

# User Manual

2019 v2.0

## AP15-3DO DIN Rail Smart Energy Meter for Single & Three Phase Electrical Systems

### 1 Introduction

This document provides operating, maintenance and installation instructions. This unit measures and displays the characteristics of Single Phase Two Wire (1P2W), Three Phase Three Wire (3P3W) and Three Phase Four Wire (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.

It also comes with a complete comms capability with built in Pulse and RS485 Modbus RTU outputs, configuration is password protected.

This unit is 10(100)A direct connected. Configuration is password protected.

#### 1.1 Unit Characteristics

The AP15-3DO can measure and display:

- 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

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

- Changing the Password
- System Configuration - 1P2W, 3P3W, 3P4W.
- Demand Interval Time
- Reset for Demand Measurements
- Pulsed Output Duration

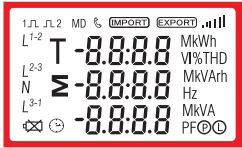


#### 1.2 RS485 Serial – Modbus RTU

RS485 serial port with Modbus RTU protocol to provide a means of remotely monitoring and controlling the Unit. Set-up screens are provided for setting up the RS485 port. Refers to section 4.8.

#### 1.3 Pulse output

Two pulsed outputs that can be set for active(kWh) or reactive (kVAh) energy.





### 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.




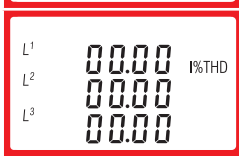
### 3 Measurements

The buttons operate as follows:

	Selects the Voltage and Current display screens. In Set-up Mode, this is the “Left” or “Back” button.
	Select the Frequency and Power factor display screens. In Set-up Mode, this is the “Up” button.
	Select the Power display screens. In Set-up Mode, this is the “Down” button.
	Select the Energy display screens. In Set-up mode, this is the “Enter” or “Right” button.




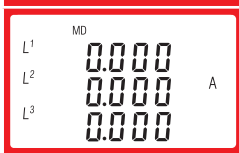
#### 3.1 Voltage and Current

Each successive press of the  button selects a new parameter:

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




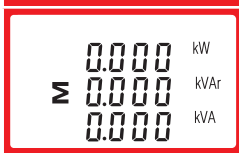
#### 3.2 Frequency and Power Factor and Demand

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


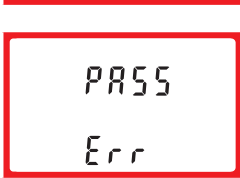
Each successive press of the  button selects a new range:

	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, press the  button for 3 seconds, until the password screen appears.











	Setting 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

To exit setting-up mode, press  repeatedly until the measurement screen is restored.

#### 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. Press  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, press  to confirm your selection. The SET indicator will appear.
5. Having completed a parameter setting, press  to return to a higher menu level. The SET indicator will be removed and you will be able to use the  and  buttons for further menu selection.
6. On completion of all setting-up, press  repeatedly until the measurement screen is 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  to confirm each digit setting. The SET indicator appears after the last digit has been set.
3. After setting the last digit, press  to exit the number setting routine. The SET indicator will be removed.











#### 4.2 Change Password

	Use the  and  to choose the change password option.
	Press the  to enter the change password routine. The new password screen will appear with the first digit flashing.
	Use  and  to set the first digit and press  to confirm your selection. The next digit will flash.
	Repeat the procedure for the remaining three digits.
	After setting the last digit, SET will show.

Press  to exit the number setting routine and return to the Set-up menu. SET will be removed

#### 4.3 DIT Demand Integration Time



This sets the period in minutes over which the current and power readings are integrated for maximum demand measurement. The options are: off, 5, 10, 15 30,60 minutes.

	From the set-up menu, use  and  buttons to select the DIT option. The screen will show the currently selected integration time.
	Press  to enter the selection routine. The current time interval will flash.
	Use  and  buttons to select the time required.
	Press  to confirm the selection. SET indicator will appear.

Press  to exit the DIT selection routine and return to the menu.











### Warnings


Important Safety Information is contained in the Maintenance section. Familiarize yourself with this information before attempting installation or other procedures. Symbols used in this document:

	Risk of Danger: These instructions contain important safety information. Read them before starting installation or servicing of the equipment.
	Caution: Risk of Electric Shock

#### 4.4 Supply System









The unit has a default setting of 3Phase 4wire (3P4). Use this section to set the type of electrical system.



