Power Cube

Installation and Operation

PREFACE

PowerCube
Installation and Operation Guide
December 2004

This manual represents your meter as manufactured at the time of publication. It assumes standard software. Special versions of software may be fitted, in which case you will be provided with additional details.

Every effort has been made to ensure that the information in this manual is complete and accurate. We revised this manual but cannot be held responsible for errors or omissions.

The apparatus has been designed and tested in accordance with EN 61010-1, 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use'. This operating guide contains information and warnings which must be followed by the user to ensure safe operation and to maintain the apparatus in a safe condition.

We reserve the right to make changes and improvements to the product without obligation to incorporate these changes and improvements into units previously shipped.

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1. Safety

1.1 Warning Symbols

This manual provides details of safe installation and operation of the meter. Safety may be impaired if the instructions are not followed. Labels on individual meters give details of equipment ratings for safe operation. Take time to examine all labels on the meter and to read this manual before commencing installation.

Caution
Refer to User Instructions

Danger
Risk of Electric Shock

Figure 1.1 Safety Symbols

WARNING
The meter contains no user serviceable parts. Installation and commissioning should be carried out by qualified personnel

1.2 Maintenance

The equipment should be maintained in good working order. Damage to the product should be repaired by the manufacturer. The meter may be cleaned by wiping lightly with a soft cloth. No solvents or cleaning agents should be used. All inputs and supplies must be isolated before cleaning any part of the equipment.

2. Meter Operation

2.1 Measurements

Power Cube measurements are based on a precision analogue kW transducer which detects true power over a wide input range. The analogue approach ensures accurate readings of all loads including electronically controlled types containing harmonics, burst fired elements, and those which are unstable due to load variations.

The meter monitors instantaneous kW as its prime parameter. Other values such as kWh, kW Demand etc. are derived from this. Derived parameters are calculated in a micro-processor, programmed specifically for the task of precision power/energy measurement. The microprocessor uses the kW transducer output, scaling factors and a precision crystal clock to determine and display the resulting measurements.

2.1.1 Power (kW)

Instantaneous kW is derived from the kW transducer, multiplied by two user programmable constants, ***CT Primary*** and ***Scaling Factor***. These constants, may be used to scale for external Current and/or Potential transformers, in a variety of systems detecting loads from a few watts to megawatts. The displayed values and all outputs from the Power Cube take these constants into account providing conveniently scaled values with decimal points and legends as required.

The decimal point position and legend (W, kW or MW) are automatically selected dependant on the scaling constants and nominal input voltage for the meter. The display is set for optimum resolution in the range 0-19999 (4½ digits). The setting takes into account maximum input signals which may be larger than the nominal ratings for the meter.

2.1.2 Examples of Display Scaling

Meter Inputs :	3-Ph Power Cube, 230V (LN), CT=200:5A
User Settings :	CT Primary = 200A, Scaling Factor = 1.0
Nominal kW :	230 x 3 x 200 x 1.0 = 138 kW
+ 20% Over-range :	138 kW + 20% = 165.6 kW
Optimum Display :	Must be < 19999 = 16560
Power Cube Display :	0.00 kW - 165.60 kW

Meter Inputs :	3-Ph Power Cube, 230V (LN), CT=75:5A
User Settings :	CT Primary = 750A, Scaling Factor = 0.1
Nominal kW :	230 x 3 x 750 x 0.1 = 51.75 kW
+ 20% Over-range :	51.75 kW + 20% = 62.1 kW
Optimum Display :	Must be < 19999 = 6210
Power Cube Display :	0.00 kW - 62.10 kW

Meter Inputs :	3-Ph Power Cube, VT=4000:400V (LL), CT=2000:5A
User Settings :	CT Primary = 2000A, Scaling Factor = 10.0
Nominal kW :	4000 x √3 x 2000 = 13.86 MW
+ 20% Over-range :	13.86 MW + 20% = 16.632 MW
Optimum Display :	Must be < 19999 = 16632
Power Cube Display :	0.000 MW - 16.632 MW

Meter Inputs :	3-Ph Power Cube, VT=40000:400V (LL), CT=2000:5A
User Settings :	CT Primary = 2000A, Scaling Factor = 100.0
Nominal kW :	40000 x √3 x 2000= 138.6 MW
+ 20% Over-range :	138.6 MW + 20% = 166.32 MW
Optimum Display :	Must be < 19999 = 16632
Power Cube Display :	0.00 MW - 166.32 MW

2.1.3 Energy (kWh)

The kWh values are derived from the scaled kW readings, integrated over time (measured by a precision crystal controlled time-base).

