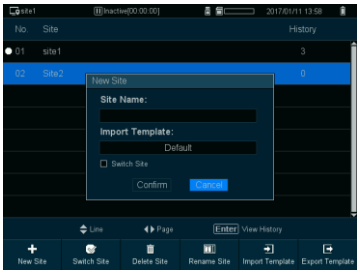
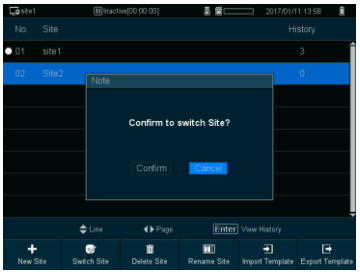
Switch Site</td><td> 
</td><td> 
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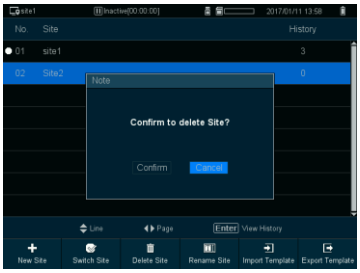
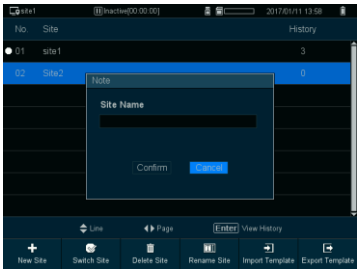
Rename Site</td><td> 
</td><td> 
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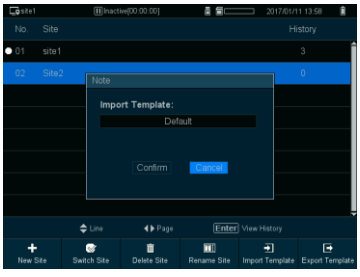
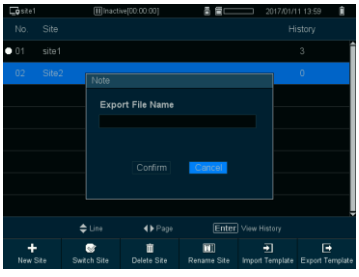
Export Template</td><td> 
</td><td> 
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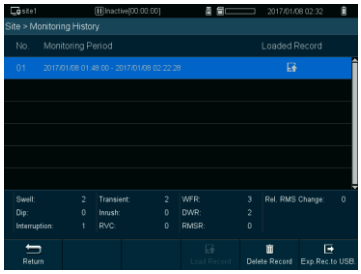
	Monitoring History	

Table 3-2 Description of each Hierarchy

Chapter 4 Applications

4.1 Power, Energy and Demand

4.1.1 Basic Measurements

The PMC-690 provides the following basic measurements with 1 second update rate:

- 3-phase Voltages and Currents
- 3-phase Powers and PFs
- Bi-directional Energy measurements
- U4, I4 and Frequency
- Voltage and Current phase angles
- Ia/Ib/Ic K-Factor and Crest Factor, Ua/Ub/Uc Crest Factor

4.1.2 Energy Measurements

The PMC-690 provides Energy measurements include fundamental energy as well as harmonic energy. The energy has a maximum value of 99,999,999,999.999 and will roll over to zero when it is reached. The energy can be reset manually or preset to user-defined values through the front panel or via communications. The PMC-690 provides the following energy measurements:

kWh	kvarh	kVAh
Imp.	Imp.	kVAh Total
Exp.	Exp.	
Net	Net	
Total	Total	
Net Fundamental	Net Fundamental	
Total Fundamental	Total Fundamental	
Imp./Exp. TH	Imp./Exp. TH	
Net TH	Net TH	
Total TH	Total TH	
Imp./Exp. H02 to H63	Imp./Exp. H02 to H63	

Table 4-1 Energy Measurements

4.1.3 Demands

Demand is defined as the average power consumption over a fixed interval (usually 15 minutes), including present demand and predicted demand. The predicted demand is typically used for pre-alarm and helps users reducing power consumption. PMC-690 also provides recording of Max. Demand of Present and last month.

The PMC-690 has the following setup parameters which can set via communication or through the Front Panel:

Setup Parameter	Definition	Options
Demand Sync. Mode	**SLD** - Internally synchronized to the meter clock	0=SLD (default)
Demand Period	1 to 60 minutes. For example, if the **# of Sliding Windows** is set as 1 and the **Demand Period** is 15, the demand cycle will be 1×15=15min.	1 to 60 minutes Default=15
# of Sliding Windows	Number of Sliding Windows.	1 to 15 Default=1
Self-Read Time	The **Self-Read Time** allows the user to specify the time and day of the month for the Peak Demand Self-Read operation. The **Self-Read Time** supports three options: • A zero value means that the Self-Read will take place at 00:00 of the first day of each month. • A non-zero value means that the Self-Read will take place at a specific time and day based on the formula: Self-Read Time = Day * 100 + Hour where 0 ≤	Default=0xFFFF

	Hour ≤ 23 and 1 ≤ Day ≤ 28. For example, the value 1512 means that the Self-Read will take place at 12:00pm on the 15th day of each month. • A 0xFFFF value will disable the Self-Read operation and replace it with manual operation. A manual reset will cause the Max. Demand of **This Time** to be transferred to the Max. Demand of **Last Time** and then reset.	
Predicted Response	The Predicated Response shows the speed of the predicted demand output. A value between 70 and 99 is recommended for a reasonably fast response. Specify a higher value for higher sensitivity.	70 to 99 Default=70

Table 4-2 Setup Parameters for Demand

The PMC-690 provides the following Present Demand and Predicted Demand parameters:

Present Demand	Ua/Ub/Uc	ULN avg	Uab/Ubc/Uca	ULL avg	
	Ia/Ib/Ic	I avg	I4	U4	kVA Total
	kWa/kWb/kWc Imp./Exp.	kW Total Imp./Exp.	kvara/kvarb/kvarc Imp./Exp.	kvar Total Imp./Exp.	kVAa/kVAb/kVAc
	P.F.a/P.F.b/P.F.c	Total P.F.	Frequency	Ua/Ub/Uc Deviation	Uab/Ubc/Uca Deviation
	Ua/Ub/Uc Over Deviation	Uab/Ubc/Uca Over Deviation	Ua/Ub/Uc Under Deviation	Uab/Ubc/Uca Under Deviation	Freq Deviation
	U2/U0 Unbalance	I2/I0 Unbalance	Ia/Ib/Ic K Factor	I4 K Factor	Ia/Ib/Ic THD
	Ua/Uab THD	Ub/Ubc THD	Uc/Uca THD	U4 THD	I4 THD
	Ua/Uab TOHD	Ub/Ubc TOHD	Uc/Uca TOHD	U4 TOHD	Ia/Ib/Ic TOHD
	I4 TOHD	Ua/Uab TEHD	Ub/Ubc TEHD	Uc/Uca TEHD	U4 TEHD
	Ia/Ib/Ic TEHD	I4 TEHD			
	Ia Fund.	Ib Fund.	Ic Fund.	I4 Fund.	
Predicted Demand	Ua/Ub/Uc	ULN avg	Uab/Ubc/Uca	ULL avg	U4
	Ia/Ib/Ic	I avg	I4		
	kWa/kWb/kWc Imp./Exp.	kW Total Imp./Exp.	kvara/kvarb/kvarc Imp./Exp.	kvar Total Imp./Exp.	
	kVAa/kVAb/kVAc	Total kVA	P.F.a/P.F.b/P.F.c	Total P.F.	Frequency
Max. Demand	Ia/Ib/Ic		kW Total Imp./Exp.		
	kvar Total Imp./Exp.		Total kVA		

Table 4-3 Demand Parameters

4.2 Setpoints

The PMC-690 comes standard with 40 user programmable setpoints which provide extensive control by allowing a user to initiate an action in response to a specific condition. There are 24 Standard Setpoints and 16 High-Speed Setpoints. Typical setpoint applications include alarming, fault detection and power quality monitoring.

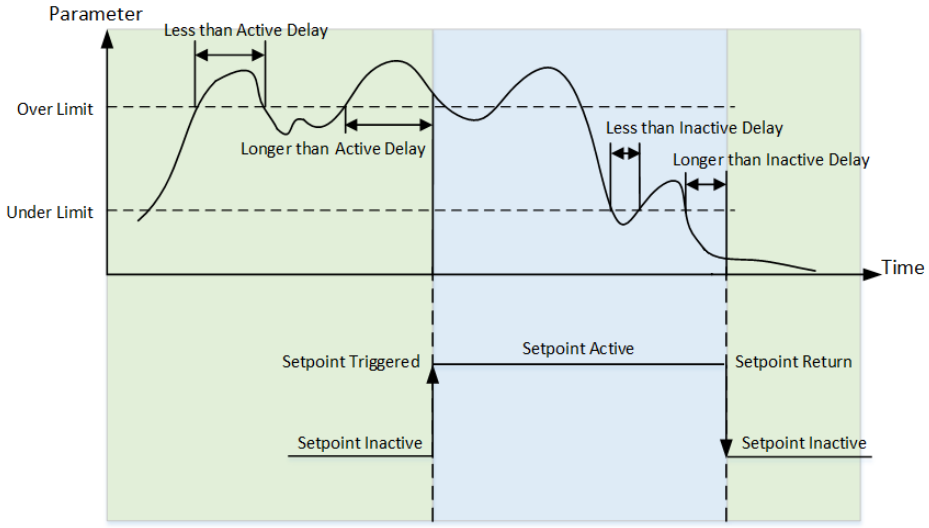


Figure 4-1 Over Setpoint

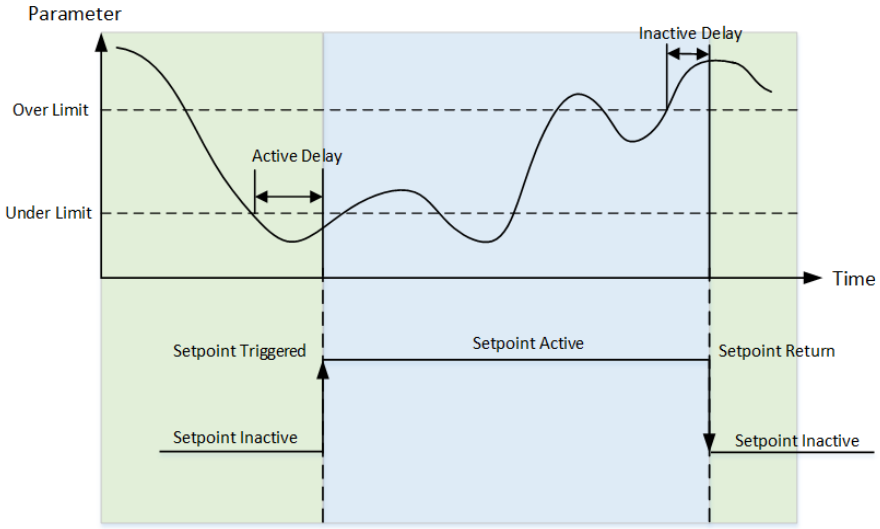


Figure 4-2 Under Setpoint

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

Setup Parameter	Definition	Options
Setpoint Type	Specify the monitoring condition -- Over Setpoint, Under Setpoint.	0=Over Setpoint* 1=Under Setpoint
Setpoint Parameter	Specify the parameter to be monitored.	See Table 4-5
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.	0*
Setpoint Inactive Limit	Specify the value that the setpoint parameter must go below for Over Setpoint or exceed for Under Setpoint for the setpoint to becomes inactive.	0*
Setpoint Active Delay	Specify the minimum duration that the setpoint condition must be met before the setpoint becomes active. An event will be generated and stored in the SOE Log. The range of the **Setpoint Active Delay** is between 0 and 9999 seconds for Standard Setpoints and between 0 and 9999 cycles for High Setpoints.	0* to 9999s
Setpoint Inactive Delay	Specify the minimum duration that the setpoint return condition must be met before the setpoint becomes inactive. An event will be generated and stored in the SOE Log. The range of the **Setpoint Inactive Delay** is between 0 and 9999 seconds for Standard Setpoints and between 0 and 9999 cycles for High Setpoints.	0* to 9999
Setpoint Trigger	Specify what action a setpoint can take when it becomes active. Please refer to Table 4-6 below for a list of Setpoint Triggers.	0*

*Default

Table 4-4 Description for Setpoint Parameters

Key	Parameter	Key	Parameter	Key	Parameter
1	ULN*	25	U TEHD	49	kW Exp. Total Demand
2	ULL*	26	I THD	50	kvar Exp. Total Demand
3	U4*	27	I TOHD	51	kVA Total Demand
4	Ia/Ib/Ic*	28	I TEHD	52	P.F. Total Demand
5	I4*	29	U TIHD	53	kW Imp. Total Pred. DMD
6	Reserved*	30	U TOIHD	54	kvar Exp. Total Pred. DMD
7	kW Total*	31	U TEIHD	55	kW Exp. Total Pred. DMD
8	kvar Total*	32	I TIHD	56	kvar Exp. Total Pred. DMD
9	kVA Total*	33	I TOIHD	57	kVA Pred. Total DMD
10	P.F. Total*	34	I TEIHD	58	P.F. Pred. Total DMD
11	U0 Unbalance	35	U TH RMS	59	Pst
12	U2 Unbalance	36	U TOH RMS	60	Plt
13	I0 Unbalance	37	U TEH RMS	61	Voltage Fluct.
14	I2 Unbalance	38	I TH RMS	0x0002xxxx	U HD02
15	U Fundamental	39	I TOH RMS	...	U HD03~HD62
16	I Fundamental	40	I TEH RMS	0x003fxxxx	U HD63
17	U Deviation	41	U TIH RMS	0x0081xxxx	U IHD01
18	U Over Deviation	42	U TOIH RMS	...	U IHD02~IHD62
19	U Under Deviation	43	U TEIH RMS	0x00bfxxxx	U IHD063
20	Frequency	44	I TIH RMS	0x02xxxxxx	I HD02

21	Frequency Deviation	45	I TOIH RMS	...	I HD03~HD62
22	Phase Reversal	46	I TEIH RMS	0x3fxxxxxx	I HD63
23	U THD	47	kW Imp. Total DMD	0x81xxxxxx	I IHD01
24	U TOHD	48	kvar Imp. Total DMD	...	I IHD02~IHD62
				0xbfxxxxxx	I IHD063

* High-Speed Setpoint Parameters

Table 4-5 Setpoint Parameters

Bit	Action
Bit0~Bit26	Reserved
Bit27	DWR
Bit28	WFR
Bit29	RMS Recorder
Bit30~Bit31	Reserved

Table 4-6 Setpoint Triggers

4.3 Power Quality Parameters

4.3.1 Power Frequency

The PMC-690 is capable of measuring **Frequency** accurate to ±0.005Hz or 0.01%. The measurement range is ±15% of $f_{nominal}$, which is 40Hz to 60Hz for 50Hz system and 48 Hz to 72Hz for 60Hz system.

The measurement method of **Frequency** is in accordance with Section 5.1 of IEC 61000-4-30 Standard for Class A performance. The PMC-690 also computes **Freq. Deviation** as per below:

Freq. Deviation = $((f - f_{nominal})/f_{nominal}) \times 100\%$ where $f_{nominal}$ is the Nominal Frequency

4.3.2 Magnitude of the Supply Voltage

The measurement method of the **Magnitude of the Supply Voltage** parameters is in accordance with Section 5.2 of IEC 61000-4-30 Standard for Class A performance. The measurement method is not intended for the detection and measurement of disturbances such as **Dips**, **Swells**, **Voltage Interruptions** and **Transients**. The RMS value includes voltage related measurements such as **Harmonics**, **Interharmonics**, **Mains Signaling**, etc.

4.3.3 Flicker

The PMC-690 provides the **Flicker** measurements in accordance with the IEC 61000-4-15 (2010) Standard for Class A performance using the recommended models for 120V and 230V, supporting both 50Hz and 60Hz for each model. Voltage Dips, Swells and Interruptions shall cause P_{st} and P_{lt} output values as well as "output 4 and 5 values" (see IEC 61000-4-15) to be **flagged**. Please refer to Section **4.3.13 Flagging Concept** for a detailed description.

Figure 4-3 Flicker Display

4.3.4 Supply Voltage Dips/Swells and Interruption

The PMC-690 supports the detection of the **Supply Voltage Dips/Swells** and **Interruption** using a method that is in accordance with Section 5.4 of IEC 61000-4-30 Standard for Class A performance.

The PMC-690 provides Dip/Swell and Interruption detection for voltage quality monitoring on a per phase basis and records an event in the **SOE Log**, which includes the event timestamp, event type, event characteristics and ITIC/SEMI F47 curve. Moreover, Dip/Swell detection for each phase voltage would trigger WFR, DWR and RMS Recorder.

4.3.4.1 Voltage Dip Evaluation

A **Voltage Dip** is characterized by a pair of data, the **Residual Voltage** (U_{res}) or **Depth** and **Duration**:

Parameter	Definition
Residual Voltage	The lowest $U_{rms\,(1/2)}$ value measured on any channel during the **Dip**
Depth	The difference between the **Reference Voltage** (either U_{din} or U_{sr}) and the **Residual Voltage**. It's generally expressed in percentage of the **Reference Voltage**.
Duration	The time difference between the beginning and the end of the **Voltage Dip**.

Table 4-7 Dip Evaluation Parameter

4.3.4.2 Voltage Swell Evaluation

A **Voltage Swell** is characterized by a pair of data, the **Maximum Swell Voltage Magnitude** and **Duration**:

Parameter	Definition
Max. Voltage Swell Magnitude	The largest $U_{rms\,(1/2)}$ value measured on any channel during the **Swell**.
Duration	The time difference between the beginning and the end of the **Voltage Swell**.

Table 4-8 Swell Evaluation Parameter

4.3.4.3 Sliding Reference Voltage (U_{sr})

If a sliding reference is chosen for the detection of **Voltage Dip** or **Swell**, this shall be calculated using a first order filter with a 1-min time constant. This filter is given by

$$U_{sr(n)} = 0.9967 \times U_{sr(n-1)} + 0.0033 \times U_{(10/12)rms}$$

where

$U_{sr(n)}$ is the present value of the **Sliding Reference Voltage**

$U_{sr(n-1)}$ is the previous value of the **Sliding Reference Voltage**

$U_{(10/12)rms}$ is the most recent 10/12-cycle r.m.s. value

4.3.4.4 Dip/Swell Setpoint

As per IEC 41000-4-30:

Voltage Swell Detection

On polyphase systems a Swell begins when the Urms(1/2) voltage of one or more channels rises above the Swell Threshold and ends when the Urms(1/2) voltage on all measured channels is equal to or below the Swell Threshold minus the Hysteresis voltage.

Voltage Dip Detection

On polyphase systems a Dip begins when the Urms(1/2) voltage of one or more channels is below the Dip Threshold and ends when the Urms(1/2) voltage on all measured channels is equal to or above the Dip Threshold plus the Hysteresis voltage.

The Dip/Swell Threshold and the Hysteresis Voltage are both set by the user according to the actual situation. The Dip/Swell Setpoint provides the following setup parameters which can be programmed via the Front Panel or over communications:

Parameter	Definition	Options/Value
Dip/Swell Reference Voltage	Udin / Usr	0*= $U_{din,}$ 1= U_{sr}
Dip/Swell Enable	Dip/Swell Enable.	0*=Disabled, 1=Enabled
Swell Limit	Specify the limit of Swell.	101 to 200(%) of reference voltage. Default=110%

Dip Limit	Specify the limit of Dip.	1 to 99(%) of reference voltage. Default=90%
Dip Hysteresis	Specify the return value of Dips.	1 to 1000 (x0.001 Udin). Default=5
Swell Hysteresis	Specify the return value of Swells.	1 to 1000 (x0.001 Udin). Default=5
Dip/Swell Trigger	Specify what action a setpoint can take when Dip / Swell become active	WFR* / DWR / RMS Recorder

*default

Table 4-9 Description for Dip/Swell Parameter

The **Dip Limit**, **Swell Limit**, **Voltage Interruption Threshold** and **Dip/Swell Return** values should be configured to meet the following criteria:

a) The **Voltage Interruption Threshold** (please see Section 4.3.5) shall be set below **Dip Limit**.
b) The **Swell Limit** and **Dip Limit** should associate with Voltage Rapid Changes in the minimum difference between the two steady-states. The absolute value of the difference between the Dip/Swell Limits and 100% must always be greater than the **Voltage Rapid Changes** in the minimum pressure difference between the two steady-states (actual percentage).
c) The **Dip/Swell Return** value should associate with Swell limit and Dip Limit, Dip/Swell return value (actual value) must be less than the Dip/Swell limit (Dip, Swell of the absolute difference of the minimum value and 100%).
d) Regardless of whether **Dip/Swell** is enabled, the conditions for a), b) and c) must always be met.

4.3.4.5 WFR of Dips/Swells Events

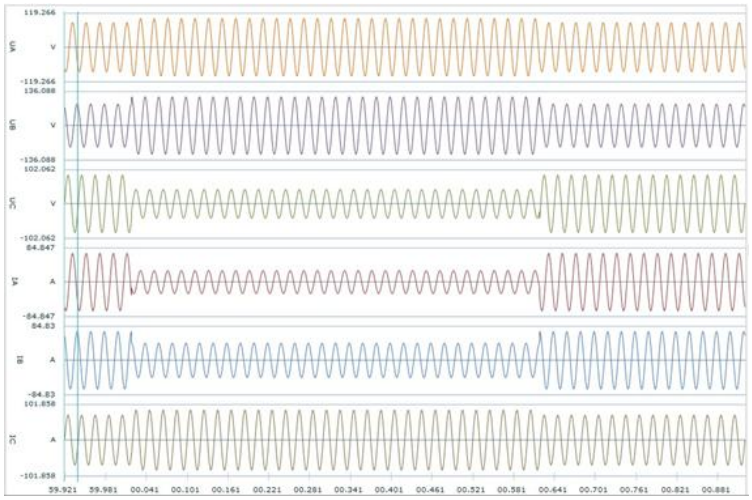


Figure 4-4 WFR of a Dip Event

4.3.5 Voltage Interruptions

The PMC-690 supports the detection of **Voltage Interruptions** using a method that is in accordance with Section 5.5 of IEC 61000-4-30 Standard for Class A performance.

4.3.5.1 Voltage Interruption Evaluation

On polyphase systems, a Voltage Interruption begins when the $U_{rms\,(1/2)}$ voltages of all channels fall below the **Interruption Threshold** and ends when the $U_{rms\,(1/2)}$ voltage on any one channel is equal to, or greater than, the **Interruption Threshold** plus the **Hysteresis**.

The **Interruption Threshold** and **Hysteresis** are both set by the user according to the use. The **Interruption Threshold** shall not be set below the uncertainty of **Residual Voltage** measurement plus the value of **Hysteresis**. Typically, **Hysteresis** is equal to 2% of U_{din}. The **Interruption Threshold** can, for example, be set to 5% of U_{din}.

Note:

For polyphase systems, an interruption occurs when the voltage falls below the Interruption threshold on all phases (otherwise, it is considered to be a dip).

The **Duration** of a voltage interruption is the time difference between the beginning and the end of the **Voltage Interruption**.

4.3.5.2 Voltage Interruption Setpoint

The Voltage Interruption Setpoint provides the following setup parameters which can be programmed via the Front Panel or over communications:

Parameter	Definition	Options/Value
Interruption Limit	Specify the limit of Interruption.	50 to 0(%) of reference voltage, default=10%
Interruption Hysteresis	Specify the return value of Interruption.	1 to 1000 (x0.001 Udin), default=5
Interruption Trigger	Specify what action a setpoint can take when Interruption become active	WFR / DWR / RMS Recorder, default=WFR

Table 4-10 Description for Interruption Setpoint Parameter

4.3.6 Voltage Transients

The PMC-690 provides the capability for detecting voltage transient disturbances using the sliding-window method according to IEC 61000-4-30 with a maximum resolution of 40μs (@50Hz) for the standard. The PMC-690 provides transient detection for voltage quality monitoring and records an event in the **SOE Log**, which includes the event timestamp event type, and event characteristics. In addition, transient would trigger WFR, DWR and RMS Recorder.

4.3.6.1 Transient Setpoint

The Transient Setpoint provides the following setup parameters which can be programmed via the Front Panel or over communications:

Setup Parameter	Definition	Options
Transient Enable	Transient enable or disable.	Disabled / Enabled*
Transient Limit	Specify the limit of Transient.	5% to 500% Udin, 35*
Transient Trigger	Specify what action a setpoint can take when Transient become active.	WFR / DWR / RMS Recorder, default=WFR

Table 4-11 Setup parameters for Transient Setpoint

4.3.6.2 WFR of Transient Events

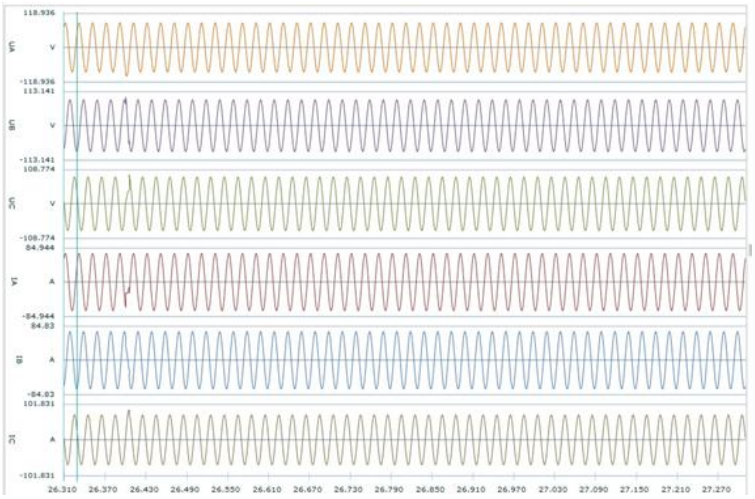


Figure 4-5 WFR of a Transient Event

4.3.7 Supply Voltage Unbalance

The PMC-690 provides both the Zero Sequence and Negative Sequence Voltage and Current Unbalance measurements using Symmetrical Components and in accordance with Section 5.7 of IEC 61000-4-30 Standard for Class A performance.

$$V2\ \text{Unbalance} = \frac{V2}{V1} x100\%, \quad I2\ \text{Unbalance} = \frac{I2}{I1} x100\% \quad \text{(Negative Sequence Unbalance)}$$

$$V0\ \text{Unbalance} = \frac{V0}{V1} x100\%, \quad I0\ \text{Unbalance} = \frac{I0}{I1} x100\% \quad \text{(Zero Sequence Unbalance)}$$

where

V0, V1, V2 are the Zero, Positive and Negative Sequence Components for Voltage, respectively.

and

I0, I1, I2 are the Zero, Positive and Negative Sequence Components for Current, respectively.

4.3.8 Harmonics and Interharmonics

The PMC-690 provides the Harmonics and Interharmonics measurements in accordance with Sections 5.8 and 5.9 of IEC 61000-4-30 Standard for Class A performance using a 10/12 cycle gapless centered harmonic sub-group measurement, denoted C_{ng} for Harmonics and $C_{n\text{-}200\text{-}ms}$ for Interhamonics, as per IEC 61000-4-7:2002.

There are three methods to calculate the Harmonic Distortion (HD):

a) Fundamental Method:

Voltage K^{th} Harmonic/Interharmonic Distortion= $\frac{U_k}{U_1} X100\%$ where U_1 is the Fundamental Voltage

Current K^{th} Harmonic/Interharmonic Distortion= $\frac{I_k}{I_1} X100\%$ where I_1 is the Fundamental Current

b) RMS Method:

Voltage K^{th} Harmonic /Interharmonic Distortion= $\frac{U_k}{\sqrt{\sum_{K=1}^{\infty} U_K^{\,2}}} X100\%$ where the denominator is the RMS

Current K^{th} Harmonic/Interharmonic Distortion= $\frac{I_k}{\sqrt{\sum_{K=1}^{\infty} I_K^{\,2}}} X100\%$ where the denominator is the RMS

c) Nominal Method:

Voltage K^{th} Harmonic/Interharmonic Distortion= $\frac{U_k}{U_{nom}} X100\%$ where U_{nom} is the Nominal Voltage

Current K^{th} Harmonic/Interharmonic Distortion= $\frac{I_k}{I_{nom}} X100\%$ where I_{nom} is the Nominal Current

The PMC-690 also provides, in addition to Voltage Harmonics, measurements for Current Harmonics, K-Factor, Crest Factor, Power Harmonics and Energy Harmonics.

K-Factor and Crest Factor

K-Factor is defined as the weighted sum of the harmonic load currents according to their effects on

transformer heating, as derived from ANSI/IEEE C57.110. A **K-Factor** of 1.0 indicates a linear load (no harmonics). The higher the **K-Factor**, the greater the harmonic heating effects.

