# *Operating Guide*
# *October 2006*

# 1 Safety

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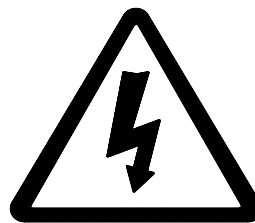
We reserve the right to make changes and improvements to the product without obligation to incorporate these changes and improvements into units previously shipped.

## 1.1 Warning Symbols

This instruction manual gives details of safe installation and operation of the **Cube400** electricity meter. Safety may be impaired if the instructions are not followed. 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.

**Refer To User Manual**        **Risk of Electric Shock**

| WARNING |
|---|
| The meter contains no user serviceable parts. |
| Installation and commissioning should only 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.

Further information is available at http://www.ndmeter.co.uk.

## 1.3 Waste Electrical/Electronic Equipment

At the end of this products useful life it should be disposed of ONLY via a recycling center as defined by the EU WEEE directive. This product should not be incinerated.

# 2 Display Pages

Measured data is displayed on numerous pages organised in four Standard Menus and two Distortion Menus as follows:

## 2.1 Power Up

The following screen is shown when auxiliary power is first supplied.
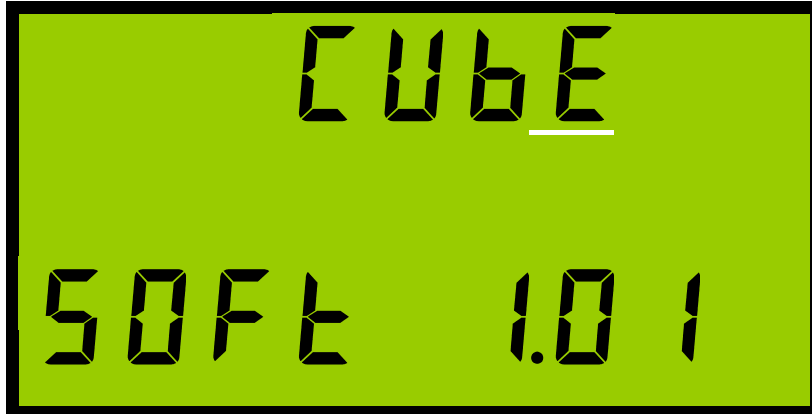


## 2.2 Current Menu

Press the [⊿] key to select from the available Current Menu pages.



### Phase Amps

Phase 1 true rms amps

Phase 2 true rms amps.

Phase 3 true rms amps.

This display is updated every second.



### Peak Hold Phase Amps

The maximum value of displayed phase amps. These are stored in non-volatile memory when the meter loses auxiliary power

Press [⊿] and [V] to reset all three maximums to zero [note 1].

### *Time-Averaged Amps*

The calculated average of phase amps taken over a user definable time period $T_{VI}$ (10s to 1800s).

A rolling time window is used and the display updated every $T_{VI}/10$ with the average of the most recent period displayed.

**T-Avg**    200.0   A
200.0
200.0

### *Peak Time-Averaged Amps*

The maximum value of Time-Averaged amps. These are stored in non-volatile memory when the meter loses auxiliary power

Press ⬛ and ⬛ to reset all three maximums to zero [note 1].

**Pk hold**    200.0   A
**T-Avg**    200.0
200.0

## 2.3 Voltage Menu

Press the ⬛ key to select from the available Voltage Menu pages.

### *Phase Volts*

Phase 1 to neutral true rms volts

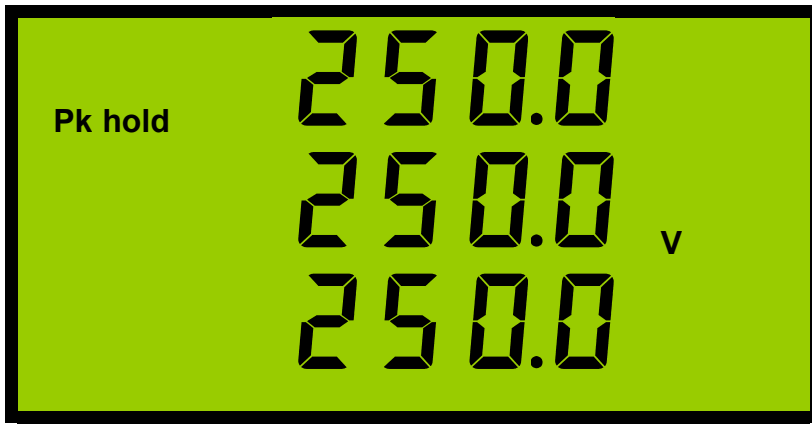Phase 2 to neutral true rms volts.

Phase 3 to neutral true rms volts.

This display is updated every second.

230.0
230.0   V
230.0

### *Line Volts*

Line 1 true rms volts (Phases 1-2)

Line 2 true rms volts (Phases 2-3)

Line 3 true rms volts (Phases 3-1)

This display is updated every second.

400.0
400.0   L-L V
400.0

## Peak Hold Phase Volts

The maximum value of displayed phase volts. These are stored in non-volatile memory when the meter loses auxiliary power

Press [I] and [V] to reset all three maximums to zero [note 1].



## Time-Averaged Volts

The calculated average of phase volts taken over a user definable time period $T_{VI}$ (10s to 1800s).

A rolling time window is used and the display updated every $T_{VI}/10$ with the average of the most recent period displayed.



## Peak Time-Averaged Volts

The maximum value of Time-Averaged volts. These are stored in non-volatile memory when the meter loses auxiliary power

Press [I] and [V] to reset all three maximums to zero [note 1].

## 2.4 Power Menu

Press the [P ▲] key to select from the available Power Menu pages.

```
  - 239.0  ⊣⊢
           KVAr
   276.0
3-Phase    KVA
   138.0
           KW
```

### System Power

System Reactive Power (var)

System Active Power (VA)

System Real Power (Watts)

A ⊣⊢ symbol after the var value indicates a capacitive load.

