Power Monitor Sensor
Single Phase
User Manual

Help Version updated till firmware 404p

What is the Power Monitoring Sensor?

The Power Monitoring Sensor or PMS as it will be referred to through the rest of this user manual for DIN rail single phase two wire multi-tariff energy meter with MODBUS protocol.

The PMS can only be connected to our sensorProbe+ & our securityProbe base units and not the old sensorProbe units. The PMS is compatible with the securityProbe 5E, 5ES, 5ES-X20/X60, 5ESV and 5ESV-X20 and X60 base units & the SP2+ & SPX+. The PMS is connected to the securityProbe's RS-485 port and uses the Modbus protocol to communicate with the PMS.

NOTE: Please refer to the sensorProbe+ Modbus and AKCP PMS manual for connection & setup instruction on the SP+ units.

Safety instructions

Information for Your Own Safety

This manual does not contain all of the safety measures for operation of the equipment (module, device), because special operating conditions, and local code requirements or regulations may necessitate further measures. However, it does contain information which must be read for your personal safety and to avoid material damages. This information is highlighted by a warning triangle and is represented as follows, depending on the degree of potential danger.

Warning
This means that failure to observe the instruction can **result in death, serious injury or considerable material** damage.

Caution
This means hazard of electric shock and failure to take the necessary safety precautions will result in death, serious injury

Operation of the equipment (module, device) described in this manual may only be performed by qualified personnel. Qualified personnel in this manual means person who are authorized to commission, start up, ground and label devices, systems and circuits according to safety and Regulatory standards.

Use for the intended purpose

The equipment (device, module) may only be used for the application specified in the catalogue and the user manual, and only be connected with devices and components recommended and approved by Forlong.

Proper handling

The prerequisites for perfect, reliable operation of the product are proper transport, proper storage, installation and proper operation and maintenance. When operating electrical equipment, parts of this equipment automatically carry dangerous voltages. Improper handling can therefore result in serious injuries or material damage.

 Use only insulating tools.
 Do not connect while circuit is live (hot).

- Do not connect the meter to a 3 phase - 400VAC – network.
- Place or install the meter only in dry surroundings.
- Do not mount the meter in an explosive area or expose the meter to dust, mildew and insects.
- Make sure the wires are suitable for the maximum current of this meter.
- Make sure the AC wires are connected correctly before activating the current/voltage to the meter.
- Do not touch the meter connecting clamps directly with metal, blank wire and your bare hands as you may recieve an electrical shock.
- Make sure the protection cover is in place after installation.
- Installation, maintenance and reparation should only be done by qualified personnel.
- Never break the seals and open the front cover as this might influence the function of the meter, and will void the warranty.
- Do not drop, or allow strong physical impact on the meter as the high precisely components inside may be damaged.

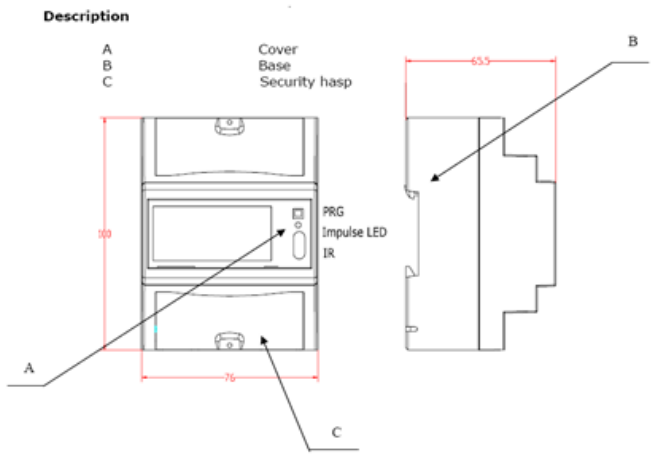
Disclaimer
We have checked the contents of this publication and every effort has been made to ensure that the descriptions are as accurate as possible.

However, deviations from the description cannot be completely ruled out, so that no liability can be accepted for any errors contained in the information given. The data in this manual is checked regularly and the necessary corrections are included in subsequent editions.

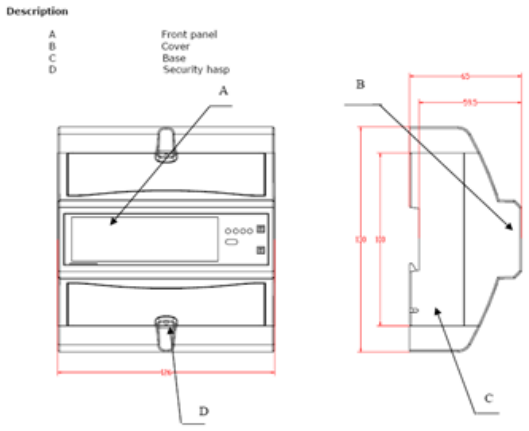
The Single Phase PMS can be mounted on a standard DIN rail (see above).

Meter specifications:

	Single Phase Meter	Three Phase Meter	Three Phase Meter - CT Type
Voltage (V)			
Rated Voltage (Un)	230V AC	230/400V AC (3~)	230/400V AC (3~)
Operational Voltage Range	0.7~1.3Un	161/279 – 300/520V AC (3~)	161/279 – 300/520V AC (3~)
Current (A)			
Basic Current (Ib)	10A	10A	1.5A
Maximum Current	100A	100A	6A
Operational Current Range	0.4% Ib- Imax	0.4% Ib- Imax	0.4% Ib- Imax
Over Current Withstand	30Imax for 0.01s	30Imax for 0.01s	30Imax for 0.01s
Internal Power Consumption	≤2W / 10VA	≤2W / 10VA per phase	≤2W / 10VA per phase
Frequency (Hz)			
Operational Frequency Range	50~60Hz ±10%	50Hz ±10%	50Hz ±10%
Operating Environment			
Operating humidity	≤ 75%	≤ 75%	≤ 75%
Operating temperature	-10°C - +50°C	-10°C - +50°C	-10°C - +50°C
International standard	IEC 62053-21	IEC 62053-21	IEC 62053-21
Accuracy Class			
Voltage	±0.5%	±0.5%	±0.5%
Amps	±0.5%	±0.5%	±0.5%
Frequency (Hz)	±0.2%	±0.2%	±0.2%
Dimensions			
Height	100 mm	130 mm	130 mm
Width	76 mm	126 mm	126 mm
Depth	65.5 mm	65 mm	65 mm
Max Diameter Cable	11.5 mm		
Weight	0.35 Kg	0.7 Kg (net)	0.7 Kg (net)



Single Phase PMS



3 Phase & 3 Phase CT Type PMS

Single Phase PMS Readings

Each Single Phase PMS can be setup to monitor up to 5 separate values as follows;
List of Single Phase values
- 1 Voltages
- 1 Amps
- 1 Frequency
- 1 Active Energy

Total 4 values

Maximum Voltage and Current Ratings

If you need to monitor AC current over 100 amps of current, then you need to use the 3 Phase CT-Type PMS and the CT's or current transformers. These CT's range from 100 to 4000 Amps. Please see the Current Transformer data sheet for more information on the CT's.

