Series PM170
Powermeters

Installation and Operation Manual

This manual is intended for the user of any one of the *Series PM170* Powermeters. It provides installation and setup instructions for the instrument, including communications. For additional information on using communications, refer to the *Series PM170 Communications Manual*. All installation and setup procedures must be performed by qualified persons only.

IMPORTANT

For the safety of personnel and equipment, it is essential to read this manual prior to using the equipment.

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 good 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 may void the warranty.

Your instrument should only be opened 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 electronics and will void the warranty.

NOTE

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

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

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1 Initial Inspection

Confirm that the instrument is damage-free, and only then test the electrical performance. ***Under no circumstances should the instrument be connected to a power source if it is damaged.***

Check that the instrument conforms to your order (appropriate power supply, voltage and current input options).

2 Mechanical Installation

Location

- away from heat sources in a dirt-free environment
- away from direct sunlight
- no contact with oil, moisture or rain
- away from very high electric fields

Mounting Procedure

Prepare the panel cut-out, 136 x 136 mm, prior to mounting. Lock the instrument into place using the 4 supplied latches (see *Figure 2-1*).

STEP 1: Place the instrument through the cut-out.

STEP 2: Assemble the latches onto the outer wall of the enclosure.

STEP 3: Tighten the screws, torque 30 Oz Inch (0.21 N m).

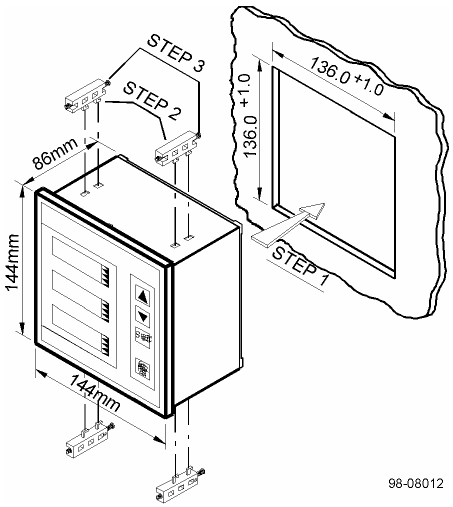


Figure 2-1 Dimensions and Mounting System

3 Electrical Installation

> ☞ **Before performing any installation procedure, 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.**

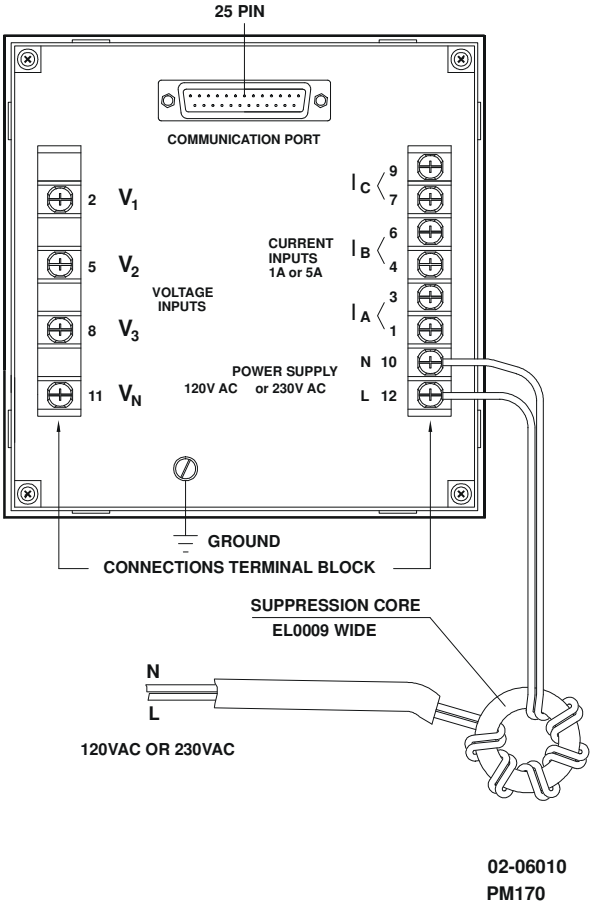


Figure 3-1 Locations of Terminals and Communication Connector: Rear View

3.1 Power Supply Connections

Use the suppression core provided for connecting the live line to terminal 12 and the neutral to terminal 10.

3.2 Voltage Inputs

660V Input (Standard)

Use any of the five wiring configurations shown in *Figures 3-2* through *3-6*.

120V Input (Option U)

120V input usually implies use of a potential transformer (PT). Use either of the wiring configurations shown in *Figures 3-4* and *3-6*.

3.3 Current Inputs

The secondary of a 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.

The CTs must be connected in the correct order and with the correct polarity as shown in the wiring diagrams for the instrument to operate properly. If the instrument displays a power factor of zero or close to it, or if power readings show unreasonable values, this may indicate that the polarity of the CT connections is reversed.

3.4 Wiring Configurations

- *3 Wire Direct*
- *4 Wire Direct*
- *4 Wire Wye (with PT)*
- *4 Wire Direct Delta*
- *3 Wire Open Delta (with PT)*

