

# **PMC-D721MD**

## **Digital Multifunction Meter**

### **User Manual**

### **Version: V1.0**

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## **DANGER**

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



## **CAUTION**

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



## DANGER

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

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

### **Limited warranty**

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

## Table of Contents

|                                                   |    |
|---------------------------------------------------|----|
| Chapter 1 Introduction .....                      | 7  |
| 1.1 Overview .....                                | 7  |
| 1.2 Features.....                                 | 7  |
| 1.3 Getting more information .....                | 8  |
| Chapter 2 Installation .....                      | 9  |
| 2.1 Appearance .....                              | 9  |
| 2.2 Unit Dimensions .....                         | 10 |
| 2.3 Mounting.....                                 | 10 |
| 2.4 Input Wiring .....                            | 11 |
| 2.5 Communications Wiring.....                    | 11 |
| 2.6 Digital Input Wiring .....                    | 11 |
| 2.7 Pulse Output Wiring .....                     | 12 |
| 2.8 Power Supply Wiring .....                     | 12 |
| Chapter 3 Front Panel.....                        | 13 |
| 3.1 Display .....                                 | 13 |
| 3.1.1 LCD Testing .....                           | 13 |
| 3.1.2 LCD Display Areas.....                      | 13 |
| 3.2 Using the Front Panel Buttons.....            | 15 |
| 3.3 LED Pulse Outputs .....                       | 15 |
| 3.4 Display Screen Types .....                    | 15 |
| 3.5 Setup Configuration via the Front Panel ..... | 15 |
| 3.5.1 Making Setup Changes.....                   | 16 |
| 3.5.2 Setup Menu .....                            | 16 |
| 3.5.3 Configuration .....                         | 17 |
| Chapter 4 Applications .....                      | 18 |
| 4.1 Digital Inputs .....                          | 18 |
| 4.2 Pulse Outputs .....                           | 18 |
| 4.3 Basic Measurement.....                        | 18 |
| 4.4 SOE .....                                     | 18 |
| Chapter 5 Modbus Register Map.....                | 19 |
| 5.1 Basic Measurements .....                      | 19 |
| 5.2 SOE Log.....                                  | 19 |
| 5.3 Device Setup.....                             | 21 |
| 5.3.1 Basic Setup Parameters.....                 | 21 |
| 5.3.2 I/O Setup Parameters.....                   | 21 |
| 5.3.3 Energy Pulse Setup Parameter .....          | 21 |
| 5.3.4 Communication Setup Parameters .....        | 21 |
| 5.4 Time.....                                     | 21 |
| 5.5 Clear Control .....                           | 22 |
| 5.6 Meter Information.....                        | 22 |
| Appendix A Technical Specifications.....          | 24 |

|                                      |    |
|--------------------------------------|----|
| Appendix B Standards Compliance..... | 25 |
| Appendix C Ordering Guide .....      | 26 |
| Contact us.....                      | 27 |

## Chapter 1 Introduction

This manual explains how to use the PMC-D721MD DC Multifunction Meter. Throughout the manual the term “meter” generally refers to all models. Differences between the models are indicated with the appropriate model number.

This chapter provides an overview of the PMC-D721MD meter and summarizes many of its key features.

### 1.1 Overview

The PMC-D721MD DC Multifunction Meter is CET’s latest offer for the low-cost DC metering market. Housed in an industry standard DIN form factor measuring 72mmx72mmx71.8mm, it is perfectly suited for industrial, commercial and utility DC metering applications. The PMC-D721MD complies with Class 0.5S kWh Accuracy Standard and features quality construction, multifunction measurements and a bright, easy to read LCD display. The PMC-D721MD comes standard with two front panel LED indicators for Energy Pulsing and Communication. It optionally provides two Digital Inputs for Status Monitoring and two Solid State Pulse Outputs for kWh Energy Pulsing applications. The standard SOE Log records meter events such as power-off, setup changes and DI operations in 1ms resolution. With the standard RS485 port and Modbus protocol support, the PMC-D721MD becomes a vital component of an intelligent, multifunction monitoring solution for any DC Power and Energy Management systems.

You can setup the meter through its front panel or via our free PMC Setup software. The meter is also supported by our PecStar® iEMS Integrated Energy Management System.

Following is a list of typical applications for the PMC- D721MD:

- DC Inverter, DC Panel Metering and DC Charging Station
- Industrial and commercial DC metering
- DC Distribution Monitoring

Contact CET Technical Support should you require further assistance with your application.

### 1.2 Features

#### Ease of use

- Large, backlit LCD display with wide viewing angle
- Intuitive user interface
- LED indicators for Energy Pulsing and Communication activities
- Password-protected setup via front panel or free PMC Setup software
- Easy installation with mounting clips, no tools required

#### Measurements

- Voltage, Current and kW
- Bi-directional kWh measurements

#### SOE Log

- 32 events time-stamped to  $\pm 1$ ms resolution
- Record all setup and Digital Input status changes

#### **Inputs and Outputs**

- 2xFront Panel LED indicators for Energy Pulsing and Communication
- Optional 2xDigital Inputs for Status Monitoring
- Optional 2xSolid State Relay for kWh Imp and kWh Exp Pulse Output.

#### **Communications**

- Standard RS-485 port with Modbus RTU support at 1200 to 19,200 bps equipped

#### **System Integration**

- Supported by CET's PecStar® iEMS and PMC Setup
- Easy integration into other Automation, SCADA or BMS systems via Modbus RTU

### **1.3 Getting more information**

Additional information is available from CET via the following sources:

- Visit [www.cet-global.com](http://www.cet-global.com)
- Contact your local representative
- Contact CET directly via email or telephone

## Chapter 2 Installation



### Caution

Installation of the PMC-D721MD should only be performed by qualified, competent personnel that have the appropriate training and experience with high voltage and current devices. The meter must be installed in accordance with all local and national electrical codes.