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

I_h = h_{th} Harmonic Current in RMS

h_{max} = Highest harmonic order

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

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

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

X_{rms} = RMS value

4.3.8.1 Voltage and Current Harmonics and Interharmonics

The following table illustrates the Voltage and Current Harmonics and Interharmonics measurements available on the PMC-690:

	Ua	Ub	Uc	U4	Ia	Ib	Ic	I4
THD, TOHD, TEHD (%)	▪	▪	▪	▪	▪	▪	▪	▪
HD01 to HD63 (%)	▪	▪	▪	▪	▪	▪	▪	▪
TH, H01 to H63 (RMS)	▪	▪	▪	▪	▪	▪	▪	▪
TOH/TEH/DC RMS	▪	▪	▪	▪	▪	▪	▪	▪
Current K-Factor	--	--	--	--	▪	▪	▪	▪
Crest Factor	▪	▪	▪	▪	▪	▪	▪	▪
IHD01 to IHD63 (%)	▪	▪	▪	▪	▪	▪	▪	▪
IH01 to IH63 (RMS)	▪	▪	▪	▪	▪	▪	▪	▪
TIHD, TOIHD, TEIHD (%)	▪	▪	▪	▪	▪	▪	▪	▪
Phase Angle H01 to H63	▪	▪	▪	▪	▪	▪	▪	▪

Table 4-12 Voltage and Current Harmonics and Interharmonics Measurements

4.3.8.2 Power Harmonics

The following table illustrates the Power Harmonic measurements available on the PMC-690:

	Ua	Ub	Uc	U4	Ia	Ib	Ic	I4
kW/kvar/kVA TH	▪	▪	▪	--	▪	▪	▪	--
PF TH	--	--	--	--	--	--	--	--
kW/kvar/kVA Fundamental	▪	▪	▪	--	▪	▪	▪	--
PF Fundamental	▪	▪	▪	--	▪	▪	▪	--
kW/kvar/kVA H02 to H63	▪	▪	▪	--	▪	▪	▪	--
PF H02 to H63	▪	▪	▪	--	▪	▪	▪	--

Table 4-13 Power Harmonics Measurements

4.3.8.3 Harmonic Setup Parameters

The Harmonic provides the following setup parameters which can be programmed via the Front Panel or over communications:

Setup Parameter	Definition	Options/Default*
Harmonics Calculation	Specifies the Harmonics calculation methods, please refer to above introduction.	0*=% of Fundamental, 1=% of RMS 2=% of Nominal
Statistical Harmonic Calculation	Specifies the mode of calculating harmonic.	0*=Subgroup, 1=Group
Order of Harmonic Calculation	Specifies the order of harmonic statistic.	2 to 63*

Table 4-14 Setup parameters for Harmonic

4.3.8.4 Screen Captures of Harmonics Measurements

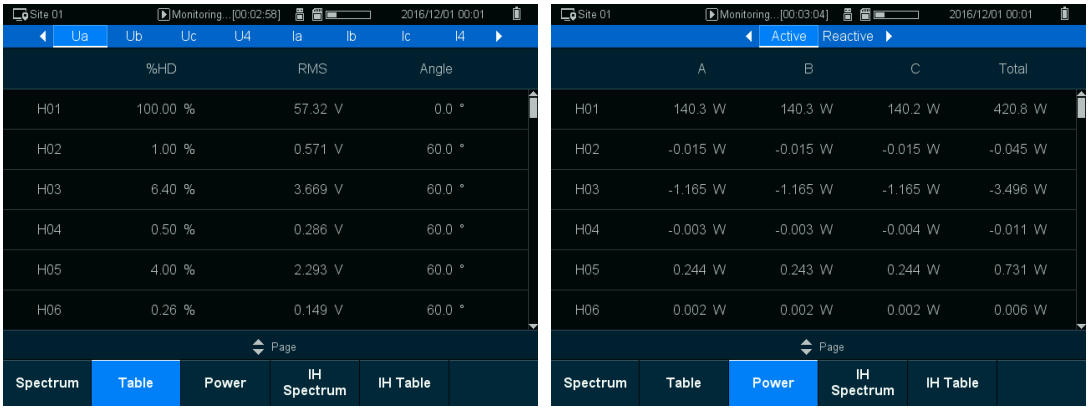


Figure 4-6 Harmonic Measurements Display on Front Panel

4.3.9 Mains Signalling Voltage (MSV)

As per 5.10 of IEC 61000-4-30:

Mains Signaling Voltage is RMS voltage of mains signal.

Mains signaling voltage measurement shall be based on

- *Either the corresponding 10/12-cycle r.m.s. value interharmonic bin*
- *Or the r.m.s. of the four nearest 10/12-cycle r.m.s. value interharmonic bins*

The beginning of a signaling emission shall be detected when the measured value of the concerned interharmonic exceeds a threshold. The measured values are recorded during a period of time specified by the user, in order to give the level and the sequence of the signal voltage.

The user must select a detection threshold above 0.1% U_{din} as well as the length of the recording period up to 120s.

The PMC-690 provides 3 groups of waveform recorder for MSV in accordance with Section 5.10 of IEC 61000-4-30 Standard for Class A performance. Each MSV WR will be recorded in SOE Log and EN50160 report.

The MSV provides the following setup parameters which can be programmed through the Front Panel or communication:

Setup Parameter	Value
MSV #x Enable	0 = Enable, 1 = Disable, default=0
MSV #x Frequency	50 Hz: 600 to 30000 (x0.1Hz), 60 Hz: 700 to 30000 (x0.1Hz), default=10000
MSV #x Limit	3 to 1000 (x0.001Udin), default=50 (x0.001Udin)

Table 4-15 Mains Signal Voltage Setup Parameters

4.3.10 Voltage Deviation

As per Section 5.12 of IEC 61000-4-30:

The 10/12-cycle r.m.s value Urms can be used to assess the underdeviation and overdeviation parameters in per cent of Udin. The underdeviation Uunder and overdeviation Uover parameters are determined by the following equations. w:

Voltage Overdeviation (%)

$$U_{over} = 0 \qquad \text{if } U_{rms} < U_{din}$$

$$U_{over} = ((U_{rms} - U_{din}) / U_{din}) \times 100\% \qquad \text{if } U_{rms} \geq U_{din}$$

Voltage Underdeviation (%)

$$U_{under} = 0 \qquad \text{if } U_{rms} > U_{din}$$

$$U_{under} = ((U_{din} - U_{rms}) / U_{din}) \times 100\% \qquad \text{if } U_{rms} \leq U_{din}$$

The PMC-690 is capable of measuring Voltage accurate to 0.1% and monitoring Voltage deviation on line. In addition, the Voltage deviation can be set as setpoint. The following screen captures illustrates

the display of the Deviation parameters in the Front Panel.

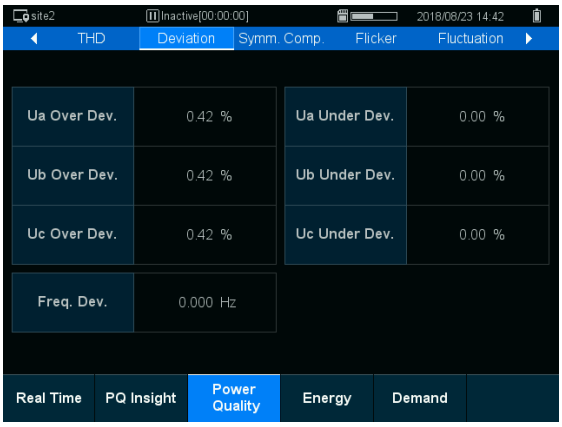


Figure 4-7 Voltage Deviation Display on Front Panel

4.3.11 Rapid Voltage Changes (RVC)

As per IEC 61000-4-30:

A rapid voltage change is a quick transition in RMS voltage between two steady-state conditions.

To measure rapid voltage change, threshold must be defined for each of the following: the minimum rate of change, the minimum duration of the steady-state conditions, the minimum difference in voltage between the two steady-state conditions, and the steadiness of the steady-state conditions.

The voltage during a rapid voltage change must not exceed the voltage dip and/or the voltage swell threshold, as it would otherwise be considered as a voltage dip or swell.

The characteristic parameter of the rapid voltage change is the difference between the steady-state value reached after the change and the initial steady-state value.

The PMC-690 provides the ability to capture RVC in accordance with the IEC 61000-4-30 Standard and records in SOE Log and High-speed Recording with event timestamp, event type, and event characteristics.

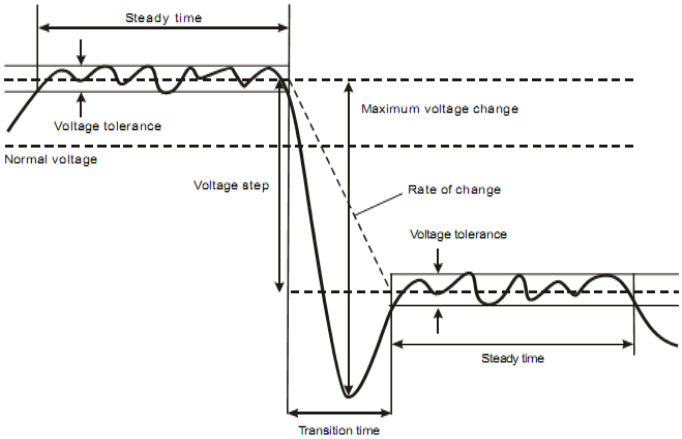


Figure 4-8 Rapid Voltage Changes

The RVC Setpoint provides the following setup parameters which can be programmed through the Front Panel or over communications:

Setup Parameter	Definition	Options/Default*
RVC Enable	Specifies if RVC Setpoint is enabled.	Disabled* / Enabled
Detection Mode	Specifies detection mode of the RVC.	0*= Based on Steady-state V 1= Based on Maximum V Change
Voltage Tolerance	Maximum allowable fluctuation between the maximum and minimum voltage values during the steady state condition. For	1 to 1000 (x0.001Udin), 2*

	example, the voltage tolerance is 0.5% that is the allowable fluctuation max voltage is 0.005Vll $_{nominal.}$	
Steady-State Duration	Duration to reach the steady-state condition.	1 to 50 (x0.1s), 10*
Min. of V Change Step	Minimum voltage step change between two steady-state conditions	1 to 1000 (x0.001Udin), 50*
Min. of V Change Rate	Minimum rate of change between two steady-state conditions.	1 to 100 (x0.01Udin/s), 5*
RVC Trigger	Specify what action a setpoint can take when RVC become active.	WFR* / DWR / RMS Recorder

Table 4-16 Setup Parameters for RVC Setpoint

To reach the steady-state condition, the voltage fluctuation (voltage difference in RMS between Max. and Min.) must be less than **Voltage Tolerance** for a period longer than **Steady-State Duration.**

For the RVC Setpoint to trigger, the following conditions must be met:

a) The voltage step or the Maximum voltage change between two steady-state conditions is greater than **Min. of V Change Step.**
   - For the **Based on Steady-state V** mode, the Voltage Step is determined by the following equation:

$$\Delta U_{step} = \frac{ABS\left(U_{last\ steady} - U_{steady}\right)}{U_{rate}} \times 100\%$$

   - For the **Based on Maximum V Change** mode, the Maximum Voltage Change calculated based on the following equation:

$$\Delta U_{max} = \frac{ABS\left(MAX\left(MAX\left(\left(U_{max\ charge} - U_{last\ steady}\right), \left(U_{min\ charge} - U_{last\ steady}\right)\right), MAX\left(\left(U_{max\ charge} - U_{steady}\right), \left(U_{min\ charge} - U_{steady}\right)\right)\right)\right)}{U_{rate}} \times 100\%$$

where

Usteady represents the Steady Voltage of This Steady State;

UlastSteady represents the Steady Voltage of Last Steady State;

Urate represents the Nominal Voltage;

UmaxChange is the Max. Voltage Value during the whole Rapid Voltage Change duration

UminChange is the Min. Voltage Value during the RVC duration

b) The rate of change between two steady-state conditions is greater than **Min. of V Change Rate.**

c) The voltage during a rapid voltage change must not exceed the voltage dip and/or the voltage swell threshold, as it would otherwise be considered as a voltage dip or swell.

4.3.12 Inrush Current

As per IEC 61000-4-30:

The inrush current begins when the $I_{half\ cycle\ rms}$ *current rises above the* ***Inrush Threshold****, and ends when the* $I_{half\ cycle\ rms}$ *current is equal to or below the* ***Inrush Threshold*** *minus a user-selected* ***Inrush Hysteresis*** *value.*

The inrush current can be further characterized by

- *the time duration between the beginning and the end of the inrush current*
- *the maximum value of inrush current measured* $I_{half\ cycle\ rms}$ *value*
- *the square root of the mean of the squared* $I_{half\ cycle\ rms}$ *values measured during the inrush duration*

Inrush current refers to the maximum instantaneous current drawn by an electrical device, often several times above their normal full-load current (I_{Normal}), such as turning on of an AC electric motor or the energization of a transformer or a capacitor bank. The higher than normal inrush current typically only lasts for a few cycles before returning to their steady state condition.

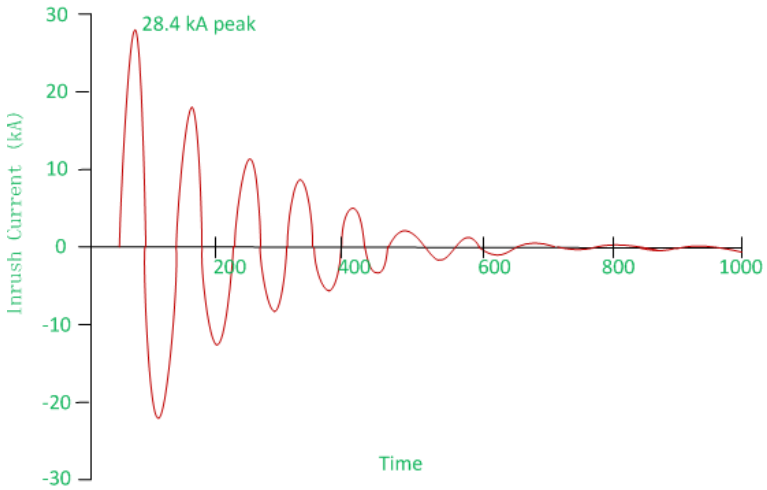


Figure 4-9 Inrush Current

The PMC-690 provides the capability for detecting and the capturing of the inrush current transient disturbance that is in accordance with the IEC 61000-4-30 Standard for Class A performance.

The PMC-690 provides following programmable parameters for Inrush Current Setpoint which can be set via the Front Panel or through communication.

Setup Parameters	Definition	Options/Default*
Inrush Current Enable	Specifies if inrush current setpoint is enabled.	0*=Disabled, 1=Enabled
Inrush Current Threshold	Defines the range that current must exceed for the Inrush Current becomes active.	100% to 500% (Default=120% I_{Normal})
Inrush Current Hysteresis	Defines the limit, which is equal to Inrush Threshold - Inrush Hysteresis, for the $I_{half\ cycle\ rms}$ current below which the inrush transient end.	1-1000(x0.1% I_{Normal}) (Default = 10)
Inrush Current Trigger	Specify what action a setpoint can take when Inrush Current become active	WFR* / DWR / RMS Recorder

Table 4-17 Setup Parameters for Inrush Current Setpoint

4.3.13 Flagging Concept

As per Section 4.7 of IEC 61000-4-30:

During a dip, swell, or interruption, the measurement algorithm for other parameters (for example, frequency measurement) might produce an unreliable value. The flagging concept therefore avoids counting a single event more than once in different parameters (for example, counting a single dip as both a dip and a frequency variation) and indicates that an aggregated value might be unreliable.

Flagging is only triggered by dips, swells and interruptions. The detection of dips and swells is dependent on the threshold selected by the user, and this selection will influence which data are "flagged".

The flagging concept is applicable for Class A measurement performance during measurement of power frequency, voltage magnitude, flicker, supply voltage unbalance, voltage harmonics, voltage interharmonics, mains signalling and measurement of underdeviation and overdeviation parameters.

If during a given time interval any value is flagged, the aggregate value indicating that value shall also be flagged. The flagged value shall be stored and also included in the aggregation process, for example, if during a given time interval any value is flagged the aggregated value that includes this value shall also be flagged and stored.

The PMC-690 is a certified IEC 61000-4-30 Class A device so it supports the **Flagging Concept**.

Flagging Setup The **Flagging Setup** register (40825) defines if ***Flagging*** is enabled for a particular type of Statistical Log as illustrated in the following table, with a bit value of 1 meaning that ***Flagging*** is enabled for the corresponding Log type.

Bit 15~Bit 4	Bit 3	Bit 2	Bit1	Bit 0
Reserved	EN50160	Min. Log	Max. Log	SDR Log

Table 4-18 Flagging Setup Register (40825)

Flagging Status This register indicates if a particular type of data has been ***flagged*** with a bit value of 1 meaning ***flagged*** and 0 meaning ***not flagged***. The following table illustrates the details of the **Flagging Status** register for real-time data.

Bit	Description		Bit	Description	
B0	Basic Measurement	Dip	**B8**	Pst.	Dip
B1		Swell	**B9**		Swell
B2		Interruption	**B10**		Interruption
B3		Over Current Limit	**B11**		Reserved
B4	Freq.	Dip	**B12**	Plt.	Dip
B5		Swell	**B13**		Swell
B6		Interruption	**B14**		Interruption
B7		Reserved	**B15**		Reserved

Table 4-19 Flagging Status Register (0080)

Statistical Log For any Statistical Log (such as SDR Log, Max. Log, Min. Log and/or EN50160 Log), its log entry will be discarded and will not be included in the statistical evaluation if any data within the log entry has been ***Flagged*** while the bit representing the particular Log type in the **Flagging Setup** register is enabled (set to 1).

Real-time Data Real-time data via Modbus communications will only refresh after the **Flagging Status** register has been read if Bit 15 of the **Flagging Setup** register is enabled (set to 1) and if ***Flagging*** is active. Conversely, real-time data via Modbus communications will automatically refresh if Bit 15 of the **Flagging Setup** register is disabled (set to 0) so there is no need to read the **Flagging Status** register before reading the real-time data.

Real-time data includes Frequency, Voltage, Current, Unbalance, Harmonics and Interharmonics measurements.

4.3.14 EN50160 Compliance Report

The EN50160 Standard defines the ***Voltage Characteristics of Electricity Supplied by Public Distribution Systems***. It provides the limits within which any customer can expect voltage characteristics to remain. For a complete definition of the non-conformity level for each of the following EN50160 parameters, please refer to the EN50160 Standard document.

The PMC-690 can measure, summarize data and statistics relevant data in accordance with the EN50160 standard. In addition, the device is capable of creating a report per week for the following PQ parameters and the report can be stored for one year.

- Power Frequency, including Maximum and Minimum
- Supply Voltage Variations, including Maximum and Minimum
- Flicker, including Max./Min. and CP95
- Voltage Unbalance, including Max./Min. and CP95
- Harmonic Voltage, including Max./Min., Avg. and CP95
- Mains Signal Voltage, including Max./Min. and CP95
- Rapid Voltage Changes
- Swells and Dips, statistic parameters classified according to characteristic voltage and duration
- Interruptions, statistics parameters classified according to duration
- Transients

The programming of EN50160 Log only supports communications, please refer to **Section 5.8.12** to set parameters for each item. EN50160 Report can be accessed through the Front Panel or via

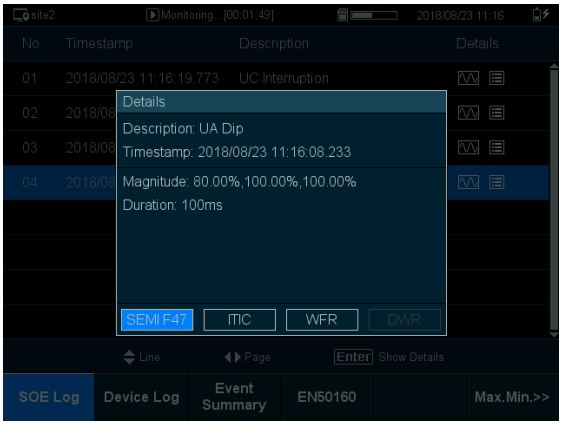
communications. The following screen capture illustrate the PMC-690's EN50160 Compliance Report available on its Front Panel.

Figure 4-10 EN50160 Report Display via Front Panel

4.3.15 ITIC/SEMI F47 Curve

The ITIC Curve describes an AC input voltage which typically can be tolerated (no interruption in function) by most Information Technology Equipment (ITE), while SEMI F47 is specification for Semiconductor Processing Equipment Voltage Dip Immunity, which specifies the required voltage Dip tolerance for semiconductor fabrication equipment.

PMC-690's Front Panel can display ITIC or SEMI F47 curve for PQ Events. Navigate to SOE Log page in the Front Panel, move cursor to curve in the Front Panel to display ITIC or SEMI F47 curve.



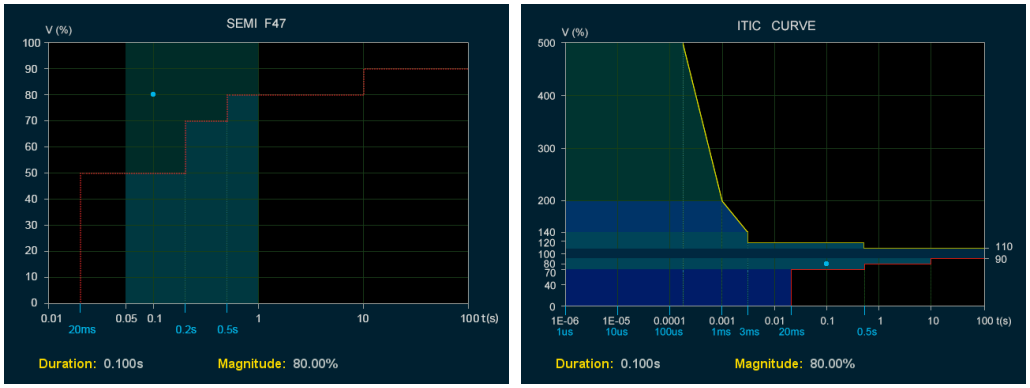


Figure 4-11 SMEI F47 and ITIC Curves

4.3.16 RMS Change Detection

The PMC-690 is capable of detecting Voltage and Current RMS Change which can help monitoring parameter changes and quick response to improve maintenance. RMS Changes are stored as events in the SOE Log.

The RMS Change Detection can be programmed via the Front Panel or through communications and have the following setup parameters:

Setup Parameter	Definition	Options/Default*
Voltage Enable	Specify if Voltage RMS Change detection is enabled.	Disabled */ Enabled
Voltage Threshold	Specify the range that Voltage must exceed for the Voltage RMS Change would be detected.	0~999,999,999 (x0.01V) Default=1000
Current Enable	Specify if Current RMS Change detection is enabled.	Disabled */ Enabled
Current Threshold	De Specify fines the range that current must exceed for the Current RMS Change would be detected.	0~999,999,999 (x0.01A) Default=100
RMS Change Trigger	Specify what action can take when the RMS Change is detected.	WFR

Table 4-20 RMS Change Setup Parameters

Bit	Action
Bit0~Bit26	Reserved
Bit27	DWR
Bit28	WFR
Bit29	RMS Recorder
Bit30~Bit31	Reserved

Table 4-21 RMS Change Triggers

4.4 Data Logging

4.4.1 Device Log and SOE Log

The PMC-690's **Device Log** and **SOE Log** can store up to 1024 events in its non-volatile memory. The **Device Log** consists of such events as power-on, power-off, sites management and setup changes for the device, as well as system operations, while **SOE Log** consists of setpoints, WFR and RMS Recorder Dip/Swell, Transient, Inrush Current, Rapid Voltage Changes and Mains Signaling Voltages for monitoring sites. For detailed event and log description, please refer to **Appendix B**. Each event record includes the event classification, its relevant parameter values and a timestamp in 1ms resolution.

All events can be retrieved via communications. If there are more than 1024 events, the newest event will replace the oldest event on a FIFO basis.

4.4.2 Statistical Data Recorder (SDR)

The PMC-690 provides a comprehensive **SDR** for IEC 61000-4-30 parameters that is un-matched by other PQ devices. The **SDR** records the Min., Max., Avg. (also known as Demand) and CP95 for each parameter. There are 5 **SDR**s of 64 parameters each that can be individually programmed to record different parameters at different time intervals, which may vary from 1 to 60 minutes. The PMC-690 can retain the SDR Logs for 450 days when the recording interval is set to 15 minutes. The recorded data is stored in non-volatile memory and will not suffer any loss in the event of a power failure. If storage is full, the newest log will replace the oldest on a first-in-first-out basis.

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

Setup Parameters	Value/Option	Default
Recording Interval	1 to 60 minutes, (0 = inactive)	3
Recording Mode	0=Stop-When-Full / 1=First-In-First-Out	1

Number of Parameters	0 to 64 (user defined)	64
Parameters 1 to 64	See **Section 5.8.10**	

Table 4-22 Setup Parameters for SDR

The **SDR Log** is only operational when the values of **Recording Interval** and **Number of Parameters** are all non-zero.

4.4.3 Max./Min. Log

The PMC-690 provides 4 Max./Min. Logs and capable of recording 20 parameters each since Last Reset (This Month) or before Last Reset (Last Month). Each record includes relevant parameter values and timestamp. The recorded data is stored in non-volatile memory and will not suffer any loss in the event of a power failure. All Max./Min. Log can be accessed over communication.

The PMC-690's Max./Min. Log can record the following parameters:

Max./Min. Parameters					
Ua	Ub	Uc	Uab	Ubc	Uca
Ia	Ib	Ic	kW Total	kvar Total	kVA Total
P.F. Total	Ua Pst	Ub Pst	Uc Pst	Ua Plt	Ub Plt
Uc Plt	Ua Over Deviation	Ub Over Deviation	Uc Over Deviation	Uab Over/Under Deviation	Ubc Over/Under Deviation
Uca Over/Under Deviation	Freq. Deviation	U0 Unbal.	U2 Unbal.	I0 Unbal.	I2 Unbal.
U4 RMS	I4 RMS	U1	U0	I1	I0
Ua THD	Ub THD	Uc THD	Ia THD	Ib THD	Ic THD
kW Total TH	kvar Total TH	kVA Total TH	P.F. Total TH	kW Total H01	kvar Total H01
kVA Total H01	P.F. Total H01	Frequency	Ia/Ib/Ic/I4 K-Factor	U2	I2

Table 4-23 Max./Min. Measurements

The programming of the Max./Min. Log is only supported over communications. Each Max./Min. Log provides the following setup parameters:

Parameters	**Value**
Self-Read time	▪ A zero value means that the Self-Read will take place at 00:00 of the first day of each month. (Default) ▪ A non-zero value means that the Self-Read will take place at a specific time and day based on the formula: Self-Read Time = Day * 100 + Hour where 0 ≤ Hour ≤ 23 and 1 ≤ Day ≤ 28. For example, the value 1512 means that the Self-Read will take place at 12:00pm on the 15th day of each month. ▪ A 0xFFFF value will disable the Self-Read operation and replace it with manual operation. A manual reset will cause the Max./Min. Log of **This Month** to be transferred to the Max/Min. Log of **Last Month** and then reset. The terms **This Month** and **Last Month** will become **Since Last Reset** and **Before Last Reset**.
Number of Parameters	0 to 20
Parameter 1 to 20	All real-time data can be configured to parameters, please see **Section 5.8.11**

Table 4-24 Setup Parameters for Max./Min. Log

4.4.4 Pst Log

The PMC-690's Pst Log can store up to 52560 events per 10 minutes about voltage Pst in its non-volatile memory. Each event record includes the event classification, its relevant parameter values and a timestamp in 1ms resolution.

All events can be retrieved via communications for display. If there are more than 52560 events, the newest event will replace the oldest event on a first-in-first-out basis. The Pst Log can be reset from the front panel or via communications.

4.4.5 Plt Log

The PMC-690's Plt Log can store up to 4380 events per 2 hours about voltage Plt in its non-volatile memory. Each event record includes the event classification, its relevant parameter values and a timestamp in 1ms resolution.

All events can be retrieved via communications for display. If there are more than 4380 events, the newest event will replace the oldest event on a first-in-first-out basis. The Plt Log can be reset from the front panel or via communications.

4.4.6 Waveform Recorder (WFR)

The PMC-690 provides one group of **WFR** with a total of 500 entries. **WFR** Log can simultaneously capture 3-phase voltage and current signals. **WFR** on the PMC-690 can be triggered by Dip/Swell, Transient, Inrush Current, Rapid Voltage Changes, Setpoints or manually through communications. The manual trigger command has the highest priority. When WFR is already in progress, other WFR commands will be ignored until the present recording has completed. The WFR has a capacity of 500 entries organized in a FIFO basis, with the newest waveform log replacing the oldest one. The WFR log is stored in the device's non-volatile memory with COMTRADE or PQDIF file format and will not suffer any loss in the event of power failure. The log can be accessed via communication.

The programming of the **WFR** is supported over the Front Panel or communications. The **WFR** provides the following setup parameters:

Setup Parameters	Value/Option/Default*
Consecutive Recording Depth	1* to 7
# of Samples	0*=16 Samples/640 Cycles 2=64 Samples/160 Cycles 5=256 Samples/40 Cycles 1=32 Samples/320 Cycles 3=128 Samples/80 Cycles 6=512 Samples/20 Cycles
Pre-fault Cycle of WFR	2 to 384 Cycles (16 Samples/640 Cycles) 2 to 192 Cycles (32 Samples/320 Cycles) 2 to 96 Cycles (64 Samples/160 Cycles) 2 to 48 Cycles (128 Samples/80 Cycles) 2 to 24 Cycles (256 Samples/40 Cycles) 2 to 12 Cycles (512 Samples/20 Cycles)
Pre-fault Cycles of DWR	5 to 10 Cycles (@ 512 Samples/Cycle)

Table 4-25 Setup Parameters for WFR

All waveform recorder logs can be retrieved via communications by our **DiagSys** analyzing software.

4.4.7 Disturbance Waveform Recorder (DWR)

The PMC-690 provides disturbance waveform recording including Ua/Ub/Uc/U4 and Ia/Ib/Ic/I4. The disturbance waveform recording can be triggered by dip, swell, transient, rapid voltage changes, setpoint event and communications. The Disturbance Waveform data is stored in the device's non-volatile memory with COMTRADE file format and will not suffer any loss in the event of power failure. The PMC-690 can store DWR logs up to 500 entries. Each disturbance waveform recording consists of the following stages.

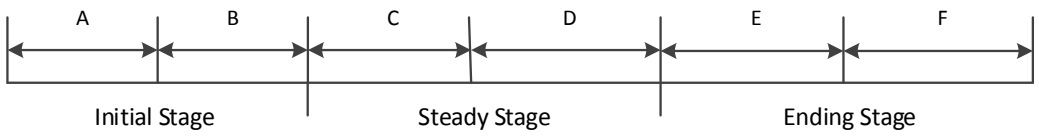


Figure 4-12 Disturbance Location

Stage	Description	Recording Length	Recording Frequency
A	Pre-Fault cycles for the Initial Stage	5 to 10 cycles	512 Samples/Cycle
B	Waveform Recording of the Initial Stage	25 to 30 cycles Initial Stage (A+B) up to 35 cycles	512 Samples/Cycle

C	Waveform Recording during the Steady Stage	0 to 150 cycles	16 Samples/Cycle
D	RMS Recording during the Steady Stage	0 to 18,000 cycles	1 Sample/Cycle
E	Pre-Fault cycles of the Ending Stage	2 cycles	512 Samples/Cycle
F	Waveform Recording of the Ending Stage	13 cycles	512 Samples/Cycle

Table 4-26 Time frames of waveform

Notes:

1) For stages C and D:

If **C** < 150 cycles, the **D** would be 0.

