

# User Manual

2019 v1.0

## AP15-3DL DIN Rail Smart Energy Meter for Single and Three Phase Electrical Systems

### 1 Introduction

This document provides operating, maintenance and installation instructions. This Dual Load unit measures and displays the characteristics of two three phase four wires (3P4W) networks. The measuring parameters include Voltage (V), Current (A), Frequency (Hz), Power (kW/KVA/KVAh), Power Factor (PF), Imported, Exported and Total Energy (kWh/kVAh). The unit also measures Maximum Demand Current and Power, this is measured over preset periods of up to 60 minutes.

This particular model accommodates two RJ12 sockets for 100mA Current Transformers and can be configured to work with a wide range of CTs. It also comes with a complete comms capability with built in RS485 Modbus RTU outputs, configuration is password protected.

This unit does not require a separate auxiliary supply for power. The self-supplied auxiliary comes from any Phase that is connected to the voltage inputs, meaning should one of the Phases fail, the unit will power itself from another Phase, ensuring the meter continues to measure usage.

#### 1.1 Unit Characteristics

The AP15-3DLcan measure and display one or two 3 phase loads:

- Phase to Neutral Voltage and THD% (Total Harmonic Distortion) of all Phases
- Line Frequency
- Current, Maximum Demand Current and Current THD% of all Phases
- Power, Maximum Power Demand and Power Factor
- Imported, Exported & Total Active Energy
- Imported, Exported & Total Reactive Energy
- C1 =- Current Transformer / Load 1
- C2 =- Current Transformer / Load 2

The unit has a Password-Protected set up menu for:

- Changing the Password
- System Configuration - 1P2W & 3P4W.
- Demand Interval Time
- Reset for Demand Measurements

#### 1.2 Current Transformer Primary Current




This unit requires configuring to operate with the appropriate current transformer(s), the secondary current is 0.1A. It is programmed by inputting the ratio (CT Primary). It can be used on primary currents up to 6000A.

- C1 =- Current Transformer / Load 1
- C2 =- Current Transformer / Load 2

#### 1.3 RS485 Serial – Modbus RTU

This unit is compatible with remote monitoring through RS485 Modbus RTU. Set-up screens are provided for configuring the RS485 port. Refers to section 4.8.





## 2 Start Up Screens

	The first screen lights up all display segments and can be used as a display check.
	The second screen indicates the firmware installed in the unit and its build number.
	The interface performs a self-test and indicates the result if the test passes.

\*After a short delay, the screen will display active energy measurements.

## 3 Measurements






The buttons operate as follows:

	Selects the Voltage and Current display screens. In Set-up Mode, this is the “Left” (press) or “Escape” (hold 3sec) button.
	Select the Frequency and Power factor display screens. In Set-up Mode, this is the “Up” (press) button.
	Select the Power display screens. In Set-up Mode, this is the “Down” (press) button. Pressing and holding the button will switch between Circuit 1 and Circuit 2
	Select the Energy display screens. In Set-up mode, this is the “Right” (press) or “Enter” (hold 3sec) button.

There are two LED indicators on the front panel, namely Pulse1 and Pulse2. Pulse 1 is for total active energy of C1 circuit, and Pulse 2 is for total active energy of C2 circuit. Pulse constant is 1000imp/kWh.





#### 3.1 Voltage and Current

Each successive press of the  button selects a new parameter:

	Phase to neutral voltages.
	Phase to Phase voltages.
	Current on each phase.
	Phase to neutral voltage THD%.
	Current THD% for each phase.




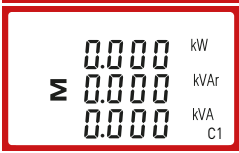
#### 3.2 Frequency and Power Factor and Demand

Each successive press of the  button selects a new range:

	Frequency and Power Factor (total).
	Power Factor of each phase.
	Maximum Power Demand.
	Maximum Current Demand.

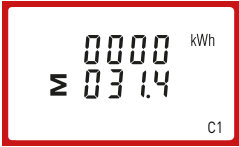




#### 3.3 Power


Each successive press of the  button select a new range:

	Instantaneous Active Power in kW.
	Instantaneous Reactive Power in kVAh.
	Instantaneous Volt-Amps in kVA.
	Total kW, kVAh, kVA.

#### 3.4 Energy Measurements


Each successive press of the  button selects a new range:


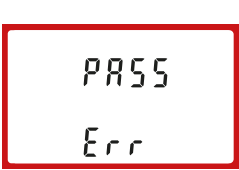
	Imported active energy in kWh.
	Exported active energy in kWh.
	Imported reactive energy in kVAh.
	Exported reactive energy in kVAh.
	Total active energy in kWh.

