PM296/RPM096
Power Quality Analyzers

Installation and Operation Manual

LIMITED WARRANTY

The manufacturer offers the customer an 24-month functional warranty on the instrument for faulty workmanship or parts from date of dispatch from the distributor. In all cases, this warranty is valid for 36 months from the date of production. This warranty is on a return to factory basis.

The manufacturer does not accept liability for any damage caused by instrument malfunction. The manufacturer accepts no responsibility for the suitability of the instrument to the application for which it was purchased.

Failure to install, set up or operate the instrument according to the instructions herein will void the warranty.

Your instrument may be opened only by a duly authorized representative of the manufacturer. 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.

NOTE

The greatest care has been taken to manufacture and calibrate your instrument. However, these instructions do not cover all possible contingencies that may arise during installation, operation or maintenance, and all details and variations of this equipment are not covered by these instructions.

For additional information regarding installation, operation or maintenance of this instrument, contact the manufacturer or your local representative or distributor.

IMPORTANT

Please read the instructions this manual before performing installation, and take note of the following precautions:

1. **Ensure that all incoming AC power and other power sources are turned OFF** before performing any work on the instrument. Failure to do so may result in serious or even fatal injury and/or equipment damage.
2. **Before connecting the instrument to the power source, check** the labels on the side of the instrument to ensure that your instrument is equipped with the appropriate power supply voltage, input voltages, currents, analog output and communication protocol for your application.
3. **Do not** connect the instrument to a power source if it is damaged.
4. **Do not** expose the instrument to rain or moisture.
5. **CLEANING: Use only a DRY cloth** to clean the instrument.
6. **The secondary of an external current transformer must never be** allowed to be open circuit when the primary is energized. An open circuit can cause high voltages, possibly resulting in equipment damage, fire and even serious or fatal injury. Ensure that the current transformer wiring is made through

shorting switches and is secured using an external strain relief to reduce mechanical strain on the screw terminals, if necessary.

7. **Setup procedures must be performed only by qualified** personnel familiar with the instrument and its associated electrical equipment.
8. **DO NOT open the instrument under any circumstances.**

☞ **Read this manual thoroughly before connecting the meter to the current carrying circuits. During operation of the meter, hazardous voltages are present on input terminals. Failure to observe precautions can result in serious or even fatal injury or damage to equipment.**

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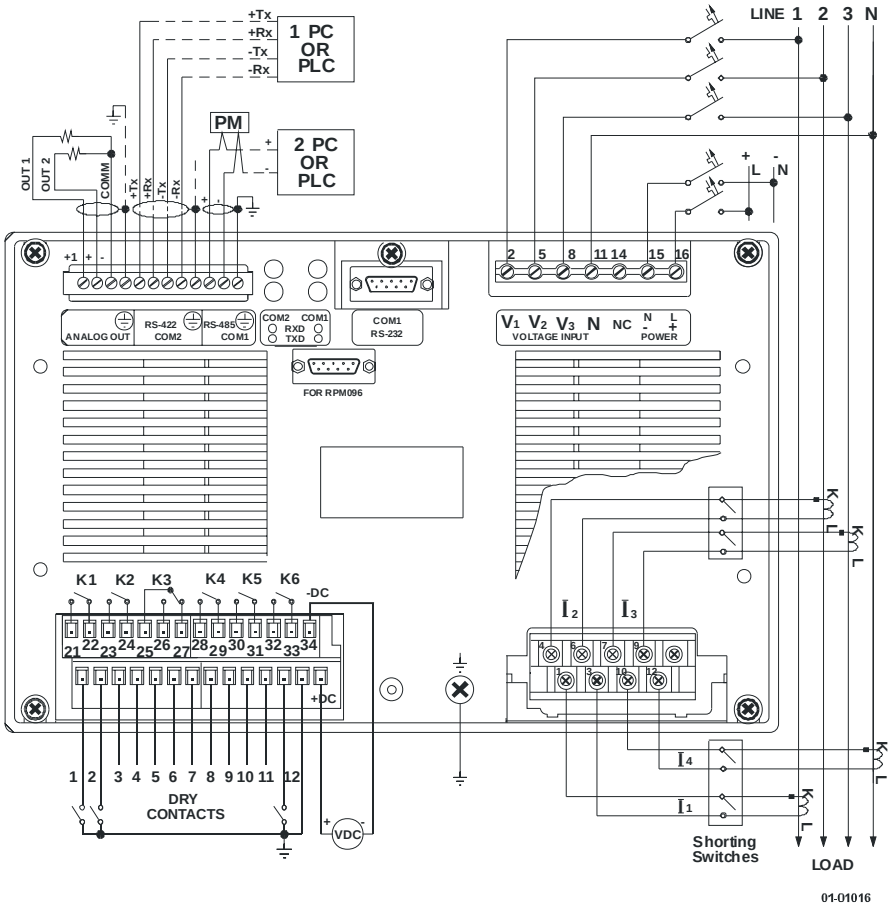
Table of Contents

Quick Start

TYPICAL INSTALLATION : Wiring Mode 4LL3, RS-485 Connection

(see Sections 2.2.4 and 7.2 for complete set of diagrams)

General Schematic

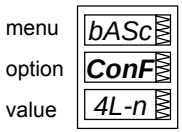


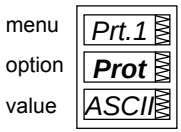
SETUP (see Chapter 4 for full instructions)

Setups can be performed directly on the front panel or via PComTest/PAS communication software - see Chapter 4 for details.

Performing *Basic* and *Communications* Setup

Press **SELECT** ➔ *CHG* ➔ **ENTER**
Press **SELECT** to activate middle window; press ▲▼ to scroll to *option*.
Press **SELECT** to activate lower window; press ▲▼ to scroll to *value*.
Press **ENTER** to save selected value.





Basic and Communications Setup: Default Options

Code	Parameter	Default	Description of Options
ConF	Wiring mode	*4Ln3*	4-wire Wye using 3 PTs
Pt	PT ratio	*1.0*	Phase potential transformer ratio
Ct	CT primary current	*5A*	Primary rating of the phase current transformer
d.P	Power demand period	*15*	Length of demand period for power demand calculations, in minutes. E = external synch.
n.dp	Number of power demand periods	*1*	No. of demand periods to be averaged for sliding window demands. 1 = block interval
A.dP	Ampere/Volt demand period	*900* s	Length of demand period for volt/ampere demand calculations, in seconds 0 = measuring peak current
buF	Buffer size	*8*	No. of measurements for RMS sliding averaging
Freq	Nominal frequency	*50/60* Hz	Nominal power utility frequency
LoAd	Maximum demand load current	*0*	Maximum demand load current used in TDD calculations 0 = CT primary current
rSt	Reset	*En*	Enabled (disable to protect all reset functions)
Prt.1	Communications protocol, COM 1	*ASCII*	ASCII protocol
rS	Interface standard	*485*	RS-485 interface
Addr	Address	ASCII: *0*, Modbus: *1*, DNP3.0: *0*	
bAud	Baud rate	*9600* bps	
dAtA	Data format	*8n* (8 bits, no parity)	
H.Sh	Incoming flow control	*nonE*	No handshaking
Ctrl	Outgoing flow control	*nonE*	RTS signal not used
Prn.P	Printout period	*1* minutes	Time interval between successive printouts
Prt.2	Communications protocol, COM 2	ASCII	ASCII protocol
rS	Interface standard	422	RS-422 interface
Addr	Address	ASCII: *0*, Modbus: *1*, DNP3.0: *0*	
bAud	Baud rate	*9600* bps	
dAtA	Data format	*8n* (8 bits, no parity)	
CPtb	ASCII compatibility mode	*diS*	Disabled

Chapter 1 Introduction

1.1 About This Manual

This manual is intended for the user of the *PM296/RPM096* Power Quality Analyzer. The *PM296/RPM096* is a microprocessor-based instrument used for the measurement, monitoring, management and analysis of electrical parameters.

This chapter gives an overview of this manual and an introduction to the *PM296/RPM096*.

Chapter 2, *Installation*, provides instructions for mechanical and electrical installation.

Chapter 3, *Using the Menus*, presents the structure of menus for setup and status viewing.

Chapter 4, *Setup Menus*, provides instructions for performing parameter setup on the front panel.

Chapter 5, *Data Display*, guides you through the display pages.

Chapter 6, *Viewing Status Information*, tells you how to access additional status information on the instrument. This information may be useful during installation.

Chapter 7, *Communications*, provides drawings for communications connections and instructions for printing electrical parameter readings.

Technical Specifications for the *PM296/RPM096* are found in the *Appendix*.

1.2 About The *PM296/RPM096*

The *PM296/RPM096* is an advanced microprocessor-based digital instrument that incorporates the capabilities of a network analyzer, data recorder and programmable controller. The instrument provides three-phase measurements of electrical quantities in power distribution systems, monitoring external events, operating external equipment via relay contacts, fast and long-term on-board recording of measured quantities and events, harmonic network analysis and disturbance recording.

The instrument is available in two models: the *PM296* with a front-panel display and the *RPM096* with a remote display module *RDM096*.

Features

Local Display

The front panel features bright LED displays (11 windows, 9-digit energy counters) with adjustable update time.

Display auto scroll is available on the main screen with a programmable scroll interval of 2 to 15 seconds. Automatic return to the main screen is available after 30 seconds of uninterrupted use.

Remote Display Module - Optional

The *RPM096* can be equipped with a Remote Display Module (*RDM096*) that provides local data display as well as setup capabilities. The *RDM096* is connected to the *RPM096* via a conventional DB15 connector (0.4/1.8/3.0 m cable supplied).

The display is multi-page and is composed of three windows with high-brightness digital LEDs.

One galvanically isolated ***direct current voltage input*** with options 300V, 100V or 20V.

3 voltage and ***4 current*** galvanically isolated ***inputs*** for direct connection to power line or via potential and current transformers.

Setup is menu driven, with optional password protection.

Two communication ports are available for RS-232/RS-485 and RS-422/RS-485 standards, with ASCII, Modbus and DNP3.0 protocols. In ASCII and Modbus protocols, 120 ***assignable registers*** allow the user to re-map either register address accessible in the instrument to the user assignable register area. Changing setups and resetting accumulated data through communications can be secured by the password.

6 relays are provided for energy pulsing (KYZ) or alarm and remote control.

12 optically isolated status inputs are provided for status monitoring with timestamp and for external demand and time synchronization.

Two optically isolated analog outputs with an internal power supply are provided for remote monitoring or control. Current loop options are 0-20mA, 4-20mA, 0-1mA, ± 1mA.

Real Time Clock is provided in the PM296/RPM096E for date and time stamp log and demand interval synchronization. Standard or Daylight Savings Time (DST) with automatic time adjustment is available. DST switch dates can be configured for the use in different time zones.

The ***TOU (Time of Use)*** system:

- up to 16 TOU energy register groups, each of which can be allocated to accumulate kWh (import and export), kvarh (import and export), kVAh and energy from 12 external meters through 12 pulse inputs
- up to 3 TOU Maximum Demand register groups, each of which can be allocated to record maximum kW import and export, kvar import and export, or kVA demand
- sliding window and thermal maximum demand options
- up to 16 tariff energy registers (counters) per group
- up to 16 tariff Maximum Demand registers per group
- up to 16 daily profiles (e.g., 4 seasons, 4 daily profiles per season)
- up to 8 daily start times (tariff changes)
- 2 calendars
- automatically configurable daily and monthly TOU profile log for each allocated energy and maximum demand register using season energy tariffs

Waveform Recorder for waveform capture and logging on different events. Along with the disturbance monitor it allows for capture and recording of various types of disturbances with a duration from one millisecond and up to tens seconds - transients, outages, sags, surges and deviations in voltage level.

Event and data logging on different events with real time clock and 1-Mbyte non-volatile memory:

- instrument switch on/off
- instrument setup change
- external status change
- event/alarm setpoints operations
- clock update

Each **event** record stores: date and time stamp, event name, log value (after alarm setup operation) and effect (operation or release).

Data logging is used for: load profile logging (at 5,15 or 30 minute intervals), TOU energy counters logging and data logging after alarm setup operation or new state of digital status input.

Calculation of memory size is according to the following:

Log name	*Number of bytes in record*	*Number of daily/ monthly records*	*Number of days/months*	*Memory size (bytes)*
Event log	14	NR (up to 10) daily	ND	14 * NR * ND
Load profile log	NB = 4 * NP+8	NR =1440/TI - daily	ND	NB * NR * ND
TOU energy log	NB = 4 * NP+8	NR = 1- monthly	NM	NB * NR * NM
Alarm data log	NB = 4 * NP+8	NR (up to 5) - daily	ND	NB * NR * ND
Total memory				524288

Where:

NP = number of parameters in a record (up to 16) and 8 - number of bytes for timestamp;

TI = time interval between two records, minutes.

Example:

Event log must store data up to 60 days (ND=60)

Load profile log - up to 60 days and every record consist of NP=5 parameters: voltages per phase, active and reactive powers integrated TI=5 minutes),

Monthly TOU energy log - 60 months and every record consist of NP=10 parameters - 4 energy tariffs and 4 TOU Maximum Demand registers, Active and Reactive Energy registers),

Alarm Data log - 60 days, every record consist of NP=13 parameters - 3 voltages, 3 currents, active, reactive and apparent powers, frequency, THD voltage of phases L1, L2 and L3,

Data logging requires the following memory:

Log name	Number of bytes in one record	Number of daily/monthly records	Number of days (months)	Memory size, in bytes
Event log	14	10	60	8400
Load profile log	4 * 5+8 =28	1440/5= 288	60	483840
TOU energy log	4 * 10+8 = 48	1	60	2880
Alarm data log	4 * 13+8 = 60	5	60	18000
Required memory				513120

User-selectable options are provided (see Section 4.11):

1) Power calculation mode (*P.cAL*)

2) Energy rollover value
This option specifies the point at which the energy value rolls over to zero.

3) Thermal demand calculation option (thr.d)
This option is used to enable or disable thermal power demand calculations.

PM296/RPM096 Dimensions

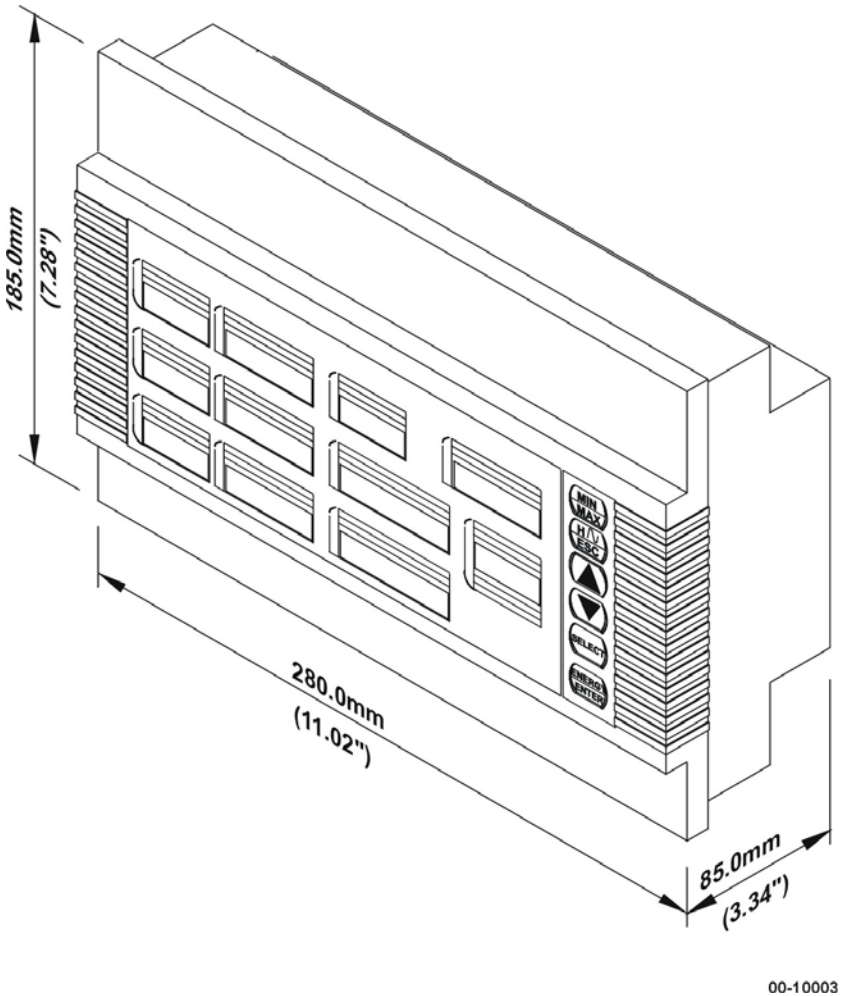


Figure 1-1 *PM296/RPM096* Dimensions

Measured Parameters

NOTE: Real-time values are measured over 1 cycle of fundamental frequency;
Average values are of 8, 16 or 32 Real-time values

Parameter	Display	Comm.	Outputs		
			Analog	Pulse	Alarm
Sliding Average Values			# = setup via panel $ = setup via PC		
Average RMS Voltage per phase	✓	✓	#$		$
Average RMS Current per phase	✓	✓	#$		$
Average Active Power per phase	✓	✓			$
Average Reactive Power per phase	✓	✓			$
Average Apparent Power per phase	✓	✓			$
Average Power Factor per phase	✓	✓			$
Average Total Active Power	✓	✓	#$		$
Average Total Reactive Power	✓	✓	#$		$
Average Total Apparent Power	✓	✓	#$		$
Average Total Power Factor	✓	✓	#$		$
Average Frequency	✓	✓	#$		$
Average Neutral Current	✓	✓	#$		$
Average Auxiliary Current I_4	✓	✓	#$		$
3-phase average Voltage & Current		✓	#$		$
Voltage & Current unbalance		✓			$
Average DC Voltage	✓	✓			$
Amps & Volt Demands					
Ampere & Volt Demand per phase		✓			$
Ampere Maximum Demand per phase	✓	✓			$
Voltage Maximum Demand per phase	✓	✓			$
Power Demands					
Active Power Accumulated Demand Import		✓	#$		$
Active Power Accumulated Demand Export		✓	#$		$
Reactive Power Accumulated Demand Import		✓	#$		$
Reactive Power Accumulated Demand Export		✓	#$		$
Apparent Power Accumulated Demand		✓	#$		$
Active Power Demand Import & Export		✓			$
Reactive Power Demand Import & Export		✓			$
Apparent Power Demand		✓			$
Active Power Sliding Demand Import & Export		✓			$
Reactive Power Sliding Demand Import & Export		✓			$
Apparent Power Sliding Demand		✓			$
Active Power Thermal Demand Import & Export		✓			$
Reactive Power Thermal Demand Import & Export		✓			$
Apparent Power Thermal Demand		✓			$
Active Power Predicted Demand Import & Export		✓			$
Reactive Power Predicted Demand Import & Export		✓			$

