`Cube350
Installation Guide
Revision 4

1 Safety

This instruction sheet gives details of safe installation and operation of the ***Cube350*** electricity meter. Labels on each meter give details of equipment ratings for safe operation. Take time to examine all labels before commencing installation. Safety symbols on the meter have specific meanings as:

Caution Risk of Danger
Refer to Instructions

Danger
Risk of Electric Shock

Safety may be impaired if the instructions are not followed or the meter is used in a manner not specified by the manufacturer.

Contains no user serviceable parts. Field wiring and commissioning should only be carried out by qualified personnel, in compliance with applicable national regulations.
e.g. National Electrical Code (NEC) for US; Canadian Electrical Code for Canada

For further Information contact the manufacturer:

Address: Northern Design (Electronics) Ltd: 228 Bolton Road, Bradford, West Yorkshire, BD3 0QW. (UK)
Web: http://www.ndmeter.co.uk
Email: sales@ndmeter.co.uk

2 Maintenance

The equipment should be maintained in good working order. Damaged equipment must be sent to the manufacturer (or his authorised agent) for repair. 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.

3 Intended Use

The ***Cube350*** is a precision multi function electricity monitor which measures system power parameters, including kW, Volts and Amps and displays them on an LCD. Measured parameters may be sent to remote systems for storage or display using an optional communications interface (e.g. Modbus® RTU RS485 or Ethernet).
The ***Cube350*** is intended for mounting in the faceplate (panel) of an electrical enclosure with only the front keypad/display panel remaining accessible to an operator after installation. Panels should be 1mm to 4mm (0.04” to 0.16”) thick with a square cut-out of 92mm, +0.8/-0.0mm (3.62” +0.03” -0”). Insert the meter from the front of the panel, slide the panel clips from the rear of the case and push firmly against the panel ensuring even pressure on each clip.

The safety of any system containing the meter as a component remains the responsibility of the system manufacturer. After installation in a system, the ratings of the overall system, which reflect the ratings of the meter, must be visible to the user.

A suitably located and easily reached switch or circuit breaker must be included as part of the installation. This could, for example, be a safety-interlocking device on the door/front panel of the electrical enclosure. This switch/circuit breaker must be marked as the disconnecting device for the equipment and must comply with the relevant requirements of IEC 60947-1 and IEC 60947-3.

Disconnect / Isolate all supplies before commencing installation.

4 Standard Connections

4.1 Current Connections

4.1.1 Current Cables

Current cables must remain inaccessible to the end user and be suitably rated for safe use in the electrical enclosure which houses the meter (e.g. UL1015) and must meet the following minimum specification: Temperature: 105°C (221°F); Insulation 600Vac.

4.1.2 Current Terminals

Voltage:	30Vac maximum
Cable:	22-14 AWG, Stripped 5.5 to 6.5mm (0.2” to 0.25”)
Torque:	0.5Nm (4.4in lb)

4.2 Voltage Connections

To maintain proper insulation from the mains supply, the neutral wire should only be used in power networks where the system neutral is protectively earthed.

4.2.1 Voltage Cables

Voltage cables must be rated for safe use in the electrical enclosure which houses the meter (e.g. UL1015) and must meet the following minimum specification: Temperature: 105°C (221°F); Insulation 600Vac.

4.2.2 Auxiliary Mains Supply

The meter is powered from an auxiliary mains supply which is required to energise the metering circuit and display. This can be connected in parallel with one of the measurement phase voltages if it is rated correctly.

Ensure the auxiliary mains supply L-N is powered from a correctly rated and fused AC source as specified on the meter label.

4.2.3 Voltage Terminals

Voltage:	277Vac (3-4) 480Vac (4-5, 5-6)
Cable:	30-14 AWG, Stripped 5.5 to 6.5mm (0.2” to 0.25”)
Torque:	0.5Nm (4.4in lb)

4.2.4 Voltage Fuses

Fuses (US/Canada)

Rated Voltage	Type	Rupture In (A)	Standards
≥ 500Vac	Fast	1.0A	UL248 (US) C22.2 No. 248 (CAN)

Fuses (Other Countries)

Rated Voltage	Type	Rupture In (A)	Standards
≥ 500Vac	Fast	1.0A	IEC 60269 - 2

4.2.5 Auxiliary Mains Fuses

Fuses (US/Canada)

Rated Voltage	Type	Rupture In (A)	Standards
≥ 250Vac	Fast	0.1A	UL248 (US) C22.2 No. 248 (CAN)

Fuses (Other Countries)

Rated Voltage	Type	Rupture In (A)	Standards
≥ 250Vac	Fast	0.1A	IEC 60269 - 2

4.3 Communications Options

Communications outputs are safety isolated from the measurement voltages at a minimum of 3.5kV.

