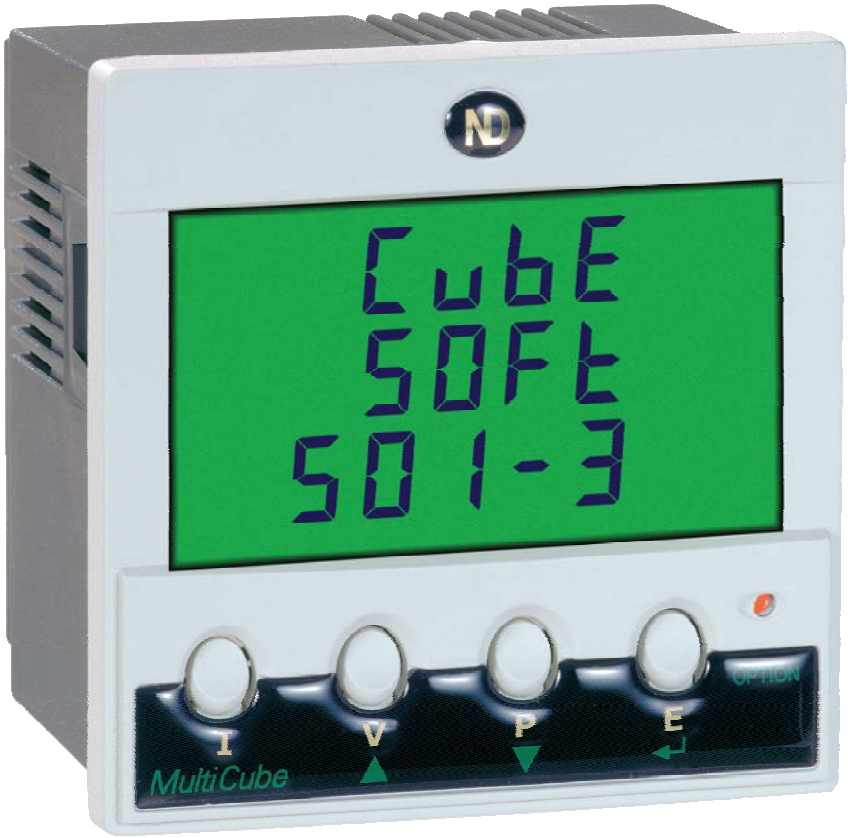
MultiCube
Single Phase
Multi-Function Electricity Meter



Installation and Operation

PREFACE

MultiCube Single Phase Meter
Operating Guide Revision 5.01
August 2002

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 Operating Manual

WARNING
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

The MultiCube makes use of a high speed micro-processor and an Analogue to Digital converter to monitor input signals. The phase voltage, current and power (kW) are measured directly and a number of other parameters derived from these in software. The measurement process is continuous with all signals scanned simultaneously at high speed ensuring that all input cycles are detected. Distorted input waveforms, with harmonics to the 20th are therefore detected accurately.

Derived parameters are calculated and displayed once a second, scaled by user programmed constants for current and voltage transformers.

Instantaneous power parameters are integrated over long time periods providing a number of energy registers. System frequency is detected by digital processing of the voltage input signal.

2.1.1 Rolling Demand (Amps and kW Demands)

Average values of Amps and kW are calculated over a user programmable time period (10 - 2500 seconds for Amps, 1 - 60 minutes for kW). The displays show the averages 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***".

2.1.1.1 Calculating Rolling Demand

Each user set time period is split into smaller sub-periods (10 for Amps, 15 for kW). An average value for measurements taken every second during a sub-period are calculated for each parameter. The most recent 10 (15 for kW) sub-period averages are stored in memory as an array. An average of the data in each of these arrays is displayed as MD (rolling demand).

On power up (or after a brown-out) the sub-period array values are reset to zero. During the first full MD period the Rolling Demand value will accumulate as the zeroes are replaced with valid sub-period averages.

2.1.1.2 Peak Demand (kW and I Pk Demand)

Peak MD readings are the maximum recorded values of corresponding Rolling Demand values.

These may be used to determine the maximum load requirement of a system. They are often used to determine spare capacity in a supply system, supply plant requirement etc.

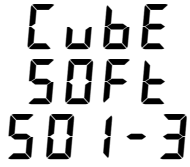
On power failure or brown-out Peak Demand values are automatically saved in non-volatile memory within the MultiCube. The memory requires no battery and will hold the value for up to 10 years in the absence of mains power.