Maximum number of PMS per securityProbe

It is recommended to not connect more than 14 x Single Phase PMS to a single securityProbe base unit and 4 PMS to the SP+ units.

Please see page #8 through #10 for the physical connections of the cabling and configuration setup of more than one PMS on the securityProbe base unit.

Again, please refer to the ***sensorProbe+ Modbus and AKCP PMS*** manual for connection & setup instruction on the SP+ units.

VERY IMPORTANT: Please see pages #9 and #10 for the wire impedance specifications and termination resisters that must be in place when installing multiple PMS in one Modbus string.

Installing / Connecting the Meters

⚠ CAUTION

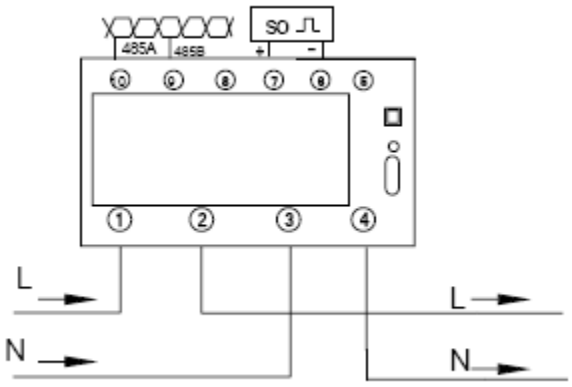
- Turn off all the power before working on it.
- Always use a properly rated voltage sensing device to confirm that power is off.

⚠ WARNING

- Installation should be performed by qualified personnel familiar with applicable codes and regulations.
- Use isolated tools to install the meter.
- Fuse or thermal cut-off or single-pole circuit breaker can't be fitted on the supply line and not the neutral line.
- Don't put your finger into the hole, because there is a screw inside.
- Please choose the available adapter which is supplied with the meter to suit the diameter of the cable.

- We recommend that the connecting wire which is used to connect the meter to the outside circuit should be sized according to local codes and regulations for the amps of the circuit breaker or over current device used in the circuit.
- An external switch or a circuit-breaker should be installed on the inlet wire, which will be used as a disconnection device for the meter. And there it is recommended that the switch or circuit-breaker is near the meter so that it is more convenience for the operator. The switch or circuit-breaker should comply with the specifications of the building electrical design and all local regulations.
- An external fuse or thermal cut-off which will be used as a over-current protection device for the meter must be installed on the supply side wire, and it is recommended that the over-current protection device is near the meter so that it is more convenience for the operator. The over-current protection device should comply with the specifications of the buildings electrical design and all local regulations.
- This meter can be installed indoor directly, or in a meter box which is waterproof outdoor, subject to local codes and regulations.
- The meter has to be installed against a wall which is fire resistant.
- The meter has to be installed in a good ventilated and dry place.
- The meter has to be installed in a protection box when placed in dangerous or dusty environment.
- The meter can be installed on a 35mm DIN rail or direct on a meter board with screws.
- When the meter is installed in an area with frequent surges due to e.q. thunderstorms, welding machines, inverters etc, protect the meter with Surge Protection Devices.

Connection Diagram



1/2 Phase line IN/OUT
3/4 Neutral line IN/OUT
6 and 7 Test pulse output contact
9 and 10 RS485 communication contact (to securityProbe)

Consumption indication

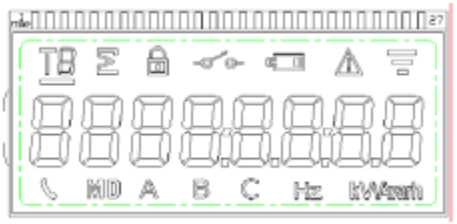
There is a red LED which is used to indicate the power consumption in the front panel of the Single Phase PMS. When consumption transpires, the LED will flash. The more quickly LED flashes, the more consumption there is. For this LED, the flash rate is indicated per kWh on the front panel.

Reading the meter

The Single Phase energy meter is equipped with 6+2 LCD display. which is used as recording consumption and can't be reset to zero, including the energy of every tariff. The number system is based on units of 10. And unit is kWh.

In the first 3minutes meter display total energy （2digits decimal）、meter serial-number（SN）、MODBUS address. the time of every screen display is 3 seconds.

After 3 minutes，if the meter set up 2 tariff，it will display total energy, tariff 1 electric quantity、tariff 2 electric quantity、voltage、current、frequency. If it set up 1tariff ,it will display it will display total energy、voltage、current、frequency.



The LCD display presents various information from the PMS meter.

Symbol	Description
kW h	Unit indicator: kWh—active energy
	Displayed Program Inhibit
	Battery status:3.6V When the battery voltage is low, flashes show
	LCD alarm indicator
	Communication symbols（ When communicating, it flashed ）. For 485 and infrared communication interface in communication instructions
	Tariff: T0,T1,T2 T0 Total energy
	current time tariff 1  current time tariff 2

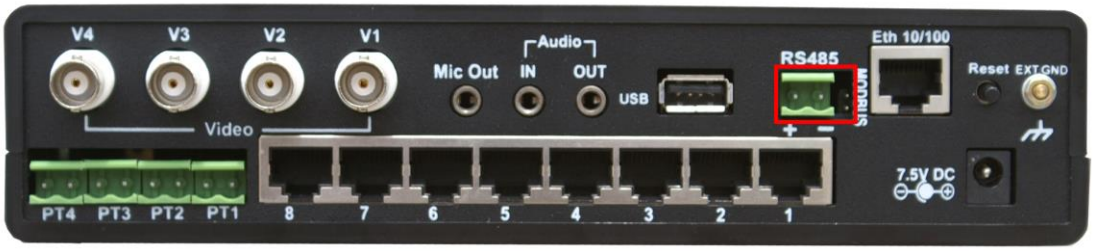
Connecting to the securityProbe and Ports 9 and 10 (RS485)

Connect two wires/twisted pair from ports 9 and 10 to the terminal block on the securityProbe RS485 port.

The AKCP PMS uses the Modbus connection (RS485) port on the rear of the securityProbe (note your rear panel may differ depending on the model of securityProbe you have) Using a pair of wires from ports 23/24 on the PMS (see wiring diagram) to the terminal block on your securityProbes RS485 port. **VERY IMPORTANT:** On the interconnection between the +/- on the securityProbe unit and the A B on the PMS, The A goes to - while the B goes to + .

VERY IMPORTANT NOTE: You need to connect the AC POWER TO THE PMS FIRST before connecting it to the securityProbe base unit and adding the meter to the web interface.

The PMS should ONLY be installed by a qualified Electrician Engineer who is also familiar with Modbus.