If **C** = 150 cycles, the **D** stage data will be recorded.

If **D** = 18,000 cycles, the recording of **D** stage data end even if disturbance does not finish. After 10 minutes, the **E** and **F** stage data will be recorded.

2) The following figure shows an example of Disturbance Waveform Recording.

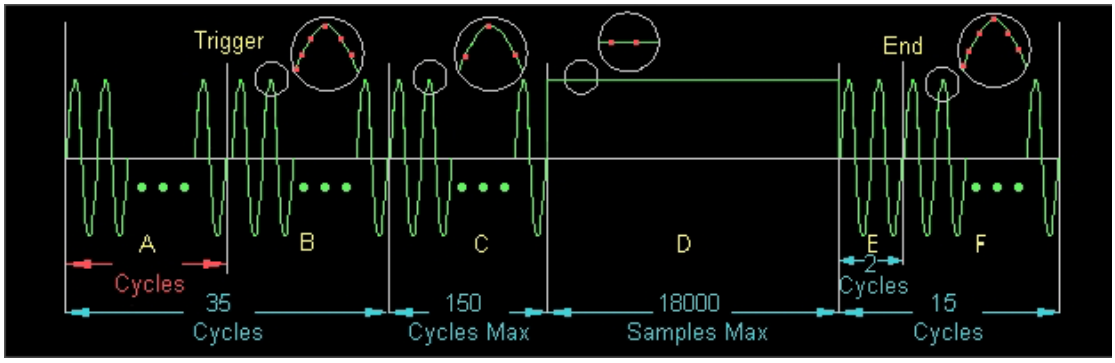


Figure 4-13 Disturbance Waveform Recorder

4.4.8 RMS Log

The PMC-690's **RMS Log** can store up to 500 events for each monitoring site in its non-volatile memory. The **RMS Log** records RMS @1/2 cycle for parameters including 3-phase Voltage and 3-phase Current. **RMS Log** on the PMC-690 can be triggered by Dip/Swell, Transient, Inrush Current, Rapid Voltage Changes, Setpoints or manually through communications. The **RMS Log** has a capacity of 500 entries organized in a FIFO basis, with the newest RMS log replacing the oldest one. The RMS log is stored in the device's non-volatile memory with COMTRADE file format and will not suffer any loss in the event of power failure. The log can be accessed via communication.

The programming of the **RMS Log** is supported over the Front Panel or through the communication (Register 41313) and provides the **Pre-fault Samples** setup:

Figure 4-14 Setup Parameters for RMS Log

4.4.9 Trend and SDR Trend

The PMC-690 provides **Trend** plot for realtime 3-phase V & I parameters (see Figure 4-15), and **SDR Trend** plot for Max./Min., Avg. and CP95 with up to 11 SDR parameters including frequency, voltage, current, power and PF. It's important to note that the source of SDR Trend data are coming from SDR Log. The selection of the **SDR Trend** plot is supported on Front Panel for only one parameter at a time.

	SDR Trend Parameters
Channels (ON/OFF)	Freq., Ua, Ub, Uc, Ia, Ib, Ic, P Total, Q Total, S Total, PF Total
Cursor (ON/OFF)	Displaying the recorded Max., Min., Avg. and CP95 value

Table 4-27 On-screen Selections for SDR Trend Plot

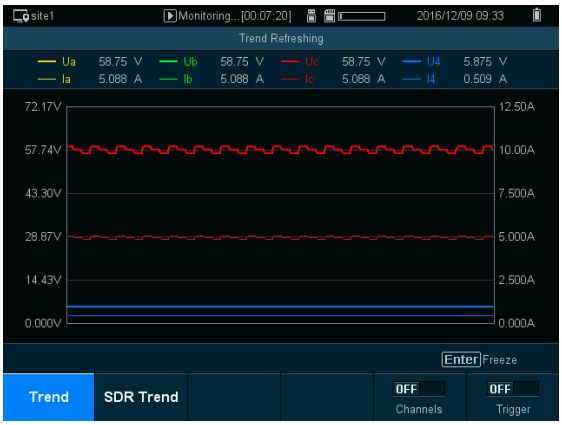


Figure 4-15 SDR Trend display via Front Panel

4.4.10 PQDIF and COMTRADE Storage

The PMC-690 is capable of storing standard data with PQDIF format, DWR data, RMS data and WFR data with COMTRADE format in its 16GB removable SD card. All record can be stored for about half a year and will not suffer any loss in the event of a power failure. The PMC-690 can store following standard data with PQDIF format.

Parameter	Description	Sampling intervals
Freq.	Freq.	150 cycles
Voltage RMS	Ua, Ub, Uc, U4	150 cycles
	Uab, Ubc, Uca	150 cycles
Current RMS	Ia, Ib, Ic, I4	150 cycles
Voltage Deviation	Ua/Ub/Uc Deviation	150 cycles
Unbalance	U1/U2/U0 Unbalance	150 cycles
	I1/I2/I0 Unbalance	150 cycles
Harmonic Voltage	Ua/Ub/Uc/U4_THD, Ua/Ub/Uc/U4_TOHD, Ua/Ub/Uc/U4_TEHD,	150 cycles
	Ua/Ub/Uc/U4_HD_01 ... Ua/Ub/Uc/U4_HD_63	
Harmonic Current	Ia/Ib/Ic/I4_THD, Ia/Ib/Ic/I4_TOHD, Ia/Ib/Ic/I4_TEHD	150 cycles
	Ia/Ib/Ic/I4_H01_RMS ... Ia/Ib/Ic/I4_H63_RMS	
Flicker	Pst	10 mins
	Plt	2 hours
Fundamental Power	kWa/kWb/kWc, kvara/kvarb/kvarc, kVAa/kVAb/kVAc, kW Total, kvar Total, kVA Total	150 cycles
Total Power	kWa/kWb/kWc, kvara/kvarb/kvarc, kVAa/kVAb/kVAc, kW Total, kvar Total, kVA Total	150 cycles
Total Harmonic Power	kWa/kWb/kWc TH, kvara/kvarb/kvarc TH kVAa/kVAb/kVAc TH, kW/kvar/kVA TH	150 cycles
Power Factor	PFa/PFb/PFc, PF Total	-

Table 4-28 PQDIF Parameters

The PQDIF and COMTRADE file can be retrieved via reading SD card, under the **pqdif/** and

comtradeInfo/ folder of corresponding site.

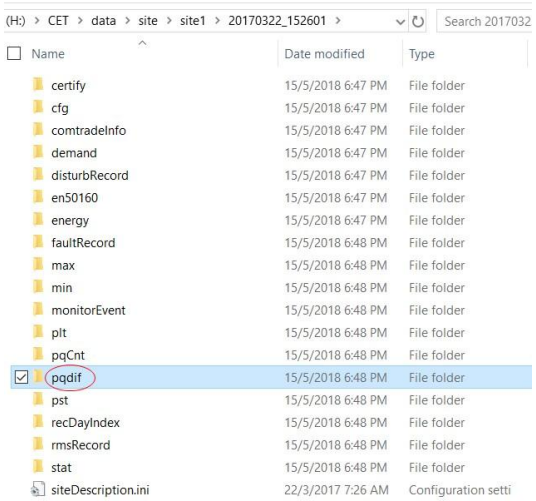


Figure 4-16 Data files in SD card

4.4.11 PQ Counters

The PMC-690 Provides counting ability for PQ Events. When a new event generated, the register will add 1 and system will alarm. The maximum of counter register is 2^{32} (4,294,967,296), the register will roll over to 0 when it reaches the maximum. The counter can be reset by Front Panel or via communications. The PMC-690 provides following PQ event counter.

No	Event	No	Event	No	Event
0	Dip	4	Rapid Voltage Changes	10	DWR
1	Swell	5	Inrush Current	11	WFR
2	Interruption	6	Reserved	12	RMSR
3	Transient	7,8,9	Signal Voltage#1, #2, #3		

Table 4-29 PQ Event Counter

4.5 Site Management and Monitoring

The PMC-690 provides function of managing up to 8 sites that is capable of recording and saving a maximum of 50 monitoring records each in the device non-volatile memory. Users just need to load the sites information and parameters that are configured before testing and therefore greatly improve the efficiency.

Each site has independent parameters and data logs that are saved for the corresponding site. Once the record number of a site exceeds 50, the monitoring function would be disabled, users can restart the function by deleting parts of historical data or switch to other sites. In addition, users can switch among different sites, export and import parameters to another site as well as other operations such as rename a site or delete a site from the Front Panel.

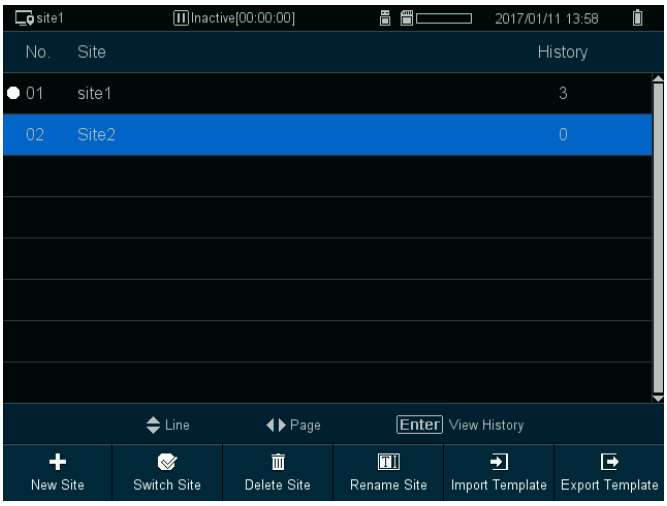


Figure 4-17 Switch Sites via Front Panel

After selecting and configuring a monitoring site, you may start the monitoring function by pressing the "Start/Stop" button on the front panel. A setup page will pop-up (Figure 4-18) for setting the Start and Stop Mode (Table 4-30). The monitoring data can be saved only after the "Start" key is pressed and the log would be saved in the independent directory that named by starting timestamp.

Parameters	Value
Start Mode	▪ **Scheduled** means that the monitoring will take place at a specific time. ▪ **Manual** means that the monitoring will start after 10s when "Start/Stop" button is pressed.
End Mode	▪ **Scheduled** means that the monitoring will be ended at a specific time. ▪ **Manual** means that the monitoring will stop when "Start/Stop" button is pressed. ▪ **Timer** means that the monitoring will run for a specific period and then stop.
End Duration	This parameter is only valid when the **End Mode** is set to **Timer.**

Table 4-30 Site Parameters Setup

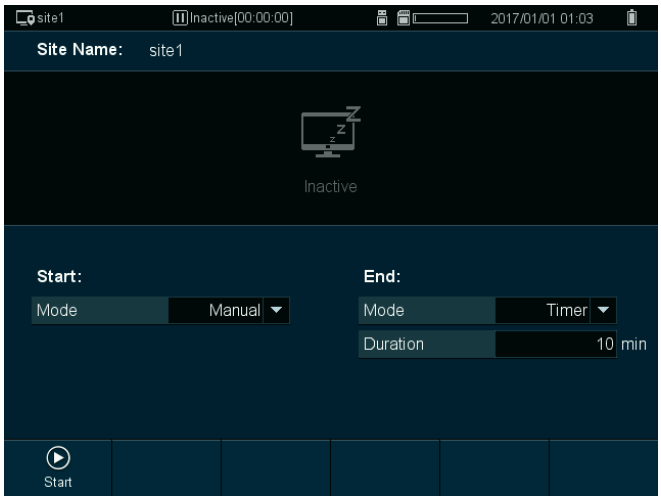


Figure 4-18 Setup Start/End Mode for Sites via Front Panel

4.6 Time Synchronization

The PMC-690 provides timestamps for all recorded data so it's extremely important for the clock to be properly configured to achieve precise events time stamping for energy and power quality analysis. There are two methods to set and synchronize the PMC-690's clock, please refer to the following description.

4.6.1 SNTP

SNTP (Simple Network Time Protocol) can be used to synchronize the clock through the connected Ethernet port providing that the network has been properly configured for the PMC-690 to connect to the **SNTP Server**, wherever it resides.

The SNTP supports two time synchronization modes: Unicast and Broadcast.

- Unicast: the PMC-690 would connect to the SNTP Server automatically as per specified **SNTP Sync. Interval** to synchronize time. The programming of the **SNTP** setup parameters are supported via the Front Panel or communications and provides the following setup parameters:

Setup Parameters	Option	Default
Clock Source	0=RTC, 1=SNTP. Set **Clock Source**=1	
SNTP Sync. Interval	1 to 1440 minutes	60
IP Address of SNTP Server	Set the IP address of the **SNTP Server**	192.168.101.2

Table 4-31 SNTP Setup Parameters

- Broadcast: the PMC-690 would receive packets of broadcast time synchronization from the intranet and compare clock if the time difference between intranet and the device is less than 5 minutes.

4.6.2 Modbus

Modbus can be used to synchronize the PMC-690's clock through the communication. Set the **Clock Source** as **RTC** via the Front Panel or communication, then set the register values of 60000 to 60005 or 9000 to 9005, please refer to **Section 5.9 Time Registers** for a detailed description.

4.7 Communication

4.7.1 Ethernet Port

The PMC-690 comes standard with one 100BaseT TCP/IP Ethernet port with RJ45 connector for connecting PC for firmware upgrade, configuration and data analysis. The IP Address, Subnet mask and Gateway under device setup are required to be configured so as to match the settings in the corresponding application software on PC for establishing a connection.

4.7.2 USB Port

The PMC-690 comes standard with an USB port for data transfer to the USB storage device. After inserting a reliable USB drive into the USB port, the system would detect the drive and users can transfer data, waveform logs as well as event logs via the user friendly interface in the Front Panel.

4.8 Data Storage

The PMC-690 is equipped with a removable 16GB SD card for non-volatile data storage for SDR data, events, WFR log and facilitating easy data transfer to PC. Most importantly, SD Card storage is much more reliable than HDD because it has no moving parts and is immune from mechanical breakdown. The 16GB SD card is sufficient for a site to perform continuous monitoring for about half-year.

The table below illustrates the directories and stored data:

Data	Directory
Screen captures	/hmi
Device Logs	/data/device/device/deviceLog
User Folders	/data/customFile
Site parameter templates	/data/site/site n/Cfg/para.ini
Present monitoring system parameters	/data/site/site n/20230414_071155/Cfg/param.ini
Present Peak Demands	/data/site/site n/20230414_071155/Demand/this

Max. Demand of Last Time	/data/site/site n/20230414_071155/Demand/last
Energy	/data/site/site n/20230414_071155/Energy
Max.	/data/site/site n/20230414_071155/Max
Min.	/data/site/site n/20230414_071155/Min
Pst Log	/data/site/site n/20230414_071155/pst/
Plt Log	/data/site/site n/20230414_071155/plt/
EN50160	/data/site/site n/20230414_071155/EN50160
PQDIF	/data/site/site n/20230414_071155/PQDIF/
PQDIF Internal DR	/data/site/site n/20230414_071155/pqdifStatRecord/...
Site Events	/data/site/site n/20230414_071155/monitorEvent/
PQ Counter	/data/site/site n/20230414_071155/pqCnt
SDR #1~5	/data/site/site n/20230414_071155/stat/group_00 … /data/site/site n/20230414_071155/stat/group_04
WFR Log	/data/site/site n/20230414_071155/faultRecord/
DWR Log	/data/site/site n/20230414_071155/disturbRecord
RMS Log	/data/site/site n/20230414_071155/rmsRecord

Table 4-32 Data Stored Directory

Chapter 5 Modbus Register Map

This chapter provides a complete description of the Modbus register map (**Protocol Version 3.0**) for the PMC-690 Advanced Utility Power Quality Analyzer to facilitate the development of 3rd party Modbus RTU communications driver for accessing information on the PMC-690.

The PMC-690 supports the following Modbus functions:

1) Read Holding Registers (Function Code 0x03)
2) Force Single Coil (Function Code 0x05)
3) Preset Multiple Registers (Function Code 0x10)

The following table provides a description of the different data formats used for the Modbus registers. The PMC-690 uses the Big Endian byte ordering system.

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

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

5.1 Basic Measurements

Register	Property	Description	Format	Unit
0000	RO	Uan[1]	Float	V
0002	RO	Ubn[1]	Float	V
0004	RO	Ucn[1]	Float	V
0006	RO	ULN Avg.[1]	Float	V
0008	RO	Uab	Float	V
0010	RO	Ubc	Float	V
0012	RO	Uca	Float	V
0014	RO	ULL Avg.	Float	V
0016	RO	Ia	Float	A
0018	RO	Ib	Float	A
0020	RO	Ic	Float	A
0022	RO	I Avg.	Float	A
0024	RO	kWa[1]	Float	W
0026	RO	kWb[1]	Float	W
0028	RO	kWc[1]	Float	W
0030	RO	kW Total	Float	W
0032	RO	kvara[1]	Float	var
0034	RO	kvarb[1]	Float	var
0036	RO	kvarc[1]	Float	var
0038	RO	kvar Total	Float	var
0040	RO	kVAa[1]	Float	VA
0042	RO	kVAb[1]	Float	VA
0044	RO	kVAc[1]	Float	VA
0046	RO	kVA Total	Float	VA
0048	RO	P.F.a[1]	Float	--
0050	RO	P.F.b[1]	Float	--
0052	RO	P.F.c[1]	Float	--
0054	RO	P.F. Total	Float	--
0056	RO	FREQ	Float	Hz
0058	RO	U4	Float	V
0060	RO	I4	Float	A
0062	RO	Reserved		
0064	RO	Real-time Data Timestamp - Second	UINT32	s
0066	RO	Real-time Data - Millisecond	UINT32	ms
0068	RO	Freq. Timestamp - UNIX Time (Second)	UINT32	s
0070	RO	Freq Timestamp - Millisecond	UINT32	ms
0072	RO	Pst Timestamp - UNIX Time	UINT32	s
0074	RO	Pst Timestamp - Millisecond	UINT32	ms
0076	RO	Plt Timestamp - UNIX Time	UINT32	s

0078	RO	Plt Timestamp - Millisecond	UINT32	ms
0080	RO	Flagging Status of Real-time Data[2]	Bitmap	
0081~0092		Reserved		
0093	RO	Standard Setpoint Status[3]	Bitmap	
0095~0109	RO	Reserved	Bitmap	
0111	RO	HS Setpoint Status[3]	Bitmap	
0113		Reserved		
0115	RO	Dips Counter	UINT32	
0117	RO	Swells Counter	UINT32	
0119	RO	Interruption Counter	UINT32	
0121	RO	Transient Counter	UINT32	
0123	RO	RVC Counter	UINT32	
0125	RO	Inrush Current Counter	UINT32	
0127	RO	RMS Change Counter	UINT32	
0129	RO	MSV (Mains Signalling Voltage) #1 Counter	UINT32	
0131	RO	MSV #2 Counter	UINT32	
0133	RO	MSV #3 Counter	UINT32	
0135	RO	Total PQ Event	UINT32	
0137	RO	Device Log Pointer	UINT32	
0139	RO	SOE Log Pointer	UINT32	
0141	RO	WFR Log Pointer	UINT32	
0143	RO	RMS Log Pointer	UINT32	
0145	RO	Disturbance Recorder Pointer	UINT32	
0147~0157		Reserved		
0159	RO	SDR #1 Pointer	UINT32	
0161	RO	SDR #2 Pointer	UINT32	
0163	RO	SDR #3 Pointer	UINT32	
0165	RO	SDR #4 Pointer	UINT32	
0167	RO	SDR #5 Pointer	UINT32	
0169~0237		Reserved		
0239	RO	Pst Log Pointer	UINT32	
0241	RO	Plt Log Pointer	UINT32	
0243		Reserved		
0245	RO	Reserved		
0247	RO	EN50160 Pointer	UINT32	
0249	RO	Qualification Rate Pointer (Reserved for English Version)	UINT32	
0251	RO	Reserved	UINT32	

Table 5-1 Basic Measurements

Notes:

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

2) Please refer to **Section 4.3.13 Flagging Concept** for a detailed description of the **Flagging Status** register.

Bit	Description		Bit	Description	
B0	Basic Measurement	Dip	**B8**	Pst.	Dip
B1		Swell	**B9**		Swell
B2		Interruption	**B10**		Interruption
B3		Over Current Limit*	**B11**		Reserved
B4	Freq.	Dip	**B12**	Plt.	Dip
B5		Swell	**B13**		Swell
B6		Interruption	**B14**		Interruption
B7		Reserved	**B15**		Reserved

* 2x I_{Normal}

Table 5-2 Flagging Status

3) The **Standard Setpoint Status** register represent the states of Standard Setpoints #1 to #24 while the **HS Setpoint Status** register represents the states of HS Setpoints #1 to #16, with a bit value of 1 meaning active and 0 meaning inactive.

Bit	B0	B1	B2	…	B23	B24~B31
Standard Setpoint	Setpoint #1	Setpoint #2	Setpoint #3	…	Setpoint #24	Reserved

Table 5-3 Standard Setpoint Status #1 (0093)

Bit	B0	B1	B2	…	B15	B16~B31
HS Setpoint	HS Setpoint #1	HS Setpoint #2	HS Setpoint #3	…	HS Setpoint #16	Reserved

Table 5-4 High-speed Setpoint Status (0111)

4) The range of the **Device / SOE Log Pointer** is between 0 and 0xFFFFFFFF. The **Device / SOE Log Pointer** is incremented by

one for every **Device / SOE Log** generated and will roll over to 0 if its current value is 0xFFFFFFFF. Since the **Device /SOE Log Pointer** is a 32-bit value and the **Device / SOE Log** capacity is relatively small with only 1024 entries in the PMC-690, an assumption has been made that the **Device / SOE Log pointer** will never roll over. If a **Clear Device / SOE Log** is performed from the front panel or via communications, the **Device / SOE Log Pointer** will be reset to zero. Therefore, any 3rd party software should assume that a **Clear Device / SOE Log** action has been performed if it sees the **Device / SOE Log Pointer** rolling over to zero or to a value that is smaller than its own pointer. In this case, the new **Device / SOE Log Pointer** also indicates the number of logs in the **Device / SOE Log** if it is less than 1024. Otherwise, there will always be 1024 entries in the **Device / SOE Log**.

5) The PMC-690 has 5 Statistical Data Recorder Logs (**SDR Log #1 to 5**). Each **SDR Log** has a pointer that indicates its present logging position. The range of the **SDR Log Pointer** is between 0 and 0xFFFFFFFF. The **SDR Log Pointer** is incremented by one for every **SDR Log** generated and will roll over to 0 if its current value is 0xFFFFFFFF. A value of zero indicates that the device does not contain any **SDR Log**. If a **Clear All SDR Log** is performed via communications, all **SDR Log Pointers** will be reset to zero.

   To determine the latest **SDR Log #X** location (X=1 to 5):

   SDR Log #X latest location = Modulo [**DR Pointer #X / DR #X Depth**]

6) **WFR Log** has a pointer that indicates its present logging position. The range of the **WFR Log Pointer** is between 0 and 0xFFFFFFFF. The **WFR Log Pointer** is incremented by one for every **WFR Log** generated and will roll over to 0 if its current value is 0xFFFFFFFF. A value of zero indicates that the device does not contain any **WFR Log**. The depth of **WFR Log** is 500 entries. Since the **WFR Log Pointers** are 32-bit values, an assumption has been made that these pointers will never roll over. If a **Clear WFR** log is performed via communications, the **WFR Log Pointers** will be reset to zero.

   To determine the latest **WFR Log** location:

   WFR Log latest location = Modulo [**WFR Log Pointer** / **WFR Log Depth**]

5.2 Energy Measurements

Register	Property	Description	Format	Unit
0500	RW	kWh Imp.	INT64	wh
0504	RW	kWh Exp.	INT64	wh
0508	RW	kvarh Imp.	INT64	varh
0512	RW	kvarh Exp.	INT64	varh
0516	RW	kVAh Total	INT64	VAh
0520	RO	kWh Net	INT64	wh
0524	RO	kWh Total	INT64	wh
0528	RO	kvarh Net	INT64	varh
0532	RO	kvarh Total	INT64	varh
0536	RO	Reserved	INT64	

Table 5-5 Energy Measurements

5.3 PQ Measurements

Register	Property	Description	Format	Unit
0700	RO	Ua Deviation[1]	Float	
0702	RO	Ub Deviation[1]	Float	
0704	RO	Uc Deviation[1]	Float	
0706	RO	Uab Deviation	Float	
0708	RO	Ubc Deviation	Float	
0710	RO	Uca Deviation	Float	
0712	RO	Over Ua Deviation[1]	Float	
0714	RO	Over Ub Deviation[1]	Float	
0716	RO	Over Uc Deviation[1]	Float	
0718	RO	Over Uab Deviation	Float	
0720	RO	Over Ubc Deviation	Float	
0722	RO	Over Uca Deviation	Float	
0724	RO	Under Ua Deviation[1]	Float	
0726	RO	Under Ub Deviation[1]	Float	
0728	RO	Under Uc Deviation[1]	Float	
0730	RO	Under Uab Deviation	Float	
0732	RO	Under Ubc Deviation	Float	
0734	RO	Under Uca Deviation	Float	
0736	RO	Freq. Deviation	Float	Hz
0738	RO	Ua (WYE) / Uab (Delta) Fluctuation	Float	
0740	RO	Ub (WYE) / Ubc (Delta) Fluctuation	Float	
0742	RO	Uc (WYE) / Uca (Delta) Fluctuation	Float	
0744	RO	Ua (WYE) / Uab (Delta) Fluctuation Freq.	Float	
0746	RO	Ub (WYE) / Ubc (Delta) Fluctuation Freq.	Float	
0748	RO	Uc (WYE) / Uca (Delta) Fluctuation Freq.	Float	

0750	RO	U0 Unbal.	Float	
0752	RO	U2 Unbal.	Float	
0754	RO	I0 Unbal.	Float	
0756	RO	I2 Unbal.	Float	
0758	RO	U0	Float	V
0760	RO	U1	Float	V
0762	RO	U2	Float	V
0764	RO	I0	Float	A
0766	RO	I1	Float	A
0768	RO	I2	Float	A
0770	RO	Ua (WYE) / Uab (Delta) Pst	Float	
0772	RO	Ub (WYE) / Ubc (Delta) Pst	Float	
0774	RO	Uc (WYE) / Uca (Delta) Pst	Float	
0776	RO	Ua (WYE) / Uab (Delta) Plt	Float	
0778	RO	Ub (WYE) / Ubc (Delta) Plt	Float	
0780	RO	Uc (WYE) / Uca (Delta) Plt	Float	
0782	RO	Reserved	Float	
0784	RO	Ia TDD (Total Harmonic Demand Deviation)	Float	
0786	RO	Ib TDD	Float	
0788	RO	Ic TDD	Float	
0790	RO	I4 TDD	Float	
0792	RO	Reserved	Float	
0794	RO	Ia TDD Odd	Float	
0796	RO	Ib TDD Odd	Float	
0798	RO	Ic TDD Odd	Float	
0800	RO	I4 TDD Odd	Float	
0802	RO	Reserved	Float	
0804	RO	Ia TDD Even	Float	
0806	RO	Ib TDD Even	Float	
0808	RO	Ic TDD Even	Float	
0810	RO	I4 TDD Even	Float	
0812	RO	Reserved	Float	
0814	RO	Ia K-Factor	Float	
0816	RO	Ib K-Factor	Float	
0818	RO	Ic K-Factor	Float	
0820	RO	I4 K-Factor	Float	
0822	RO	Reserved	Float	
0824	RO	Ia Crest Factor	Float	
0826	RO	Ib Crest Factor	Float	
0828	RO	Ic Crest Factor	Float	
0830	RO	I4 Crest Factor	Float	
0832	RO	Reserved	Float	
0834	RO	Ua Crest Factor	Float	
0836	RO	Ub Crest Factor	Float	
0838	RO	Uc Crest Factor	Float	
0840	RO	U4 Crest Factor	Float	
0842~0858	RO	Reserved	Float	

Table 5-6 PQ Measurements

Notes:

1) When the **Wiring Mode** is **Delta**, the per phase line-to-neutral voltage deviations have no meaning, and their registers are reserved
2) Please refer to Section **4.3.10 Voltage Deviation** for a detailed description.
3) Please refer to Section **4.3.1 Power Frequency** for a detailed description.
4) Please refer to Section **4.3.7 Supply Voltage Unbalance** for a detailed description.