Parameter	Display	Comm.	Outputs Analog	Outputs Pulse	Outputs Alarm
Apparent Power Predicted Demand		✓			$
Active Power Maximum Demand Import	✓	✓			$
Active Power Maximum Demand Export		✓			$
Reactive Power Maximum Demand Import	✓	✓			$
Reactive Power Maximum Demand Export		✓			$
Apparent Power Maximum Demand	✓	✓			$
Total Energy					
Total Active Energy Import	✓	✓		#$	
Total Active Energy Export	✓	✓		#$	
Total Active Energy Net		✓			
Total Active Energy Absolute		✓		#$	
Total Reactive Energy Import	✓	✓		#$	
Total Reactive Energy Export	✓	✓		#$	
Total Reactive Energy Net		✓			
Total Reactive Energy Absolute		✓		#$	
Total Apparent Energy	✓	✓		#$	
Volt-hours	✓	✓			
Ampere-hours	✓	✓			
TOU Registers					
16 Energy registers	✓	✓			
3 Maximum demand registers (selectable kW import & export, kvar import & export, kVA, sliding window or thermal demand)		✓			
16 Tariffs for each TOU register		✓			
Harmonic Parameters					
Voltage THD per phase	✓	✓	#$		$
Current THD per phase	✓	✓	#$		$
Current TDD per phase	✓	✓	#$		$
K-factor per phase	✓	✓	#$		$
Voltage harmonics per phase up to 40th	✓	✓			$
Current harmonics per phase up to 40th	✓	✓			$
Harmonic Values (odd harmonics up to 39th)					
Harmonic Voltage & Current per phase	✓	✓			$
Harmonic total kW, PF	✓	✓			$
Harmonic total kvar	✓	✓			$
Real-time (RT) Values					
RT RMS Voltage per phase		✓	#$		$
RT RMS Current per phase		✓	#$		$
RT Active Power per phase		✓			$
RT Reactive Power per phase		✓			$
RT Apparent Power per phase		✓			$

Parameter	Display	Comm.	Outputs Analog	Outputs Pulse	Outputs Alarm
RT Power Factor per phase		✓			$
RT Total Active Power		✓	#$		$
RT Total Reactive Power		✓	#$		$
RT Total Apparent Power		✓	#$		$
RT Frequency		✓	#$		$
RT Neutral Current		✓	#$		$
RT Total Power Factor		✓	#$		$
RT Auxiliary Current I_4	✓	✓	#$		$
3-phase RT Voltage & Current		✓			$
RT Voltage & Current unbalance		✓			$
RT DC Voltage	✓	✓	#$		$
Min/Max Logging					
Min/Max A, V, Frequency, total kW, kvar, kVA,	✓	✓			$
Min/Max log for all real-time parameters		✓			$
Programmable Min/Max for harmonic values		✓			$
Voltage Disturbance					$
Phase Rotation	✓				$
Phase Angles	✓				
Day and Time	✓	✓			$
Pulse Counters	✓	✓			$
Remote Relay Control		✓			
Inputs & Outputs Status					
Digital Inputs Status	✓	✓			$
Alarm Relay Status	✓	✓			$
Alarm Trigger Status		✓			
Self-diagnostic Tests	✓	✓			

Chapter 2 Installation

2.1 Mechanical Installation

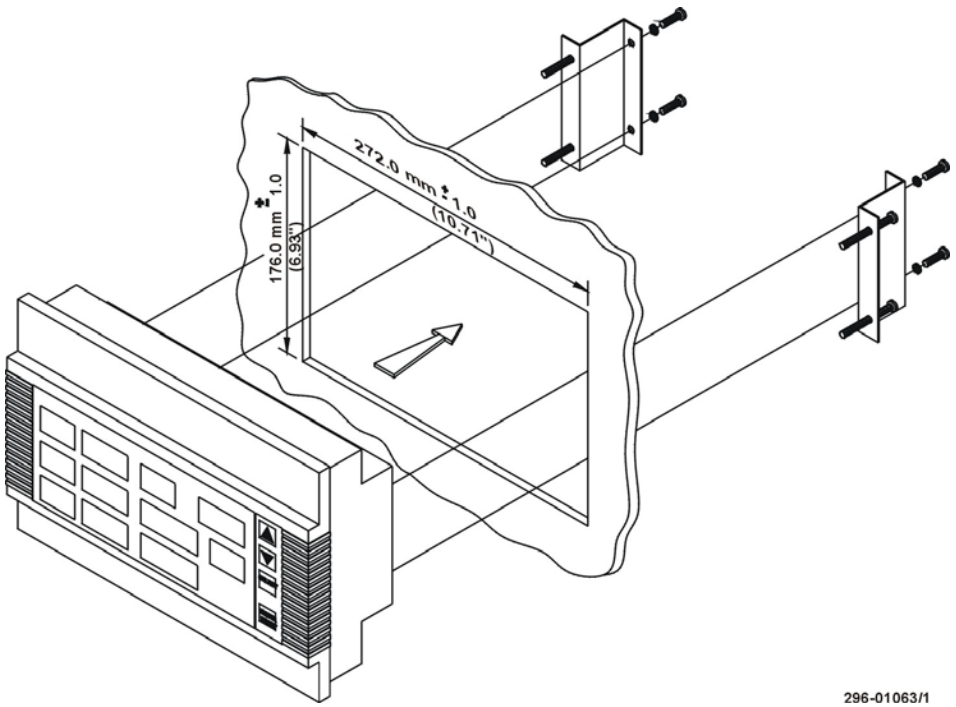


Figure 2-1 Front Mounting of the PM296

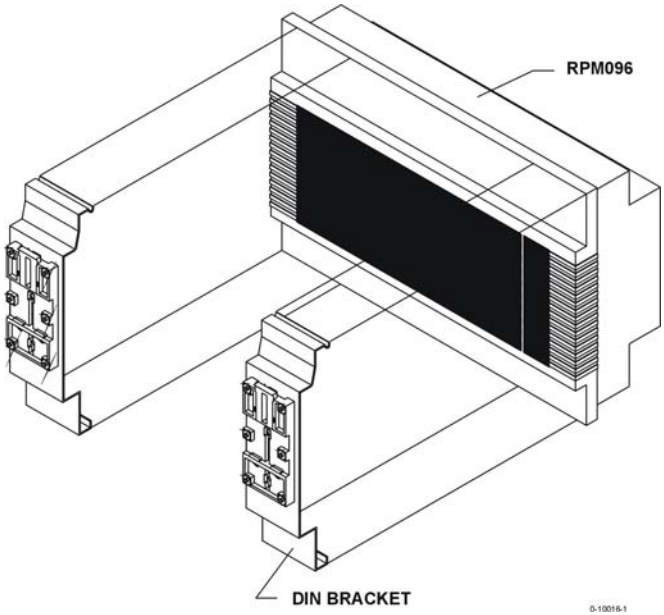


Figure 2-2 Mounting Brackets onto RPM096

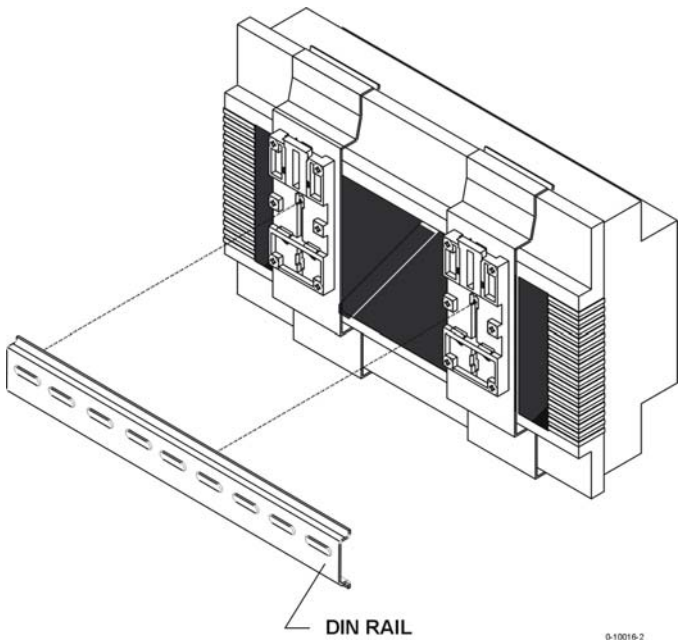


Figure 2-3 RPM096 Mounting on DIN Rail

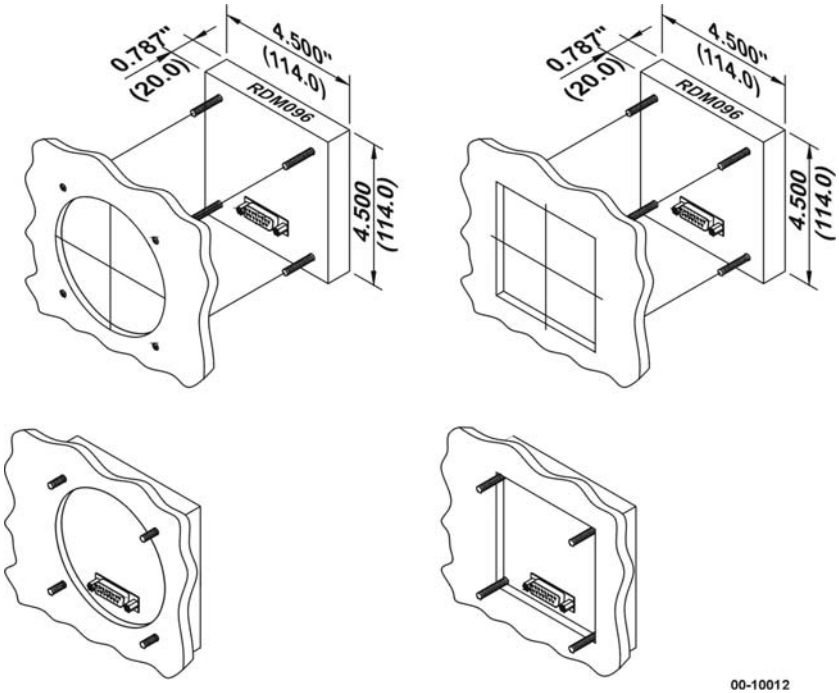


Figure 2-4 Mounting the RDM096 on Square/Round Cutout

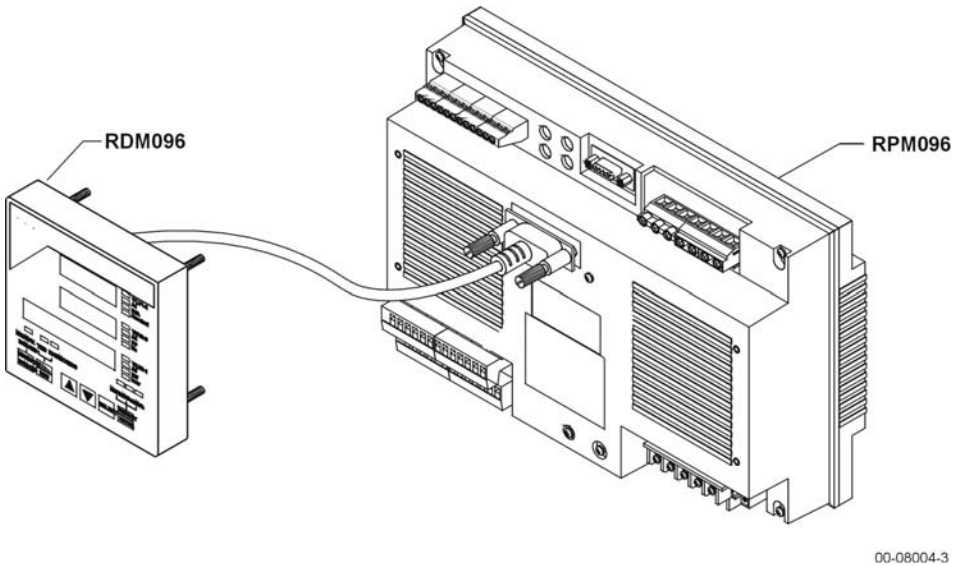


Figure 2-5 Connection of RDM096 to RPM096

2.2 Electrical Installation

> ☞ **Before installation ensure that all incoming power sources are shut OFF. Failure to observe this practice can result in serious or even fatal injury and damage to equipment.**

See ***General Schematic*** on page iv.

2.2.1 Power Source Connection

The power source can be dedicated-fused, or from a monitored voltage if it is within the instrument's power supply range.

AC power supply: line to terminal 16; neutral to terminal 15.
DC power supply: positive to terminal 16; negative to terminal 15.

2.2.2 Current Inputs

To ensure accurate readings, the input current should not exceed 2A RMS and 2.82A amplitude for the 1A CT secondary, or 10A RMS and 14.2A amplitude for the 5A CT secondary.

Copper wiring 2.5 - 4 mm^2 (13 -11 AWG) should be used.

2.2.3 Ground

Connect the chassis ground of the *PM296/RPM096* to the switchgear earth ground using dedicated wire greater than 2 mm^2/14 AWG.

2.2.4 Voltage Inputs

Input of 690V (Standard): To ensure accurate readings, the measured voltage between terminals 2-5, 5-8 and 8-2 should not exceed 790V AC RMS, and the measured voltage between terminals 2-11, 5-11 and 8-11 should not exceed 460V AC RMS and 695V amplitude. Use any of the seven wiring configurations shown in *Figures 2-6* through *2-12*.

Input of 120V (Option U): To ensure accurate readings, the measured voltage between terminals 2-5, 5-8, 8-2, 2-11, 5-11 and 8-11 should not exceed 144V AC RMS and 225V amplitude. 120V input usually implies use of a potential transformer (PT). The PT requires use of any of the four wiring configurations shown in *Figures 2-8* through *2-11*.

Wiring Configuration (See parameter setup instructions in Section 4.1)	*Wiring* **Code for Setup**	**See Figure:**
3-wire direct connection using 2 CTs (2-element)	3dir2	2-6
4-wire WYE direct connection using 3 CTs (3-element)	4Ln3 or 4LL3	2-7
4-wire WYE connection using 3 PTs, 3 CTs (3-element)	4Ln3 or 4LL3	2-8
3-wire open delta connection using 2 PTs, 2 CTs (2-element)	3OP2	2-9
4-wire WYE connection using 2 PTs, 3 CTs (2½-element)	3Ln3 or3LL3	2-10
3-wire open delta connection using 2 PTs, 3 CTs (2½ -element)	3OP3	2-11
4-wire delta direct connection using 3 CTs (3-element)	4Ln3 or 4LL3	2-12

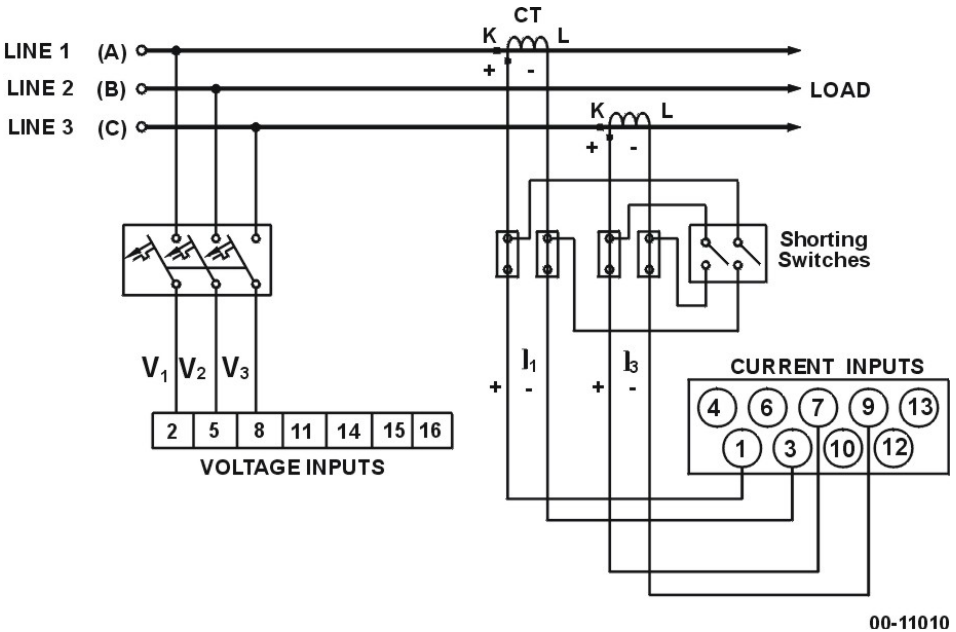


Figure 2-6

Three Wire Direct Connection Using 2 CTs (2-element) Wiring Mode = **3dir2**

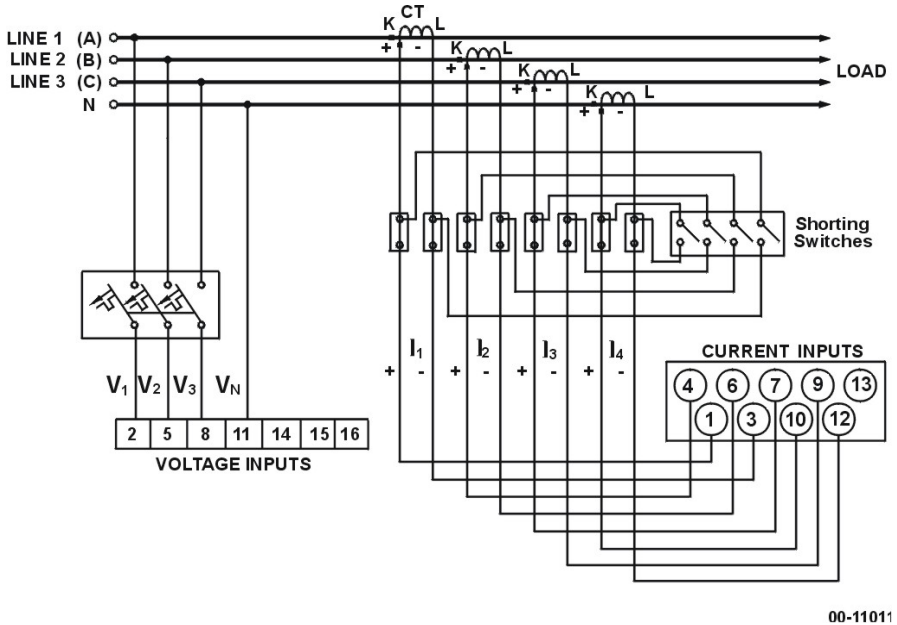


Figure 2-7
Four Wire WYE Direct Connection Using 3 CTs (3-element) Wiring Mode = **4LL3** or **4Ln3**

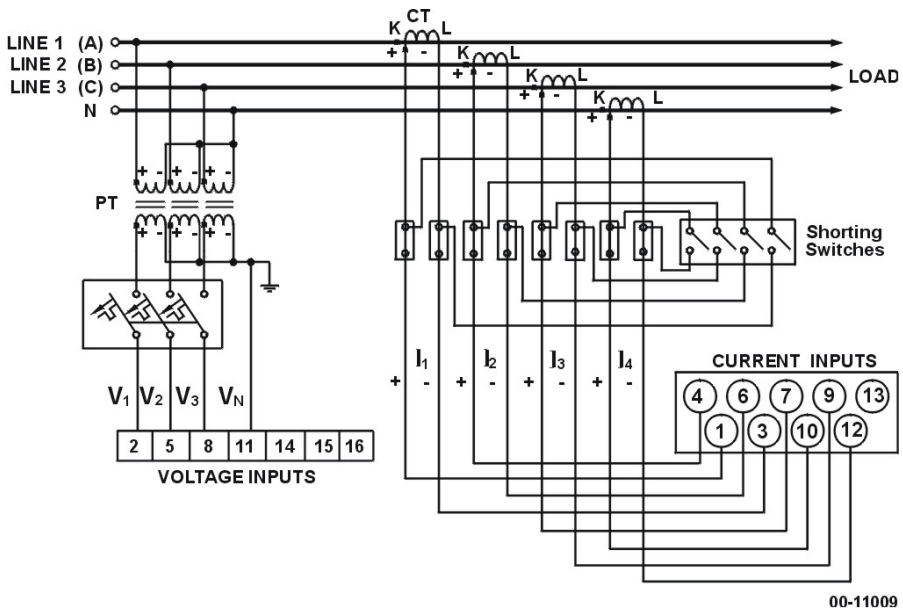


Figure 2-8
Four Wire WYE Connection Using 3 PTs, 3 CTs (3-element) Wiring Mode = **4LL3** or **4Ln3**