RS485 Cabling and Run Length

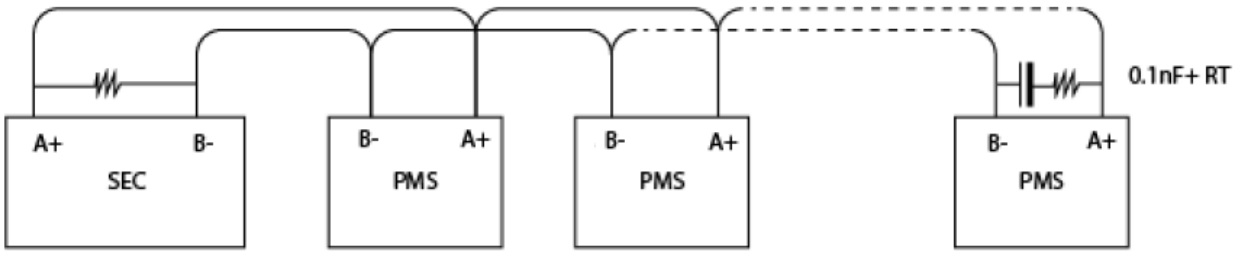
All Modbus manufacturers recommend a cable with 120Ohm characteristic impedance or higher so we highly recommend that you use shielded AWG 24 twisted pair copper wire and this cable has an impedance of at least 120Ohm, most importantly when connecting multiple PMS to a single base unit. The maximum cable length is determined by the combination of cable length (in meters) and data signaling rate. The data signaling rate on the power meter is 9600 bps (bits per second), so the maximum cable run length for this cable is roughly 300 meters, or 1000 feet.

Connecting Multiple PMS to a single securityProbe base unit

As mentioned, it is possible to connect multiple PMS's to a single securityProbe base unit. It is not recommended to connect more than 14 Single Phase PMS to a single securityProbe base unit.

It is also VERY critical that you are using at least 120Ohm impedance shielded twisted pair cable as mentioned above including the termination resisters described below.

The terminal resistors should always match the impedance of the installation cables.



As shown in the diagram above you will need to use the cable and terminal resistors in the Modbus line as recommended by the Modbus standard. That is: a 120 Ohm impedance cable, 120 Ohm (0.25W) termination resistor + 0.1nF capacitor at the end of

the line.

- The SEC has a polarized line implemented
- Use the jumper aside the connector for 120 Ohm terminal resistor at the SEC side (inside RS485 port), if the jumper is used, you must not add a terminal resistor at the SEC side.
- If cable characteristic impedance differs from 120 Ohm, terminal resistors should match the same impedance.
- the two ends of the cable must be connected on Line Terminations.

If you have any questions about this please consult with your engineer or contact us at support@akcp.com

Adding each PMS to the securityProbe's web interface

When adding the multiple PMS to the web interface in the securityProbe base unit you have to add each PMS one at a time then change the ID from "1" to a different ID. Scan again then change "1" to a unique ID (like PMS1, PMS2) and so on.

You will need to use the following procedures to pre-configure the multiple PMS's:

1. Start by connecting only one PMS, run the scan ID, set this PMS to ID 1, and then remove this PMS both physically and from the web interface. This will hard code the PMS as ID 1.

2. Connect the second PMS, run the scan ID, set this PMS to ID 2, and then remove this PMS both physically and from the web interface. This will hard code the PMS as ID 2.

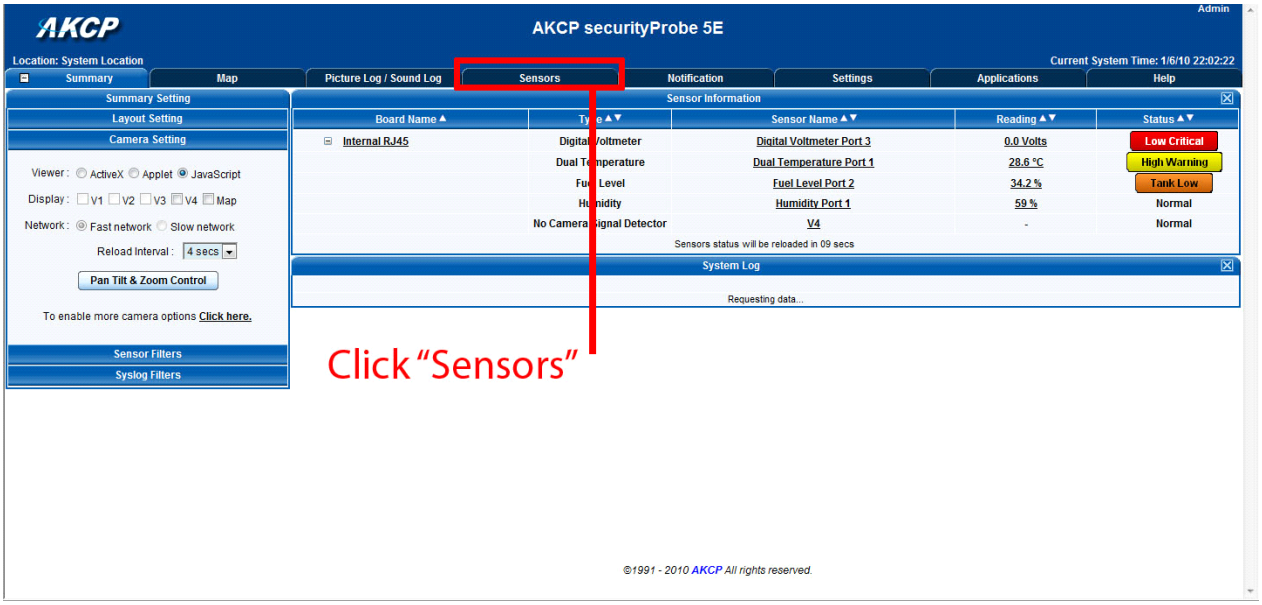
3. Connect the third PMS, run the scan ID, set this PMS to ID 3, and then again remove this PMS, both physically and from the web interface. This will hard code the PMS as ID 3.

4. Repeat this procedure with all PMS's you plan on connecting.
Note: This will guarantee all of the PMS's in the daisy chain will function normally without any problem and insure there are no duplicate PMS ID numbers in the chain.

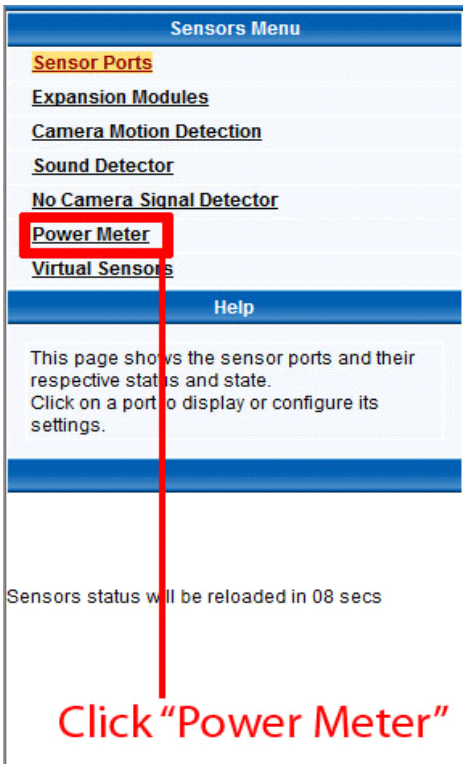
5. After you have completed the pre-configurations of all of your PMS's that you are going to connect, then reconnect each of them again in the same numerical sequence as you previously configured them with. Start with PMS ID 1 and PMS ID 2. If these are working OK, then you can connect the other PMS's in the string.
Note: Connect PMS ID 1 and PMS ID 2 on the same bus. Take caution that RS485 A and RS485 B should not be swapped.