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

### 2.1 Appearance



Figure 2-1 Appearance

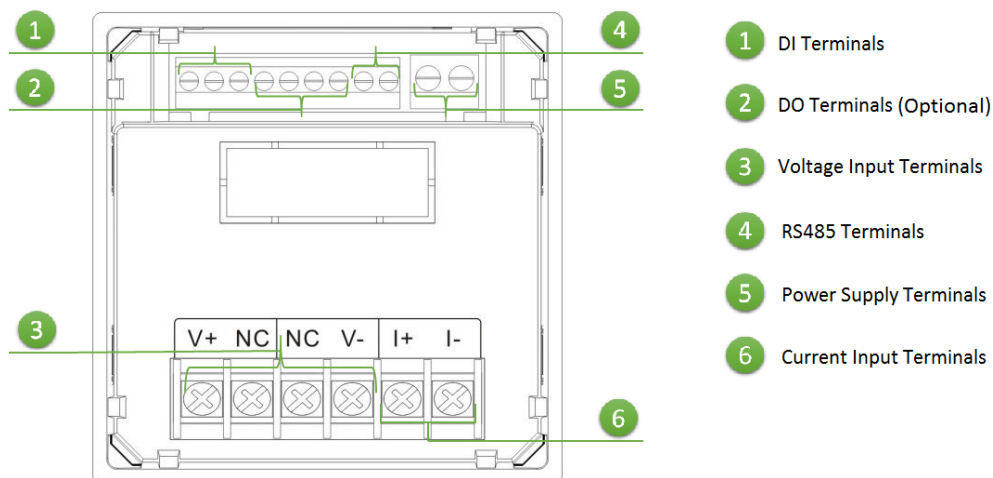


Figure 2-2 Rear Panel (2DIs + 2DOs)

## 2.2 Unit Dimensions

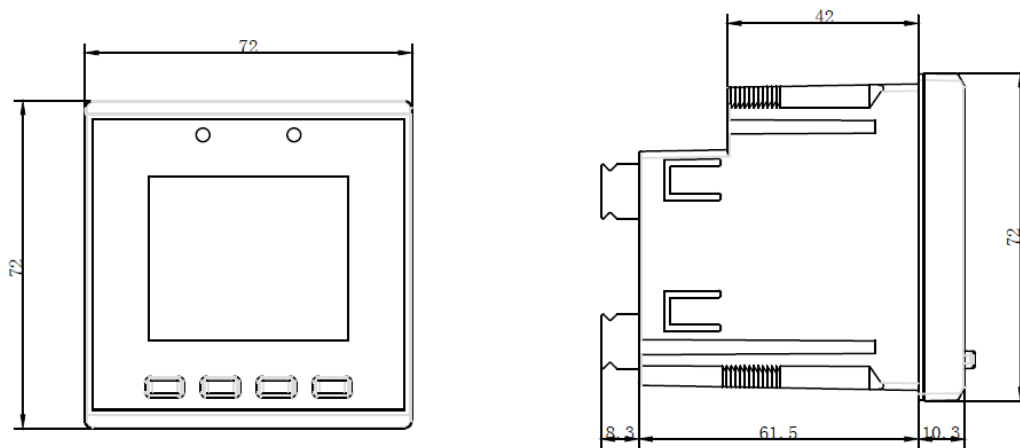


Figure 2-3 Dimension

## 2.3 Mounting

The PMC-D721MD meter should be installed in a dry environment with no dust and kept away from heat, radiation and electrical noise source.

Installation steps:

- Remove the installation clips from the meter
- Fit the meter through a 68mmx68mm cutout as shown in Figure 2-4
- Re-install the installation clips and push the clips tightly against the panel to secure the meter

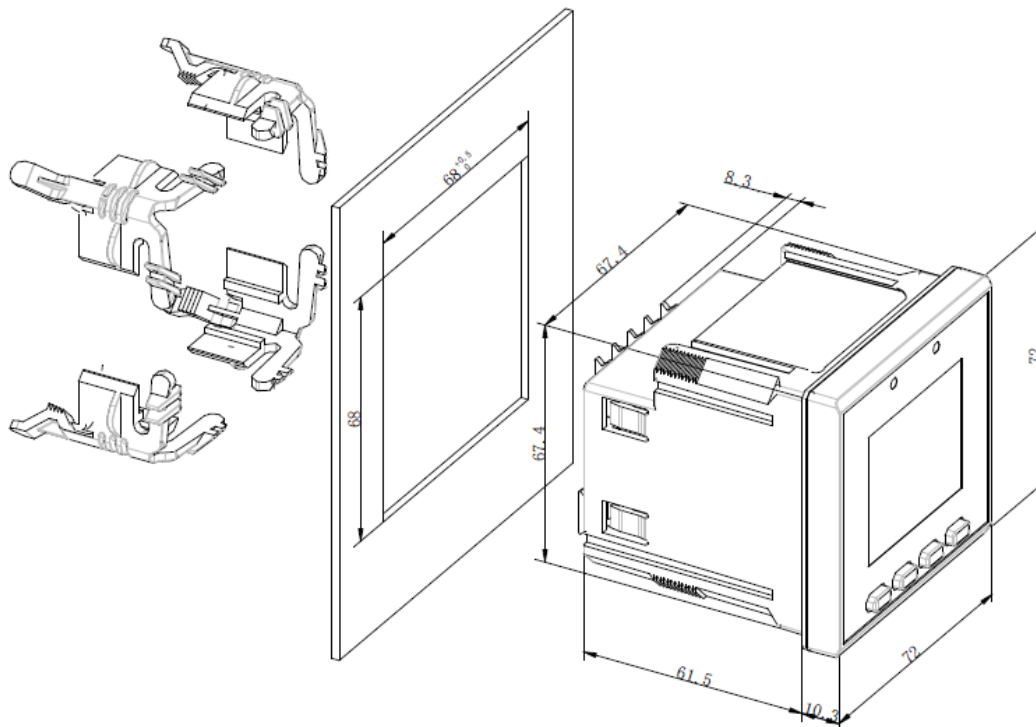


Figure 2-4 Panel Cutout

## 2.4 Input Wiring

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

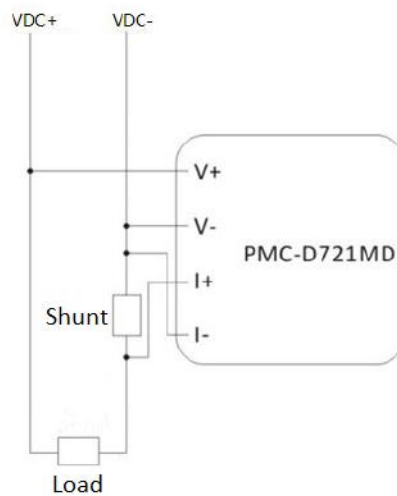


Figure 2-5 Input Connections

## 2.5 Communications Wiring

The following figure illustrates the RS485 communications connections on the PMC-D721MD:

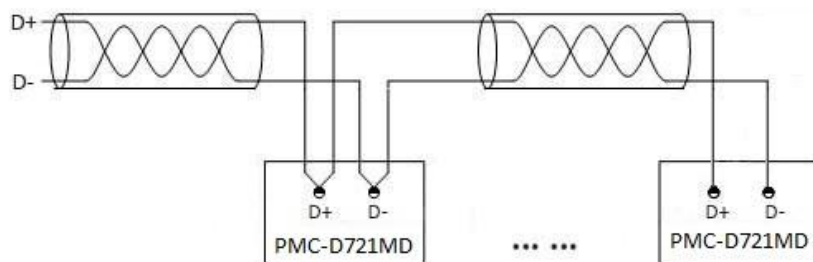


Figure 2-6 Communications Connections

The PMC-D721MD provides one RS485 port and supports the Modbus RTU protocol. Up to 32 devices can be connected on a RS485 bus. The overall length of the RS485 cable connecting all devices should not exceed 1200m.