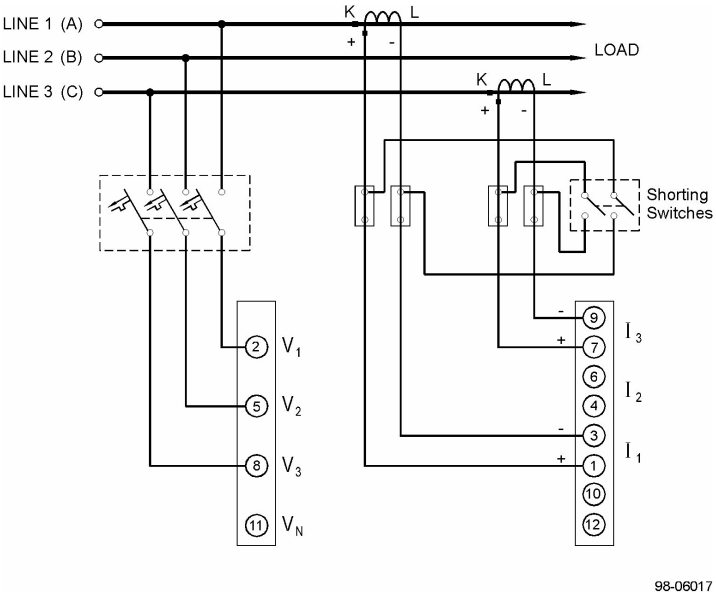


Figure 3-2 3 Wire Direct Connection Wiring Mode: **3dir**

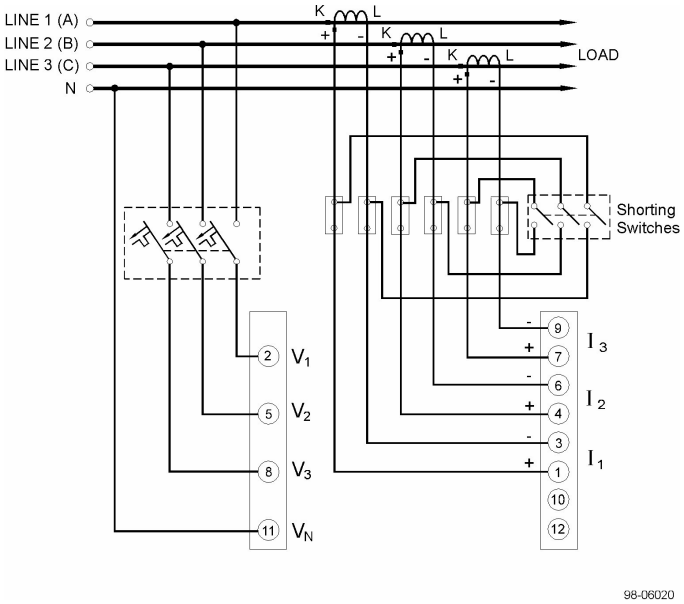


Figure 3-3 4 Wire Direct Connection Wiring Mode: **4L-n** *or* **4L-L**

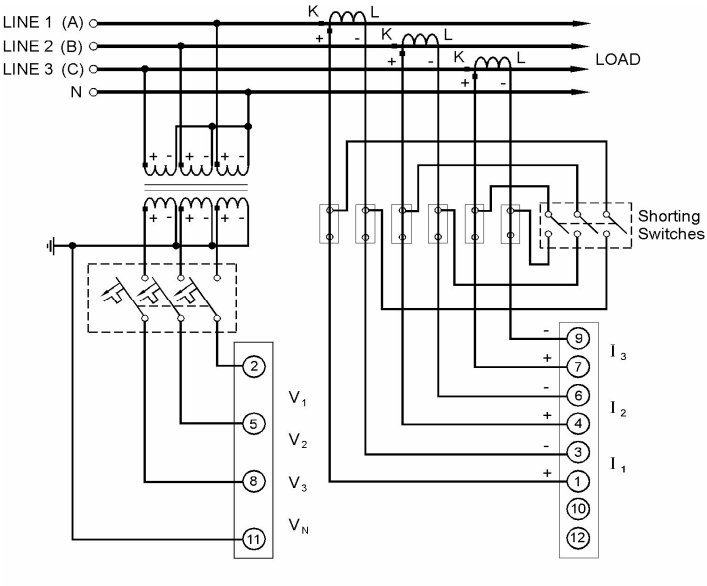


Figure 3-4 4 Wire Wye Connection via PT Wiring Mode: **4L-n** *or* **4L-L**

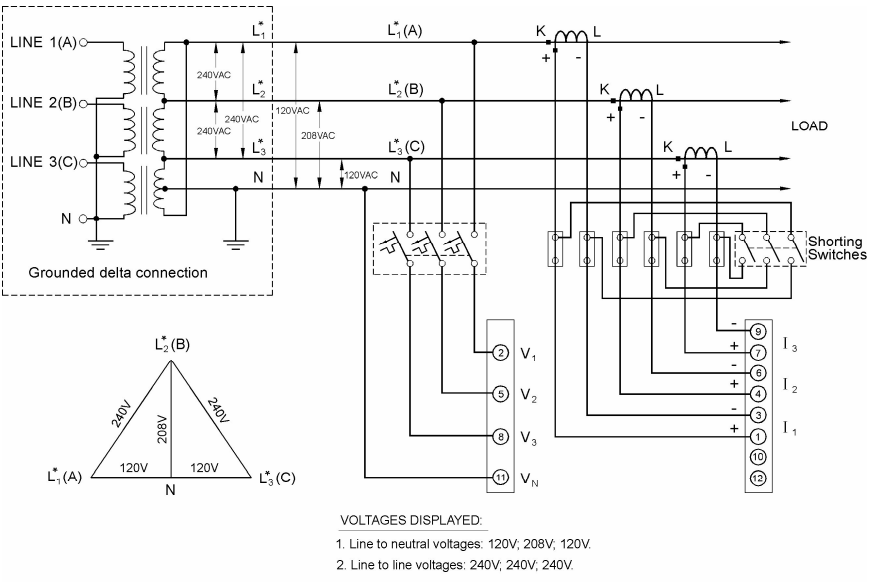


Figure 3-5 4 Wire Direct Delta Connection Wiring Mode: **4L-n** *or* **4L-L**

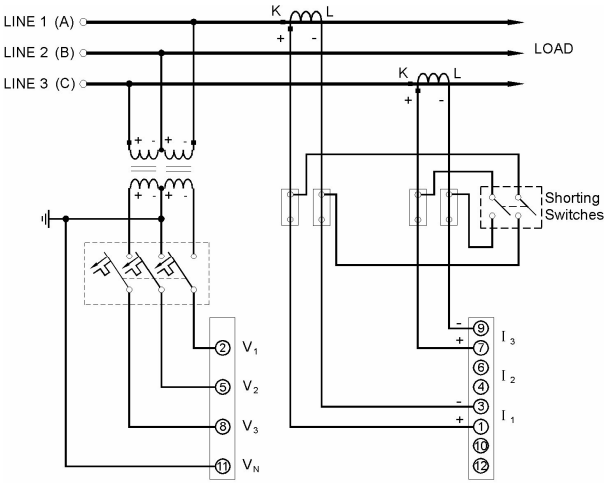


Figure 3-6 3 Wire Open Delta Connection via PT Wiring Mode: **3 OP**

3.5 Communication Connections - *Optional*

Adapters

EIA RS-232, RS-422 and RS-485 communication lines are connected to the PM170 via the communication adapter, which must be installed on the 25-pin female connector on the rear of the instrument. The two types of communication adapters, **D Type** and **Terminal Block**, are shown in *Figure 3-7*.

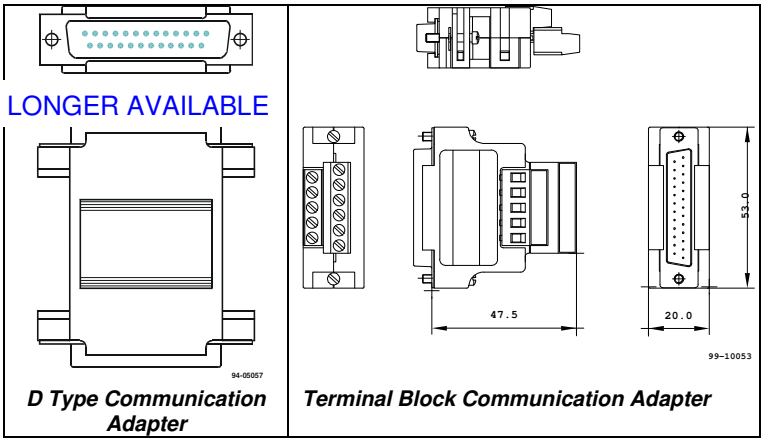


Figure 3-7 Communication Adapters

Connecting the D Type Adapter

1. Plug the 25-pin male end of the adapter into the Powermeter connector (port) and tighten the screws.
2. Connect your serial line to the adapter's 25-pin female plug.

Connecting the Terminal Block Adapter

1. Plug the 25-pin male end of the adapter into the Powermeter connector (port) and tighten the screws.
2. Connect your communications lines to the terminal block of the communication adapter.

The terminals and their functions for the two adapter types are listed in *Tables 3-1* and *3-2*.

Table 3-1 Terminals: D Type Adapter

Pin	*Terminal*	*Function*	*Signal*
1	OV	Common (signal ground)	RS-232
2	TXD	Transmit Data	RS-232
3	RXD	Receive Data	RS-232
4	DTR	Data Terminal Ready	RS-232
5	DSR/CTS	Data Set Ready/Clear To Send	RS-232