Communications cables running within an electrical enclosure may come close to high voltages and therefore must be insulated to the following minimum specification:
Safety Compliant: e.g UL1015; Operating Temperature: 105°C (221°F); Insulation 600Vac

4.3.1 RS485 Output Terminals (Optional)

Voltage:	30Vdc
Cable:	30-14 AWG, Stripped 5.5 to 6.5mm (0.2” to 0.25”)
Torque:	0.5Nm (4.4in lb)

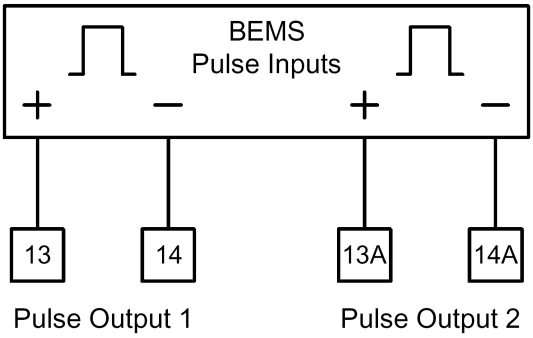
4.3.2 Ethernet Output (Optional)

Connection:	RJ45
Cable:	Cat5e FTP (Foil screened)

4.4 Pulse Output Connections

The pulse outputs take the form of isolated volt free normally open contact pairs. Pulse 1 is associated with active energy (kWh) and Pulse 2 with reactive energy (kvarh).
The contacts are isolated from all other circuits (3.5kV) and at 50V from pulse 1 to pulse 2.
Pulses can be used as input to remote counters, pulse loggers, building energy management system etc.

Light emitting diodes Л1 and Л2 remain ***ON*** during each associated output pulse.