A negative sign before the var readings indicates export reactive power.

```
   46.00

   46.00

   46.00
           KW
```

### Phase Watts

Phase 1 true rms watts

Phase 2 true rms watts.

Phase 3 true rms watts

```
    10.0  bal
            A
    50.0
            Hz
3-Phase
    1.000  COSΦ
            ⊣⊢
```

### System Page 2

Balance current. (I1+I2+I3)

Frequency (Measured on V1)

System Power Factor

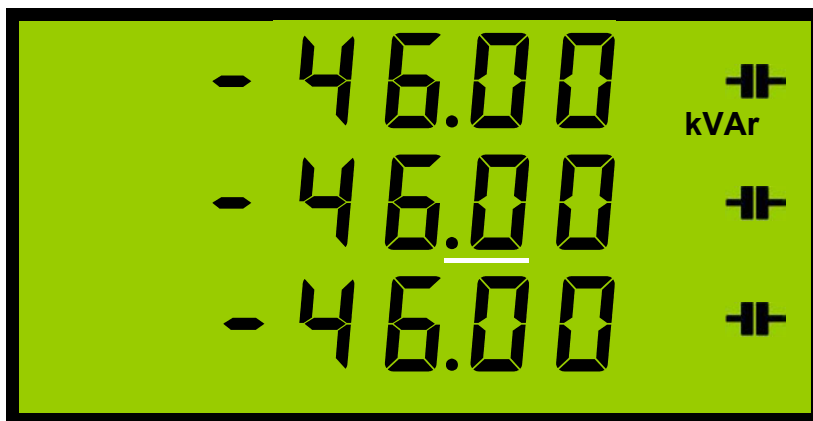A ⊣⊢ symbol after the power factor value indicates a capacitive load.

```
   46.00
           kVA
   46.00

   46.00
```

### Phase VA

Phase 1 true rms VA

Phase 2 true rms VA.

Phase 3 true rms VA

## Phase VAr

| | |
|---|---|
| - 46.00 | kVAr |
| - 46.00 | |
| - 46.00 | |

Phase 1 true rms Var.

Phase 2 true rms Var.

Phase 3 true rms Var.

A **⊣⊢** symbol after a var value indicates a capacitive load.

A negative sign before a var reading indicates export reactive power.

## Phase Power Factor

| | |
|---|---|
| 1.000 | |
| 1.000 | |
| 1.000 | COSΦ |

Phase 1 Power Factor.

Phase 2 Power Factor.

Phase 3 Power Factor.

A **⊣⊢** symbol after each value indicates a capacitive load.

## Power Mean Demand (MD)

| MD | 239.0 | KVAr |
|---|---|---|
| 3-Phase | 276.0 | KVA |
| | 138.0 | KW |

The calculated average of the system power values taken over a user definable time period $T_p$ (1min to 60min).

A rolling time window is used and the display updated every $T_p/60$ with the averages of the most recent period displayed.

## Peak Hold MD

| Pk hold MD | 239.0 | KVAr |
|---|---|---|
| 3-Phase | 276.0 | KVA |
| | 138.0 | KW |

The maximum value of each power MD value. These are stored in non-volatile memory when the meter loses auxiliary power

Press [◄] and [V] to reset all three maximums to zero [note 1].

**NOTE 1:** Meters may be installed with the option to reset all peak hold values using the front keys disabled.

## 2.5 Energy Menu

Press the [E ▼] key to select from the available Energy Menu pages.

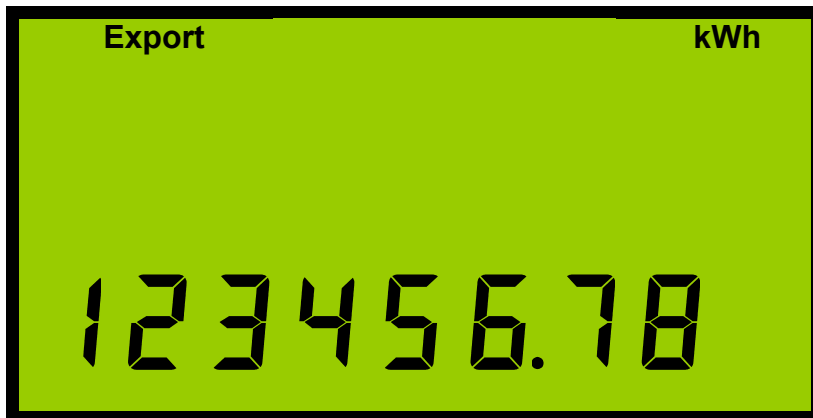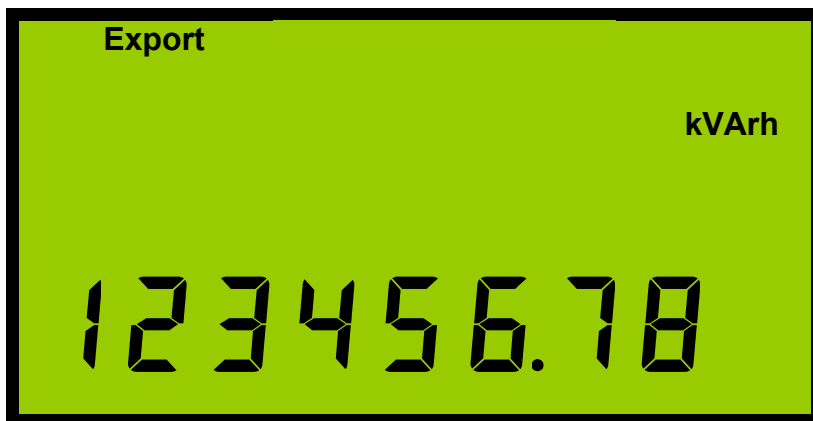| | |
|---|---|
| **kWh** <br> *123456.78* | ### Real Energy (Wh) <br> This register accumulates only when real power (kW) is positive (import). <br><br> This value returns to 0 when the value exceeds 99999999. <br><br> This register is stored in non-volatile memory when auxiliary power is not supplied to the meter. |
| **kVArh** <br> *123456.78* | ### Reactive Energy (VArh) <br> Import varh Accumulating register. <br><br> This value returns to 0 when the value exceeds 99999999. <br><br> This register is stored in non-volatile memory when auxiliary power is not supplied to the meter. |
| **kVA h** <br> *123456.78* | ### Apparent Energy (VAh) <br> Import VAh Accumulating register. <br><br> This value returns to 0 when the value exceeds 99999999. <br><br> This register is stored in non-volatile memory when auxiliary power is not supplied to the meter. |
| *HrS* <br> *run* <br> *1234567.8* | ### Hours Run[Note 2] <br> This register accumulates time in Hours only while real power (kWh) is above a user set level (see programming section). <br><br> This value returns to 0.0 when the value exceeds 99999999. <br><br> This register is stored in non-volatile memory when auxiliary power is not supplied to the meter. |