14	TXD+	+ Transmit Data	RS-422/RS-485
15	RXD+	+ Receive Data	RS-422/RS-485
16	TXD-	- Transmit Data	RS-422/RS-485
17	RXD-	- Receive Data	RS-422/RS-485

Table 3-2 Terminals: Terminal Block Adapter

Terminal		*Function*
RS-232	TXD	Transmit Data
	RXD	Receive Data
	DTR	Data Terminal Ready
	DSR	Data Set Ready/Clear To Send
	SG	Common (signal ground)
RS-422/RS-485	TX	+ Transmit Data
	RX	+ Receive Data
	-TX	- Transmit Data
	-RX	- Receive Data

NOTE: For RS-485 communications, connect together terminals TX and RX, and terminals -TX and -RX.

Cable Connections

RS-232 communication allows a single point-to-point connection (one instrument to the serial port of the computer, printer or modem. A flat cable can be used. Cable length may be maximum 15m.

RS-422/RS-485 communications allow connection of up to 32 instruments to one host computer or PLC. The total cable length may be 1200m, using 22 gauge shielded, twisted pair cables. RS-422 (full duplex) requires 4 wires; RS-485 (half duplex), 2 wires. To minimize reflections and reduce cross talk, it is recommended to terminate line ends with termination resistors RT1 and RT2 of 150-500 Ohm, 0.25W. The manufacturer's RS-232 to RS-422/RS-485 converter has an internal termination resistor and does not require the RT1 external resistor.

When lines are routed through an electrically noisy environment, input protection against switching or lightning-induced surge voltages is required in addition to line termination. Surge voltages can be generated by switching operations in power substations, or can occur as a result of voltage deep fade, phase gating controls, contactor relay controls, etc. Transient surge voltage effects may disable the master PC or PLC and in the worst case lead to destruction of unprotected electronic components.

