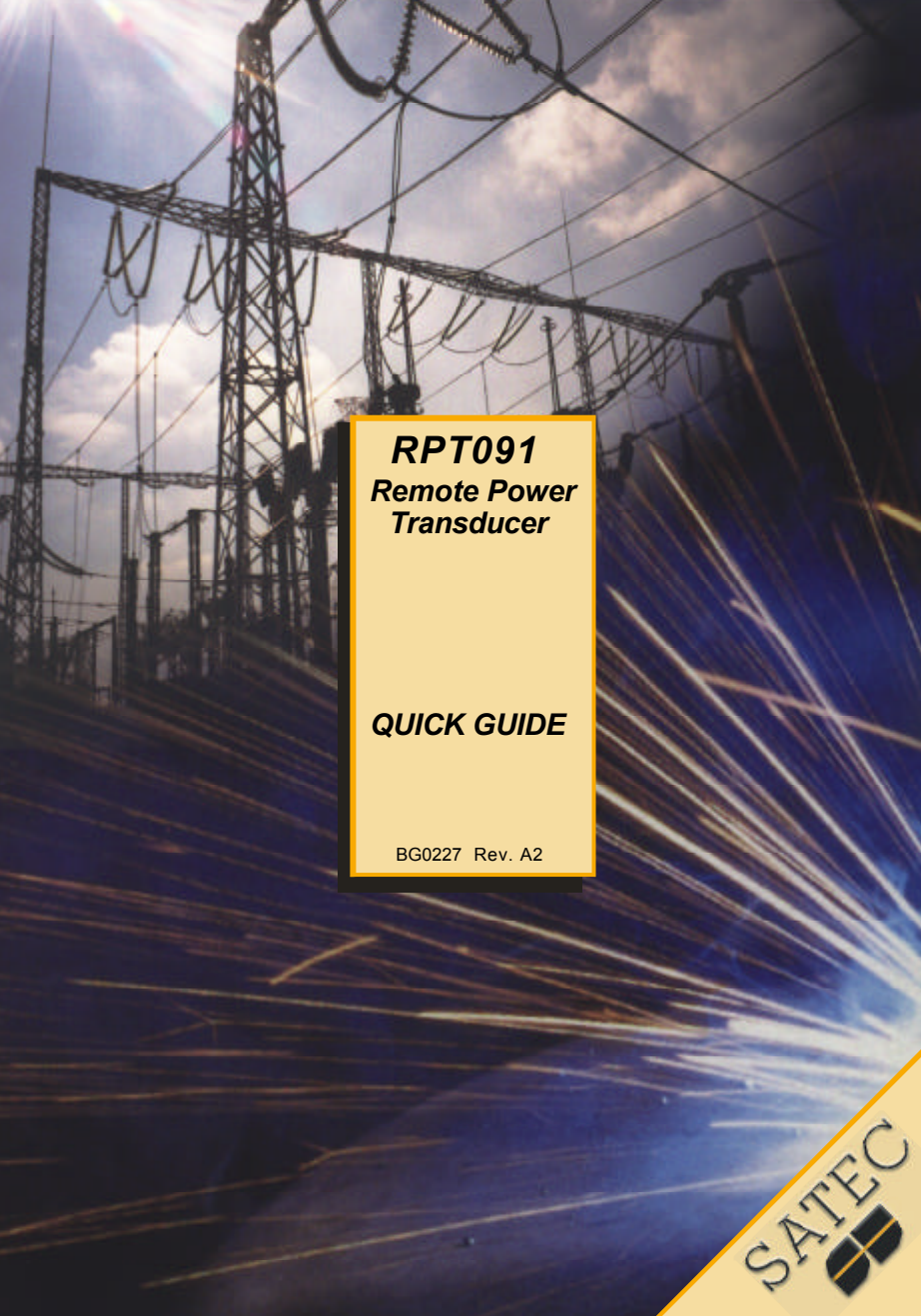

# RPT091

## Remote Power Transducer

## QUICK GUIDE

BG0227 Rev. A2

SATEC

# *RPT091 Remote Power Transducer*
# QUICK GUIDE

The *RPT091* is a compact three-phase AC Remote Power Transducer. The unit operates with a remote master (computer or PLC), and with an optional Remote Display Module (*RDM091*) for local display/setup. The *RDM091* is stand-alone or operable with a remote master, and can be panel-mounted or hand-held. Communications are via an RS-422 or RS-485 line, operable in multi-drop mode for connection of up to 32 instruments to a single line.

## IMPORTANT

**Please read instructions contained in 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. Also check the correctness of other ordering options.
3. **Under no circumstances should the instrument be connected to a** power source if it is damaged.
4. **To prevent potential fire or shock hazard, do not expose the instrument** to rain or moisture.
5. **Mount the instrument away from heat sources in a dirt-free environment.** Do not operate the instrument in direct sunlight.
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. **The *RPT091* relays should not be used for basic (primary) protection of** power lines, transformers or motors, or for protection of people from injury.
8. **Setup procedures must be performed only by qualified personnel** familiar with the instrument and its associated electrical equipment.

9. **DO NOT attempt to open the instrument under any circumstances.**
10. **Although designed to operate in an electrically noisy environment,** the instrument should not be placed near very high electric fields. In the event that the instrument is mounted in a harsh, noisy environment with high potential for electromagnetic impulses from heavy switch gears, motors or lightning, it is recommended to install appropriate protective devices such as lightening and over-voltage arresters to all incoming voltage inputs.

## LIMITED WARRANTY

The manufacturer offers the customer a 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, setup 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 not all details and variations of this equipment are covered by these instructions.

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

**BG0227 Rev. A2**

## Table of Contents



## Instrument Dimensions

# 1 Measured Parameters and Outputs

'●' = averages of 8, 16, or 32 real-time values; '**+**' = real-time values, 1 frequency cycle

| *Parameter* | *Communication* | *Display RDM* | *Analog Output* | *Pulsing Relay* | *Alarm/Control Relay* |
|---|---|---|---|---|---|
| ***Voltages and Currents*** | | | | | |
| *Voltage (L-n/L-L) per phase* | ● + | ● | ● + | | ● + |
| *Current per phase* | ● + | ● | ● + | | ● + |
| *Neutral (unbalanced) current* | ● + | ● | ● | | ● |
| ***Powers*** | | | | | |
| *kW per phase* | ● + | ● | | | |
| *kvar per phase* | ● + | ● | | | |
| *kVA per phase* | ● + | ● | | | |
| *Power factor per phase* | ● + | ● | | | |
| *kW total* | ● + | ● | ● + | | ● |
| *kvar total* | ● + | ● | ● + | | ● |
| *kVA total* | ● + | ● | ● + | | ● |
| *Power factor total* | ● + | ● | ● + | | ● |
| *Frequency* | ● + | ● | ● + | | ●+ |
| ***Demand*** | | | | | |
| *Ampere Demand per phase* | ● | | | | ● |
| *Max. Amp. Demand per phase* | ● | ● | | | |
| *Accumulated kW Demand* | ● | | ● | | ● |
| *Accumulated kVA Demand* | ● | | ● | | ● |
| *kW Demand* | ● | | | | ● |
| *KVA Demand* | ● | | | | ● |
| *kW Sliding Demand* | ● | | | | ● |
| *KVA Sliding Demand* | ● | | | | ● |
| *kW Maximum Sliding Demand* | ● | ● | | | |
| *KVA Maximum Sliding Demand* | ● | ● | | | |
| ***Energy*** | | | | | |
| *kWh Import per phase* | ● | ● | | | |
| *kvarh Import per phase* | ● | ● | | | |
| *kVAh Import per phase* | ● | ● | | | |
| *kWh Total Import / Export* | ● | ● | | ● | |
| *kvarh Total Import / Export* | ● | ● | | ● | |
| *kvarh Total Absolute* | | | | ● | |
| *kVA Total* | ● | ● | | ● | |
| *kvarh net* | ● | | | | |
| ***Harmonic Distortion (RPT091H only)*** | | | | | |
| *Voltage THD per phase* | ● + | ● | | | + |
| *Current THD per phase* | ● + | ● | | | + |
| *Current TDD per phase* | ● + | ● | | | + |
| *K- Factor per phase* | ● + | | | | |
| ***Status*** | | | | | |
| *Digital Input Status* | ● | ● | | | ● |
| *Relay Output Status* | ● | ● | | | |
| *Alarm Trigger Status* | ● | | | | |
| *Phase Rotation* | ● | ● | | | ● |
| *Remote Control via Comm.* | ● | | | | ● |

# 2 Mechanical Installation

Inspect the instrument for physical damage incurred in transit. If the instrument is damaged, inform your local distributor immediately.