**Export**                             **kWh**

*123456.78*

### Export kWh[Note 2]

This register accumulates only when real power (kW) is negative (export).

This value returns to 0 when the value exceeds 99999999.

This register is stored in non-volatile memory when auxiliary power is not supplied to the meter.

**Export**

                                 **kVArh**

*123456.78*

### Export kvarh[Note 2]

This register accumulates only when reactive power (kvar) is negative (export).

This value returns to 0 when the value exceeds 99999999.

This register is stored in non-volatile memory when auxiliary power is not supplied to the meter.

**NOTE 2:** Hours Run, Export kWh and Export kvarh are factory fitted options. If these options are not supplied relevant page(s) will be omitted.

Meters may be supplied with an option to reset energy registers to zero using the front keys.

If the option is fitted, press [I ◄] and [V] together and hold for approximately 3 seconds to simultaneously reset all energy registers to zero. Once reset the registers may not be recovered.

## 2.6 Power Quality Menus

To enter/exit power quality display mode press **P ▲** and **E ▼** together and hold for approximately 3 seconds.

### 2.6.1 Amps Power Quality Menu

Press the **I ◄** key to select the Amps Power Quality Sub Menu. Press **P ▲** or **E ▼** keys to select the next/previous Amps Power Quality page.



### Amps Total Harmonic Distortion

Phase 1 Amps THD

Phase 2 Amps THD.

Phase 3 Amps THD.

This display is updated every second.

THD is scaled as 0-100.0%.



### Amps Individual Harmonics 02-15

Phase 1 Amps harmonic 02-15

Phase 2 Amps harmonic 02-15

Phase 3 Amps harmonic 02-15.

The harmonics are scaled as a percentage of the fundamental rms amps value. This example shows 10.0% second harmonic.

## 2.6.2 Volts Power Quality Menu

Press the [V] key to select the Volts Power Quality Sub Menu. Press [▲] or [▼] keys to select the next/previous Volts Power Quality page.



### Volts Total Harmonic Distortion

Phase 1 Volts THD

Phase 2 Volts THD.

Phase 3 Volts THD.

This display is updated every second.

THD is scaled as 0-100.0%.



### Volts Individual Harmonics 02-15

Phase 1 Volts harmonic 02-15

Phase 2 Volts harmonic 02-15

Phase 3 Volts harmonic 02-15.

The harmonics are scaled as a percentage of the fundamental rms volts value. This example shows 10.0% second harmonic.

## *2.7 Display Scaling*

Measured values displayed on the LCD are scaled by the user settings of CT and/or PT primaries to provide optimum resolution.

### *2.7.1 Voltage Scaling)*

| PT Setting | Resolution |
|---|---|
| $10V_{L-L}$ - $80V_{L-L}$ | 0.01 V |
| $81V_{L-L}$ - $800V_{L-L}$ | 0.1 V |
| $801V_{L-L}$ – $8,000V_{L-L}$ | 1 V |
| $8,001V_{L-L}$ - $80,000V_{L-L}$ | 0.01 kV |
| $80,001V_{L-L}$ - $440,000V_{L-L}$ | 0.1 kV |

### *2.7.2 Current Scaling*

| CT Setting | Resolution |
|---|---|
| 5A - 8A | 0.001 A |
| 9A - 80A | 0.01 A |
| 81A - 800A | 0.1 A |
| 801A – 8,000A | 1 A |
| 8,001A – 25,000A | 0.01 kA |

### *2.7.3 Power Scaling (W, VA, var)*

| PT Setting x CT Setting | Phase Power Resolution | System Power Resolution |
|---|---|---|
| 100VA - 1,400VA | 0.1 W | 0.001 kW |
| 1,401VA – 14,000VA | 0.001 kW | 0.01 kW |
| 14,001VA - 140,000VA | 0.01 kW | 0.1 kW |
| 140,001VA - 1,400,000VA | 0.1 kW | 1 kW |
| 1,400,001VA - 14,000,000VA | 1 kW | 0.01 MW |
| 14,000,001VA - 140,000,000VA | 0.01 MW | 0.1 MW |
| 140,000,001VA – 1,000,000,000VA | 0.1 MW | 1 MW |

### *2.7.4 Energy Registers (Wh, VAh, varh)*

| PT Setting x CT Setting | Resolution |
|---|---|
| 100VA - 1,400VA | .001 kWh |
| 1,401VA - 14,000VA | 0.01 kWh |
| 14,001VA - 140,000VA | 0.1 kWh |
| 140,001VA - 1,400,000VA | 1 kWh |
| 1,400,001VA - 14,000,000VA | 0.01 MWh |
| 14,000,001VA - 140,000,000VA | 0.1 MWh |
| 140,000,001VA – 1,000,000,000VA | 1 MWh |