Computer Connections

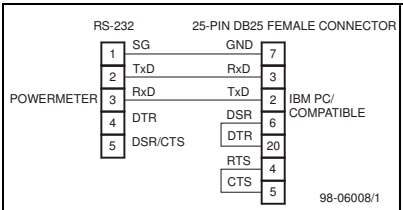


Figure 3-8 *RS-232 Simple 3-Wire Connection, 25-pin*

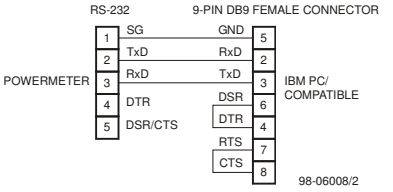


Figure 3-9 *RS-232 Simple 3-Wire Connection, 9-pin*

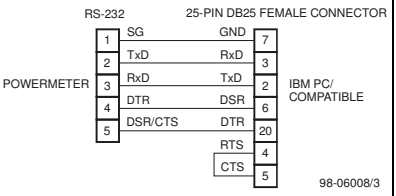


Figure 3-10 *RS-232 Hardware Handshaking Connection, 25-pin*

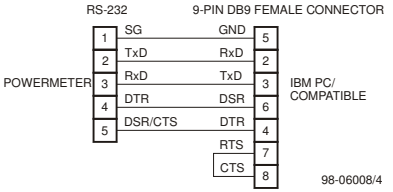


Figure 3-11 *RS-232 Hardware Handshaking Connection, 9-pin*

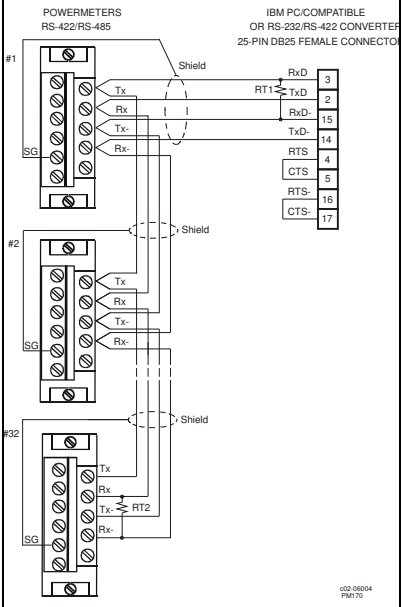


Figure 3-12
RS-422 Multidrop Connection, 25-pin

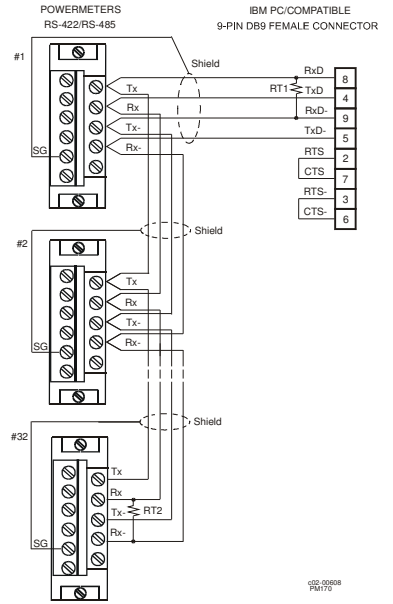


Figure 3-13
RS-422 Multidrop Connection, 9-pin

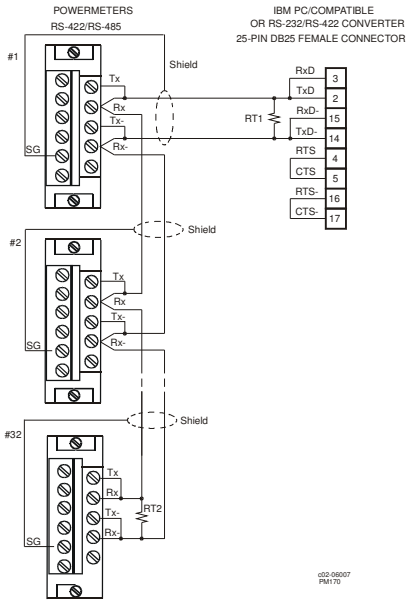


Figure 3-14 *RS-485 Multidrop, 25-pin*

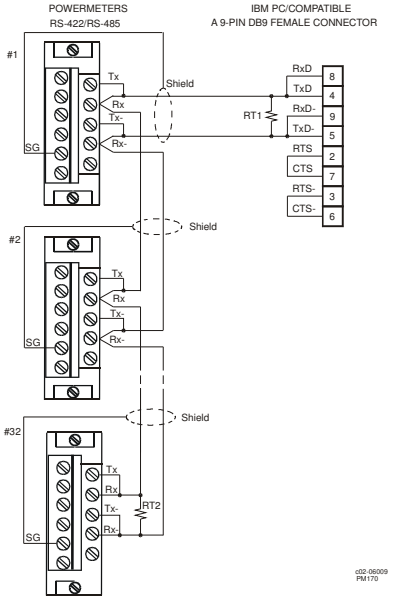


Figure 3-15 *RS-485 Multidrop, 9-pin*

Printer Connections

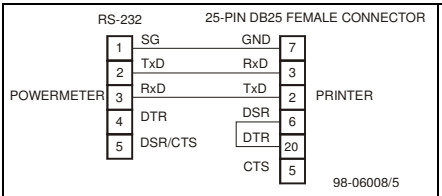


Figure 3-16 *Simple 3-Wire Connection, 25-pin DTE Printer*

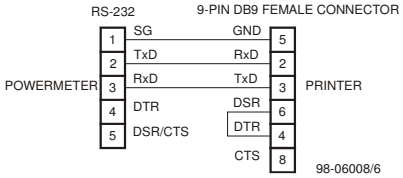


Figure 3-17 *Simple 3-Wire Connection, 9-pin DTE Printer*

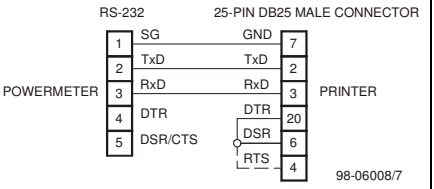


Figure 3-18 *Simple 3-Wire Connection, 25-pin DCE Printer*

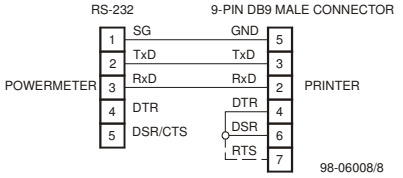


Figure 3-19 *Simple 3-Wire Connection, 9-pin DCE Printer*

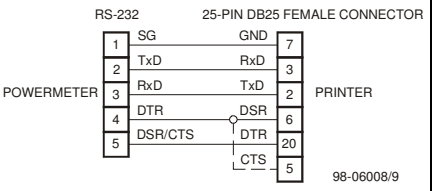


Figure 3-20 *Hardware Handshaking Connection, 25-pin DTE Printer*

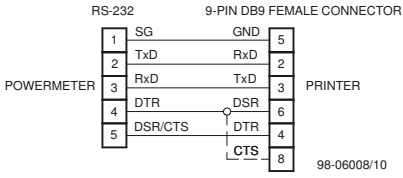


Figure 3-21 *Hardware Handshaking Connection, 9-pin DTE Printer*

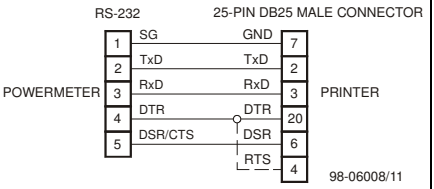


Figure 3-22 *Hardware Handshaking Connection, 25-pin DCE Printer*

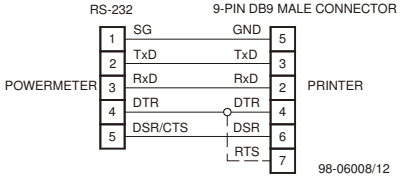


Figure 3-23 *Hardware Handshaking Connection, 9-pin DCE Printer*

Modem Connection

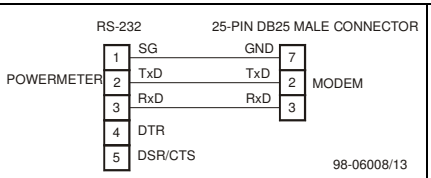


Figure 3-24
Connection for 25-pin Modem Connector

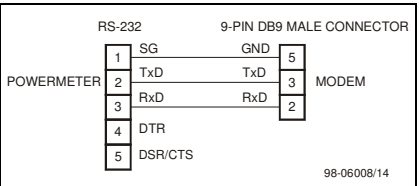


Figure 3-25
Connection for 9-pin Modem Connector

3.6 External Synchronization Input - *Optional*

External synchronization can be used in the *PM170E* and *PM170M* for power demand interval measurements. External synchronization requires a timing pulse from the source utility company indicating the beginning of the demand interval. The signal is delivered via pins 13 and 25 on the Powermeter's communication connector (port). If you are using the optional communication adapter, the external synchronization source should be connected as follows:

if D Type adapter: to pins 13 and 25 on the 25-pin female side of the adapter;