	Total reactive energy in kVAh.
------------------------------------------------------------------------------------	--------------------------------

Please note the register is 9999999.9 display over two lines.

### 4 Set Up

To enter set up mode, hold the  button for 3 seconds, until the password screen appears.









	The set up is password-protected so you must enter the correct password (default '1000') before processing.
	If an incorrect password is entered, the display will show:  PASS Err (Error)

To exit the set up menu, hold the  for 3 seconds, the measurement screen will display.

#### 4.1 Set up Entry Methods





Some menu items, such as Password and CT, require a four-digit number entry while others, such as supply system, require selection from a number of menu options.

##### 4.1.1 Menu Option Selection

1. Use the  and  buttons to scroll through the different options of the set up menu.
2. Hold the  button for 3 seconds to confirm your selection.
3. If an item flashes, then it can be adjusted by the  and  buttons.
4. Having selected an option from the current layer, hold the  button for 3 seconds to confirm your selection.
5. Having completed a parameter setting, hold the  button for 3 seconds to return to a higher menu level.
6. On completion of all setting-up, hold the  button for 3 seconds, the measurement screen will then be restored.

##### 4.1.2 Number Entry Procedure

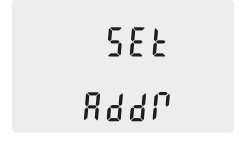












When setting up the unit, some screens require the entering of a number. In particular, on entry to the setting up section, a password must be entered. Digits are set individually, from left to right. The procedure is as follows:





1. The current digit to be set flashes and then can be adjusted using the  and  buttons.
2. Press the  button to more right to the next digit.
3. After setting the last digit, hold the  button for 3 seconds to save your selection.

#### 4.2 Communication






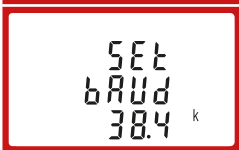


The RS485 port can be used for communication using Modbus RTU Protocol. To configure the Modbus settings, such as Address and Baud Rate, this is also done within the Password-protected set up menu.


##### 4.2.1RS485 Address

	(The range is from 001 to 247)
	Use the  and  buttons to select the menu option. The screen will show the current setting. For example: Modbus Address 001 for C1
	Hold the  button to set the meter Address. Range: 001(default) to 247. Hold the  button to confirm selection
	Use the  and  buttons to select the menu option. The screen will show the current setting. For example: Modbus Address 002 for C2
	Hold the  button to confirm the selection. Range: 001 (default) to 247. Hold the  button to confirm the selection.









Use the  and  buttons to choose the necessary number, then press the  button to move along to the next number. To save the new setting, hold the  button for 3 seconds until the selection stops flashing.


##### 4.2.2 Baud Rate

	Use the  and  buttons to select the menu option. The screen will show the current setting.
	Hold the  button to enter the menu option, the
	Use the  and  buttons to select the required option.









On completion of the entry procedure, hold the  button to confirm the setting.


##### 4.2.3 Parity

	Use the  and  buttons to select the menu option. The screen will show the current setting.
	Hold the  button to enter the menu option, the current selection will flash.
	Use the  and  buttons to select the required option. Range: None (default), Odd or Even.

On completion of the entry procedure, hold the  button for 3 seconds until the selection stops flashing.

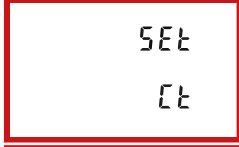








##### 4.2.4 Stop bits

	Use the  and  buttons to select the menu option. The screen will show the current setting.
	Hold the  button to enter the menu option, the current selection will flash.
	Use the  and  buttons to select the required option. Range: 1 (default) or 2.

On completion of the entry procedure, hold the  button for 3 seconds until the selection stops flashing.

#### 4.5 CT Configuration








This unit is CT Operated, the primary (CT1) and secondary (CT2) of the current transformer need to be programmed correctly for the meter to scale the inputs accordingly.

	Use the  and  buttons to select the menu option. The screen will show the configure CT setting.
	Secondary CT (CT2): Hold the  button to set the CT secondary option: 0.1A.(Not Configurable)
	Set the CT Ratio Value: Hold the  button to enter the CT Ratio setting screen. The range is from 0001 to 9999. 0005A default
	Pressing and holding the  button will switch between Circuit 1 and Circuit 2

The CT Rate is the primary rate/ratio of the CT. For Example: 200/100mA Current Transformers , so the CT Rate would be 0200 and the CT2 would be 0.1A.