### 2.7.5 Miscellaneous

| All Settings | Resolution |
|---|---|
| System and Phase PF | 0.001 |
| Amps and Volts % THD | 0.1% |
| Amps and Volts % Harmonic | 0.1% |
| Frequency | 0.1 hz |

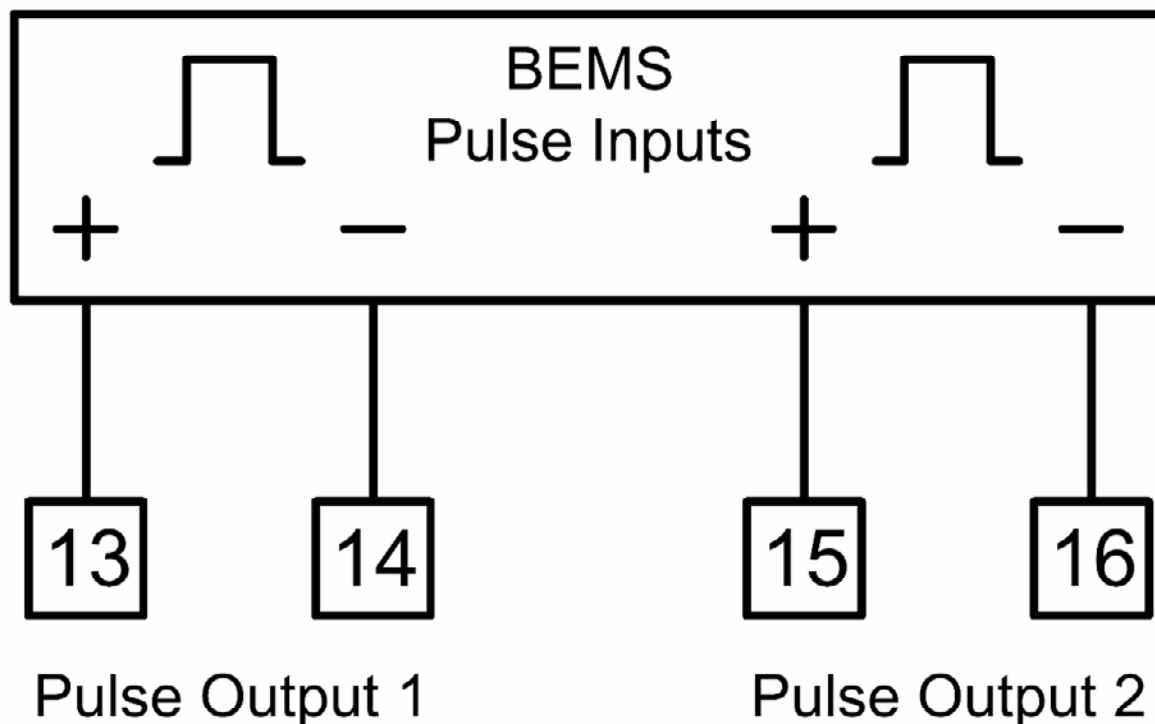# 3  Connection

## 3.1 Mounting In a Panel

Panels should be 1mm to 4mm thick with a square cutout of 92mm (+0.8/-0.0mm).  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.

## 3.2 Pulse Output Connection

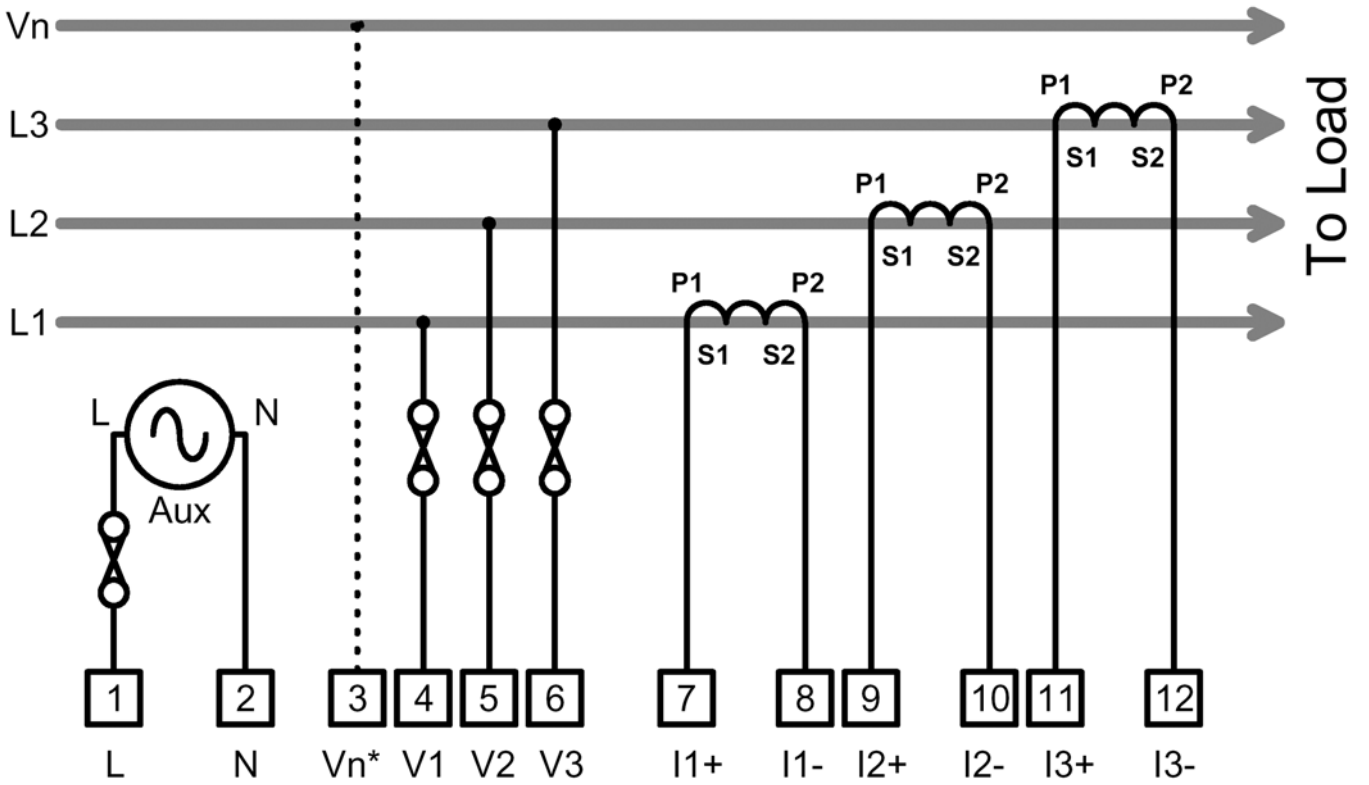The pulse outputs take the form of isolated volt free normally open contact pairs.