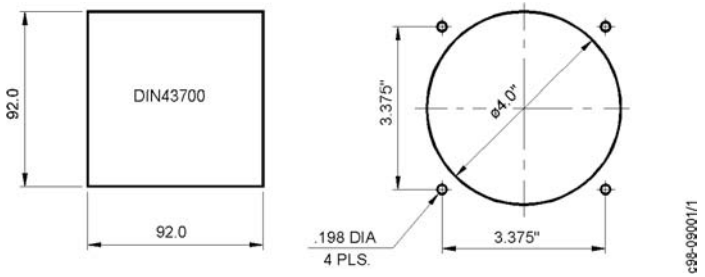


*Figure 2-1 RDM Cut-out Dimensions*

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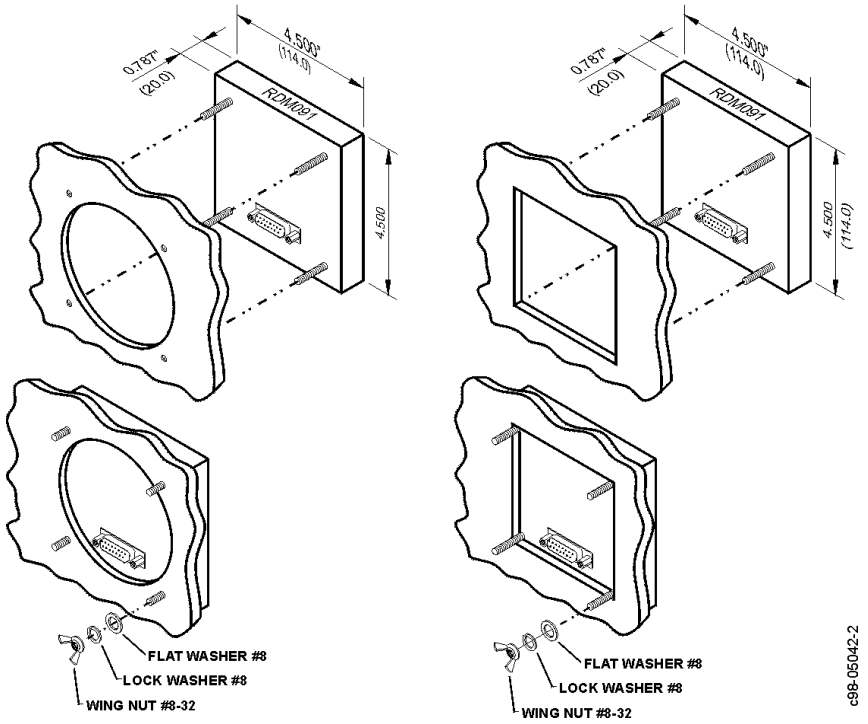



*Figure 2-2*
*RDM Panel Mounting*

STEP 1: Insert RDM into cut-out.
STEP 2: Fasten washers and nut on screws

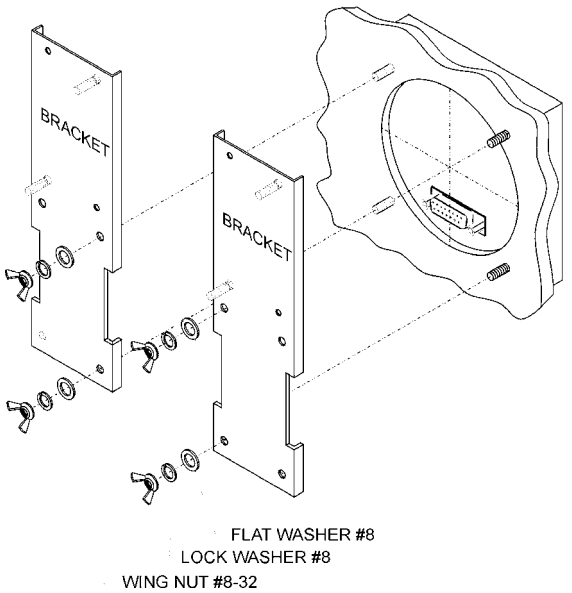



*Figure 2-3 Retrofit: Brackets Mounting*

STEP 1: Insert RDM into cutout.

STEP 2: Mount brackets on studs.

STEP 3: Fasten brackets; do not tighten nuts.

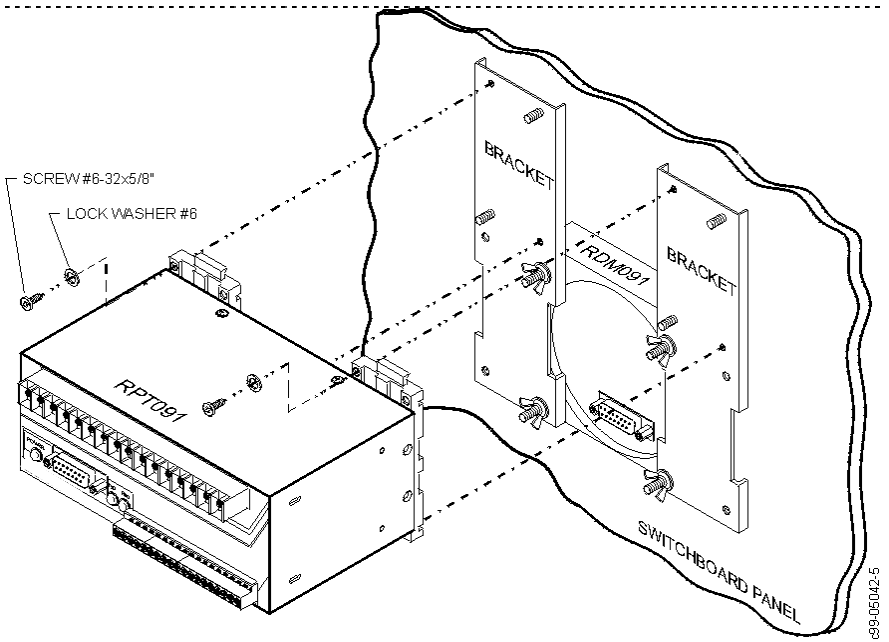



*Figure 2-4 Retrofit: RPT Mounting*

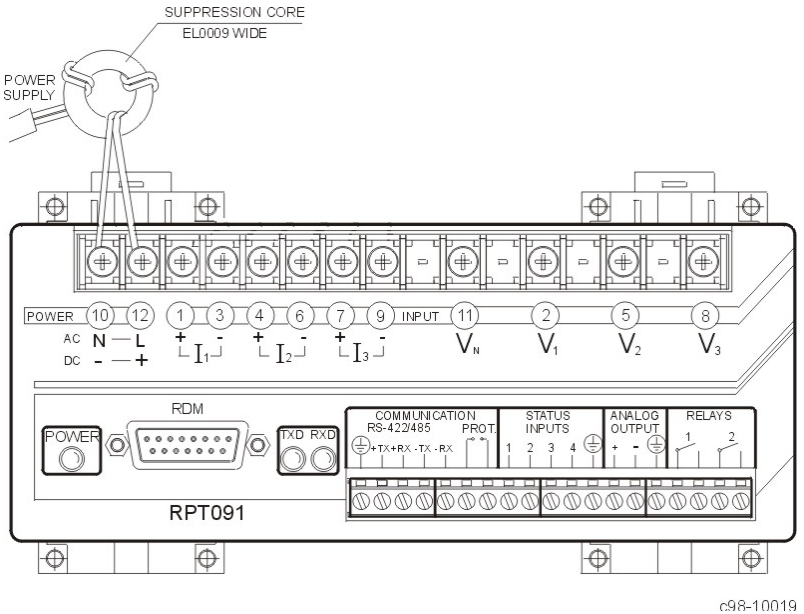
STEP 4: Mount RPT on studs.
STEP 5: Assemble 4 screws and washers.
STEP 6: Fasten RPT to brackets; tighten nuts.
STEP 7: Connect RDM to RPT via the 15-pin connectors using cable supplied.