Basic Setup Of your PMS

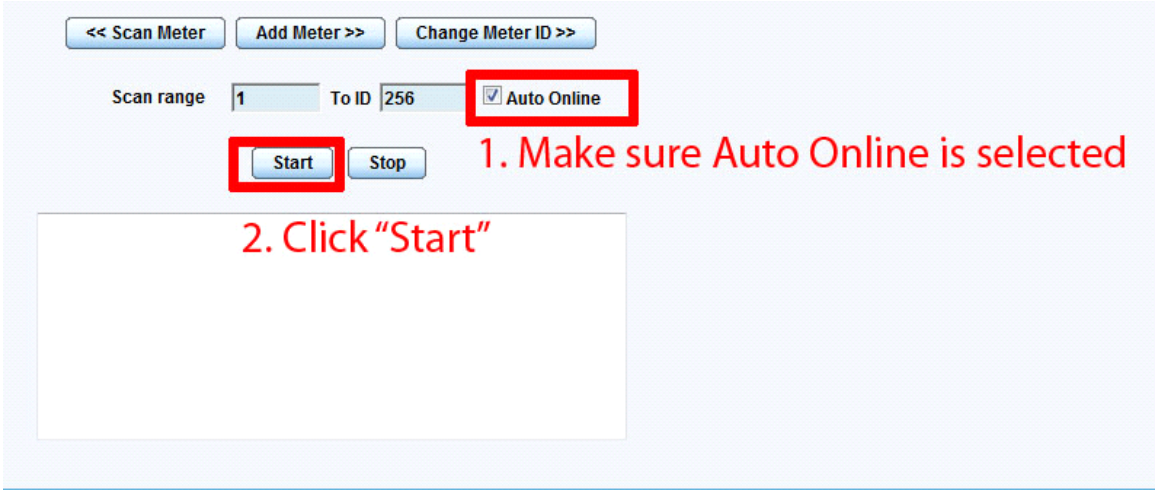
Once you have connected your PMS unit to the securityProbe and you have ensured correct power connection to the PMS, navigate to the web interface of your securityProbe. You should be bought to summary page :-



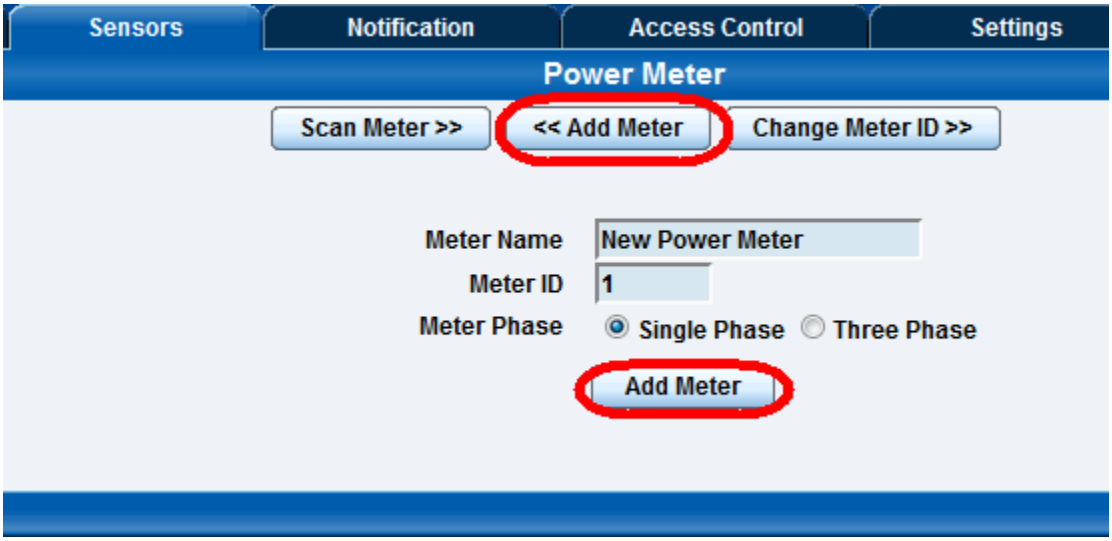
After you have clicked the "Sensors" tab you will be bought to the sensor settings page:-



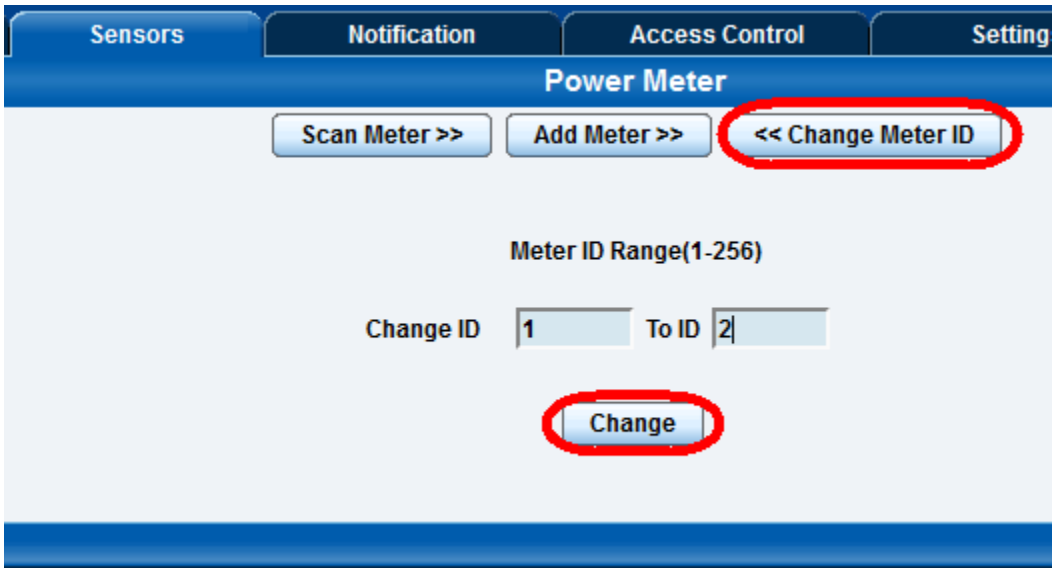
This will now bring you to the "Scan Meter" page, follow the directions below for a quick setup:-