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

## 2.6 Digital Input Wiring

The following figure illustrates the Digital Input connections on the PMC-D721MD:

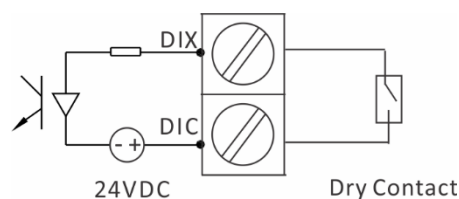


Figure 2-7 DI Connections

## 2.7 Pulse Output Wiring

The following figure illustrates the Pulse Output connections on the PMC-D721MD:

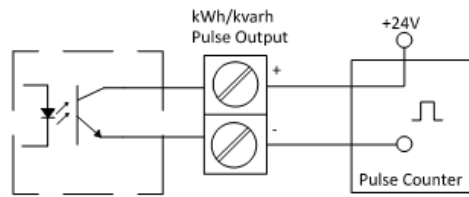


Figure 2-8 Pulse Output Connections

## 2.8 Power Supply Wiring

For AC supply, connect the live wire to the L/+ terminal and the neutral wire to the N/- terminal.

For DC supply, connect the positive wire to the L/+ terminal and the negative wire to the N/- terminal.

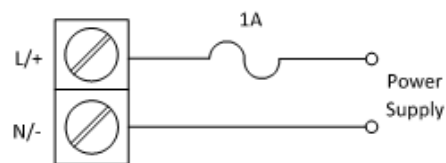


Figure 2-9 Power Supply Connections

## Chapter 3 Front Panel

The PMC-D721MD meter has a large, bright, backlit LCD display and four buttons for data display and meter configuration. This chapter introduces the front panel operations.



Figure 3-1 Front Panel

### 3.1 Display

#### 3.1.1 LCD Testing

Pressing both the <Phase> and the <Energy> buttons simultaneously for 2 seconds enters the LCD Testing mode. All LCD segments are illuminated during testing. The LCD will return to its normal display mode when any button is pressed.

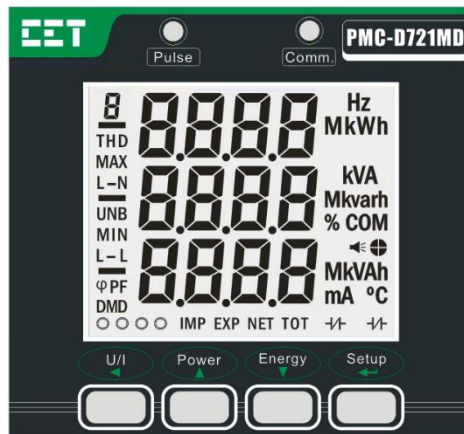


Figure 3-2 Full LED/LCD Display

#### 3.1.2 LCD Display Areas

This section provides a description of the LCD display areas. The PMC-D721MD with LCD display can generally be divided into 4 areas:

A: Measurement symbols for Voltage and Current. Other symbols such as THD, Unbalance, PF, Voltage Phase Angle, Current Phase Angle and Demand are reserved.

B: Measurement values

C: Measurement Units of kW and kWh. Other symbols such as Comm. Indicator, Hz, kvar/kvarh, kVA/kVAh, PF Quadrant status symbols, mA and °C are reserved.

D: DI Status and kWh Imp/Exp indicators. DO Status and kWh Net/Total indicators are reserved.

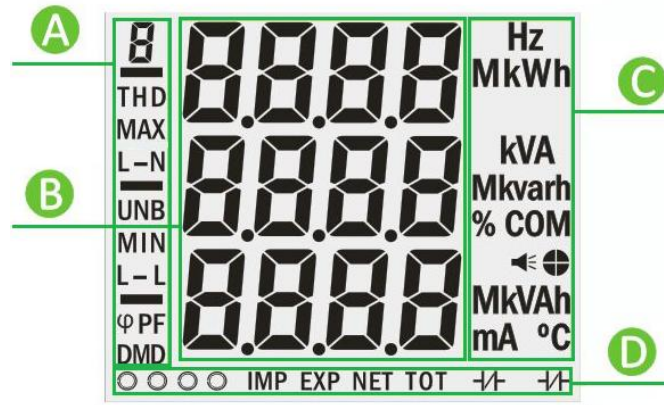


Figure 3-3 LCD Display

The following table shows the special LCD display symbols:

| NO. | Label                                                 | Description                                       |               |               |               |
|-----|-------------------------------------------------------|---------------------------------------------------|---------------|---------------|---------------|
| A   |                                                       | Voltage                                           |               | Current       |               |
|     | THD<br>MAX<br>L-N<br>UNB<br>MIN<br>L-L<br>φ PF<br>DMD | Reserved                                          |               |               |               |
| C   | MkWh                                                  | Measurement Units of Power (kW) and Energy (kWh). |               |               |               |
|     | Hz<br><br>kVA<br>Mkvarh<br>% COM<br>MkVAh<br>mA °C    | Reserved                                          |               |               |               |
| D   | ● IMP EXP                                             | ○<br>DI Open                                      | ●<br>DI Close | IMP<br>Import | EXP<br>Export |
|     | NET TOT                                               | Reserved                                          |               |               |               |

Table 3-1 LCD Display Symbols

### 3.2 Using the Front Panel Buttons

The button definitions under **Data Display Mode** and **Setup Configuration Mode** are explained in the following table. The default password is 0.

