

# ***Rail350 Operating Manual***

***January 2010***

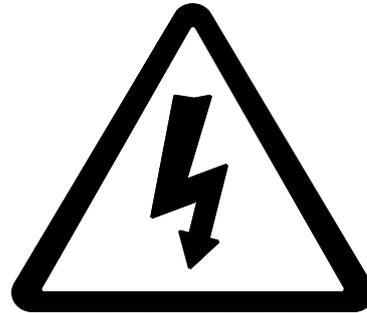


## 1 Safety

This instruction sheet gives details of safe installation and operation of the **Rail350** 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

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

## 2 Operation

### 2.1 Energy Displays

Press  to select kWh kvarh and Hours Run display pages.



Active Energy Register



Reactive Energy Register



Hours Run

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.

Press  and  together and hold for 2 seconds to reset the hours run register. 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.

### 2.2 Voltage Displays

Press  to select from the following displays;



Phase-n Voltages 1 - 3



Line-Line Voltages 1 - 3

### 2.3 Current Displays

Press  to select from the following displays;



Phase 1 - 3 Current

## Operation

### 2.4 Power Displays

Press  to select from the following displays;



System Active Power



Frequency. Hz (Phase 1 voltage)



System Power Factor (C=Capacitive)



Phase 1-3 Active Power



Phase 1-3 Power Factor (C=Capacitive)

### 2.5 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 associated with the active energy (kWh) register and Pulse 2 with the reactive energy (kvarh) 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.

#### 2.5.1 Pulse LEDs

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



Pulse Output Indicators

## 3 Programming

### 3.1 Programming Menu

To enter programming mode:

Hold  and  together for 5 Seconds.

A **Security Code** may be required before changes to programmed parameters are allowed. This is only required if a **Security Code** greater than zero is set via serial communications. This is then stored in non-volatile memory during power interruptions.



4-Digit Security Code

To Enter A Security Code:

Press  or  to change each digit. (Lowest significant digit first).

Press  to select next most significant digit.

*When a valid code is input the programming menu is displayed.*

To change a Programmable Value:

Press  or  until the required value is set.

To Move to The Next Setting:

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

#### Program Menu Pages



Current Transformer Primary



Nominal Line-Line V (or PT Primary)



Output Pulse Rate



Pulse On Time



Pulse Output Test



Hours Run Trip Point (Percent Amps)



True 3-Phase Measurement Mode



CT Auto Rotation Mode



Changes Are Stored to Non-Volatile Memory

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

## 3.2 Fine Adjust

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  and  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."**)

## 3.3 CT Preferred Values Table (Amps)

5,10,15,20,30,40,50,60,75,80,100,125,150,200,250,300,400,500,600,800,1000,1200,1250,1500,1600,2000,2400,2500,3000,3500,4000,4500,5000,5500,6000,6500,7000,7500,8000,8500,9000,9500,10000,10500,11000,11500,12000,12500,13000,13500,14000,14500,15000,15500,16000,16500,17000,17500,18000,18500,19000,19500,20000,20500,21000,21500,22000,22500,23000,23500,24000,24500,25000

## 3.4 PT Preferred Values Table (Volts)

11,40,48,100,110,208,400,480,600,800,1000,1100,2200,3300,4000,4400,6600,7500,10000,11000,15000,22000,25000,33000,66000,132000,220000,440000

## 3.5 Pulse Rate Selection Table (Counts)

1,2,5,10,100,1000

## 3.6 Pulse On-Time Selection Table

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

## 3.7 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  to start/stop the test pulses on both outputs.

Press  and  together to stop the test pulses and simultaneously reset the test counter.

## 3.8 Voltage Input Mode Selection

In “**Balance Voltage Mode**” the **PowerRail350** 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  or  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.

## 3.9 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**.

**PowerRail350** 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  or  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.

## 4 Display Scaling

The units, Wh, kWh or MWh and the position of the decimal point for the energy/power displays are automatically set dependant on the **CT** and **Un** settings for the meter.

The nominal 3-phase input for the meter is defined as:

$$W_{nom} = \sqrt{3} \times Un \times CT$$

Where: **Un** is the nominal Line-Line voltage or PT primary (10V - 55kV).  
**CT** is the current transformer nominal primary (10A – 25kA)  
**Un** and **CT** are set in programming mode.