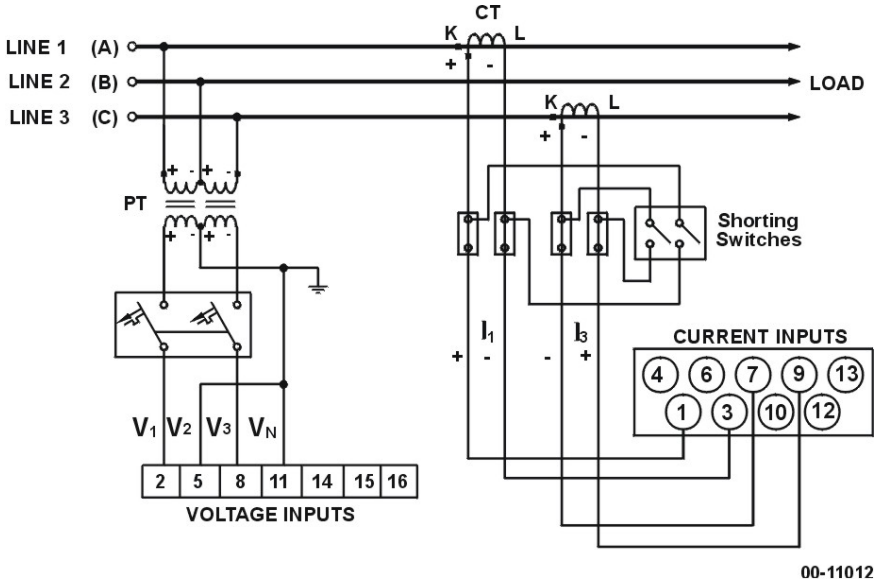


Figure 2-9
Three Wire Open Delta Connection Using 2 PTs, 2 CTs (2-element) Wiring Mode = **3OP2**

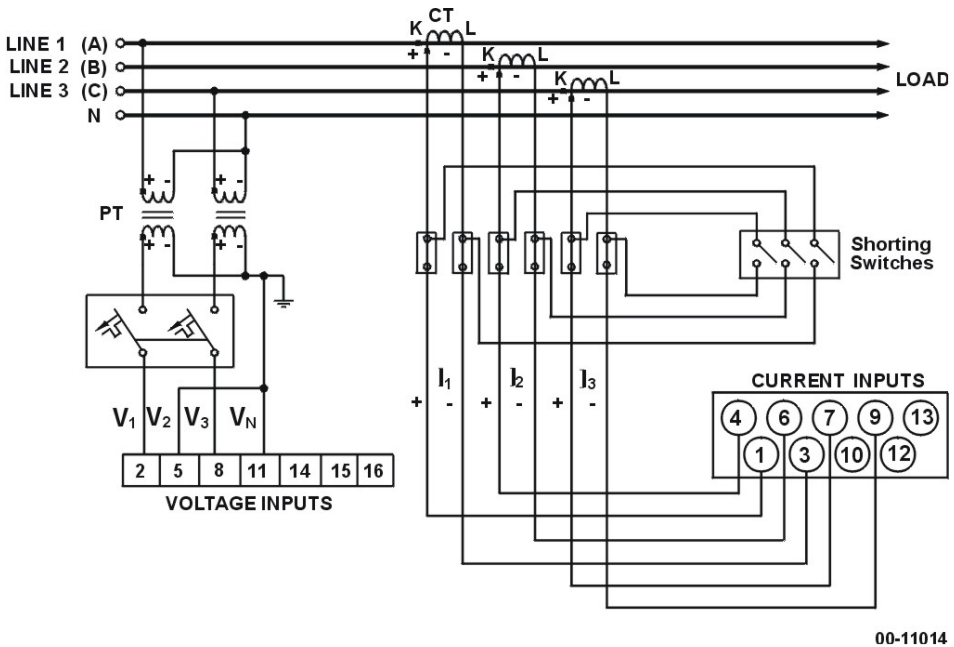


Figure 2-10
Four Wire Wye Connection Using 2 PTs, 3 CTs (2½-element) Wiring Mode = **3LL3** or **3Ln3**

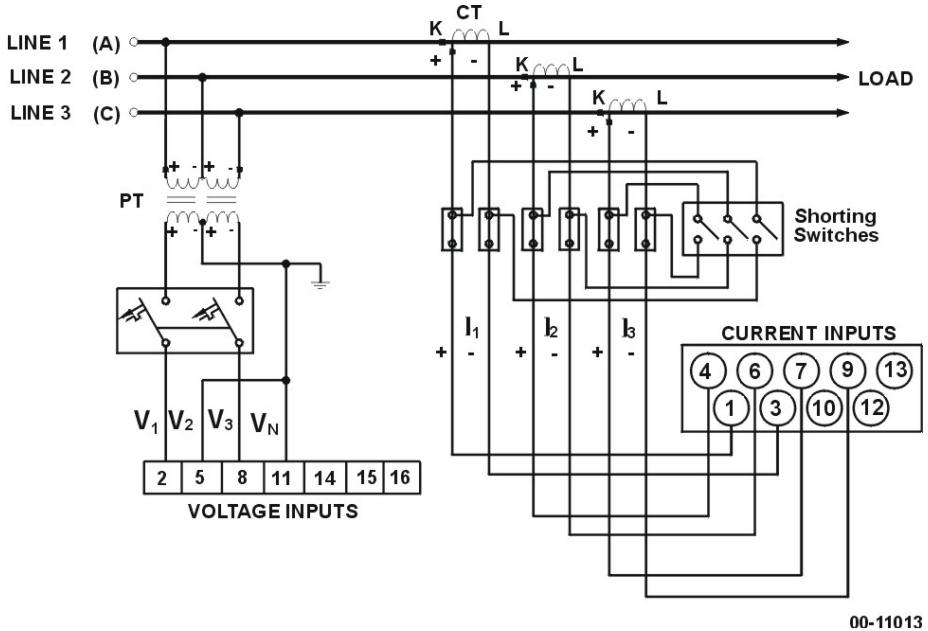


Figure 2-11
Three Wire Open Delta Connection Using 2 PTs, 3 CTs (2½-element) Wiring Mode = **3OP3**

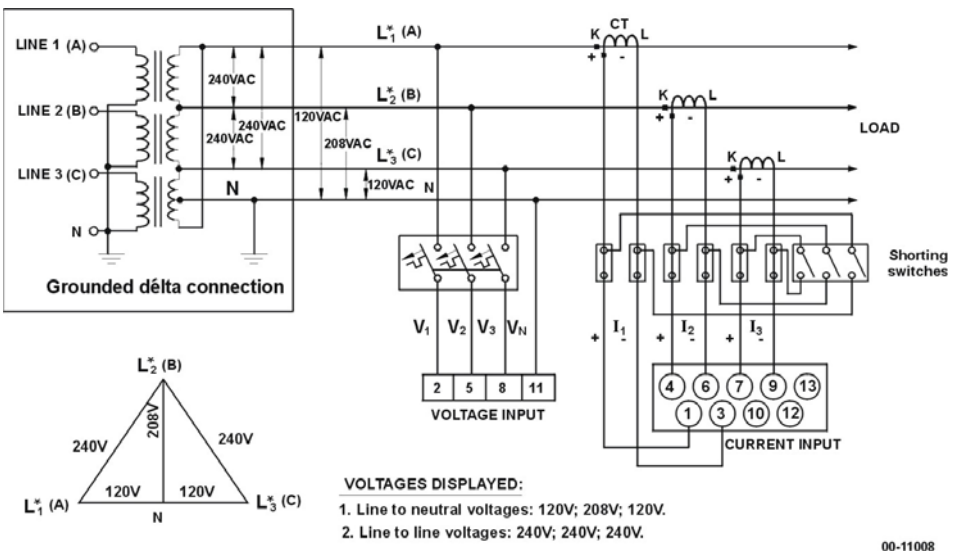


Figure 2-12 Four Wire Delta Direct Connection Using 3 CTs (3 element)
Wiring Mode **= 4LL3** or **4Ln3**

2.2.5 Relays

Six relays are provided for energy pulsing, alarms or remote control.

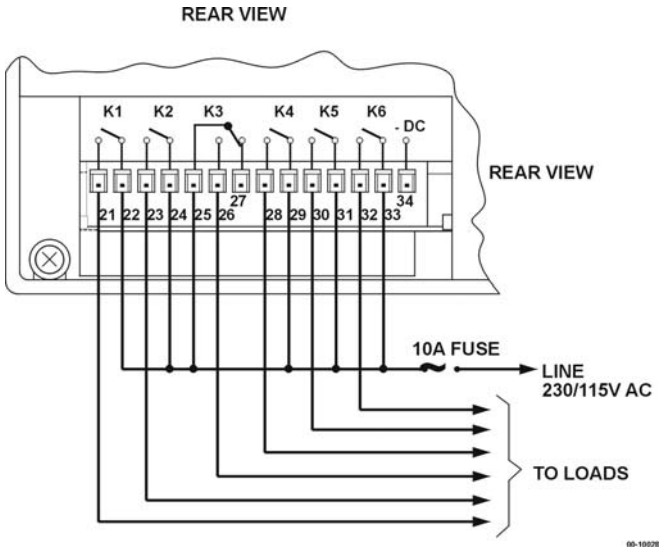


Figure 2-13 Relays Connection

2.2.6 Status Inputs

12 optically isolated status inputs are provided for status monitoring and external synchronization of power demand period and time.

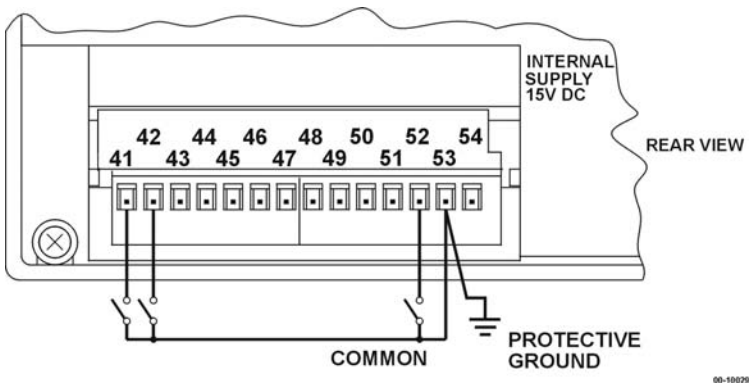


Figure 2-14 Status Inputs Connection

2.2.7 Analog Output

The *PM296/RPM096* provides two optically isolated analog outputs with an internal power supply and current output options of 0-20 mA and 4-20 mA (current loop load of up to 500 Ohm), 0-1 mA and ±1 mA (current loop load of up to10 kOhm).

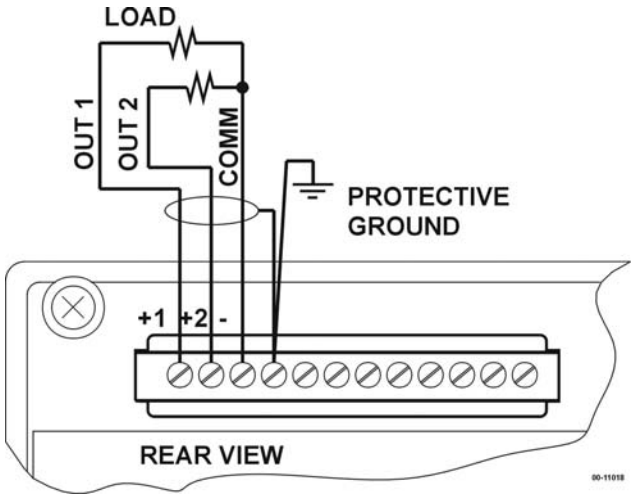


Figure 2-15 Analog Output Connection

2.2.8 DC Input

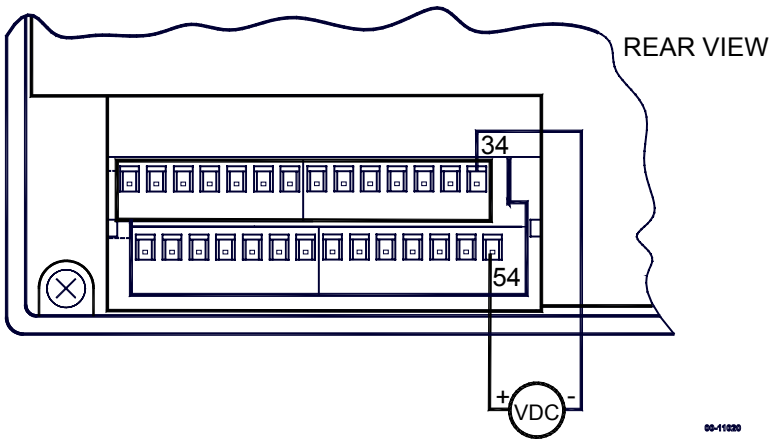
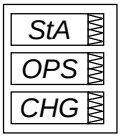


Figure 2-16 DC Input Connection

Chapter 3 Using The Menus

Press and release **SELECT** to enter the setup mode. The primary menus will appear:



- StA - Status Information Menu (see Chapter 6)
- OPS - Setup Options Menu
- CHG - Setup Change Menu (see Chapter 4)

Press **SELECT** again to activate the window of the desired primary menu.
Press **ENTER** .

Select ***CHG*** to initialize or modify the instrument setup, or to clear the accumulated values stored in the instrument. Entry to this menu can be protected by a password.

SELECT ➔ ***CHG*** ➔ **ENTER**

Select ***StA*** to view extended status information which may be useful during installation and in certain applications.

SELECT ➔ ***StA*** ➔ **ENTER**

Select ***OPS*** for *viewing* (not editing) the instrument setup options.

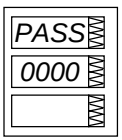
SELECT ➔ ***OPS*** ➔ **ENTER**

After selecting either *OPS* or *CHG,* the list of setup menus is displayed in the upper window. Figure 3-1 presents a complete menu list. Depending on the model of your instrument, some menus may not appear.

Password

The *Setup Change Menu* can be secured by a user-defined password comprised of 4 digits. The instrument is shipped with password protection disabled. To enable password protection, go to the *Access Control Menu* (see Section 4.12).

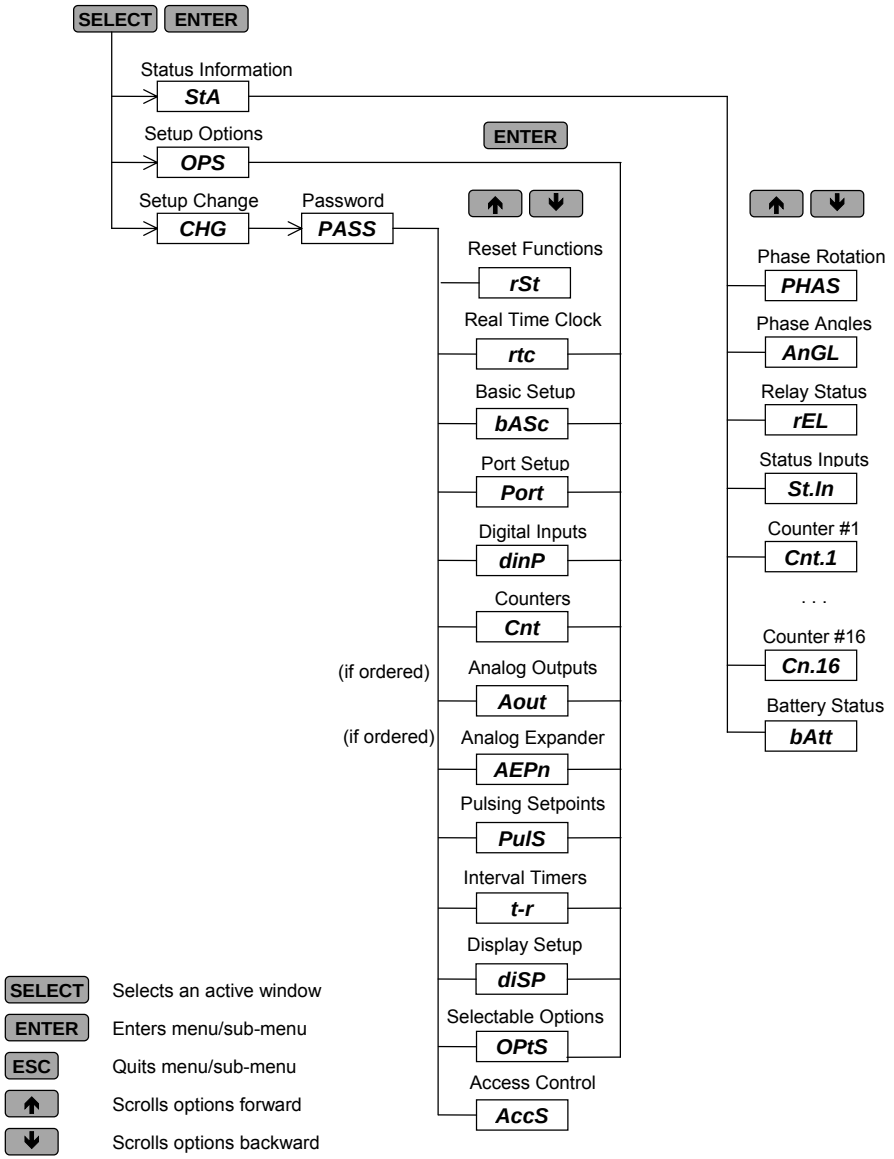
The *Password Menu* appears if password protection is enabled.



To enter a password:

- ✓ Set the first digit using the up and down arrow keys.
- ✓ Press **SELECT** to advance to the next digit.
- ✓ Set the other password digits in the same manner.
- ✓ Press **ENTER** to continue setup. If your password is incorrect, you will return to the *Primary Selection Menu.*

Figure 3-1 Menu Structure



Chapter 4 Setup Menus

NOTE: Instrument setup can be performed directly on the front panel using the setup menus or via communications using PComTest or PAS communication software, supplied with your instrument. Alarm/Event Setpoints can be programmed only through communications. For information on using PComTest or PAS, refer to the user documentation provided.

Setup	Display	PComTest	PAS
Basic	+	+	++
Communication port	++	+	-
User selectable options	++	+	-
Analog output, analog expander	+	+	++
Digital inputs	+	+	++
Timer	+	+	++
Alarm/Event set points	-	+	++
Pulsing output, pulse counter	+	+	++
Log memory partitions	-	+	++
Data log	-	-	++
Real time clock	+	+	++
TOU system	-	-	++
Assignable registers	-	++	-
Display	++	-	-

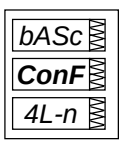
++ Recommended method + Possible - Not possible

4.1 Basic Setup Menu

SELECT ➔ *CHG* ➔ ENTER ➔ *bASc* ➔ ENTER

This menu contains the basic configuration options which define the general operating characteristics of your instrument, such as wiring mode, input scales, the size of the RMS averaging buffer, etc. Table 4-1 lists the basic setup options, their code names and applicable ranges.

Activate the middle window to scroll through the list of available options, and then activate the lower window to set the option value.



To select and view a setup option:

✓ Press SELECT to activate the middle window
✓ Use the up/down arrow keys to scroll to the desired option. The current value for this option appears in the lower window.

To change the value of the selected option:

✓ Press SELECT to make the lower window active.
✓ Press the up/down arrow keys to scroll to the desired value.
✓ Press ENTER to store the selected value, or press ESC to quit the menu.

