

PiMx

EM-PiMx - Energy Monitor



PiGx

EM-PiGx - Energy Controller

PiRx

EM-PiRx - Load Management Controller

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*Quick Start: For the quick start procedure, please jump to section 6 of this manual:
“Powering up your PiMx”.*

1) INTRODUCTION

The PiMx Energy Monitor offers an extremely versatile Energy Monitoring System for home, office or industrial use. It allows for non-invasive monitoring of the AC grid Voltage, Current and Power of your utility supply and so increases awareness of your energy consumption. Such awareness assists in realising where energy efficiency steps can be taken. Reduction of energy bills of up to a third is achievable with very small lifestyle changes, once you know where and when your energy is used.

Either single-phase or three-phase mode of operation is available (note for true three-phase operation, 3 AC Voltage Sensors are required (Part# EM-ACTr) – only one AC Voltage Sensor is supplied in the basic package).

The PiMx incorporates an on-board Web browser & Graphical Display for configuration, calibration and to view real-time data. The Data is also “pushed” to a remote graphical interface portal for further long term display and analysis. Please review: www.SmartEnergyMonitor.co.za and login with your units details (see section xxx below). Alternatively, the local onboard graphical software can be used for displaying real-time data when used with an optional HDMI local display (Part# EM-LCD-DIS).

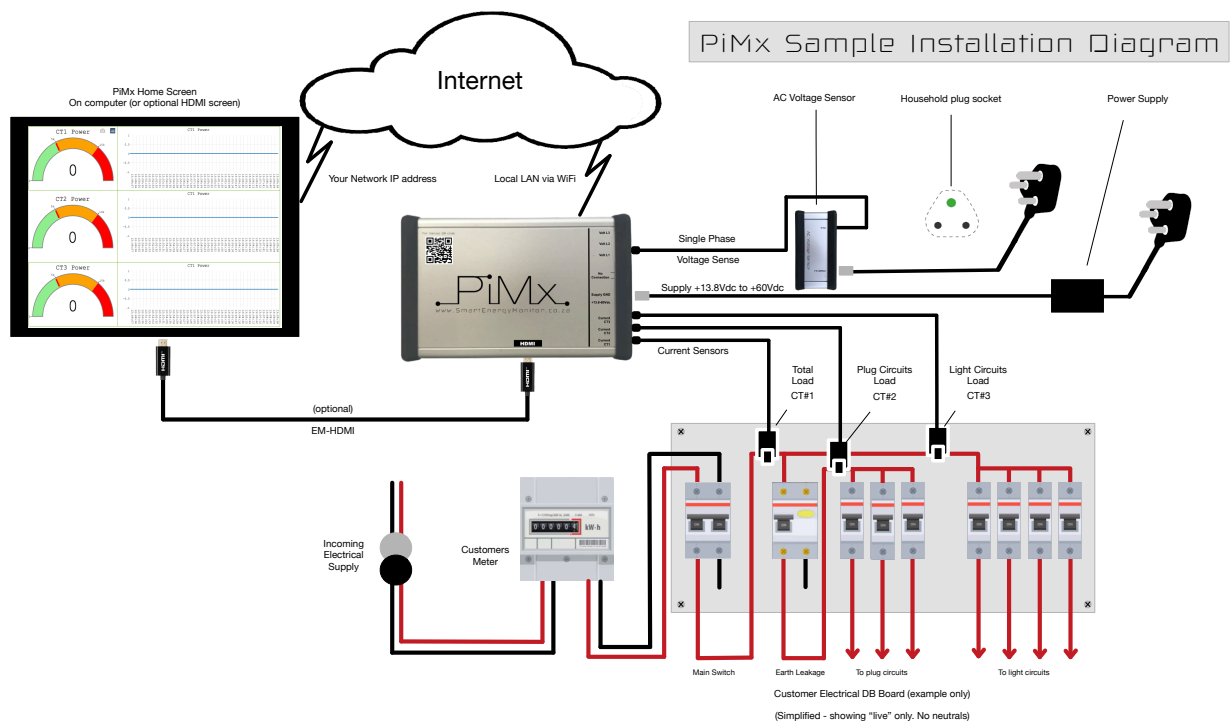
Included in the Smart Energy Monitor Package (Part# EM-PiMx):

(includes WiFi, LAN and access to data processing via the remote graphical interface portal)

- 1 x EM-PiMx Includes uP & I/O Box
- 1 x EM-PSU Power Supply Pack (13.8V/2.5A DC)
- 1 x EM-ACTr AC Voltage Sensor Box (230Vac-9Vac) (one unit, per phase monitored, is required)
- 3 x EM-CT10 10mm Current Transformers (20Amp rating)

Optional Items:

- EM-ACTr AC Voltage Sensor Box (230Vac-9Vac) (requirement is one for each phase monitored)
- EM-CT16 16mm Current transformer (100Amp rating)
- EM-CT25 25mm Current transformer (250Amp rating)
- EM-LCD-DIS (optional) 5” Colour Screen (VGA & HDMI)



2) PiMx TECHNICAL SPECIFICATIONS

2.1)Connectivity:

- 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN.
- Gig Ethernet socket.
- 3 x AC Voltage Sensing Ports (L1, L2 & L3).
- 3 x AC Current Sensing Ports (CT1, CT2 & CT3).
- Single Phase or true three-phase operation modes.