	From the set-up menu, use  and  buttons to select the system option. The screen will show the currently selected power supply.
	Press  to enter the selection routine. The current selection will flash.
	Use  and  buttons to select the required system option: 1P2(W),3P3(W) ,3P4(W).
	Press  to confirm the selection. SET indicator will appear.

Press  to exit the system selection routine and return to the menu. SET will disappear and you will be returned to the main set-up Menu.

#### 4.5 Pulse Output

This option allows you to configure the pulse output. The output can be set to provide a pulse for a defined amount of energy active or reactive. Use this section to set up the relay pulse output—Units: kWh, kVAh

	From the set-up menu, use  and  buttons to select the Pulse output option.
	Press  to enter the selection routine. The unit symbol will flash.
	Use  and  buttons to choose kWh or kVAh.






On completion of the entry procedure, press  to confirm the setting and press  to return to the main set up menu.





##### 4.5.1 Pulse rate

You can configure the pulse output to relate to a defined amount of imported or exported energy. This can also be set to use with active energy (kWh) or reactive energy (kVAh).

Please note there are limitations that need to be factored in when setting the pulsed output. This is based upon the relay output only being able to pulse 2 times in one second.






Pulse settings: 1 pulse per 0.01(10W) / 0.1(100W) / 1 (1kWh) / 10(10kWh) / 100(100kWh) /1000 (1000kWh)





	From the set-up menu, use  and  buttons to select the Pulse Rate option.
	Press  to enter the selection routine. The current setting will flash. 0.01/0.1/1/10/100kWh/ kVAh per pulse.

Use  and  buttons to choose pulse rate. On completion of the entry procedure, press  to confirm the setting and press  to return to the main set up menu.

##### 4.5.2 Pulse Duration

The energy monitored can be active or reactive and the pulse width can be selected as 200, 100 or 60ms.

	From the set-up menu, use  and  buttons to select the Pulse width option.
	Press  to enter the selection routine. The current setting will flash.

Use  and  buttons to choose pulse width. On completion of the entry procedure press  to confirm the setting and press  to return to the main set up menu.

4.6 Communication

There is a RS485 port can be used for communication using Modbus RTU protocol. For Modbus RTU, parameters are selected from Front panel.

4.6.1 RS485 Address

Set Addr 001

From the set-up menu, use **MD** and **P** buttons to select the address ID.

Set Addr 101

Press **ESC** button to enter the selection routine. The current setting will be flashing.

Set Addr 101

Use **MD** and **P** buttons to choose Modbus address (001 to 247).

On completion of the entry procedure, press **ESC** button to confirm the setting and press **VA** button to return the main set-up menu.

4.6.2 Baud Rate

Set baud 9.6 k

From the set-up menu, use **MD** and **P** buttons to select the Baud Rate option.

Set baud 9.6 k

Press **ESC** to enter the selection routine. The current setting will flash.

Set baud 38.4 k

Use **MD** and **P** buttons to choose Baud rate 2.4k, 4.8k, 9.6k, 19.2k, 38.4k

On completion of the entry procedure, press **ESC** to confirm the setting and press **VA** to return to the main set up menu.

4.6.3 Parity

Set Par EVEN

From the set-up menu, use **MD** and **P** buttons to select the parity option.

Set Par EVEN

Press **ESC** to enter the selection routine. The current setting will flash.

Set Par NONE

Use **MD** and **P** buttons to choose parity (EVEN / ODD / NONE (default)).

On completion of the entry procedure, press **ESC** to confirm the setting and press **VA** to return to the main set up menu.

4.6.4 Stop bits

Set stop 2

From the set-up menu, use **MD** and **P** buttons to select the stop bit option.

Set stop 2

Press **ESC** to enter the selection routine. The current setting will flash.

Set stop 1

Use **MD** and **P** buttons to choose stop bit (2 or 1)

On completion of the entry procedure, press **ESC** to confirm the setting and press **VA** to return to the main set up menu.

4.7 CLR

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

CLR

From the set-up menu, use **MD** and **P** buttons to select the reset option.

CLR

Press **ESC** to enter the selection routine. The dit will flash.

Press **ESC** to confirm the setting and press **VA** to return to the main set up menu.

4.8 Backlight Set-up

Our high-definition backlit display can be set to a duration that suits the end-customer best.

Set LP 60

From the set-up menu, use **MD** and **P** buttons to select the reset option.

Set LP 20

Press **ESC** to enter the selection routine. The dit will flash. The options are 0/5/10/30/60/120 minutes.