# 3 Electrical Installation

## 3.1 Power Supply

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

AC power supply: line to terminal 12; neutral to terminal 10.
DC power supply: positive to terminal 12; negative to terminal 10.




c98-10019

*Figure 3-1 Locations of Terminals: Front View*

NOTE: Power source connection requires use of the suppression core provided with the instrument.

**IMPORTANT: It is recommended to solder the wire ends before attaching them to the connectors.**

## 3.2 Current Inputs

To ensure accurate readings, the input current should not exceed 1.2A RMS and 1.76A amplitude for the 1A CT secondary, or 6A RMS and 8.8A amplitude for the 5A CT secondary.

If copper wiring is used, its thickness should be 2.5 - 4 $mm^2$ (13 - 11 AWG).

## 3.3 Ground

Connect the chassis ground of the *RPT091* to the switchgear earth ground using dedicated wire greater than 2 $mm^2$/14 AWG.

## 3.4 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 3-2* through *3-8*.

***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 3-4* through *3-7*.

| **Wiring Configurations** | **'Wiring Mode' Definition** (See parameter setup instructions in Section 5) | |
|---|---|---|
| 3-wire direct connection using 2 CTs (2-element) | 3dir2 | (Figure 3-2) |
| 4-wire WYE direct connection using 3 CTs (3-element) | 4Ln3 or 4LL3 | (Figure 3-3) |
| 4-wire WYE connection using 3 PTs, 3 CTs (3-element) | 4Ln3 or 4LL3 | (Figure 3-4) |
| 3-wire open delta connection using 2 PTs, 2 CTs (2-element) | 3OP2 | (Figure 3-5) |
| 4-wire WYE connection using 2 PTs, 3 CTs (2½ -element) | 3Ln3 or 3LL3 | (Figure 3-6) |
| 3-wire open delta connection using 2 PTs, 3 CTs (2½-element) | 3OP3 | (Figure 3-7) |
| 4-wire delta direct connection using 3 CTs (3-element) | 4Ln3 or 4LL3 | (Figure 3-8) |

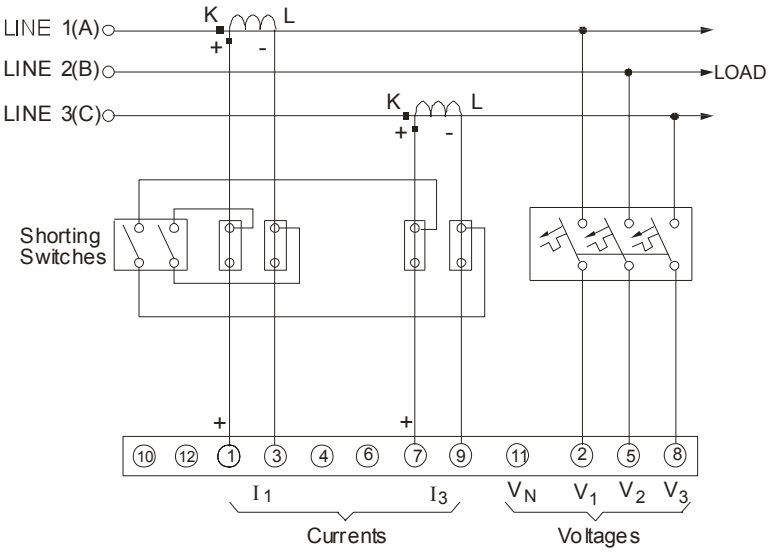



*Figure 3-2*
*Three Wire Direct Connection Using 2 CTs (2-element)*
*Wiring Mode* = **3dir2**

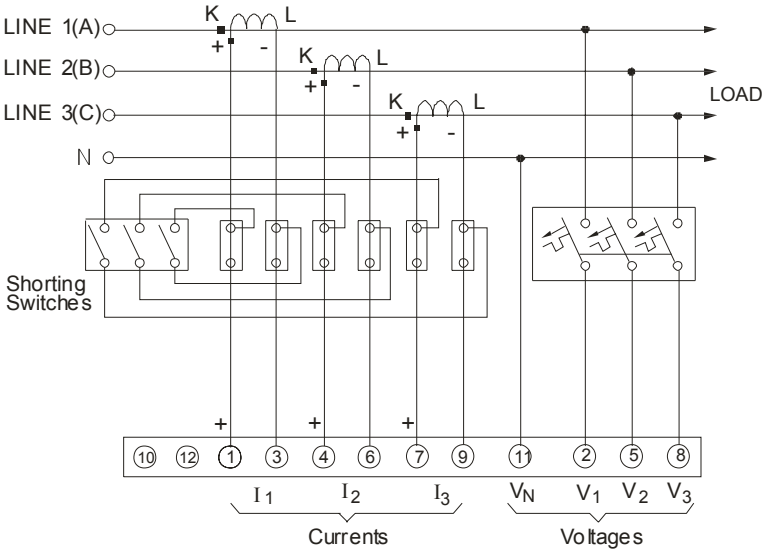



*Figure 3-3*
*Four Wire WYE Direct Connection using 3 CTs (3-element)*
*Wiring Mode* = **4LL3** or **4Ln3**

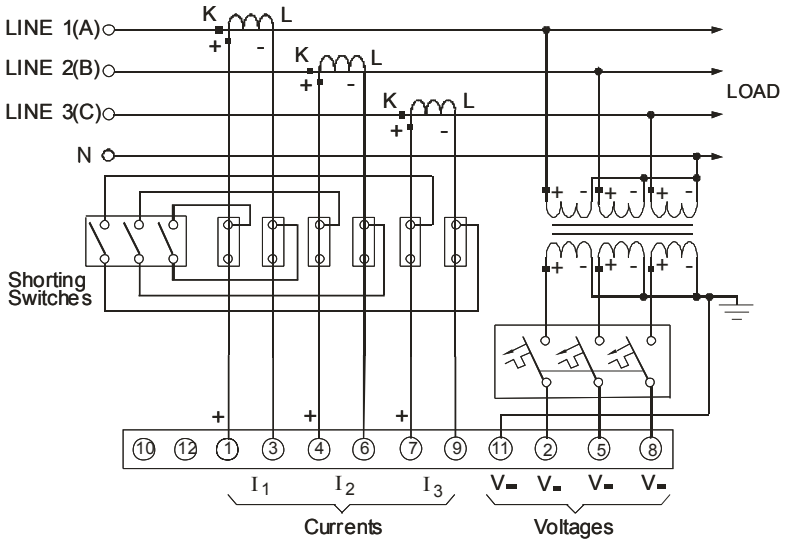



*Figure 3-4*
*Four Wire Wye Connection Using 3 PTs,3 CTs (3-element)*
*Wiring Mode* = **4LL3** or **4Ln3**