2.2)Display Output (when fitted):

- 1080 HDMI

2.3)Dimensions:

- 127 x 81 x 46 (Main PiMx Housing)
- 127 x 42 x 46 (AC Voltage Sensing unit)

2.4)Power Requirements:

- 13.8V/2.5A DC to 60V DC – Adapter/Power Supply (as supplied).

2.5)System Configurations:

“NOTE: Higher licence level includes all the lower-level licence capabilities”

- PiMx Smart Energy Monitor – 1-phase or 3-phase (No licence required).
- PiGx Smart Energy Monitor – 1-phase or 3-phase with Victron Inverter/Charger & Lithium Battery interface as used in backup installations (Licence level 1 required).
- PiGx+ Grid Tied Limiter – 1-phase or 3-phase (Fronius & Kaco inverters only) as used in solar installations (Licence level 2 required)
- PiRx Smart Load Distribution System - Single phase only (Licence level 3 required) – Infrared Air Conditioner Remote Control, as used in combined solar & load distribution systems.

2.6)Safety Instructions:

To avoid malfunction of, or damage to this product, please observe the following:

- Do not expose to water or moisture.
- Do not place on a conductive surface whilst in operation.
- Do not expose to heat from any source; the PiGx is designed for reliable operation at normal ambient temperatures in a well-ventilated environment.
- Take care whilst handling to avoid mechanical or electrical damage to the connectors.
- Whilst it is powered, avoid handling to minimize the risk of electrostatic discharge damage.
- Remove the supply voltage before making *any* connections to the PiMx.

3) USES AND ADVANTAGES

Non-invasive monitoring of grid Voltage, Current & Power, as well as power consumption of the users household loads.

Integrated, onboard, Web browser/graphical software with optional local display, or remote access via LAN/WiFi for non-local analysis. Either single-phase or three-phase mode of operation.

4) AVAILABLE OPTIONS / COMPONENTS

In its basic form (see system (4.1) below), the PiGx operates as a stand-alone single-phase or three-phase Energy Monitor for either domestic or industrial grid supplies where data is pushed either by WiFi, LAN or GSM to our online graphical portal at www.SmartEnergyMonitor.co.za.

If you then wish to expand the system, additional licences are available, as detailed in (4.2) & (4.3).

4.1) Smart Energy Monitor Basic Configuration (Part# EM-PiMx):

(includes WiFi, LAN and access to data processing via the remote graphical interface portal)

- 1 x EM-PiMx: Includes uP & I/O Board
- 1 x EM-PSU: Power Supply Pack
- 1 x EM-ACTr: AC Voltage Sensor Box 230Vac-9Vac (one unit per phase monitored is required)
- 3 x EM-CT10: 10mm Current Transformers (20Amp)

Optional Items:

- EM-ACTr AC Voltage Sensor Box 230Vac-9Vac (for each phase monitored)
- EM-CT16 16mm Current Transformer (100Amp)
- EM-CT25 25mm Current Transformer (250Amp)
- EM-LCD-DIS (optional) 5" Colour Screen (VGA & HDMI)
- EM-HDMI (optional) HDMI Cable (1.5m)

4.2) Smart Energy Controller (EM-PiGx):

(Requires all items listed above in (4.1) above), and then the following items are also required)

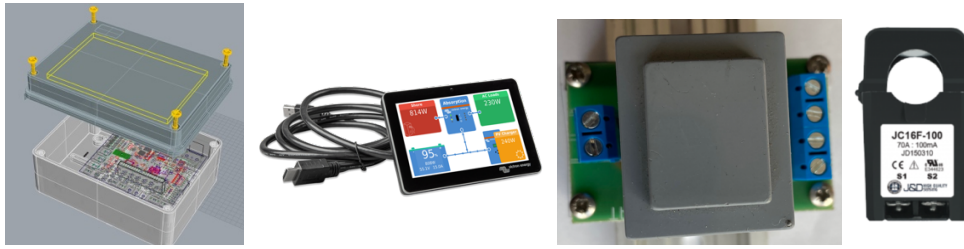
- 1 x EM-SEM-LIC Smart Energy Monitor Licence
- 1 x ASS030140000 Victron Mk3 USB interface (Victron Inverter/Charge to SEM interface)
- 1 x EM-CAB-CAN LAN cable (Freedom Won Battery to PiGx interface)
- 1 x ASS030530010 VE.Direct to USB interface (Victron MPPT to PiGx interface)
- 1 x EM-RS485 RS485 Communications interface for Fronius or Kaco inverters (please specify)