if Terminal Block adapter: to terminals EXT.1 and EXT.2 on the terminal block of the adapter.

A utility pulse signal should be supplied via a volt-free relay contact having a minimum rating of 24V DC, 0.5A. The minimum pulse width is 50 ms.

4 Turning on the Powermeter

Connect the Powermeter to a suitable power supply. If a diagnostic code other than '8' constantly appears when you apply power to the instrument, contact your local distributor for instructions.

Upon power up, the Powermeter assumes the *working mode*. In this mode, the Powermeter executes measurement functions and displays the results on the front panel (see Section 6, *Viewing the Displays*).

5 Initial Setup

Correct definition of the setup parameters is essential to proper functioning of the instrument and correct readings.

A typical setup menu display is shown in *Figure 5-1*.

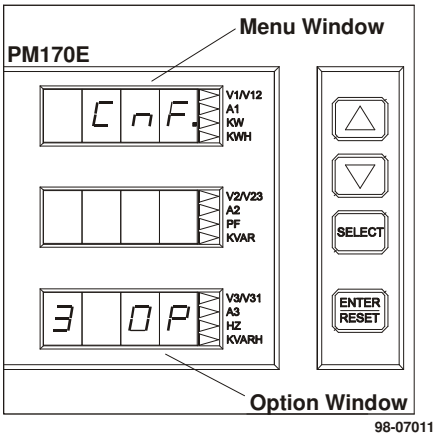


Figure 5-1 Display Example

Procedure

Upon power up, the instrument is in the **working** mode.

- Press the **SELECT** key to enter the **configuration** mode. The small arrow LEDs will cease to be lit up.
- Use the arrow keys to scroll up or down the pages until the code for the parameter you want to define appears in the upper window.

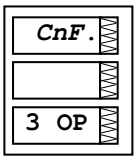
The menu list is circular, i.e., when you reach the last parameter and continue to scroll down, the first parameter will appear.

When you are selecting a setup parameter, the menu (upper) window is the active window. This is indicated by a dot following the menu code.

When you are ready to choose an option/value for the selected parameter, you must make the option (lower) window the active window. For communications setup parameters, there may be two options together, which will be displayed in this case in the middle and lower windows.

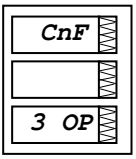
- Press the **SELECT** key and hold; while holding, press the up arrow key as well, and hold both for about 5 seconds, until the dot in the menu window disappears. Now the option window is active.
- Use the **up and down arrow keys** to choose the desired option/value.
- When the desired option/value appears in the option window, press the **ENTER** key. The chosen option/value has now been entered, and the dot will reappear in the menu window, indicating that the menu window is now active.
- Press **ENTER** to exit the **configuration** mode and return to the **working** mode.