Energy is displayed as a 7-digit accumulating register (counter) which is displayed with a decimal point and legend (Wh, kWh or MWh) for direct reading.

Scaling of kWh is derived from the scaling of kW with 1 less digit of resolution. For example if the kW display is in the range 0.00 kW - 62.10 kW the energy display will be in the range 0.0 kWh - 999999.9 kWh.

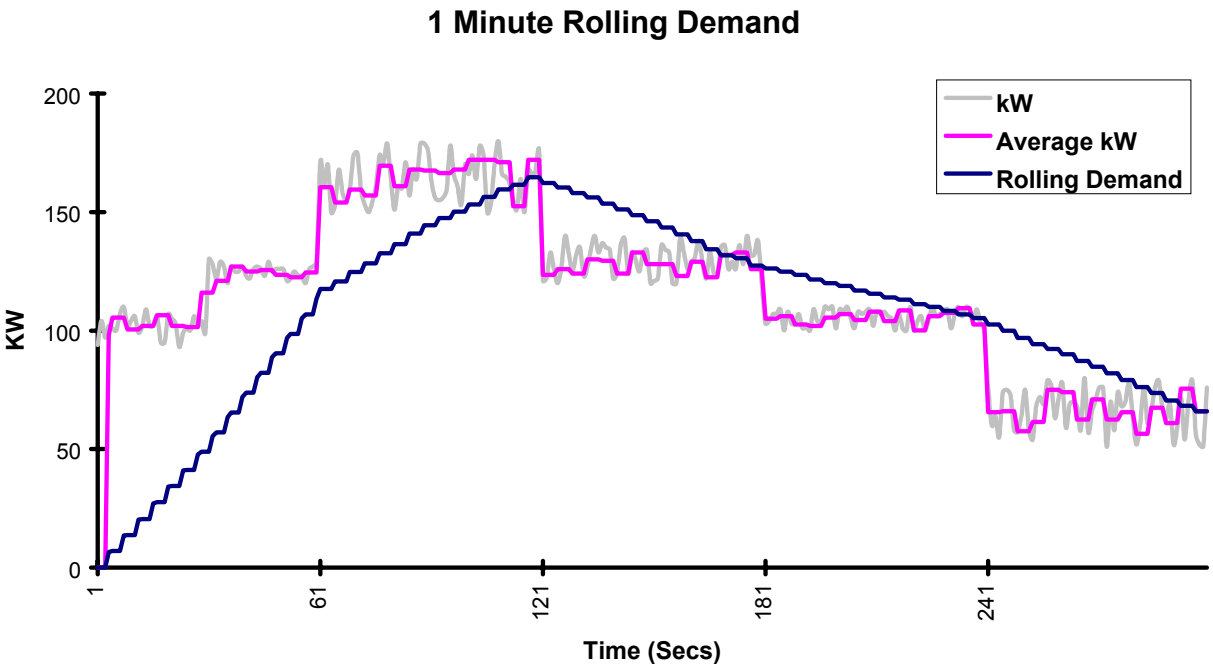
In the event of power failure or brown-out the kWh register is automatically saved in non-volatile memory within the Power Cube. The memory requires no battery and will hold the value for up to 10 years in the absence of mains power.

2.1.4 Rolling Demand (kW MD)

This parameter provides a smoothed average of the kW readings taken over a user programmable time period (1 - 60 Minutes). The display shows the average for the most recent time period ending at the time the display was last updated. The demand period is continuously updated as time progresses hence the term "***Rolling Demand***". Scaling of Rolling Demand displays is identical to display of kW.

2.1.4.1 Calculating Rolling Demand

Each time period is split into 15 smaller sub-periods. The average of instantaneous kW measured during each sub-period is stored in the meters memory. The latest sub-period average is stored in place of the oldest reading thus providing an array of the 15 most recent sub period averages. The overall average of the 15 most recent sub-period values is displayed as kW MD (rolling demand). On power up (or after a brown-out) the 15 sub-period values are reset to zero. During the first full MD period the Rolling Demand value will accumulate as the zeroes are replaced with valid average kW readings.