| Buttons  | Data Display Mode                                             | Setup Configuration Mode                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <U/I>    | Pressing <U/I> views the Voltage and Current measurements.    | <ul style="list-style-type: none"> <li>Once a parameter is selected, pressing this button moves the cursor to the left by one position if the parameter being changed is a numeric value.</li> </ul>                                                                                                                                                                                                                   |
| <Power>  | Pressing <Power> views the kW measurements.                   | <ul style="list-style-type: none"> <li>Before a parameter is selected for modification, pressing this button advances to the next parameter in the menu.</li> <li>If a parameter is already selected, pressing this button increments a numeric value or advances to the next value in the selection list.</li> </ul>                                                                                                  |
| <Energy> | Pressing <Energy> views kWh Import and kWh Export parameters. | <ul style="list-style-type: none"> <li>Before a parameter is selected for modification, pressing this button goes back to the last parameter in the menu.</li> <li>If a parameter is already selected, pressing this button decrements a numeric value or goes back to the last value in the selection list.</li> </ul>                                                                                                |
| <Setup>  | This button is ignored.                                       | <ul style="list-style-type: none"> <li>Pressing this button for more than two seconds toggles between Data Display mode and Setup Configuration mode.</li> <li>Once inside the Setup Configuration mode and at the main menu, pressing this button selects a sub-menu or a parameter for modification.</li> <li>After changing the parameter, pressing this button again saves the new setting into memory.</li> </ul> |

Table 3-2 Buttons Description

### 3.3 LED Pulse Outputs

The PMC-D721MD comes standard with one LED indicator for Energy Pulse Output which can be used for kWh energy pulsing if the **EN PULSE** is enabled (see **Section 4.2 LED Pulse Outputs** for more information) and a second LED indicator for Communication Status.

### 3.4 Display Screen Types

The front panel provides two display modes: **Data Display** and **Setup Configuration**. There are four buttons on the front panel: <U/I>, <Power>, <Energy> and <Setup>. The <Setup> button is only used when configuring the meter.

The following table illustrates the display screens for the PMC-D721MD model.

| Press button | Display screens     | First row  | Second row | Third row |
|--------------|---------------------|------------|------------|-----------|
| <U/I>        | Display 1 (default) | -          | Voltage    | Current   |
| <Power>      | Display 1           | -          | Power      | -         |
| <Energy>     | Display 1           | kWh Import |            |           |
|              | Display 2           | kWh Export |            |           |

Table 3-3 PMC-D721MD Data Display Screens

### 3.5 Setup Configuration via the Front Panel

Pressing the <Setup> button for more than 2 seconds enters the **Setup Configuration** mode where the setup parameters can be changed. Upon completion, pressing the <Setup> button for more than 2 seconds returns to the **Data Display** mode.

### 3.5.1 Making Setup Changes

#### 1) Entering the Password:

- Press the **<Setup>** button for more than 2 seconds to access **Setup Configuration** mode.
- Press the **<Energy>** button to advance to the Password page.
- A correct password must be entered before changes are allowed. The factory default password is zero. Press the **<Setup>** button to select the parameter for modification. Use the **<U/I>**, **<Power>** and **<Energy>** buttons to enter the correct password.

#### 2) Selecting a parameter to change:

- Use the **<Power>** and **<Energy>** button to scroll to the desired parameter.
- Press the **<Setup>** button to select the parameter. Once selected, the parameter value will blink.

#### 3) Changing and saving a parameter:

- Use the **<U/I>**, **<Power>** and **<Energy>** buttons to make modification to the selected parameter.
- After modification, press the **<Setup>** button to save the new value into memory.
- If necessary, pressing the **<U/I>** button from inside a sub-menu to return to the main menu.

#### 4) Returning to Data Display mode:

- Pressing the **<Setup>** button for more than 2 seconds to return to the default display screen.

### 3.5.2 Setup Menu

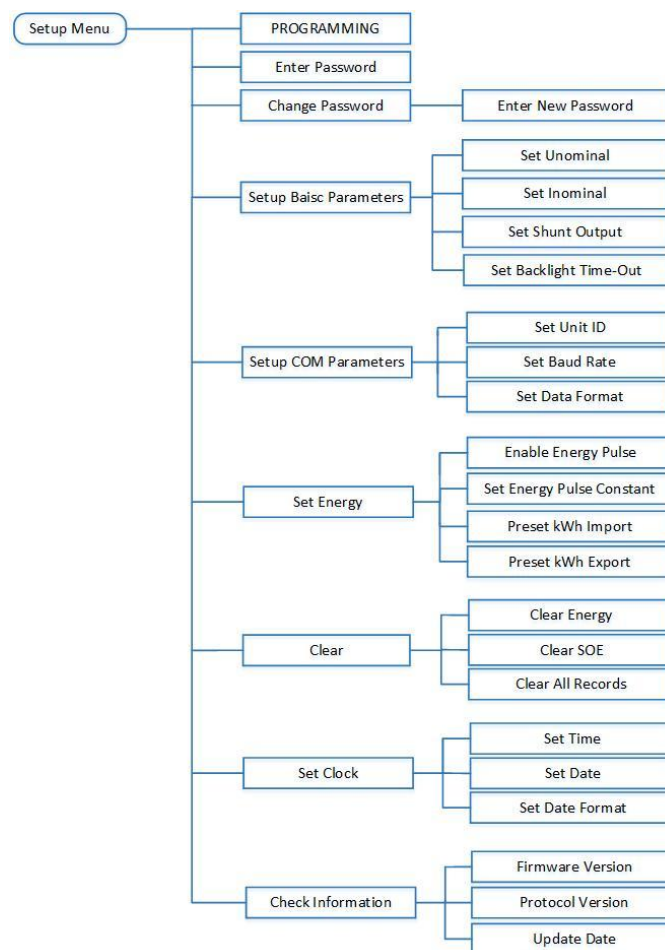


Figure 3-3 Setup Menu

### 3.5.3 Configuration

The Setup Configuration mode provides access to the following setup parameters:

| Label               |            | Parameters                                                                                                                         | Description                        | Range                        | Default |
|---------------------|------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------|---------|
| Main                | Menu Sub   |                                                                                                                                    |                                    |                              |         |
| PROG                |            | Programming                                                                                                                        | Setup Configuration Mode           | /                            | /       |
| PASS                |            | Password                                                                                                                           | Enter Password                     | 0 to 9999                    | "0"     |
| PASS SET            |            | Change Password                                                                                                                    |                                    |                              |         |
| NEW PASS            |            | New Password                                                                                                                       | Change Password                    | 0000 to 9999                 | "0"     |
| SYS SET             |            | Setup System Parameters                                                                                                            |                                    |                              |         |
|                     | Un         | Unominal                                                                                                                           | Set nominal Voltage                | 1 to 1000V                   | 750     |
|                     | I E        | Inominal                                                                                                                           | Set nominal Current                | 1 to 10000A                  | 100     |
|                     | SH         | Shunt Output                                                                                                                       | Set Shunt Nom. Output              | 1 to 100mV                   | 75      |
|                     | BLTO       | Backlight Time-Out                                                                                                                 | Set Backlight Time-out             | 0 to 60 mins                 | 3       |
| COM SET             |            | Setup Comm. Parameters                                                                                                             |                                    |                              |         |
|                     | ID         | Meter Address                                                                                                                      | Set Modbus Unit ID                 | 1-247                        | 100     |
|                     | BAUD       | Baud rate                                                                                                                          | Set Data rate in bits per second   | 1200/2400/4800/9600/19200bps | 9600    |
|                     | CFG        | Data Format                                                                                                                        | Set Comm. Port Configuration       | 8N2/8O1/8E1/8N1/8O2/8E2      | 8E1     |
| ENGY SET            |            | Setup Energy Outputs Parameters and Preset kWh Import/Export.                                                                      |                                    |                              |         |
|                     | ENGY PULS  | Energy Pulsing                                                                                                                     | Enable Energy Pulsing              | YES/NO                       | YES     |
|                     | ENGY CNST  | Pulse Constant                                                                                                                     | Pulse Constant                     | 25/100/400/1000/3200 imp/kWh | 100     |
|                     | kWh Import | kWh Import                                                                                                                         | Preset kWh Import                  | 0 to 99,999,999.9            | 0       |
|                     | kWh Export | kWh Export                                                                                                                         | Preset kWh Export                  | 0 to 99,999,999.9            | 0       |
| IO SET <sup>1</sup> |            | Specifies the minimum duration the DI must remain in the Active or Inactive state before a state change is considered to be valid. |                                    |                              |         |
|                     | DI1        | DI1 Debounce                                                                                                                       | DI1 Debounce                       | 1 to 9999ms                  | 20      |
|                     | DI2        | DI2 Debounce                                                                                                                       | DI2 Debounce                       | 1 to 9999ms                  | 20      |
| CLR                 |            |                                                                                                                                    |                                    |                              |         |
|                     | ENEY       | Clear Energy                                                                                                                       | Clear Energy Registers             | YES/NO                       | NO      |
|                     | SOE CLR    | Clear SOE                                                                                                                          | Clear SOE Log                      | YES/NO                       | NO      |
|                     | ALL CLR    | Clear All Records                                                                                                                  | Clear Energy Registers and SOE Log | YES/NO                       | NO      |
| TM SET              |            | Setup Date and Clock                                                                                                               |                                    |                              |         |
|                     | DATE       | Date                                                                                                                               | Enter the Current Date             | YYYY-MM-DD                   | /       |
|                     | CLK        | Clock                                                                                                                              | Enter the Current Time             | HH:MM:SS                     | /       |
| INFO                |            | Check meter information                                                                                                            |                                    |                              |         |
|                     | FW         | Firmware Version                                                                                                                   | Firmware Version                   | e.g. 1.00.00 means V1.00.00  | /       |
|                     | PROT VER   | Protocol Version                                                                                                                   | Protocol Version                   | e.g. 1.0 means V1.0          | /       |
|                     | UPDT       | Update Date                                                                                                                        | Firmware Update Date               | e.g. 20130603                | /       |

**Table 3-4 Setup Parameters**

**Notes:**

- 1) The I/O setup parameters are only displayed when the PMC-D721MD is equipped with this option.

## Chapter 4 Applications

### 4.1 Digital Inputs

The PMC-D721MD comes optionally with two self-excited Digital Inputs that are internally wetted at 24 VDC. Digital Inputs are typically used for monitoring external status which can help prevent equipment damage, improve maintenance and track security breaches. The real-time statuses of the Digital Inputs are available on the front panel LCD Display as well as through communications. Changes in Digital Input status are stored as events in the SOE Log in 1 ms resolution.

### 4.2 Pulse Outputs

The PMC-D721MD comes standard with one front panel LED Pulse Output for Energy Pulsing and can be equipped with two optional Solid Relay Output for kWh Imp and kWh Exp energy pulsing where DO Energy Pulse Outputs are typically used for accuracy testing. Energy pulsing can be enabled from the front panel through the **ENGY PULS** setup parameter. The pulse constant can be configured as 25/100/400/1000/3200 imp/kWh through the **ENGY CNST** setup parameter.

### 4.3 Basic Measurement

The PMC-D721MD provides following basic measurements which are available through the LCD display or communication:

- Voltage, Current and kW
- kWh Import and kWh Export

### 4.4 SOE

The PMC-D721MD can store up to 32 events such as Power-On, Power-Off, Digital Input status changes and setup changes in its non-volatile memory. Each event record includes the event classification, its relevant parameter values and a timestamp in 1ms resolution.

All event records can be retrieved via communications. If there are more than 32 events, the newest event will replace the oldest event on a First-In-First-Out basis. The SOE Log can be reset from the front panel or via communications.

## Chapter 5 Modbus Register Map

This chapter provides a complete description of the Modbus register map (**Protocol Versions 1.0** and above) for the PMC-D721MD Digital Multifunction Meter to facilitate the development of 3<sup>rd</sup> party communications driver for accessing information on the PMC-D721MD.

The PMC-D721MD supports the following Modbus functions:

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

The following table provides a description of the different data formats used for the Modbus registers.

The PMC-D721MD uses the Big Endian byte ordering system.

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

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

### 5.1 Basic Measurements

| Register  | Property | Description | Format | Scale | Unit |
|-----------|----------|-------------|--------|-------|------|
| 0000      | RO       | U           | Float  | x1    | V    |
| 0002      | RO       | I           | Float  | x1    | A    |
| 0004      | RO       | kW          | Float  | x1    | W    |
| 0006-0029 | RO       | Reserved    |        |       |      |
| 0030      | RO       | DI Status   | UINT16 |       |      |
| 0031      | RO       | Reserved    |        |       |      |
| 0032      | RO       | SOE Pointer | UINT32 |       |      |
| 0034-0039 | RO       | Reserved    |        |       |      |
| 0040      | RO       | kWh Import  | INT32  | x0.01 | kWh  |
| 0042      | RO       | kWh Export  | INT32  | x0.01 | kWh  |

Table 5-1 Basic Measurements

#### Notes:

- 1) For the **DI Status** register, the bit values of B0 and B1 represent the states of DI1 and DI2, respectively, with "1" meaning active (closed) and "0" meaning inactive (open).
- 2) The range of the **SOE Pointer** is between 0 and 0xFFFFFFFF and it is incremented by one for every new log generated and will roll over to 0 if its current value is 0xFFFFFFFF. A value of zero indicates that the SOE does not contain any Log. If a **SOE CLR** is performed from the front panel or via communications, the **SOE Pointer** will be reset to zero and then immediately incremented by one with a new "Setup Changes via Front Panel" or "Setup Changes via Communications" event. Therefore, any 3<sup>rd</sup> party software should assume that a **SOE CLR E** action has been performed if it sees the **SOE Pointer** rolling over to one or to a value that is smaller than its own pointer. In this case, the new **SOE Pointer** also indicates the number of events in the SOE Log if it is less than 32. Otherwise, there will always be 32 events in the SOE Log.