5.4 Harmonics & Interharmonic Measurements

5.4.1 Harmonic Distortion Measurements

Register	Property	Description	Format	Unit
1000	RO	Ua (WYE) / Uab (Delta) THD	Float	% / x100
1002	RO	Ub (WYE) / Ubc (Delta) THD	Float	% / x100
1004	RO	Uc (WYE) / Uca (Delta) THD	Float	% / x100
1006	RO	U4 THD	Float	% / x100
1008	RO	Ia THD	Float	% / x100
1010	RO	Ib THD	Float	% / x100

1012	RO	Ic THD	Float	% / x100
1014	RO	I4 THD	Float	% / x100
1016	RO	Reserved	Float	% / x100
1018	RO	Ua (WYE) / Uab (Delta) TOHD	Float	% / x100
1020	RO	Ub (WYE) / Ubc (Delta) TOHD	Float	% / x100
1022	RO	Uc (WYE) / Uca (Delta) TOHD	Float	% / x100
1024	RO	U4 TOHD	Float	% / x100
1026	RO	Ia TOHD	Float	% / x100
1028	RO	Ib TOHD	Float	% / x100
1030	RO	Ic TOHD	Float	% / x100
1032	RO	I4 TOHD	Float	% / x100
1034	RO	Reserved	Float	% / x100
1036	RO	Ua (WYE) / Uab (Delta) TEHD	Float	% / x100
1038	RO	Ub (WYE) / Ubc (Delta) TEHD	Float	% / x100
1040	RO	Uc (WYE) / Uca (Delta) TEHD	Float	% / x100
1042	RO	U4 TEHD	Float	% / x100
1044	RO	Ia TEHD	Float	% / x100
1046	RO	Ib TEHD	Float	% / x100
1048	RO	Ic TEHD	Float	% / x100
1050	RO	I4 TEHD	Float	% / x100
1052	RO	Reserved	Float	% / x100
1054	RO	Ua (WYE) / Uab (Delta) DC Distortion	Float	% / x100
1056	RO	Ub (WYE) / Ubc (Delta) DC Distortion	Float	% / x100
1058	RO	Uc (WYE) / Uca (Delta) DC Distortion	Float	% / x100
1060	RO	U4 DC Distortion	Float	% / x100
1062	RO	Ia DC Distortion	Float	% / x100
1064	RO	Ib DC Distortion	Float	% / x100
1066	RO	Ic DC Distortion	Float	% / x100
1068	RO	I4 DC Distortion	Float	% / x100
1070	RO	Reserved	Float	% / x100
1072	RO	Ua (WYE) / Uab (Delta) HD01	Float	% / x100
1074	RO	Ub (WYE) / Ubc (Delta) HD01	Float	% / x100
1076	RO	Uc (WYE) / Uca (Delta) HD01	Float	% / x100
1078	RO	U4 HD01	Float	% / x100
1080	RO	Ia HD01	Float	% / x100
1082	RO	Ib HD01	Float	% / x100
1084	RO	Ic HD01	Float	% / x100
1086	RO	I4 HD01	Float	% / x100
1088	RO	Reserved	Float	% / x100
	…	…	…	% / x100
2188	RO	Ua (WYE) / Uab (Delta) HD63	Float	% / x100
2190	RO	Ub (WYE) / Ubc (Delta) HD63	Float	% / x100
2192	RO	Uc (WYE) / Uca (Delta) HD63	Float	% / x100
2194	RO	U4 HD63	Float	% / x100
2196	RO	Ia HD63	Float	% / x100
2198	RO	Ib HD63	Float	% / x100
2200	RO	Ic HD63	Float	% / x100
2202	RO	I4 HD63	Float	% / x100
2204	RO	Reserved	Float	% / x100

Table 5-7 Harmonics Measurements

5.4.2 Harmonic Voltage & Current RMS

Register	Property	Description	Format	Unit
2300	RO	Ua (WYE) / Uab (Delta) TH* RMS	Float	V
2302	RO	Ub (WYE) / Ubc (Delta) TH* RMS	Float	V
2304	RO	Uc (WYE) / Uca (Delta) TH* RMS	Float	V
2306	RO	U4 TH* RMS	Float	V
2308	RO	Ia TH* RMS	Float	A
2310	RO	Ib TH* RMS	Float	A
2312	RO	Ic TH* RMS	Float	A
2314	RO	I4 TH* RMS	Float	A
2316	RO	Reserved	Float	A
2318	RO	Ua (WYE) / Uab (Delta) TOH01 RMS	Float	V
2320	RO	Ub (WYE) / Ubc (Delta) TOH01 RMS	Float	V
2322	RO	Uc (WYE) / Uca (Delta) TOH01 RMS	Float	V
2324	RO	U4 TOH01 RMS	Float	V

2326	RO	Ia TOH01 RMS	Float	A
2328	RO	Ib TOH01 RMS	Float	A
2330	RO	Ic TOH01 RMS	Float	A
2332	RO	I4 TOH01 RMS	Float	A
2334	RO	Reserved	Float	A
2336	RO	Ua (WYE) / Uab (Delta) TEH01 RMS	Float	V
2338	RO	Ub (WYE) / Ubc (Delta) TEH01 RMS	Float	V
2340	RO	Uc (WYE) / Uca (Delta) TEH01 RMS	Float	V
2342	RO	U4 TEH01 RMS	Float	V
2344	RO	Ia TEH01 RMS	Float	A
2346	RO	Ib TEH01 RMS	Float	A
2348	RO	Ic TEH01 RMS	Float	A
2350	RO	I4 TEH01 RMS	Float	A
2352	RO	Reserved	Float	A
2354	RO	Ua (WYE) / Uab (Delta) DC RMS	Float	V
2356	RO	Ub (WYE) / Ubc (Delta) DC RMS	Float	V
2358	RO	Uc (WYE) / Uca (Delta) DC RMS	Float	V
2360	RO	U4 DC RMS	Float	V
2362	RO	Ia DC RMS	Float	A
2364	RO	Ib DC RMS	Float	A
2366	RO	Ic DC RMS	Float	A
2368	RO	I4 DC RMS	Float	A
2370	RO	Reserved	Float	A
2372	RO	Ua (WYE) / Uab (Delta) H01 RMS	Float	V
2374	RO	Ub (WYE) / Ubc (Delta) H01 RMS	Float	V
2376	RO	Uc (WYE) / Uca (Delta) H01 RMS	Float	V
2378	RO	U4 H01 RMS	Float	V
2380	RO	Ia H01 RMS	Float	A
2382	RO	Ib H01 RMS	Float	A
2384	RO	Ic H01 RMS	Float	A
2386	RO	I4 H01 RMS	Float	A
2388	RO	Reserved	Float	A
…	RO	…	…	…
3488	RO	Ua (WYE) / Uab (Delta) H63 RMS	Float	V
3490	RO	Ub (WYE) / Ubc (Delta) H63 RMS	Float	V
3492	RO	Uc (WYE) / Uca (Delta) H63 RMS	Float	V
3494	RO	U4 H63 RMS	Float	V
3496	RO	Ia H63 RMS	Float	A
3498	RO	Ib H63 RMS	Float	A
3500	RO	Ic H63 RMS	Float	A
3502	RO	I4 H63 RMS	Float	A
3504	RO	Reserved	Float	A

*TH=Total Harmonics

Table 5-8 Harmonics Voltage & Current RMS

5.4.3 Individual Total Harmonic

Register	Property	Description	Format	Unit
27000	RO	kW[1] TH01	Float	W
27002	RO	kvar[1] TH01	Float	var
27004	RO	kVA[1] TH01	Float	VA
27006	RO	P.F. TH01	Float	
27008	RO	kW[1] TH02	Float	W
27010	RO	kvar[1] TH02	Float	var
27012	RO	kVA[1] TH02	Float	VA
27014	RO	P.F. TH02	Float	
…		…		
27496	RO	kW[1] TH63	Float	W
27498	RO	kvar[1] TH63	Float	var
27500	RO	kVA[1] TH63	Float	VA
27502	RO	P.F. TH63	Float	

Table 5-9 Individual Total Harmonic

Notes:

1) When the **Wiring Mode** is **Delta**, the per-phase kW/kvar/kVA H01 to H63 have no meaning, and their registers are reserved.

5.4.4 Harmonic Power

Register	Property	Description	Format	Unit
28000	RO	kWa[1] TH*	Float	W
28002	RO	kWb[1] TH	Float	W
28004	RO	kWc[1] TH	Float	W
28006	RO	kW Total TH	Float	W
28008	RO	kvara[1] TH	Float	
28010	RO	kvarb[1] TH	Float	
28012	RO	kvarc[1] TH	Float	
28014	RO	kvar Total TH	Float	
28016	RO	kVAa[1] TH	Float	
28018	RO	kVAb[1] TH	Float	
28020	RO	kVAc[1] TH	Float	
28022	RO	kVA Total TH	Float	
28024~28028		Reserved	Float	
28030	RO	P.F. TH	Float	
28032~28038		Reserved	Float	
28040	RO	kWa H01	Float	W
28042	RO	kWb H01	Float	W
28044	RO	kWc H01	Float	W
28046	RO	kvara H01	Float	var
28048	RO	kvarb H01	Float	var
28050	RO	kvarc H01	Float	var
28052	RO	kVAa H01	Float	VA
28054	RO	kVAb H01	Float	VA
28056	RO	kVAc H01	Float	VA
28058	RO	P.F.a H01	Float	
28060	RO	P.F.b H01	Float	
28062	RO	P.F.c H01	Float	
...	RO	...	Float	
29528	RO	kWa H63	Float	W
29530	RO	kWb H63	Float	W
29532	...	kWc H63	Float	W
29534	RO	kvara H63	Float	var
29536	RO	kvarb H63	Float	var
29538	RO	kvarc H63	Float	var
29540	RO	kVAa H63	Float	VA
29542	RO	kVAb H63	Float	VA
29544	RO	kVAc H63	Float	VA
29546	RO	P.F.a H63	Float	
29548	RO	P.F.b H63	Float	
29550	RO	P.F.c H63	Float	

*TH=Total Harmonics

Table 5-10 Harmonic Power

Notes:

1) When the **Wiring Mode** is **Delta**, the per-phase kW/kvar/kVA have no meaning, and their registers are reserved.

5.4.5 Harmonic Angles

Register	Property	Description	Format	Unit
30000~30016	RO	Reserved	Float	
30018	RO	Ua(WYE) / Uab(Delta) Angle H01	Float	
30020	RO	Ub(WYE) / Ubc(Delta) Angle H01	Float	
30022	RO	Uc(WYE) / Uca(Delta) Angle H01	Float	
30024	RO	U4 Angle H01	Float	
30026	RO	Ia Angle H01	Float	
30028	RO	Ib Angle H01	Float	
30030	RO	Ic Angle H01	Float	
30032	RO	I4 Angle H01	Float	
30034	RO	Reserved	Float	
...	RO	....	Float	
31134	RO	Ua(WYE) / Uab(Delta) Angle H63	Float	
31136	RO	Ub(WYE) / Ubc(Delta) Angle H63	Float	
31138	RO	Uc(WYE) / Uca(Delta) Angle H63	Float	
31140	RO	U4 Angle H63	Float	

31142	RO	Ia Angle H63	Float	
31144	RO	Ib Angle H63	Float	
31146	RO	Ic Angle H63	Float	
31148	RO	I4 Angle H63	Float	
31150	RO	Reserved	Float	

Table 5-11 Harmonic Angle

5.4.6 Harmonic Energy

Register	Property	Description	Format	Unit
31500	RW	kWh Imp. TH[1]	Int64	wh
31504	RW	kWh Exp. TH[1]	Int64	wh
31508	RW	kavrh Imp. TH[1]	Int64	varh
31512	RW	kvarh Exp. TH[1]	Int64	varh
31516	RO	kWh Net TH	Int64	wh
31520	RO	kWh Total TH	Int64	wh
31524	RO	kvarh Net TH	Int64	varh
31528	RO	kvarh Total TH	Int64	varh
…		Reserved		
31600	RW	kWh Imp. H01[1]	Int64	wh
31604	RW	kWh Exp. H01[1]	Int64	wh
31608	RW	kvarh Imp. H01[1]	Int64	varh
31612	RW	kvarh Exp. H01[1]	Int64	varh
31616	RW	kWh Imp. H02[1]	Int64	wh
31620	RW	kWh Exp. H02[1]	Int64	wh
31624	RW	kvarh Imp. H02[1]	Int64	varh
31628	RW	kvarh Exp. H02[1]	Int64	varh
…	RW	…	Int64	
32592	RW	kWh Imp. H63[1]	Int64	wh
32596	RW	kWh Exp. H63[1]	Int64	wh
32600	RW	kvarh Imp. H63[1]	Int64	varh
32604	RW	kvarh Exp. H63[1]	Int64	varh

Table 5-12 Harmonic Energy

Notes:

1) The registers have a maximum value of 99,999,999,999,999 and will roll over to zero automatically when it is reached.

5.4.7 Net/Total Harmonic Energy

Register	Property	Description	Format	Unit
33000	RW	Fundamental kWh Net	Int64	wh
33004	RW	Fundamental kWh Total	Int64	wh
33008	RW	Fundamental kvarh Net	Int64	varh
33012	RW	Fundamental kvarh Total	Int64	varh

Table 5-13 Net/Total Harmonic Energy

5.4.8 Interharmonics Distortion (IHD) Measurements

Register	Property	Description	Format	Unit
33100	RO	Ua (WYE) / Uab (Delta) TIHD[1]	Float	%, x100
33102	RO	Ub(WYE) / Ubc(Delta) TIHD[1]	Float	%, x100
33104	RO	Uc (WYE) / Uca (Delta) TIHD[1]	Float	%, x100
33106	RO	U4 TIHD	Float	%, x100
33108	RO	Ia TIHD	Float	%, x100
33110	RO	Ib TIHD	Float	%, x100
33112	RO	Ic TIHD	Float	%, x100
33114	RO	I4 TIHD	Float	%, x100
33116	RO	Reserved	Float	%, x100
33118	RO	Ua (WYE) / Uab (Delta) TOIHD[1]	Float	%, x100
33120	RO	Ub(WYE) / Ubc(Delta) TOIHD[1]	Float	%, x100
33122	RO	Uc (WYE) / Uca (Delta) TOIHD[1]	Float	%, x100
33124	RO	U4 TOIHD	Float	%, x100
33126	RO	Ia TOIHD	Float	%, x100
33128	RO	Ib TOIHD	Float	%, x100
33130	RO	Ic TOIHD	Float	%, x100
33132	RO	I4 TOIHD	Float	%, x100
33134	RO	Reserved	Float	%, x100

33136	RO	Ua (WYE) / Uab (Delta) TEIHD[1]	Float	%, x100
33138	RO	Ub(WYE) / Ubc(Delta) TEIHD[1]	Float	%, x100
33140	RO	Uc (WYE) / Uca (Delta) TEIHD[1]	Float	%, x100
33142	RO	U4 TEIHD	Float	%, x100
33144	RO	Ia TEIHD	Float	%, x100
33146	RO	Ib TEIHD	Float	%, x100
33148	RO	Ic TEIHD	Float	%, x100
33150	RO	I4 TEIHD	Float	%, x100
33152	RO	Reserved	Float	%, x100
33154	RO	Ua (WYE) / Uab (Delta)[1] IHD01	Float	%, x100
33156	RO	Ub(WYE) / Ubc(Delta)[1] IHD01	Float	%, x100
33158	RO	Uc (WYE) / Uca (Delta)[1] IHD01	Float	%, x100
33160	RO	U4 IHD01	Float	%, x100
33162	RO	Ia IHD01	Float	%, x100
33164	RO	Ib IHD01	Float	%, x100
33166	RO	Ic IHD01	Float	%, x100
33168	RO	I4 IHD01	Float	%, x100
33170	RO	Reserved	Float	%, x100
…	…	….	…	
34288	RO	Ua (WYE) / Uab (Delta)[1] IHD63	Float	%, x100
34290	RO	Ub(WYE) / Ubc(Delta)[1] IHD63	Float	%, x100
34292	RO	Uc (WYE) / Uca (Delta)[1] IHD63	Float	%, x100
34294	RO	U4 IHD63	Float	%, x100
34296	RO	Ia IHD63	Float	%, x100
34298	RO	Ib IHD63	Float	%, x100
34300	RO	Ic IHD63	Float	%, x100
34302	RO	I4 IHD63	Float	%, x100
34304	RO	Reserved	Float	%, x100

Table 5-14 Interharmonics Measurements

Notes:

1) The voltage TIHD / TOIHD / TEIHD / 1st to 63rd Interharmonic are phase voltage measurements in WYE mode and they will be automatically changed to line voltage measurements in Delta mode.

5.4.9 Interharmonic Voltage & Current RMS

Register	Property	Description	Format	Unit
34500	RO	Ua (WYE) / Uab (Delta) TIH RMS	Float	V
34502	RO	Ub (WYE) / Ubc (Delta) TIH RMS	Float	V
34504	RO	Uc (WYE) / Uca (Delta) TIH RMS	Float	V
34506	RO	U4 TIH RMS	Float	V
34508	RO	Ia TIH RMS	Float	A
34510	RO	Ib TIH RMS	Float	A
34512	RO	Ic TIH RMS	Float	A
34514	RO	I4 TIH RMS	Float	A
34516	RO	Reserved	Float	A
34518	RO	Ua (WYE) / Uab (Delta) TOIH RMS	Float	V
34520	RO	Ub (WYE) / Ubc (Delta) TOIH RMS	Float	V
34522	RO	Uc (WYE) / Uca (Delta) TOIH RMS	Float	V
34524	RO	U4 TOIH RMS	Float	V
34526	RO	Ia TOIH RMS	Float	A
34528	RO	Ib TOIH RMS	Float	A
34530	RO	Ic TOIH RMS	Float	A
34532	RO	I4 TOIH RMS	Float	A
34534	RO	Reserved	Float	A
34536	RO	Ua (WYE) / Uab (Delta) TEIH RMS	Float	V
34538	RO	Ub (WYE) / Ubc (Delta) TEIH RMS	Float	V
34540	RO	Uc (WYE) / Uca (Delta) TEIH RMS	Float	V
34542	RO	U4 TEIH RMS	Float	V
34544	RO	Ia TEIH RMS	Float	A
34546	RO	Ib TEIH RMS	Float	A
34548	RO	Ic TEIH RMS	Float	A
34550	RO	I4 TEIH RMS	Float	A
34552	RO	Reserved	Float	A
34554	RO	Ua (WYE) / Uab (Delta) IH00 RMS	Float	V
34556	RO	Ub (WYE) / Ubc (Delta) IH00 RMS	Float	V
34558	RO	Uc (WYE) / Uca (Delta) IH00 RMS	Float	V
34560	RO	U4 IH00 RMS	Float	V

34562	RO	Ia IH00 RMS	Float	A
34564	RO	Ib IH00 RMS	Float	A
34566	RO	Ic IH00 RMS	Float	A
34568	RO	I4 IH00 RMS	Float	A
34570	RO	Reserved	Float	A
34572	RO	Ua (WYE) / Uab (Delta) IH01 RMS	Float	V
34574	RO	Ub (WYE) / Ubc (Delta) IH01 RMS	Float	V
34576	RO	Uc (WYE) / Uca (Delta) IH01 RMS	Float	V
34578	RO	U4 IH01 RMS	Float	V
34580	RO	Ia IH01 RMS	Float	A
34582	RO	Ib IH01 RMS	Float	A
34584	RO	Ic IH01 RMS	Float	A
34586	RO	I4 IH01 RMS	Float	A
34588	RO	Reserved	Float	A
...	RO	...	Float	
35688	RO	Ua (WYE) / Uab (Delta) IH63 RMS	Float	V
35690	RO	Ub (WYE) / Ubc (Delta) IH63 RMS	Float	V
35692	RO	Uc (WYE) / Uca (Delta) IH63 RMS	Float	V
35694	RO	U4 IH63 RMS	Float	V
35696	RO	Ia IH63 RMS	Float	A
35698	RO	Ib IH63 RMS	Float	A
35700	RO	Ic IH63 RMS	Float	A
35702	RO	I4 IH63 RMS	Float	A
35704	RO	Reserved	Float	A

Table 5-15 Interharmonics Voltage & Current RMS

5.5 Demand

5.5.1 Present Demand

Register	Property	Description	Format	Unit
3600	RO	Ua[1]	Float	V
3602	RO	Ub[1]	Float	V
3604	RO	Uc[1]	Float	V
3606	RO	ULN Avg	Float	V
3608	RO	U4	Float	V
3610	RO	Uab	Float	V
3612	RO	Ubc	Float	V
3614	RO	Uca	Float	V
3616	RO	ULL Avg.	Float	V
3618	RO	Ia	Float	A
3620	RO	Ib	Float	A
3622	RO	Ic	Float	A
3624	RO	I Avg.	Float	A
3626	RO	I4	Float	A
3628	RO	Reserved	Float	A
3630	RO	kWa Imp.[1]	Float	W
3632	RO	kWb Imp.[1]	Float	W
3634	RO	kWc Imp.[1]	Float	W
3636	RO	kW Total Imp.	Float	W
3638	RO	kWa Exp.[1]	Float	W
3640	RO	kWb Exp.[1]	Float	W
3642	RO	kWc Exp.[1]	Float	W
3644	RO	kW Total Exp.	Float	W
3646	RO	kvara Imp.[1]	Float	var
3648	RO	kvarb Imp.[1]	Float	var
3640	RO	kvarc Imp.[1]	Float	var
3652	RO	kvar Total Imp.	Float	var
3654	RO	kvara Exp.[1]	Float	var
3656	RO	kvarb Exp.[1]	Float	var
3658	RO	kvarc Exp.[1]	Float	var
3660	RO	kvar Total Exp.	Float	var
3662	RO	kVAa[1]	Float	VA
3664	RO	kVAb[1]	Float	VA
3666	RO	kVAc[1]	Float	VA
3668	RO	Total kVA	Float	VA

3670	RO	P.F.a[1]	Float	--
3672	RO	P.F.b[1]	Float	--
3674	RO	P.F.c[1]	Float	--
3676	RO	P.F. Total	Float	--
3678	RO	Freq	Float	Hz
3680	RO	Ua Deviation[1]	Float	100%
3682	RO	Ub Deviation[1]	Float	100%
3684	RO	Uc Deviation[1]	Float	100%
3686	RO	Uab Deviation	Float	100%
3688	RO	Ubc Deviation	Float	100%
3690	RO	Uca Deviation	Float	100%
3692	RO	Ua Over Deviation[1]	Float	100%
3694	RO	Ub Over Deviation[1]	Float	100%
3696	RO	Uc Over Deviation[1]	Float	100%
3698	RO	Uab Over Deviation	Float	100%
3700	RO	Ubc Over Deviation	Float	100%
3702	RO	Uca Over Deviation	Float	100%
3704	RO	Ua Under Deviation[1]	Float	100%
3706	RO	Ub Under Deviation[1]	Float	100%
3708	RO	Uc Under Deviation[1]	Float	100%
3710	RO	Uab Under Deviation	Float	100%
3712	RO	Ubc Under Deviation	Float	100%
3714	RO	Uca Under Deviation	Float	100%
3716	RO	Freq. Deviation	Float	100%
3718	RO	U0 Unbal.	Float	
3720	RO	U2 Unbal.	Float	
3722	RO	I0 Unbal.	Float	
3724	RO	I2 Unbal.	Float	
3726	RO	Ia K-Factor	Float	
3728	RO	Ib K-Factor	Float	
3730	RO	Ic K-Factor	Float	
3732	RO	I4 K-Factor	Float	
3734	RO	Reserved	Float	
3736	RO	Ua (WYE) / Uab (Delta) THD	Float	
3738	RO	Ub (WYE) / Ubc (Delta) THD	Float	
3740	RO	Uc (WYE) / Uca (Delta) THD	Float	
3742	RO	U4 THD	Float	
3744	RO	Ia THD	Float	
3746	RO	Ib THD	Float	
3748	RO	Ic THD	Float	
3750	RO	I4 THD	Float	
3752	RO	Reserved	Float	
3754	RO	Ua (WYE) / Uab (Delta) TOHD	Float	
3756	RO	Ub (WYE) / Ubc (Delta) TOHD	Float	
3758	RO	Uc (WYE) / Uca (Delta) TOHD	Float	
3760	RO	U4 TOHD	Float	
3762	RO	Ia TOHD	Float	
3764	RO	Ib TOHD	Float	
3766	RO	Ic TOHD	Float	
3768	RO	I4 TOHD	Float	
3770	RO	Reserved	Float	
3772	RO	Ua (WYE) / Uab (Delta) TEHD	Float	
3774	RO	Ub (WYE) / Ubc (Delta) TEHD	Float	
3776	RO	Uc (WYE) / Uca (Delta) TEHD	Float	
3778	RO	U4 TEHD	Float	
3780	RO	Ia TEHD	Float	
3782	RO	Ib TEHD	Float	
3784	RO	Ic TEHD	Float	
3786	RO	I4 TEHD	Float	
3788	RO	Reserved	Float	
3790	RO	Ia FUND.	Float	A
3792	RO	Ib FUND.	Float	A
3794	RO	Ic FUND.	Float	A
3796	RO	I4 FUND.	Float	A
3798~3806	RO	Reserved		

Table 5-16 Present Demand

Notes:

1) When the **Wiring Mode** is **Delta**, the phase voltages demand, kWs demand, kvars demand and kVAs demand have no meaning, and their registers are reserved.

5.5.2 Predicted Demand

Register Address	Property	Description	Format	Unit
3900	RO	Ua[1]	Float	V
3902	RO	Ub[1]	Float	V
3904	RO	Uc[1]	Float	V
3906	RO	ULN Avg.	Float	V
3908	RO	U4	Float	V
3910	RO	Uab	Float	V
3912	RO	Ubc	Float	V
3914	RO	Uca	Float	V
3916	RO	ULL Avg.	Float	V
3918	RO	Ia	Float	A
3920	RO	Ib	Float	A
3922	RO	Ic	Float	A
3924	RO	I Avg.	Float	A
3926	RO	I4	Float	A
3928	RO	Reserved	Float	A
3930	RO	kWa Imp.[1]	Float	W
3932	RO	kWb Imp.[1]	Float	W
3934	RO	kWc Imp.[1]	Float	W
3936	RO	kW Total Imp.	Float	W
3938	RO	kWa Exp.[1]	Float	W
3940	RO	kWb Exp.[1]	Float	W
3942	RO	kWc Exp.[1]	Float	W
3944	RO	kW Total Exp.	Float	W
3946	RO	kvara Imp.[1]	Float	var
3948	RO	kvarb Imp.[1]	Float	var
3940	RO	kvarc Imp.[1]	Float	var
3952	RO	kvar Total Imp.	Float	var
3954	RO	kvara Exp.[1]	Float	var
3956	RO	kvarb Exp.[1]	Float	var
3958	RO	kvarc Exp.[1]	Float	var
3960	RO	kvar Total Exp.	Float	var
3962	RO	kVAa[1]	Float	VA
3964	RO	kVAb[1]	Float	VA
3966	RO	kVAc[1]	Float	VA
3968	RO	kVA Total	Float	VA
3970	RO	P.F.a[1]	Float	--
3972	RO	P.F.b[1]	Float	--
3974	RO	P.F.c[1]	Float	--
3976	RO	P.F. Total	Float	--
3978	RO	Freq	Float	Hz

Table 5-17 Predicted Demand

Notes:

1) When the **Wiring Mode** is **Delta**, the per phase V/kW/kvar/kVA/PF Predicted demand have no meaning, and their registers are reserved.

5.5.3 Present Max.

Register	Property	Description	Format	Unit
5500	RO	kW Total Imp.	See **Note 1)**	W
5506	RO	kW Total Exp.		W
5512	RO	kvar Total Imp.		var
5518	RO	kvar Total Exp.		var
5524	RO	kVA Total		VA
5530	RO	Ia		A
5536	RO	Ib		A
5542	RO	Ic		A
5548	RO	Ia FUND.		
5554	RO	Ib FUND.		

5560	RO	Ic FUND.		
5566	RO	I4 FUND.		
5572	RO	Reserved		

Table 5-18 Present Max. Demand

Notes:

1) The following table illustrates Demand Data Structure:

Offset		Description
+0	High	Year (-2000)
	Low	Month
+1	High	Day
	Low	Hour
+2	High	Minute
	Low	Second
+3	-	Reserved
+4~+5	-	Record Value

Table 5-19 Demand Data Structure

5.5.4 Max. of Last Time

Register	Property	Description	Format	Unit
5700	RO	kW Total Imp.	See **Note 1)**	W
5706	RO	kW Total Exp.		W
5712	RO	kvar Total Imp.		var
5718	RO	kvar Total Exp.		var
5724	RO	kVA Total		VA
5730	RO	Ia		A
5736	RO	Ib		A
5742	RO	Ic		A
5748	RO	Ia FUND.		
5754	RO	Ib FUND.		
5760	RO	Ic FUND.		
5766	RO	I4 FUND.		
5772	RO	Reserved		

Table 5-20 Max. Demand of Last Time

Notes:

1) The following table illustrates Demand Data Structure:

Offset		Description
+0	High	Year (-2000)
	Low	Month
+1	High	Day
	Low	Hour
+2	High	Minute
	Low	Second
+3	-	Reserved
+4 ~ +5	-	Record Value

Table 5-21 Demand Data Structure

5.6 Log Register

5.6.1 Device Log Buffer

Register	Property	Description	Format
10000	RW	Device Log Pointer n*	UINT32
10002~10037	RO	Device Log Event @ Pointer n	See Table 5-23 Device Log Data Structure
10038~10073	RO	Device Log Event @ Pointer n+1	
...		...	
10326~10361	RO	Device Log Event @ Pointer n+9	

* Writing n to the Device Log Pointer register will update the Device Log Buffer with Device Log Events from pointer positions from n to n+9.

Table 5-22 Device Log Buffer

Notes:

1) The PMC-690's **Device Log** can store up to 1024 events, if there are more than 1024 events, the newest event will replace the oldest event on a FIFO basis.

Offset	Property	Description	Format	Option
+0	RO	High-order Byte: Event Classification	UINT16	-
	RO	Low-order Byte: Sub-Classification		
+1	RO	Record Time: Year	UINT16	0-99 (Year-2000)
	RO	Record Time: Month		1 to 12
+2	RO	Record Time: Day	UINT16	1 to 31
	RO	Record Time: Hour		0 to 23
+3	RO	Record Time: Minute	UINT16	0 to 59
	RO	Record Time: Second		0 to 59
+4	RO	Record Time: Millisecond	UINT16	0 to 999
+5	RO	Reserved		
+6 to +35	RO	Event Values	See Appendix B	-

Table 5-23 Device Log Data Structure

5.6.2 SOE Log Buffer

Register	Property	Description	Format
10500	RW	SOE Log Pointer n*	UINT32
10502~10537	RO	SOE Log Event @ Pointer n	See Table 5-25 SOE Log Data Structure
10538~10573	RO	SOE Log Event @ Pointer n+1	
…		…	
10826~10861	RO	SOE Log Event @ Pointer n+9	

* Writing n to the SOE Log Pointer register will update the SOE Log Buffer with SOE Log Events at pointer positions from n to n+9.