The contacts are isolated from all other circuits (2.5kV / 1 minute) and at 50V from pulse1 to pulse 2.

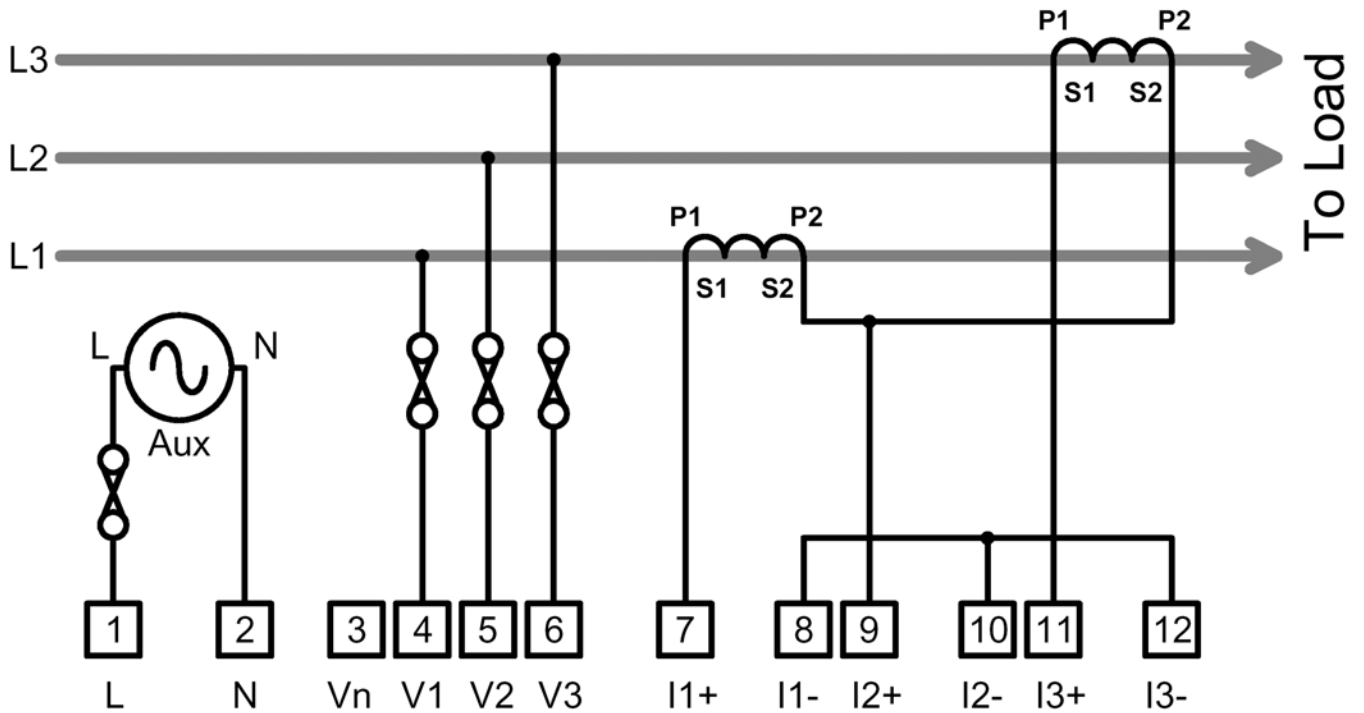The pulses can be used