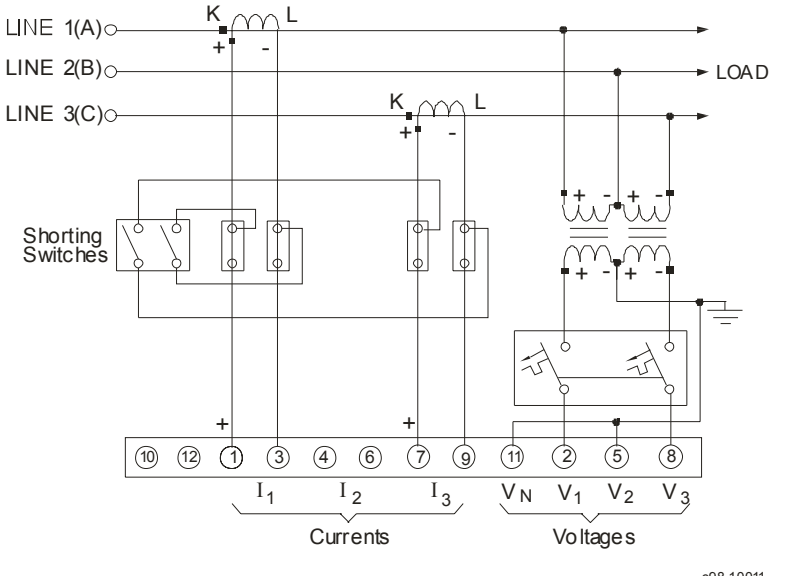



*Figure 3-5*

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

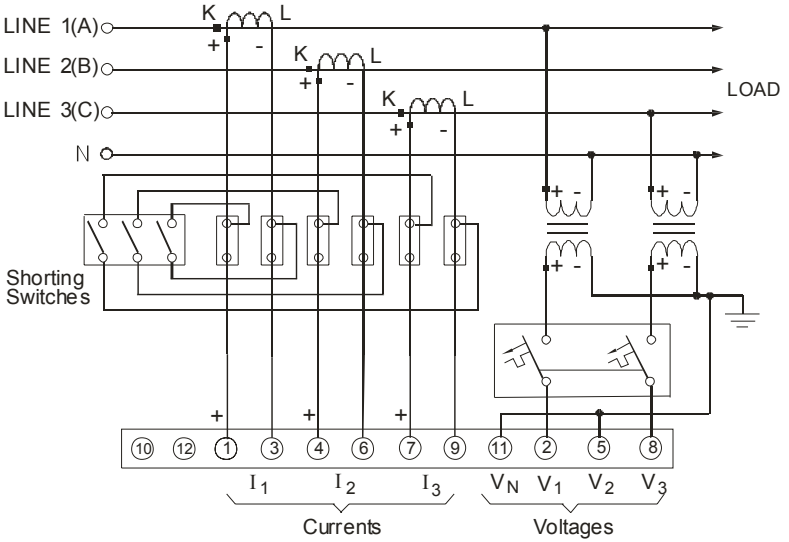



*Figure 3-6*
*Four Wire Wye Connection Using 2 PTs, 3 CTs (2 ½-element)*
*Wiring Mode* = **3LL3** or **3Ln3**

**[Note**: Use this configuration only if voltages are balanced]

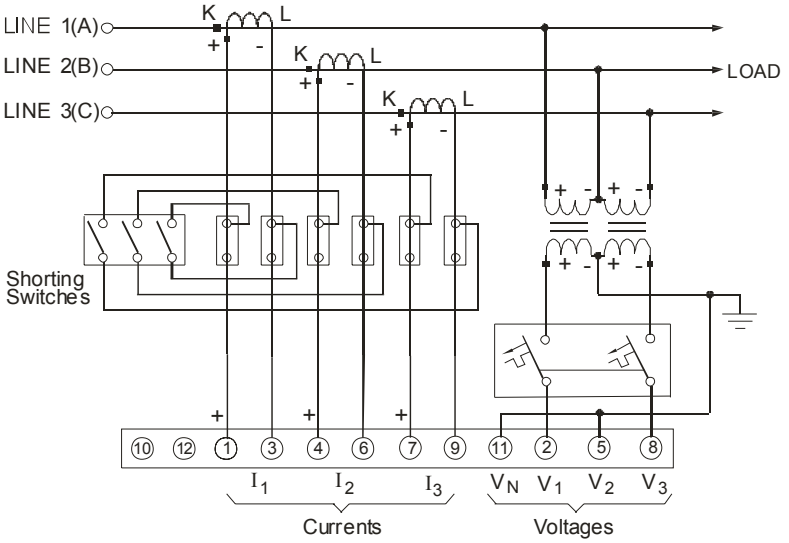



*Figure 3-7*
*Three Wire Open Delta Connection Using 2 PTs, 3 CT (2½-element)* *Wiring Mode* = **3OP3**

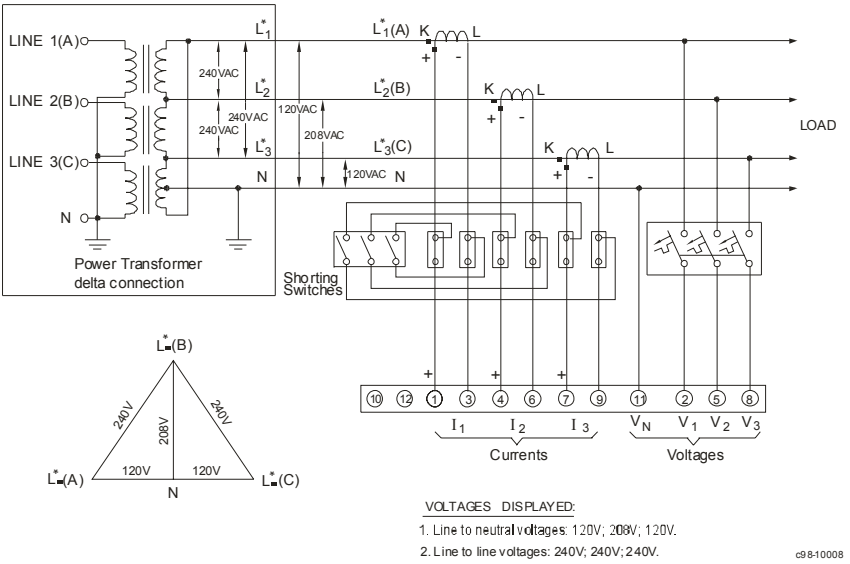



*Figure 3-8 Four Wire Delta Direct Connection Using 3 CTs (3 element) Wiring Mode* = **4LL3** or **4Ln3**

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## 3.5 Relays

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

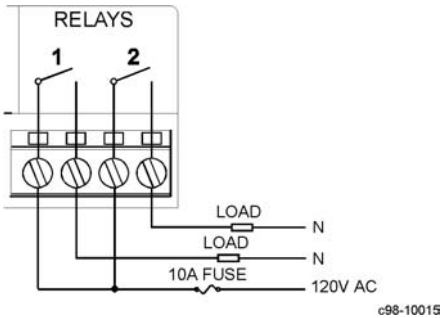



*Figure 3-9 Relay Output Terminal*

## 3.6 Status Inputs

Four status inputs are provided for status monitoring, external synchronization input for power demand period, or output selector for multiplexed analog output.

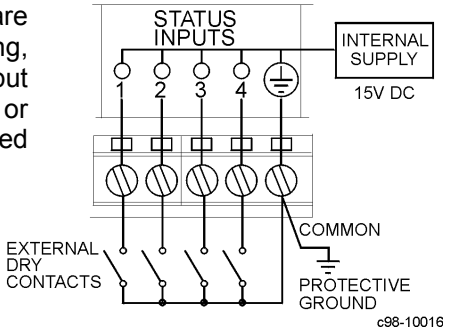



*Figure 3-10 Status Inputs Connections*

## 3.7 Analog Output

The *RPT091* provides one optically isolated analog output with an internal power supply and current output options of 0-20 mA, 4-20 mA, 0-1 mA and ±1 mA.

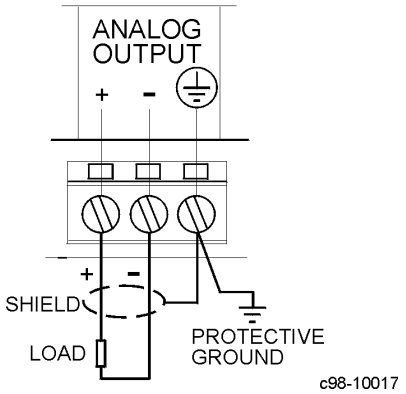



*Figure 3-11 Analog Output*

Stabilization of the analog output after an input change takes up to 250 ms for real time data, and 1 to 6 sec for average data, depending on how the buffer is defined in the setup (see *Section 5.1, Basic Setup*).

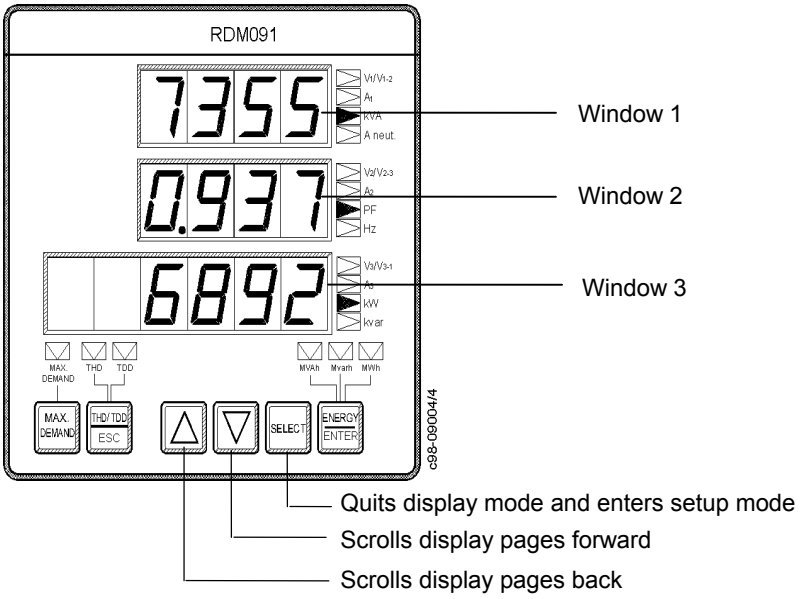
One or two AX-7 analog expanders, DIN-rail mounted and connected via an RS-422 line, can be used for extension of the internal analog output.