2.1.1.3 Meter Types

Five Single Phase MultiCube meter types are available to suit a range of applications. The meter type defines a number of display pages which may be selected and the parameters metered. This manual covers all meters independent of type.

2.2 Power Up

On power up the MultiCube shows the meter type and software issue. The example below shows software issue 5.01 meter type 3



2.3 Display Pages

To select current measurements press the **I** key repeatedly until the desired page is displayed. The number of pages available is dependant on meter type.

To select voltage measurement press the **V** key until the desired page is displayed. Only a single page is available for voltage measurement on all meter types.

To select power measurements press the **P** key repeatedly until the desired page is displayed. The number of pages available is dependant on meter type.

To select energy measurements press the **E** key repeatedly until the desired page is displayed. The number of pages available is dependant on meter type.

Display pages available on the full range of Single Phase MultiCube meters are shown below followed by tables showing those available on each standard meter type.

Amps & Peak Amps

Instantaneous true rms. Current scaled by the user programmable CT primary is updated each second on the bottom line.

The largest measured instantaneous value (peak) is shown on the top

Ampere Demand

MD based on a rolling average calculation of Amps with a user programmable period 10s to 2500s

An average display based on 10 sub-period values (1s to 250s) is updated at the end of each sub period on the bottom line. The largest recorded value of this is displayed on the top line as Peak.

Volts & Peak Volts

Instantaneous true rms. Volts scaled by the user programmable PT primary is updated each second on the bottom line.

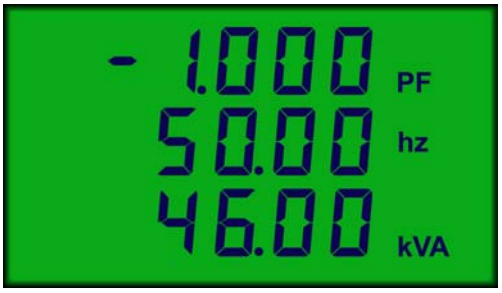
The largest measured instantaneous value (peak) is shown on the top line.

PF, Hz, W

Power Factor ('-' denotes capacitive).

Frequency detected on voltage input signal.

Instantaneous Watts scaled by the user programmable CT and PT primaries ('-' denotes Export).

	**PF, Hz, VA** Power Factor ('-' denotes capacitive). Frequency detected on voltage input signal. Instantaneous VA calculated as Volts x Amps.	
	**PF, Hz, var** Power Factor ('-' denotes capacitive). Frequency detected on voltage input signal. Instantaneous var calculated as: $var = \sqrt{(VA^2 - W^2)}$ ('-' denotes Export).	
	**Watts Demand** MD based on rolling average of instantaneous kW : Peak kW MD (largest since last reset) Current Period kW MD Instantaneous kW	
	**Import Wh Register** Instantaneous watts integrated over time is accumulated in this register while the load is receiving real power. The most significant 7th digit is displayed on the middle line.	

	**Export Wh Register** Instantaneous watts integrated over time is accumulated in this register while the load is generating real power. The most significant 7th digit is displayed on the middle line.
	**Import varh Register** Instantaneous var integrated over time is accumulated in this register while the load is receiving real power. The most significant 7th digit is displayed on the middle line.
	**Export varh Register** Instantaneous var integrated over time is accumulated in this register while the load is generating real power. The most significant 7th digit is displayed on the middle line.
	**Total varh Register** The absolute sum of import and export varh registers. A '-' sign indicates an instantaneous export condition. The most significant 7th digit is displayed on the middle line.

Single Phase MultiCube Type 1 Menus			
I	**V**	**P**	**E**
Amps & Peak Amps	Volts & Peak Volts	PF, Frequency, Watts	Import Wh

Single Phase MultiCube Type 2 Menus			
I	**V**	**P**	**E**
Amps & Peak Amps	Volts & Peak Volts	PF, Frequency, Watts	Import Wh
		PF, Frequency, var	

Single Phase MultiCube Type 3 Menus			
I	**V**	**P**	**E**
Amps & Peak Amps	Volts & Peak Volts	PF, Frequency, Watts	Import Wh
Amps Demand & Peak		PF, Frequency, VA	
		PF, Frequency, var	