as an input to a remote counter, pulse logger, building energy management system etc.
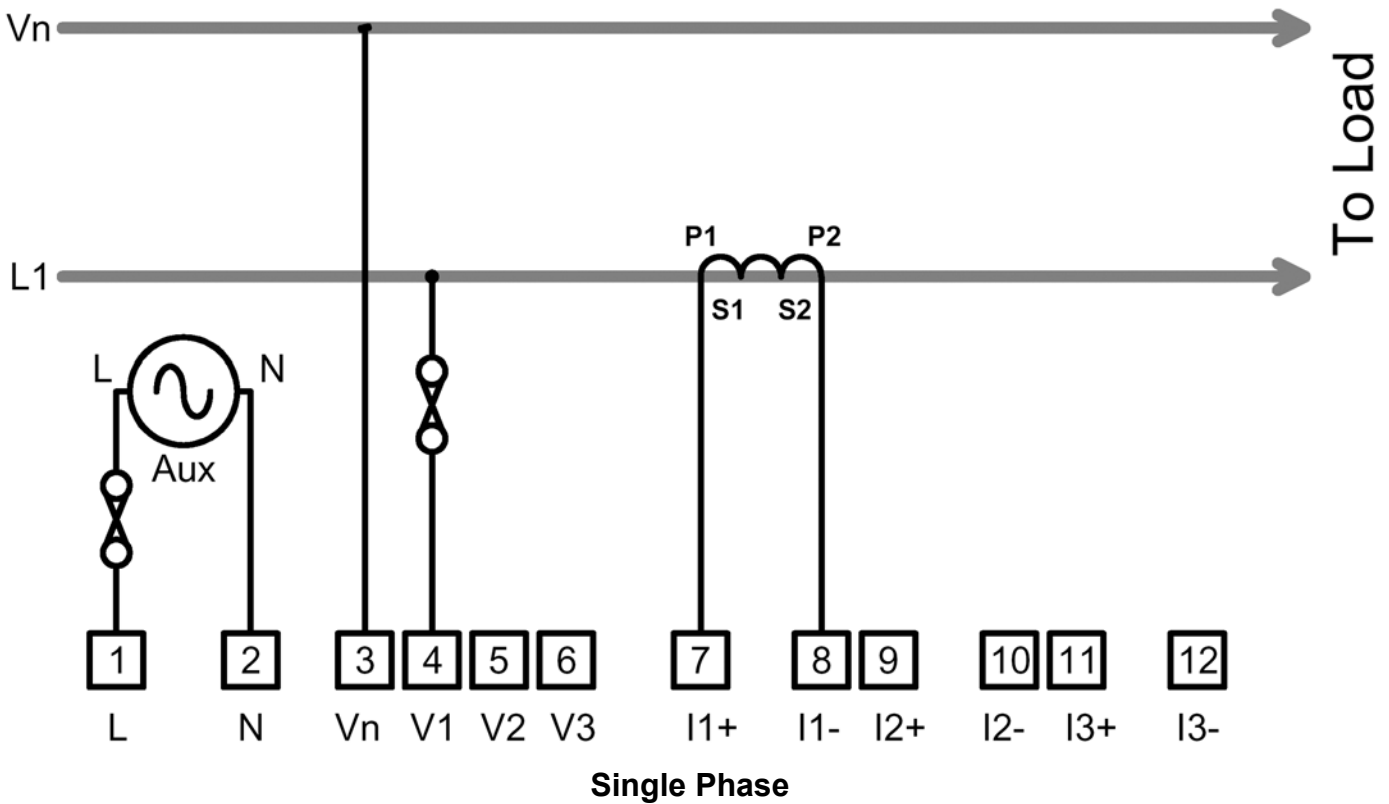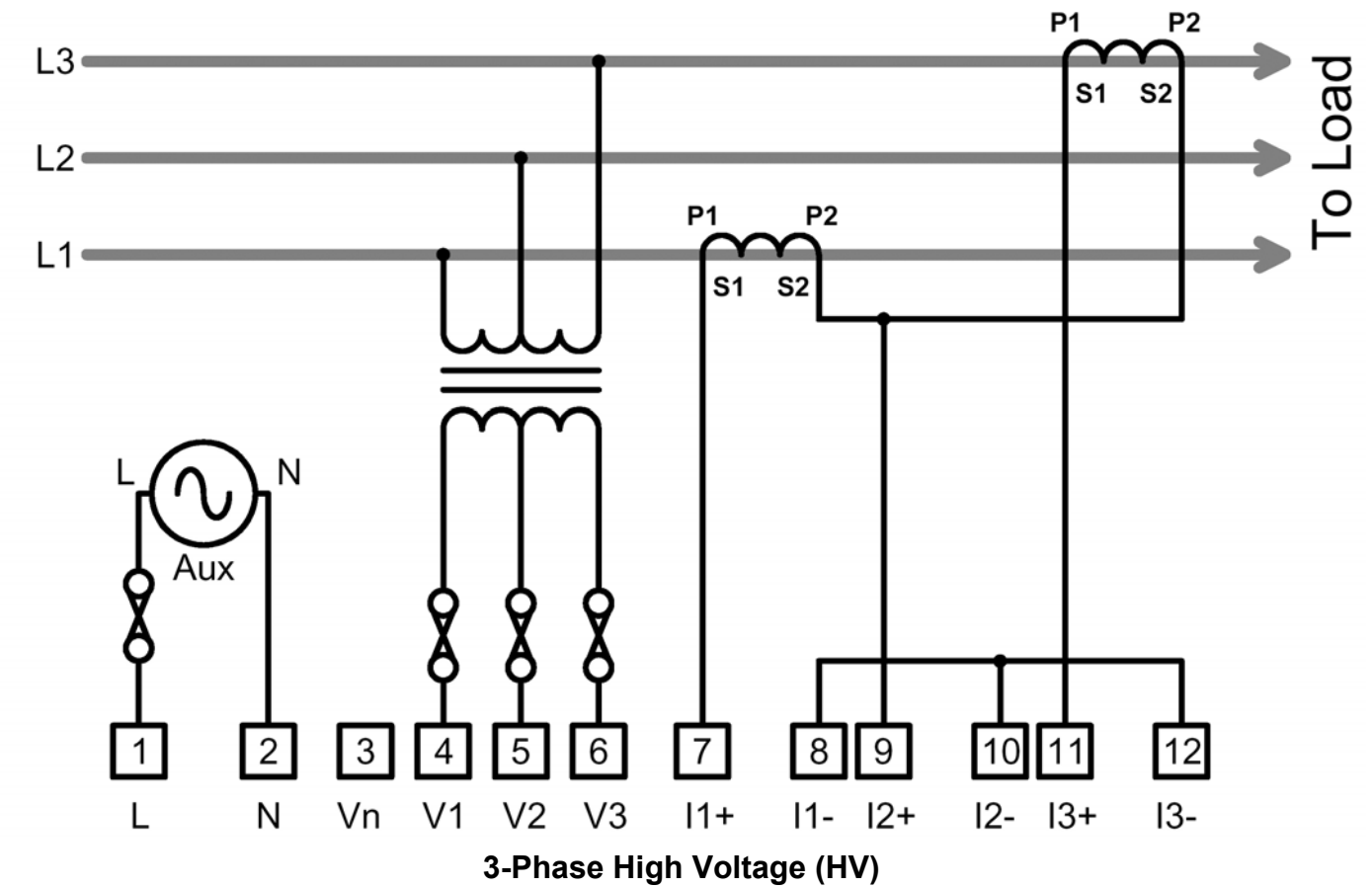