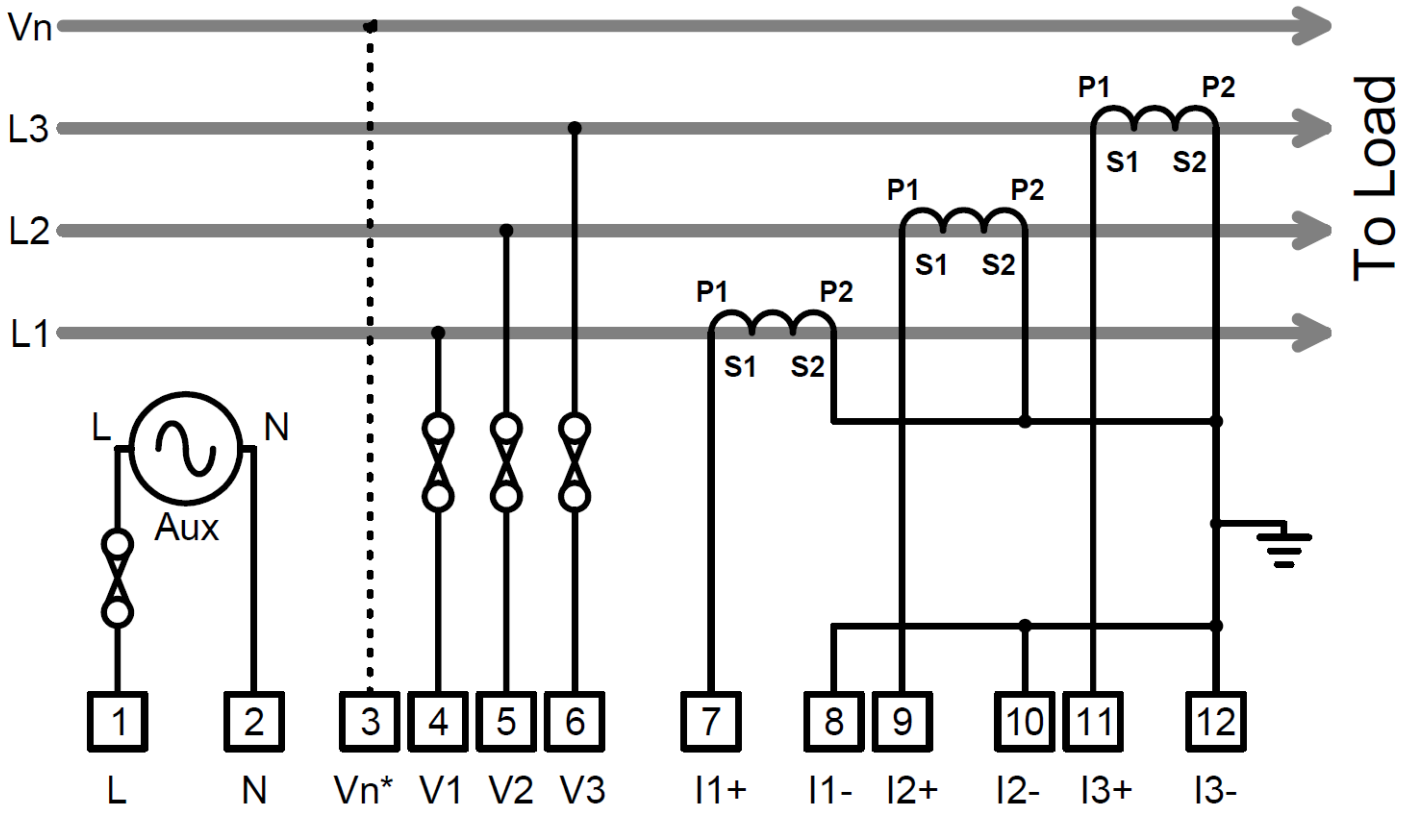


Pulse output cables running within an electrical enclosure may come close to high voltages and therefore must be insulated to the following minimum specification:
Safety Compliant: e.g UL1015; Operating Temperature: 105°C (221°F); Insulation 600Vac