Example: Wiring Mode Setup



Press SELECT to enter the configuration mode. Use the arrow keys to scroll up or down until ***CnF.*** appears in the upper window.

The lower window will have the current configuration of the wiring mode.

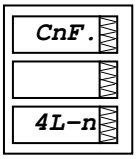


Next, make the lower window the active window, as follows:

Press the SELECT key and hold; while holding, press the up arrow key as well, and hold both keys for about 5 seconds, until the dot in the upper window disappears.

Now the lower window is active, and you are ready to change the wiring mode.

Use the up and down arrow keys to choose the desired option.



When the desired option appears in the option window, press ENTER. (In this example we changed the wiring mode to ***4L-n***). The chosen option has now been entered, and the dot will reappear in the upper window, indicating that the upper window is now active.

Press ENTER to exit the configuration mode.

Tables 5.1 and *5.2* list the basic and communications setup parameters and the available options/values for each.

Table 5-1 Basic Setup Parameters

Menu Code	*Parameter Name*	*Options / Value Range*	*Description*
CnF.	Wiring Mode	*3 OP* *4L-n* *3dir* *4L-L*	3-wire Open delta 4-wire Line-to-neutral mode 3-wire Direct connection 4-wire Line-to-line mode
Pt.	PT Ratio	*1.0 to 6500.0*	The turns ratio of the potential transformers
Ct.	CT Primary Current	*1 to 50000*	The primary current rating of the phase current transformers, in A (amperes)
P.	Power Demand Period *(PM170E, PM170M)*	*1,2,5,10,15,20, 30.60,E*	The length of the demand period for power demand calculations, in minutes E = external synchronization
AP.	Ampere Demand Period	*0 to 1800*	The length of the demand period for ampere demand calculations, in seconds; 0 = measuring peak currents
buF.	Buffer Size	*nor,UnSt*	The number of measurements for RMS sliding averaging: *nor* - normal buffer (8 entries) *UnSt* - unstable conditions (32 entries)
rSt.	RESET Enable/Disable	*OFF, On*	Protects against inadvertent reset via the front panel. When set to OFF, this function is disabled

Table 5-2 Communications Setup Parameters
(These parameters appear only if the optional communications adapter is connected).

Menu Code	*Parameter Name*	*Options / Value Range*	*Description*
br.	Data Format and Baud Rate	Data Formats: 7E, 8n, 8E Baud Rates: 110, 300, 600, 1200, 2400, 4800, or 9600	7/8 bit, even/no parity bps
Add.	Address	*0 to 247*	Communication address
H.Sh.	Handshaking	*SOFt*	Software handshaking (XON/XOFF protocol)
		HArd	Hardware handshaking (CTS protocol). DTR signal permanently asserted high
CoP.	Communica-tions Protocol and Interface	*Protocol: ASCI , rtu* or *Prnt* *Interface: 232, 422 or 485*	ASCII, Modbus or Print RS-232, RS-422 or RS-485
Pr.	Printout Period*	*1, 2, 5, 10, 15, 20, 30, 60*	Time interval between successive printouts, in minutes

*for *Print mode* only; see the *Series PM170 Communications Manual*

6 Viewing the Displays

To the right of each window on the panel, a small arrow LED will light up. This arrow indicates which parameter, or page, is being displayed. For real-time parameters, the arrow will be lit up continuously; for ampere or kW/kVA demand measurements, the arrow will flash.

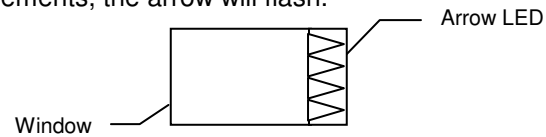


Figure 6-1 Panel Detail

The arrow lit up continuously is denoted in *Tables 6-1*, *6-2* and *6-3* as ▶. The flashing arrow is denoted as ▶.

Table 6-1 Displayed Parameters - PM170

Page	*Window*	*Parameter*	*Unit* ①	*Range*
▶	1 (upper)	Voltage L1/L12	V/kV	0 to 999.9 kV
▷	2 (middle)	Voltage L2/L23	V/kV	0 to 999.9 kV
▷	3 (lower)	Voltage L3/L31	V/kV	0 to 999.9 kV
▷				
▷	1 (upper)	Current L1	A/kA	0 to 60.00 kA
▶	2 (middle)	Current L2	A/kA	0 to 60.00 kA
▷	3 (lower)	Current L3	A/kA	0 to 60.00 kA
▷				
▷	1 (upper)	Total kW	kW/MW	-999 to 2147 MW
▷	2 (middle)	Total power factor		-0.99 to 1.00
▶	3 (lower)	Frequency	Hz	45.0 to 65.0 Hz
▷				
▷	1 (upper)	Max. ampere demand L1	A/kA	0 to 60.00 kA
▶	2 (middle)	Max. ampere demand L2	A/kA	0 to 60.00 kA
▷	3 (lower)	Max. ampere demand L3	A/kA	0 to 60.00 kA
▷				
▷	1	date (if RTC ordered)		
▷	2	month.day		
▷	3	year		
▷				
▷	1	hour		
▷	2	hour.minutes		
▷	3	seconds		
▷				