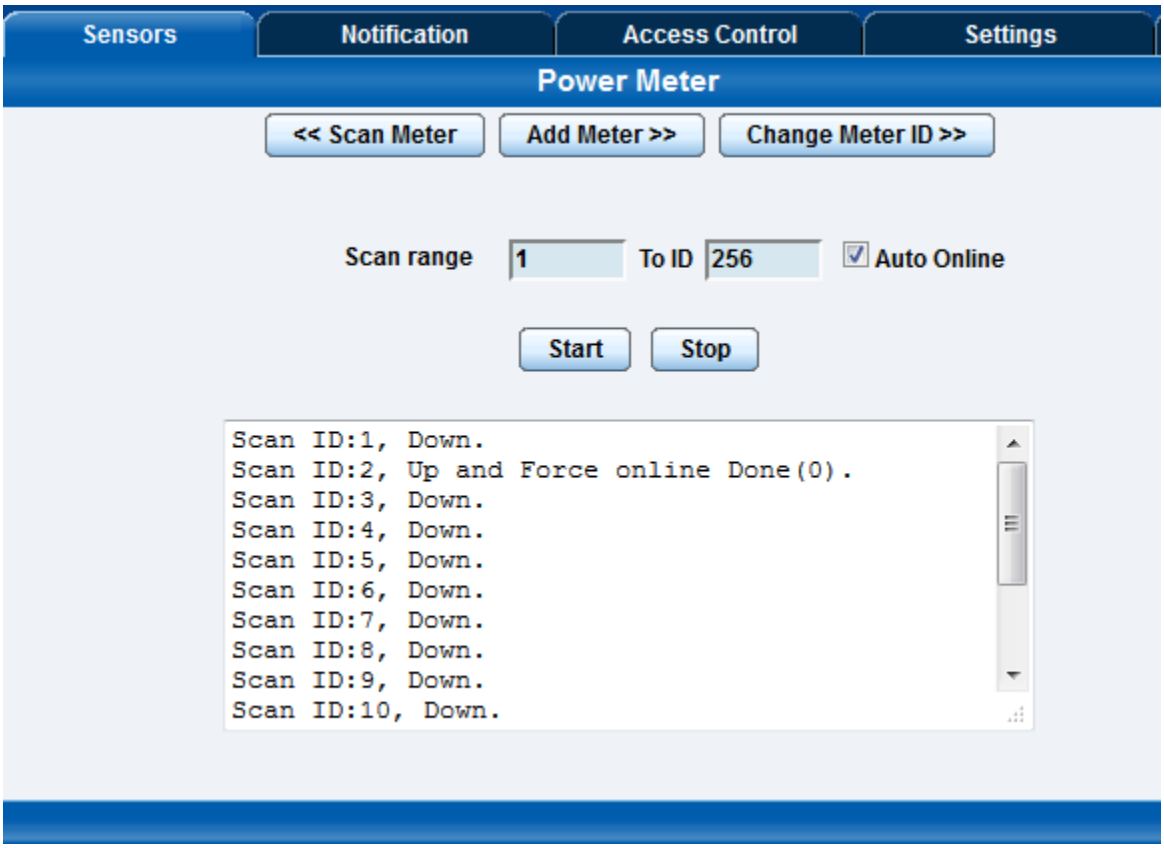
Once the AC Power has been connected to the PMS and the meter has been connected to the units RS-485 port click on the "Start" to begin scanning for the attached PMS as shown in the screen shot above.



You can also add the meter manually by clicking on the "Add Meter" button as shown in the screen shot above. The meters ID number will be from 1 to 256.

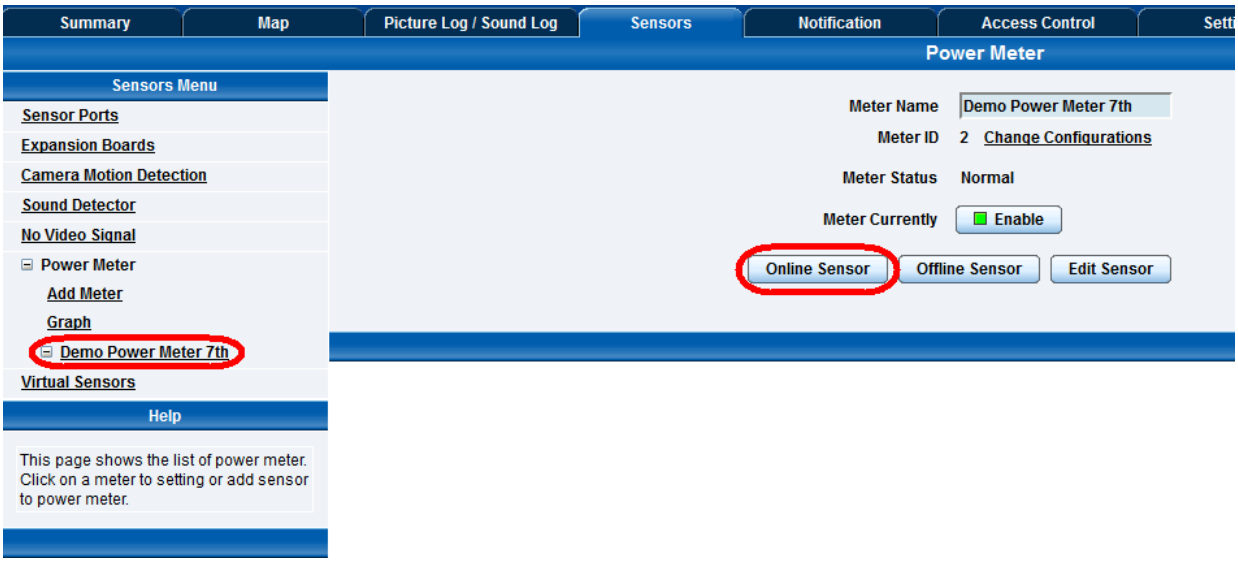


You can also change a meters ID number using the “Change Meter ID” button as shown in the screen shot above.