Table 4-1 Basic Setup Options (∗ default setting)

Code	Parameter	Options	Description
ConF	Wiring mode	3OP2	3-wire open delta using 2 CTs (2 element)
		4Ln3∗	4-wire Wye using 3 PTs (3 element), line to neutral voltage readings
		3dir2	3-wire direct connection using 2 CTs (2 element)
		4LL3	4-wire Wye using 3 PTs (3 element), line to line voltage readings
		3OP3	3-wire open delta using 3 CTs (2½ element)
		3Ln3	4-wire Wye using 2 PTs (2½ element), line to neutral voltage readings
		3LL3	4-wire Wye using 2 PTs (2½ element), line to line voltage readings
Pt	PT ratio	*1.0∗ - 6,500.0*	The phase potential transformer ratio
Ct	CT primary current	*1-5000A (5∗)*	The primary rating of the phase current transformer
Ct.Au	Auxiliary CT primary current	*1-5000A/mA (5000∗)*	The primary rating of the auxiliary current transformer
dc.OF ①	DC voltage zero offset	*0-9999 (0∗)*	The reading of the DC voltage corresponding to a zero DC voltage input
dc.FS ①	DC voltage full scale reading	*0-9999 (20, 100, 300∗)*	The reading of the DC voltage corresponding to a full-scale DC voltage input. By default it is set to the DC full-scale input (20, 100 or 300 VDC)
d.P	Demand period	*1, 2, 5, 10, 15∗, 20, 30, 60, E*	The length of the demand interval (sub-interval for sliding window demand) for power demand calculations, in minutes. E = external synchronization
n.dp	Number of demand periods	*1-15 (1∗)*	The number of demand sub-intervals to be averaged for sliding window demands. A product of the demand period and the number of demand periods should not exceed 60 min. For block demand, set this value to one.
A.dP	Ampere/Volt demand period	*0-1800s (900∗)*	The length of the demand period for volt/ampere demand calculations, in seconds 0 = measuring peak current
t.con ②	Thermal demand time constant	*1-3600.0 s (195.4∗)*	The simulated thermal element time constant for thermal demand measurements
buF	Averaging buffer size	*8∗,16,32*	The number of measurements for RMS sliding averaging
rSt	Reset enable/disable	*diS, En∗*	Protects all reset functions, both via the front panel or communications.
PrE.C	The number of pre-event cycles for the waveform recorder	*1-8 (1*)*	The number of waveform cycles to be recorded before the event that triggered waveform capture

Code	Parameter	Options	Description
rEc.C	The number of cycles in a waveform series ③	0 to 2560 (0*)	The total number of waveform cycles to be recorded on either event occurrence. Will be rounded to a nearest bigger number multiple of 16. 0 = auto-select
Freq	Nominal frequency	*50, 60 Hz***	The nominal line frequency
LoAd	Maximum demand load current	*0-10,000A (0*)*	The maximum demand load current used in TDD calculations (0 = CT primary current)

*** 60 Hz* default for North America; elsewhere, default is *50Hz.*

① The DC voltage input may be used to measure different analog quantities proportional to voltage, such as temperature. The DC Voltage reading can be scaled in order to show the primary parameter quantity by applying zero and full scale offsets to the measured voltage. To get true DC voltage readings, set the offset to zero and the full scale to 20, 100 or 300 VDC according to your order.

② The thermal demand time constant is calculated using the following formula:

$$\tau = \frac{t}{\ln \frac{100}{100 - S\%(t)}}$$

where

τ - thermal time constant, sec;
t = demand interval, sec (demand period x number of demand periods);
S%(t) - the level that the thermal demand pointer will attain at the end of the demand interval, expressed in percentage of the steady-state value.

In meters with S%(t) = 63%, τ = t. For example, using a 15-min demand interval, τ = 900 sec, and with a 30-minute interval - τ = 1800 sec.

In meters with S%(t) = 99%, using a 15-min demand interval, τ = 195.4 sec, and with a 30-minute interval τ = 390.9 sec.

③ The waveform recorder logs waveforms in series of records. A compound waveform can have as more as 2560 cycles recorded in 160 consequent records, each record comprising 16 waveform cycles. When the number of cycles is defined as zero, the instrument automatically selects the size of a waveform series. By default, a waveform series is assumed to consist of a single 16-cycle record. When a record is triggered by a voltage disturbance event and the disturbance lasts for more time than a 16-cycle record can include, the disturbance event is assumed to be a single long-duration event. In that case, the recorder will continue storing a waveform in the following adjacent records while the voltage wave shape is still non-stationary. The total number of records in a compound waveform will be limited only by the allocated memory.

NOTES

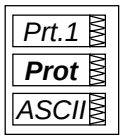
1) The maximum value for CT PRIMARY CURRENT × PT RATIO is 10,000,000. If this product is greater, power related values will be zeroed.
2) Always specify WIRING MODE, PT RATIO and CT PRIMARY CURRENT prior to setting up alarm setpoints and analog output channels, otherwise the alarm/event setpoints and analog outputs which use these parameters will automatically be disabled.

4.2 Communications Port Setup Menus

SELECT → CHG → ENTER ↑ ↓ → Prt.1 → ENTER
SELECT → CHG → ENTER ↑ ↓ → Prt.2 → ENTER

These menus allow you to access the communications port options that the *PM296/RPM096* uses to communicate with a master computer or a printer. Table 4-2 lists the communications options, their code names and applicable choices.

From the main menu, select the menu for the port you want to configure. Activate the middle window to scroll through the list of available options, and then activate the lower window to set the option value.



To select and view a setup option:

✓ Press SELECT to activate the middle window.
✓ Use the up/down arrow keys to scroll to the desired option. The option setting will appear in the lower window.

To change the selected option:

✓ Press SELECT to activate the lower window.
✓ Press the up/down arrow keys to scroll to the desired value.
✓ Press ENTER to store the selected value or press ESC to quit the setup menu.

NOTE: An optional analog expander can be connected to Communications Port #2.

Table 4-2 Communications Options (∗ default setting)

COM1

Code	Parameter	Options	Description
Prt.1	Communications protocol	*ASCII∗*	ASCII protocol
		rtu	Modbus RTU protocol
		dnP3	DNP3.0 protocol
		Prnt	Printer mode
rS	Interface standard	*232*	RS-232 interface
		485∗	RS-485 interface
Addr	Address	*0∗-99 ASCII*	Powermeter address
		1∗-247 Modbus	
		0-255 DNP3.0*	
bAud	Baud rate	*110*	110 baud
		300	300 baud
		600	600 baud
		1200	1200 baud
		2400	2400 baud
		4800	4800 baud
		9600∗	9600 baud
		19.20	19,200 baud
		38.40	38,400 baud

Code	Parameter	Options	Description
dAtA	Data format	*7E*	7 bits, even parity
		8n∗	8 bits, no parity
		8E	8 bits, even parity
H.Sh	Incoming flow control (handshaking)	*nonE∗*	No handshaking
		SOFt	Software handshaking (XON/XOFF protocol)
		Hard	Hardware handshaking (CTS protocol)
Ctrl	Outgoing flow control (RTS/DTR)	*nonE∗*	RTS signal not used
		dtr	RTS permanently asserted (DTR mode)
		rtS	RTS asserted during the transmission
Prn.P	Printout period	*1∗, 2, 5, 10, 15, 20, 30, 60* min	Time interval between successive printouts

COM2

Code	Parameter	Options	Description
Prt.2	Communications protocol	*ASCII∗*	ASCII protocol
		rtu	Modbus RTU protocol
		dnP3	DNP3.0 protocol
rS	Interface standard	*422*	RS-422 interface
		485∗	RS-485 interface
Addr	Address	*0∗-99 ASCII*	Powermeter address
		1∗-247 Modbus	
bAud	Baud rate	*110*	110 baud
		300	300 baud
		600	600 baud
		1200	1200 baud
		2400	2400 baud
		4800	4800 baud
		9600∗	9600 baud
		19.20	19,200 baud
		38.40	38,400 baud
dAtA	Data format	*7E*	7 bits, even parity
		8n∗	8 bits, no parity
		8E	8 bits, even parity
CPtb	ASCII compatibility mode	*diS∗, En*	Disables/enables ASCII compatibility mode. For more information, see ASCII Communications Protocol Reference Guide

4.3 Digital Inputs Setup Menu

SELECT ➔ *CHG* ➔ ENTER ↑ ↓ ➔ *dinP* ➔ ENTER

This menu is used to set up the 12 digital inputs provided by the *PM296/RPM096*.

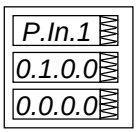
Each digital input can be allocated as:

- a **status input** to monitor external contact status, or
- a **pulse input** to sense pulses provided by an external source. One of these can be configured to receive an external synchronization pulse indicating the beginning of a new demand interval for power demand measurements.

A **pulse input** can also be configured to receive time synchronization pulses to provide synchronization of the instrument clock with a precise external time source. Time synchronization pulses can follow in intervals of one minute multiples aligned at 00 seconds. Receipt of the external pulse adjusts the RTC at the nearest round minute. Whenever a precise external demand synchronization source is used, the same input that is allocated for this pulse can be configured as a time synchronization input.

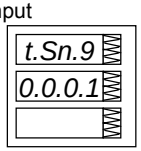
An input allocated for the external synchronization pulse will be automatically configured as a pulse input. Status inputs need not to be explicitly allocated in your instrument. All digital inputs except those you have allocated as pulse inputs are automatically configured as status inputs.

Pulse inputs



External demand synchronization input

Time synchronization input



To select and view inputs allocation:

✓ Scroll through the inputs allocation sub-menus in the upper window using the up/down arrow keys. The sub-menus are shown at left. For each allocation group, two sub-menus are used: the first showing inputs #1 through #8 and the second - inputs #9 through #12.

Digital inputs are numbered from left to right. “0” indicates “not allocated”; “1” indicates “allocated”. Each digital input is set separately.

To change the digital input allocation:

✓ Press SELECT to activate the middle window.
✓ Use the up/down arrow keys to set the input allocation status.
✓ Press ENTER to store your new inputs allocation.
✓ Press ESC to leave the allocation unchanged or to quit the menu.

NOTE

Digital inputs configured as status inputs can be monitored via the *Status Information Menu* (see Chapter 6) and communications. The pulses being received via pulse inputs can be directed to one of the four pulse counters (see Section 4.4) and, at the same time, to either of the TOU system energy registers.

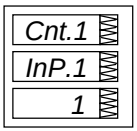
4.4 Pulse Counters Setup Menu

SELECT → CHG → ENTER ↑ ↓ → Cnt → ENTER

This menu is used to configure the 16 pulse counters provided by your *PM296/RPM096* instrument.

Any counter can be connected to one of the 12 digital inputs, to count incoming pulses (in this event the connected digital input must be allocated as a pulse input as directed in Section 4.3) or to count a wide variety of events via setpoints. Each counter can be independently scaled (weighted) by specifying a scale factor in the range of 1 to 9999. This means that each incoming pulse or an event will add to a counter the specified number of units.

Counter setup



To select and view a counter setup:

✓ Press the up/down arrow keys to choose the desired counter.

To connect a pulse input to the counter:

✓ Press SELECT to activate the middle window.

✓ Use the up/down arrow keys to select the desired pulse input. Selecting ***nonE*** disconnects pulse inputs from the counter.

To change the scale factor for the counter:

✓ Press SELECT to activate the lower window.

✓ Use the up/down arrow keys to set the desired scale factor.

✓ Press ENTER to store your new counter setup.

To quit the setup without changes:

✓ From the middle or lower window, press ESC.

To quit the menu:

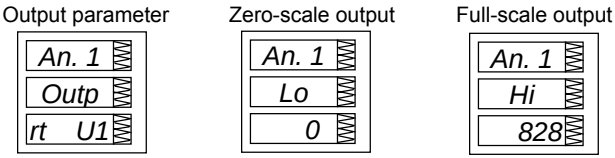
✓ From the upper window, press ENTER or ESC.

4.5 Analog Output Setup Menu

[This section is relevant to instruments ordered with this option]

SELECT → CHG → ENTER ↑ ↓ → Aout → ENTER

This menu allows you to set up an output value and its zero and full scales for either of the two internal analog output channels. Table 4-3 explains the analog output setup options, and Table 4-4 lists all measurement parameters that can be directed to analog output.



To select an analog channel:

✓ Use the up/down arrow keys to select the desired analog output channel.

To view the setup options for the selected channel:

✓ Press SELECT to activate the middle window.

✓ Use the up/down arrow keys to scroll to the desired option. The value associated with this option is displayed in the lower window.

To change the setup options for the selected channel:

✓ Press SELECT to activate the lower window.

✓ Use the up/down arrow keys to scroll to the desired value.

✓ Press SELECT to store the selected value, or press ESC to leave the value unchanged.

✓ Press ENTER again to store the setup for the channel.

To quit the setup without changes:

✓ From the middle or lower window, press ESC.

To quit the menu:

✓ From the upper window, press ENTER or ESC.

NOTES

1. Except for the signed power factor, the output scale is linear within the value range. The scale range will be inverted if the full scale specified is less than the zero scale.

2. The output scale for the signed power factor is symmetrical with regard to ±1.000 and is linear from -0 to -1.000, and from 1.000 to +0 (note that -1.000 ≡ +1.000). Negative power factor is output as [-1.000 minus measured value], and non-negative power factor is output as [+1.000 minus measured value]. To define the entire range for power factor from -0 to +0, the scales would be specified as -0.000/0.000.

3. For bi-directional analog output (±1 mA), the zero scale corresponds to the center of the scale range (0 mA) and the direction of current matches the sign of the output

parameter. For signed (bi-directional) values, such as powers and signed power factor, the scale is always symmetrical with regard to 0 mA, and the full scale corresponds to +1 mA output for positive readings and to -1 mA output for negative readings. For these, the zero scale (0 mA output) is permanently set in the instrument to zero for all parameters except the signed power factor for which it is set to 1.000, and may not change. Unsigned parameters are output within the current range 0 to +1 mA and can be scaled using both zero and full scales as in the case of single-ended analog output.

4. When the analog scale value exceeds the number of places in the window, it is converted to higher units (for instance, kW to MW) and a decimal point is placed in the window to indicate the new measurement range.

5. Each time you select the output parameter for the analog channel, its zero and full scales are set by default to the lower and upper parameter limits, respectively.

Table 4-3 Analog Output Setup Options

Code	Option	Description
OutP	Output parameter	The output parameter for the analog output channel
Lo	Zero scale (0/4 mA)	The reading of the parameter corresponding to a zero-scale current output
Hi	Full scale (1/20 mA)	The reading of the parameter corresponding to a full-scale current output

Table 4-4 Analog Output Parameters

Code	Parameter	Unit	Scale
none	Output disabled		0
	Real-time Measurements		
rt U 1	Voltage L1/L12 ②	V/kV	0 to Vmax
rt U 2	Voltage L2/L23 ②	V/kV	0 to Vmax
rt U 3	Voltage L3/L31 ②	V/kV	0 to Vmax
rt U.L12	Voltage L12	V/kV	0 to Vmax
rt U.L23	Voltage L23	V/kV	0 to Vmax
rt U.L31	Voltage L31	V/kV	0 to Vmax
rt C1	Current L1	A	0 to Imax
rt C2	Current L2	A	0 to Imax
rt C3	Current L3	A	0 to Imax
thd.U1	Voltage THD L1/L12	%	0 to 999.9
thd.U2	Voltage THD L2/L23	%	0 to 999.9
thd.U3	Voltage THD L3	%	0 to 999.9
thd.C1	Current THD L1	%	0 to 999.9
thd.C2	Current THD L2	%	0 to 999.9
thd.C3	Current THD L3	%	0 to 999.9
tdd.C1	Current TDD L1	%	0 to 100.0
tdd.C2	Current TDD L2	%	0 to 100.0
tdd.C3	Current TDD L3	%	0 to 100.0
HFc.C1	Current K-Factor L1		1.0 to 999.9
HFc.C2	Current K-Factor L2		1.0 to 999.9
HFc.C3	Current K-Factor L3		1.0 to 999.9

Code	Parameter	Unit	Scale
rt P	Total kW	kW/MW	-Pmax to Pmax
rt q	Total kvar	kvar/Mvar	-Pmax to Pmax
rt S	Total kVA	kVA/MVA	0 to Pmax
rt PF	Total PF		-0.000 to 0.000
rt PF.LG	Total PF lag		0 to 1.000
rt PF.Ld	Total PF lead		0 to 1.000
rt Au.C	Auxiliary current	A/mA	0 to Imax aux
rt nEU.C	Neutral current	A	0 to Imax
rt Fr	Frequency ①	Hz	0 to 100.00
rt U.dC	DC Voltage	V	0 to 9999.00
	Average Measurements		
Ar U 1	Voltage L1/L12 ②	V/kV	0 to Vmax
Ar U 2	Voltage L2/L23 ②	V/kV	0 to Vmax
Ar U 3	Voltage L3/L31 ②	V/kV	0 to Vmax
Ar U.AG	3-phase average voltage ②	V/kV	0 to Vmax
Ar U.L12	Voltage L12	V/kV	0 to Vmax
Ar U.L23	Voltage L23	V/kV	0 to Vmax
Ar U.L31	Voltage L31	V/kV	0 to Vmax
Ar U.L.AG	3-phase average L-L voltage	V/kV	0 to Vmax
Ar C1	Current L1	A	0 to Imax
Ar C2	Current L2	A	0 to Imax
Ar C3	Current L3	A	0 to Imax
Ar C.AG	3-phase average current	A	0 to Imax
Ar P	Total kW	kW/MW	-Pmax to Pmax
Ar q	Total kvar	kvar/Mvar	-Pmax to Pmax
Ar S	Total kVA	kVA/MVA	0 to Pmax
Ar PF	Total PF		-0.000 to 0.000
Ar PF.LG	Total PF lag		0 to 1.000
Ar PF.Ld	Total PF lead		0 to 1.000
Ar Au.C	Auxiliary current	A/mA	0 to Imax aux
Ar neU.C	Neutral current	A	0 to Imax
Ar Fr	Frequency ①	Hz	0 to 100.00
	Present Demands		
Acd.P.i	Accumulated kW import demand	kW/MW	0 to Pmax
Acd.P.E	Accumulated kW export demand	kW/MW	0 to Pmax
Acd.q.i	Accumulated kvar import demand	kvar/Mvar	0 to Pmax
Acd.q.E	Accumulated kvar export demand	kvar/Mvar	0 to Pmax
Acd.S	Accumulated kVA demand	kVA/MVA	0 to Pmax

Imax (100% over-range) = 2 × CT primary current [A]
Imax aux (100% over-range) = 2 × Auxiliary CT primary current [A]

Direct wiring (PT Ratio = 1):

Vmax (690 V input option) = 828.0 V
Vmax (120 V input option) = 144.0 V
Pmax = (Imax × Vmax × 3) [kW x 0.001] @ wiring modes 4Ln3, 3Ln3
Pmax = (Imax × Vmax × 2) [kW x 0.001] @ wiring modes 4LL3, 3OP2, 3dir2, 3OP3, 3LL3

NOTE: Pmax is rounded to nearest whole kW units.

If **Pmax** is more than 9999.000 kW, it is truncated to 9999.000 kW

Wiring via PTs (PT Ratio > 1):

Vmax (690 V input option) = 144 × PT Ratio [V]
Vmax (120 V input option) = 144 × PT Ratio [V]
Pmax = (Imax × Vmax × 3)/1000 [MW x 0.001] @ wiring modes 4Ln3, 3Ln3
Pmax = (Imax × Vmax × 2)/1000 [MW x 0.001] @ wiring modes 4LL3, 3OP2, 3dir2, 3OP3, 3LL3

NOTE: Pmax is rounded to nearest whole kW units.

① The actual frequency range is 45.00 - 65.00 Hz

② When the 4LN3 or 43LN3 wiring mode is selected, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages.