# 4 RDM Display

Upon power up, the RDM assumes the **display mode**. Displayed parameters are divided into 4 groups. Each group is accessible by pressing the appropriate key, as follows:

| *Measurement Group:* | *To Display Parameters:* |
|---|---|
| Common | default - Press the key that has an illuminated arrow LED pointing to it (below the lower window). If no LED is lit up, this means that the RDM is displaying the common measurements parameters. |
| Maximum demands | press **MAX. DEMAND** key |
| Harmonic * | press **THD/TDD** key (RPT091H only) |
| Energy | press **ENERGY** key |

* Only the *RPT091H* provides harmonic measurements. The RDM is the same for both the *RPT091* and the *RPT091H*. In the case of the *RPT091*, the **THD/TDD** key is not used.




[Press both arrows simultaneously to return to page 1of the display]

*Table 4-1 Displayed Parameters*

| Page | Window | LED ▸ | Parameter ① | Digits | Unit ② |
|---|---|---|---|---|---|
| | | | **Common Measurements** | | |
| 1 | 1 | **V1/V1-2** | Voltage L1/L12 | 4 | V/kV |
| 1 | 2 | **V2/V2-3** | Voltage L2/L23 | 4 | V/kV |
| 1 | 3 | **V3/V3-1** | Voltage L3/L31 | 4 | V/kV |
| 2 | 1 | **A1** | Current L1 | 4 | A/kA |
| 2 | 2 | **A2** | Current L2 | 4 | A/kA |
| 2 | 3 | **A3** | Current L3 | 4 | A/kA |
| 3 | 1 | **kVA** | Total kVA | 4 | kVA/MVA |
| 3 | 2 | **PF** | Total power factor | 4 | |
| 3 | 3 | **kW** | Total kW | 4 | kW/MW |
| 4 | 1 | **A NEUT** | Neutral current | 4 | A/kA |
| 4 | 2 | **Hz** | Frequency | 4 | Hz |
| 4 | 3 | **kvar** | Total kvar | 4 | kvar/Mvar |
| 5 | 1 | | **Ph.L1** | | Label |
| 5 | 2 | **PF** | Power factor L1 | 4 | |
| 5 | 3 | **kW** | kW L1 | 4 | kW/MW |
| 6 | 1 | **kVA** | kVA L1 | 4 | kVA/MVA |
| 6 | 2 | | **Ph.L1** | | Label |
| 6 | 3 | **kvar** | kvar L1 | 4 | kvar/Mvar |
| 7 | 1 | | **Ph.L2** | | Label |
| 7 | 2 | **PF** | Power factor L2 | 4 | |
| 7 | 3 | **kW** | kW L2 | 4 | kW/MW |
| 8 | 1 | **kVA** | **kVA L2** | 4 | kVA/MVA |
| 8 | 2 | | **Ph.L2** | | Label |
| 8 | 3 | **kvar** | **kvar L2** | 4 | kvar/Mvar |
| 9 | 1 | | **Ph.L3** | | Label |
| 9 | 2 | **PF** | Power factor L3 | 4 | |
| 9 | 3 | **kW** | kW L3 | 4 | kW/MW |
| 10 | 1 | **kVA** | **kVA L3** | 4 | kVA/MVA |
| 10 | 2 | | **Ph.L3** | | Label |
| 10 | 3 | **kvar** | **kvar L3** | 4 | kvar/Mvar |
| 11 | 1 | | **PHAS.** | | Label |
| 11 | 2 | | **rOt.** | | Label |
| 11 | 3 | | Phase rotation(POS/NEG/ERR) | 4 | |
| 12 | 1 | | **StAt.** | | Label |
| 12 | 3 | | Status inputs #1-#4 | 4 | |
| 13 | 1 | | **rEL.** | | Label |
| 13 | 3 | | Relay status #1-#2 | 4 | |

| Page | Window | LED ▸ | Parameter ① | Digits | Unit ② |
|---|---|---|---|---|---|
| | | | **Maximum Demands** | | |
| | | | **MAX. DEMAND** | | |
| 1 | 1 | **A1** | Maximum ampere demand L1 | 4 | A/kA |
| 1 | 2 | **A2** | Maximum ampere demand L2 | 4 | A/kA |
| 1 | 3 | **A3** | Maximum ampere demand L3 | 4 | A/kA |
| 2 | 1 | **kVA** | Max. sliding window kVA demand | 4 | kVA/MVA |
| 2 | 3 | **kW** | Max. sliding window kW demand | 4 | kW/MW |
| | | | **Harmonic Measurements** | | |
| | | **THD** | | | |
| 1 | 1 | **V1/V1-2** | Voltage THD L1/L12 | 4 | % |
| 1 | 2 | **V2/V2-3** | Voltage THD L2/L23 | 4 | % |
| 1 | 3 | **V3/V3-1** | Voltage THD L3 | 4 | % |
| 2 | 1 | **A1** | Current THD L1 | 4 | % |
| 2 | 2 | **A2** | Current THD L2 | 4 | % |
| 2 | 3 | **A3** | Current THD L3 | 4 | % |
| | | **TDD** | | | |
| 3 | 1 | **A1** | Current TDD L1 | 4 | % |
| 3 | 2 | **A2** | Current TDD L2 | 4 | % |
| 3 | 3 | **A3** | Current TDD L3 | 4 | % |
| | | | **Total Energies** | | |
| 1 | 1 | **MWh** | **Ac.En.** | | Label |
| 1 | 2 | | **IP.** | | Label |
| 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 |
| **Phase Energies** (if enabled in the BASIC SETUP configuration) | | | | | |
| 6 | 1 | **MWh** | **Ac.En.** | | Label |
| 6 | 2 | | **IP.L1** | | Label |
| 6 | 3 | | MWh import L1 | 6 | MWh |
| 7 | 1 | **Mvarh** | **rE.En.** | | Label |
| 7 | 2 | | **IP.L1** | | Label |
| 7 | 3 | | Mvarh import L1 | 6 | Mvarh |
| 8 | 1 | **MVAh** | **AP.En.** | | Label |
| 8 | 2 | | **L1** | | Label |
| 8 | 3 | | MVAh L1 | 6 | MVAh |

| Page | Window | LED ▸ | Parameter ① | Digits | Unit ② |
|---|---|---|---|---|---|
| 9 | 1 | **MWh** | **Ac.En.** | | Label |
| 9 | 2 | | **IP.L2** | | Label |
| 9 | 3 | | MWh import L2 | 6 | MWh |
| 10 | 1 | **Mvarh** | **rE.En.** | | Label |
| 10 | 2 | | **IP.L2** | | Label |
| 10 | 3 | | Mvarh import L2 | 6 | Mvarh |
| 11 | 1 | **MVAh** | **AP.En.** | | Label |
| 11 | 2 | | **L2** | | Label |
| 11 | 3 | | MVAh L2 | 6 | MVAh |
| 12 | 1 | **MWh** | **Ac.En.** | | Label |
| 12 | 2 | | **IP.L3** | | Label |
| 12 | 3 | | MWh import L3 | 6 | MWh |
| 13 | 1 | **Mvarh** | **rE.En.** | | Label |
| 13 | 2 | | **IP.L3** | | Label |
| 13 | 3 | | Mvarh import L3 | 6 | Mvarh |
| 14 | 1 | **MVAh** | **AP.En.** | | Label |
| 14 | 2 | | **L3** | | Label |
| 14 | 3 | | MVAh L3 | 6 | MVAh |

① Display readings for all electrical quantities are sliding average values.

② Voltage and current readings with a decimal point are displayed in kV and kA. Power readings with a decimal point are displayed in MW, Mvar, and MVA. When the value is wider than the window, the right-most digits are truncated.

③ The maximum range for energy readings is 999,999,999 kWh/kvarh/kVAh. Beyond this value, the reading will roll over to zero. Negative (exported) energy readings are displayed without a sign.