2.1.4.2 Peak Demand (kW PK)

This parameter is the maximum recorded value of Rolling Demand kW.

This value may be used to determine the maximum load requirement of a system. This value is often used to determine spare capacity in a supply system, supply plant requirement etc. Scaling of Peak Demand displays is identical to display of kW.

On power failure or brown-out the Peak Demand value is automatically saved in non-volatile memory within the Power Cube. The memory requires no battery and will hold the value for up to 10 years in the absence of mains power.

2.2 Display Pages

Information provided by the Power Cube is displayed on a two line custom liquid crystal display (LCD). Three display pages are available in normal operating mode. At the bottom of each page the 7 digit accumulating energy register is displayed, scaled according to the meter set-up. The larger digits of the top line show instantaneous kW, Peak kW and Rolling kW Demand on pages selected by the **kW**, **PK** and **MD** keys respectively.

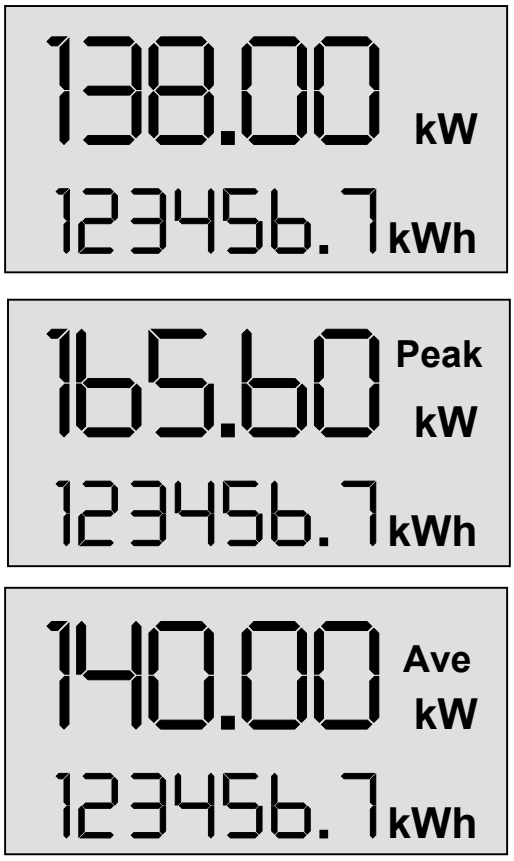


Figure 2.1 Sample Display Pages

2.3 kWh Reset

The kWh accumulating register may be reset to zero using the front panel keys. Once reset the energy reading is lost forever so great care must be taken when using this feature.

To reset the kWh register **Press CLEAR** and **kW** keys **together and Hold for 5 seconds** until the kWh display shows zero.

2.4 Peak Demand Reset

The Peak Demand kW value may be reset to zero using the front panel keys. Once reset the Peak value is lost forever so great care must be taken when using this feature.

To reset the Peak Demand Value **Press CLEAR** and **PK** keys **together and Hold for 1 second** until the Peak Demand display shows zero.

The accumulating demand and all values in the sub-period array (see 2.1.4.1) are also reset to zero. On reset, the Rolling Demand will accumulate over the first period until a full set of sub-period readings are obtained.

2.5 Isolated Pulse Output

A single isolated output is provided as standard on the Power Cube. The pulse output provides a volt free contact pair closure for a programmable number of increments (1, 10, 100 or 1000) of the kWh register. (e.g. 1 pulse per 10 kWh).

The signal provided is designed to interface to building management systems, data collectors, remote counters etc. On completion of the programmed number of counts the Pulse Output terminals momentarily appear short circuit (100ms). At all other times the pins appear open circuit. Each pulse output is indicated on the front panel of the Power Cube by a single flash of the ⎍ LED.

A second pulse output may be optionally fitted if specified at the time of ordering the meter. This repeats the primary pulse output and may be used to signal a secondary external system. The two pulses are isolated at 50V from each other and at 2kV from all other meter circuits.