Table 6-2 Displayed Parameters - PM170E

Page	*Window*	*Parameter*	*Unit* ①	*Range*
▶	1	Voltage L1/L12	V/kV	0 to 999.9 kV
▷	2	Voltage L2/L23	V/kV	0 to 999.9 kV
▷	3	Voltage L3/L31	V/kV	0 to 999.9 kV
▷				
▷	1	Current L1	A/kA	0 to 60.00 kA
▶	2	Current L2	A/kA	0 to 60.00 kA
▷	3	Current L3	A/kA	0 to 60.00 kA
▷				
▷	1	Total kW	kW/MW	-999 to 2147 MW
▷	2	Total power factor		-0.99 to 1.00
▶	3	Frequency	Hz	45.0 to 65.0 Hz
▷				
▷	1	kWh net ②	kWh/MWh	-999 to 9999 MWh
▷	2	kvar	kvar/Mvar	-999 to 2147 Mvar
▷	3	kvarh net ②	kvarh/Mvarh	-999 to 9999 Mvarh
▶				
▷	1	Max. ampere demand L1	A/kA	0 to 60.00 kA
▶	2	Max. ampere demand L2	A/kA	0 to 60.00 kA
▷	3	Max. ampere demand L3	A/kA	0 to 60.00 kA
▷				
▷	1	Max. kW demand	kW/MW	0 to 2147 MW
▷				
▶				
▷				
▷	1	date (if RTC ordered)		
▷	2	month.day		
▷	3	year		
▷				
▷	1	hour		
▷	2	hour.minutes		
▷	3	seconds		
▷				

Table 6-3 Displayed Parameters - PM170M

Page	*Window*	*Parameter*	*Unit* ①	*Range*
▶	1	Voltage L1/L12	V/kV	0 to 999.9 kV
▷	2	Voltage L2/L23	V/kV	0 to 999.9 kV
▷	3	Voltage L3/L31	V/kV	0 to 999.9 kV
▷				
▷	1	Current L1	A/kA	0 to 60.00 kA
▶	2	Current L2	A/kA	0 to 60.00 kA
▷	3	Current L3	A/kA	0 to 60.00 kA
▷				
▷	1	Total kW	kW/MW	-999 to 2147 MW
▷	2	Total kVA	kVA/MVA	0 to 2147 MVA
▶	3	Total power factor		-0.99 to 1.00
▷				
▷	1	kWh net ②	kWh/MWh	-999 to 9999 MWh
▷	2	kVAh ②	kVAh/MVAh	0 to 9999 MVAh
▷	3	Frequency	Hz	45.0 to 65.0 Hz
▶				
▷	1	Max. ampere demand L1	A/kA	0 to 60.00 kA
▶	2	Max. ampere demand L2	A/kA	0 to 60.00 kA
▷	3	Max. ampere demand L3	A/kA	0 to 60.00 kA
▷				
▷	1	Max. kW demand	kW/MW	0 to 2147 MW
▷	2	Max. kVA demand	kVA/MVA	0 to 2147 MVA
▶	3	Power factor at maximum kVA demand ③		-0.99 to 1.00
▷				
▷	1	date (if RTC ordered)		
▷	2	month.day		
▷	3	year		
▷				
▷	1	hour		
▷	2	hour.minutes		
▷	3	seconds		
▷				

NOTES to Tables 6-1, 6-2, 6-3

① When the value width exceeds the window resolution, the reading is converted to higher units and displayed with a decimal point. The right- most digits of the reading are truncated.

② The maximum range for energy readings is -999.999 to 9,999.999 MWh/Mvarh/MVAh. Beyond this value, the reading rolls over to zero, and the corresponding display window flashes until the user presses any key.

③ The Power Factor at kVA maximum demand is calculated for the Demand Period when kVA demand is the greatest. The Power Factor is calculated as follows:

PF (Demand) = kW Demand/kVA Demand

where kW Demand and kVA Demand are the average powers (kW and kVA) during the Demand Period.

Additional Notes

1. L1, L2, and L3 line-to-neutral voltages correspond to A, B and C line-to-neutral voltages, and L12, L23, and L31 line-to-line voltages to AB, BC and CA line-to-line voltages.
2. Page 1 displays are line-to-neutral voltages when the 4L-n WIRING MODE is selected. For all other wiring modes, only line-to-line voltages will be displayed.
3. The maximum acceptable value for CT PRIMARY CURRENT × PT RATIO is 10,000,000. If this product is greater, power values will be zeroed.

Resetting Accumulated Values

To reset accumulated energies (PM170E/170M only):

- From the energies page (where arrows KWH and KVARH/KVAH are illuminated), press and hold the ENTER key for about 5 seconds until displayed energies are reset to zero.

To reset maximum demands (all Series 170 models):

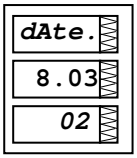
- From the demand page (where arrows A1, A2 and A3, or KW/KVA flash), press and hold the ENTER key for about 5 seconds until displayed maximum demands are reset to zero.

The reset function can be disabled in the basic setup, to avoid unauthorized resetting of values.

Real Time Clock (RTC) - *Optional*

The real time clock/calendar option provides information for real time control and data logging. The end of month date is automatically adjusted for months with less than 31 days, including corrections for leap years. The clock operates in a 24-hour format.

The real time clock function, unlike the basic setup parameters, is set up in the **working** mode (or through communications (see the *Series PM170 Communications Manual*).



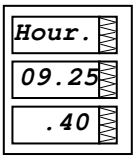
In the working mode, use the arrow keys to scroll up or down the display pages parameter list until ***dAte.*** appears in the upper window.

The middle window will contain the day and month. In the example at the left, the clock is set to the 3rd of August.

The lower window will contain the year in two-digit format; in our example, the year is 2002.

To change the date:

Press the SELECT key repeatedly until the element of the date (day or month or year) that you wish to change blinks. Then use the up arrow to set that element of the date. When the date has been set, press the ENTER/RESET key and the window will cease blinking.



To set the time, move to the following page using the arrow key, so that ***hour.*** appears in the upper window.

The middle window will contain the hour and minute; the lower window will contain the seconds (9:25:40 a.m. in the example at left).

To change the time:

Press the SELECT key repeatedly until the element of the time that you wish to change (hour or minute) blinks. Then use the up arrow to set that element of the time. When the time has been set, press the ENTER/RESET key and the window will cease blinking.