### 5.2 SOE Log

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

$$\text{Register Address} = 10000 + \text{Modulo}(\text{SOE Log Pointer} - 1 / 32) * 8$$

| Register    | Property | Description | Format            |
|-------------|----------|-------------|-------------------|
| 10000~10007 | RO       | Event 1     | See               |
| 10008~10015 | RO       | Event 2     | Table 5-3 SOE Log |

|             |    |          |                |
|-------------|----|----------|----------------|
| 10016~10023 | RO | Event 3  | Data Structure |
| 10024~10031 | RO | Event 4  |                |
| 10032~10039 | RO | Event 5  |                |
| 10040~10047 | RO | Event 6  |                |
| 10048~10055 | RO | Event 7  |                |
| 10056~10063 | RO | Event 8  |                |
| 10064~10071 | RO | Event 9  |                |
| 10072~10079 | RO | Event 10 |                |
| 10080~10087 | RO | Event 11 |                |
| 10088~10095 | RO | Event 12 |                |
| ...         |    | ...      |                |
| 10248~10255 | RO | Event 32 |                |

Table 5-2 SOE Log

**Notes:**

## 1) SOE LOG Data Structure

| Offset   | Property | Description                                        | Unit             |
|----------|----------|----------------------------------------------------|------------------|
| +0       | RO       | High-order Byte: Event Classification <sup>2</sup> | -                |
|          | RO       | Low-order Byte: Sub-Classification <sup>2</sup>    | -                |
| +1       | RO       | Record Time: Year                                  | 0-99 (Year-2000) |
|          | RO       | Record Time: Month                                 | 1 to 12          |
| +2       | RO       | Record Time: Day                                   | 1 to 31          |
|          | RO       | Record Time: Hour                                  | 0 to 23          |
| +3       | RO       | Record Time: Minute                                | 0 to 59          |
|          | RO       | Record Time: Second                                | 0 to 59          |
| +4       | RO       | Record Time: Millisecond                           | 0 to 999         |
| +5       | RO       | High-order Byte: Reserved                          | -                |
|          | RO       | Low-order Byte: Status <sup>2</sup>                | -                |
| +6 to +7 | RO       | Event Value <sup>2</sup>                           | -                |

Table 5-3 SOE LOG Data Structure

## 2) SOE Event Classification

| Event Classification | Sub-Classification | Status | Event Value | Description                                                         |
|----------------------|--------------------|--------|-------------|---------------------------------------------------------------------|
| 1= DI Change         | 1                  | 1 / 0  | 1/0         | DI1 Inactive / DI1 Active                                           |
|                      | 2                  | 1 / 0  | 1/0         | DI2 Inactive / DI2 Active                                           |
| 4 = Self-diagnosis   | 1                  | None   | None        | System Parameter Fault                                              |
|                      | 2                  |        |             | Interval Parameter Fault                                            |
| 5=Operations         | 1                  | None   | None        | Reserved                                                            |
|                      | 2                  |        |             | Power Off                                                           |
|                      | 3                  |        |             | Set Clock via Front Panel                                           |
|                      | 4                  |        |             | System Parameter Changes via Front Panel                            |
|                      | 5                  |        |             | Internal Parameter Changes via Front Panel                          |
|                      | 6                  |        |             | Comm. Parameter Changes via Front panel                             |
|                      | 7                  |        |             | Preset kWh via Front Panel                                          |
|                      | 8                  |        |             | Clear SOE via Front Panel                                           |
|                      | 9                  |        |             | Clear Energy Registers via Front Panel                              |
|                      | 10                 |        |             | Clear All Records (SOE Log and Energy Registers) via Front Panel    |
|                      | 11                 |        |             | System Parameters Changes via Communications                        |
|                      | 12                 |        |             | Internal Parameter Changes via Communications                       |
|                      | 13                 |        |             | Comm. Parameter Changes via Communications                          |
|                      | 14                 |        |             | Preset kWh via Communications                                       |
|                      | 15                 |        |             | Clear SOE via Communications                                        |
|                      | 16                 |        |             | Clear Energy Registers via Communications                           |
|                      | 17                 |        |             | Clear All Records (SOE Log and Energy Registers) via Communications |

Table 5-4 SOE Event Classification

### 5.3 Device Setup

#### 5.3.1 Basic Setup Parameters

| Register  | Property | Description        | Format | Range/Default*      |
|-----------|----------|--------------------|--------|---------------------|
| 6000      | RW       | Un                 | UINT16 | 1 to 1,000V, 750V*  |
| 6001      | RW       | I Primary          | UINT16 | 1 to 10,000A, 100A* |
| 6002      | RW       | Shunt Output       | UINT16 | 1 to 100mV, 75mV*   |
| 6003~6029 | RW       | Reserved           | UINT16 |                     |
| 6030      | RW       | Backlight Time-Out | UINT16 | 0 to 60min, 3min*   |

Table5-5 Setup Parameters

#### 5.3.2 I/O Setup Parameters

| Register | Property | Description  | Format | Range/Default*   |
|----------|----------|--------------|--------|------------------|
| 6220     | RW       | DI1 Debounce | UINT16 | 1 to 9999ms, 20* |
| 6221     | RW       | DI2 Debounce | UINT16 | 1 to 9999ms, 20* |

Table 5-6 I/O Setup

#### 5.3.3 Energy Pulse Setup Parameter

| Register | Property | Description                | Format | Range/Default*                                                                      |
|----------|----------|----------------------------|--------|-------------------------------------------------------------------------------------|
| 6400     | RW       | Energy Pulse Output Enable | UINT16 | 0= Disabled, 1= Enabled*                                                            |
| 6401     | RW       | Energy Pulse Constant      | UINT16 | 0=25 imp/kWh<br>1=100 imp/kWh*<br>2=400 imp/kWh<br>3=1000 imp/kWh<br>4=3200 imp/kWh |