2.5.1 Connecting The Pulse Output(s)

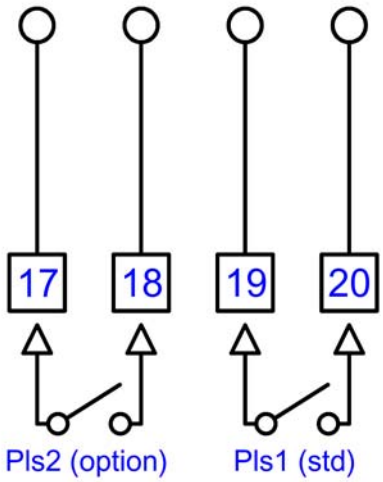


Figure 2.2 Pulse Output Connection

3. Installation

3.1 Panel Mounting

Panels should be of thickness 1mm to 4mm with a square cut-out of 92mm (+0.8 - 0.0). A minimum depth of 72mm should be allowed behind the panel for the meter. Remove the panel mounting clips and insert the meter into the cut-out from the front of the panel. Push the meter home. Ensure the screws in each panel mount clip are fully retracted and insert the clips as shown in the diagram below. Tighten the screws to secure the meter firmly in the panel. DO NOT OVERTIGHTEN.

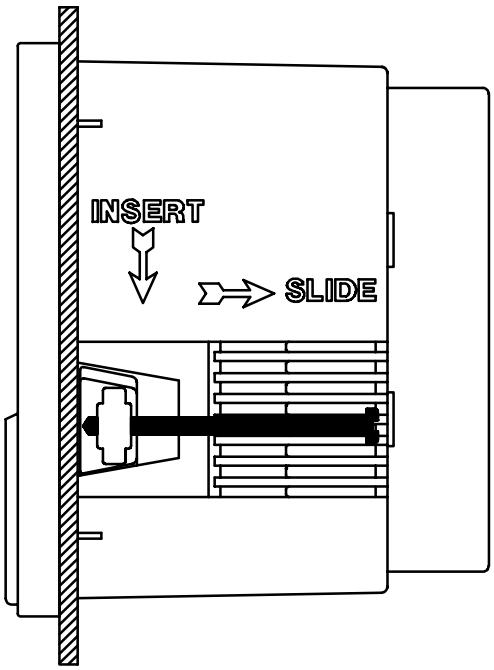


Figure 3.1 Fitting The Meter in a Panel

3.2 CT Connections

The Power Cube is designed for use with external current transformers (CTs). Recommended types should conform to Class 1 per IEC 185. The secondary of the CT should be specified to suit the input rating defined on the meter label. Cables used for the current circuit should have a maximum conductor size of 4.0mm^2 and should be kept as short as possible to reduce cable losses loading the CT secondary.

CT inputs to the meter are isolated from each other and all other parts of the circuit. This allows use on a wide variety of systems including those requiring common and/or earthed CT secondaries.

WARNING

NEVER leave the secondary of a current transformer open circuit while a primary current flows. In this condition dangerous voltages may be produced at the secondary terminals.

3.3 Voltage Connections

Cables used for the voltage measurement circuit should be insulated to a minimum of 600V AC and have a minimum current rating of 250mA. The maximum conductor size is 4.0mm^2.

External protection fuses are recommended for the voltage measurement inputs. These should be rated at 160mA maximum, Type F, and should be able to withstand voltages greater than the maximum input to the meter.

3.4 Auxiliary Mains Supply (L & N)

The Power Cube uses an isolated auxiliary mains supply separate from the voltage measurement inputs. This may be connected separately or in parallel with the measurement inputs provided the ratings detailed on the instrument label are not exceeded.

Separate connection of the auxiliary mains is required, for example, when :

- A suitable supply voltage is not available locally.
- Measurement voltages are expected to vary over a wide range
- A backup supply is required to maintain meter display

The auxiliary mains supply is internally fused at 250V, 100mA type T. External fusing is required if the auxiliary supply voltage exceeds 250V. The meter ratings are detailed on the instrument label.