4.6 Analog Expander Setup Menu

SELECT ➔ CHG ➔ ENTER ↑ ↓ ➔ AEPn ➔ ENTER

By connecting two optional AX-7 or AX-8 analog expanders (with outputs of 0-20 mA, 4-20 mA, 0-1 mA or ±1mA) to the *PM296/RPM096*, an additional 14 (with AX-7) or 16 (with AX-8) external analog output channels can be provided. This menu allows you to select an output value, and its zero and full scales, for these extended channels.

Channels A1-1 to A1-8 correspond to the first analog expander, and channels A2-1 to A2-8 correspond to the second one. The setup menu operates in the same way as the *Analog Output Setup Menu* (see Section 4.5).

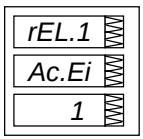
NOTES

1. The analog expander outputs operate through communications port COM2 in RS-422 and RS-485 mode. In both cases, connections between the instrument and the analog expander should be made using four wires.
2. Settings you made for analog expander outputs will not be in effect until the analog expander output is globally enabled in the instrument. To activate the analog expander output, set the analog expander option in the User Selectable Options setup (see Section 4.11) as it is set in your expander. *Do not enable the analog expander output when you do not have the analog expander connected to the instrument, otherwise the computer communications will become garbled.*
3. If you have the analog expander connected to your instrument, you will not be able to communicate with the instrument via a PC until you enable the analog expander option in the User Selectable Options setup (see Section 4.11). If this option is enabled, communications will be successful whether or not the analog expander outputs operate.

4.7 Pulsing Output Setup Menu

SELECT ➔ *CHG* ➔ ENTER ↑ ↓ ➔ *PulS* ➔ ENTER

This menu allows you to program either of the six relays provided by your *PM296/RPM096* instrument to output energy pulses. Available pulsing parameters are listed in Table 4-5.



To select a pulse relay:

✓ Use the up/down arrow keys to scroll to the desired relay. The pulsing parameter assigned to the relay is displayed in the middle window, and the amount of unit-hours per pulse is displayed in the lower window.

To change the pulse relay setup:

✓ Press SELECT to activate the middle window.

✓ Use the up/down arrow keys to scroll to the desired output parameter. Selecting ***nonE*** disables pulsing through this relay.

✓ Press SELECT to activate the lower window.

✓ Use the up/down arrow keys to set the amount of unit-hours per pulse. The available range is 1-9999.

✓ Press ENTER to store the new setup, or press ESC to quit the setup without changes.

To quit the pulsing setup menu:

✓ From the upper window, press ENTER or ESC.

Table 4-5 Pulsing Output Parameters

Code	Parameter
nonE	Output disabled
Ac.Ei	kWh import (positive)
Ac.EE	kWh export (negative)
Ac.Et	kWh total (absolute)
rE.Ei	kvarh import (inductive)
rE.EE	kvarh export (capacitive)
rE.Et	kvarh total (absolute)
AP.Et	kVAh total

NOTES

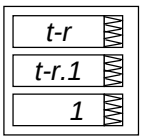
1. You will not be able to store your setup in the instrument if you assigned a parameter to relay output with a zero number of unit-hours per pulse, or if the parameter you selected has just been assigned to another relay output.
2. If a relay you allocated for pulsing has been manually operated or released, it reverts automatically to normal operation.
3. If a relay you allocated for pulsing has been engaged by an alarm/event setpoint, the setpoint is automatically disabled.

4.8 Timers Setup Menu

SELECT ➔ CHG ➔ ENTER ↑ ↓ ➔ t-r ➔ ENTER

This menu allows you to access the four interval timers provided by the *PM296/RPM096* which can trigger setpoints on a user-defined time interval basis. This is useful for continuous data logging at specified time intervals in order to produce trend and load profile graphs.

Each timer has a time interval range up to 9999 seconds at a one-second resolution and runs independently. The timer accuracy is about ±0.05 sec. To use a timer as the trigger for a setpoint, simply select one of timers as a trigger when defining the setpoint, and then specify for the selected timer a non-zero time interval at which you want the periodic action (for example, a data log) to be made. To stop a timer, set the time interval to zero. Each timer can be used to trigger multiple setpoints, for example, if you need multiple data logs at the same time.



To select a timer:

✓ Press SELECT to activate the middle window, and then use the up/down arrow keys to scroll to the desired timer. The time interval associated with the timer is displayed in the lower window.

To change the timer interval:

✓ Press SELECT to activate the lower window.

✓ Use the up/down arrow keys to set the desired time interval. The available range is 0-9999 (seconds). Setting the interval to zero stops the timer.

✓ Press ENTER to store your new setting.

✓ Press ESC to leave the timer setup unchanged.

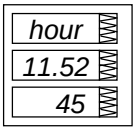
To quit the timer setup menu:

✓ Press ESC.

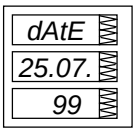
4.9 RTC Setup Menu

SELECT ➔ CHG ➔ ENTER ↑ ↓ ➔ rtc ➔ ENTER

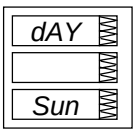
This menu allows you to view and set the time, date and day of week in the onboard Real Time Clock (RTC), and to modify the Daylight Savings Time (DST) settings for your time zone.



The **time** is displayed as HH.MM.SS, where the hour and minute are shown in the middle window separated by a dot, and the seconds - in the lower window.



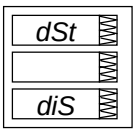
The **date** is displayed as per the user definition (YY.MM.DD, MM.DD.YY, or DD.MM.YY), where the first two items are shown in the middle window, and the last one - in the lower window. For instructions on how to select the date format, see Section 4.10.



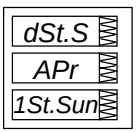
The **day** of the week is displayed in the lower window, as follows:

Sun	Sunday	thu	Thursday
ΠIon	Monday	Fri	Friday
tuE	Tuesday	Sat	Saturday
UEd	Wednesday		

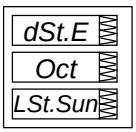
The **day** of the week can be only viewed. It is set automatically when you change the date.



The **DST** option can be disabled or enabled. When DST is disabled, the RTC will operate in standard time only. When enabled, the instrument will automatically update the time at 2:00 AM at the pre-defined DST switch dates. The DST switch points are specified by the month, week of the month and weekday. Select the appropriate weekday in the month by specifying the 1st, 2nd, 3rd, 4th or the last (abbreviated as ***LSt***) weekday in the month.



This entry specifies the **DST start date** when Daylight Savings Time begins. Press SELECT to select the date parameter you wish to change. By default, DST starts at 2:00 AM on the first Sunday in April of each year.



This entry specifies the **DST end date** when Daylight Savings Time ends. Press SELECT to select the date parameter you wish to change. By default, DST ends at 2:00 AM on the last Sunday in October of each year.

To select an option sub-menu:

✓ From the upper window, use the up/down arrow keys to scroll to the desired sub-menu (time, date, weekday, or DST).

To change time, date, day of week (not seconds) or DST setting:

✓ Press **SELECT** to activate the desired item. When in the time setup sub-menu, the hour and minutes indications are now frozen to allow you to adjust them.

✓ Use the up/down arrow keys to set the value.

✓ Set the other items in the same manner.

To update the RTC with your new setting (and to reset seconds):

✓ From the middle or lower window, press **ENTER**.

✓ If you want to reset seconds, press **SELECT** to activate the seconds window, and then press **ENTER** while the seconds window is flashing.

To quit the sub-menu without changes:

✓ From the middle or lower window, press **ESC**.

To quit the RTC menu:

✓ Press **ESC**.

4.10 Display Setup Menu

SELECT → CHG → ENTER ↑ ↓ → diSP → ENTER

This menu allows you to view and change display properties. Table 4-6 lists available options with their code names and applicable ranges.

Table 4-6 Display Options (* default setting)

Display	Code	Parameter	Options	Description
diSP **UPdt** 0.5	*UPdt*	Display update time	*0.1 - 10.0 s (0.5)**	Defines interval between display updates
diSP **ScrL** 5	*ScrL*	Auto scroll	*nonE** *2-15 s*	Disables/enables auto scroll on common measurements display (main screen) and defines scroll interval
diSP **rEtn** diS	*rEtn*	Auto return to the main screen	*diS*, En*	Disables/enables auto return to the main screen after 30 seconds of uninterrupted use
diSP **Ph.P** diS	*Ph.P*	Phase powers display mode	*diS*, En*	Disables/enables display of phase powers in common measurements (main screen)
diSP **Fund.** diS	*Fund.*	Fundamental values display mode	*diS*, En*	Disables/enables display of fundamental values in common measurements (main screen)
diSP **dAtE** n.d.Y	*dAtE*	Date format	*n.d.Y** *d.n.Y* *Y.n.d*	Defines the date format in the RTC display: d=day, n=month, Y=year Each date format character is set separately.

To select a display option:

✓ Press SELECT to activate the middle window, and then use the up/down arrow keys to scroll to the desired option.

To change the display option:

✓ Press SELECT to activate the lower window.
✓ Use the up/down arrow keys to set the desired option.
✓ Press ENTER to store your new setting or press ESC to leave your previous setting unchanged.

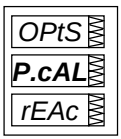
To quit the display setup menu:

✓ From the middle window, press ESC or ENTER.

4.11 User Selectable Options Menu

SELECT → CHG → ENTER ↑ ↓ → OPtS → ENTER

This menu allows you to change options which relate to the instrument features and functionality. Table 4-7 lists all available options with their code names and applicable ranges.



To select an option:

✓ Press SELECT to activate the middle window, and then use the up/down arrow keys to scroll to the desired option.

To change the selected option:

✓ Press SELECT to activate the lower window.
✓ Use the up/down arrow keys to set the desired value.
✓ Press ENTER to store your new setting or ESC to leave the previous setting unchanged.

To quit the display setup menu:

✓ From the middle window, press ESC or ENTER.

Table 4-7 User Selectable Options (∗ default setting)

Code	Parameter	Options	Description
P.cAL	Power calculation mode①	*rEAc*∗ *nAct*	Using reactive power Using non-active power
thr.d	Thermal demand calculation	*diS*∗, *En*	Disables/enables thermal power demand measurement
roLL	Energy roll value ②	*10.E4* *10.E5* *10.E6* *10.E7* *10.E8* *10.E9*∗	10,000 kWh 100,000 kWh 1,000,000 kWh 10,000,000 kWh 100,000,000 kWh 1,000,000,000 kWh

Code	Parameter	Options	Description
An.Ou	Analog output option (see Section 4.5)	*nonE*∗	No analog output
		0-20	0-20 mA
		4-20	4-20 mA
		0-1	0-1 mA
		-1-1	±1 mA
An.EP	Analog expander option (see Section 4.6)	*nonE*∗	No analog expander (output disabled)
		0-20	0-20mA
		4-20	4-20mA
		0-1	0-1mA
		-1-1	±1 mA
bAtt	Battery mode	*OFF*∗*, On*	Switches the backup battery OFF/ON

① Power calculation mode (*P.cAL*):

Mode 1: Reactive power calculation (rEAc)

Active power P and reactive power Q are measured directly and apparent power $S = \sqrt{P^2 + Q^2}$

Mode 2: Non-active power calculation (nAct)

Active power is measured directly, apparent power $S = V \times I$ (where V, I - rms voltage and currents) and non-active power $N = \sqrt{S^2 - P^2}$

Mode 1 is recommended for electrical networks with low harmonic distortion (voltage THD < 5%, current THD < 10%); Mode 2 is recommended for all other cases.

② Energy roll value example: If roll value = 10.E4, the energy counter contains 4 digits, i.e., energy is displayed up to 9.999 MWh (Mvarh, MVAh) with resolution 0.001 MWh.

Rollover Value	Maximum Energy kWh (kvarh, kVAh)	Maximum Display Reading MWh (Mvarh, MVAh) *	Display Resolution MWh (Mvarh, MVAh) *
10.E4	9,999	9.999	0.001
10.E5	99,999	99.999	0.001
10.E6	999,999	999.999	0.001
10.E7	9,999,999	9,999.99	0.01
10.E8	99,999,999	99,999.9	0.1
10.E9	999,999,999	999,999	1

The roll value may be changed in accordance with the average load of the power line. For example, if average power is 400 kW and the counter must be reset every 3 months (2160 hours), then energy during this period equals 864000 kWh (6 digits) and the roll value = 10.E6.

* RDM096 display

4.12 Access Control Menu

SELECT ➔ CHG ➔ ENTER ↑ ↓ ➔ AccS ➔ ENTER

This menu can be only accessed via the *Setup Change Menu (CHG)*. It is used in order to:

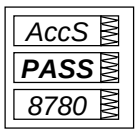
- change the user password
- enable or disable password check from the front panel keypad
- enable or disable password protection for downloading setups and resetting data through communications

To view an option setting:

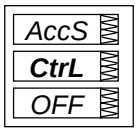
✓ Press SELECT to activate the middle window.

✓ Use the up/down arrow keys to scroll to the desired option (*PASS, CtrL, Port*).

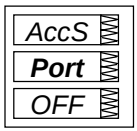
Password Setting



Password Protection for the keypad



Password Protection for communications



To change the password:

✓ Press SELECT to activate the lower window.

✓ Use the up/down arrow keys to modify the password. The password can be up to four digits long.

✓ Press ENTER to store your new password, or ESC to leave the password unchanged.

To enable/disable password checking:

✓ Press SELECT to activate the middle window, and then use the up/down arrow keys to move to the ***CtrL*** or ***Port*** entry.

✓ Press SELECT to activate the lower window.

✓ Use the up/down arrow keys to change the password checking status: select ***OFF*** to disable password protection, or select ***On*** to enable password protection.

✓ Press ENTER to store your new option, or ESC to leave the option unchanged.

To quit the setup menu:

✓ From the middle window, press ESC or ENTER.

Store your password in a safe place. If you do not provide the correct password, you will need to contact your local distributor for the super-user password to override password protection.

4.13 Reset Menu

SELECT ➔ CHG ➔ ENTER ↑ ↓ ➔ rSt ➔ ENTER

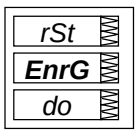
This menu allows you to reset to zero the accumulators and Min/Max registers in your instrument. The menu can be only accessed via the *Setup Change Menu (CHG)*. If the reset is disabled from the *Basic Setup Menu* (see Section 4.1), you will not be able to enter this menu.

The following designations are used in the menu to specify a data location to be reset:

A.dnd	Resets volt/ampere maximum demands
P.dnd	Resets total power maximum demands
dnd	Resets all total maximum demands
EnrG	Resets total energies
Lo.Hi	Resets Min/Max registers (does not affect maximum demands)
tOU.E	Resets the TOU energy registers
tOU.d	Resets the TOU maximum demand registers
Cnt	Resets all pulse counters
Cnt.1 - Cn.16	Resets counter # 1- #16

To reset the desired locations:

✓ Press SELECT to activate the middle window, and then use the up/down arrow keys to scroll to the desired data location entry.



✓ Press SELECT to activate the lower window.
✓ Press and hold ENTER for about 5 seconds until the ***do*** label is replaced with ***done***, and then release the key. You will return to the middle window.

To quit the reset menu:

✓ Press ESC.

NOTE

If changing data in the instrument via the front panel is not secured by a password, the fast reset of the Min/Max registers, maximum demands and total energies can be made from the data display mode (see Section 5.1) and counters from the Status Information Menu (see Section 6.1) without entering the reset menu.

Chapter 5 Data Display

5.1 Navigating in the Display Mode

The front panel has a simple interface that allows you to display numerous measurement parameters. For easier reading, the parameters are divided into groups, each accessible by a designated key. These are:

PM296

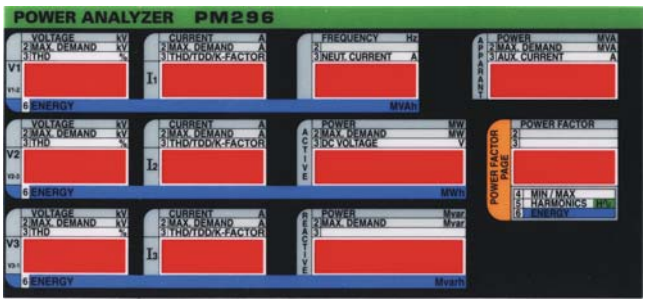
- **Common measurements** - Page 1. Main screen (no selection key)
- **Max demand measurements** - Page 2. Main screen (no selection key)
- **Min/Max measurements** - Page 4. Selected by the **MIN/MAX** key
- **Total Harmonic measurements** - Page 3. Main screen (no selection key)
- **Individual Harmonic measurements** - Page 5. Selected by the **H/ESC** key
- **Energy measurements** - Page 6. Selected by the **ENERGY** key

RDM096

- **Common measurements** - Main screen (no selection key)
- **Max demand measurements** - selected by the **MIN/MAX** key
- **Min/Max measurements** - selected by the **MIN/MAX** key
- **Total Harmonic measurements** - selected by the **H/ESC** key
- **Individual Harmonic measurements** - selected by the **H/ESC** key
- **Energy measurements** - selected by the **ENERGY** key

The up/down arrow keys are used as follows in the *Display Mode*:

- ↓ Scrolls through the pages downward (forward)
- ↑ Scrolls through the pages upward (backward)
- ↑ ↓ Returns to the first page within current measurement group



The display is updated approximately twice per second; you can adjust the display update rate via the *Display Setup Menu* (see Section 4.10).

Tables 5-1 and 5-2 list all displayed parameters and their LED indicators for the PM296 front panel display and RDM096 remote display module.

Auto Scroll

If display Auto Scroll option is enabled (see Section 4.10), the common measurements display (main screen) will scroll automatically after 30 seconds of uninterrupted use.

✓ To stop auto scrolling at the current page, press either arrow key.

Auto Return to the Main Screen

If display Auto Return option is enabled (see Section 4.10), the display will automatically return to the main screen from any other measurement screen after 30 seconds of uninterrupted use.

Fast Reset of Accumulated Data

When changing data via the front panel is not secured by a password, you can reset the Min/Max registers, maximum demands and total energies from the display mode without entering the reset menu.

NOTES

1. In the PM296, a page number at the right of the display identifies the current measurements group. The common measurements display (main screen) is designated by a page number of 1 through 3. The first display in this group shows a power factor reading instead of a page number. To return to the common measurements from another group, just press the same key that you used to display this group.
2. In the RDM096, a designated indicator LED below the display shows the current measurements group. The common measurements display (main screen) does not have an indicator LED. If no arrow LED is lit up below the display, this means that the common measurement parameters are being displayed at this time. To return to the common measurements from another group, just press the same key that you used to display this group (the key pointed to by an illuminated arrow LED) until the illuminated LED goes out.
3. When you move to another measurement group, the instrument stores your last location; when you return to the previous group, the instrument restores the last page. At power up, the instrument always returns to the common measurements group and shows you the last page that was displayed prior to loss of power.

Selecting a Display Page

✓ Press the down/up arrow keys to scroll through display pages.

Selecting Common Measurements (Main Screen)

✓ In the RDM096, press the key pointed to by the illuminated arrow LED below the front panel display. If no LED is lit up, this means that the front panel displays the common measurements parameters.

Selecting Max Demand Measurements

✓ In the RDM096, press the **MIN/MAX** key. Use the up/down arrow keys to scroll through Max demand measurements.

Selecting Min/Max Measurements

✓ Press the **MIN/MAX** key. Use the up/down arrow keys to scroll through Min/Max measurements.

Selecting Total Harmonic Measurements

✓ In the RDM096, press the **H/ESC** key until the THD/TDD LED is illuminated. Use the up/down arrow keys to scroll through harmonic measurements.

Selecting Individual Voltage and Current Harmonics Measurements

✓ In the PM296, press the **H/ESC** key until a styled % character is displayed in the FREQUENCY window. Harmonic numbers are shown in the upper-right window. Use the up/down arrow keys to scroll through the different harmonics readings.