Table 5-24 SOE Log Buffer

Note:

1) The PMC-690's **SOE Log** can store up to 1024 events and if there are more than 1024 events, the latest event will replace the oldest event on a FIFO basis.

Offset	Property	Description	Format	Option
+0	RO	High-order Byte: Event Classification	UINT16	-
	RO	Low-order Byte: Sub-Classification		
+1	RO	Record Time: Year	UINT16	0-99 (Year-2000)
	RO	Record Time: Month		1 to 12
+2	RO	Record Time: Day	UINT16	1 to 31
	RO	Record Time: Hour		0 to 23
+3	RO	Record Time: Minute	UINT16	0 to 59
	RO	Record Time: Second		0 to 59
+4	RO	Record Time: Millisecond	UINT16	0 to 999
+5	RO	Reserved		
+6 to +35	RO	Event Values	See Appendix B	-

Table 5-25 SOE Log Data Structure

5.6.3 SDR Log

5.6.3.1 SDR Log Buffer

Register	Property	Description	Format	Option
11000~11518	RO	SDR Log #1 Buffer	See Section 5.6.3.2 SDR Log Buffer Structure	-
11600~12118	RO	SDR Log #2 Buffer		-
12200~12718	RO	SDR Log #3 Buffer		-
12800~13318	RO	SDR Log #4 Buffer		-
13400~13918	RO	SDR Log #5 Buffer		-

Table 5-26 SDR Log Buffer

5.6.3.2 SDR Log Buffer Structure

Offset	Property	Description	Format	Option
+0	RW	SDR Log X Pointer n*	UINT32	--
+2~+4	RO	End Time of the Record [2]	Bitmap	--
+5	RO	Flagging Status	UINT16	0 = No Flag 1 = Flagged & Eliminated 2 = Flagged & Not Eliminated
+6~+13	RO	Data Item #1	See Section 5.6.3.3 SDR Data Item Structure	--
+14~+22	RO	Data Item #2		
…		…		

+510~+517	RO	Data Item #64		

* Writing n to the SDR Log X Pointer register will update the SDR Log X Buffer with the SDR Log X Record at pointer position n.

Table 5-27 SDR Log Buffer Structure

Notes:

1) The data items can be configured as any real-time data. Please see **Appendix A**.

2) Record Time data structure

Offset	Property	Description	Format	Option
+0	RO	Year	UINT16	0-99 (Year-2000)
	RO	Month		1 to 12
+1	RO	Day	UINT16	1 to 31
	RO	Hour		0 to 23
+2	RO	Minute	UINT16	0 to 59
	RO	Second		0 to 59

Table 5-28 Record Time Data Structure

5.6.3.3 SDR Data Item Structure

Offset	Property	Description
+0	RO	Maximum
+2	RO	Minimum
+4	RO	Avg.
+6	RO	CP95

Table 5-29 SDR Data Item Structure

Notes:

1) The specific data formats of Max., Min., AVG and CP95 are defined by the section 5.8.10 SDR Setup. For example, the Parameter#1 number is set to 10001, the statistical records data item # 1's data type is automatically updated to 6, represents a 32-bit floating-point numbers.

5.6.4 MM Log (Max./Min. Log)

5.6.4.1 MM Log Buffer

Register	Property	Description	Format
22200-22306	RW	Max. Log #1 Buffer	See Section 5.6.4.2 MM Log Buffer Structure
22350~22456	RW	Max. Log #2 Buffer	
22500~22606	RW	Max. Log #3 Buffer	
22650~22756	RW	Max. Log #4 Buffer	
22800~22906	RW	Min. Log #1 Buffer	
22950~23056	RW	Min. Log #2 Buffer	
23100~23206	RW	Min. Log #3 Buffer	
23250~23356	RW	Min. Log #4 Buffer	

Table 5-30 MM Log Buffer

5.6.4.2 MM Log Buffer Structure

Offset Address	Property	Description	Format	Range/Options
+0	RW	MM Log X Pointer (n)	UINT32	0 = Since Last Reset/This Month 1 = Before Last Reset/Last Month
+2	RO	Record Time	Bitmap	
+5	RO	Flagging Status		0 = No Flag 1 = Flagged & Eliminated 2 = Flagged & Not Eliminated
+6~+10		Data Item #1	See Section 5.6.4.3 MM Data Item Data Structure	
+11~+15	RO	Data Item #2		
…		…		
+101~+105	RO	Data Item #20		

* Writing n to the MM Log X Pointer register will update the MM Log X Buffer with the MM Log X Record at pointer position n.

Table 5-31 Max./Min. Log Data Structure

5.6.4.3 MM Data Item Data Structure

Offset	Property	Description		
+0	RO	Record Time	Hi	Year (-2000)

			Low	Month
+1	RO		Hi	Day
			Low	Hour
+2	RO		Hi	Minute
			Low	Second
+3~+4	RO	Max. or Min. Value		

Table5-32 MM Data Item Data Structure

Notes:

1) The formats of data Items are defined in Appendix A. For example, the Parameter#1 number is set to 10001, the statistical records data item # 1's data type (register address 35800) is automatically updated to 6, represents a 32-bit floating-point numbers.

5.6.5 Pst/Plt Log

5.6.5.1 Pst Log Buffer

Register	Property	Description	Format
23400	RW	Pst Log Pointer (n)*	UINT32
23402~23411	RO	Log n	See Section 5.6.5.3 Pst / Plt Log Data Structure
23412~23421	RO	Log n+1	
…		…	
23492~23501	RO	Log n+9	

* Writing n to the Pst Log Pointer register will update the Pst Log Buffer with Pst Log Records at pointer positions from n to n+9.

Table 5-33 Pst Log Buffer

5.6.5.2 Plt Log Buffer

Register	Property	Description	Format
23600	RW	Plt Log Pointer	UINT32
23602~23611	RO	Log n	See Section 5.6.5.3 Pst / Plt Log Data Structure
23612~23621	RO	Log n+1	
…		…	
23692~23701	RO	Log n+9	

* Writing n to the Plt Log Pointer register will update the Plt Log Buffer with Plt Log Records at pointer positions from n to n+9.

Table 5-34 Plt Log

5.6.5.3 Pst/Plt Log Data Structure

Offset	Property	Description	Format	Unit
+0~+2	RO	Record Time	Bitmap	--
+3	RO	Flagging Status	UINT16	
+4~+5	RO	Ua Pst/Plt	Float	V
+6~+7	RO	Ub Pst/Plt	Float	V
+8~+9	RO	Uc Pst/Plt	Float	V

Table 5-35 Pst/Plt Log Data Structure

Notes:

1) The following table illustrates Flagging Status:

Offset	Description
Bit0	Dip
Bit1	Swell
Bit2	Interruption

Table 5-36 Flagging Status

5.6.6 EN50160 Log

Register	Property	Description	Format	Option/Note
24200	RW	EN50160 Log Pointer (n)	UINT32	
24202	RO	Start Time	UINT32	
24205	RO	End Time	UINT32	
24208	RO	Flagging Status	UINT32	
24210	RO	Freq. Conclusion	UINT32	0=Pass, 1=Failed
24212	RO	Freq N Valid	UINT32	Number of valid intervals
24214	RO	Freq N Invalid	UINT32	Number of invalid intervals

24216	RO	Freq Wide Conclusion	UINT32	0=Pass, 1=Failed
24218	RO	Freq N2	UINT32	Number of valid intervals in which the freq deviates from the nominal by more than user defined wide limit
24220	RO	Freq (1 - N2/N)	Float	
24222	RO	Freq Narrow Conclusion	UINT32	0=Pass, 1=Failed
24224	RO	Freq N1	UINT32	Number of valid intervals in which the freq deviates from the nominal by more than user defined narrow limit
24226	RO	Freq (1 - N1/N)	Float	
24228	RO	Freq Max.	UINT32	Hz, on OP - Observation Period, a week by default
24230	RO	Freq Min.	UINT32	Hz
24232	RO	U Magnitude Conclusion	UINT32	0=Pass, 1=Failed
24234	RO	U Mag N Valid	UINT32	--
24236	RO	U Mag Invalid N	UINT32	--
24238	RO	U Mag Wide Conclusion	UINT32	Note 1
24240	RO	Ua Mag N2	UINT32	Number of valid intervals in which the voltage on 3-phase deviates from nominal by more than user defined wide limit
24242	RO	Ub Mag N2	UINT32	
24244	RO	Uc Mag N2	UINT32	
24246	RO	Ua Mag (1 - N2/N)	Float	--
24248	RO	Ub Mag (1 - N2/N)	Float	--
24250	RO	Uc Mag (1 - N2/N)	Float	--
24252	RO	U Mag Narrow Conclusion	UINT32	0=Pass, 1=Failed
24254	RO	Ua Mag N1	UINT32	Number of valid intervals in which the voltage on 3-phase deviates from nominal by more than user defined narrow limit
24256	RO	Ub Mag N1	UINT32	
24258	RO	Uc Mag N1	UINT32	
24260	RO	Ua Mag (1 - N1/N)	Float	--
24262	RO	Ub Mag (1 - N1/N)	Float	
24264	RO	Uc Mag (1 - N1/N)	Float	--
24266	RO	Ua mean Max.	Float	Max. of average voltage Ua/Ub/Uc over 1 week
24268	RO	Ub mean Max.	Float	
24270	RO	Uc mean Max.	Float	
24272	RO	Ua mean Min.	Float	Min. of average voltage Ua/Ub/Uc over 1 week
24274	RO	Ub mean Min.	Float	
24276	RO	Uc mean Min.	Float	
24278	RO	Flicker Conclusion	UINT32	0=Pass, 1=Failed
24280	RO	Plt N Valid	UINT32	--
24282	RO	Plt N invalid	UINT32	--
24284	RO	Ua Plt N1	UINT32	Number of valid intervals in which Plt on 3-phase is greater than 1
24286	RO	Ub Plt N1	UINT32	
24288	RO	Uc Plt N1	UINT32	
24290	RO	Ua (1 - N1/N)	Float	
24292	RO	Ub (1 - N1/N)	Float	
24294	RO	Uc (1 - N1/N)	Float	
24296	RO	Ua Plt Max.	Float	Maximum Plt value for 3-phase over 1 week
24298	RO	Ub Plt Max.	Float	
24300	RO	Uc Plt Max.	Float	
24302	RO	Ua Plt Min.	Float	Minimum Plt value for 3-phase over 1 week
24304	RO	Ub Plt Min.	Float	
24306	RO	Uc Plt Min.	Float	
24308	RO	Ua Plt CP95	Float	CP95 of Plt value for 3-phase over 1 week
24300	RO	Ub Plt CP95	Float	
24312	RO	Uc Plt CP95	Float	
24314	RO	U Unbalance Conclusion	UINT32	0=Pass, 1=Failed
24316	RO	U Unbalance N valid	UINT32	
24318	RO	U Unbalance N invalid	UINT32	
24320	RO	U Unbalance N1	UINT32	Number of valid intervals in which the voltage unbalance exceeds user defined unbalance limit value

24322	RO	U Unbalance (1 - N1/N)	Float	
24324	RO	U Unbalance Max.	Float	Maximum/Minimum/CP95 voltage unbalance value over 1 week
24326	RO	U Unbalance Min.	Float	
24328	RO	U Unbalance CP95	Float	
24320	RO	Harmonic Conclusion	UINT32	0=Pass, 1=Failed
24332	RO	Harmonic N Valid	UINT32	
24334	RO	Harmonic N Invalid	UINT32	
24336	RO	THD Conclusion	UINT32	0=Pass, 1=Failed
24338	RO	Ua THD N1	UINT32	Number of intervals in which the THD on3-phase exceed user defined limits
24340	RO	Ub THD N1	UINT32	
24342	RO	Uc THD N1	UINT32	
24344	…	Ua THD (1 - N1/N)	Float	
24346	RO	Ub THD (1 - N1/N)	Float	
24348	RO	Uc THD (1 - N1/N)	Float	
24350~24376	RO	Reserved	UINT32	
24378	RO	H02 Conclusion	UINT32	0=Pass, 1=Failed
24380	RO	Ua H02 N1	UINT32	
24382	RO	Ub H02 N1	UINT32	
24384	RO	Uc H02 N1	UINT32	
24386	RO	Ua H02 (1 - N1/N)	Float	
24388	RO	Ub H02 (1 - N1/N)	Float	
24400	RO	Uc H02 (1 - N1/N)	Float	
	RO	…	UINT32	
24700	RO	H25 Conclusion	UINT32	
24702	RO	Ua H25 N1	UINT32	
24704	RO	Ub H25 N1	UINT32	
24706	RO	Uc H25 N1	UINT32	
24708	RO	Ua H25 (1 - N1/N)	Float	
24710	RO	Ub H25 (1 - N1/N)	Float	
24712	RO	Uc H25 (1 - N1/N)	Float	
24714	RO	Ua THD Max.	Float	
24716	RO	Ub THD Max.	Float	
24718	RO	Uc THD Max.	Float	
24720	RO	Ua THD Min.	Float	
24722	RO	Ub THD Min.	Float	
24724	RO	Uc THD Min.	Float	
24726	RO	Ua THD CP95	Float	
24728	RO	Ub THD CP95	Float	
24730	RO	Uc THD CP95	Float	
24732	RO	Ua THD Avg	Float	
24734	RO	Ub THD Avg	Float	
24736	RO	Uc THD Avg	Float	
24738~24748	RO	Reserved	Float	
24750	RO	Ua H02 Max.	Float	
24752	RO	Ub H02 Max.	Float	
24754	RO	Uc H02 Max.	Float	
	RO	.....	Float	
24888	RO	Ua H25 Max.	Float	
24890	RO	Ub H25 Max.	Float	
24892	RO	Uc H25 Max.	Float	
24894~24904	RO	Reserved	Float	
24906	RO	Ua H02 Min.	Float	
24908	RO	Ub H02 Min.	Float	
24910	RO	Uc H02 Min.	Float	
	RO	.....	Float	
25044	RO	Ua H25 Min.	Float	
25046	RO	Ub H25 Min.	Float	
25048	RO	Uc H25 Min.	Float	
25050~25060	RO	Reserved	Float	
25062	RO	Ua H02 CP95	Float	
25064	RO	Ub H02 CP95	Float	
25066	RO	Uc H02 CP95	Float	
	RO	.....	Float	
25200	RO	Ua H25 CP95	Float	

25202	RO	Ub H25 CP95	Float	
25204	RO	Uc H25 CP95	Float	
25206~25216	RO	Reserved	Float	
25218	RO	Ua H02 Avg	Float	
25220	RO	Uc H02 Avg	Float	
25222	RO	Uc H02 Avg	Float	
	RO	.....	Float	
25356	RO	Ua H25 Avg	Float	
25358	RO	Uc H25 Avg	Float	
25360	RO	Uc H25 Avg	UINT32	
25362	RO	Interharmonics N Valid	UINT32	
25364	RO	Interharmonics N Invalid	Float	
25366	RO	Ua TIHD Max.	Float	
25368	RO	Ub TIHD Max.	Float	
25370	RO	Uc TIHD Max.	Float	
25372	RO	Ua TIHD Min.	Float	
25374	RO	Ub TIHD Min.	Float	
25376	RO	Uc TIHD Min.	Float	
25378	RO	Ua TIHD CP95	Float	
25380	RO	Ub TIHD CP95	Float	
25382	RO	Uc TIHD CP95	Float	
25384	RO	Ua TIHD Avg	Float	
25386	RO	Ub TIHD Avg	Float	
25388	RO	Uc TIHD Avg	Float	
25390~25394	RO	Reserved	Float	
25396	RO	Ua IH01 Max.	Float	
25398	RO	Ub IH01 Max.	Float	
25400	RO	Uc IH01 Max.	Float	
	RO	.....	Float	
25540	RO	Ua IH25 Max.	Float	
25542	RO	Ub IH25 Max.	Float	
25544	RO	Uc IH25 Max.	Float	
25546~25550	RO	Reserved	Float	
25552	RO	Ua IH01 Min.	Float	
25554	RO	Ub IH01 Min.	Float	
25556	RO	Uc IH01 Min.	Float	
	RO	.....	Float	
25696	RO	Ua IH25 Min.	Float	
25698	RO	Ub IH25 Min.	Float	
25700	RO	Uc IH25 Min.	Float	
25702~25706	RO	Reserved	Float	
25708	RO	Ua IH01 CP95	Float	
25710	RO	Ub IH01 CP95	Float	
25712	RO	Uc IH01 CP95	Float	
	RO	.....	Float	
25852	RO	Ua IH25 CP95	Float	
25854	RO	Ub IH25 CP95	Float	
25856	RO	Uc IH25 CP95	Float	
25858~25862	RO	Reserved		
25864	RO	Ua IH01 Avg	Float	
25866	RO	Ub IH01 Avg	Float	
25868	RO	Uc IH01 Avg	Float	
25870~25006	RO	.....	Float	
26008	RO	Ua IH25 Avg	Float	
26010	RO	Ub IH25 Avg	Float	
26012	RO	Uc IH25 Avg	Float	
26014	RO	MSV Conclusion	UINT32	
26016	RO	MSV N Valid	UINT32	
26018	RO	MSV N Invalid	UINT32	
26020	RO	MSV1 Conclusion	UINT32	
26062	RO	Ua MSV N1	UINT32	
26024	RO	Ub MSV N1	UINT32	
26026	RO	Uc MSV N1	UINT32	
26028	RO	Ua MSV1 (1 - N1/N)	Float	
26030	RO	Ub MSV1 (1 - N1/N)	Float	
26032	RO	Uc MSV1 (1 - N1/N)	Float	

…	RO	…		
26048	RO	MSV3 Conclusion	UINT32	
26050	RO	Ua MSV3 N1	UINT32	
26052	RO	Ub MSV3 N1	UINT32	
26054	RO	Uc MSV3 N1	UINT32	
26056	RO	Ua MSV3 (1 - N1/N)	Float	
26058	RO	Ub MSV3 (1 - N1/N)	Float	
26060	RO	Uc MSV3 (1 - N1/N)	Float	
26062	RO	Ua MSV1 Max.	Float	
26064	RO	Ub MSV1 Max.	Float	
26066	RO	Uc MSV1 Max.	Float	
26068	RO	Ua MSV2 Max.	Float	
26070	RO	Ub MSV2 Max.	Float	
26072	RO	Uc MSV2 Max.	Float	
26074	RO	Ua MSV3 Max.	Float	
26076	RO	Ub MSV3 Max.	Float	
26078	RO	Uc MSV3 Max.	Float	
26080	RO	Ua MSV1 Min.	Float	
26082	RO	Ub MSV1 Min.	Float	
26084	RO	Uc MSV1 Min.	Float	
26086	RO	Ua MSV2 Min.	Float	
26088	RO	Ub MSV2 Min.	Float	
26090	RO	Uc MSV2 Min.	Float	
26092	RO	Ua MSV3 Min.	Float	
26094	RO	Ub MSV3 Min.	Float	
26096	RO	Uc MSV3 Min.	Float	
26098	RO	Ua MSV1 CP95	Float	
26100	RO	Ub MSV1 CP95	Float	
26102	RO	Uc MSV1 CP95	Float	
26104	RO	Ua MSV2 CP95	Float	
26106	RO	Ub MSV2 CP95	Float	
26108	RO	Uc MSV2 CP95	Float	
26110	RO	Ua MSV3 CP95	Float	
26112	RO	Ub MSV3 CP95	Float	
26114	RO	Uc MSV3 CP95	Float	
26116	RO	Ua RVC N1	Reserved	RVC counter occurs on 3-phase within a week
26118	RO	Ub RVC N1	Reserved	
26120	RO	Uc RVC N1	Reserved	
26122~26124		Reserved		
26126	RO	Swell N11	UINT32	See Note 1)
26128	RO	Swell N21	UINT32	
26130	RO	Swell N31	UINT32	
26132	RO	Swell N41	UINT32	
26134	RO	Swell N12	UINT32	
26136	RO	Swell N22	UINT32	
26138	RO	Swell N32	UINT32	
26140	RO	Swell N42	UINT32	
26142	RO	Swell N13	UINT32	
26144	RO	Swell N23	UINT32	
26146	RO	Swell N33	UINT32	
26148	RO	Swell N43	UINT32	
26150	RO	Swell N14	UINT32	
26152	RO	Swell N24	UINT32	
26154	RO	Swell N34	UINT32	
26156	RO	Swell N44	UINT32	
26158	RO	Swell N15	UINT32	
26160	RO	Swell N25	UINT32	
26162	RO	Swell N35	UINT32	
26164	RO	Swell N45	UINT32	
26166	RO	Dip N11	UINT32	
26168	RO	Dip N21	UINT32	
26170	RO	Dip N31	UINT32	
26172	RO	Dip N41	UINT32	
26174	RO	Dip N51	UINT32	
26176	RO	Dip N61	UINT32	
26178	RO	Dip N12	UINT32	

26180	RO	Dip N22	UINT32	
26182	RO	Dip N32	UINT32	
26184	RO	Dip N42	UINT32	
26186	RO	Dip N52	UINT32	
26188	RO	Dip N62	UINT32	
26190	RO	Dip N13	UINT32	
26192	RO	Dip N23	UINT32	
26194	RO	Dip N33	UINT32	
26196	RO	Dip N43	UINT32	
26198	RO	Dip N53	UINT32	
26200	RO	Dip N63	UINT32	
26202	RO	Dip N14	UINT32	
26204	RO	Dip N24	UINT32	
26206	RO	Dip N34	UINT32	
26208	RO	Dip N44	UINT32	
26210	RO	Dip N54	UINT32	
26212	RO	Dip N64	UINT32	
26214	RO	Dip N15	UINT32	
26216	RO	Dip N25	UINT32	
26218	RO	Dip N35	UINT32	
26220	RO	Dip N45	UINT32	
26222	RO	Dip N55	UINT32	
26224	RO	Dip N65	UINT32	
26226	RO	Interruptions N11	UINT32	
26228	RO	Interruption N21	UINT32	
26230	RO	Interruption N31	UINT32	
26232	RO	Ua Transient N1	UINT32	Transient counter occurs on 3-Phase over 1 week
26234	RO	Ub Transient N1	UINT32	
26236	RO	Uc Transient N1	UINT32	

* Writing n to the EN50160 Log Pointer register will update the EN50160 Log Buffer with a Log Record at the pointer position.

Table 5-37 EN50160 Log

Notes:

1) Nxx have following definitions:

Swell (t indicates Duration, while u indicates Residual Voltage)				
Counter	10ms <= *t* <= 500ms	500ms < t <= 5000ms	5000ms < t <= 60000ms	t > 60000ms
110% < u < 120%	N11	N21	N31	N41
120% <= u < 140%	N12	N22	N32	N42
140% <= u < 160%	N13	N23	N33	N43
160% <= u < 200%	N14	N24	N34	N44
u >= 200%	N15	N25	N35	N45

Table 5-38 Swell Counter Definition

Dip (t indicates Duration, while u indicates Residual Voltage)						
Counter	10ms < t <= 200ms	200ms < t <= 500ms	500ms < t <= 1000ms	1000ms < t <= 5000ms	5000ms < t <= 60000ms	t > 60000ms
u < 5%	N11	N21	N31	N41	N51	N61
5% <= u < 40%	N12	N22	N32	N42	N52	N62
40% <= u < 70%	N13	N23	N33	N43	N53	N63
70% <= u < 80%	N14	N24	N34	N44	N54	N64
80% <= u < 90%	N15	N25	N35	N45	N55	N65

Table 5-39 Dip Counter Definition

Interruption (t indicates Duration, while u indicates Residual Voltage)			
Counter	t <= 1s	t <= 180000ms	t > 180000ms
	N11	N21	N31

Table 5-40 Interruption Counter Definition

5.7 Real-time WFR Register

Register	Property	Description	Format	Note/Range
53000	RO	Start Time	Bitmap	
53004	RO	Reserved	Unit16	
53005	RO	Reserved	Unit16	
53006	RO	Frequency	Float	
53008	RO	Ia 1st Sample	Float	

…	RO	…	Float	
54030	RO	Ia 512nd Sample	Float	
54032	RO	Ib 1st Sample	Float	
…	RO	…	Float	
55054	RO	Ib 512nd Sample	Float	
55056	RO	Ic 1st Sample	Float	
…	RO	…	Float	
56078	RO	Ic 512nd Sample	Float	
56080	RO	Ua 1st Sample	Float	
…	RO	…	Float	
57102	RO	Ua 512nd Sample	Float	
57104	RO	Ub 1st Sample	Float	
…	RO	…	Float	
58126	RO	Ub 512nd Sample	Float	
58128	RO	Uc 1st Sample	Float	
…	RO	…	Float	
59150	RO	Uc 512nd Sample	Float	

Table 5-41 Real-time WFR Register

Notes:

1) Read real-time WFR by reading 53000, and when the register is read, it will refresh automatically to ensure WFR's integrity.

5.8 Device Setup Parameters

5.8.1 Communications Setup

Register	Property	Description		Format	Note
40000~40015	RW	Reserved		UINT16	
40016	RW	Ethernet 1 (P1)	IP Address[4]	UINT32	Default=192.168.0.100
40018	RW		Subnet Mask[4]	UINT32	Default=255.255.255.0
40020	RW		Default Gateway[4]	UINT32	Default=192.168.0.1
40022~40030	RW	Reserved			
40032	RW	MODBUS TCP – IP Port #		UINT16	502* to 60000
40033~40063	RW	Reserved		--	--
40065	RW	IP Address of SNTP Server		UINT32	Default=192.168.101.2
40067	RW	SNTP Sync. Interval		UINT16	1 to 1440 min, Default=60
40068	RW	Reserved		UINT16	

*Default

Table 5-42 Communication Setup Parameters

Notes:

1) If the IP Address is 192.168.0.100, write "0xC0A00064" to the register.

5.8.2 Basic Setup Parameters

Register	Property	Description	Format	Range / Options
41000	RW	Wiring Mode	UINT16	1=4W-WYE*, 2=3W-WYE 3=Delta, 4=Demo, 5=One-Phase
41001	RW	PT Primary (V)	UINT32	1 to 1,000,000, 100*
41003	RW	PT Secondary (V)	UINT32	1 to 1500, 100*
41005	RW	CT Primary (A)	UINT32	1 to 30000, 5*
41007	RW	CT Secondary (A)	UINT32	1 to 50, 5*
41009	RW	U4 Primary (V)	UINT32	1 to 1,000,000, 100*
41011	RW	U4 Secondary (V)	UINT32	1 to 1500, 100*
41013	RW	I4 Primary (A)	UINT32	1 to 30,000, 5*
41015	RW	I4 Secondary (A)	UINT32	1 to 50, 5*
41017~41019	RW	Reserved	UINT32	
41021	RW	ULL Nominal ($Vll_{nominal}$)	UINT32	1 to 1500, 100*
41023	RW	Nominal Current ($I_{nominal}$)	UINT32	1 to 10000 , 5*
41025	RW	CT Polarity[1]	Bitmap	0=Normal*, 1=Reverse
41026	RW	Reserved	UINT16	
41027	RW	Power Factor Convention[2]	UINT16	0=IEC*, 1=IEEE, 2=-IEEE
41028	RW	kVA Calculation[3]	UINT16	0=Vector*, 1=Scalar
41029	RW	Harmonics Calculation	UINT16	0=% of Fundamental* 1=% of RMS 2=% of Nominal
41030	RW	Statistical Harmonic Calculation	UINT16	0=Subgroup*, 1=Group

41031	RW	Order of Harmonic Calculation	UINT16	2 to 63*
41032~41033	RW	Reserved		
41035	RW	CT Clamp Specification	UINT16	0*=5A (50A) @10mV/A 1=20A@10mV/A 2=200A@1mV/A 3=500A @1mV/A 4=500A(550A) @1mV/A 5=5kA @0.1mV/A
41036	RW	Frequency	UINT16	0=50Hz*, 1=60Hz

*Default

Table 5-43 Basic Setup Parameters

Notes:

1) The **CT Polarity** register defines the polarity for the Current Inputs as illustrated in the following table.

Bit 15~Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	I4	Ic	Ib	Ia

Table 5-44 CT Polarity Register

2) P.F. Convention: -IEEE is the same as IEEE but with the opposite sign.

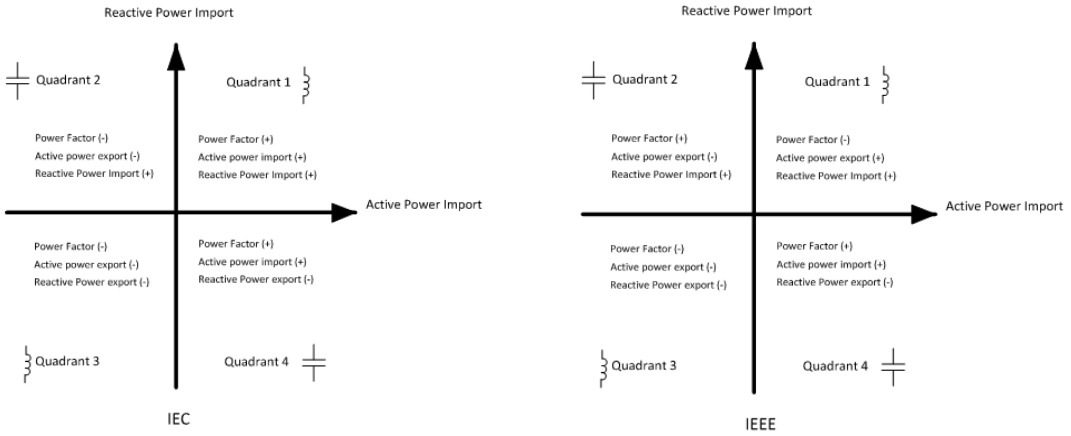


Figure 5-1 Power Factor Definitions

3) There are two ways to calculate kVA:

Mode V (Vector method**):** $KVA_{total} = \sqrt{KW_{total}^{2} + KVAR_{total}^{2}}$

Mode S (Scalar method**):** $KVA_{total} = KVA_a + KVA_b + KVA_c$

5.8.3 SMTP Setup

Register	Property	Description	Format	Range/Options
40900	RW	SMTP Event Classification[1]	Bitmap	Note 1)
40902	RW	SMTP IP Port	UINT16	1 to 65535 (Default=25)
40903	RW	IP Address of SMTP Server[2]	UINT32	Default=0.0.0.0
40905	RW	Source Email Address[3]	CHAR	Note 2)
40925	RW	Source Username[4]	CHAR	
40945	RW	Login Password[5]	CHAR	Note 3)
40955	RW	Destination Email Address[6]	CHAR	Note 4)

Table 5-45 SMTP Setup Parameters

Notes:

1) **SMTP Event Classification** register determines if a newly generated Device/SOE LOG is sent out by email. The following table illustrates the Bitmap definition of this register. When a particular bit is set to 1, its corresponding events will be sent out by email.