WARNING :
CHECK the instrument **LABELS** for correct input ratings.
Incorrectly rated inputs may permanently damage the device

3.5 Connection Schematics

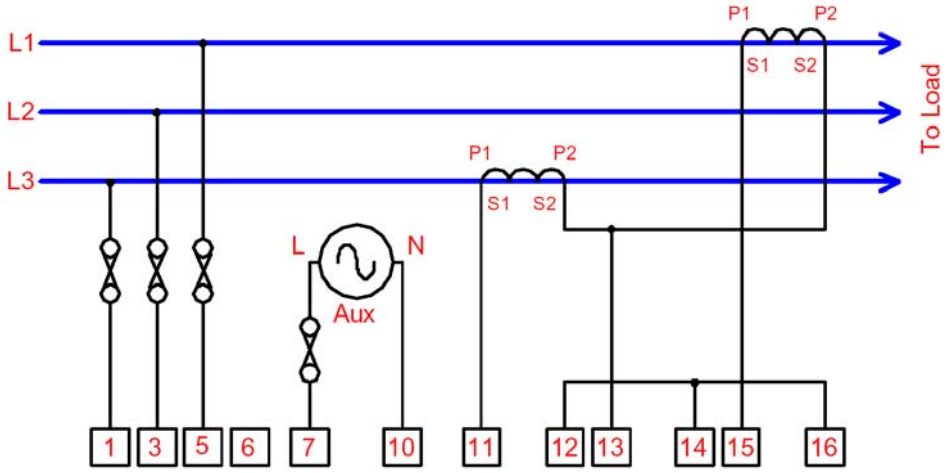


Figure 3.2 3-Phase 3-Wire 2CTs

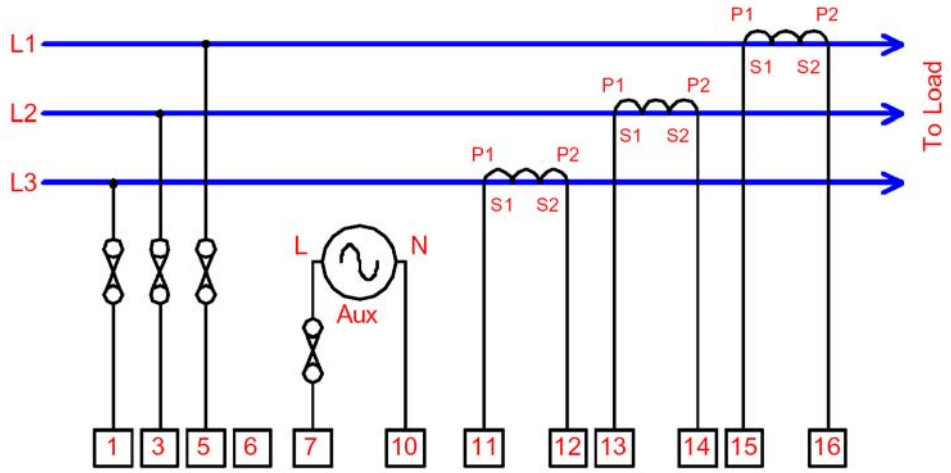


Figure 3.3 3-Phase 3-Wire 3CTs

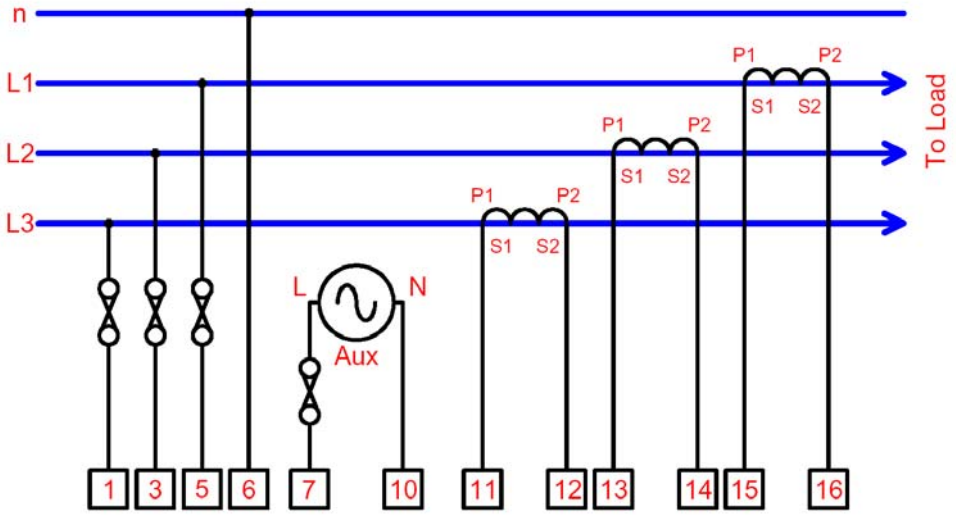


Figure 3.4 3-Phase 4-Wire

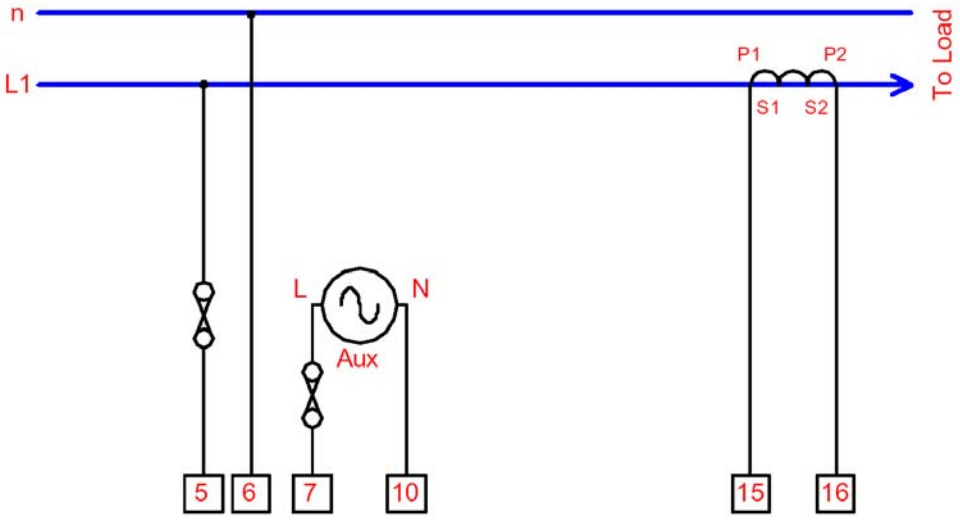


Figure 3.5 Single Phase