✓ In the RDM096, press the **H/ESC** key until the HARMONICS LED is illuminated and volts or amps LEDs at the right are lit while a harmonic number is shown at the left in the lower window. Use the up/down arrow keys to scroll through the different harmonics readings.

Selecting Individual Harmonic Voltage, Current and Power Measurements

✓ In the PM296, press the **H/ESC** key until the *Unit* label is displayed in the FREQUENCY window. Harmonic numbers are shown in the upper-right window. Use the up/down arrow keys to scroll through the different harmonics readings.

✓ In the RDM096, press the **H/ESC** key until the HARMONICS LED is illuminated and volts, amps or PF&kW LEDs at the right are lit while a harmonic number is shown in the upper window. Use the up/down arrow keys to scroll through the different harmonics readings.

Selecting Energy Measurements

✓ Press the **ENERGY** key. Use the up/down arrow keys to scroll through the different energy readings.

Selecting TOU Energy Registers

✓ Press the **ENERGY** key until the REG.1 label appears in the upper window (upper-right window in the PM296). Use the up/down arrow keys to scroll through the different tariff readings for the selected register. Use the **ENERGY** key to scroll through all TOU registers. Note that only registers you have allocated will be displayed.

Fast Reset of Accumulated Data

✓ Select a display page where the data you want to reset is displayed. To reset:

- Min/Max log registers: select a Min/Max page from the Min/Max measurements display (where Lo or Hi is displayed in the PAGE window in the PM296 or at the left in the lower window in the RDM096).
- Ampere and volt maximum demands: select the maximum demands page in the PM296, or select the ampere or volt maximum demand page from the Min/Max measurements display in the RDM096 (where Hd is displayed at the left in the lower window, and volts or amps arrow LEDs at the right are lit).
- Power maximum demands in the RDM096: select the power maximum demand page from the Min/Max measurements display (where Hd is displayed at the left in the lower window, and kVA/MVA and kW/MW arrow LEDs at the right are lit).
- Total and phase energies: select the energy measurements display (not a TOU register).

✓ While holding the SELECT key, press and hold ENTER for about 5 seconds. The displayed data is reset to zero.

5.2 Data Display Formats

Tables 5-1 and 5-2 specify all front panel local displays available in the *display mode*.

The PM296 Data Display

The display windows are labeled in the table in the direction up-to-down and left-to-right as shown in the following picture.

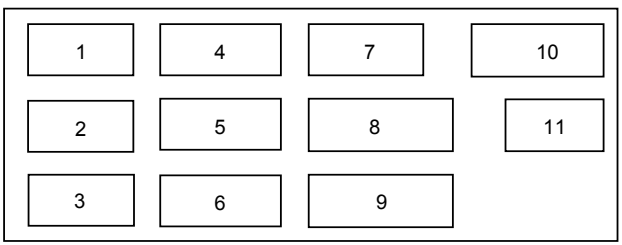


Table 5-1 Displayed Parameters for the PM296

Page	Window	PAGE LEDs	Parameter ①	Digits	Unit ②
			Common Measurements		
1	1		Voltage L1/L12 ⑦	4	V/kV
1	2		Voltage L2/L23 ⑦	4	V/kV
1	3		Voltage L3/L31 ⑦	4	V/kV
1	4		Current L1	4	A
1	5		Current L2	4	A
1	6		Current L3	4	A
1	7		Frequency	4	Hz
1	8		Total kW	5	kW/MW

Page	Window	PAGE LEDs	Parameter ①	Digits	Unit ②
1	9		Total kvar	5	kvar/Mvar
1	10		Total kVA	5	kVA/MVA
1	11		Total power factor	4	
2	11	**PAG.1**			Label
2	7		**L-L**		Label
2	1		Voltage L12 ⑧	4	V/kV
2	2		Voltage L23 ⑧	4	V/kV
2	3		Voltage L31 ⑧	4	V/kV
3	7		**Ph.L1** ⑤		Label
3	1		Voltage L1/L12 ⑦	4	V/kV
3	4		Current L1	4	A
3	8		kW L1	5	kW/MW
3	9		kvar L1	5	kvar/Mvar
3	10		kVA L1	5	kVA/MVA
3	11		Power factor L1	4	
4	7		**Ph.L2** ⑤		Label
4	2		Voltage L2/L23 ⑦	4	V/kV
4	5		Current L2	4	A
4	8		kW L1	5	kW/MW
4	9		kvar L2	5	kvar/Mvar
4	10		kVA L2	5	kVA/MVA
4	11		Power factor L2	4	
5	7		**Ph.L3** ⑤		Label
5	3		Voltage L3/L31 ⑦	4	V/kV
5	6		Current L3	4	A
5	8		kW L3	5	kW/MW
5	9		kvar L3	5	kvar/Mvar
5	10		kVA L3	5	kVA/MVA
5	11		Power factor L3	4	
Maximum Demand Measurements					
6	11	**PAG.2**			Label
6	1		Maximum volt demand L1/L12 ⑦	4	V/kV
6	2		Maximum volt demand L2/L23 ⑦	4	V/kV
6	3		Maximum volt demand L3/L31 ⑦	4	V/kV
6	4		Maximum ampere demand L1	4	A/kA
6	5		Maximum ampere demand L2	4	A/kA
6	6		Maximum ampere demand L3	4	A/kA
6	8		Maximum sliding window kW import demand	5	kW/MW
6	9		Maximum sliding window kvar import demand	5	kvar/Mvar
6	10		Maximum sliding window kVA demand	5	kVA/MVA
Total Harmonic and Auxiliary Measurements					
7	11	**PAG.3**			Label
7	1		Voltage THD L1/L12 ⑥	4	%
7	2		Voltage THD L2/L23 ⑥	4	%

Page	Window	PAGE LEDs	Parameter ①	Digits	Unit ②
7	3		Voltage THD L3	4	%
7	4		Current THD L1	4	%
7	5		Current THD L2	4	%
7	6		Current THD L3	4	%
7	7		Neutral current	4	A
7	8		DC voltage	5	V
7	10		Auxiliary current I4	5	A/mA
8	11	**PAG.3**			Label
8	7		**tdd**		Label
8	4		Current TDD L1	4	%
8	5		Current TDD L2	4	%
8	6		Current TDD L3	4	%
9	11	**PAG.3**			Label
9	7		**H-Fc.**		Label
9	4		Current K-Factor L1	4	
9	5		Current K-Factor L2	4	
9	6		Current K-Factor L3	4	
10	7		**U. Unb.**		Label
10	4		Voltage unbalance	4	%
10	8		**C. Unb.**		Label
10	5		Current unbalance	4	%
11	10	④	**H01** (Fundamental harmonic)		Label
11	1		Fund. Harmonic voltage L1/L12	4	V/kV
11	2		Fund. Harmonic voltage L2/L31	4	V/kV
11	3		Fund. Harmonic voltage L3	4	V/kV
11	4		Fund. Harmonic current L1	4	A
11	5		Fund. Harmonic current L2	4	A
11	6		Fund. Harmonic current L3	4	A
11	8		Fund. Harmonic total kW	5	kW/MW
11	9		Fund. Harmonic total kvar	5	kvar/Mvar
11	11		Fund. Harmonic total PF	4	kW/MW
			Min/Max Measurements		
	11	**Lo. 4**			Label
1	1		Minimum voltage L1/L12 ⑦	4	V/kV
1	2		Minimum voltage L2/L23 ⑦	4	V/kV
1	3		Minimum voltage L3/L31 ⑦	4	V/kV
1	4		Minimum current L1	4	A
1	5		Minimum current L2	4	A
1	6		Minimum current L3	4	A
1	7		Minimum frequency	4	Hz
1	8		Minimum total kW	5	kW/MW
1	9		Minimum total kvar	5	kvar/Mvar
1	10		Minimum total kVA	5	kVA/MVA
	11	**Hi. 4**			Label
2	1		Maximum voltage L1/L12 ⑦	4	V/kV
2	2		Maximum voltage L2/L23 ⑦	4	V/kV
2	3		Maximum voltage L3/L31 ⑦	4	V/kV

Page	Window	PAGE LEDs	Parameter ①	Digits	Unit ②
2	4		Maximum current L1	4	A
2	5		Maximum current L2	4	A
2	6		Maximum current L3	4	A
2	7		Maximum frequency	4	Hz
2	8		Maximum total kW	5	kW/MW
2	9		Maximum total kvar	5	kvar/Mvar
2	10		Maximum total kVA	5	kVA/MVA
Individual Odd Voltage and Current Harmonics H03-H39					
	11	**PAG. 5**			Label
	7		**%**		Label
1	10		**H03**		Label
1	1		Voltage harmonic H03 L1/L12 ⑥	4	%
1	2		Voltage harmonic H03 L2/L23 ⑥	4	%
1	3		Voltage harmonic H03 L3	4	%
1	4		Current harmonic H03 L1	4	%
1	5		Current harmonic H03 L2	4	%
1	6		Current harmonic H03 L3	4	%
			...		
	7		**%**		Label
20	10		**H39**		Label
20	1		Voltage harmonic H39 L1/L12 ⑥	4	%
20	2		Voltage harmonic H39 L2/L23 ⑥	4	%
20	3		Voltage harmonic H39 L3	4	%
20	4		Current harmonic H39 L1	4	%
20	5		Current harmonic H39 L2	4	%
20	6		Current harmonic H39 L3	4	%
Individual Odd Harmonic Values H03-H39					
	7		**Unit**		Label
1	10		**H03**		Label
1	1		Harmonic H03 voltage L1/L12 ⑥	4	V/kV
1	2		Harmonic H03 voltage L2/L23 ⑥	4	V/kV
1	3		Harmonic H03 voltage L3	4	V/kV
1	4		Harmonic H03 current L1	4	A
1	5		Harmonic H03 current L2	4	A
1	6		Harmonic H03 current L3	4	A
1	8		Harmonic H03 total kW	5	kW/MW
1	9		Harmonic H03 total kvar	5	kvar/Mvar
1	11		Harmonic H03 total power factor	4	
			...		
	7		**Unit**		Label
20	10		**H39**		Label
20	1		Harmonic H39 voltage L1/L12 ⑥	4	V/kV
20	2		Harmonic H39 voltage L2/L23 ⑥	4	V/kV
20	3		Harmonic H39 voltage L3	4	V/kV
20	4		Harmonic H39 current L1	4	A
20	5		Harmonic H39 current L2	4	A
20	6		Harmonic H39 current L3	4	A

Page	Window	PAGE LEDs	Parameter ①	Digits	Unit ②
20	8		Harmonic H39 total kW	5	kW/MW
20	9		Harmonic H39 total kvar	5	kvar/Mvar
20	11		Harmonic H39 total power factor	4	
			Total Energies		
	11	**PAG. 6**			Label
1	1,4,7		MVAh	9	MVAh
1	2		**IP.**		Label
1	5,8		MWh import	9	MWh
1	3		**IP.**		Label
1	6,9		Mvarh import	9	Mvarh
2	2		**EP.**		Label
2	5,8		MWh export	9	MWh
2	3		**EP.**		Label
2	6,9		Mvarh export	9	Mvarh
3	2		**U-h**		Label
3	5,8		Volt-hours	9	kV-h
3	3		**A-h**		Label
3	6,9		Ampere-hours	9	kA-h
			TOU Energy Registers		
1-16	10		**trF.1 - tF.16**		Label
1-16	11		**rEG.1 - rG.16**		Label
1-16	2,5,8		Tariff register reading	9	⑨

① Display readings for all electrical quantities except Min/Max log and energies are sliding average values.

② When using direct wiring (PT Ratio = 1), voltages are displayed in 0.1 V units, currents in 0.01 A units, and powers in 0.001 kW/kvar/kVA units. For wiring via PTs (PT Ratio > 1), voltages are displayed in 1V units, currents in 0.01 A units, and powers in 0.001 MW/Mvar/MVA units. When the value width is over the window resolution, the right most digits are truncated

③ By default, the maximum range for energy readings is 999,999,999 MWh/Mvarh/MVAh. Beyond this value, the reading will roll over to zero. You can change the energy roll value to lower limit via the *User Selectable Options* menu (see Section 4.11).Negative (exported) energy readings are displayed without a sign.

④ Fundamental values are displayed if they are enabled in the *Display Setup* menu (see Section 4.10).

⑤ Per phase power and power factor readings are displayed only in 4LN3/4LL3 and 3LN3/3LL3 wiring modes (see Section 4.1) if the phase power display is enabled in the *Display Setup* menu (see Section 4.10).

⑥ Phase voltage harmonics will be line-to-line in 3OP2 and 3OP3 wiring modes, and line-to-neutral in any other wiring mode.

⑦ When the 4LN3 or 3LN3 wiring mode is selected, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages.

⑧ Displayed only in the 4LN3 or 3LN3 wiring mode.

⑨ TOU energy readings are displayed in MWh/Mvarh/MVAh according to energy input assigned to the register.

The RDM096 Data Display

The display windows are labeled in the table as follows: 1 = upper window, 2 = middle window, 3 = lower window.

Table 5-2 Displayed Parameters for the RDM096

Page	Window	Arrow LED	Parameter ①	Digits	Unit ②
			Common Measurements		
1	1	**V1/V1-2**	Voltage L12	4	V/kV
1	2	**V2/V2-3**	Voltage L23	4	V/kV
1	3	**V3/V3-1**	**L.** Voltage L31	4	V/kV
2	1	**V1/V1-2**	Voltage L1 ⑧	4	V/kV
2	2	**V2/V2-3**	Voltage L2 ⑧	4	V/kV
2	3	**V3/V3-1**	**P.** Voltage L3 ⑧	4	V/kV
3	1	**A1**	Current L1	4	A
3	2	**A2**	Current L2	4	A
3	3	**A3**	Current L3	4	A
4	1	**kVA**	Total kVA	4	kVA/MVA
4	2	**PF**	Total power factor	4	
4	3	**kW**	Total kW	4	kW/MW
5	1	**A NEUT**	Neutral current	4	A
5	2	**Hz**	Frequency	4	Hz
5	3	**kvar**	Total kvar	4	kvar/Mvar
6	1		**Au. C.**		Label
6	3	**A3**	Auxiliary current I4	4	A/mA
7	1		**U. dC.**		Label
7	3	**V3**	DC voltage	4	V
8	1		**U. Unb.**		Label
8	3		Voltage unbalance	4	%
9	1		**C. Unb.**		Label
9	3		Current unbalance	4	%
10	1		**Ph.L1** ⑤		Label
10	2	**PF**	Power factor L1	4	
11	3	**kW**	kW L1	4	kW/MW
12	1	**kVA**	kVA L1	4	kVA/MVA
12	2		**Ph.L1** ⑤		Label
12	3	**kvar**	kvar L1	4	kvar/Mvar
13	1		**Ph.L2** ⑤		Label
13	2	**PF**	Power factor L2	4	
13	3	**kW**	kW L2	4	kW/MW
14	1	**kVA**	kVA L2	4	kVA/MVA
14	2		**Ph.L2** ⑤		Label
14	3	**kvar**	kvar L2	4	kvar/Mvar
15	1		**Ph.L3** ⑤		Label
15	2	**PF**	Power factor L3	4	
15	3	**kW**	kW L3	4	kW/MW
16	1	**kVA**	kVA L3	4	kVA/MVA
16	2		**Ph.L3** ⑤		Label
16	3	**kvar**	kvar L3	4	kvar/Mvar

Page	Window	Arrow LED	Parameter ①	Digits	Unit ②
17	1		**01H** (Fundamental harmonic) ④		Label
17	2	**PF**	H01 total power factor	4	
17	3	**kW**	H01 total kW	4	kW/MW
18	1	**V1/V1-2**	Fund. Harmonic voltage L1/L12 ④	4	V/kV
18	2	**V2/V2-3**	Fund. Harmonic voltage L2/L31 ④	4	V/kV
18	3	**V3/V3-1**	**1H** Fund. Harmonic voltage L3 ④	4	V/kV
19	1	**A1**	Fund. Harmonic current L1 ④	4	A
19	2	**A2**	Fund. Harmonic current L2 ④	4	A
19	3	**A3**	**1H** Fund. Harmonic current L3 ④	4	A
		MIN/MAX	**Maximum Demand Measurements**		
	3		**Hd**		Label
9	1	**V1**	Maximum volt demand L1/L12 ⑦	4	V/kV
9	2	**V2**	Maximum volt demand L2/L23 ⑦	4	V/kV
9	3	**V3**	Maximum volt demand L3/L31 ⑦	4	V/kV
10	1	**A1**	Maximum ampere demand L1	4	A/kA
10	2	**A2**	Maximum ampere demand L2	4	A/kA
10	3	**A3**	Maximum ampere demand L3	4	A/kA
11	1	**kVA**	Maximum sliding window kVA demand	4	kVA/MVA
11	2	**PF**	Power factor (import) at maximum kVA demand	4	
11	3	**kW**	Maximum sliding window kW import demand	4	kW/MW
		MIN/MAX	**Min/Max Measurements**		
	3		**Lo**		Label
1	1	**V1/V1-2**	Minimum voltage L1/L12 ⑦	4	V/kV
1	2	**V2/V2-3**	Minimum voltage L2/L23 ⑦	4	V/kV
1	3	**V3/V3-1**	Minimum voltage L3/L31 ⑦	4	V/kV
2	1	**A1**	Minimum current L1	4	A
2	2	**A2**	Minimum current L2	4	A
2	3	**A3**	Minimum current L3	4	A
3	1	**kVA**	Minimum total kVA	4	kVA/MVA
3	2	**PF**	Minimum total power factor	4	
3	3	**kW**	Minimum total kW	4	kW/MW
4	1	**A NEUT**	Minimum neutral current	4	A
4	2	**Hz**	Minimum frequency	4	Hz
4	3	**kvar**	Minimum total kvar	4	kvar/Mvar
	3		**Hi**		Label
5	1	**V1/V1-2**	Maximum voltage L1/L12 ⑦	4	V/kV
5	2	**V2/V2-3**	Maximum voltage L2/L23 ⑦	4	V/kV
5	3	**V3/V3-1**	Maximum voltage L3/L31 ⑦	4	V/kV
6	1	**A1**	Maximum current L1	4	A
6	2	**A2**	Maximum current L2	4	A
6	3	**A3**	Maximum current L3	4	A
7	1	**kVA**	Maximum total kVA	4	kVA/MVA
7	2	**PF**	Maximum total power factor	4	
7	3	**kW**	Maximum total kW	4	kW/MW

Page	Window	Arrow LED	Parameter ①	Digits	Unit ②
8	1	**A NEUT**	Maximum neutral current	4	A
8	2	**Hz**	Maximum frequency	4	Hz
8	3	**kvar**	Maximum total kvar	4	kvar/Mvar
			Total Harmonic Measurements		
		THD/TDD			
1	1	**V1/V1-2**	Voltage THD L1/L12 ⑥	4	%
1	2	**V2/V2-3**	Voltage THD L2/L23 ⑥	4	%
1	3	**V3/V3-1**	**thd.** Voltage THD L3	4	%
2	1	**A1**	Current THD L1	4	%
2	2	**A2**	Current THD L2	4	%
2	3	**A3**	**thd.** Current THD L3	4	%
3	1	**A1**	Current TDD L1	4	%
3	2	**A2**	Current TDD L2	4	%
3	3	**A3**	**tdd.** Current TDD L3	4	%
4	1	**A1**	Current K-Factor L1	4	
4	2	**A2**	Current K-Factor L2	4	
4	3	**A3**	**HF** Current K-Factor L3	4	
			Individual Odd Voltage Harmonics H03-H39		
		HARMONICS			
1	1	**V1/V1-2**	Voltage harmonic H03 L1/L12 ⑥	4	%
1	2	**V2/V2-3**	Voltage harmonic H03 L2/L23 ⑥	4	%
1	3	**V3/V3-1**	**03H** Voltage harmonic H03 L3	4	%
			...		
20	1	**V1/V1-2**	Voltage harmonic H39 L1/L12	4	%
20	2	**V2/V2-3**	Voltage harmonic H39 L2/L23	4	%
20	3	**V3/V3-1**	**39H** Voltage harmonic H39 L3	4	%
			Individual Odd Current Harmonics H03-H39		
		HARMONICS			
1	1	**A1**	Current harmonic H03 L1	4	%
1	2	**A2**	Current harmonic H03 L2	4	%
1	3	**A3**	**03H** Current harmonic H03 L3	4	%
			...		
20	1	**A1**	Current harmonic H39 L1	4	%
20	2	**A2**	Current harmonic H39 L2	4	%
20	3	**A3**	**39H** Current harmonic H39 L3	4	%
			Individual Odd Power Harmonics H03-H39		
		HARMONICS			
1	1		**03H**		Label
1	2	**PF**	Harmonic H03 total power factor	4	
1	3	**kW**	Harmonic H03 total kW	4	kW/MW
			...		
20	1		**39H**		Label
20	2	**PF**	Harmonic H39 total power factor	4	
20	3	**kW**	Harmonic H39 total kW	4	kW/MW
			Total Energies		
1	1	**MWh**	**Ac.En.**		Label
1	2		**IP.**		Label

Page	Window	Arrow LED	Parameter ①	Digits	Unit ②
1	3		MWh import	6	MWh
2	1	**Mvarh**	**rE.En.**		Label
2	2		**IP.**		Label
2	3		Mvarh import	6	Mvarh
3	1	**MVAh**	**AP.En.**		Label
3	3		MVAh	6	MVAh
4	1	**MWh**	**Ac.En.**		Label
4	2		**EP.**		Label
4	3		MWh export	6	MWh
5	1	**Mvarh**	**rE.En.**		Label
5	2		**EP.**		Label
5	3		Mvarh export	6	Mvarh
6	1		**U-h**		Label
6	3		Volt-hours	6	kV-h
7	1		**A-h**		Label
7	3		Ampere-hours	6	kA-h
TOU Energy Registers					
1-16	1	**MWh/**	**rEG.1 - rG.16**		Label
1-16	2	**Mvarh/**	**trF.1 - tF.16**		Label
1-16	3	**MVAh**	Tariff register reading	6	⑨

① Display readings for all electrical quantities except Min/Max log and energies are sliding average values.