Table 5-7 Energy Pulse Setup Parameter

#### 5.3.4 Communication Setup Parameters

| Register | Property | Description   | Format | Range/Default*                              |
|----------|----------|---------------|--------|---------------------------------------------|
| 6500     | RW       | Reserved      |        |                                             |
| 6501     | RW       | Unit ID       | UINT16 | 1 to 247, 100*                              |
| 6502     | RW       | Baud Rate     | UINT16 | 0=1200, 1=2400, 2=4800<br>3=9600*, 4=19200  |
| 6503     | RW       | Comm. Config. | UINT16 | 0=8N2, 1=8O1, 2=8E1*<br>3=8N1, 4=8O2, 5=8E2 |

Table 5-8 Communication Setup

### 5.4 Time

There are two sets of Time registers supported by the PMC-D721MD – Year / Month / Day / Hour / Minute / Second (Register # 60000 to 60002) and UNIX Time (Register # 60004). When sending time to the PMC-D721MD over Modbus communications, care should be taken to only write one of the two Time register sets. All registers within a Time register set must be written in a single transaction. If registers 60000 to 60004 are being written to at the same time, both Time register sets will be updated to reflect the new time specified in the UNIX Time register set (60004) and the time specified in registers 60000-60002 will be ignored. Writing to the Millisecond register (60003) is optional during a Time Set operation. When broadcasting time, the function code must be set to 0x10 (Pre-set Multiple Registers). Incorrect date or time values will be rejected by the meter. In addition, attempting to write a Time value less than Jan 1, 2000 00:00:00 will be rejected.

| Register | Property | Description             | Format | Note             |
|----------|----------|-------------------------|--------|------------------|
| 60000    | 9000     | High-order Byte: Year   | UINT16 | 0-37 (Year-2000) |
|          |          | Low-order Byte: Month   |        | 1 to 12          |
| 60001    | 9001     | High-order Byte: Day    | UINT16 | 1 to 31          |
|          |          | Low-order Byte: Hour    |        | 0 to 23          |
| 60002    | 9002     | High-order Byte: Minute | UINT16 | 0 to 59          |

|                     |                   |    |                        |        |                                                                                                                       |
|---------------------|-------------------|----|------------------------|--------|-----------------------------------------------------------------------------------------------------------------------|
|                     |                   |    | Low-order Byte: Second |        | 0 to 59                                                                                                               |
| 60003               | 9003              | RW | Millisecond            | UINT16 | 0 to 999                                                                                                              |
| 60004<br>~<br>60005 | 9004<br>~<br>9005 | RW | UNIX Time              | UINT32 | 0x386D4380 to 0x7FE8177F<br>The corresponding time is 2000.01.01 00:00:00 to 2037.12.31 23:59:59 (GMT 0:00 Time Zone) |

Table 5-9 Time Registers

### 5.5 Clear Control

| Register  | Property | Description       | Format | Note                                                                      |
|-----------|----------|-------------------|--------|---------------------------------------------------------------------------|
| 9600      | WO       | Clear SOE         | UINT16 | Writing "0xFF00" to this register to clear SOE Logs.                      |
| 9601      | WO       | Clear Energy      | UINT16 | Writing "0xFF00" to this register to clear Energy Registers (0040~0042)   |
| 9602~9609 | WO       | Reserved          | UINT16 |                                                                           |
| 9610      | WO       | Clear all Records | UINT16 | Writing "0xFF00" to this register to clear SOE Logs and Energy Registers. |

Table 5-10 Clear Control

### 5.6 Meter Information

| Register          |                     | Property | Description                     | Format | Note                                                                                                       |
|-------------------|---------------------|----------|---------------------------------|--------|------------------------------------------------------------------------------------------------------------|
| 9800<br>~<br>9819 | 60200<br>~<br>60219 | RO       | Meter model <sup>1</sup>        | UINT16 | See Note 1                                                                                                 |
| 9820              | 60220               | RO       | Firmware Version                | UINT16 | e.g. 10000 shows the version is V1.00.00                                                                   |
| 9821              | 60221               | RO       | Protocol Version                | UINT16 | e.g. 10 means V1.0                                                                                         |
| 9822              | 60222               | RO       | Firmware Update Date: Year-2000 | UINT16 | e.g. 140110 means January 10, 2014                                                                         |
| 9823              | 60223               | RO       | Firmware Update Date: Month     | UINT16 |                                                                                                            |
| 9824              | 60224               | RO       | Firmware Update Date: Day       | UINT16 |                                                                                                            |
| 9825              | 60225               | RO       | Serial Number                   | UINT32 | e.g. 1701030100 means the 100 <sup>th</sup> device that was manufactured on January 3 <sup>rd</sup> , 2017 |
| 9827<br>~<br>9828 | 60027<br>~<br>60228 | RO       | Reserved                        | UINT16 |                                                                                                            |
| 9829              | 60229               | RO       | Feature Number                  | Bitmap | <b>B7B6B5:</b><br>000: None<br>001: 2DIs + 2Pulse Outputs                                                  |
|                   |                     |          |                                 |        | <b>B4B3:</b><br>00: Shunt Input<br>Others: Reserved                                                        |
|                   |                     |          |                                 |        | <b>B2B1B0:</b><br>000: 0 to 1000V<br>Others: Reserved                                                      |

Table 5-11 Meter Information

#### Notes:

- 1) The Meter Model appears from registers 9800-9819 and contains the ASCII encoding of the string "PMC-D721MD" as shown in the following table.

| Register | Value(Hex) | ASCII |
|----------|------------|-------|
| 9800     | 0x50       | P     |
| 9801     | 0x4D       | M     |
| 9802     | 0x43       | C     |
| 9803     | 0x2D       | -     |
| 9804     | 0x44       | D     |
| 9805     | 0x37       | 7     |
| 9806     | 0x32       | 2     |

|           |      |      |
|-----------|------|------|
| 9807      | 0x31 | 1    |
| 9808      | 0x4D | M    |
| 9809      | 0x44 | D    |
| 9810~9819 | 0x20 | Null |

Table 5-12 ASCII Encoding of “PMC-D721MD”