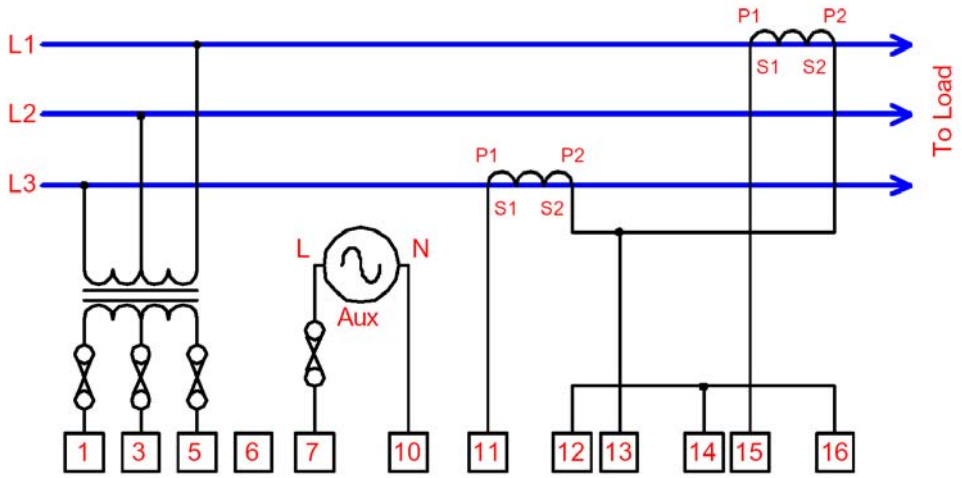


Figure 3.6 3 Phase 3 Wire Using Potential Transformers

4. Programming

4.1 Description

The Power Cube is designed for use in a wide variety of systems. A range of programmable features allow the unit to be set-up for a specific application. Programming is available using the front panel keypad and display while the unit is operational.

4.2 Entering Programming Mode

To enter programming Press △ and ▽ together and hold for 5 seconds.