Bit	Classification	Event Type	Bit	Classification	Event Type
Bit 0	1=System Events See Appendix B	Device	Bit 16	0x81=Dip/Swell Disturbance	SOE Log
Bit 1	2=Standard Setpoints Events		Bit 17	0x82=Transient Disturbance	

Bit 2	3=High-speed Setpoints Events		Bit 18	0x83 = Inrush Current	
Bit 3	Reserved		Bit 19	0x84 = RVC	
Bit 4	5 =WFR		Bit 20	0x85 = MSV	
Bit 5	6 = DWR		Bit 21	0x86 = RMS Change	
Bit 6~Bit 8	Reserved				
Bit 9	RMS Recorder				

Table 5-46 SMTP Event Classification Register (40900)

2) If the IP Address is 192.168.0.100, write "0xC0A00064" to the register.

3) This string parameter may be up to 20 characters long and specifies the source email address that appears in the "**From**" field of the email. For example, if the email address is PMC-690@ceiec-electric.com, set the parameter as"70 6D 63 2D 36 38 30 69 40 63 65 69 65 63 2D 65 6C 65 63 74 72 69 63 2E 63 6F 6D 00 00" where the two zero characters "00 00" at the end of the string are the string terminator.

4) This string parameter may be up to 10 characters long and specifies the "**Source Username**" that appears in the email. For example, if the username is "abc", set the parameter as "61 62 63 00 00" where the two zero characters "00 00" at the end of the string are the string terminator.

5) This string parameter may be up to 10 characters long and specifies the Logon Password to login the "**Source Email**" account. For example, if the password is "PMC-690", set the parameter as "50 4D 43 2D 36 38 30 69 00 00" where the two zero characters "00 00" at the end of the string are the string terminator.

6) This string parameter may be up to 20 characters long and specifies the destination email address that appears in the "**To**" field of the email. For example, if the email address is PMC-690-a@ceiec-electric.com, so set the registers as"70 6D 63 2D 36 38 30 69 2D 61 40 63 65 69 65 63 2D 65 6C 65 63 74 72 69 63 2E 63 6F 6D 00 00" where the two zero characters "00 00" at the end of the string are the string terminator.

5.8.4 PQ Setup

Register	Property	Description	Format	Note
41100	RW	Dip/Swell Enable[1]	UINT16	0=Disabled, 1=Enabled*
41101	RW	Dip/Swell Voltage Reference	UINT16	0=Udin (Nominal)* 1=Usr (Slide Reference Voltage)
41102	RW	Swell Limit	UINT16	101 to 200 (x0.01Udin), 110*
41103	RW	Dip Limit[2]	UINT16	1 to 99 (x0.01Udin), 90*
41104	RW	Interruption Limit[2]	UINT16	0 to 50 (x0.01Udin), 10*
41105	RW	Swell Hysteresis	UINT16	1 to 1000 (x0.001Udin), 5*
41106	RW	Dip Hysteresis	UINT16	
41107	RW	Interruption Hysteresis	UINT16	
41108	RW	Dip/Swell Trigger	UINT32	WFR*
41110~41111	RW	Reserved	UINT16	
41112	RW	Transient Enable	UINT16	0=Disabled, 1=Enabled*
41113	RW	Transient Limit	UINT16	5 to 500 (%), 35*
41114	RW	Transient Trigger[3]	UINT32	WFR*
41116~41119	RW	Reserved	UINT16	
41120	RW	Inrush Current Enable	UINT16	0=Disabled*, 1=Enabled
41121	RW	Inrush Current Limit	UINT16	100 to 500 (%), 120*
41122	RW	Inrush Current Hysteresis	UINT16	1 to 1000 (0.1% to 100%), 10*
41123	RW	Inrush Current Trigger	UINT32	WFR*
41125~41127	RW	Reserved	UINT16	
41128	RW	Rapid Voltage Changes (RVC) Enable	UINT16	0=Disabled*, 1=Enabled
41129	RW	Detection mode (Set Voltage Reference)	UINT16	0= Based on Steady-state V* 1= Based on Maximum V Change
41130	RW	Voltage Tolerance	UINT32	0 to 1000 (x0.001Udin), 2*
41132	RW	Steady-State Duration	UINT32	1 to 50 (x0.1s), 10*
41134	RW	Min. of V Change Step	UINT32	1 to 1000 (x0.001Udin), 50*
41136	RW	Min. of V Change Rate	UINT32	0 to 100 (x0.01Udin), 5*
41138	RW	RVC Trigger[3]	UINT32	WFR*
41140~41141	RW	Reserved	UINT16	
41142	RW	RMS Change Enable	UINT16	Bit0: Voltage, Bit1=Current 0=Disabled*, 1=Enabled
41143~41144	RW	Reserved	UINT16	
41145	RW	RMS Change Trigger[3]	UINT16	WFR*
41147	RW	Reserved	UINT16	
41148	RW	Voltage RMS Change Threshold	UINT32	0~999,999,999 (x0.01V) Default=1000
41150	RW	Current RMS Change Threshold	UINT32	0~999,999,999 (x0.01A) Default=100
41152~41153	RW	Reserved	UINT16	

41154	RW	MSV #1 Enable	UINT16	0=Disabled*, 1=Enabled
41155	RW	MSV #1 Frequency	UINT16	50 Hz: 600 to 30000 (x0.1Hz) 60 Hz: 700 to 30000 (x0.1Hz) Default=10000
41156	RW	MSV #1 Limit	UINT16	3 to 1000 (x0.001Udin) Default=50 (x0.001Udin)
41157	RW	Reserved	UINT16	
41158~41159	RW	Reserved		
41160	RW	MSV #2 Enable	UINT16	0*=Disabled, 1=Enabled
41161	RW	MSV #2 Frequency	UINT16	50 Hz: 600 to 30000 (x0.1Hz) 60 Hz: 700 to 30000 (x0.1Hz) Default=20000
41162	RW	MSV #2 Limit	UINT16	3 to 1000 (x0.001Udin) Default=50 (x0.001Udin)
41163	RW	Reserved	UINT16	
41164~41165	RW	Reserved		
41166	RW	MSV #3 Enable	UINT16	0*=Disabled, 1=Enabled
41167	RW	MSV #3 Frequency	UINT16	50 Hz: 600 to 30000 (x0.1Hz) Default=30000 60 Hz: 700 to 30000 (x0.1Hz) Default=30000
41168	RW	MSV #3 Limit	UINT16	3 to 1000 (x0.001Udin) Default=50 (x0.001Udin)
41169	RW	Reserved	UINT16	
41170~41171		Reserved	UINT16	
41172	RW	Flicker Mode	UINT16	0=120V*, 1=230V

*Default

Table 5-47 SOE Log Setup

Notes:

1) When the **Wiring Mode** is WYE, Dip/Swell Voltage is line to phase voltage. When the **Wiring Mode** is Delta, it will be line to line voltage.

2) The **Dip Limit**, **Swell Limit**, **Voltage Interruption Threshold** and **Dip/Swell Return** values should be configured to meet the following criteria:

   a) The **Voltage Interruption Threshold** shall not be set below **Dip Limit**.

   b) The **Swell Limit** and **Dip Limit** should associate with Voltage Rapid Changes in the minimum difference between the two steady-states. The absolute value of the minimum Dip/Swell limit (the differential between Dip/Swell and 100%) must be greater than the **Voltage Rapid Changes** in the minimum pressure difference between the two steady-states (actual percentage).

   c) Dip/Swell return value should associate with Swell limit and Dip Limit, Dip/Swell return value (actual value) must be less than the Dip/Swell limit (Dip, Swell of the absolute difference of the minimum value and 100%).

   d) Regardless of Dip/Swell enable, a), b) and c) must be complied.

3) Table 5-48 provides a list of Dip/Swell, Voltage Transient and Rapid Voltage Changes Triggers.

Bit	Action
Bit0~Bit26	Reserved
Bit27	DWR
Bit28	WFR
Bit29	RMS Recorder
Bit30~Bit31	Reserved

Table 5-48 Dip/Swell and Rapid Voltage Change Triggers

5.8.5 PQDIF Setup

Register	Property	Description	Format	Range / Options
41200	RW	Freq. Statistics Interval	UINT16	1 to 60 Mins, 3*
41201	RW	Symmetrical Components and Unb. Statistics Interval	UINT16	1 to 60 Mins, 3*
41202	RW	U & I RMS and Deviation Statistics Interval	UINT16	1 to 60 Mins, 3*
41203	RW	Harmonic & Inter-Harmonic Statistics Interval	UINT16	1 to 60 Mins, 3*

41204	RW	PQDIF Save Interval	UINT16	0 to 1* Hour 0 Indicates PQDIF is disabled

*Default

Table 5-49 PQDIF Setup

5.8.6 Demand Setup

Register Address	Property	Description	Format	Range / Options
41250	RW	Demand Sync.	UINT16	0=SLD*
41251	RW	Demand Period	UINT16	1 to 60minutes, 15*
41252	RW	Number of Sliding Windows	UINT16	1* to 15
41253	RW	Self-read Time[1]	UINT16	Default = 0xFFFF
41254	RW	Predicated Response	UINT16	70* to 99

*Default

Table 5-50 Demand Setup

Notes:

1) The **Self-Read Time** supports the following three options:

- A zero value means that the Self-Read will take place at 00:00 of the first day of each month.
- A non-zero value means that the Self-Read will take place at a specific time and day based on the formula: Self-Read Time = (Day x 100 + Hour) where 0 ≤ Hour ≤ 23 and 1 ≤ Day ≤ 28. For example, the value 1512 means that the Self-Read will take place at 12:00pm on the 15th day of each month.
- A 0xFFFF value means the automatic self-read operation is disabled and the log will be transferred manually.

5.8.7 WFR Setup

Register	Property	Description	Format	Range/Option
41300	RW	Pre-fault Cycles[1]	UINT16	2 to 384 (16 Samples/640 Cycles), 2 to 192 (32 Samples/320 Cycles), 2 to 96 (64 Samples/160 Cycles), 2 to 48 (128 Samples/80 Cycles), 2 to 24 (256 Samples/40 Cycles), 2 to 12 (512 Samples/20 Cycles), 4*
41301	RW	Consecutive Recording Depth	UINT16	1 to 7, 1*
41302	RW	# of Samples[2]	UINT16	0=16 Samples/640 Cycles 1=32 Samples/320 Cycles 2=64 Samples/160 Cycles 3=128 Samples/80 Cycles 4=256 Samples/40 Cycles* 5=512 Samples/20 Cycles
41303~41305	RW	Reserved	UNIT16	
41306	RW	Pre-fault Cycles of DWR	UINT16	5* to 10 Cycles
41307	RW	Scheduled WFR Enable	UNIT16	0*=Disabled, 1=Enabled
41308	RW	Start Time	UINT16	
41311	RW	Record Interval	UNIT16	1 to 960 Hour, 24*
41312	RW	Depth	UINT16	1* to 10,000
41313	RW	Pre-fault Samples of RMS Record	UNIT16	100* to 500

*Default

Table 5-51 WFR Setup

5.8.8 Standard Setpoints Setup

Register	Property	Description		Format	Range/Options
41400	RW	Setpoint #1	Parameter [1]	UINT32	0*
41402	RW		Type	UINT16	0=Disabled* 1=Over Setpoint 2=Under Setpoint
41403	RW		Active Limit	Float	0*
41405	RW		Inactive Limit	Float	0*
41407	RW		Active Delay	UINT16	0* to 9999 s
41408	RW		Inactive Delay	UINT16	0* to 9999 s
41409	RW		Trigger[2]	UINT32	0=Disabled*
41411	RW		Reserved		
…		…			…
41699	RW	Setpoint #24	Parameter[1]	UINT32	0*

41701	RW		Type	UINT16	0=Disabled* 1=Over Setpoint 2=Under Setpoint
41702	RW		Active Limit	Float	0*
41704	RW		Inactive Limit	Float	0*
41706	RW		Active Delay	UINT16	0* to 9999 s
41707	RW		Inactive Delay	UINT16	0* to 9999 s
41708	RW		Trigger[2]	UINT32	0=Disabled*
41710	RW		Reserved		

*Default

Table 5-52 Setpoint Setup Parameters

Notes:

1) The PMC-690 provides the following setpoint parameters:

Key	Parameter	Key	Parameter	Key	Parameter
1	ULN*	25	U TEHD	49	kW Exp. Total Demand
2	ULL*	26	I THD	50	kvar Exp. Total Demand
3	U4*	27	I TOHD	51	kVA Total Demand
4	Ia/Ib/Ic*	28	I TEHD	52	P.F. Total Demand
5	I4*	29	U TIHD	53	kW Imp. Total Pred. DMD
6	Reserved*	30	U TOIHD	54	kvar Exp. Total Pred. DMD
7	kW Total*	31	U TEIHD	55	kW Exp. Total Pred. DMD
8	kvar Total*	32	I TIHD	56	kvar Exp. Total Pred. DMD
9	kVA Total*	33	I TOIHD	57	kVA Pred. Total DMD
10	P.F. Total*	34	I TEIHD	58	P.F. Pred. Total DMD
11	U0 Unbalance	35	U TH RMS	59	Pst
12	U2 Unbalance	36	U TOH RMS	60	Plt
13	I0 Unbalance	37	U TEH RMS	61	Voltage Fluct.
14	I2 Unbalance	38	I TH RMS	0x0002xxxx	U HD02
15	U Fundamental	39	I TOH RMS	…	U HD03~HD62
16	I Fundamental	40	I TEH RMS	0x003fxxxx	U HD63
17	U Deviation	41	U TIH RMS	0x0081xxxx	U IHD01
18	U Over Deviation	42	U TOIH RMS	…	U IHD02~IHD62
19	U Under Deviation	43	U TEIH RMS	0x00bfxxxx	U IHD063
20	Frequency	44	I TIH RMS	0x02xxxxxx	I HD02
21	Frequency Deviation	45	I TOIH RMS	…	I HD03~HD62
22	Phase Reversal	46	I TEIH RMS	0x3fxxxxxx	I HD63
23	U THD	47	kW Imp. Total DMD	0x81xxxxxx	I IHD01
24	U TOHD	48	kvar Imp. Total DMD	…	I IHD02~IHD62
				0xbfxxxxxx	I IHD063

* High-speed setpoint parameters

Table 5-53 Setpoint Parameters

2) The PMC-690 provides the following Setpoint Triggers:

Bit	Action
Bit0~Bit26	Reserved
Bit27	DWR
Bit28	WFR
Bit29	RMS Recorder
Bit30~Bit31	Reserved

Table 5-54 Setpoint Triggers

5.8.9 HS (High-speed) Setpoints Setup

Register	Property	Description		Format	Range/Options
45400	RW	HS Setpoint #1	Parameter	UINT32	See Table 5-53 above
45402	RW		Type	UINT16	0=Disabled* 1=Over Setpoint 2=Under Setpoint
45403	RW		Active Limit	Float	Default=0
45405	RW		Inactive Limit	Float	Default=0
45407	RW		Active Delay	UINT16	0* to 9999 cycle
45408	RW		Inactive Delay	UINT16	0* to 9999 cycle
45409	RW		Trigger	UINT32	See Table 5-54 (Default=0)
45411			Reserved	UINT32	
…		…			…

45595	RW	HS Setpoint #16	Parameter[1]	UINT32	See Table 5-53 above
45597	RW		Type	UINT16	0=Disabled* 1=Over Setpoint 2=Under Setpoint
45598	RW		Active Limit	Float	Default=0
45600	RW		Inactive Limit	Float	Default=0
45602	RW		Active Delay	UINT16	0* to 9999 cycle
45603	RW		Inactive Delay	UINT16	0* to 9999 cycle
45604	RW		Trigger	UINT32	See Table 5-54 (Default=0)
45606			Reserved	UINT32	

*Default

Table 5-55 Setpoint Setup Parameters

5.8.10 SDR Setup

5.8.10.1 SDR #1 Setup

Register	Property	Description	Format	Range/Options	Default
45900	RW	Recording Interval	UINT16	0 to 60 min	3
45901	RW	Recording Mode	UINT16	0=Stop-When-Full 1=First-In-First-Out	1
45902	RW	Number of Parameters	UINT16	0 to 64	64
45903	RW	Parameter #1	UINT16	Uab Fund. RMS	10130*
45904	RW	Parameter #2	UINT16	Ubc Fund. RMS	10131
45905	RW	Parameter #3	UINT16	Uca Fund. RMS	10132
45906	RW	Parameter #4	UINT16	Ua/Uab TIHD	12727
45907	RW	Parameter #5	UINT16	Ub/Ubc TIHD	12728
45908	RW	Parameter #6	UINT16	Uc/Uca TIHD	12729
45909	RW	Parameter #7	UINT16	U4 TIHD	12730
45910	RW	Parameter #8	UINT16	Ia TIHD	12739
45911	RW	Parameter #9	UINT16	Ib TIHD	12740
45912	RW	Parameter #10	UINT16	Ic TIHD	12741
45913	RW	Parameter #11	UINT16	I4 TIHD	12742
45914	RW	Parameter #12	UINT16	Ua/Uab TOIHD	12731
45915	RW	Parameter #13	UINT16	Ub/Ubc TOIHD	12732
45916	RW	Parameter #14	UINT16	Uc/Uca TOIHD	12733
45917	RW	Parameter #15	UINT16	U4 TOIHD	12734
45918	RW	Parameter #16	UINT16	Ia TOIHD	12744
45919	RW	Parameter #17	UINT16	Ib TOIHD	12745
45920	RW	Parameter #18	UINT16	Ic TOIHD	12746
45921	RW	Parameter #19	UINT16	I4 TOIHD	12747
45922	RW	Parameter #20	UINT16	Ua/Uab TEIHD	12735
45923	RW	Parameter #21	UINT16	Ub/Ubc TEIHD	12736
45924	RW	Parameter #22	UINT16	Uc/Uca TEIHD	12737
45925	RW	Parameter #23	UINT16	U4 TEIHD	12738
45926	RW	Parameter #24	UINT16	Ia TEIHD	12749
45927	RW	Parameter #25	UINT16	Ib TEIHD	12750
45928	RW	Parameter #26	UINT16	Ic TEIHD	12751
45929	RW	Parameter #27	UINT16	I4 TEIHD	12752
45930	RW	Parameter #28	UINT16	Ia THD DMD	51073
45931	RW	Parameter #29	UINT16	Ib THD DMD	51074
45932	RW	Parameter #30	UINT16	Ic THD DMD	51075
45933	RW	Parameter #31	UINT16	I4 THD DMD	51076
45934	RW	Parameter #32	UINT16	kW Imp. DMD	51019
45935	RW	Parameter #33	UINT16	kW Imp. Max. DMD	53001
45936	RW	Parameter #34	UINT16	Ua Pst	50001
45937	RW	Parameter #35	UINT16	Ub Pst	50002
45938	RW	Parameter #36	UINT16	Uc Pst	50003
45939	RW	Parameter #37	UINT16	Ua Plt	50004
45940	RW	Parameter #38	UINT16	Ub Plt	50005
45941	RW	Parameter #39	UINT16	Uc Plt	50006
45942~45966	RW	Parameter #40~ Parameter #64	UINT16	Reserved	0

*Default for 150 cycles

Table 5-56 SDR #1 Setup

5.8.10.2 SDR #2 Setup

Register	Property	Description	Format	Range/Options	Default
46000	RW	Recording Interval	UINT16	0 to 60 min	3
46001	RW	Recording Mode	UINT16	0=Stop-When-Full 1=First-In-First-Out	1
46002	RW	Number of Parameters	UINT16	0 to 64	64
46003	RW	Parameter #1	UINT16	Ua HD00	10500
46004	RW	Parameter #2	UINT16	Ub HD00	10501
46005	RW	Parameter #3	UINT16	Uc HD00	10502
46006	RW	Parameter #4	UINT16	U4 HD00	10503
46007	RW	Parameter #5	UINT16	Ua HD01	10504
46008	RW	Parameter #6	UINT16	Ub HD01	10505
46009	RW	Parameter #7	UINT16	Uc HD01	10506
46010	RW	Parameter #8	UINT16	U4 HD01	10507
46011	RW	Parameter #9	UINT16	Ua HD02	10508
46012	RW	Parameter #10	UINT16	Ub HD02	10509
46013	RW	Parameter #11	UINT16	Uc HD02	10510
46014	RW	Parameter #12	UINT16	U4 HD02	10511
46015	RW	Parameter #13	UINT16	Ua HD03	10512
46016	RW	Parameter #14	UINT16	Ub HD03	10513
46017	RW	Parameter #15	UINT16	Uc HD03	10514
46018	RW	Parameter #16	UINT16	U4 HD03	10515
46019	RW	Parameter #17	UINT16	Ua HD04	10516
46020	RW	Parameter #18	UINT16	Ub HD04	10517
46021	RW	Parameter #19	UINT16	Uc HD04	10518
46022	RW	Parameter #20	UINT16	U4 HD04	10519
46023	RW	Parameter #21	UINT16	Ua HD05	10520
46024	RW	Parameter #22	UINT16	Ub HD05	10521
46025	RW	Parameter #23	UINT16	Uc HD05	10522
46026	RW	Parameter #24	UINT16	U4 HD05	10523
46027	RW	Parameter #25	UINT16	Ua HD06	10524
46028	RW	Parameter #26	UINT16	Ub HD06	10525
46029	RW	Parameter #27	UINT16	Uc HD06	10526
46030	RW	Parameter #28	UINT16	U4 HD06	10527
46031	RW	Parameter #29	UINT16	Ua HD07	10528
46032	RW	Parameter #30	UINT16	Ub HD07	10529
46033	RW	Parameter #31	UINT16	Uc HD07	10530
46034	RW	Parameter #32	UINT16	U4 HD07	10531
46035	RW	Parameter #33	UINT16	Ua HD08	10532
46036	RW	Parameter #34	UINT16	Ub HD08	10533
46037	RW	Parameter #35	UINT16	Uc HD08	10534
46038	RW	Parameter #36	UINT16	U4 HD08	10535
46039	RW	Parameter #37	UINT16	Ua HD09	10536
46040	RW	Parameter #38	UINT16	Ub HD09	10537
46041	RW	Parameter #39	UINT16	Uc HD09	10538
46042	RW	Parameter #40	UINT16	U4 HD09	10539
46043	RW	Parameter #41	UINT16	Ua HD10	10540
46044	RW	Parameter #42	UINT16	Ub HD10	10541
46045	RW	Parameter #43	UINT16	Uc HD10	10542
46046	RW	Parameter #44	UINT16	U4 HD10	10543
46047	RW	Parameter #45	UINT16	Ua HD10	10544
46048	RW	Parameter #46	UINT16	Ub HD11	10545
46049	RW	Parameter #47	UINT16	Uc HD11	10546
46050	RW	Parameter #48	UINT16	U4 HD11	10547
46051	RW	Parameter #49	UINT16	Ua HD11	10548
46052	RW	Parameter #50	UINT16	Ub HD12	10549
46053	RW	Parameter #51	UINT16	Uc HD12	10550
46054	RW	Parameter #52	UINT16	U4 HD12	10551
46055	RW	Parameter #53	UINT16	Ua HD13	10552
46056	RW	Parameter #54	UINT16	Ub HD13	10553
46057	RW	Parameter #55	UINT16	Uc HD13	10554
46058	RW	Parameter #56	UINT16	U4 HD13	10555
46059	RW	Parameter #57	UINT16	Ua HD14	10556
46060	RW	Parameter #58	UINT16	Ub HD14	10557
46061	RW	Parameter #59	UINT16	Uc HD14	10558

46062	RW	Parameter #60	UINT16	U4 HD14	10559
46063	RW	Parameter #61	UINT16	Ua HD15	10560
46064	RW	Parameter #62	UINT16	Ub HD15	10561
46065	RW	Parameter #63	UINT16	Uc HD15	10562
46066	RW	Parameter #64	UINT16	U4 HD15	10563

Table 5-57 SDR #2 Setup

5.8.10.3 SDR #3 Setup

Register	Property	Description	Format	Range/Options	Default
46100	RW	Recording Interval	UINT16	0 to 60 min	3
46101	RW	Recording Mode	UINT16	0=Stop-When-Full 1=First-In-First-Out	1
46102	RW	Number of Parameters	UINT16	0 to 64	64
46103	RW	Parameter #1	UINT16	Ua HD16	10564
46104	RW	Parameter #2	UINT16	Ub HD16	10565
46105	RW	Parameter #3	UINT16	Uc HD16	10566
46106	RW	Parameter #4	UINT16	U4 HD16	10567
46107	RW	Parameter #5	UINT16	Ua HD17	10568
46108	RW	Parameter #6	UINT16	Ub HD17	10569
46109	RW	Parameter #7	UINT16	Uc HD17	10570
46110	RW	Parameter #8	UINT16	U4 HD17	10571
46111	RW	Parameter #9	UINT16	Ua HD18	10572
46112	RW	Parameter #10	UINT16	Ub HD18	10573
46113	RW	Parameter #11	UINT16	Uc HD18	10574
46114	RW	Parameter #12	UINT16	U4 HD18	10575
46115	RW	Parameter #13	UINT16	Ua HD19	10576
46116	RW	Parameter #14	UINT16	Ub HD19	10577
46117	RW	Parameter #15	UINT16	Uc HD19	10578
46118	RW	Parameter #16	UINT16	U4 HD19	10579
46119	RW	Parameter #17	UINT16	Ua HD20	10580
46120	RW	Parameter #18	UINT16	Ub HD20	10581
46121	RW	Parameter #19	UINT16	Uc HD20	10582
46122	RW	Parameter #20	UINT16	U4 HD20	10583
46123	RW	Parameter #21	UINT16	Ua HD21	10584
46124	RW	Parameter #22	UINT16	Ub HD21	10585
46125	RW	Parameter #23	UINT16	Uc HD21	10586
46126	RW	Parameter #24	UINT16	U4 HD21	10587
46127	RW	Parameter #25	UINT16	Ua HD22	10588
46128	RW	Parameter #26	UINT16	Ub HD22	10589
46129	RW	Parameter #27	UINT16	Uc HD22	10590
46130	RW	Parameter #28	UINT16	U4 HD22	10591
46131	RW	Parameter #29	UINT16	Ua HD23	10592
46132	RW	Parameter #30	UINT16	Ub HD23	10593
46133	RW	Parameter #31	UINT16	Uc HD23	10594
46134	RW	Parameter #32	UINT16	U4 HD23	10595
46135	RW	Parameter #33	UINT16	Ua HD24	10596
46136	RW	Parameter #34	UINT16	Ub HD24	10597
46137	RW	Parameter #35	UINT16	Uc HD24	10598
46138	RW	Parameter #36	UINT16	U4 HD24	10599
46139	RW	Parameter #37	UINT16	Ua HD25	10600
46140	RW	Parameter #38	UINT16	Ub HD25	10601
46141	RW	Parameter #39	UINT16	Uc HD25	10602
46142	RW	Parameter #40	UINT16	U4 HD25	10603
46143	RW	Parameter #41	UINT16	Ua HD26	10604
46144	RW	Parameter #42	UINT16	Ub HD26	10605
46145	RW	Parameter #43	UINT16	Uc HD26	10606
46146	RW	Parameter #44	UINT16	U4 HD26	10607
46147	RW	Parameter #45	UINT16	Ua HD27	10608
46148	RW	Parameter #46	UINT16	Ub HD27	10609
46149	RW	Parameter #47	UINT16	Uc HD27	10610
46150	RW	Parameter #48	UINT16	U4 HD27	10611
46151	RW	Parameter #49	UINT16	Ua HD28	10612
46152	RW	Parameter #50	UINT16	Ub HD28	10613
46153	RW	Parameter #51	UINT16	Uc HD28	10614
46154	RW	Parameter #52	UINT16	U4 HD28	10615

46155	RW	Parameter #53	UINT16	Ua HD29	10616
46156	RW	Parameter #54	UINT16	Ub HD29	10617
46157	RW	Parameter #55	UINT16	Uc HD29	10618
46158	RW	Parameter #56	UINT16	U4 HD29	10619
46159	RW	Parameter #57	UINT16	Ua HD30	10620
46160	RW	Parameter #58	UINT16	Ub HD30	10621
46161	RW	Parameter #59	UINT16	Uc HD30	10622
46162	RW	Parameter #60	UINT16	U4 HD30	10623
46163	RW	Parameter #61	UINT16	Ua HD31	10624
46164	RW	Parameter #62	UINT16	Ub HD31	10625
46165	RW	Parameter #63	UINT16	Uc HD31	10626
46166	RW	Parameter #64	UINT16	U4 HD31	10627