# 5 Setup on the RDM

Setup can be performed via the RDM or *PComTest* software. *PComTest* is supplied on a disk which includes setup instructions[1].

The functions of the RDM keys in the **setup mode** are shown below:

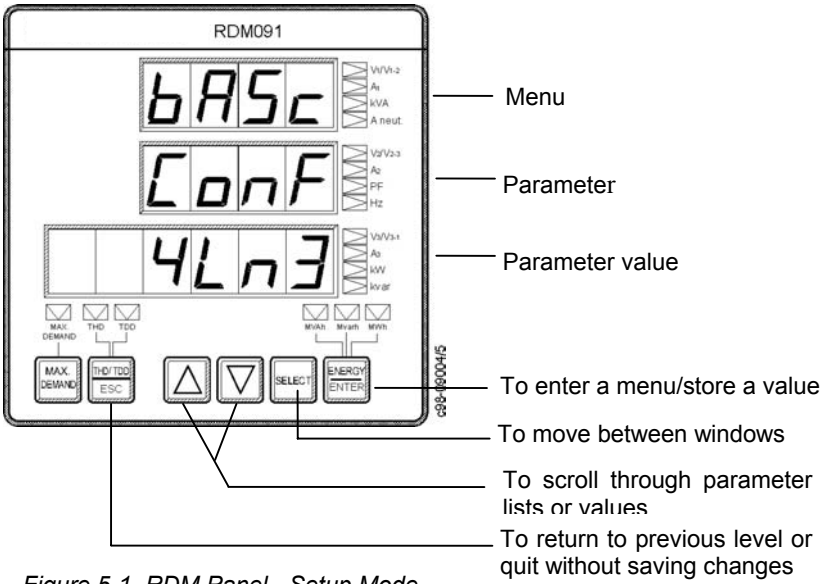



*Figure 5-1 RDM Panel - Setup Mode*

**Setup Procedure**

1. Press SELECT to enter **setup mode**.

2a. Press SELECT again to go to SEE (for viewing only), or

2b. Press SELECT again to go to CHG (for editing setup)

3. Press ENTER. If a password is required, use ▲ ▼ to input the first digit and press SELECT to advance to next digit. After all 4 digits are input, press ENTER.

4. Press SELECT to choose the menu; press ENTER.

[1] All parameters may be set up via either the RDM or *PComTest*. It is recommended to use the RDM for Basic and Communications parameters setup, and to use *PComTest* for setup of all other menus.

5. Press SELECT to activate the middle window; use ▲ ▼ to choose the parameter; press ENTER.
6. Press SELECT to activate the lower window; use ▲ ▼ to choose the value; press ENTER (or press ESC to leave value unchanged).

**Menus**

| Code | Full Name | Code | Full Name |
|---|---|---|---|
| *bASc* | Basic - *see Section 5.1* | *PulS* | Pulsing Relay * |
| *Port* | Communications Port - *see Section 4.2* | *SetP* | Alarm Setpoints * |
| | | *rtc* | Real time Clock* |
| *dinP* | Digital (Status) Inputs * | *disp* | Display* |
| *Aout* | Analog Output * | *rSt* | Reset enable/disable * |
| *AEPn* | Analog Expander * | *AccS* | Password enable/disable * |

* For full setup instructions for these parameters, see the complete *RPT091 Installation and Operation Manual*.

## 5.1 Basic Setup Parameters

| *Code* | *Parameter* | *Options / Value Range* | *Description* |
|---|---|---|---|
| *ConF* | Wiring Mode | *3OP2* | 3-wire open delta using 2 CTs (2 element) |
| | | *3OP3* | 3-wire open delta using 3 CTs (2½ element) |
| | *Default =* | *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 |
| | | *3Ln3* | 4-wire Wye using 2 PTs (2 ½ element), line to neutral voltage readings |
| | | *3LL3* | 4-wire Wye using 2 PTs (2 ½ element), line to line voltage readings |
| *Pt* | PT Ratio | *1.0 to 6500.0* | The phase potential transformer ratio. If direct connection, set PT to 1; otherwise, PT= primary voltage/ secondary voltage<br>*Default = 1* |

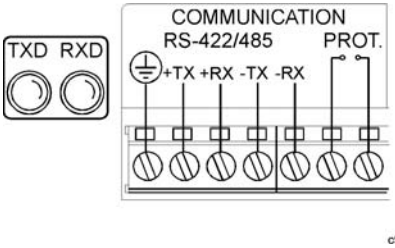
| Code | Parameter | Options / Value Range | Description |
|---|---|---|---|
| *Ct* | CT Primary Current | *1 to 50000* | The primary current rating of the phase current transformer, in A<br>*Default = 5* |
| *d.P* | Demand Period | *1,2,5,10, 15,20, 30,60,E* | The length of the demand period for power demand calculations, minutes. E = external synchronization<br>*Default = 15 min* |
| *n.dp* | Number of Demand Periods | *1-15* | The number of demand periods to be averaged for sliding window demands.<br>*Default = 1* = block interval demand calculation |
| *A.dP* | Ampere Demand Period | *0 to 1800* | The length of the demand period for ampere demand calculations, in seconds.<br>0 = measuring peak currents<br>*Default = 900 sec* |
| *buF* | Averaging Buffer Size | *8,16,32* | The number of measurements for RMS sliding averaging. *Default = 8* |
| *rSt* | RESET enable/disable | *diS, En* | Protects all reset functions either via the RDM or communications. When set to diS, these functions are disabled. *Default = En* |
| *Freq* | Nominal Frequency | *50, 60* | The nominal frequency of the monitored electrical network, in Hz. *Default = 50 Hz*<br>NOTE: When measured voltages exist, the nominal frequency is the measured frequency. This parameter is used when measuring currents in the absence of voltages. |
| *LoAd* | Maximum Demand Load Current | *1-50,000* | The maximum demand load current used in TDD calculations, in A. If value is unknown, set to CT Primary Current value.<br>*Default* = 5000 |
| *Ph.En* | Phase Energy Measurement | *dis, En* | Enables/disables measurements of energies per phase. *Default = En* |

## 5.2 Communications Port Setup Parameters

| *Code* | *Parameter* | *Options / Value Range* | *Description* |
|---|---|---|---|
| *Prot* | Communications Protocol * | *ASCII* | *ASCII* protocol = *Default* |
| | | *rtu*<br>*dnP3* | non-ASCII protocol |
| *rS* | Interface Standard | *422*<br>*485* | RS-422 (4 wires)<br>RS-485 (2 wires)=*Default* |
| *Addr* | Address | *0-255* | Powermeter address:<br>1-99: ASCII;<br>1-247: Modbus<br>255: DNP 3.0, SPA<br>*Default = 1* |
| *bAud* | Baud Rate | *110, 300, 600, 1200, 2400, 4800, 9600, 19.2* | 110 baud, 300 baud, 600 baud, 1200 baud, 2400 baud, 4800 baud, 9600 baud = *Default*, 19200 baud |
| *dAtA* | Data Format | *7E*<br>*8n*<br>*8E* | 7 bits, even parity<br>8 bits, no parity = *Default*<br>8 bits, even parity |

* The communications protocol is selected by a short between terminals 13 and 14 on the RPT091 (see Section 6). The protocol may be modified after a cold restart of the RPT091.

# 6 Communications




+TX Transmit Data Plus
+RX Receive Data Plus

-TX Transmit Data Minus
-RX Receive Data Minus

PROT Communication Protocol

*Figure 6-1 Terminal Block - ASCII*

---

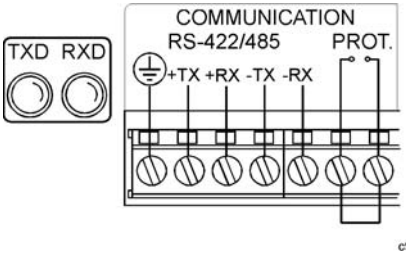



*Figure 6-2 Terminal Block - Non-ASCII*

Both the RS-422 and RS-485 standards enable connection of up to 32 instruments on one multi-drop line for a distance of up to 1200 meters.

The *RPT091* provides two green LED indicators TXD and RXD, which show activity on the RS-422/RS-485 communication port. The TXD indicator flashes when the instrument sends out data. The RXD indicator flashes when the instrument receives data.

*Figures 6-3* through *6-6* illustrate all RS-422 and RS-485 cable configurations and wiring connections.