##### 4.6 PT

The PT option sets the Secondary Voltage (PT2 100-500V) of the Voltage Transformer (PT) that may be connected to the meter.

	Use the  and  buttons to select the menu option. The screen will show the current setting.The default value is 400V.
	Secondary PT Setting: Hold the  button to set the PT secondary option: 100-500V.
	Set the PT Ratio Value: Hold the  button to enter the PT Ratio setting screen. The range is from 0001 to 9999.

The PT Rate is the PT Primary divided by the PT Secondary. For Example: Voltage Transformer - 11000÷110=100, so the PT Rate would be 0100 and the PT2 would be 110.

4.7 DIT (Demand Integration Time)

This sets the period (in minutes) in which the Current and Power readings are integrated for maximum demand measurement. The options are off; 5; 10; 15; 30 or 60 minutes.

Set  
dit  
10

Use the **M** and **P** buttons to select the menu option. The screen will show the current setting.

Set  
dit  
10

Hold the **E** button to enter the menu option, the current selection will flash.

Set  
dit  
20

Use the **M** and **P** buttons to select the required option.

Set  
dit  
20

Hold the **E** button to confirm the selection.

Hold the **U/I** button for 3 seconds to exit the set up menu.

4.8 Supply System

The unit has a default setting of 3 Phase 4 Wire (3P4W). Use this section to set the type of electrical system.

545  
3P4

Use the **M** and **P** buttons to select the menu option. The screen will show the current setting.

545  
1P2

Hold the **E** button to enter the menu option, the current selection will flash.

545  
1P2

Use the **M** and **P** buttons to select the required option.

Hold the **E** button to confirm your adjustment. Hold the **U/I** button for 3 seconds to exit the set up menu.

4.9 CLR

The meter provides a function to reset the maximum demand value of current and power.

CLR

Use the **M** and **P** buttons to select the menu option. The screen will show the current setting.

CLR  
dit

Hold the **E** button to enter the menu option, the current selection will flash.

Hold the **E** button to confirm the setting and press **U/I** to return to the main set up menu.

4.10 Change Password

Set  
PASS  
1000

Use the **M** and **P** to choose the change password option.

Set  
PASS  
1000

Hold the **E** button to enter the set up menu. The first digit will start flashing.

Set  
PASS  
1000

Use **M** and **P** to set the first digit and press **E** to move right. The next digit will flash.

Set  
PASS  
1100

Repeat the procedure for the remaining three digits.

Set  
PASS  
1100

After setting the last digit, Hold the **E** button to save your selection.

Hold the **U/I** button for 3 seconds to exit the set up menu.

5 Specifications

5.1 Measured Parameters

The unit can monitor and display the following parameters of a Single Phase Two Wire (1P2W) or Three Phase Four Wire (3P4W) system.

5.1.1 Voltage and Current

- Phase to Neutral Voltages 100-289V AC (not for 3P3W supplies).
- Phase to Phase Voltages 173-500V AC (3 Phase supplies only).
- Percentage Total Voltage Harmonic Distortion (V %THD) for each Phase to Neutral (not for 3P3W supplies).
- Percentage Total Voltage Harmonic Distortion (V% THD) between Phases (3 Phase supplies only).
- Current %THD for each Phase.

5.1.2 Power factor and Frequency and Max. Demand

- Frequency in Hz
- Instantaneous power:
- Power 0-3600 MW
- Reactive power 0-3600 MVAR
- Volt-amps 0-3600 MVA
- Maximum Demand Power since last reset
- Power factor
- Maximum Neutral Demand Current, since the last reset (for Three Phase supplies only)

5.1.3 Energy Measurements

- Imported/Exported active energy 0 to 9999999.9 kWh
- Imported/Exported reactive energy 0 to 9999999.9 kVARh
- Total active energy 0 to 9999999.9 kWh
- Total reactive energy 0 to 9999999.9 kVARh

5.2 Measured Inputs

Voltage inputs through 4-way fixed connector with 2.5mm<sup>2</sup> stranded wire capacity. Single Phase Two Wire (1P2W)OR Three Phase Four Wire (3P4W) unbalanced. Line frequency measured from L1 Voltage or L3 Voltage. Three current inputs (six physical terminals) with 2.5mm<sup>2</sup> stranded wire capacity for connection of external CTs. Nominal rated input current 0.1A AC RMS.