Table 5-58 SDR #3 Setup

5.8.11 Max./Min. Recorder (MMR) Setup

5.8.11.1 Max./Min. Recorder #1 Setup

Register		Property	Description	Format	Range/Options	Default
Max.	Min.					
48900	49301	RW	Self-read Time	UINT16		0
48901	49302	RW	Number of Parameters	UINT16	0 to 20	20
48902	49303	RW	Parameter #1	UINT16	Freq.	10001
48903	49304	RW	Parameter #2	UINT16	Ua RMS	10002
48904	49305	RW	Parameter #3	UINT16	Ub RMS	10003
48905	49306	RW	Parameter #4	UINT16	Uc RMS	10004
48906	49307	RW	Parameter #5	UINT16	Uab RMS	10007
48907	49308	RW	Parameter #6	UINT16	Ubc RMS	10008
48908	49309	RW	Parameter #7	UINT16	Uca RMS	10009
48909	49310	RW	Parameter #8	UINT16	Ia RMS	10011
48910	49311	RW	Parameter #9	UINT16	Ib RMS	10012
48911	49312	RW	Parameter #10	UINT16	Ic RMS	10013
48912	49313	RW	Parameter #11	UINT16	kW Total	10020
48913	49314	RW	Parameter #12	UINT16	kvar Total	10024
48914	49315	RW	Parameter #13	UINT16	kVA Total	10028
48915	49316	RW	Parameter #14	UINT16	P.F. Total	10032
48916	49317	RW	Parameter #15	UINT16	Ua Pst	50001
48917	49318	RW	Parameter #16	UINT16	Ub Pst	50002
48918	49319	RW	Parameter #17	UINT16	Uc Pst	50003
48919	49320	RW	Parameter #18	UINT16	Ua Plt	50004
48920	49321	RW	Parameter #19	UINT16	Ub Plt	50005
48921	49301	RW	Parameter #20	UINT16	Uc Plt	50006

Table 5-59 Max./Min. Recorder #1 Setup

Notes:

1) The **Self-Read Time** supports the following two options:

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

5.8.11.2 Max./Min. Recorder #2 Setup

Register		Property	Description	Format	Range/Options	Default
Max.	Min.					
49000	49400	RW	Self-read Time	UINT16		0
49001	49401	RW	Number of Parameters	UINT16	0 to 20	20
49002	49402	RW	Parameter #1	UINT16	Ua Over Deviation	10039
49003	49403	RW	Parameter #2	UINT16	Ub Over Deviation	10040
49004	49404	RW	Parameter #3	UINT16	Uc Over Deviation	10041
49005	49405	RW	Parameter #4	UINT16	Uab Over Deviation	10042
49006	49406	RW	Parameter #5	UINT16	Ubc Over Deviation	10043
49007	49407	RW	Parameter #6	UINT16	Uca Over Deviation	10044
49008	49408	RW	Parameter #7	UINT16	Ua Under Deviation	10045
49009	49409	RW	Parameter #8	UINT16	Ub Under Deviation	10046

49010	49410	RW	Parameter #9	UINT16	Uc Under Deviation	10047
49011	49411	RW	Parameter #10	UINT16	Uab Under Deviation	10048
49012	49412	RW	Parameter #11	UINT16	Ubc Under Deviation	10049
49013	49413	RW	Parameter #12	UINT16	Uca Under Deviation	10050
49014	49414	RW	Parameter #13	UINT16	Freq. Deviation	10051
49015	49415	RW	Parameter #14	UINT16	U0 Unbal.	10055
49016	49416	RW	Parameter #15	UINT16	U2 Unbal.	10056
49017	49417	RW	Parameter #16	UINT16	I0 Unbal.	10057
49018	49418	RW	Parameter #17	UINT16	I2 Unbal.	10058
49019	49419	RW	Parameter #18	UINT16	U4 RMS	10005
49020	49420	RW	Parameter #19	UINT16	I4 RMS	10014
49021	49421	RW	Parameter #20	UINT16	Reserved	

Table 5-60 Max. Recorder #2 Setup

Notes:

1) The **Self-Read Time** supports the following two options:

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

5.8.11.3 Max./Min. Recorder #3 Setup

Register		Property	Description	Format	Range/Options	Default
Max.	Min.					
49100	49500	RW	Self-read Time	UINT16		0
49101	49501	RW	Number of Parameters	UINT16	0 to 20	20
49102	49502	RW	Parameter #1	UINT16	U1	10061
49103	49503	RW	Parameter #2	UINT16	U2	10060
49104	49504	RW	Parameter #3	UINT16	U0	10059
49105	49505	RW	Parameter #4	UINT16	I1	10064
49106	49506	RW	Parameter #5	UINT16	I2	10063
49107	49507	RW	Parameter #6	UINT16	I0	10062
49108	49508	RW	Parameter #7	UINT16	Ua THD	10103
49109	49509	RW	Parameter #8	UINT16	Ub THD	10104
49110	49510	RW	Parameter #9	UINT16	Uc THD	10105
49111	49511	RW	Parameter #10	UINT16	Ia THD	10115
49112	49512	RW	Parameter #11	UINT16	Ib THD	10116
49113	49513	RW	Parameter #12	UINT16	Ic THD	10117
49114	49514	RW	Parameter #13	UINT16	kW TH	11715
49115	49515	RW	Parameter #14	UINT16	kvar TH	11716
49116	49516	RW	Parameter #15	UINT16	kVA TH	11717
49117	49517	RW	Parameter #16	UINT16	P.F. TH	11718
49118	49518	RW	Parameter #17	UINT16	kW TH01	11719
49119	49519	RW	Parameter #18	UINT16	kvar TH01	11720
49120	49520	RW	Parameter #19	UINT16	kVA TH01	11721
49121	49521	RW	Parameter #20	UINT16	P.F. TH01	11722

Table 5-61 Max./Min. Recorder #3 Setup

Notes:

1) The **Self-Read Time** supports the following two options:

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

5.8.11.4 Max./Min. Recorder #4 Setup

Register Address		Property	Description	Format	Range/Options	Default
Max.	Min.					
49200	49600	RW	Self-read Time	UINT16		0
49201	49601	RW	Number of Parameters	UINT16	0 to 20	20
49202~49221	49602~49621	RW	Parameter #1~20	UINT16	Reserved	0

Table 5-62 Max./Min. Recorder #4 Setup

Notes:

1) The **Self-Read Time** supports the following two options:

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

5.8.12 EN50160 Setup

Register	Property	Description	Format	Range/Value
49790	RW	Voltage Level	UNIT16	0=LV*, 1=MV, 2=HV
49791	RW	Start Week	UNIT16	0=Sunday* 1~6=Monday to Saturday
49792~49799	RW	Reserved		
49800	RW	Freq Wide Tolerance	Float	1.0
49802	RW	Freq positive deviation wide limit	Float	1.04
49804	RW	Freq negative deviation wide limit	Float	0.94
49806	RW	Freq narrow tolerance	Float	0.995
49808	RW	Freq positive deviation narrow limit	Float	1.01
49810	RW	Freq negative deviation narrow limit	Float	0.99
49812	RW	Voltage wide tolerance	Float	1.0
49814	RW	Voltage positive deviation wide limit	Float	LV: 1.1 MV/LV: 1.15
49816	RW	Voltage negative deviation wide limit	Float	0.85
49818	RW	Voltage narrow tolerance	Float	LV: 0.95 MV/HV: 0.99
49820	RW	Voltage positive deviation narrow limit	Float	1.1
49822	RW	Voltage negative deviation narrow limit	Float	0.9
49824	RW	Flicker tolerance	Float	0.95
49826	RW	Flicker limit	Float	1
49828	RW	Voltage Unbalance tolerance	Float	0.95
49830	RW	Voltage Unbalance limit	Float	0.02
49832	RW	Harmonic Voltage tolerance	Float	0.95
49834	RW	THD limit	Float	0.08
49836	RW	Reserved	Float	
49838	RW	Reserved	Float	
49840	RW	H02 Voltage limit	Float	LV/MV: 0.02 HV: 0.019
49842	RW	H03 Voltage limit	Float	LV/MV: 0.05 HV: 0.03
49844	RW	H04 Voltage limit		0.01
49846	RW	H05 Voltage limit	Float	LV/MV: 0.06 HV: 0.05
49848	RW	H06 Voltage limit	Float	0.005
49850	RW	H07 Voltage limit	Float	LV/MV: 0.05 HV: 0.04
49852	RW	H08 Voltage limit	Float	0.005
49854	RW	H09 Voltage limit	Float	LV/MV:0.015 HV: 0.013
49856	RW	H10 Voltage limit	Float	0.005
49858	RW	H11 Voltage limit	Float	LV/MV:0.035 HV: 0.03
49860	RW	H12 Voltage limit	Float	0.005
49862	RW	H13 Voltage limit	Float	LV/MV:0.03 HV: 0.025
49864	RW	H14 Voltage limit	Float	0.005
49866	RW	H15 Voltage limit	Float	0.005
49868	RW	H16 Voltage limit	Float	0.005
49870	RW	H17 Voltage limit	Float	0.02
49872	RW	H18 Voltage limit	Float	0.005
49874	RW	H19 Voltage limit	Float	0.015
49876	RW	H20 Voltage limit	Float	0.005
49878	RW	H21 Voltage limit	Float	0.005
49880	RW	H22 Voltage limit	Float	0.005
49882	RW	H23 Voltage limit	Float	0.015

49884	RW	H24 Voltage limit	Float	0.005
49886	RW	H25 Voltage limit	Float	0.015
49888	RW	Reserved	Float	0

Table 5-63 EN50160 Parameters Setup

5.8.13 Trend Log Setup

The Trend Log is displayed on the PMC-690's Front Panel Interface. Up to 12 parameters can be displayed at the same time. The Trend Log parameters must be part of the SDR Log.

Register	Property	Description	Format	Range/Option
50050	RW	Number of Parameters	UINT16	0 to12, (Default=12)
50051	RW	Parameter #1: Freq.	UINT16	
50052	RW	Parameter #2: Ua RMS	UINT16	
50053	RW	Parameter #3: Ub RMS	UINT16	
50054	RW	Parameter #4: Uc RMS	UINT16	
50055	RW	Parameter #5: Ia RMS	UINT16	
50056	RW	Parameter #6: Ib RMS	UINT16	
50057	RW	Parameter #7: Ic RMS	UINT16	
50058	RW	Parameter #8: kWh Total	UINT16	
50059	RW	Parameter #9: kvarh Total	UINT16	
50060	RW	Parameter #10: kVAh Total	UINT16	
50061	RW	Parameter #11: P.F. TH01	UINT16	
50062	RW	Parameter #12: reserved	UINT16	

Table 5-64 Trend Log Setup

5.8.14 System Setup

Register	Property	Description	Format	Range / Options	Default
40800	RW	Clock Source[1]	UINT16	0=RTC, 1=SNTP	0
40801	RW	Time Zone[2]	UINT16	0 to 32	26
40802	RW	Reserved	UINT16		
40803	RW	Language	UINT16	0=English	0
40804	RW	Date Format	UINT16	0=YYMMDD 1=MMDDYY 2=DDMMYY 3=YY-MM-DD 4=MM-DD-YY 5=DD-MM-YY	0
40805	RW	Reserved			
40806	RW	Backlight Timeout	UINT16	0 to 60 min	5
40807	RW	LCD Contrast (%)	UINT16	50 to 100	90
40808	RW	Phase A Color	UINT16	0=Brown, 1=Red 2=Pink, 3=Orange 4=Yellow, 5=Yellow-green 6=Green, 7=Light-blue 8=Dark-blue 9=Purple, 10=Gray 11=Natural Gray 12=White, 13=Black	4
40809	RW	Phase B Color	UINT16		6
40810	RW	Phase C Color	UINT16		1
40811	RW	Phase N Color	UINT16		13
40812	RW	Earth Wire Color	UINT16	0=Green 2= Yellow-green	1
40813	RW	Set Password	UINT32	0~999999	0
40815~40817	RW	Reserved	UINT32		
40819	RW	Time Zone of data timestamp[1]	UINT16		0
40820	RW	Reserved	UINT16	0=ITIC, 1=SEMI F47	0
40821	RW	Set Interval	UINT16	0=50/60cycles 1=150/180cycles 2=10min, 3=2hour	0
40822	RW	Freq. Interval	UINT16	0=1s, 1=3s, 2=10s	0
40823	RW	Reserved	UINT16		
40824	RW	Sampling Section of DWR .cfg File[4]	UINT16	0=0 1=Actual Sampling	0
40825	RW	Eliminate Flagged Data	UINT16	0=Disabled, 1=Enabled	0

				BIT0: SDR Log BIT1: Max. Log BIT2: Min. Log BIT3: EN50160 Others: Reserved	
40826~40833	RW	FTP User name	char		
40834~40841	RW	FTP Password	char		
40842	RW	Login FTP with Anonymous	uint16	0= Enabled, 1= Disabled	0
40843	RW	FTP Visible	uint16	0= Enabled, 1= Disabled	0
40844	RW	TELNET Visible	uint16	0= Enabled, 1= Disabled	0

Table 5-65 System Setup Parameters

Notes:

1) The following table lists the Codes for different Time Zones.

Code	Time Zone	Code	Time Zone	Code	Time Zone
0	GMT-12:00	**11**	GMT-2:00	**22**	GMT+5:45
1	GMT-11:00	**12**	GMT-1:00	**23**	GMT+6:00
2	GMT-10:00	**13**	GMT-0:00	**24**	GMT+6:30
3	GMT-9:00	**14**	GMT+1:00	**25**	GMT+7:00
4	GMT-8:00	**15**	GMT+2:00	**26**	GMT+8:00
5	GMT-7:00	**16**	GMT+3:00	**27**	GMT+9:00
6	GMT-6:00	**17**	GMT+3:30	**28**	GMT+9:30
7	GMT-5:00	**18**	GMT+4:00	**29**	GMT+10:00
8	GMT-4:00	**19**	GMT+4:30	**30**	GMT+11:00
9	GMT-3:30	**20**	GMT+5:00	**31**	GMT+12:00
10	GMT-3:00	**21**	GMT+5:30	**32**	GMT+13:00

Table 5-66 Time Zones

2) The timestamp of historical data is programmable which is illustrates below:

0: local time

1: UTC time

BIT	Description	Note
BIT0	MODBUS	Timestamp of retrived Data log via Modbus: Real-time measurement, Device/PQLOG, SDR, Real-time measurements, Max./Min. log, Plt/Pst
BIT1	COMTRADE	Timestamp of COMTRADE file and the first/trigger point in .cfg file
BIT2	PQDIF	Timestamp of PQDIF file, file name and store directory.

Table 5-67 Timestamp of Historical Data

3) 0 means the DWR file doesn't involve sampling section information.

5.9 Time Registers

There are two sets of **Time** registers supported by the PMC-690 - 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 600005 for 6-digit addressing and Registers # 9004 to 9005 for 5-digit addressing). When sending time to the PMC-690 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 (or 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.

Register		Property	Description	Format	Note
6-digit	**5-digit**				
60000	9000	RW	High-order Byte: Year	UINT16	0-37 (Year-2000)
			Low-order Byte: Month		1 to 12

60001	9001	RW	High-order Byte: Day	UINT16	1 to 31
			Low-order Byte: Hour		0 to 23
60002	9002	RW	High-order Byte: Minute	UINT16	0 to 59
			Low-order Byte: Second		0 to 59
60003	9003	RW	Millisecond	UINT16	0 to 999
60004-60005	9004-9005	RW	UNIX Time	UINT32	(0 to 2145916799) This time shows the number of seconds since 00:00:00 January 1, 2000

Table 5-68 Time Registers

5.10 Information

5.10.1 Meter Information

Register		Property	Description	Format	Note
60200~60219	9800~9819	RO	Meter Model[1]	Char	See Note 1
60220	9820	RO	Firmware Version	UINT16	e.g. 10000 shows the version is V1.00.00
60221	9821	RO	Modbus Version	UINT16	e.g. 10 shows the version is V1.0
60222	9822	RO	IEC 61850 Version	UINT16	e.g. 0100 means the version is V01.00 e.g. 0000 means no 61850 support or 61850 version number error
60223	9823	RO	Hardware Version	UINT16	e.g. 10 shows the version is V1.0
60224	9824	RO	PPC Firmware Update Date: Year-2000	UINT16	e.g. 130709 means July 9,2013
60225	9825	RO	PPC Firmware Update Date: Month	UINT16	
60226	9826	RO	PPC Firmware Update Date: Day	UINT16	
60227	9827		Serial Number: AA(Year-2000) - BB(Month) - CC(Lot Number) - DDDD(Meter Number)	UINT32	
60229~60233	9829	RO	Reserved		
60235	9835	RO	**Self-Diagnostics -** ARM	UNIT32	Bit0: System Parameters Error Bit1: Secret Parameters Error Bit2: DSP Error Bit3: Memory Configuration Error
60237	9837		**Self-Diagnostics** - DSP	UNIT32	Bit0: AD Error
60239	9839	RO	Reserved	UNIT32	
60241	9841	RO	Reserved	UNIT32	
60243	9843	RO	MAC 1 Address-01	UNIT16	0x00A0
60244	9844	RO	MAC 1 Address-23	UNIT16	0x1EA0
60245	9845	RO	MAC 1 Address-45	UNIT16	0xAAA0
60246	9846	RO	Reserved	UNIT16	0x00A0
60247	9847	RO	Reserved	UNIT16	0x1EA1
60248	9848	RO	Reserved	UNIT16	0xAAA0
60249	9849	RO	Memory Capacity	UNIT16	Units: MB
60250	9850	RO	Remaining Memory	UNIT16	Units: MB

Table 5-69 Meter Information

Notes:

1) The **Meter Model** appears in registers 60200 to 60219 and contains the ASCII encoding of the string “PMC-690” as shown in the following table.

Offset Address	Value(Hex)	ANSCII
60200	0x50	P
60201	0x4D	M
60202	0x43	C
60203	0x2D	-
60204	0x36	6
60205	0x39	9
60206	0x30	0

60207-60219	0x20	<Null>

Table 5-70 ASCII Encoding of "PMC-690"

5.10.2 Device Tag Information

Register Address	Property	Description	Format	Note
40600	RW	Supply Company Tag 1[1]	Char	Devtag 0
40630	RW	Supply Company Tag 2	Char	Devtag 1
40660	RW	Substation Name	Char	Devtag 2
40690	RW	Voltage Level	Char	Devtag 3

Table 5-71 Device Tag Information

Notes:

1) However, the PMC-690's Front Panel Interface supports the display of up to 39 characters only.

5.10.3 Circuit Tag Information

Register	Property	Description	Format	Note
52000	RW	Circuit Name	Char	60 characters
52008	RW	Bus Name	Char	60 characters
52038	RW	Monitoring Name	Char	60 characters
52068	RW	Monitoring Voltage Level	Char	60 characters
52098	RW	Assets Management ID	Char	60 characters
52128	RW	Monitoring Network ID	Char	60 characters
52158	RW	Commissioning Date	Char	60 characters
52188	RW	Exclusive Use (Yes/No)	Char	60 characters
52218	RW	Minimum Short Circuit Capacity	Char	60 characters
52248	RW	Power Supply Capacity	Char	60 characters
52278	RW	Customer Usage Agreement	Char	60 characters
52308	RW	Comtrade Tag	Char	60 characters

Table 5-72 Circuit Tag Information

Appendix A - Data ID

SDR Data ID

Key ID				Parameters
50-cycle	150-cycle	10-min	2-hour	
1	10001	20001	30001	FREQ
2	10002	20002	30002	Ua
3	10003	20003	30003	Ub
4	10004	20004	30004	Uc
5	10005	20005	30005	U4
6	10006	20006	30006	Uln Avg.
7	10007	20007	30007	Uab
8	10008	20008	30008	Ubc
9	10009	20009	30009	Uca
10	10010	20010	30010	Ull Avg.
11	10011	20011	30011	Ia
12	10012	20012	30012	Ib
13	10013	20013	30013	Ic
14	10014	20014	30014	I4
15	10015	20015	30015	Reserved
16	10016	20016	30016	I Avg.
17	10017	20017	30017	kWa
18	10018	20018	30018	kWb
19	10019	20019	30019	kWc
20	10020	20020	30020	kW Total
21	10021	20021	30021	kvara
22	10022	20022	30022	kvarb
23	10023	20023	30023	kvarc
24	10024	20024	30024	kvar Total
25	10025	20025	30025	kVAa
26	10026	20026	30026	kVAb
27	10027	20027	30027	kVAc
28	10028	20028	30028	kVA Total
29	10029	20029	30029	PFa
30	10030	20030	30030	PFb
31	10031	20031	30031	PFc
32	10032	20032	30032	PF Avg.
33	10033	20033	30033	Ua Dev.
34	10034	20034	30034	Ub Dev.
35	10035	20035	30035	Uc Dev.
36	10036	20036	30036	Uab Dev.
37	10037	20037	30037	Ubc Dev.
38	10038	20038	30038	Uca Dev.
39	10039	20039	30039	Ua Over Dev.
40	10040	20040	30040	Ub Over Dev.
41	10041	20041	30041	Uc Over Dev.
42	10042	20042	30042	Uab Over Dev.
43	10043	20043	30043	Ubc Over Dev.
44	10044	20044	30044	Uca Over Dev.
45	10045	20045	30045	Ua Under Dev.
46	10046	20046	30046	Ub Under Dev.
47	10047	20047	30047	Uc Under Dev.
48	10048	20048	30048	Uab Under Dev.
49	10049	20049	30049	Ubc Under Dev.
50	10050	20050	30050	Uca Under Dev.
51	10051	20051	30051	Freq. Dev.
52	10052	20052	30052	Ua Fluctuation
53	10053	20053	30053	Ub Fluctuation
54	10054	20054	30054	Uc Fluctuation
55	10055	20055	30055	U0 Unb.
56	10056	20056	30056	U2 Unb.
57	10057	20057	30057	I0 Unb.
58	10058	20058	30058	I2 Unb.

59	10059	20059	30059	U0
60	10060	20060	30060	U2
61	10061	20061	30061	U1
62	10062	20062	30062	I0
63	10063	20063	30063	I2
64	10064	20064	30064	I1
65	10065	20065	30065	Ia TDD
66	10066	20066	30066	Ib TDD
67	10067	20067	30067	Ic TDD
68	10068	20068	30068	I4 TDD
69	10069	20069	30069	Reserved
70	10070	20070	30070	Ia TDD Odd
71	10071	20071	30071	Ib TDD Odd
72	10072	20072	30072	Ic TDD Odd
73	10073	20073	30073	I4 TDD Odd
74	10074	20074	30074	Reserved
75	10075	20075	30075	Ia TDD Even
76	10076	20076	30076	Ib TDD Even
77	10077	20077	30077	Ic TDD Even
78	10078	20078	30078	I4 TDD Even
79	10079	20079	30079	Reserved
80	10080	20080	30080	Ia K-Factor
81	10081	20081	30081	Ib K-Factor
82	10082	20082	30082	Ic K-Factor
83	10083	20083	30083	I4 K-Factor
84	10084	20084	30084	Reserved
85	10085	20085	30085	Ia Crest Factor
86	10086	20086	30086	Ib Crest Factor
87	10087	20087	30087	Ic Crest Factor
88	10088	20088	30088	I4 Crest Factor
89	10089	20089	30089	Reserved
90	10090	20090	30090	Ua Crest Factor
91	10091	20091	30091	Ub Crest Factor
92	10092	20092	30092	Uc Crest Factor
93	10093	20093	30093	U4 Crest Factor
94	10094	20094	30094	Ua MSV #1
95	10095	20095	30095	Ub MSV #1
96	10096	20096	30096	Uc MSV #1
97	10097	20097	30097	Ua MSV #2
98	10098	20098	30098	Ub MSV #2
99	10099	20099	30099	Uc MSV #2
100	10100	20100	30100	Ua MSV #3
101	10101	20101	30101	Ub MSV #3
102	10102	20102	30102	Uc MSV #3
103	10103	20103	30103	Ua THD
104	10104	20104	30104	Ub THD
105	10105	20105	30105	Uc THD
106	10106	20106	30106	U4 THD
107	10107	20107	30107	Ua TOHD
108	10108	20108	30108	Ub TOHD
109	10109	20109	30109	Uc TOHD
110	10110	20110	30110	U4 TOHD
111	10111	20111	30111	Ua TEHD
112	10112	20112	30112	Ub TEHD
113	10113	20113	30113	Uc TEHD
114	10114	20114	30114	U4 TEHD
115	10115	20115	30115	Ia THD
116	10116	20116	30116	Ib THD
117	10117	20117	30117	Ic THD
118	10118	20118	30118	I4 THD
119	10119	20119	30119	Reserved
120	10120	20120	30120	Ia TOHD
121	10121	20121	30121	Ib TOHD
122	10122	20122	30122	Ic TOHD
123	10123	20123	30123	I4 TOHD
124	10124	20124	30124	Reserved

125	10125	20125	30125	Ia TEHD
126	10126	20126	30126	Ib TEHD
127	10127	20127	30127	Ic TEHD
128	10128	20128	30128	I4 TEHD
129	10129	20129	30129	Reserved
130	10130	20130	30130	Uab Fund.
131	10131	20131	30131	Ubc Fund.
132	10132	20132	30132	Uca Fund.
133	10133	20133	30133	Ua Fluct. CPM
134	10134	20134	30134	Ub Fluct. CPM
135	10135	20135	30135	Uc Fluct. CPM
				Reserved
500	10500	20500	30500	Ua HD00
501	10501	20501	30501	Ub HD00
502	10502	20502	30502	Uc HD00
503	10503	20503	30503	U4 HD00
504	10504	20504	30504	Ua HD01
505	10505	20505	30505	Ub HD01
506	10506	20506	30506	Uc HD01
507	10507	20507	30507	U4 HD01
…	…			…
748	10748	20748	30748	Ua HD62
749	10749	20749	30749	Ub HD62
750	10750	20750	30750	Uc HD62
751	10751	20751	30751	U4 HD62
752	10752	20752	30752	Ua HD63
753	10753	20753	30753	Ub HD63
754	10754	20754	30754	Uc HD63
755	10755	20755	30755	U4 HD63
756	10756	20756	30756	Ia HD00
757	10757	20757	30757	Ib HD00
758	10758	20758	30758	Ic HD00
759	10759	20759	30759	I4 HD00
760	10760	20760	30760	Reserved
761	10761	20761	30761	Ia HD01
762	10762	20762	30762	Ib HD01
763	10763	20763	30763	Ic HD01
764	10764	20764	30764	I4 HD01
765	10765	20765	30765	Reserved
				…
1066	11066	21066	31066	Ia HD62
1067	11067	21067	31067	Ib HD62
1068	11068	21068	31068	Ic HD62
1069	11069	21069	31069	I4 HD62
1070	11070	21070	31070	Reserved
1071	11071	21071	31071	Ia HD63
1072	11072	21072	31072	Ib HD63
1073	11073	21073	31073	Ic HD63
1074	11074	21074	31074	I4 HD63
1075	11075	21075	31075	Reserved
1076	11076	21076	31076	Ua TH RMS
1077	11077	21077	31077	Ub TH RMS
1078	11078	21078	31078	Uc TH RMS
1079	11079	21079	31079	U4 TH RMS
1080	11080	21080	31080	Ua TOH RMS
1081	11081	21081	31081	Ub TOH RMS
1082	11082	21082	31082	Uc TOH RMS
1083	11083	21083	31083	U4 TOH RMS
1084	11084	21084	31084	Ua TEH RMS
1085	11085	21085	31085	Ub TEH RMS
1086	11086	21086	31086	Uc TEH RMS
1087	11087	21087	31087	U4 TEH RMS
1088	11088	21088	31088	Ia TH RMS
1089	11089	21089	31089	Ib TH RMS
1090	11090	21090	31090	Ic TH RMS
1091	11091	21091	31091	I4 TH RMS

1092	11092	21092	31092	Reserved
1093	11093	21093	31093	Ia TOH RMS
1094	11094	21094	31094	Ib TOH RMS
1095	11095	21095	31095	Ic TOH RMS
1096	11096	21096	31096	I4 TOH RMS
1097	11097	21097	31097	Reserved
1098	11098	21098	31098	Ia TEH RMS
1099	11099	21099	31099	Ib TEH RMS
1100	11100	21100	31100	Ic TEH RMS
1101	11101	21101	31101	I4 TEH RMS
1102	11102	21102	31102	Reserved
1103	11103	21103	31103	Ua DC Component
1104	11104	21104	31104	Ub DC Component
1105	11105	21105	31105	Uc DC Component
1106	11106	21106	31106	U4 DC Component
1111	11111	21111	31111	Ua H02 RMS
1112	11112	21112	31112	Ub H02 RMS
1113	11113	21113	31113	Uc H02 RMS
1114	11114	21114	31114	U4 H02 RMS
1115	11115	21115	31115	Ua H03 RMS
1116	11116	21116	31116	Ub H03 RMS
1117	11117	21117	31117	Uc H03 RMS
1118	11118	21118	31118	U4 H03 RMS
				…
1351	11351	21351	31351	Ua H62 RMS
1352	11352	21352	31352	Ub H62 RMS
1353	11353	21353	31353	Uc H62 RMS
1354	11354	21354	31354	U4 H62 RMS
1355	11355	21355	31355	Ua H63 RMS
1356	11356	21356	31356	Ub H63 RMS
1357	11357	21357	31357	Uc H63 RMS
1358	11358	21358	31358	U4 H63 RMS
1359	11359	21359	31359	Ia DC Component
1360	11360	21360	31360	Ib DC Component
1361	11361	21361	31361	Ic DC Component
1362	11362	21362	31362	I4 DC Component
1363	11363	21363	31363	Reserved
1364	11364	21364	31364	Ia Fund.
1365	11365	21365	31365	Ib Fund.
1366	11366	21366	31366	Ic Fund.
1367	11367	21367	31367	I4 Fund.
1368	11368	21368	31368	Reserved
1369	11369	21369	31369	Ia H02 RMS
1370	11370	21370	31370	Ib H02 RMS
1371	11371	21371	31371	Ic H02 RMS
1372	11372	21372	31372	I4 H02 RMS
1373	11373	21373	31373	Reserved
1374	11374	21374	31374	Ia H03 RMS
1375	11375	21375	31375	Ib H03 RMS
1376	11376	21376	31376	Ic H03 RMS
1377	11377	21377	31377	I4 H03 RMS
1378	11378	21378	31378	Reserved
				…
1669	11669	21669	31669	Ia H62 RMS
1670	11670	21670	31670	Ib H62 RMS
1671	11671	21671	31671	Ic H62 RMS
1672	11672	21672	31672	I4 H62 RMS
1673	11673	21673	31673	Reserved
1674	11674	21674	31674	Ia H63 RMS
1675	11675	21675	31675	Ib H63 RMS
1676	11676	21676	31676	Ic H63 RMS
1677	11677	21677	31677	I4 H63 RMS
1678	11678	21678	31678	Reserved
1679	11679	21679	31679	kWa TH
1680	11680	21680	31680	kWb TH
1681	11681	21681	31681	kWc TH