A full description of the communications software is found in the *RPT091 Communications Manual*.

**NOTE**

Where an RS-232/RS-422 converter is used, R1 is not applicable (see *Figures 6-3* and *6-4*) since it is built in to the converter.

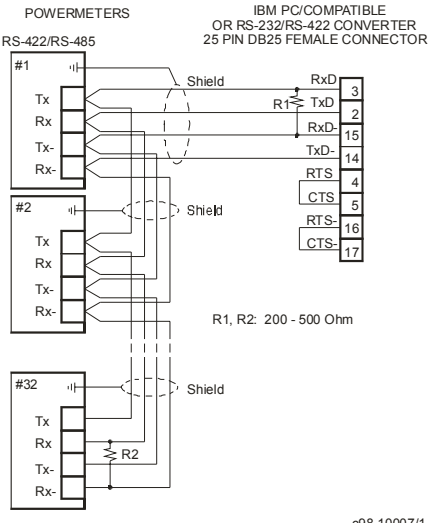



*Figure 6-3 RS-422 Multidrop Connection, 25-Pin PC Port*

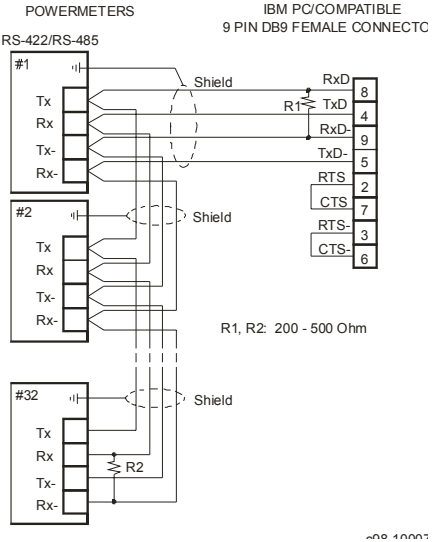



*Figure 6-4 RS-422 Multidrop Connection, 9-Pin PC Port*

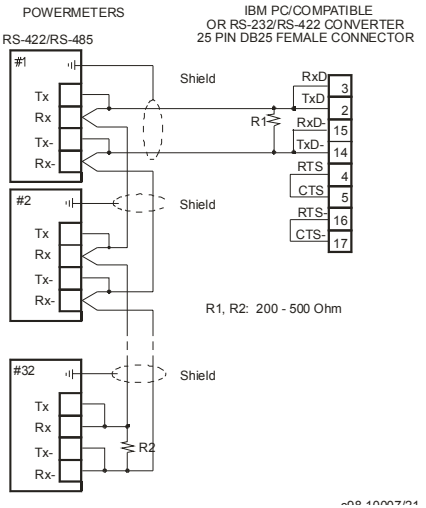



*Figure 6-5 RS-485 Multidrop Connection, 25-Pin PC Port*

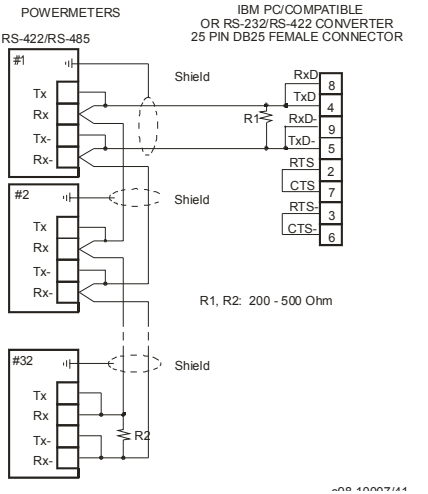



*Figure 6-6 RS-485 Multidrop Connection, 9-Pin PC Port*

Use a shielded, 0.33 $mm^2$/22 AWG twisted pair cable for each communication link; terminate the ends of multi-drop line with 200-500 Ohm resistors. Connect the cable shield to the ground input.

# 7 Troubleshooting

| *Problem* | *Probable Cause* | *What to do* |
|---|---|---|
| Code other than '8'on RDM panel LED | Self-diagnostic test negative result | Note the code and call your distributor |
| Power LED on RPT not lit | Insufficient power supply | Check voltage level on power supply inputs (10,12) |
| Display LED on RDM not lit | Faulty cable connection | Check RDM cable connections |
| Varying line-to-line voltages | Incorrect voltage inputs connections | Check voltage inputs connections |
| Non-positive phase rotation | 1. Concrete load has negative sequence<br>2. Incorrect voltage inputs connections<br>3. One or two phase voltages not connected | Check voltage inputs connections |
| One or more phase currents not displayed | Incorrect current inputs connections | Check current inputs connections |
| Phase active powers or power factors unequal or values do not correspond to actual load | Incorrect voltage or current inputs connections | Check voltage and current inputs connections; check polarity of CT connections |
| Cannot proceed past the first RDM menu | Incorrect password | Check that your password is correct. If you cannot provide the correct password, call your distributor for instructions on overriding password protection. |
| RDM window continues to flash after pressing ENTER | Value has been entered incorrectly or is incompatible with other setup parameters. | Check that parameter definition is correct. |

| ***Problem*** | ***Probable Cause*** | ***What to do*** |
|---|---|---|
| Alarm setpoints or analog output channels disabled | Setup parameters that affect voltage/current/ power were changed | Define these setup parameters (wiring mode, PT ratio, CT primary current) prior to setting up alarm setpoints/analog channels. |
| Status inputs setup not accepted | 1. The analog selector inputs and the external synchronization pulse input overlap.<br>2. Allocated inputs for the analog output selector are not contiguous and do not start from input #1. | Check that all inputs are allocated correctly |
| Cannot store pulsing output setup | 1. You assigned a parameter to a relay output with zero number of unit-hours per pulse<br>2. You selected an output parameter already assigned to another relay output. | 1. Check that no. unit-hours is within allowed range (1-9999)<br>2. Check that output parameters are assigned correctly. |
| Cannot store setpoint setup | Setpoint action is directed to a relay already allocated for pulsing | Check definition of setpoint actions |
| Cannot enter ***reset*** menu | 1. Reset function disabled<br>2. You are at SEE level (viewing only) | 1. Enable reset function in BASIC setup<br>2. Go to CHG (editing) level |
| No phase energy readings displayed | Phase energy not enabled in BASIC setup | Enable phase energy measurement |
| TXD LED flashes continuously after turning on instrument | Analog expander AX-7 outputs are allocated | If analog expander not used, analog outputs must be cancelled |

| ***Problem*** | ***Probable Cause*** | ***What to do*** |
|---|---|---|
| PCOMTEST program works continuously but TXD LED of PC COMPORT does not flash | 1. PC COMPORT number is not correct<br>2. PC COMPORT setting uncorrected<br>3. PC COMPORT is damaged | Change COMPORT number (setup of PCOMTEST);<br>Check COMPORT card setting;<br>Change COMPORT card |
| Instrument RXD LED does not flash | Communication cable not connected properly | Check cable |
| Instrument TXD LED does not flash | Instrument COMPORT setting is not correct | Check that instrument & PC COMPORT settings match:<br>RS Standard<br>Address<br>Data Format<br>Baud rate<br>Protocol name (ASCII or non-ASCII) |
| PC COMPORT RXD LED does not flash | Communication cable not connected properly | Check cable |
| Instrument does not respond more than 1% of sessions in the ASCII or non-ASCII test | 1. ON the communication line there are a few instruments with the same address or instruments with address zero<br>2. Analog expander outputs are allocated on the one of the instruments | 1. Check every instrument separately<br>2. Cancel the analog outputs if analog expander is not used |
| PCOMTEST receives reply from the instrument with an incorrect check sum | Problems with the communication lines | Check the communication line:<br>Wires must be more than 0.33 $mm^2$ / 22 AWG<br>Grounded screen<br>Terminated resistors<br>Communication line Distance < 1200 m |