4.3 Setting The CT Primary Current

The first item in the programming menu allows the user to set the CT Primary current, in the range 10A to 2000A (steps of 10), to match the primary of the current transformers connected to the meter inputs. Once set, the constant acts as a multiplying factor in the internal calculation of all measurements.

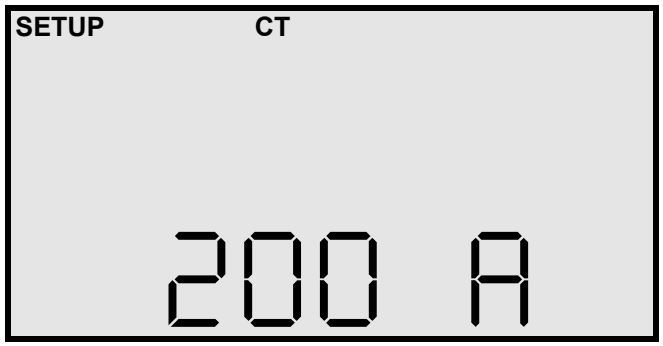


Figure 4.1 Setting The CT Primary Constant

Press △ to increase the CT Primary Constant in steps of 10 Amps.

Press ▽ to decrease the CT Primary Constant in steps of 10 Amps.

Press △ and ▽ together and hold for 3 seconds when done.

4.4 Setting The Scaling Factor

The next item in the programming menu allows the user to set an additional multiplying factor (0.1, 1.0, 10.0, 100.0 or 1000.0) used in the internal calculation of all measurements.

This is useful if the Power Cube connected to HV systems using measurement Voltage Transformers (VTs) or to select CT Primary values not programmable using the above procedure.

Example :

The Power Cube is connected via 200A CTs and 11,000V:110V VTs.
Set CT Primary = 200A. Set Scale = 100

Example :

The Power Cube is connected via 25A CTs.
Set CT Primary = 250A. Set Scale = 0.1

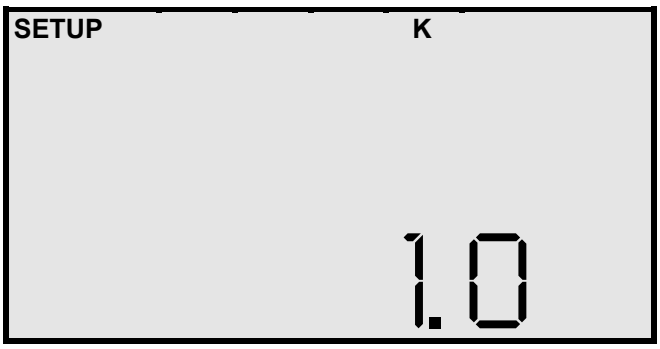


Figure 4.2 Setting The Scaling Factor Constant

Press △ to increase the Scaling Constant by a factor of 10.

Press ▽ to decrease the Scaling Constant by a factor of 10.

Press △ and ▽ together and hold for 3 seconds when done

4.5 Setting The Pulse Output Rate

The Power Cube may be set to provide a single pulse at the end of every 1, 10, 100 or 1000 increments of the kWh register. This allows the unit to be configured to suit a wide variety of data logging, building management type applications.

During programming, the Pulse Output Rate is displayed scaled as kWh for convenience. A display of ***SETUP PULSE T 100.0 kWh*** indicates that a single pulse will occur at the end of each 100 kWh.

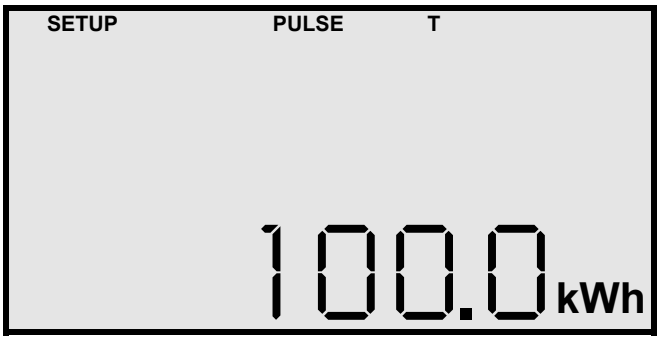


Figure 4.3 Setting The Pulse Output Rate

Press △ to increase the Pulse Output Rate by a factor of 10.