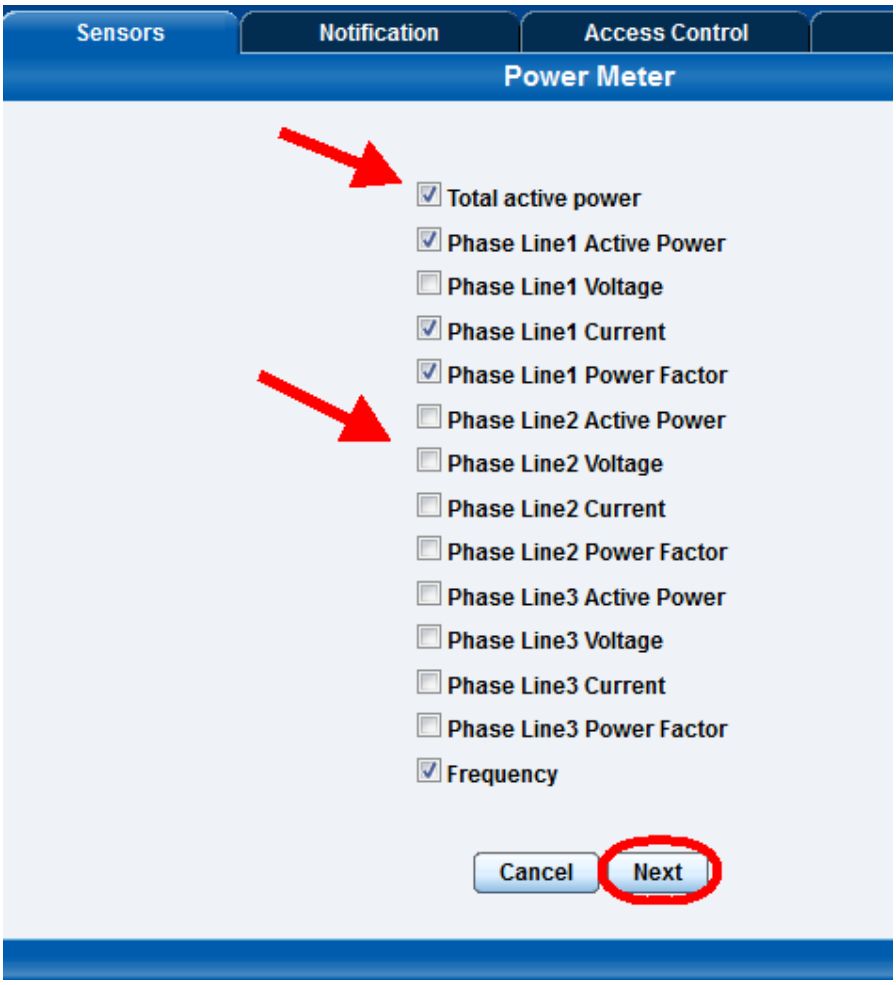


Once the scan has begun any connected PMS units will be detected and added and put online as shown in the screen shot above. You can enter your Scan range if you know the amount of meters you will be adding.You can stop the scan at any time by clicking

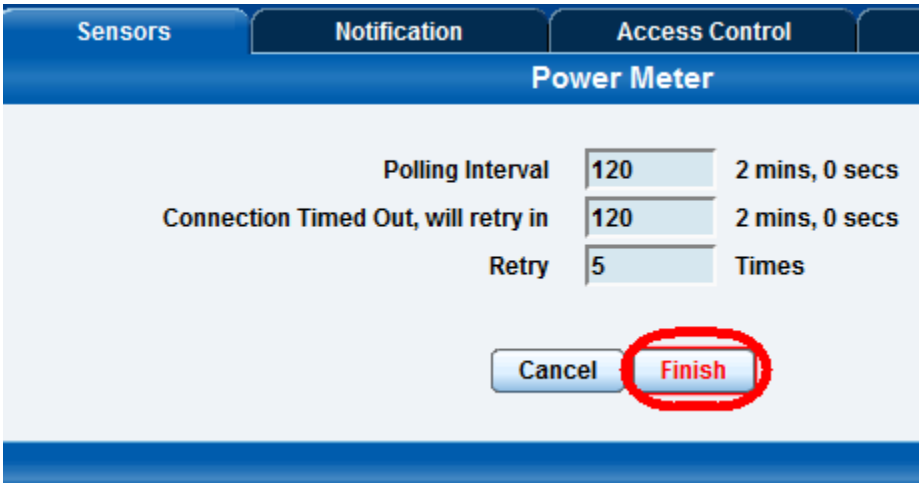
on the “Stop” button.



You will now be taken to the meter settings page where you can enable each of the separate values you want to monitor. First click on the “Online Sensor” button as shown.

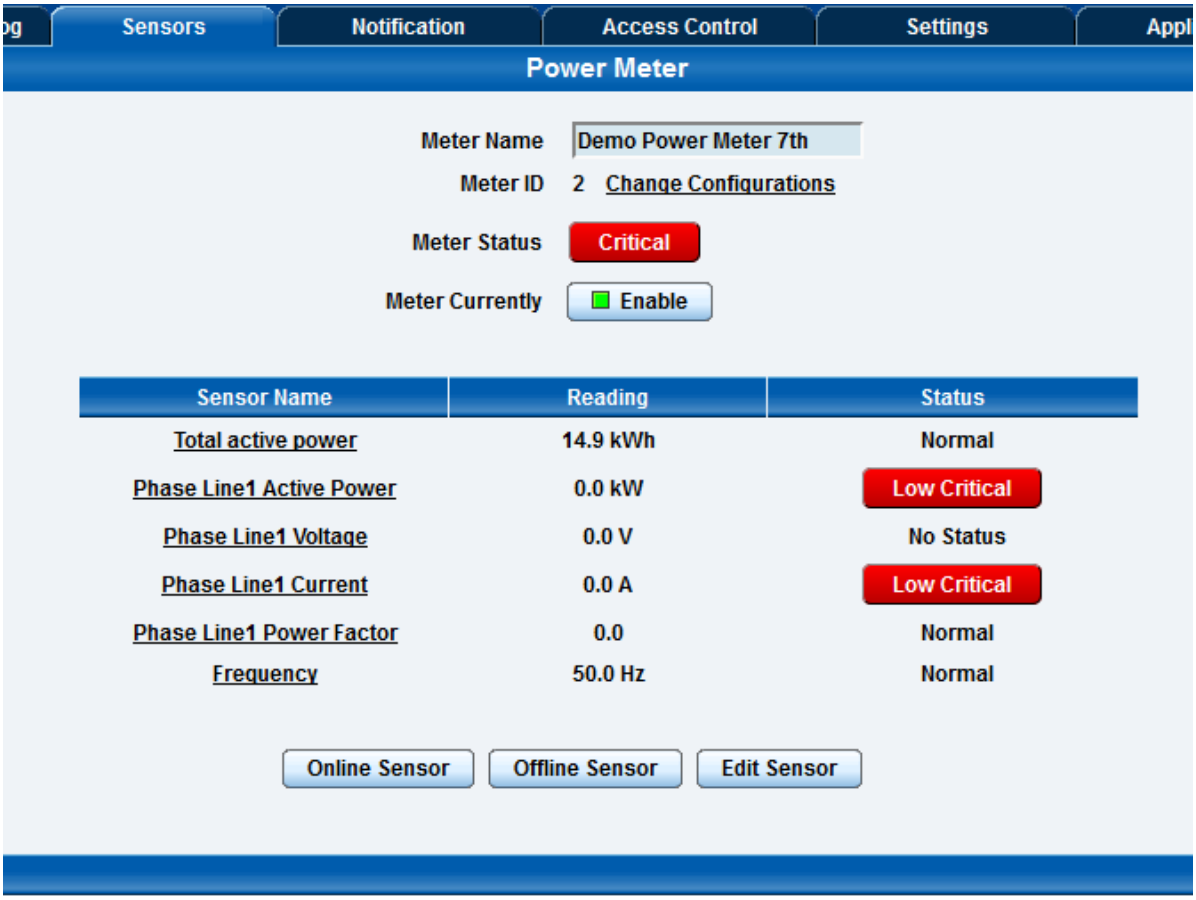


In the next screen you can enable all the values by adding a check in each of the check boxes that represent each of the listed values. Then you would click on the “Next” button to continue as shown in the screen shot above. The values available will be different on the Single Phase PMS.