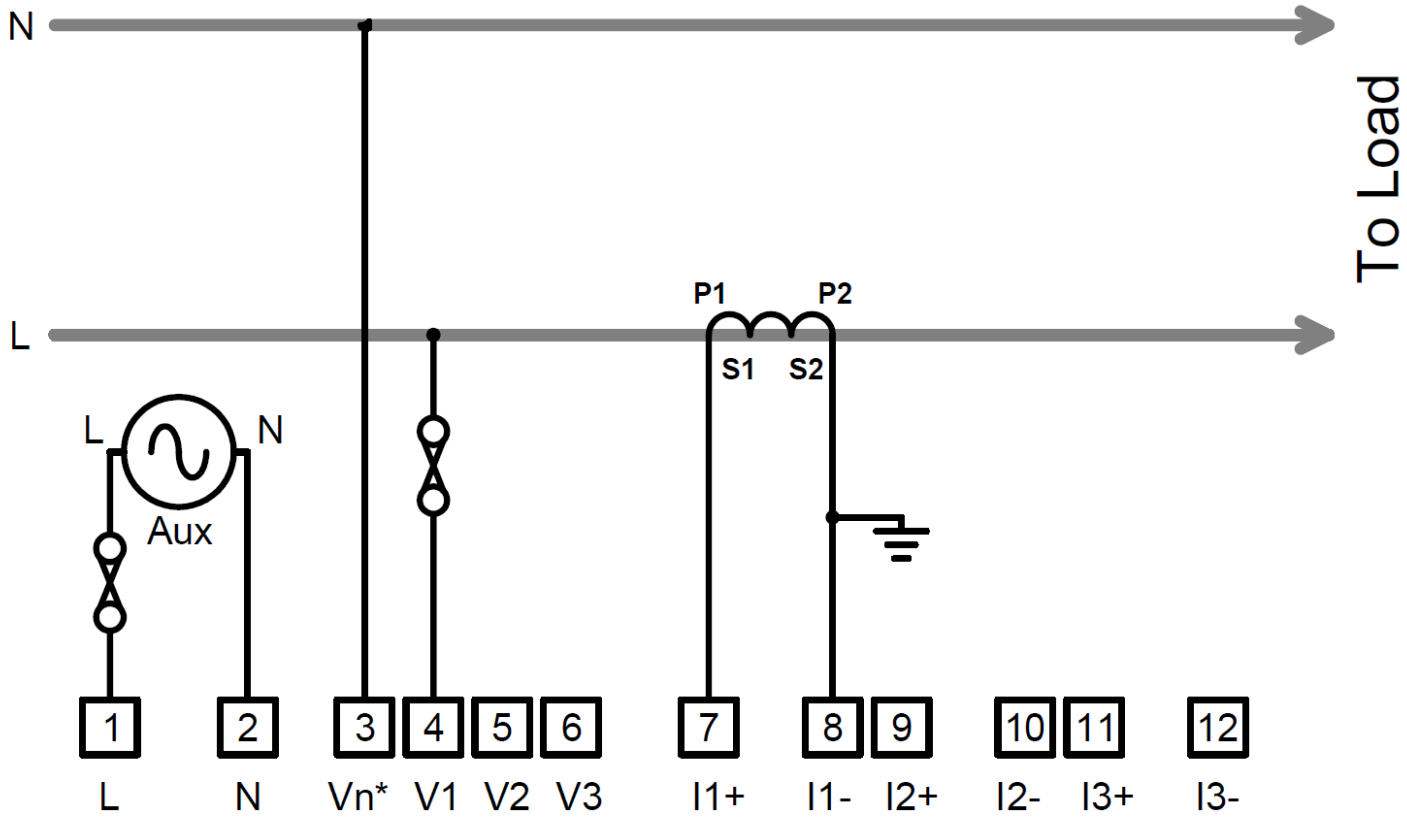
4.4.1 Pulse Output Terminals

Voltage:	70Vdc/33Vac (13-14, 13a-14a)
Cable:	30-14 AWG, Stripped 5.5 to 6.5mm (0.2” to 0.25”)
Torque:	0.5Nm (4.4in lb)