The display pages are scaled as follows:

<b>CT</b>	<b>Amps Resolution</b>
< 80 A	0.01 A
< 800 A	0.1 A
< 8,000A	1 A
> 8,000A	0.01 kA

<b>Un</b>	<b>Volts Resolution</b>
<= 90 V	0.01 V
<= 1200 V	0.1 V
<= 9,000 V	0.001 kV
> 9,000 V	0.01 kV

<b>W<sub>nom</sub></b>	<b>kW/kvar Resolution</b>	<b>kWh/kvarh Resolution</b>
< 243 W	0.1W (var)	0.001 kWh (kvarh)
< 2.43 kW	0.1W (var)	0.001 kWh (kvarh)
< 24.3 kW	0.001 kW (kvar)	0.01 kWh (kvarh)
< 243 kW	0.01 kW (kvar)	0.1 kWh (kvarh)
< 2.43 MW	0.1 kW (kvar)	1 kWh (kvarh)
< 24.3 MW	1 kW (kvar)	0.01 MWh (Mvarh)
< 243 MW	0.01 MW (Mvar)	0.1 MWh (Mvarh)
> 243 MW	0.1 MW (Mvar)	1 MWh (Mvarh)

## 5 Installation

### 5.1 Mounting On A Rail

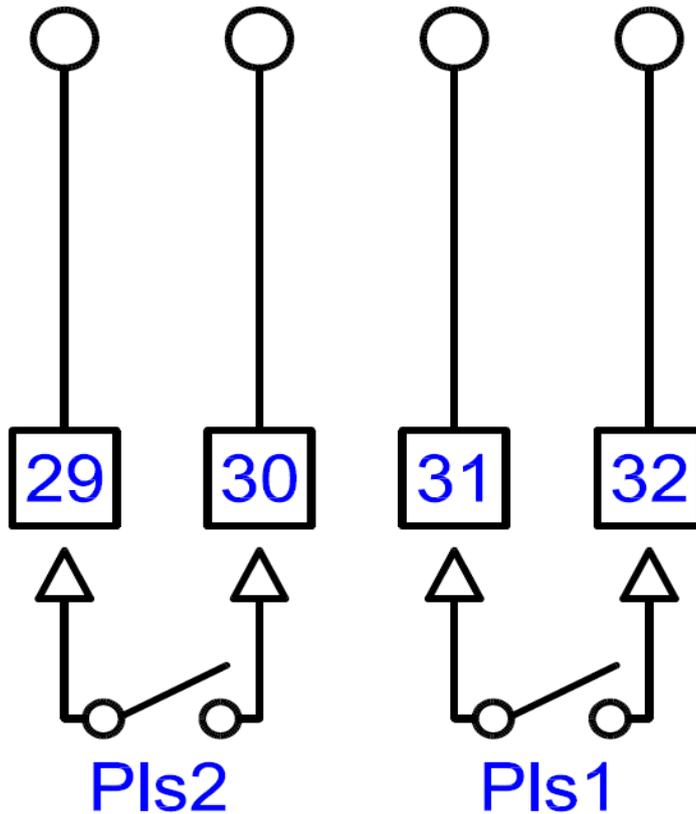
The **Rail350** conforms to DIN 43880, 6-Module Wide. The unit is therefore compatible with a number of standard distribution systems with 45mm cut-outs. The meter should be mounted on a 35mm symmetrical ("Top-Hat") DIN rail of minimum length 106mm.

### 5.2 Pulse Output Connection

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

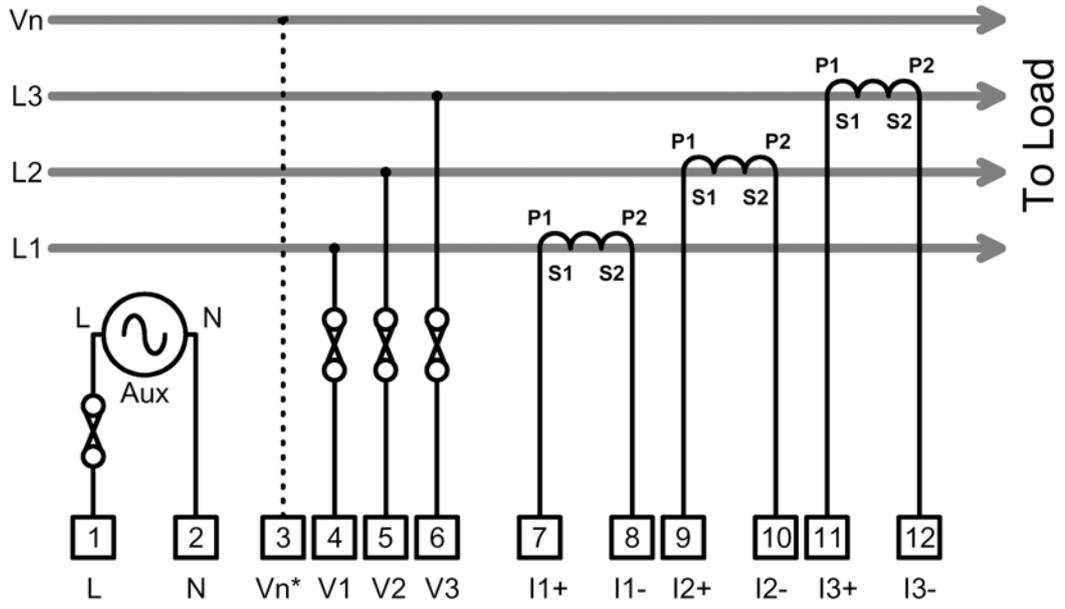
The contacts are isolated from all other circuits (2.5kV / 1minute) and at 50V from pulse1 to pulse 2.