Single Phase MultiCube Type 4 Menus			
I	**V**	**P**	**E**
Amps & Peak Amps	Volts & Peak Volts	PF, Frequency, Watts	Import Wh
Amps Demand & Peak		PF, Frequency, VA	Export Wh
		PF, Frequency, var	
		Watts Demand & Peak	

Single Phase MultiCube Type 5 Menus			
I	**V**	**P**	**E**
Amps & Peak Amps	Volts & Peak Volts	PF, Frequency, Watts	Import Wh
Amps Demand & Peak		PF, Frequency, VA	Export Wh
		PF, Frequency, var	Import varh
		Watts Demand & Peak	Export varh
			Total varh

2.4 Display Scaling

The MultiCube scales it's displays automatically to provide the optimum resolution dependant on user settings (CT and PT Primary). This provides direct readings with decimal points and legends automatically selected (e.g. kW or MW etc).

2.4.1 Voltage Scaling (Phase, Peak)

PT Setting	Example Display
60V - 80V	20.00 V
81V - 800V	200.0 V
801V – 8,000V	2.000 kV
8,001V – 50,000V	20.00 kV

2.4.2 Current Scaling (Phase, Peak, MD, Pk MD)

CT Setting	Example Display
5A - 8A	5.000 A
9A - 80A	50.00 A
81A - 800A	500.0 A
801A – 8,000A	5.000 kA
8,001A – 20,000A	20.00 kA

2.4.3 Per Phase & System Power Scaling (W, VA, var)

PT Setting x CT Setting	Example Display
300VA – 3,000VA	2000.1 W
3,001VA – 30,000VA	2.000 kW
30,001VA – 300,000VA	20.00 kW
300,001VA – 3,000,000VA	200.0 kW
3,000,001VA – 30,000,000VA	2000 kW
30,000,001VA – 300,000,000VA	20.00 MW
300,000,001VA – 1,000,000,000VA	200.0 MW

Note: Rolling kW Demand, Peak Demand and kW on the MD page are displayed with 1 less digit of resolution than those above. (e.g. 20.00 kW becomes 20.0 kW)

2.4.4 Energy Registers (Wh, VAh, varh)

PT Setting x CT Setting	Example Display
300VA – 3,000VA	9999.999 kWh
3,001VA – 30,000VA	99999.99 kWh
30,001VA – 300,000VA	999999.9 kWh
300,001VA – 3,000,000VA	9999999 kWh
3,000,001VA – 30,000,000VA	99999.99 MWh
30,000,001VA – 300,000,000VA	999999.9 MWh
300,000,001VA – 1,000,000,000VA	9999999 MWh

2.4.5 Miscellaneous (Frequency, PF, THD)

All Settings	Example Display
Power Factor	1.000 PF
Frequency	50.00 hz

2.5 Energy Register Reset

All accumulating energy registers may be simultaneously reset to zero using the front panel keys. Once reset, energy readings are lost forever so great care must be taken when using this feature. To reset all energy registers

- Select any energy display page as described above
- Press P and E keys together and Hold for 5 seconds.

2.6 Peak Voltage Reset

The peak voltage reading may be reset to zero using the front panel keys. Once reset the old value will be immediately replaced by the latest instantaneous reading and subsequent peaks as they occur. To reset Peak Voltage

- Select the Voltage display page as described above
- Press P and E keys together and Hold for 5 seconds.

2.7 Peak Current Reset

The peak current reading may be reset to zero using the front panel keys. Once reset the old value will be immediately replaced by the latest instantaneous reading and subsequent peaks as they occur. To reset Peak Amps

- Select the Current display page as described above
- Press P and E keys together and Hold for 5 seconds.

2.8 Peak Demand Reset

Peak rolling demand readings (Amps and kW) may be reset to zero using the front panel keys. At the end of the next sub period the peak will be set to the latest rolling average value. To reset the Peak MD

- Select the Ampere Demand or Watts Demand display page as required
- Press P and E keys together and Hold for 5 seconds.

2.9 Isolated Pulse Outputs

MultiCube meters which display kWh and/or Export kWh incorporate isolated pulse output(s). These outputs provide a simple interface to external systems such as building management centres etc.

Each output takes the form of a normally open, volt free contact pair which provides a low resistance, for 100mS, at the end of a pre-set number of increments of the associated energy register ('pulse rate'). The pulse rate of each output may be programmed by the user to match the requirements of the external system. For further details on programming the MultiCube refer to Section 4.