4.5 Typical Connections

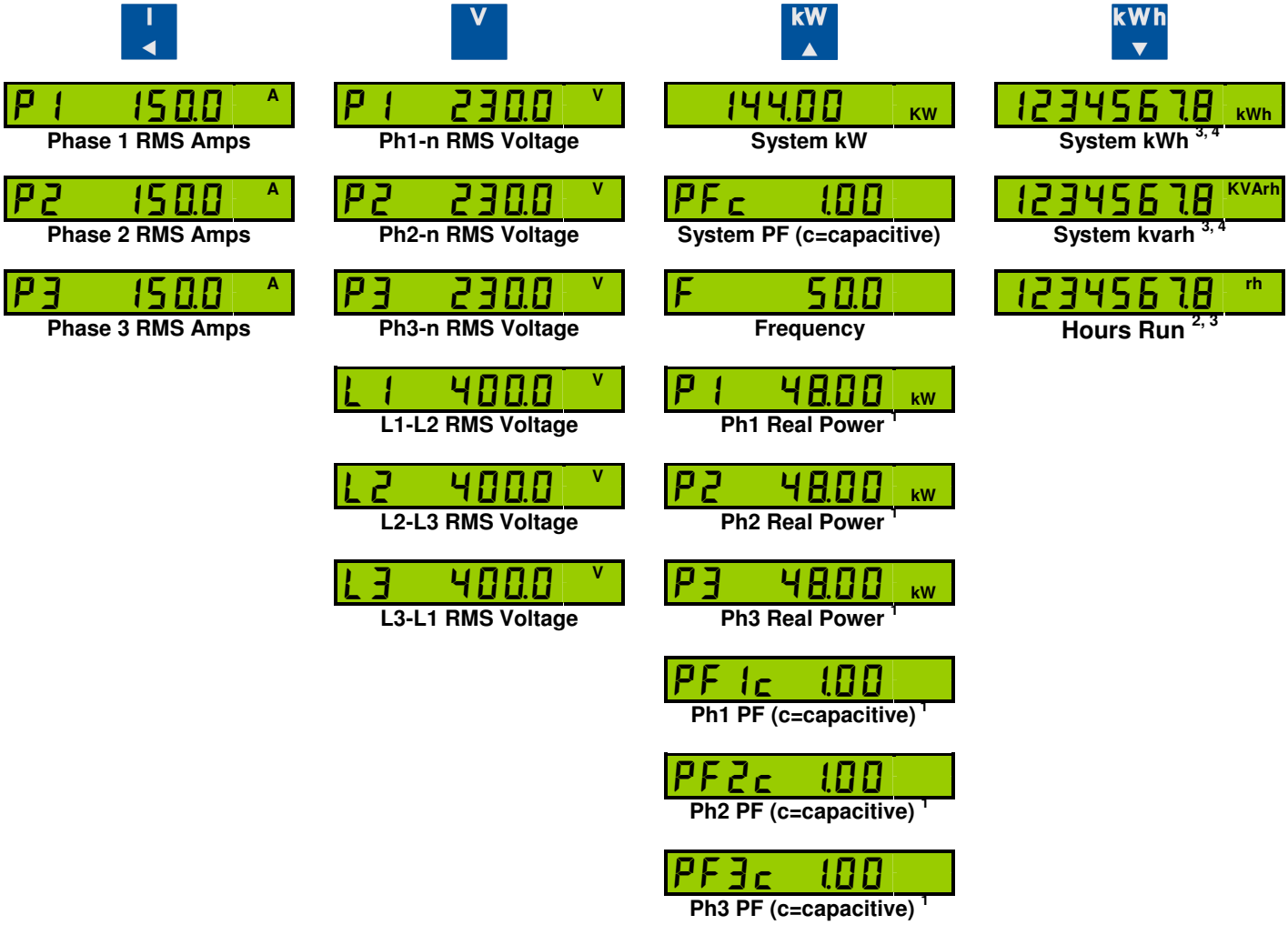


3-Phase 3 or 4-Wire (*Optional Neutral)



Single Phase

5 Display Menus



Note 1: Display of some per phase values may be disabled before mounting in a panel. These displays are enabled by default as they are useful during commissioning. Refer to Cube350 option links guide to disable.

Note 2: The Hours Run register accumulates the total time during which the average 3-phase load current exceeds a preset level. This is always displayed with a resolution of 0.1hour.

The percentage level of (I1+I2+I3) at which the Hours Run register accumulates is user programmable from 1% to 100% of full scale current.

Note 3: Press kW and kWh together and hold for 2 seconds to reset the displayed value. This feature is disabled by default. Refer to Cube350 option links guide to enable. The reset function works simultaneously on kWh or kvarh registers.

Reset of Hours Run cannot be disabled.

Note 4: Scaling of the energy registers is set by the nominal input currents and voltages and remains constant during operation of the meter. Energy registers will each accumulate from zero to 99,999,999 then restart from zero.

5.1 Phase Healthy Indicators

Three LEDs indicate when the individual phase-neutral voltages are present. These will illuminate when the measured voltage is above 20% of the nominal value (Note 1). Below this level the LEDs will be off.

Phase Healthy LEDs

Note1: In firmware versions earlier than V1.11, the LEDs illuminated at voltages above 80% of Nominal Phase Volts.

5.2 Programming

To Enter Programming:

Press and hold I and V together until display shows **CT**.

To Change a Setting Value:

Press kW or kWh until the required value is set.

To Move to The Next Setting:

Press I until the next page in the list is displayed. Parameters are set in the following order:

After the last parameter is set the new values are stored and the meter continues to measure with the new settings.

Fine Adjust Ct and Un Settings

CT Primary and Nominal Voltage settings are selected from a table of preferred values. This reduces the time to program these parameters to industry standard values.

Fine Adjust Mode allows values other than those provided by the default tables to be set. To enter/exit ***Fine Adjust Mode:***

Hold kW and I together for 2 Seconds while setting ***CT*** or ***Un***.

Fine Adjust Mode is indicated by a decimal point immediately after the parameter type (ie. ***"CT."*** or ***"Un."***)

Current Transformer Primary

Voltage Transformer Primary [5]

Pulse Output Rate (1 and 2)

Pulse On Time (Seconds)

Pulse Test

Hours Run %Amps Trigger

Voltage Input

CT Auto Rotation Mode

Store Setup to Memory

5.3 Current Sensor Type Selection (CT)

Current sensor types are selected from a table of preferred types identified by their nominal primary current rating. The following types may be selected.

5, 10, 15, 20, 30, 40, 50, 60, 75, 80, 100, 125, 150, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1250, 1500, 1600, 2000, 2400, 2500, 3000, 3500, ---- in steps of 500---, 24000, 24500, 25000

5.3.1 Fine Adjust

Fine Adjust Mode allows values other than those provided by the default tables to be set. To enter/exit ***Fine Adjust Mode:***

Hold P and I together for 2 Seconds while setting ***Ct. Fine Adjust Mode*** is indicated by a decimal point after "Ct".

5.4 Nominal Line-Line Voltage Selection (Un)

The nominal line-line voltage of the measured supply system may be programmed.