② When using direct wiring (PT Ratio = 1), voltages are displayed in 0.1 V units, currents in 0.01 A units, and powers in 0.001 kW/kvar/kVA units. For wiring via PTs (PT Ratio > 1), voltages are displayed in 1V units, currents in 0.01 A units, and powers in 0.001 MW/Mvar/MVA units. When the value width is over the window resolution, the right most digits are truncated

③ By default, the maximum range for energy readings is 999,999,999 MWh/Mvarh/MVAh. Beyond this value, the reading will roll over to zero. When the energy reading exceeds the window resolution, the right-most digits are truncated. To avoid truncation, you can change the energy roll value to lower limit via the *User Selectable Options* menu (see Section 4.11). Negative (exported) energy readings are displayed without a sign.

④ Fundamental values are displayed if they are enabled in the *Display Setup* menu (see Section 4.10).

⑤ Per phase power and power factor readings are displayed only in 4LN3/4LL3 and 3LN3/3LL3 wiring modes (see Section 4.1) if the phase power display is enabled in the *Display Setup* menu (see Section 4.10).

⑥ Phase voltage harmonics will be line-to-line in 3OP2 and 3OP3 wiring modes, and line-to-neutral in any other wiring mode.

⑦ When the 4LN3 or 3LN3 wiring mode is selected, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages.

⑧ Displayed only in the 4LN3 or 3LN3 wiring mode.

⑨ TOU energy readings are displayed in MWh/Mvarh/MVAh according to energy input assigned to the register. A corresponding arrow LED will be lit showing energy units when a register reading is displayed. If a TOU register counts external pulses, the MWh LED will be lit.

5.3 Self-Test Diagnostics Display

The *PM296/RPM096* periodically performs self-test diagnostics during operation. If the instrument fails the test, it discards the last measurement results, and an error code is displayed for one second on all LEDs. Error codes are listed in Table 5-2. Frequent failures may be the result of excessive electrical noise in the region of the instrument. If the instrument resets itself continuously, contact your local distributor.

Table 5-2 Self-Test Diagnostic Codes

Code	Meaning	Code	Meaning
1	ROM error	5	Out of control trap
2	RAM error	7	Timing failure
3	Watch dog timer reset	8	Normal power up
4	Sampling failure	9	External reset (warm restart)

NOTE

The PM296/RPM096 provides a self-check alarm register accessible through communications that indicates possible problems with instrument hardware or setup configuration. The hardware problems are indicated by the appropriate bits, which are set whenever the instrument fails self-test diagnostics, or in the event of loss of power. The setup configuration problems are indicated by the dedicated bit which is set when either configuration register is corrupted. In this event, your instrument will use the default configuration. For more information on the self-check alarm register, refer to the communications reference guides shipped with your instrument.

Chapter 6 Viewing Status Information

Through the *Status Information Menu (STA)*, it is possible to view the status of various instrument features.

6.1 The Status Information Menu

SELECT ➔ *StA* ➔ ENTER

***To enter the Status Information Menu*:**

- ✓ From the display mode, press SELECT to enter the *Primary Selection Menu*.
- ✓ Press SELECT to activate the ***StA*** window.
- ✓ Press ENTER

To select a display page:

- ✓ Press the up/down arrow keys to scroll through the display pages.

To quit the menu and return to the display mode:

- ✓ Press ESC or ENTER

Front Panel Display

When you are in the *Status Information Menu*, the front panel display is updated approximately four times per second and shows you a wide variety of status information that you can review by scrolling through display pages.

The status parameters are designated by the abbreviated labels in the upper and/or middle window. The upper window flashes, indicating that you are in the menu display.

Fast Reset of Counters

When changing data via the front panel is not secured by a password, you can reset the counters from the *Status Information Menu* display without entering the reset menu:

- ✓ Select a display page where the counter you want to reset is displayed.
- ✓ While holding the SELECT key, press and hold ENTER for about 5 seconds. The displayed data is reset to zero.

6.2 Status Display Formats

Tables 6-1 and 6-2 list all the displays available from the *Status Information Menu*.

The PM296 Status Display

The display windows are labeled in the table in the direction up-to-down and left-to-right.

Table 6-1 Status Information Display for the PM296

Page	Window	Parameter	Digits	Unit
1	4	**PHAS.**		Label
1	5	**rOt.**		Label
1	6	Phase rotation (POS/NEG/ERR)	4	
2	4	**AnGL**		Label
2	1	Phase L1/L12 angle	4	Degree
2	2	Phase L2/L23 angle	4	Degree
2	3	Phase L3/L31 angle	4	Degree
3	1	**rEL.**		Label
3	2,5	**1.2.3.4.5.6.**		Label
3	4,6	Relay #1-6 status	6	
4	1	**St.In**		Label
4	3,6,9	**1.2.3.4.5.6.7.8.9.A.b.C**		Label
4	3,6,9	Status inputs #1-#12	4	
7	1	**Cnt.1**		Label
7	3	Counter #1	6	
		. . .		
22	1	**Cn.16**		Label
22	3	Counter #16	6	
23	1	**bAtt**		Label
23	3	The battery status (NORMAL/LOW)		

The RDM096 Status Display

The display windows are labeled in the table as follows: 1 = upper window, 2 = middle window, 3 = lower window.

Table 6-2 Status Information Display for the RDM096

Page	Window	Parameter	Digits	Unit
1	1	**PHAS.**		Label
1	2	**rOt.**		Label
1	3	Phase rotation (POS/NEG/ERR)	4	
2	1	**rEL.**		Label
2	2	**1.2.3.4**		Label
2	3	Relay #1-4 status	4	

Page	Window	Parameter	Digits	Unit
3	1	**rEL.**		Label
3	2	**5.6.**		Label
3	3	Relay #5-6 status	2	
4	1	**St.In**		Label
4	2	**1.2.3.4**		Label
4	3	Status inputs #1-#4	4	
5	1	**St.In**		Label
5	2	**5.6.7.8**		Label
5	3	Status inputs #5-#8	4	
6	1	**St.In**		Label
6	2	**9.a.b.C**		Label
6	3	Status inputs #9-#12	4	
7	1	**Cnt.1**		Label
7	3	Counter #1	6	
		. . .		
22	1	**Cn.16**		Label
22	3	Counter #16	6	
23	1	**bAtt**		Label
23	3	The battery status (NORMAL/LOW)		

Chapter 7 Communications

A full description of the communications software is found in the *PM296/RPM096 ASCII, Modbus* and *DNP 3.0 Communications Manuals* provided on electronic media.

7.1 Using a Printer

7.1.1 Configuring the Port for Printer

Set the printer mode and desired printout period in the communications port setup (see Section 4.2). The baud rate and data format should be configured as those on the printer.

Cable connections to the printer are shown in *Figures 7-2* through *7-5*.

Most printers provide a few bytes of buffer storage where characters can queue for printing. If the buffer size is sufficient to accept full print report, i.e., when a printer has at least 256 bytes of input buffer, flow control is not needed. If the buffer size is less than 256 bytes, you should provide hardware handshaking, otherwise the printer output will become garbled. Use the DSR/CTS signal to provide hardware flow control. Set the handshaking parameter to *HArd* in the communications port setup. It is possible to use a parallel printer as well with a serial-to-parallel converter. When a converter is used, hardware handshaking is required.

7.1.2 Printout Format

Your instrument prints a fixed format report at user-defined intervals. After resetting the instrument or completing the current page, the record heading is printed on the top of the new page. 14 data records are printed on each page provided with date and time stamps. The record format is shown in the following illustration and detailed in Table 7-1. The date format is user-selectable (see Section 4.10).

13:15:45 08-Feb-99

kV1	kV2	kV3	A1	A2	A3	MW	Mvar	MVA	PF
THDU1	THDU2	THDU3	THDI1	THDI2	THDI3	Hz	A_NEU	U_UNB	I_UNB
A1_MD	A2_MD	A3_MD	MW_MD	MVA_MD	+MWh	-MWh	+Mvarh	-Mvarh	MVAh

Table 7-1 Printout Record Parameters

Line	Place	Heading	Parameter ①	Digits	Unit ③
1	1	**V1/kV1**	Voltage L1/L12	5	V/kV
1	2	**V2/kV2**	Voltage L2/L23	5	V/kV
1	3	**V2/kV3**	Voltage L3/L31	5	V/kV
1	4	**A1**	Current L1	5	A
1	5	**A2**	Current L2	5	A
1	6	**A3**	Current L3	5	A
1	7	**kW/MW**	Total kW	6	kW/MW
1	8	**kvar/Mvar**	Total kvar	6	kvar/Mvar
1	9	**kVA/MVA**	Total kVA	6	kVA/MVA
1	10	**PF**	Total power factor	6	
2	1	**THDU1**	Voltage THD L1/L12	5	%
2	2	**THDU2**	Voltage THD L2/L23	5	%
2	3	**THDU3**	Voltage THD L3	5	%
2	4	**THDI1**	Current THD L1	5	%
2	5	**THDI2**	Current THD L2	5	%
2	6	**THDI3**	Current THD L3	5	%
2	7	**Hz**	Frequency	5	Hz
2	8	**A_NEU**	Neutral current	5	A
2	9	**U_UNB**	Voltage unbalance	5	%
2	10	**I_UNB**	Current unbalance	5	%
3	1	**A1_MD**	Maximum ampere demand L1	5	A
3	2	**A2_MD**	Maximum ampere demand L2	5	A
3	3	**A3_MD**	Maximum ampere demand L3	5	A
3	4	**kW_MD/ MW_MD**	Maximum sliding window kW import demand	6	kW/MW
3	5	**kVA_MD/ MVA_MD**	Maximum sliding window kVA demand	6	kVA/MVA
3	6	**+MWh**	MWh import	7	MWh
3	7	**-MWh**	MWh export ②	7	MWh
3	8	**+Mvarh**	Mvarh import	7	Mvarh
3	9	**-Mvarh**	Mvarh export ②	7	Mvarh
3	10	**MVAh**	MVAh	7	MVAh

① Readings for all electrical quantities except of energies are sliding average values. When the value width is over the field resolution, the right most digits are truncated.

② Negative (exported) energy readings are printed without a sign.

③ When using direct wiring (PT Ratio = 1), voltages are displayed in 0.1 V units, currents in 0.01 A units, an powers in 0.001 kW/kvar/kVA units. For wiring via PTs (PT Ratio > 1), voltages are displayed in 1V units, currents in 0.01 A units, and powers in 0.001 MW/Mvar/MVA units. When the value width is over the window resolution, the right most digits are truncated.

7.2 Connections

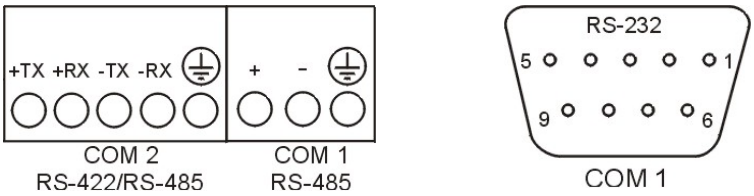


Figure 7-1 RS-232 and RS-422/RS-485 Terminal Blocks

RS-232 - up to 15 meters distance, 1 PC/PLC/Printer to 1 *PM296/RPM096,* by flat or twisted pair cable of 0.33mm^2/22AWG

RS-422, RS-485 - up to1200 meters distance, up to 32 instruments on 1 multi-drop line

Printer Connections for RS-232 only: ***COM1***

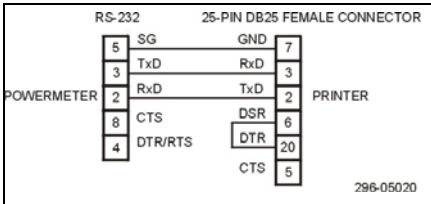


Figure 7-2 Simple 3-wire Connection, 25-pin DTE Printer

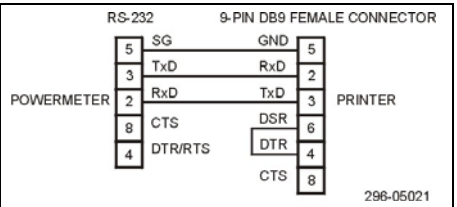


Figure 7-3 Simple 3-wire Connection, 9-pin DTE Printer

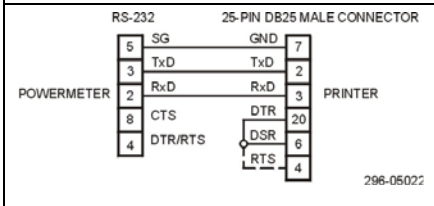


Figure 7-4 Simple 3-wire Connection, 25-pin DCE Printer

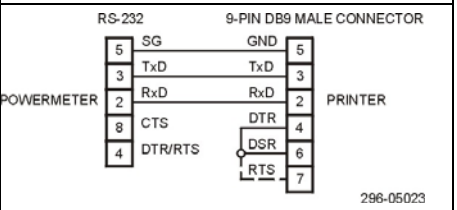


Figure 7-5 Simple 3-wire Connection, 9-pin DCE Printer

Modem Connections: ***COM1***

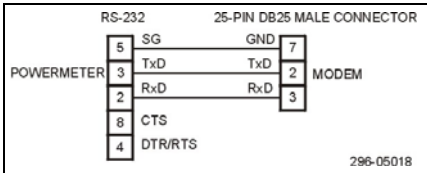


Figure 7-6 Connection for 25-pin Modem Connector

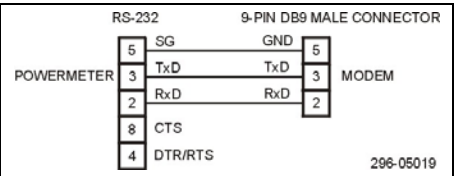


Figure 7-7 Connection for 9-pin Modem Connector

Computer Connections for RS-232: ***COM1***

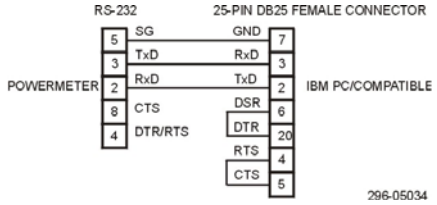


Figure 7-8 RS-232 Simple 3-Wire Connection, 25-pin

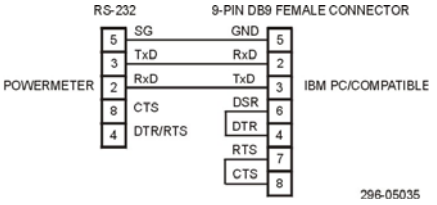


Figure 7-9 RS-232 Simple 3-Wire Connection, 9-pin

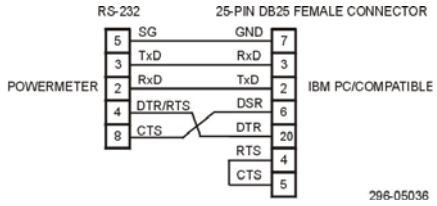


Figure 7-10 RS-232 Hardware Handshaking Connection, 25-pin

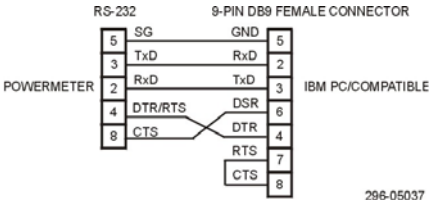
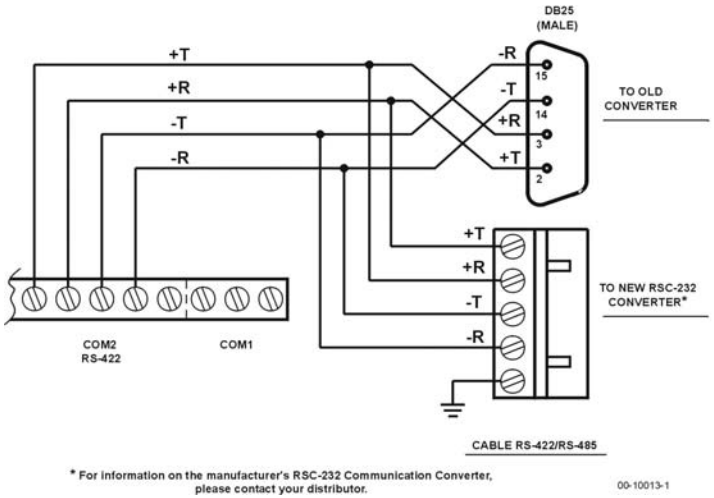