As with any clock, you cannot set the seconds but can reset them to zero. This is done by exiting the RTC setup while the seconds window is blinking.

Appendix: Technical Specifications

Input & Output Ratings

Voltage inputs	*660 V: standard*	DIRECT INPUT (up to 660V line-to-line voltage, or up to 550V where the wiring mode is set to 3 OP). *Burden:* <0.3 VA INPUT USING PT (up to 120V+20% line-to-line voltage) *Burden:* <0.015 VA
	120 V: option	INPUT USING PT (up to 120V+20% line-to-line voltage). *Burden:* <0.07 VA
Current inputs	*5 A: standard*	INPUT VIA CT with 5A secondary output, not to exceed 6A RMS; *Burden:* <0.15 VA *Overload withstand*: 10A RMS continuous, 150A RMS for 1 second
	1 A: option	INPUT VIA CT with 1A secondary output, not to exceed 1.2A RMS; *Burden:* <0.15 VA *Overload withstand:* 2A RMS continuous, 30A RMS for 1 second
Input terminals		Standard, UL recognized E101708 *Screw:* M4, brass, nickel plated *Spring lock washer*: M4, brass, nickel plated *Maximum wire diameter:* 3.5 mm (7 AWG)
External synchronization input (optional, PM170E/170M)		Dry contact, 24V DC/0.5A
Communications (optional)		EIA RS-232, RS-422, and RS-485 standards *Connector:* 25-pin female D-type or Terminal Block

Display

Display	3 windows with high-brightness seven-segment digital LEDs

Power Supply

Power supply (factory set)	88-138V AC/176-265V AC, 50/60 Hz, 10VA

Measurement Specifications

Parameter	*Full scale*	*Accuracy, %* *Rdg*	*FS*	*Conditions*	*Range*	*Display resolution (%Rdg) ② @ range*
Voltage	120V×PT@ 120V,4L-N/3OP 208V×PT@ 120V,4L-L/3DIR 380V×PT@ 660V,4L-N/3OP 660V×PT@ 660V,4L-L/3DIR	0.5	0.25	10% to 120% FS	0 to 999,000 V	1 V @ 1V to 9,999 V ≤0.1% @ 10,000 V to 999,000 V
Line current	CT PRIMARY CURRENT	0.5	0.25	2% to 120% FS	0 to 60,000 A	1 A @ 1A to 9,999 A ≤0.1% @ 10,000 A to 60,000 A
Active power	0.36×PT×CT @ 120V input 1.14×PT×CT @ 660V input	1	0.5	|PF| ≥ 0.5 ①	-999,000 to +2,147,000 kW	1 kW @ 1kW to 9,999/-999 kW ≤0.1% @ 10 MW to 2,147 MW ≤0.1% @ -1 MW to -999 MW
Reactive power (PM170E/M)	0.36×PT×CT @ 120V input 1.14×PT×CT @ 660V input	1	0.5	|PF| ≤ 0.9 ①	-999,000 to +2,147,000 kvar	1 kvar @ 1kvar to 9,999/-999 kvar ≤0.1% @ 10 Mvar to 2,147 Mvar ≤0.1% @ -1 Mvar to -999 Mvar
Apparent power (PM170M)	0.36×PT×CT @ 120V input 1.14×PT×CT @ 660V input	1	0.5	|PF| ≥ 0.5 ①	0 to +2,147,000 kVA	1 kVA @ 1kVA to 9,999 kVA ≤0.1% @ 10 MVA to 2,147 MVA
Power factor	1		1	|PF| ≥ 0.5	-0.99 to +1.00	0.01
Frequency		0.3			45.0 to 65.0 Hz	0.1 Hz
Unbalanced (neutral) current	CT PRIMARY CURRENT	0.7	0.4	2% to 120% FS	0 to 60,000 A	1 A @ 1A to 9,999 A ≤0.1% @ 10,000 A to 60,000 A
Ampere demand	*same as for current*					
kW demand (PM170E/M)	*same as for kW ③*					
kVA demand (PM170M)	*same as for kVA ③*					

Parameter	*Full scale*	*Accuracy, %* *Rdg*	*FS*	*Conditions*	*Range*	*Display resolution (%Rdg) ② @ range*
Active energy net (PM170E/M)		≤1.5 (typical)			-999,999 to +9,999,999 kWh	1 kWh @ ±1 to 9,999/-999 kWh ≤0.1% @ 10 MWh to 2,147 MWh ≤0.1% @ -1 MWh to -999 MWh
Reactive energy net (PM170E/M)		≤1.5 (typical)			-999,999 to +9,999,999 kvarh	1 kvarh @ ±1 to 9,999/-999 kvarh ≤0.1% @ 10 Mvarh to 2,147 Mvarh ≤0.1% @ -1 Mvarh to -999 Mvarh
Apparent energy (PM170M)		≤1.5 (typical)			0 to +9,999,999 kVAh	1 kVAh @ ±1 to 9,999 kVAh ≤0.1% @ 10 MVAh to 2,147 MVAh

PT = external potential transformer ratio
CT, CT PRIMARY CURRENT = primary current rating of the external current transformer

① @ 10% to 120% of voltage full scale and 2% to 120% of current full scale

② Higher resolution can be obtained via communications

③ When using external synchronization with a demand interval greater than 10 min., the measured power should not exceed 2,147/(D x 0.1) [MW/MVA], where D = demand interval in minutes

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. Indicated accuracy specifications show the maximum allowed error. In fact, ordinary measurement error may be considerably less than the specified accuracy.
3. Specifications for kvar, kVA and PF assume voltage and current waveforms with THD ≤ 5%.
4. Specifications assume a reference temperature of 20 - 26° C.