# Appendix: Technical Specifications

## *Input and Output Ratings*

| | | |
|---|---|---|
| *3 Galvanically Isolated Voltage inputs* | *120 V:* | INPUT USING PT (up to 120V+20% line-to-line voltage) Burden: <0.15 VA |
| | *690 V:* | DIRECT INPUT (up to 690V +15% line-to-line voltage) Burden: <0.5 VA<br>INPUT USING PT - Burden: <0.15 VA |
| *3 Galvanically Isolated Current inputs* | *1 A:* | INPUT VIA CT with 1A secondary output<br>Burden: <0.02 VA<br>Overload withstand: 2A RMS continuous, 50A RMS for 1 second |
| | *5 A:* | INPUT VIA CT with 5A secondary output<br>Burden: <0.1 VA<br>Overload withstand: 10A RMS continuous, 250A RMS for 1 second |
| *Voltage and Current Input terminals* | | UL recognized<br>Maximum wire section: 4 $mm^2$ (10 AWG) |
| *Optically Isolated Communication Port* | | EIA RS-422 and RS-485 standards<br>Maximum wire section: 2.5 $mm^2$ (12 AWG) |
| *2 Relay Outputs* | | Relay rated at 5A, 250 VAC/ 5A, 30 VDC<br>2 contacts (SPST Form A) |
| *4 Optically Isolated Digital Inputs* | | Dry Contact |
| *Optically Isolated Analog Output* | *4-20 mA default*<br>*0-20 mA (option)*<br>*± 1 mA (option)* | Accuracy 0.5%, Non-linearity 0.2%<br><br>Load up to 510 Ohm for 20 mA<br>Load up to 10kOhm for 1 mA |

| | |
|---|---|
| ***Display*** *(optional)* | 3 high-brightness seven-segment digital LEDs |

## *Power Supply*

| | |
|---|---|
| *Galvanically isolated Power supply (factory set)* | |
| *120&230 V AC and 110&220 V DC* | 85 - 265V AC 50/60 Hz and 88 - 290V DC Burden 10 W |
| *option 12 V DC* | 9.6 - 19 VDC |
| *option 24 V DC* | 19 - 37 VDC |
| *option 48 V DC* | 37 - 72 VDC |

## *Environmental Conditions*

| | |
|---|---|
| *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: Aluminum, anodized<br>Dimension: 186x75x109 mm (7.33 x 2.95 x 4.30 “)<br>Mounting: 35 mm DIN rail or wall mount or 4-inch panel mount |
| *Instrument weight* | 0.94 kg (2.1 lb.) |
| *Display body* | Display body: plastic<br>Front Panel: plastic ABS/PC blend<br>Dimension: 114.3x114.3x20.0 mm (4.5x4.5x .787”)<br>Mounting: wall mount |
| *Display weight* | 0.2 kg (0.44 lb.) |

## *Standards Compliance*

| | |
|---|---|
| *Standards* | UL File # E129258<br>CE-EMC: 89/336/EEC as amended by 92/31/EEC and 93/68/EEC<br>CE-SAFETY: 72/23/EEC as amended by 93/68/EEC and 93/465/EEC<br>Harmonized standards to which conformity is declared:<br>EN55011:1991; EN50082-1:1992; EN61010-1:1993; A2/1995<br>ANSI C37.90.1 1989 Surge Withstand Capability (SWC)<br>ANSI C62.41 - 1991 Standard Surge<br>EN50081-2 Generic Emission Standard - Industrial Environment<br>EN50082-2 Generic Immunity Standard - Industrial Environment<br>EN55022: 1994 Class A<br>EN61000-4-2<br>ENV50140: 1983<br>ENV50204: 1995 (900MHz)<br>ENV50141: 1993<br>EN61000-4-4:1995<br>EN61000-4-8: 1993 |

## *Measurement Specifications*

| ***Parameter*** | ***Full Scale*** | | ***Accuracy, %*** ***Rdg*** | ***FS*** | ***Conditions*** | ***Range*** | ***Display Resolution (%Rdg) ② @ range*** |
|---|---|---|---|---|---|---|---|
| *Voltage* | 120V×PT @ 120V **or** 380V×PT @ 660V | For Ln reading and for 3OP2/3OP3 wiring modes | | 0.25 | 10% to 120% FS | 0 to 999,000 V | 1 V @ 1V to 9,999 V<br>≤0.1% @ 10,000 V to 999,000 V<br>Starting voltage 1.5% FS |
| | 208V×PT @ 120V **or** 660V×PT @ 660V | For LL reading except 3OP2/3OP3 wiring modes | | | | | |
| *Line current* | CT PRIMARY CURRENT | | | 0.25 | 2% to 120% FS | 0 to 60,000 A | 1 A @ 1A to 9,999 A<br>≤0.1% @ 10,000 A to 60,000 A<br>Starting current 0.5% FS |
| *Active power* | 0.36×PT×CT @ 120V input<br>1.2×PT×CT @ 690V input | | | 0.5 | \|PF\| ≥ 0.5 ① | -2,000,000 to +2,000,000 kW | 1 kW @ 1kW to 9,999 kW<br>≤0.1% @ 10 MW to 2,000 MW |
| *Reactive power* | 0.36×PT×CT @ 120V input<br>1.2×PT×CT @ 690V input | | | 0.5 | \|PF\| ≤ 0.9 ① | -2,000,000 to +2,000,000 kvar | 1 kvar @ 1kvar to 9,999 kvar<br>≤0.1% @ 10 Mvar to 2,000 Mvar |
| *Apparent power* | 0.36×PT×CT @ 120V input<br>1.2×PT×CT @ 690V input | | | 0.5 | \|PF\| ≥ 0.5 ① | 0 to 2,000,000 kVA | 1 kVA @ 1kVA to 9,999 kVA<br>≤0.1% @ 10 MVA to 2,000 MVA |
| *Power factor* | 1 | | | 1 | \|PF\| ≥ 0.5 | -0.999 to +1.000 | 0.001 |
| *Frequency* | | | 0.1 | | | 45.00 to 65.00 Hz | 0.01 Hz |

| *Parameter* | *Full Scale* | *Accuracy, %* *Rdg* | *FS* | *Conditions* | *Range* | *Display Resolution (%Rdg) ② @ range* |
|---|---|---|---|---|---|---|
| *Neutral (unbalanced) current* | CT PRIMARY CURRENT | | 0.5 | 2% to 120% FS | 0 to 60,000 A | 1 A @ 1A to 9,999 A<br>≤0.1% @ 10,000 A to 60,000 A |
| *Ampere demand* | *same as for current* | | | | | |
| *kW demand (block & sliding)* | *same as for kW* | | | | | |
| *kVA demand (block & sliding )* | *same as for kVA* | | | | | |
| *K-Factor* | 999.9 | 5 typical | | | 1.0 to 999.9 | 0.1 (via communication) |
| *Total harmonic distortion THD U (I), % $U_1$ ($I_1$)* | 100 | | 1.5 | ≥ 1% FS @ U(I) ≥ 10% FSU (FSI) | 0 to 100 | 0.1 |
| *Total Demand harmonic distortion TDD (I), %* | 100 | | 1.5 | ≥ 1% FS @ I ≥ 10% FSI | 0 to 100 | 0.1 |
| *Active energy Import & Export* | | *according to power accuracy* ③ | | | 0 to 999,999 MWh | 1 kWh @ 1 to 999999 kWh<br>10 kWh @ 1000 to 9,999 MWh<br>100 kWh @ 10 to 99.999 GWh<br>1MWh @ 100 to 999.9 GWh |
| *Reactive energy Import & Export* | | *according to power accuracy* ③ | | | 0 to 999,999 Mvarh | 1 kvarh @ 1 to 999999 kvarh<br>10 kvarh @ 1000 to 9,999 Mvarh<br>100 kvarh @ 10 to 99.999 Gvarh<br>1Mvarh @ 100 to 999.9 Gvarh |

| *Parameter* | *Full Scale* | *Accuracy, %* *Rdg* *FS* *Conditions* | *Range* | *Display Resolution (%Rdg) ② @ range* |
|---|---|---|---|---|
| *Apparent energy* | | *according to power accuracy* ③ | 0 to 999,999 MVAh | 1 kVAh @ 1 to 999999 kVAh<br>10 kVAh @ 1000 to 9,999 MVAh<br>100 kVAh @ 10 to 99.999 GVAh<br>1MVAh @ 100 to 999.9 GVAh |

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

① @ 10% to 120% of voltage FS and 2% to 120% of current FS
② Higher resolution is achievable via communications
③ Where the current is > 10% FS, the energy accuracy is better than 1.5% Rdg.

**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 waveforms with THD ≤ 5% for kvar, kVA and PF; reference operating temperature: 20 - 26 °C.
3. Ordinary measurement error is considerably less than the specified accuracy which indicates maximum error.