## Appendix A Technical Specifications

| DC Inputs                                                                                                          |                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>Voltage Input</b><br>Standard<br>Range<br>Overload                                                              | 1000V DC<br>1% to 100% Un<br>1.2xUn continuous, 2xUn for 1s                                                      |
| <b>Current Input (via Shunt Resistor)</b><br>Nominal Input (In)<br>Nominal Current<br>Starting Current<br>Overload | 100mV<br>100A / 200A / 300A / 400A / 500A / 600A<br>0.2% of In<br>1.2xIn continuous, 10xIn for 10s, 20xIn for 1s |
| Power Supply (L/+, N/-, GND)                                                                                       |                                                                                                                  |
| Standard<br>Burden                                                                                                 | 95-250VAC/DC, $\pm 10\%$ , 47-440Hz<br><2W                                                                       |
| Optional Digital Inputs                                                                                            |                                                                                                                  |
| Type<br>Hysteresis                                                                                                 | Dry contact, 24VDC internally wetted<br>20ms minimum                                                             |
| Energy Pulse Output                                                                                                |                                                                                                                  |
| Type<br>Pulse Constant<br>Pulse Width                                                                              | LED / Solid State Relay<br>25 / 100 / 400 / 1000 / 3200 Imp/kWh<br>80ms $\pm$ 20ms                               |
| Communications                                                                                                     |                                                                                                                  |
| RS-485<br>Baudrate                                                                                                 | Modbus RTU<br>1200 / 2400 / 4800 / 9600 / 19200bps                                                               |
| Environmental Conditions                                                                                           |                                                                                                                  |
| Operating Temp.<br>Storage Temp.<br>Humidity<br>Atmospheric Pressure                                               | -25°C to 70°C<br>-40°C to 85°C<br>5% to 95% non-condensing<br>70 kPa to 106 kPa                                  |
| Mechanical Characteristics                                                                                         |                                                                                                                  |
| Panel Cutout<br>Unit Dimensions<br>IP Rating<br>Shipping Weight<br>Shipping Dimensions                             | 68x68 mm<br>72x72x71.8 mm<br>52<br>TBD<br>TBD                                                                    |

## Accuracy

| Parameters | Accuracy                    | Resolution |
|------------|-----------------------------|------------|
| Voltage    | $\pm 0.2\%$                 | 0.1V       |
| Current    | $\pm 0.2\%$                 | 0.01A      |
| kW         | $\pm 0.2\%$                 | 0.001kW    |
| kWh        | IEC 62053-22:2003 Class 0.5 | 0.1kWh     |

## Appendix B Standards Compliance

| Safety Requirements                                                                                                                                    |           |                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------------------------------------|
| CE LVD 2014 / 35 / EU                                                                                                                                  |           | EN 61010-1: 2010,<br>EN 61010-2-030: 2010                    |
| Insulation<br>Dielectric test:<br>Insulation resistance:<br>Impulse voltage:                                                                           |           | IEC 60255-5-2000<br>2kV @ 1 minute<br>>40MΩ<br>6kV, 1.2/50μs |
| Electromagnetic Compatibility<br>CE EMC Directive 2004 / 108 / EC (EN 61326: 2006)                                                                     |           |                                                              |
| Immunity Tests                                                                                                                                         |           |                                                              |
| Electrostatic discharge                                                                                                                                |           | EN 61000-4-2:2009                                            |
| Radiated fields                                                                                                                                        |           | EN 1000-4-3:2006+A1:2008+A2:2010                             |
| Fast transients                                                                                                                                        |           | EN 61000-4-4:2012                                            |
| Surges                                                                                                                                                 |           | EN 61000-4-5:2006                                            |
| Conducted disturbances                                                                                                                                 |           | EN 61000-4-6:2009                                            |
| Magnetic fields                                                                                                                                        |           | EN 61000-4-11:2004                                           |
| Oscillatory waves                                                                                                                                      |           | EN 61000-4-2:2009                                            |
| Emission Tests                                                                                                                                         |           |                                                              |
| Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment |           | EN 55011: 2009 + A1: 2010<br>(CISPR 11)                      |
| Limits and methods of measurement of radio disturbance characteristics of information technology equipment                                             |           | EN 55022: 2010 (CISPR 22)                                    |
| Limits for harmonic current emissions for equipment with rated current ≤16 A                                                                           |           | EN 61000-3-2: 2006+A1: 2009 +A2: 2009                        |
| Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤16 A                                    |           | EN 61000-3-3: 2008                                           |
| Emission standard for residential, commercial and light-industrial environments                                                                        |           | EN 61000-6-4: 2007+A1: 2011                                  |
| Electromagnetic emission tests for measuring relays and protection Equipment                                                                           |           | EN 61000-4-12: 2006                                          |
| Mechanical Tests                                                                                                                                       |           |                                                              |
| Vibration Test                                                                                                                                         | Response  | IEC 255-2-1:1989 Level I                                     |
|                                                                                                                                                        | Endurance | IEC 255-2-1:1989 Level I                                     |
| Shock Test                                                                                                                                             | Response  | IEC 255-2-2: 1989 Level I                                    |
|                                                                                                                                                        | Endurance | IEC 255-2-2: 1989 Level I                                    |
| Bump Test                                                                                                                                              |           | IEC 255-2-2: 1989 Level I                                    |

## Appendix C Ordering Guide



Version 20170222

| Product Code                      |   |   |   |   | Description                |   |   |   |                                     |
|-----------------------------------|---|---|---|---|----------------------------|---|---|---|-------------------------------------|
| PMC-D721MD DC Multifunction Meter |   |   |   |   |                            |   |   |   |                                     |
|                                   |   |   |   |   | Display Screen             |   |   |   |                                     |
| L                                 |   |   |   |   | LCD                        |   |   |   |                                     |
|                                   |   |   |   |   | Input Current              |   |   |   |                                     |
| 1                                 |   |   |   |   | 0-100mV (via Shunt Output) |   |   |   |                                     |
|                                   |   |   |   |   | Input Voltage              |   |   |   |                                     |
| 1                                 |   |   |   |   | 0-1000V                    |   |   |   |                                     |
|                                   |   |   |   |   | Power Supply               |   |   |   |                                     |
| 2                                 |   |   |   |   | 95-250V AC/DC , 47-440Hz   |   |   |   |                                     |
|                                   |   |   |   |   | I/O                        |   |   |   |                                     |
| X                                 |   |   |   |   | None                       |   |   |   |                                     |
| A*                                |   |   |   |   | 2xDI+2xPulse Output        |   |   |   |                                     |
|                                   |   |   |   |   | Communications             |   |   |   |                                     |
| A                                 |   |   |   |   | 1xRS-485 Port              |   |   |   |                                     |
|                                   |   |   |   |   | Display Language           |   |   |   |                                     |
| E                                 |   |   |   |   | English                    |   |   |   |                                     |
| PMC-D721MD                        | - | L | 1 | 1 | 2                          | X | A | E | PMC-D721MD-L112XAE (Standard Model) |

\* Additional charges apply

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