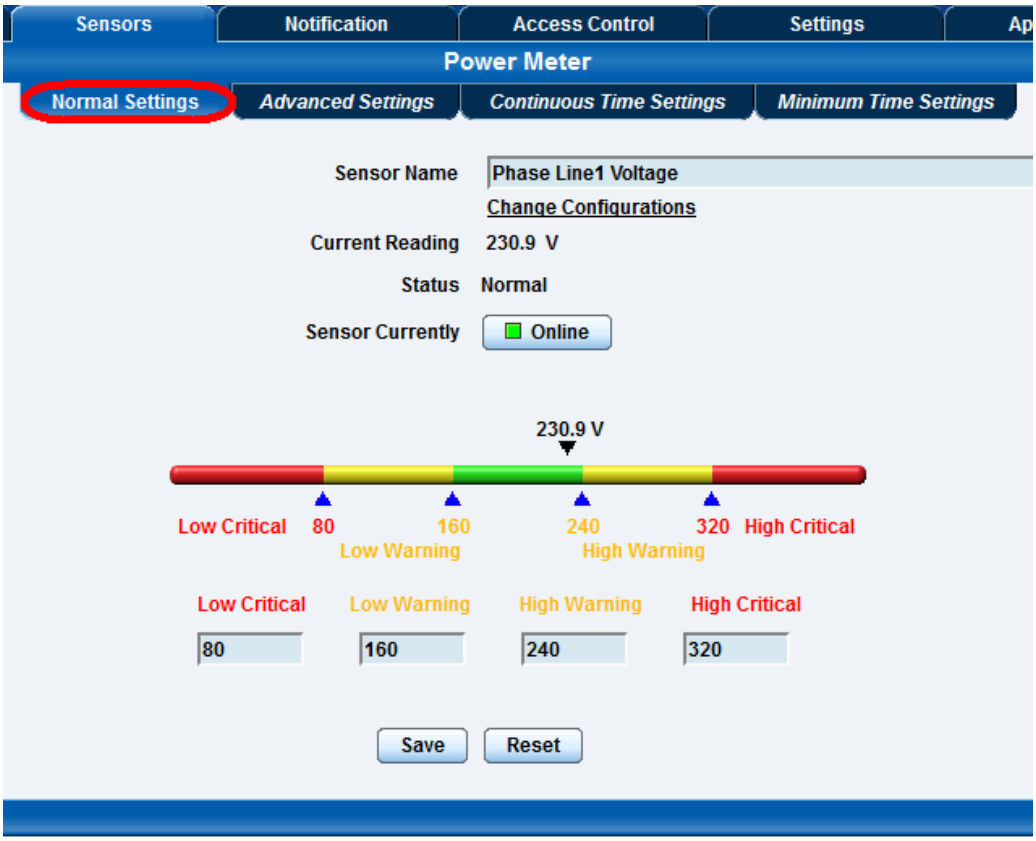
In the next screen you can setup your Polling Interval times and retry times as shown above.

- Polling Interval -Here you can select how often the securityProbe polls information from the PMS unit.
- Connection Time out- This option allows you to adjust the time (in seconds) the securityProbe will wait for a response from the PMS before timing out.
- Retry - You can set the number of times the securityProbe will retry after a timeout has occurred.



After adding all the values you require you will be returned to the PMS main settings page which will now show the list of values or sensors, each reading and status. It may take a few minutes for the readings to be updated depending on how many PMS you have connected.

How to setup each of the sensor or value thresholds will be shown on the next page. However to open the sensor threshold page simply click on the links in the Sensor Name column in the left side of the Power Meter page.



Now you are able setup each of the sensors or value thresholds as shown in the screen shot above.

If you have the 3 phase PMS connected to each of the 3 phases of the AC lines each Phase Line will be shown in the PMS Menu column as shown in the screen shot above.

Replacement Procedures for previous type PMS with new type

Please use the following steps if your replacing an old type PMS with this new type PMSFL in the same Modbus string.

1. Check and take note the **new** PMSFL meter's LCD to see what is its current Modbus ID and also the old type PMS that it will be replacing.

2. Connect the **new** PMSFL power meter to a SEC's RS485 bus which doesn't have the ID noted in step #1 and the ID which the PMS will be changed to (old PMS ID).

3. Use the SEC UI to change the new PMSFLS's ID to the old PMS ID that it will replace.

4. Delete the old power meter from the securityProbe's web UI (disable the meter and remove the meter)

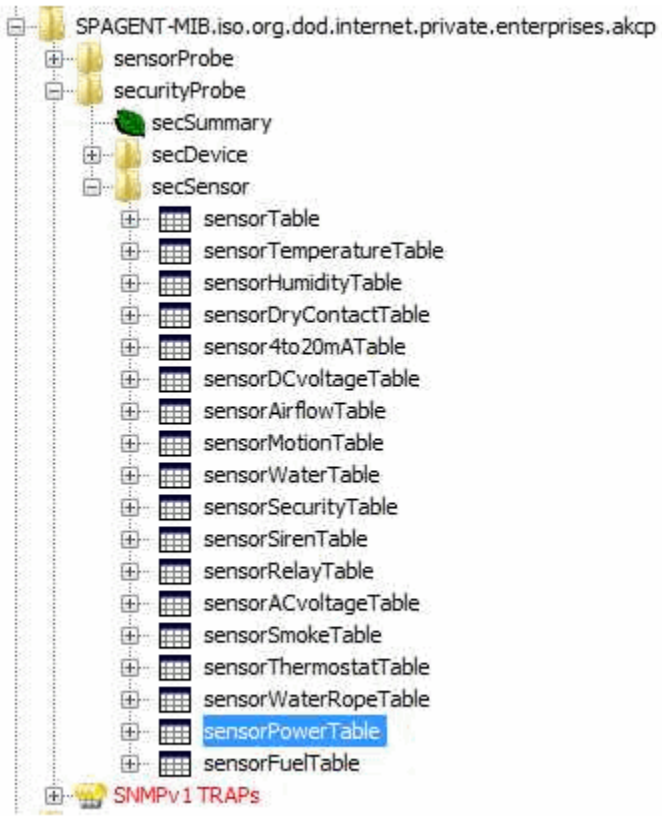
5. Physically replace the old power meter with the new PMSFL meter in the string.

6. Add the new power meter manually or Scan with add the meter automatically from the web UI.

7. Turn online the sensor readings required. Only turn online 4 readings or less at a time before saving.

PMS OID and OID location

The OID of the PMS is located in the sensorPowerTable (.1.3.6.1.4.1.3854.2.3.22).