1682	11682	21682	31682	kvara TH
1683	11683	21683	31683	kvarb TH
1684	11684	21684	31684	kvarc TH
1685	11685	21685	31685	kVAa TH
1686	11686	21686	31686	kVAb TH
1687	11687	21687	31687	kVAc TH
1688	11688	21688	31688	PFa TH
1689	11689	21689	31689	PFb TH
1690	11690	21690	31690	PFc TH
1691	11691	21691	31691	kWa TH SUM
1692	11692	21692	31692	kWb TH SUM
1693	11693	21693	31693	kWc TH SUM
1694	11694	21694	31694	kvara TH SUM
1695	11695	21695	31695	kvarb TH SUM
1696	11696	21696	31696	kvarc TH SUM
1697	11697	21697	31697	kVAa TH SUM
1698	11698	21698	31698	kVAb TH SUM
1699	11699	21699	31699	kVAc TH SUM
1703	11703	21703	31703	kWa TH ABS
1704	11704	21704	31704	kWb TH ABS
1705	11705	21705	31705	kWc TH ABS
1706	11706	21706	31706	kvara TH ABS
1707	11707	21707	31707	kvarb TH ABS
1708	11708	21708	31708	kvarc TH ABS
1709	11709	21709	31709	kVAa TH ABS
1710	11710	21710	31710	kVAb TH ABS
1711	11711	21711	31711	kVAc TH ABS
1715	11715	21715	31715	kW Total TH
1716	11716	21716	31716	kvar Total TH
1717	11717	21717	31717	kVA Total TH
1718	11718	21718	31718	PF Avg. TH
1719	11719	21719	31719	kW Total Fund.
1720	11720	21720	31720	kvar Total Fund.
1721	11721	21721	31721	kVA Total Fund.
1722	11722	21722	31722	dPF
1723	11723	21723	31723	kW Total H02
1724	11724	21724	31724	kvar Total H02
1725	11725	21725	31725	kVA Total H02
1726	11726	21726	31726	PF H02
1727	11727	21727	31727	kW Total H03
1728	11728	21728	31728	kvar Total H03
1729	11729	21729	31729	kVA Total H03
1730	11730	21730	31730	PF H03
				...
1963	11963	21963	31963	kW Total H62
1964	11964	21964	31964	kvar Total H62
1965	11965	21965	31965	kVA Total H62
1966	11966	21966	31966	PF H62
1967	11967	21967	31967	kW Total H63
1968	11968	21968	31968	kvar Total H63
1969	11969	21969	31969	kVA Total H63
1970	11970	21970	31970	PF H63
1971	11971	21971	31971	kWa Fund.
1972	11972	21972	31972	kWb Fund.
1973	11973	21973	31973	kWc Fund.
1974	11974	21974	31974	kvara Fund.
1975	11975	21975	31975	kvarb Fund.
1976	11976	21976	31976	kvarc Fund.
1977	11977	21977	31977	kVAa Fund.
1978	11978	21978	31978	kVAb Fund.
1979	11979	21979	31979	kVAc Fund.
1980	11980	21980	31980	dPFa
1981	11981	21981	31981	dPFb
1982	11982	21982	31982	dPFc
1983	11983	21983	31983	kWa H02
1984	11984	21984	31984	kWb H02

1985	11985	21985	31985	kWc H02
1986	11986	21986	31986	kvara H02
1987	11987	21987	31987	kvarb H02
1988	11988	21988	31988	kvarc H02
1989	11989	21989	31989	kVAa H02
1990	11990	21990	31990	kVAb H02
1991	11991	21991	31991	kVAc H02
1992	11992	21992	31992	PFa H02
1993	11993	21993	31993	PFb H02
1994	11994	21994	31994	PFc H02
				…
2715	12715	22715	32715	kWa H63
2716	12716	22716	32716	kWb H63
2717	12717	22717	32717	kWc H63
2718	12718	22718	32718	kvara H63
2719	12719	22719	32719	kvarb H63
2720	12720	22720	32720	kvarc H63
2721	12721	22721	32721	kVAa H63
2722	12722	22722	32722	kVAb H63
2723	12723	22723	32723	kVAc H63
2724	12724	22724	32724	PFa H63
2725	12725	22725	32725	PFb H63
2726	12726	22726	32726	PFc H63
2727	12727	22727	32727	Ua TIHD
2728	12728	22728	32728	Ub TIHD
2729	12729	22729	32729	Uc TIHD
2730	12730	22730	32730	U4 TIHD
2731	12731	22731	32731	Ua TOIHD
2732	12732	22732	32732	Ub TOIHD
2733	12733	22733	32733	Uc TOIHD
2734	12734	22734	32734	U4 TOIHD
2735	12735	22735	32735	Ua TEIHD
2736	12736	22736	32736	Ub TEIHD
2737	12737	22737	32737	Uc TEIHD
2738	12738	22738	32738	U4 TEIHD
2739	12739	22739	32739	Ia TIHD
2740	12740	22740	32740	Ib TIHD
2741	12741	22741	32741	Ic TIHD
2742	12742	22742	32742	I4 TIHD
2743	12743	22743	32743	Reserved
2744	12744	22744	32744	Ia TOIHD
2745	12745	22745	32745	Ib TOIHD
2746	12746	22746	32746	Ic TOIHD
2747	12747	22747	32747	I4 TOIHD
2748	12748	22748	32748	Reserved
2749	12749	22749	32749	Ia TEIHD
2750	12750	22750	32750	Ib TEIHD
2751	12751	22751	32751	Ic TEIHD
2752	12752	22752	32752	I4 TEIHD
2753	12753	22753	32753	Reserved
2754	12754	22754	32754	Ua IHD00
2755	12755	22755	32755	Ub IHD00
2756	12756	22756	32756	Uc IHD00
2757	12757	22757	32757	U4 IHD00
2758	12758	22758	32758	Ua IHD01
2759	12759	22759	32759	Ub IHD01
2760	12760	22760	32760	Uc IHD01
2761	12761	22761	32761	U4 IHD01
…	…			…
3006	13006	23006	33006	Ua IHD63
3007	13007	23007	33007	Ub IHD63
3008	13008	23008	33008	Uc IHD63
3009	13009	23009	33009	U4 IHD63
3010	13010	23010	33010	Ia IHD00
3011	13011	23011	33011	Ib IHD00
3012	13012	23012	33012	Ic IHD00

3013	13013	23013	33013	I4 IHD00
3014	13014	23014	33014	Reserved
3015	13015	23015	33015	Ia IHD01
3016	13016	23016	33016	Ib IHD01
3017	13017	23017	33017	Ic IHD01
3018	13018	23018	33018	I4 IHD01
3019	13019	23019	33019	Reserved
…	…			…
3325	13325	23325	33325	Ia IHD63
3326	13326	23326	33326	Ib IHD63
3327	13327	23327	33327	Ic IHD63
3328	13328	23328	33328	I4 IHD63
3329	13329	23329	33329	Reserved
3330	13330	23330	33330	Ua TIH RMS
3331	13331	23331	33331	Ub TIH RMS
3332	13332	23332	33332	Uc TIH RMS
3333	13333	23333	33333	U4 TIH RMS
3334	13334	23334	33334	Ua TOIH RMS
3335	13335	23335	33335	Ub TOIH RMS
3336	13336	23336	33336	Uc TOIH RMS
3337	13337	23337	33337	U4 TOIH RMS
3338	13338	23338	33338	Ua TEIH RMS
3339	13339	23339	33339	Ub TEIH RMS
3340	13340	23340	33340	Uc TEIH RMS
3341	13341	23341	33341	U4 TEIH RMS
3342	13342	23342	33342	Ia TIH RMS
3343	13343	23343	33343	Ib TIH RMS
3344	13344	23344	33344	Ic TIH RMS
3345	13345	23345	33345	I4 TIH RMS
3346	13346	23346	33346	Reserved
3347	13347	23347	33347	Ia TOIH RMS
3348	13348	23348	33348	Ib TOIH RMS
3349	13349	23349	33349	Ic TOIH RMS
3350	13350	23350	33350	I4 TOIH RMS
3351	13351	23351	33351	Reserved
3352	13352	23352	33352	Ia TEIH RMS
3353	13353	23353	33353	Ib TEIH RMS
3354	13354	23354	33354	Ic TEIH RMS
3355	13355	23355	33355	I4 TEIH RMS
3356	13356	23356	33356	Reserved
3357	13357	23357	33357	Ua IH00 RMS
3358	13358	23358	33358	Ub IH00 RMS
3359	13359	23359	33359	Uc IH00 RMS
3360	13360	23360	33360	U4 IH00 RMS
3361	13361	23361	33361	Ua IH01 RMS
3362	13362	23362	33362	Ub IH01 RMS
3363	13363	23363	33363	Uc IH01 RMS
3364	13364	23364	33364	U4 IH01 RMS
…	…			…
3609	13609	23609	33609	Ua IH63 RMS
3610	13610	23610	33610	Ub IH63 RMS
3611	13611	23611	33611	Uc IH63 RMS
3612	13612	23612	33612	U4 IH63 RMS
3613	13613	23613	33613	Ia IH00 RMS
3614	13614	23614	33614	Ib IH00 RMS
3615	13615	23615	33615	Ic IH00 RMS
3616	13616	23616	33616	I4 IH00 RMS
3617	13617	23617	33617	Reserved
3618	13618	23618	33618	Ia IH01 RMS
3619	13619	23619	33619	Ib IH01 RMS
3620	13620	23620	33620	Ic IH01 RMS
3621	13621	23621	33621	I4 IH01 RMS
3622	13622	23622	33622	Reserved
…	…			…
3928	13928	23928	33928	Ia IH63 RMS
3929	13929	23929	33929	Ib IH63 RMS

3930	13930	23930	33930	Ic IH63 RMS
3931	13931	23931	33931	I4 IH63 RMS
3932	13932	23932	33932	Reserved
3933	13933	23933	33933	Ua Angle
3934	13934	23934	33934	Ub Angle
3935	13935	23935	33935	Uc Angle
3936	13936	23936	33936	U4 Angle
3937	13937	23937	33937	Ia Angle
3938	13938	23938	33938	Ib Angle
3939	13939	23939	33939	Ic Angle
3940	13940	23940	33940	I4 Angle
3941	13941	23941	33941	Reserved
3942	13942	23942	33942	Ua Fund. Angle
3943	13943	23943	33943	Ub Fund. Angle
3944	13944	23944	33944	Uc Fund. Angle
3945	13945	23945	33945	U4 Fund. Angle
3946	13946	23946	33946	Ua H02 Angle
3947	13947	23947	33947	Ub H02 Angle
3948	13948	23948	33948	Uc H02 Angle
3949	13949	23949	33949	U4 H02 Angle
...	...			...
4190	14190	24190	34190	Ua H63 Angle
4191	14191	24191	34191	Ub H63 Angle
4192	14192	24192	34192	Uc H63 Angle
4193	14193	24193	34193	U4 H63 Angle
4194	14194	24194	34194	Ia Fund. Angle
4195	14195	24195	34195	Ib Fund. Angle
4196	14196	24196	34196	Ic Fund. Angle
4197	14197	24197	34197	I4 Fund. Angle
4198	14198	24198	34198	Reserved
4199	14199	24199	34199	Ia H02 Angle
4200	14200	24200	34200	Ib H02 Angle
4201	14201	24201	34201	Ic H02 Angle
4202	14202	24202	34202	I4 H02 Angle
4203	14203	24203	34203	Reserved
...	...			...
4504	14504	24504	34504	Ia H63 Angle
4505	14505	24505	34505	Ib H63 Angle
4506	14506	24506	34506	Ic H63 Angle
4507	14507	24507	34507	I4 H63 Angle
4508	14508	24508	34508	Reserved

Key ID	Parameters
50001	Ua Pst
50002	Ub Pst
50003	Uc Pst
50004	Ua Plt
50005	Ub Plt
50006	Uc Plt
55000~55021	Reserved

Demand Data ID

Key ID	Parameters	Key ID	Parameters	Key ID	Parameters
Present Demand					
51001	Ua	51036	PFa	51071	Uc THD
51002	Ub	51037	PFb	51072	U4 THD
51003	Uc	51038	PFc	51073	Ia THD
51004	Uln	51039	PF Avg.	51074	Ib THD
51005	U4	51040	Freq.	51075	Ic THD
51006	Uab	51041	Ua Dev.	51076	I4 THD
51007	Ubc	51042	Ub Dev.	51077	Reserved

51008	Uca	51043	Uc Dev.	51078	Ua TOHD
51009	Ull Avg.	51044	Uab Dev.	51079	Ub TOHD
51010	Ia	51045	Ubc Dev.	51080	Uc TOHD
51011	Ib	51046	Uca Dev.	51081	U4 TOHD
51012	Ic	51047	Ua Over Dev.	51082	Ia TOHD
51013	I Avg.	51048	Ub Over Dev.	51083	Ib TOHD
51014	I4	51049	Uc Over Dev.	51084	Ic TOHD
51015	Reserved	51050	Uab Over Dev.	51085	I4 TOHD
51016	kWa Imp.	51051	Ubc Over Dev.	51086	Reserved
51017	kWb Imp.	51052	Uca Over Dev.	51087	Ua TEHD
51018	kWc Imp.	51053	Ua Under Dev.	51088	Ub TEHD
51019	kW Total Imp.	51054	Ub Under Dev.	51089	Uc TEHD
51020	kWa Exp.	51055	Uc Under Dev.	51090	U4 TEHD
51021	kWb Exp.	51056	Uab Under Dev.	51091	Ia TEHD
51022	kWc Exp.	51057	Ubc Under Dev.	51092	Ib TEHD
51023	kW Total Exp.	51058	Uca Under Dev.	51093	Ic TEHD
51024	kvara Imp.	51059	Freq. Dev.	51094	I4 TEHD
51025	kvarb Imp.	51060	U0 Unb.	51095	Reserved
51026	kvarc Imp.	51061	U2 Unb.	51096	Ia Fund.
51027	kvar Total Imp.	51062	I0 Unb.	51097	Ib Fund.
51028	kvara Exp.	51063	I2 Unb.	51098	Ic Fund.
51029	kvarb Exp.	51064	Ia K-Factor	51099	I4 Fund.
51030	kvar c Exp.	51065	Ib K-Factor	51100	Reserved
51031	kvar Total Exp.	51066	Ic K-Factor	51101	Reserved
51032	kVAa	51067	I4 K-Factor	51102	Reserved
51033	kVAb	51068	Reserved	51103	Reserved
51034	kVAc	51069	Ua THD	51104	Reserved
51035	kVA Total	51070	Ub THD	51071	
Predicted Demand					
52001	Ua Pred.	52015	Reserved.	52029	kvarb Exp. Pred.
52002	Ub Pred.	52016	kWa Imp. Pred.	52030	kvarc Exp. Pred.
52003	Uc Pred.	52017	kWb Imp. Pred.	52031	kvar Total Exp. Pred.
52004	Uln Pred.	52018	kWc Imp. Pred.	52032	kVAa Pred.
52005	U4 Pred.	52019	kW Total Imp. Pred.	52033	kVAb Pred.
52006	Uab Pred.	52020	kWa Exp. Pred.	52034	kVAc Pred.
52007	Ubc Pred.	52021	kWb Exp. Pred.	52035	kVA Total Pred.
52008	Uca Pred.	52022	kWc Exp. Pred.	52036	PFa Pred.
52009	Ull Avg. Pred.	52023	kW Total Exp. Pred.	52037	PFb Pred.
52010	Ia Pred.	52024	kvara Imp. Pred.	52038	PFc Pred.
52011	Ib Pred.	52025	kvarb Imp. Pred.	52039	PF Avg. Pred.
52012	Ic Pred.	52026	kvarc Imp. Pred.	52040	Freq. Pred.
52013	I Avg. Pred.	52027	kvar Total Imp. Pred.		
52014	I4 Pred.	52028	kvara Exp. Pred.		
Max./Min. Demand					
53001	kW Total Imp. Max.	53010	Ib Fund. Max.	54006	Ia Last Max.
53002	kW Total Exp. Max.	53011	Ic Fund. Max.	54007	Ib Last Max.
53003	kvar Total Imp. Max.	53012	I4 Fund. Max.	54008	Ic Last Max.
53004	kvar Total Exp. Max.	53013	Reserved	54009	Ia Fund. Last Max.
53005	kVA Total Max.	54001	kW Total Imp. Last Max.	54010	Ib Fund. Last Max.
53006	Ia Max.	54002	kW Total Exp. Last Max.	54011	Ic Fund. Last Max.
53007	Ib Max.	54003	kvar Total Imp. Last Max.	54012	I4 Fund. Last Max.
53008	Ic Max.	54004	kvar Total Exp. Last Max.	54013	Reserved
53009	Ia Fund. Max.	54005	kVA Total Last Max.	54006	

Appendix B - Event Classification

Device Event Classification

Event Classification	Sub-Classification	Description	Value Scale/Option
1=System	0	Power On	None
	1	Power Off	None
	2	Change System Parameters	None
	3	Change Secret Parameters	None
	4	Set Clock	0= Set Clock via Front Panel 1= Set Clock via Communication
	5	Reserved	
	6	Restore Factory Defaults	None
	7	Format Device	
	8	Clear System Parameters	None
	9	Clear Secret Parameters	None
	10	Clear Device Log	None
	11~33	Reserved	
	34	Hardware Alarm	Device self-test PPC Device self-test DSP
	35	Hardware is working normally	None
	36~38	Reserved	None
	39	Format SD Card	None
	40	Uninstallation SD Card	None
	41	Start Monitoring	None
	42	Stop Monitoring	None
	43	Add a Site	
	44	Rename a Site	
	45	Switch Sites	
	46	Switch Record	
	47	Delete Record	
2=Standard Setpoint	0	Over Setpoint Active	UINT32: Setpoint Parameters FP32: The Setpoint Active/ Inactive limit (be consistent with real-time-limit) UINT32: Setpoint #X (0-23)
	1	Over Setpoint Return	UINT32: Setpoint Parameters FP32: The Setpoint Active/ Inactive limit (be consistent with real-time-limit) UINT32: Setpoint #X (0-23) FP32: Max. during Setpoint UINT32: Duration
	128	Under Setpoint Active	See Over Setpoint Active
	129	Under Setpoint Return	See Over Setpoint Return
3=HS Setpoint	0	Over Setpoint Active	UINT32: Setpoint Parameters FP32: The Setpoint Active/ Inactive limit (be consistent with real-time-limit) UINT32: Setpoint #X (0-15)
	1	Over Setpoint Return	UINT32: Setpoint Parameters FP32: The Setpoint Active/ Inactive limit (be consistent with real-time-limit) UINT32: Setpoint #X (0-15) FP32: Max. during Setpoint UINT32: Duration
	128	Under Setpoint Active	See Over Setpoint Active
	129	Under Setpoint Return	See Over Setpoint Return
5=WFR	0	WFR Triggered by RMS Change	UNIT32: 0~7=Sub RMS Change Event Number
	1	WFR Triggered by Dip/Swell	None
	2	WFR Triggered by Transient	
	3	WFR Triggered by Standard Setpoint	UNIT32: Standard Setpoint Number

	4	WFR Triggered by High-speed Setpoint	UNIT32: HS Setpoint Number
	5	Reserved	
	6	WFR Triggered by Rapid Voltage Changes	None
	7	WFR Triggered by Inrush Current	None
	8	Triggered WFR Manually	None
	9	Triggered WFR by Timer	
6=DWR	0	DWR Triggered by RMS Change	UNIT32: 0~7=Sub RMS Change Event Number
	1	DWR Triggered by Dip/Swell	
	2	DWR Triggered by Transient	
	3	DWR Triggered by Standard Setpoint	UNIT32: Standard Setpoint Number
	4	DWR Triggered by High-speed Setpoint	UNIT32: HS Setpoint Number
	5	Reserved	
	6	DWR Triggered by Rapid Voltage Changes	None
	7	DWR Triggered by Inrush Current	None
	8	DWR Triggered Manually	None
	9	DWR End	None
7=MSV Recorder	0	MSV Recorder Triggered by Detected Signalling Voltage	UNIT32:0~2=MSV#1~MSV#3
8=Reserved		Reserved	
9=HS DR		Reserved	
10=RMS Record	0	RMS Record Triggered by RMS Change	UNIT32: 0~7=Sub RMS Change Event Number
	1	RMS Record Triggered by Dip/Swell	
	2	RMS Record Triggered by Transient	
	3	RMS Record Triggered by Standard Setpoint	UNIT32: Standard Setpoint Number
	4	RMS Record Triggered by High-speed Setpoint	UNIT32: HS Setpoint Number
	5	Reserved	
	6	RMS Record Triggered by Rapid Voltage Changes	None
	7	Manual Triggered RMS Record	None

SOE Log Classification

SOE Log Classification	Sub-Classification	Description	Value Scale/Option
0X81: Dip/Swell	0	Voltage Swell Active	UINT32 Bit0=Phase A, Bit1= Phase B, Bit2= Phase C Bit3= AB, Bit4=BC, Bit 5=CA
	1	Voltage Swell Inactive	FP32: Residual Voltage Max. (%) UINT32: Duration (ms) FP32: Ua Residual FP32: Ub Residual FP32: Uc Residual FP32: Ua Benchmark FP32: Ub Benchmark FP32: Uc Benchmark
	2	Voltage Dips Active	UINT32 Bit0=Phase A, Bit1= Phase B, Bit2= Phase C Bit3= AB, Bit4=BC, Bit 5=CA
	3	Voltage Dips Swell Inactive	FP32: Residual Voltage Min. (%) UINT32: Duration (ms) FP32: Ua Residual FP32: Ub Residual FP32: Uc Residual FP32: Ua Benchmark FP32: Ub Benchmark FP32: Uc Benchmark
	4	Voltage Interruption Active	UINT32 Bit0=Phase A, Bit1= Phase B, Bit2= Phase C Bit3= AB, Bit4=BC, Bit 5=CA
	5	Voltage Interruption Inactive	FP32: Residual Voltage Min. (%) UINT32: Duration (ms) FP32: Ua Residual FP32: Ub Residual FP32: Uc Residual FP32: Ua Benchmark FP32: Ub Benchmark FP32: Uc Benchmark

	6	Dips Location Detective	UINT32: Location 0=UpStream, 1=DownStream UINT32: Reliability 0=Low, 1=Middle, 2=High
0X82: Transient	0	Voltage Transient	FP32: Disturbance Max./Min. (%) UINT32: Duration (μs) FP32: Ua Disturbance (%) FP32: Ub Disturbance (%) FP32: Uc Disturbance (%)
0X83: Inrush Current	0	Inrush Ia Active	None
	1	Inrush Ib Active	
	2	Inrush Ic Active	
	3	Inrush Ia Inactive	UINT32: Duration (μs) FP32: Phase Current Disturbance (%) FP32: I_{rms} during Disturbance UINT32: Start Time (s) UINT32: Start Time (ms)
	4	Inrush Ib Inactive	
	5	Inrush Ic Inactive	
0X84:RVC	0	Rapid Ua Change	FP32: Voltage Change Rate UINT32: Voltage Change Time (ms) FP32: Direction (0=Down, 1=Up) UINT32: Max. Voltage Change Rate
	1	Rapid Ub Change	
	2	Rapid Uc Change	
	3	Rapid Uab Change	
	4	Rapid Ubc Change	
	5	Rapid Uca Change	
0X85:MSV	0	MSV #1 Active	FP32: Frequency (Hz) uint32: Phase Bit0=Phase A, Bit1= Phase B, Bit2= Phase C Bit3= AB, Bit4=BC, Bit 5=CA
	1	MSV #1 Inactive	FP32: Frequency (Hz) FP32: Ua MSV Max. (%) FP32: Ub MSV Max. (%) FP32: Uc MSV Max. (%)
	2	MSV #2 Active	FP32: Frequency (Hz) uint32: Phase Bit0=Phase A, Bit1= Phase B, Bit2= Phase C Bit3= AB, Bit4=BC, Bit 5=CA
	3	MSV #2 Inactive	FP32: Frequency (Hz) FP32: Ua MSV Max. (%) FP32: Ub MSV Max. (%) FP32: Uc MSV Max. (%)
	4	MSV #3 Active	FP32: Frequency (Hz) uint32: Phase Bit0=Phase A, Bit1= Phase B, Bit2= Phase C Bit3= AB, Bit4=BC, Bit 5=CA
	5	MSV #3 Inactive	FP32: Frequency (Hz) FP32: Ua MSV Max. (%) FP32: Ub MSV Max. (%) FP32: Uc MSV Max. (%)
0X86: Relative RMS	0	Ua RMS Change Active	FP32: Ua Diff.
	1	Ub RMS Change Active	FP32: Ub Diff.
	2	Uc RMS Change Active	FP32: Uc Diff.
	3	U0 RMS Change Active	FP32: U0 Diff.
	4	Ia RMS Change Active	FP32: Ia Diff.
	5	Ib RMS Change Active	FP32: Ib Diff.
	6	Ic RMS Change Active	FP32: Ic Diff.
	7	I0 RMS Change Active	FP32: I0 Diff.
	8	Uab RMS Change Active	FP32: Uab Diff.
	9	Ubc RMS Change Active	FP32: Ubc Diff.
	10	Uca RMS Change Active	FP32: Uca Diff.

Appendix C - Technical Specifications

Voltage Inputs (CH1, CH2, CH3, CH4)	
Voltage Range	5V to 600V
Burden	<0.1VA per phase
PT Ratio	
Primary	1-1,000,000V
Secondary	1-690V
V4 Primary	1-1,000,000V
V4 Secondary	1-400V
Frequency	40Hz-60Hz @ 50Hz 48Hz-72Hz @ 60Hz
CT Clamps Current Inputs (CH1, CH2, CH3, CH4)	
Input Range	550mV max.
CT Ratio	
Primary	1-30,000A
Secondary	1-50A
I4 Primary	1-30,000A
I4 Secondary	1-50A
Power Supply (L+, N-, G)	
Power Adaptor	100-240VAC± 10%, 47-63 Hz
Rated Output	12VDC/3A, Eff. > 75%
Burden	<2.5W
Battery	
Capacity	7.2V, 4400mAh, Lithium
Battery Life	8 hours (Backlit on) 16 hours (Backlit off)
Charge Time	3.5 hours
LCD Display	
Type	Color TFT LCD, Industrial Grade
Resolution	640x480
Viewing Area	115x86mm
Environmental Conditions	
Operating Temp.	-10°C to 55°C
Storage Temp.	-20°C to 60°C
Humidity	5% to 95% non-condensing
Atmospheric Pressure	70kPa to 110kPa
Pollution Degree	2
Measurement Category	CAT IV
Mechanical Characteristics	
Unit Dimensions	252x160x59 mm
IP Rating	51

Appendix D - Accuracy Specifications

Parameters	Accuracy	Resolution
Voltage	±0.1%	0.01V
Current	±0.1% + CT Clamps Accuracy	0.001A
kW, kVA	±0.2% + CT Clamps Accuracy	0.001kX
kWh, kVAh	IEC 62053-22 Class 0.5S	0.1kXh
kvar	±0.2% + CT Clamps Accuracy	0.001kvar
kvarh	IEC 62053-23 Class 2	0.1kvarh
P.F.	±0.5%	0.001
Frequency	±0.005 Hz	0.001Hz
Harmonics	IEC 61000-4-7 Class A	0.01%
K-Factor	IEC 61000-4-7 Class A	0.01
Phase angles	±2°	0.1°
Voltage Deviation	±0.1%	0.01%
Voltage Unbalance	±0.1%	0.01%
Current Unbalance	±0.5%	0.01%
Pst, Plt	±5%	0.001

Appendix E - Standards Compliance

Power Quality		
Voltage characteristics of electricity supplied by public distribution systems		EN 50160
General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto		IEC 61000-4-7
Flicker meter - Functional and design specifications		IEC 61000-4-15
Testing and measurement techniques - Power quality measurement methods		IEC 61000-4-30
Safety Requirements		
Insulation		IEC 60255-5-2000
Dielectric test:		2kV @ 1 minute
Resistance		>100MΩ
Impulse voltage		5kV, 1.2/50µs
Electromagnetic Compatibility EMC Directive 2004 / 108 / EC (EN 61326: 2006)		
Immunity Tests		
Electrostatic Discharge		IEC 61000-4-2: 2009 Level IV
Radiated Fields		IEC 61000-4-3: 2008 Level III
Fast Transients		IEC 61000-4-4: 2004 Level IV
Surges		IEC 61000-4-5: 2005 Level IV
Conducted Disturbances		IEC 61000-4-6: 2008 Level III
Magnetic Fields		IEC 61000-4-8: 2009 Level IV
Oscillatory Waves		IEC 61000-4-12: 2006 Level III
Voltage Dips, Short Interruptions & Voltage Variation		IEC 61000-4-11: 2004
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 + AI: 2007 (CISPR 22)
Limits for harmonic current emissions for equipment with rated current ≤16 A		EN 61000-3-2: 2006 + AI: 2009
Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤16 A		EN 61000-3-3: 2008
Emission standard for residential, commercial and light-industrial environments		EN 61000-6-3: 2007
Electromagnetic Emission Tests for Measuring Relays and Protection Equipment		IEC 60255-25: 2000
Mechanical Tests		
Vibration Test	Response	IEC 60255-21-1: 1988 Level I
	Endurance	IEC 60255-21-1: 1988 Level I
Shock Test	Response	IEC 60255-21-2: 1988 Level I
	Endurance	IEC 60255-21-2: 1988 Level I
Bump Test		IEC 60255-21-2: 1988 Level I

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