5.3 Accuracy

- Voltage 0-5% of range maximum
- Current 0-5% of nominal
- Frequency 0-2% of mid-frequency
- Power factor 1% of unity (0.01)
- Active power (W) ±1% of range maximum
- Reactive power (VAR) ±1% of range maximum
- Apparent power (VA) ±1% of range maximum
- Active energy (Wh) Class 1 IEC 62053-21
- Reactive energy (VARh) ±1% of range maximum
- Total harmonic distortion 1% up to 31st harmonic
- Response time to step input 1s, typical, to >99% of final reading, at 50 Hz.

5.4 Auxiliary Supply

This unit does not require a separate auxiliary supply; the unit is self supplied it draws the necessary power from the voltage input connections. If a three phase supply is connected, and the phase that is powering the unit fails, it will change the phase supply to avoid shutting down.

5.5 Interfaces for External Monitoring

Three interfaces are provided:

- RS485 communication channel that can be programmed for Modbus RTU protocol

The Modbus configuration (baud rate etc.) and the pulse relay output assignments (kW/kVARh) are configured through the set-up screens.

5.5.1 RS485 Output for Modbus RTU

For Modbus RTU, the following RS485 communication parameters can be configured from the set-up menu:

Baud rate: 2400, 4800, 9600, 19200, 38400

Parity: none (default) / odd / even

Stop bits: 1 or 2

RS485 Network Address: 3 digit number - 001-247

Modbus™ Word order Hi/Lo byte order is set automatically to normal or reverse. It cannot be configured from the set-up menu.

5.6 Reference Conditions of Influence Quantities

Influence Quantities are variables that affect measurement errors to a minor degree. Accuracy is verified under nominal value (within the specified tolerance) of these conditions.

- Ambient temperature 23°C ±1°C
- Input waveform 50 or 60Hz ±2%
- Input waveform Sinusoidal (distortion factor < 0-005)
- Auxiliary supply voltage Nominal ±1%
- Auxiliary supply frequency Nominal ±1%
- Auxiliary supply waveform (if AC) Sinusoidal (distortion factor < 0-05)
- Magnetic field of external origin Terrestrial flux

5.7 Environment

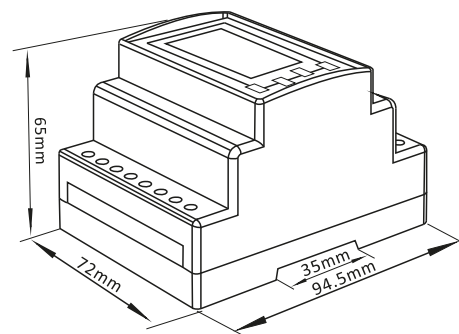
- Operating temperature -25°C to +55°C\*
- Storage temperature -40°C to +70°C\*
- Relative humidity 0 to 95%, non-condensing
- Altitude Up to 3000m
- Warm up time 1 minute
- Vibration 10Hz to 50Hz, IEC 60068-2-6, 2g
- Shock 30g in 3 planes

\*Maximum operating and storage temperatures are in the context of typical daily and seasonal variation.

5.8 Mechanics

- DIN rail dimensions 72 x 94.5 mm (WxH) per DIN 43880
- Mounting DIN rail (DIN 43880)
- Sealing IP51 indoor
- Material Self-extinguishing UL 94 V-0

6 Dimensions



7 Installation

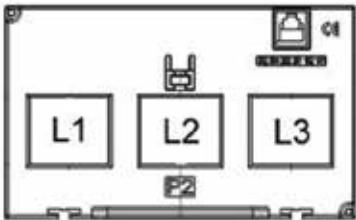
7.1 CT Orientation

With this meter the CT can be installed one of two ways depending in which way, will determine which patch lead to use.

RJ12 3 Phase Current Transformer installation

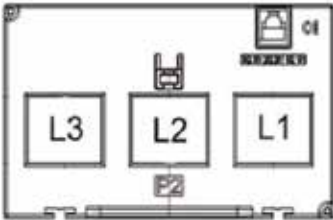
**Note:** RJ12 3 phase current transformers are supplied with 1.5 metres of straight RJ12 cable (as highlighted in Set-up 1 diagram) for reversed phased connections it is necessary to purchase the optional reversed RJ12 cable.

Set-up 1, Straight RJ12 Lead  
Please Check User Manual



SET-UP 1

Set-up 2, Reversed RJ12 Lead  
Please Check User Manual



SET-UP 2

7.2 Three Phase Four Wire