**Pulse Output Connections**

## 3.3 Input Connections

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

**3-Phase 3-Wire**

**3-Phase High Voltage (HV)**



**Single Phase**

# 4  Pulse Outputs

Two isolated pulse outputs are provided for connection to external systems such as Building Energy Management Systems (BEMS), data loggers, remote counters etc.

Pulse 1 is always associated with the active energy (kWh) register.

Pulse 2 is normally associated with the reactive energy (kvarh) register but meters may be supplied with this pulse linked to the kVAh register.

A single pulse occurs for each unit of energy on the display (eg 1 pulse per 0.1kWh).  The pulse rate (amount of energy associated with each pulse) and pulse length may be set to suit the external system.

### 4.1.1 Pulse LEDs

Light emitting diodes (LEDs) on the front panel of the instrument remain ON during each associated output pulse.



***Pulse Output Indicators***

# 5 Meter Setup

## 5.1 Programming Menu

**To enter programming mode:**

Hold [I ◄] and [E ▼] together for 5 Seconds.

---

### 4-Digit Security Code

```
COdE


   1234
```

This page is only shown if a **security code** greater than 0 is set via serial communication.

Press [P ▲] or [E ▼] to select each digit (least significant first)

Press [I ◄] to move to the next most significant digit.

A correct 4 digit security code is required to access other programming menu pages.
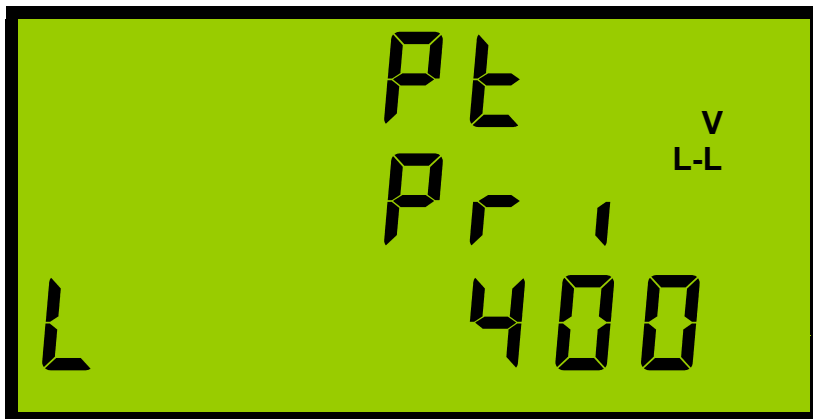
---

### Current Transformer Primary

```
Ct
              A
Pri

L     200
```

Press [P ▲] or [E ▼] to select from the standard list of CT primaries while L is displayed. (List Mode)

Press [P ▲] or [E ▼] to increase or decrease the value by 10 while F is displayed. (Fine adjust)

Press [I ◄] and [P ▲] together to toggle between L and F.

Press [I ◄] to accept the set value.

---

### Potential Transformer Primary

```
Pt
              V
            L-L
Pri

L     400
```

Press [P ▲] or [E ▼] to select from the standard list of PT primaries while L is displayed. (List Mode)

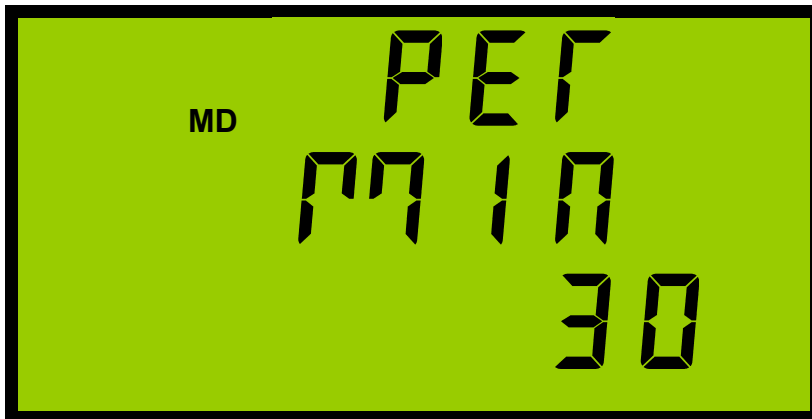Press [P ▲] or [E ▼] to increase or decrease the value by 10 while F is displayed. (Fine adjust)

Press [I ◄] and [P ▲] together to toggle between L and F.

Press [I ◄] to accept the set value.

---

## *Power MD Integration Period* [Note 1]

**MD**

`PEr`
`MIN`
`30`

This sets the integration period in minutes used for the sliding time window MD calculation for power.

Press **P ▲** or **E ▼** to increment or decrement the value.

Press **I ◄** to accept the set value.

## *Current/Voltage Time Ave Period* [Note 1]

**T-Avg**

`PEr`
`SEC`
`10`

This sets the integration period in seconds used for the sliding time window average calculation for current and voltage.

Press **P ▲** or **E ▼** to increment or decrement the value.

Press **I ◄** to accept the set value.

## *Hours Run Set Point* [Note 1]

`HrS`
`run`
`SEt` `250` **kW**

This sets the instantaneous system kW level above which the Hours Run timer will accumulate.