Press **ESC** to confirm the setting and press **VA** to return to the main 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), three phase three wire (3p3w) or three phase four wire (3p4w) system.

5.1.1 Voltage and Current

- Phase to neutral voltages 100 to 289V a.c. (not for 3p3w supplies).
- Voltages between phases 173 to 500V a.c. (3p supplies only).
- Percentage total voltage harmonic distortion (THD%) for each phase to N ( not for 3p3w supplies).
- Percentage voltage THD% between phases (three 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 to 3600 MW
- Reactive power 0 to 3600 MVAR
- Volt-amps 0 to 3600 MVA
- Maximum demanded power since last Demand reset Power factor
- Maximum neutral demand current, since the last Demand 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 35mm<sup>2</sup> stranded wire capacity. Single phase two wire(1p2w), three phase three wire(3p3w) or three phase four wire(3p4w) unbalanced. Line frequency measured from L1 voltage or L3 voltage.

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 Interfaces for External Monitoring

- Three interfaces are provided:
- RS485 communication channel that can be programmed for Modbus RTU protocol
  - Relay output indicating real-time measured energy. (configurable)
  - Pulse output 400imp/kWh (not configurable)

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

5.4.1 Pulse Output

Opto-coupler with potential free SPST-NO Contact (Contact range 5-27VDC / Max current input: Imin 2mA and Imax 27mA DC). The pulse output can be set to generate pulses to represent kWh or kVarh.

Rate can be set to generate 1 pulse per:  
0.01 = 10 Wh/VArh  
0.1 = 100 Wh/VArh  
1 = 1 kWh/kVarh  
10 = 10 kWh/kVarh  
100 = 100 kWh/kVarh

Pulse width 200/100/60 ms.

5.4.2 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 nnn – 3-digit number, 1 to 247
- Modbus™ Word order Hi/Lo byte order is set automatically to normal or reverse. It cannot be configured from the set-up menu.

5.5 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

5.6 Environment

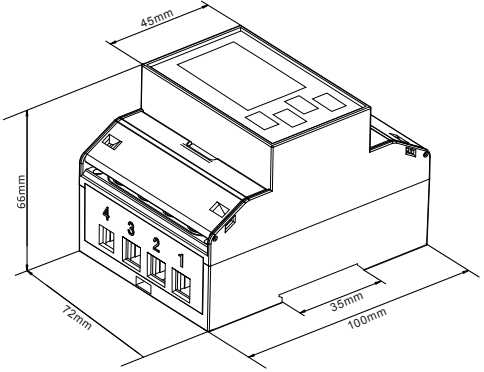
- Operating temperature -25°C to +55°C\*
- Storage temperature -40°C to +70°C\*
- Relative humidity 0 to 95%, non-condensing
- Altitude Up to 3000m
- Warm up time 1 minute
- Vibration 10Hz to 50Hz, IEC 60068-2-6, 2g
- Shock 30g in 3 planes

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

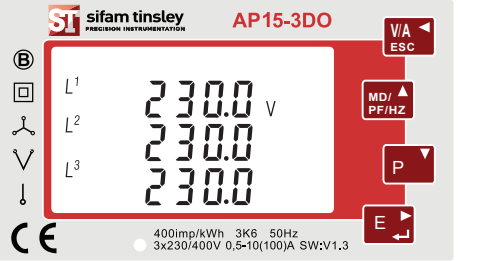
5.7 Mechanics

- DIN rail dimensions 76 x 100 mm (WxH) per DIN 43880
- Mounting DIN rail (DIN 43880)
- Sealing IP51 indoor
- Material Self-extinguishing UL 94 V-0