Press ▽ to decrease the Pulse Output Rate by a factor of 10.

Press △ and ▽ together and hold for 3 seconds when done

4.6 Setting The MD Time Period

Rolling Demand and Peak Demand are average values measured over a given time period (Ref. 2.1.4.1). The time period used may be set, in the range 1-60 minutes, to suit a variety of applications or tariff arrangements.

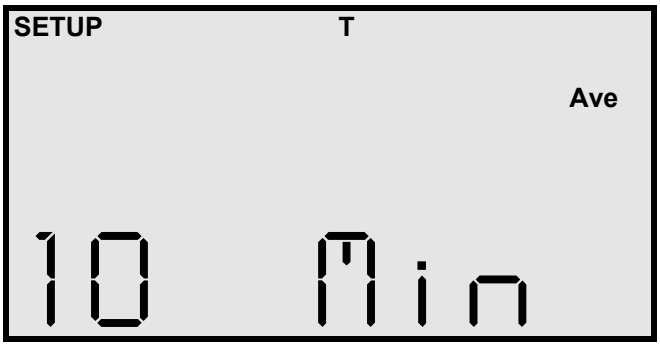


Figure 4.4 Setting The MD Time Period

Press △ to increase the Time Period in steps of 1 minute.

Press ▽ to decrease the Time Period in steps of 1 minute.

Press △ and ▽ together and hold for 3 seconds when done

5. Specification

Inputs	
System	3-Phase 3 or 4 Wire Unbalanced Load 3-Phase Balanced and Single Phase to order
Voltage	230 / 400 Volt. 3-Phase 3 or 4 Wire 63 / 110 Volt optional 120 / 208 Volt optional. (other inputs are available to order)
Current	5 Amp from external current transformers (CTs) 1 Amp optional **Fully Isolated**
Measurement Range **Voltage** **Current**	 50% to 120% 0.5% to 120%
Frequency Range **Fundamental** **Harmonics**	 45 to 65Hz Up to 50th harmonic
Input Loading **Voltage** **Current**	 Less than 0.1 VA per phase Less than 0.1 VA per phase
Overloads **Voltage** **Current**	 x2 for 2 seconds maximum x40 for 1.0 seconds maximum

Auxiliary Supply	
Standard	230 Volt 50/60Hz ±15%
Options	110 Volt 50/60Hz ±15%. (Others to order)
Load	4 VA Maximum

Display	
Display Type	Custom, supertwist, LCD with LED backlight
Data Retention	10 years minimum Stores kWh, Peak Demand, User Settings.
Display Format	Top Line 4½, 21mm digits. Btm Line 6, 12mm digits. Custom legends.
kW & kW Demand	4½ digits maximum. DP dependant on user settings
kWh	7 digits. DP dependant on user settings
Scaling	Direct reading. User programmable CT, VT
Legends	W, kW, MW etc dependant on user settings
Display Update	kW/kWh 1 sec. Rolling/Peak Demand T/15 T=Demand Period
Demand Period	
Setting	User programmable 1 to 60 minutes
Resolution	Demand period split into 15 sub periods

Accuracy	
kW	Class 0.4 EN 60668
kWh	Better than Class 1 per EN 61036 (IEC 1036)
kW Demand	Class 0.4 EN 60668
Peak Demand	Class 0.4 EN 60668
Timebase	Better than 100ppm

Specification

Output Relay(s)	
Function	1 pulse per unit of energy
Scaling	Settable 1,10,100 or 1000 counts of kWh register
Pulse Period	100mS. (2mS Rise, 2mS Fall)
Type	N/O Volt free contact. Optically isolated BiFET
Contacts	100mA AC/DC max, 100V AC/DC max
Isolation	2.5kV

General	
Temperature	
Operating	-10 deg C to +65 Deg C
Storage	-25 deg C to +70 deg C
Humidity	<75% non-condensing
Environment	IP 54

Mechanical	
Enclosure	DIN 96mm x 96mm Mablex ULV94-V-O
Dimensions	96mm x 96mm x 80mm (72mm behind panel)
Weight	Approx 400g
Terminals	Rising Cage. 4.0mm^2 cable max

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