Figure 7-11 RS-232 Hardware Handshaking Connection, 9-pin

Computer Connections for RS-422: ***COM2***



Computer Connections for RS-485: ***COM1***

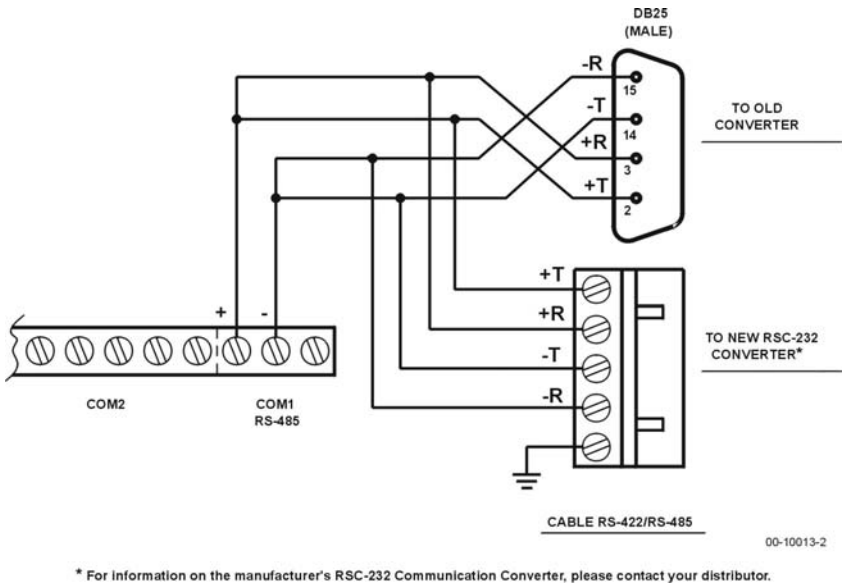


Figure 7-12 *RS-422/RS-485 Connections Using Converter*

Computer Multidrop Connections for RS-485: ***COM1***

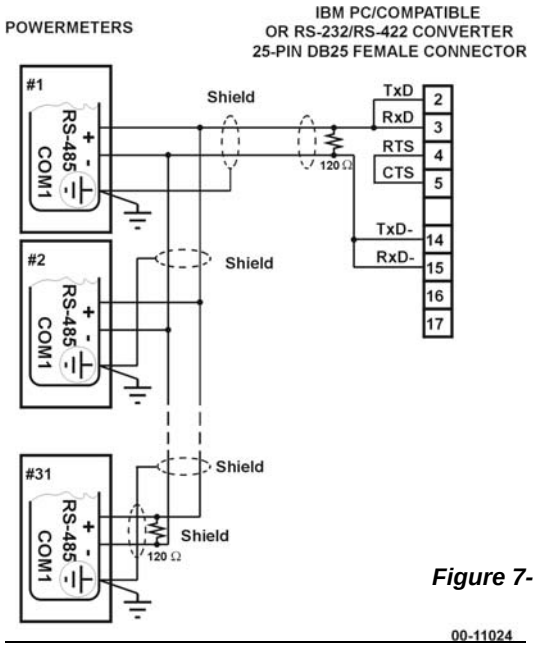


Figure 7-13 *RS-485 Multidrop Connection, 25-Pin Connector*

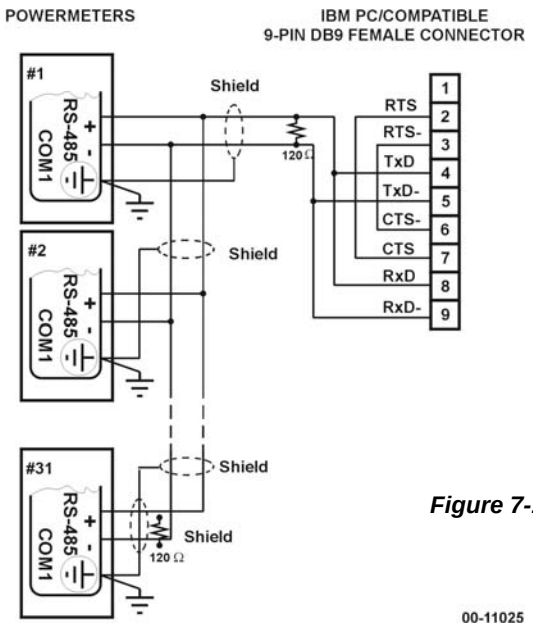


Figure 7-14 *RS-485 Multidrop Connection, 9-Pin Connector*

Computer Multidrop Connections for RS-422/RS-485: ***COM2***

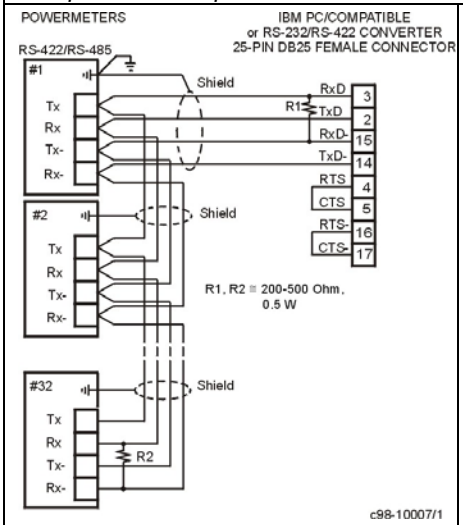


Figure 7-15 *RS-422 Multidrop Connection, 25-Pin PC Port*

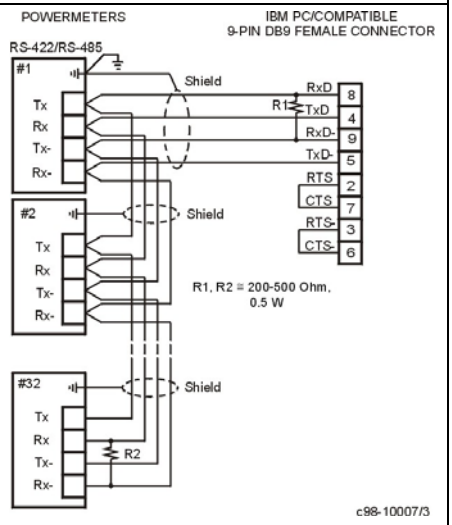


Figure 7-16 *RS-422 Multidrop Connection, 9-Pin PC Port*

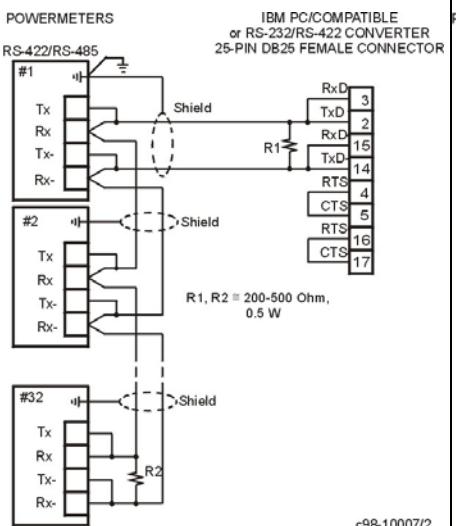


Figure 7-17 *RS-485 Multidrop Connection, 25-Pin PC Port*

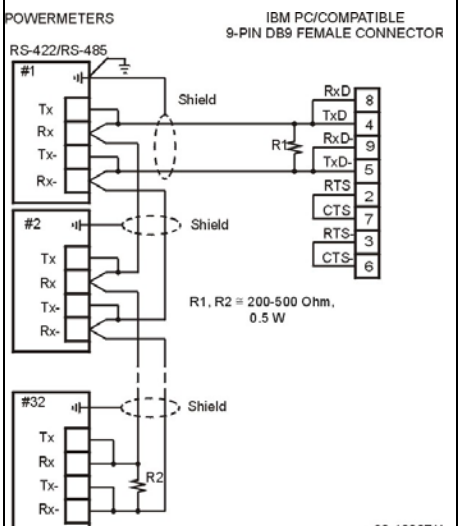


Figure 7-18 *RS-485 Multidrop Connection, 9-Pin PC Port*

NOTE: Where an RS-232/RS-422 converter is used, R1 is not applicable since it is built in to the converter.

Appendix: Technical Specifications

Input and Output Ratings

CATEGORY II POLLUTION DEGREE 2 (IEC 664)	120 V AC	INPUT USING PT (up to 120+20% V line-to-line voltage) Burden: < 0.15 VA
3 galvanically isolated current inputs CATEGORY II	690 V AC	DIRECT INPUT (up to 690+15% V line-to-line voltage or up to 500 V line-to-neutral voltage) Burden: < 0.35 VA INPUT USING PT (up to 120+20% V line-to-line voltage) Burden: < 0.03 VA
POLLUTION DEGREE 2 (IEC 664)	1 A	INPUT via CT with 1 A secondary output Burden: < 0.15 VA Overload withstand: 2 A RMS continuous, 50 A RMS for 1 second
1 galvanically isolated auxiliary current input - I_4 CATEGORY II	5 A	INPUT via CT with 5 A secondary output Burden: < 0.15 VA Overload withstand: 10 A RMS continuous, 250 A RMS for 1 second
POLLUTION DEGREE 2 (IEC 664)	1 A	INPUT via CT with 1 A secondary output Burden: < 0.15 VA Overload withstand: 2 A RMS continuous, 50 A RMS for 1 second
CATEGORY II POLLUTION DEGREE 2 (IEC 664)	5 A	INPUT via CT with 5 A secondary output Burden: < 0.15 VA Overload withstand: 10 A RMS continuous, 250 A RMS for 1 second
1 galvanically isolated direct current voltage input		CATEGORY II, POLLUTION DEGREE 2 (IEC 664) 300 V DC Burden: 0.4 W 100 V DC Burden: 0.15 W 20 V DC Burden: 0.005 W
Digital inputs	12 optically isolated, dry contact sensing inputs (voltage-free)	
Relay outputs	5 relays rated at 5A, 250 VAC/30 VDC, 2 contacts (SPST Form A) 1 relay rated at 5A, 250 VAC/30 VDC, 3 contacts (SPDT Form C)	
2 optically isolated analog outputs 0(4)-20 mA ±1 mA 0-1 mA	Accuracy: 0.5%, Non-linearity: ±100 µA Maximum load: 510 Ω Maximum load: 10K Ω Maximum load: 10K Ω	

Input and Output Ratings

Current input terminal	Rated 10A 250V Pitch 10 mm Wire 3 mm^2 (10 AWG)
Voltage input connector	Rated 32A 690V Pitch 9.5 mm Wire max. 4 mm^2 (10 AWG)
Communications	Two optically isolated serial ports: COM1 RS-232 (9-pin D-type connector) (COM1: only one line operable at a time) COM1 RS-485 (3-pin connector) COM2 RS-422/RS-485 (5-pin connector)
Service terminals	Standard 5 mm pitch (UL recognized 7463) SCREW M3 Maximum wire diameter 2.05 mm (12 AWG)

Display

Display	High-brightness seven-segment digital LEDs, 11 windows. A total of 55 pages on two page levels with simultaneous display up to 11 parameters.
Real-time clock	Accuracy: about 1 minute per month @ 25°C

Power Supply

Galvanically isolated power supply	*Manufacturer's spec.* 85-265V AC 50/60 Hz and 88-290 V DC, 18VA Low DC voltages: 12V (9.6-19), 12W 24V (19-37), 12W 48V (37-72), 12W	*UL Rating* 95-264 VAC 50/60 Hz and 90-290 V DC, 10W Low DC voltages: 12V (9-18) 24V (18-36) 48V (36-72) CATEGORY II POLLUTION DEGREE 2 (IEC 664)

Environmental Conditions

The instrument has been designed to be safe at least under the following conditions:

- indoor use
- altitude up to 2000m
- temperature 5°C to 40°C
- maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C
- mains supply voltage fluctuations not to exceed ±10% of the nominal voltage
- transient overvoltages according to INSTALLATION CATEGORY II
- POLLUTION DEGREE 2 in accordance with IEC 664

Operating temperature	-20°C to 60°C (-4°F to 140°F)

Storage temperature	-25°C to 80°C (-13°F to 176°F)
Humidity	0 to 95% non-condensing

Construction

Instrument body	CASE ENCLOSURE: plastic ABS/PC Blend (UL recognized UL94V0) FRONT PANEL: plastic PC -Film (UL recognized UL94V0)
Instrument weight	2.65 kg (6 lbs.)

Standards Compliance

Standards

UL File # E236895, UL 61010B-1
Directive Complied With: EMC: 89/336/EEC as amended by 92/31/EEC and 93/68/EEC
LVD: 72/23/EEC as amended by 93/68/EEC and 93/465/EEC
Harmonized Standards to which Conformity is Declared: EN55011:1991; EN50082-1:1992; EN61010-1:1993; A2/1995
ANSI C37.90.1 1989 Surge Withstand Capability (SWC)
EN50081-2 Generic Emission Standard - Industrial Environment
EN50082-2 Generic Immunity Standard - Industrial Environment
EN55022: 1994 Class A
EN61000-4-2
ENV50140: 1983
ENV50204: 1995 (900MHz)
ENV50141: 1993
EN61000-4-4:1995
EN61000-4-8: 1993
IEC687: 1992 Accuracy Class 0.2
IEC817 Spring Hammer Test
ANSI C12.20 Accuracy Class 0.2
CISPR14: 1993 Conducted Emission on AC Mains Lines and Measured Wires
Ingress Protection IP65 (IEC 529) for front panel only

Measurement Specifications

Parameter	Full scale @ input		Accuracy, % Rdg	FS	Conditions	Range	Display resolution (%Rdg) ③ @ range
Voltage	120VxPT @ 120V 400VxPT @ 690V	For L-N reading and 3OP2/3OP3 wiring modes	0.1	0.11	10% to 120% FS	0 to 999,000 V	Direct wiring (PT=1): 0.1 V @ 0.1V to 999.9 V Wiring via PTs (PT>1): 0.001 kV @ 0.001kV to 9.999 kV ≤0.1% @ 10.00 kV to 999.0 kV Starting voltage 1.5% FS
	208VxPT @ 120V 690VxPT @ 690V	For L-L reading except 3OP2/3OP3 wiring modes					
Line current	CT PRIMARY CURRENT		0.2	0.007	1% to 200% FS	0 to 9999 A	0.01 A @ 0.01A to 99.99 A ≤0.1% @ 100.0 A to 9999 A Starting current 0.5% FS
Active power	0.36×PT×CT @ 120V 1.2×PT×CT @ 690V		0.3 0.3 + 0.5 x (1-U/U_{FS})	0.002 0.002	|PF| ≥ 0.5 and ① or ②	-2,000,000 to +2,000,000 kW	Direct wiring (PT=1): 0.001 kW @ 0.001kW to 9.999 kW Wiring via PTs (PT>1): 0.001 MW @ 0.001MW to 9.999 MW ≤0.1% @ 10.00 MW to 2000 MW
Reactive power	0.36×PT×CT @ 120V 1.2×PT×CT @ 690V		0.38 0.38 + 0.6 x (1-U/U_{FS})	0.002 0.002	|PF| ≤ 0.9 and ① or ②	-2,000,000 to +2,000,000 kvar	Direct wiring (PT=1): 0.001 kvar @ 0.001kvar to 9.999 kvar Wiring via PTs (PT>1): 0.001 Mvar @ 0.001Mvar to 9.999 Mvar ≤0.1% @ 10.00 Mvar to 2000 Mvar
Apparent power	0.36×PT×CT @ 120V 1.2×PT×CT @ 690V		0.3 0.3 + 0.5 x (1-U/U_{FS})	0.002 0.002	|PF| ≥ 0.5 and ① or ②	0 to 2,000,000 kVA	Direct wiring (PT=1): 0.001 kVA @ 0.001kVA to 9.999 kVA Wiring via PTs (PT>1): 0.001 MVA @ 0.001MVA to 9.999 MVA ≤0.1% @ 10.00 MVA to 2000 MVA
Power factor	1			0.35	|PF| ≥ 0.5, ≥ 2% FSI	-0.999 to +1.000	0.001
Frequency			0.02			45.00 to 65.00 Hz	0.01 Hz
Neutral (unbalanced)	CT PRIMARY CURRENT		0.3	0.01	1% to 200% FS	0 to 9999 A	0.01 A @ 0.01A to 99.99 A ≤0.1% @ 100.0 A to 9999 A

Parameter	Full scale @ input	Accuracy, %			Range	Display resolution (%Rdg) ③ @ range
		Rdg	FS	Conditions		
current						Starting current 0.5% FS
Auxiliary current	AUXILIARY CT PRIMARY CURRENT	0.1	0.1	1% to 200% FS	0 to 9999 A/mA	0.01 A/mA @ 0.01A/mA to 99.99 A/mA ≤0.1% @ 100.0 A/mA to 9999 A/mA Starting current 0.5% FS
DC Voltage	20, 100, 300 VDC (upon order). Can be scaled up to 9999.		0.3	1% to 100% FS	0 to 9999 VDC	0.01VDC @ 0.01 to 99.99 VDC ≤0.1% @ 100.0 to 9999 VDC Starting voltage 2% FS
Ampere demand	same as for current					
kW demand (block & sliding)	according to active power accuracy					
kvar demand	according to reactive power accuracy					
KVA demand (block & sliding)	according to apparent power accuracy					
Total Harmonic Distortion, THD U (I), % U_1 (I_1)	999.9	1.5	0.2	≥ 1% FS, U (I) ≥ 10% FSU (FSI)	0 to 999.9	0.1
Total Demand Distortion, TDD, %	100		1.5	≥ 1% FS, I ≥ 10% FSI	0 to 100	0.1
Active energy Import & Export		Class 0.2S (IEC 687-1992-6)			0 to 999,999.999 MWh	PM296: 1 kWh @ 1 to 999,999,999 kWh RPM096: 1 kWh @ 1 to 999,999 kWh 10 kWh @ 1000 to 9,999.99 MWh 100 kWh @ 10,000 to 99,999.9 MWh 1MWh @ 100,000 to 999,999 MWh
Reactive energy Import & Export		Class 0.2, under conditions as per IEC 687-1992-6			0 to 999,999.999 Mvarh	PM296: 1 kvarh @ 1 to 999,999,999 kvarh RPM096: 1 kvarh @ 1 to 999,999 kvarh 10 kvarh @ 1000 to 9,999.99 Mvarh 100 kvarh @ 10,000 to 99,999.9 Mvarh 1Mvarh @ 100,000 to 999,999 Mvarh
Apparent energy		Class 0.2, under conditions as per IEC 687-1992-6			0 to 999,999.999 MVAh	PM296:

Parameter	Full scale @ input	Accuracy, %			Range	Display resolution (%Rdg) ③ @ range
		Rdg	FS	Conditions		
						1 kVAh @ 1 to 999,999,999 kVAh RPM096: 1 kVAh @ 1 to 999,999 kVAh 10 kVAh @ 1000 to 9,999.99 MVAh 100 kVAh @ 10,000 to 99,999.9 MVAh 1MVAh @ 100,000 to 999,999 MVAh
Volt-hours					0 to 999,999.999 kVh	PM296: 1 Vh @ 1 to 999,999,999 Vh RPM096: 1 Vh @ 1 to 999,999 Vh 10 Vh @ 1000 to 9,999.99 kVh 100 Vh @ 10,000 to 99,999.9 kVh 1kVh @ 100,000 to 999,999 kVh
Ampere-hours					0 to 999,999.999 kAh	PM296: 1 Ah @ 1 to 999,999,999 Ah RPM096: 1 Ah @ 1 to 999,999 Ah 10 Ah @ 1000 to 9,999.99 kAh 100 Ah @ 10,000 to 99,999.9 kAh 1kAh @ 100,000 to 999,999 kAh

Key:

PT = external potential transformer ratio CT, CT Primary Current = primary current rating of external current transformer
FSU = voltage full scale FSI = current full scale U_1 = voltage fundamental I_1 = current fundamental

① @ 80% to 120% of voltage FS and 1% to 200% of current FS

② @ 10% to < 80% of voltage FS and 1% to 200% of current FS

③ Higher resolution is achievable via communications

Additional Notes

1. Accuracy is expressed as ± (percentage of reading + percentage of full scale) ± 1 digit. This does not include inaccuracies introduced by the user's potential and current transformers.
2. Specifications assume: voltage and current wave forms with THD ≤ 5% for kvar, kVA and PF; reference operating temperature: 20 - 26°C.
3. Measurement error is typically less than the maximum error indicated here.

Index