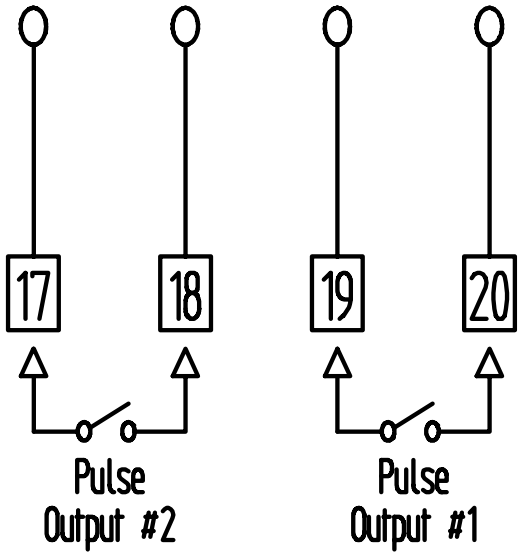


Figure 2.1 Pulse Output Connection

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.

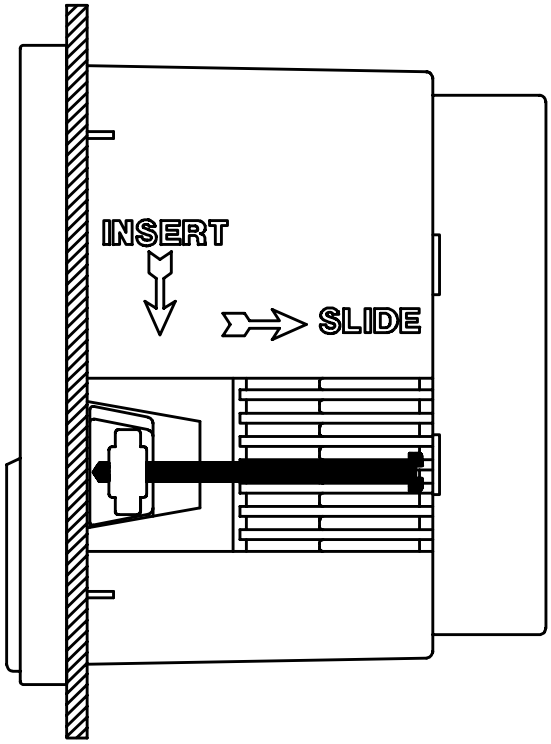


Figure 3-1 Fitting The Meter in a Panel

3.2 CT Connections

The MultiCube is designed for use with an external current transformer (CT). Recommended types should conform to Class 1 per IEC 60044-1. 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.

The CT Input to the meter is isolated from all other parts of the circuit.

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.

An external protection fuse is recommended for the voltage measurement input. This 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 MultiCube uses an isolated auxiliary mains supply separate from the voltage measurement input. 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

External fusing is required for safe installation. The external fuse should be rated at 250V, 100mA Type T.

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

NOTE: The MultiCube may be supplied with a non-standard auxiliary mains supply type (eg 72V DC). In this case separate documentation will be available, providing specific installation/safety information.