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

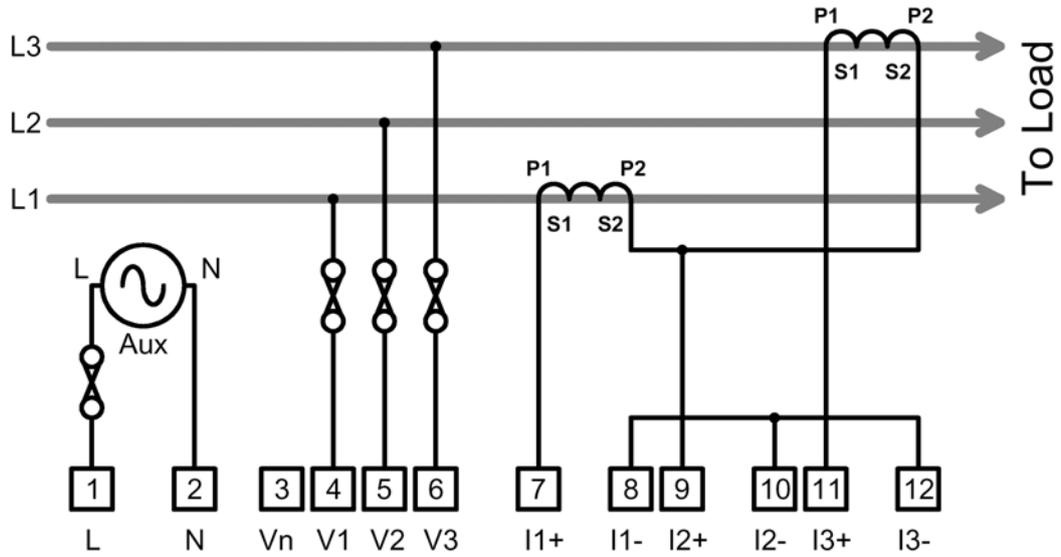


Pulse Output Connections

## 6 Standard Connections



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



**3-Phase 3-Wire**



## 7 Specification

<b>INPUTS</b>		
System		3 Phase 3 or 4 Wire Unbalanced Load
Voltage	Un	400/230V. 3 Phase 3 or 4 Wire 110/63V & 208/120V optional. Others to order.
Current	In	5A from external CTs. 1A optional. Fully isolated Input from Voltage Output Current Transducers Optional
Measurement		Voltage 50% to 120%
Range		Current 0.2% to 120%
Frequency Range		Fundamental 45 to 65Hz Harmonics Up to 30th harmonic at 50Hz Individual to the 15th
Burden		Voltage <0.1VA per phase Current <0.1VA per phase
Overload		Voltage x4 for 1 hour Current x40 for 0.5 second max
<b>DISPLAY</b>		
Type		Custom, Supertwist, LCD
Data Retention		10 years min. Stores kWh & Meter set-up
Format		8 x 6.66mm high digits with DPs & 3.2mm legends
Scaling		Direct reading. User programmable CT & VT CT Primary programmable from 5A to 25kA VT primary programmable from 11V to 440kV
Legends		Wh, kWh, MWh etc. depending on user settings
<b>AUXILIARY SUPPLY</b>		
Standard		230V 50/60 Hz $\pm 15\%$
Options		110V 50/60 Hz $\pm 15\%$
Load		2VA max.
Overload		x1.2 continuous
<b>ACCURACY All errors <math>\pm 1</math> digit</b>		
kWh		Better than Class 1 per EN 62053-21 & BS 8431
kvarh		Better than Class 2 per EN 62053-23 & BS 8431
kW		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		$\pm 0.2^\circ$ (0.05In – 1.2In and 0.2Un – 1.2Un)
Neutral Current		Class 0.5 IEC 60688 (0.05In – 1.2In)
<b>PULSE OUTPUTS</b>		
Function		1 Pulse per unit of energy
Scaling		Settable between 1 & 1000 counts of kWh 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., 100V ac/dc max.
Isolation		2.5kV 50Hz 1 minute
<b>MODBUS® Serial Comms</b>		
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
<b>GENERAL</b>		
Temperature		Operating -10°C to +55°C Storage -25°C to +70°C
Humidity		< 75% non-condensing
Environment		IP20
<b>MECHANICAL</b>		
Terminals		Rising Cage. 4mm <sup>2</sup> (12 AWG) cable max.
Enclosure		DIN 43880, 6-Modules Wide
Material		Noryl® with fire protection to UL94-V-O. Self extinguishing
Dimensions		106 x 90 x 58mm (Cut out 106 x 45mm)
Weight		~ 250 gms
<b>SAFETY</b>		
Conforms to		EN 61010-1 Installation Category III