11, 40, 48, 100, 110, 208, 400, 480, 600, 800, 1000, 1100, 2200, 3300, 4000, 4400, 6600, 7500, 10000, 11000, 15000, 22000, 33000, 66000,132000, 220000,440000

Note 5: If external VT is not used, **DO NOT ALTER** the voltage transformer primary setting for any other system voltage i.e. for 110V, 208V, 230V system. **LEAVE Un (Voltage Transformer Primary Setting) TO 480V ONLY.**

If external VT is used, alter the voltage transformer primary setting as stated in the following examples.
For 11000/110V VT, alter the setting to 48000 (multiplying factor: 11000 / 110 = 100 i.e. 480X100)
For 6600/110V VT, alter the setting to 28800 (multiplying factor: 6600 / 110 = 60 i.e. 480X60)

5.4.1 Fine Adjust

Fine Adjust Mode allows values other than those provided by the default tables to be set. To enter/exit ***Fine Adjust Mode:***

Hold P ▲ and I ◀ together for 2 Seconds while setting ***Un***. ***Fine Adjust Mode*** is indicated by a decimal point after "Un".

5.5 Pulse Rate Selection Table (Counts)

Pulse values are displayed scaled as 1 count of energy.

1, 2, 5, 10, 100, 1000

5.6 Pulse On-Time Selection Table

100ms, 200ms, 500ms, 1s, 2s, 3s, 5s, 10s, 20s

5.7 Pulse Output Test 

This feature allows the pulse output hardware and external system connections to be commissioned without a measured load. The LCD shows ***Pto*** (off) and ***Ptr*** (run) and the number of test pulses. The test pulse rate is set automatically dependant on the programmed pulse length (maximum 0.5Hz).

Press kW ▲ to start/stop the test pulses on both outputs.

Press kW ▲ and kWh ▼ together to stop the test pulses and simultaneously reset the test counter.

5.8 Voltage Input Mode Selection

In "***Balance Voltage Mode***" the ***Cube350*** may be connected to a single voltage source in place of the three phases normally required for full accuracy measurement.

When ***Balanced Voltage Mode*** is enabled the voltage measured on phase 1 is copied to phases 2 & 3 and all three power-factors are assumed to be unity (1.00). In this mode, the voltage connected to phase 1 on the meter may be fed from any of the 3-Phase system voltages.

This connection is valid for loads with a near unity power-factor (PF=0.95 equates to an error of 5%) and balanced 3-Phase voltages.

The combination of ***Split Core Current Sensors*** and ***Balanced Voltage Mode*** allows for rapid commissioning where access cannot be made to 3-Phase terminations. At a later date when access is possible, for example during planned maintenance, the meter may be connected safely to the 3-Phase voltages and ***Balanced Voltage Mode*** de-selected.

Press P ▲ or E ▼ to toggle between ***Balanced Voltage Mode*** and ***True 3-Phase Measurement Mode***.

True 3-Phase Measurement Mode

Balanced Voltage Mode

In ***Balance Voltage Mode*** some display menu pages are removed as they have little or no meaning and voltage is displayed as:

Voltage Display in Balanced Voltage Mode

Single Phase kW, Power Factor and kvarh displays are removed while ***Balanced Voltage Mode*** is enabled.

5.9 CT Auto Rotation Mode

When "***CT Auto Rotation Mode***" is selected, the orientation of each ***Current Transformer (CT)*** on its respective cable becomes irrelevant. It is therefore possible to pass the cable through the centre of the CT in either direction. In this mode current direction is ignored and all power is assumed to be feeding a load (import).

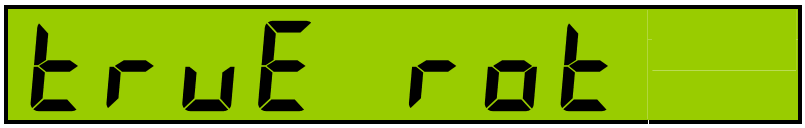
When "***CT Auto Rotation Mode***" is de-selected ("***True Rotation Mode***") current direction is monitored and measurement of import and export power is provided.

In both modes it is essential to place each CT on the correct phase conductor associated with the relevant phase voltage: Therefore link ***CT1 with V1***, ***CT2 with V2***, ***CT3 with V3***.

Cube350 meters are normally supplied with "***CT Auto Rotation Mode***" selected. In order to detect Positive and Negative power values in all four quadrants it is necessary to de-select "***CT Auto Rotation Mode***".