3.5 Connection Schematics

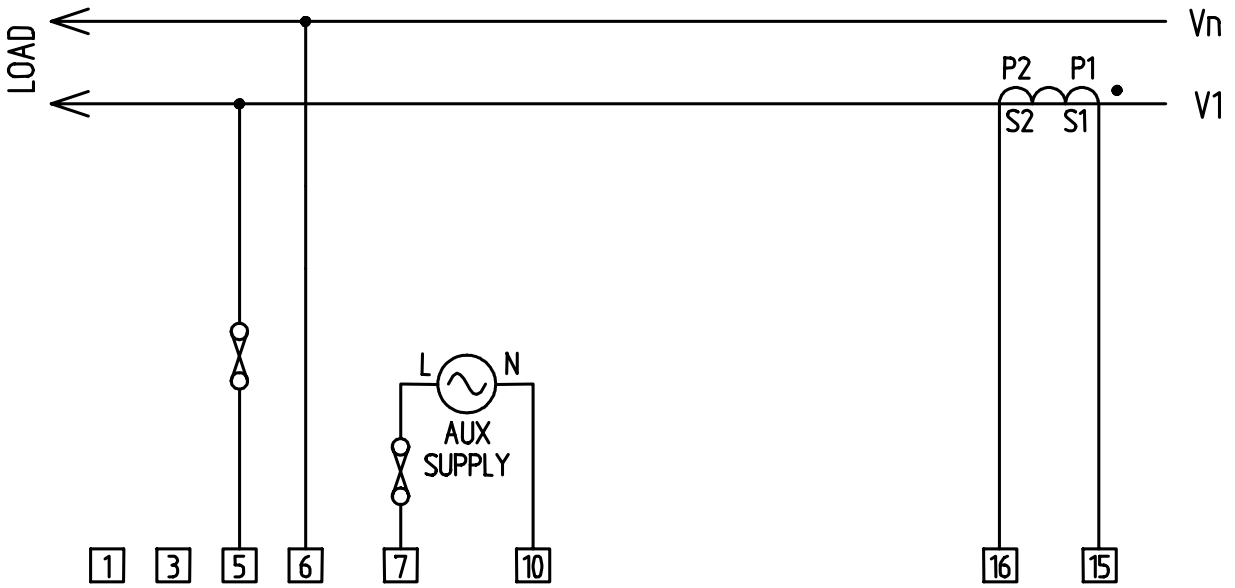


Figure 3-2 Single Phase Connection

4. Programming

4.1 Description

The MultiCube 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 and Exiting Programming Mode

To enter programming, Press I and V together and hold for 5 seconds.

When all user programmable settings are complete, Press I and V together and hold for 5 seconds to return to measurement mode.

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 5A to 20000A, to match the primary of the current transformer connected to the meter inputs. The secondary of the CT must match the nominal input current specified on the meter label. Once set, the constant acts as a multiplying factor in the internal calculation of relevant measurements.

Figure 4-1 Setting The CT Primary Constant

Press △ to increase the CT Primary Constant in steps of 1 Amp.

Press ▽ to decrease the CT Primary Constant in steps of 1 Amp.

Press ↵ and hold for 2 seconds when done.

4.4 Setting The PT Primary Voltage

The next item in the programming menu allows the user to set the PT Primary line-line voltage, in the range 60V to 50,000V, to match the primary of the potential transformers connected to the meter inputs. The secondary of the PTs must match the nominal line-line input voltage specified on the meter label. If no potential transformers are fitted the PT setting must match the nominal line-line input voltage specified on the meter label.

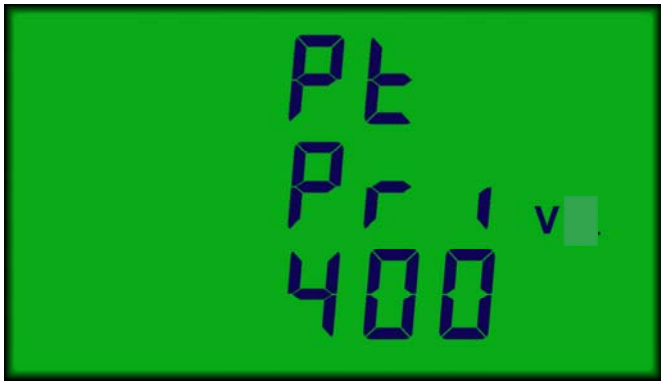


Figure 4-2 Setting The PT Primary Constant

Press △ to increase the PT Primary Constant in steps of 1 Volt.

Press ▽ to decrease the PT Primary Constant in steps of 1 Volt.

Press ↵ and hold for 2 seconds when done.

4.5 Setting Pulse Output 1 Rate

Isolated pulse output #1 may be set to provide a single pulse at the end of every 1, 10, or 100 increments of the Wh register irrespective of display scaling and decimal point. This allows the unit to be configured to suit a wide variety of data logging, building management type applications.

During programming, the Pulse Output #1 Rate is displayed scaled as the Wh register for convenience. A display of ***PL 1 rAtE 10.0 kWh*** indicates that a single pulse will occur, at output #1, at the end of each 10 kWh.

Figure 4-3 Setting The Pulse Output #1 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 hold for 2 seconds when done.

4.6 Setting Pulse Output 2 Rate

Isolated pulse output #2 may be set to provide a single pulse at the end of every 1, 10, or 100 increments of the Total varh register irrespective of display scaling and decimal point. This allows the unit to be configured to suit a wide variety of data logging, building management type applications.