Below this level Hours Run will remain unchanged.

Press **P ▲** or **E ▼** to increment or decrement the value. The speed of change will increase as the button is held.

Press **I ◄** to accept the set value.

## Pulse Rate

**PULS**
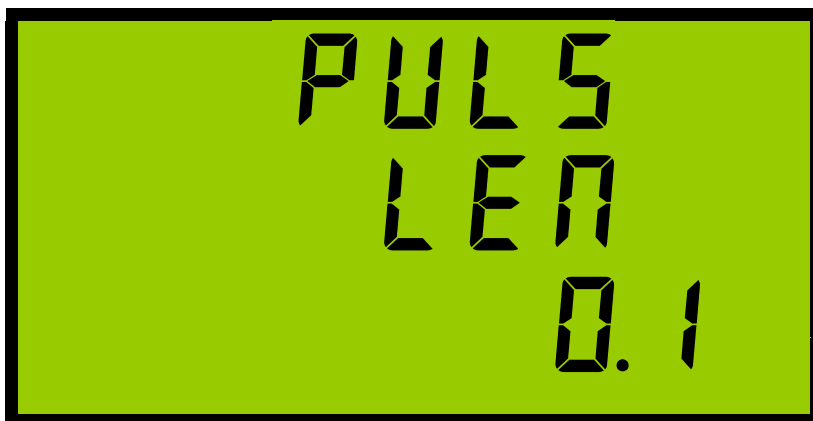**rAtE**          **kWh**
**0.1**

This sets the amount of energy (kWh) required to trigger each Pulse 1 output.

Pulse 2 is set at the same rate but linked to a different register (eg kvarh).

Press **P ▲** or **E ▼** to select the next/previous Pulse Rate from a standard list.

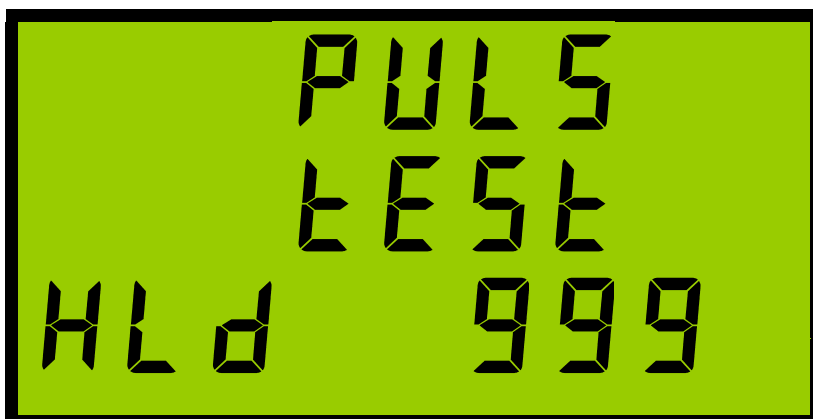Press **I ◄** to accept the set value.

## Pulse Length

**PULS**
**LEn**
**0.1**

This sets the contact closure time for both pulse outputs.

Press **P ▲** or **E ▼** to select the next/previous Pulse Length from a standard list.

Press **I ◄** to accept the set value.

## Pulse Test

**PULS**
**tESt**
**HLd          999**

This allows the commissioning engineer to test both pulse outputs and associated circuits without the need of a test load.

Press **P ▲** or **E ▼** to start/stop a test pulse stream. The display shows *HLd* (Hold) or *rUn* respectively.

The counter shows the total number of pulses during the test.

Press **I ◄** and **V ▼** to reset the test counter to zero.

Press **I ◄** to accept the set value.

**Note 1**. Some setup screens are only available on meters with corresponding measurement options.

Specification

| | |
|---|---|
| **Aux Supply** | Nominal 230Vac ±15%, 45-65Hz, 1W max. <br> Optional 115Vac ±15%. <br> Isolation 2.5kV (1 minute) |
| **Input Voltage** | Un 400V Line-Line. Range 20%-120% Un <br> Burden 0.1VA / Phase. Overload 2xUn Continuous. <br> Other nominal voltages are available to order. |
| **Input Currents** | Nominal Ib = 5A. Range 0.2%-120% Ib <br> Burden 0.1VA / Phase. Overload 40xIb (0.5 sec) <br> Isolation 2.5kV (1 minute) (50V Pulse1-Pulse2) <br> Optional Ib = 1A |
| **Accuracy** | KWh: Cl.1.EN62053-21 & BS8431 (2-120% Nom kW) <br> Kvarh: Cl.2.0. EN62053-23 <br> KW: 1% Rdg (5% - 120% Nom kW) <br> Amps: 0.2% Ib or 1.0% Rdg (0.05Ib < Iph < 1.2Ib) <br> Volts: 0.2% Un or 1.0% Rdg (0.2Un < Vph < 1.2Un) <br> PF: ±0.2 Degrees <br> Frequency: ±0.05hz (45hz $\leq$ F $\leq$ 65hz) |
| **LCD Display** | LCD 8 Digits h=6.7mm + Legends h=3.2mm. <br> kWh Memory 10 years without power. |
| **Pulse Outputs** | Normally open volt free contacts <br> Pulse rate and length selectable. <br> Contacts: 100V ac/dc, 100mA, 5W max <br> Isolation 2.5kV for 1 minute. |
| **Environment** | Operate-10°C > T < 65°C. RH < 75% Non Condensing <br> Storage- 25C > T < 75C <br> IP 54 (IP65 with optional kit) |
| **Other** | **Size**: 96 x 96 x 83.5mm (72mm behind panel) <br> **Case**: DIN 96x96mm Mablex UL94-V0 <br> **Terminals**: Rising Cage 4.0mm$^2$ <br> **Weight**: Approx 250g |