In the programming Menu Press P ▲ or E ▼ to toggle between ***CT Auto Rotation Mode*** and ***True Rotation Mode***.

CT Auto Rotation Mode



True Rotation Mode

NOTE: ***CT Auto Rotation Mode*** is not available when ***Balanced Voltage Mode*** is selected as all Power Factors are assumed to be unity and current phase and direction is ignored.

6 Specification

INPUTS		
System	3 Phase 3 or 4 Wire Unbalanced Load or Single Phase	
Voltage Un	480/277V. 3 Phase 3 or 4 Wire	
Current In	5Amp from external CTs. (1A optional) Isolated at 2.21kV	
Measurement Range	Voltage	20% to 120% Un
	Current	0.2% to 120%
Frequency Range	Fundamental	45 to 65Hz
	Harmonics	Up to 25th harmonic at 60Hz Individual to the 15th
Burden	Voltage	<0.1VA per phase
	Current	<0.1VA per phase
Overload	Voltage	x4 for 1 hour
	Current	x20 for 0.5 seconds max
DISPLAY		
Type	Custom, Supertwist, LCD	
Data Retention	10 years min. Stores kWh & Meter set-up	
Format	8 x 6.66mm high 7-segment digits + 3.2mm Legends	
Scaling	Direct reading. User programmable CT & PT CT Primary programmable from 5A to 25kA VT primary programmable from 10V to 440kV	
Legends	Wh, kWh, MWh etc. depending on user settings	
AUXILIARY SUPPLY		
Standard	230V 50/60 Hz ±15%	
Options	110V 50/60 Hz ±15%	
Load	5 Watt Max.	
Overload	x1.2 continuous	
METER ACCURACY	**All errors ± 1 digit**	
kWh	Better than Class 1 per EN 62053-21 & BS 8431	
Kvarh	Better than Class 2 per EN 62053-23 & BS 8431	
kW & kVA	Better than Class 0.25 IEC 60688	
kvar	Better than Class 0.5 IEC 60688	
Amps & Volts	Class 0.1 IEC 60688 (0.01In – 1.2In or 0.1Un – 1.2Un)	
PF	±0.2° (0.05In – 1.2In and 0.2Un – 1.2Un)	
Neutral Current	Class 0.5 IEC 60688 (0.05In – 1.2In)	

PULSE OUTPUTS	
Function	1 Pulse per unit of energy
Scaling	Settable between 1 & 1000 counts of energy register
Pulse Period	0.1 sec. default; Settable between 0.1 and 20 sec
Rise & Fall Time	< 2.0ms
Type	N/O Volt free contact. Optically isolated BiFET
Contacts	100mA ac/dc max ; 70Vdc/33Vac max ; 5W maximum load
Isolation	3.5kV 50Hz 1 minute
MODBUS® Serial Comms (Option)	
Bus Type	RS485 2 wire + 0v. ½ Duplex, ¼ unit load
Protocol	MODBUS® RTU with 16 bit CRC
Baud Rate	4800, 9600 or 19,200 User settable
Address	1 – 247 User settable
Latency	Reply within 250ms max.
Command Rate	New command within 5ms of previous one
Isolation	3.5kV
ETHERNET (Option)	
Electrical	IEEE std 802.3. 2000 Edition
Data Rate	10 Mbits/s
Protocol	TCP, UDP, DHCP, FTP, TFTP, HTTP, SNTP, SNMP
Connection	10/100 Base T - RJ45
Isolation	3.5kV
GENERAL	
Temperature	Operating -10°C to +55°C (14°F to 131°F) Storage -25°C to +70°C (-13°F to 158°F)
Humidity	< 75% non-condensing
Environment	IP54 (when correctly mounted, as described, in a panel) Altitude <2000m (6561ft)
MECHANICAL	
Terminals	Rising Cage. 4mm^2 (12 AWG) cable max.
Enclosure	DIN 43700 96 x 96
Material	Mablex® with fire protection to UL94-V-O. Self extinguishing
Dimensions	96 x 96 mm x 83.5 mm (72 mm behind panel) 3.78" x 3.78" x 3.29" (2.83" behind the panel)
Weight	~ 250 gms
SAFETY	
Conforms to	EN 61010-1 Second Edition – Overvoltage Category III & BS 8431

E. & O. E.