6 Dimensions



6.1 Nameplate



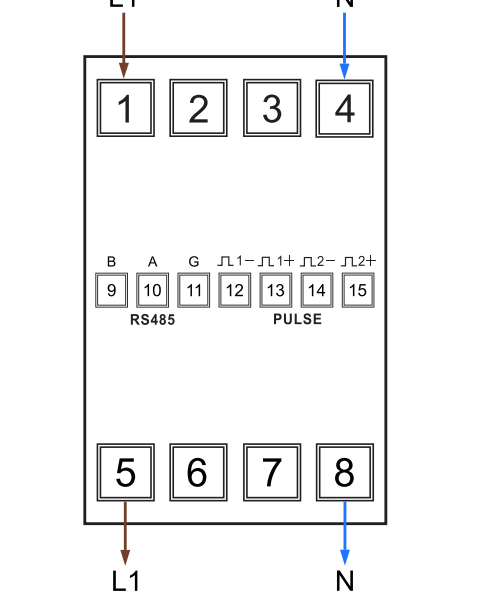
7 Installation / Maintenance



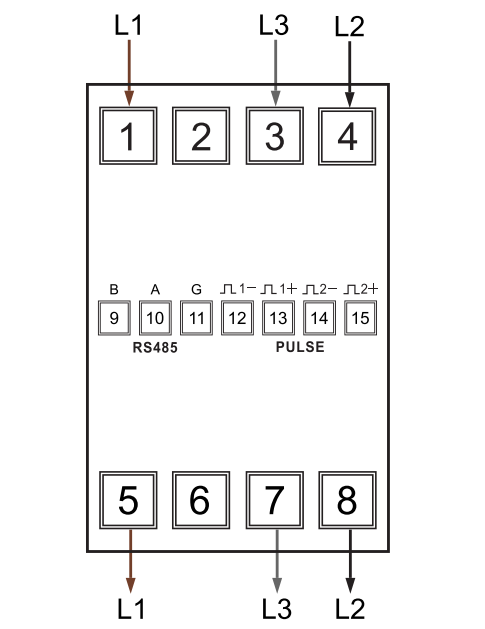
Read these instructions carefully and look at the equipment to become familiar with the device before trying to install “HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH”

Apply appropriate personal protective equipment and follow safe electrical work practices applicable to local standards. Turn off all power supplying this device and the equipment in which it is installed before working on it. Always use a properly rated voltage sensing device to confirm that all power is off. Do not exceed the device's ratings for maximum limits. Do not use this device for critical control or protection applications where human or equipment safety relies on the operation of the control circuit. Do not allow the total additive current flowing through the device to exceed maximum continuous current rating. Failure to follow these instructions will result in death or serious injury.

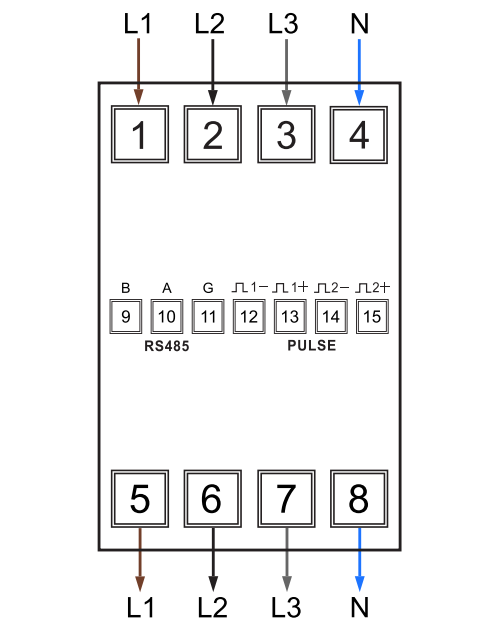
7.1 Single phase two wires



7.2 Three phase three wires



7.3 Three phase four wires



7.4



Turn off all power supplying this device and the equipment in which it is installed before working on it. 2. Always use a properly rated voltage sensing device to confirm that all power is off.

7.5 Input Wiring and Fusing

Choose fuses of a type and with a breaking capacity appropriate to the supply and in accordance with local regulations.

A switch or circuit breaker allowing isolation of supplies to the unit must be provided where practical. In primary metering applications, ensure the supply is isolated before any maintenance on the product. Tampering with the product seals may contravene local laws

7.6 Wire Size / Torque

Connections (depending on system type, see section 8.1 to 8.3)													
				Cable size (mm² / AWG)	Torque								
<table><tr><td>B</td><td>A</td><td>G</td><td>┐1-┐1+┐2-┐2+</td></tr><tr><td>9</td><td>10</td><td>11</td><td>12 13 14 15</td></tr></table> RS485PULSE				B	A	G	┐1-┐1+┐2-┐2+	9	10	11	12 13 14 15	22 Gauge Belden 8761 or equivalent	0.6 Nm
B	A	G	┐1-┐1+┐2-┐2+										
9	10	11	12 13 14 15										
L1 L2 L3 N				25mm²	3.5 Nm								

7.7 Maintenance

The front of the case should be wiped with a dry cloth only, using minimal pressure. If necessary wipe the rear case with a dry cloth.

No user serviceable parts