PMS FAQ

Question #1

Can the total active power be read for each phase?

Answer

No, the total active power reading in the web interface will be the total active power of all 3 phases combined.

Question #2

Can the PMS monitor the AC without the neutral?

Answer

No, can not

Question #3

Can I connect the Modbus output directly to alternative BMS interface?

Answer

We use the Modbus RTU standard on RS485. If the BMS supports the Modbus RTU standard on RS485, it can support that BMS.

Question #4

Is it possible to connect multiple Modbus devices on the securityProbe's RS-485 port simultaneously?

Answer

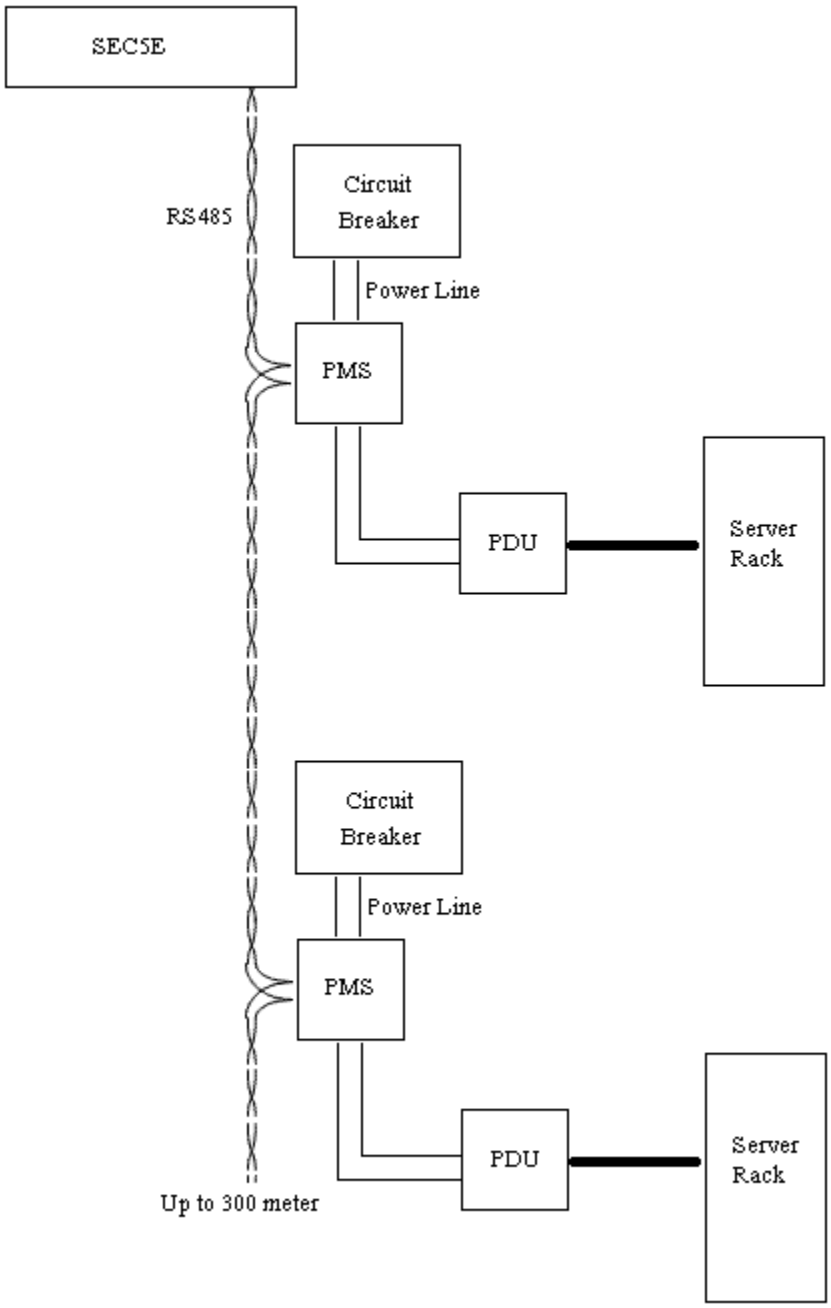
Yes, we can use many Modbus devices on our RS485 port in the same time. However, the Modbus device should be a Master or Slave device, so we cannot use the SEC in both modes simultaneously. We need to choose our securityProbe to one mode. The page "Settings - Connectivity - Modbus" is where this setting is found for enabling our securityProbe to be the Slave device.

Question #5

Do you have an example of how I would connect the PMS to monitor the voltages from my PDU or power distribution unit?

Answer

Yes, please see the diagram following page that shows how these can be connected.



Question #6

What are the Modbus Read Regisors for the PMS?

Answer

Please see the registors on the follow page which includes the chart showing all the read registors.

Modbus Read Registers for the PMS

This is the setting.

Modbus-RTU on RS485

Baudrate: 9600

parity bit: even

data bit: 8

stop bit: 1

See this table for the Modbus registers.

Start_address	Function code	description	register-len	byte-len	R/W	units	format
0x0200	04H	[Current]total active energy	2	4	R	kWh	float
0x0202	04H	[Current]T1 active energy	2	4	R	kWh	float
0x0204	04H	[Current] T2 active energy	2	4	R	kWh	float
0x0206	04H	[Current]T3 active energy	2	4	R	kWh	float
0x0208	04H	[Current] T4 active energy	2	4	R	kWh	float
0x0220	04H	[Current]total reserve active energy	2	4	R	kWh	float
0x0222	04H	[Current]T1 reserve active energy	2	4	R	kWh	float
0x0224	04H	[Current] T2 reserve active energy	2	4	R	kWh	float
0x0226	04H	[Current]T3 reserve active energy	2	4	R	kWh	float
0x0228	04H	[Current] T4 reserve active energy	2	4	R	kWh	float
0x0300	04H	[Current]MD of forward active energy	2	4	R	kW	float
0x0600	04H	Phase A active power	2	4	R	kW	float
0x0602	04H	Phase B active power	2	4	R	kW	float
0x0604	04H	Phase C active power	2	4	R	kW	float
0x0606	04H	Phase A voltage	2	4	R	V	float
0x0608	04H	Phase B voltage	2	4	R	V	float
0x060A	04H	Phase C voltage	2	4	R	V	float
0x060C	04H	Phase A current	2	4	R	A	float
0x060E	04H	Phase B current	2	4	R	A	float
0x0610	04H	Phase C current	2	4	R	A	float
0x0612	04H	Phase A power factor	2	4	R		float
0x0614	04H	Phase B power factor	2	4	R		float
0x0616	04H	Phase C power factor	2	4	R		float
0x0618	04H	frequency	2	4	R	Hz	float

Question #10

Do you know where I can get more informaton online about AC power and voltage?

Yes, please go to this page on the web for more informaton;
http://en.wikipedia.org/wiki/AC_power

This concludes the PMS User Manual

I you have any further questions or problems with the PMS please contact support@akcp.com for further assistance.

Thanks for choosing AKCess Pro!