During programming, the Pulse Output #2 Rate is displayed scaled as the total varh register for convenience. A display of ***PL 2 rAtE 10.0 kVArh*** indicates that a single pulse will occur, at output #2, at the end of each 10 kvarh.

Figure 4-4 Setting The Pulse Output #2 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 hold for 2 seconds when done.

4.7 Setting The Ampere Demand Period

The averaging period used in calculation of Ampere Rolling Demand (ref. Section 2.1.1) may be set in the range 10-2500 seconds (steps of 10s). This period may be selected to set a convenient filter for short term fluctuations in input power, as required.

During programming, the Average Period is displayed in seconds.

Figure 4-5 Setting Ampere Demand Period

Press △ to increase the Averaging Period by 10 seconds.

Press ▽ to decrease the Averaging Period by 10 seconds.

Press ↵ and hold for 2 seconds when done.

4.8 Setting The kW Rolling Average Period

The averaging period used in calculation of Watts Rolling Demands (ref. Section 2.1.1) may be set in the range 1-60 minutes. This period may be selected to match specific standards, or to set a convenient filter for short term fluctuations in input power, as required.

During programming, the Average Period is displayed in minutes.

Figure 4-6 Setting Watts Rolling Demand Period

Press △ to increase the Averaging Period by 1 minute.

Press ▽ to decrease the Averaging Period by 1 minute.

Press ↵ and hold for 2 seconds when done.

5. Specification

Inputs	
System	1-Phase 2 Wire Balanced/Unbalanced Loads
Voltage	Vb. 230 Volt. 1-Phase 2 Wire Vb. 120 Volt optional
Current	Ib 5 Amp from external current transformer (CT) Ib 1 Amp optional Fully Isolated (2.5kV / 1 minute)
Measurement Range **Voltage** **Current**	 20% to 120% 0.5% to 120%
Frequency Range **Fundamental** **Harmonics**	 45 to 65Hz Up to 20th harmonic
Input Loading **Voltage** **Current**	 Less than 0.1 VA Less than 0.1 VA
Overloads **Voltage** **Current**	 x2 for 2 seconds maximum x40 for 0.5 seconds maximum

Auxiliary Supply	
Standard	230 Volt 50/60Hz ±15%
Options	110 Volt 50/60Hz ±15%. (Others to order)
Load	5 VA Maximum

Accuracy	
Current	0.2% Ib (1.0% Rdg. 0.05 Ib ≤ I_{ph} ≤ 1.2 Ib) ±1 digit.
Voltage	0.2% Vb (1.0% Rdg. 0.2 Vb ≤ V_{ph} ≤ 1.2 Vb) ±1 digit.
Watts	0.4% FS (1.0% Rdg. 0.05FS ≤ P ≤ 1.2FS) ±1 digit.
VA	0.6% FS (1.5% Rdg. 0.05FS ≤ Q ≤ 1.2FS) ±1 digit.
var	0.8% FS (2.0% Rdg. 0.05FS ≤ S ≤ 1.2FS) ±1 digit.
PF	± 0.2 Degrees
Frequency	±0.05Hz. 45Hz ≤ F ≤ 65Hz
Wh Register	Class 1.0 EN 61036
VAh Register	Class 2.0
varh Registers	Class 2.0 IEC 1268
Timebase	Better than 100ppm

Display	
Display Type	Custom, supertwist, LCD with LED backlight
Data Retention	10 years minimum Stores energy registers, user settings, and peaks
Display Format	3 Lines 12mm digits + 3.8mm custom legends
Display Update	1 second

Digital (Pulse) Outputs	
Function	1 pulse / energy unit (Output #1=N Import Wh, Output #2=N Export Wh)
Scaling	Settable 1,10 or 100 counts of associated 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 (50V #1 to #2)

General	
Temperature **Operating** **Storage**	 -10 deg C to +65 deg C -25 deg C to +70 deg C
Environment	IP40
Humidity	<75% non-condensing

Mechanical	
Enclosure	DIN 96mm x 96mm Mablex ULV94-V-O
Dimensions	96mm x 96mm x 80mm (72mm behind panel) 130mm behind panel with options unit fitted
Weight	Approx. 400g
Terminals	Rising Cage. 4.0mm^2 cable max

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