4.3) Smart Load Distributor (EM-PiRx):

(Ability to control Air Conditioning via IR remote control, or other load items via up to 7 Solid State Relays (SSR) either locally or remotely) - available early 2021

Requires all items listed above in (A) & (B), and then the following items are also required:

- 1 x EM-SLD-LIC Smart Load Distribution Licence
- 1 x EM-SSR Solid State Relay board (up to 7 SSR's can be supported)
Note: If the loads are remote from the main EM-SLD unit, then an additional EM-PiGx will allow remote connections via LAN or Bluetooth.
- 1 x EM-PiGx includes a main processor, PSU and I/O board



5) INSTALLATION

The most suitable location for installation of the PiMx Energy Monitor is typically in close proximity to the Main Electrical Distribution Board (DB Board). The PiMx unit can be either hung on the wall using appropriate screws, or it can be magnetically attached to the metal housing of the distribution board (using the Mag-Mount option).

Mount the PiGx such that there is adequate ventilation or at least 100mm around the unit, and with good airflow to assist with cooling. Do not block the vents in the housing as this may then cause overheating.

“NOTE: All electrical connections should be performed by a competent person. There is a risk of electrocution and hence only experienced persons should attempt such installation. It is strongly suggested that the main breaker is turned off during installation to avoid the possibility of electrocution.”

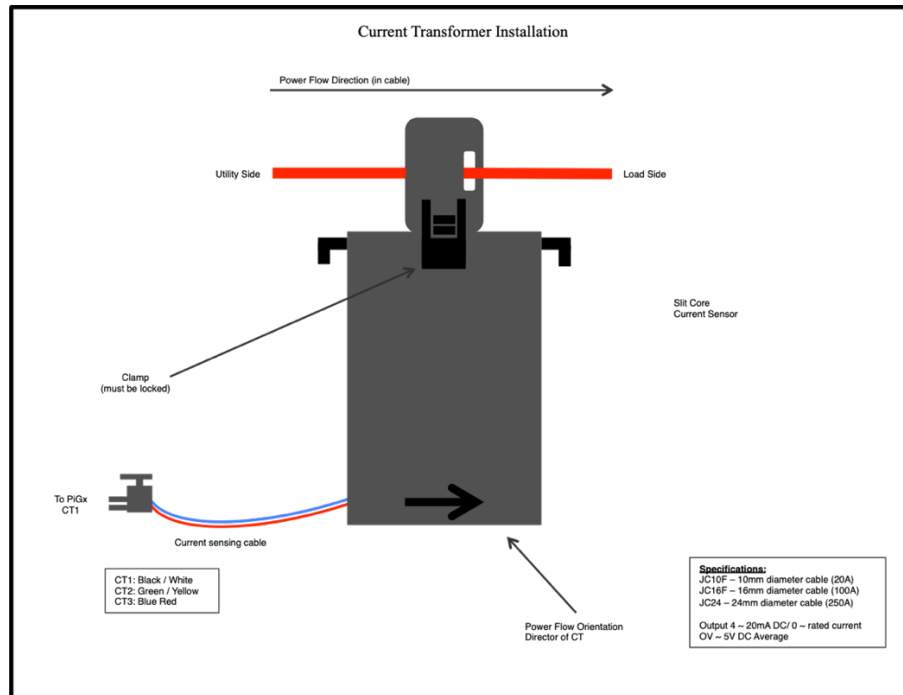
5.1) Current Transformers (CT): *(or current clamps)*

- Are of the split core type, that is, they do not require the cable being monitored to be removed from its existing installation.
- There are up to 3 CT's per PiMx. Connections for these are labelled in the PiGx as CT1, CT2 & CT3.
- The CT's are normally connected around the Live (typically red) cable in the distribution board, but can also be connected around the Neutral (typically black) cable in some cases.
- When clamping the CT's around the cable, a firm “click” noise will indicate that the clamp is secure. (Erroneous readings will occur if the CT's are not securely clamped).
-

“NOTE: The orientation of the CT is important. There is an arrow that depicts the correct orientation of the power flow i.e. the arrow should “point” to the “load” and not the source of the supply. (see example)”

5.2) Single Phase CT Installation:

- CT1 should be clamped around the main incoming utility supply.
- The other clamps, CT2 and CT3, are optional and can be clamped on other cables to monitor general loads (eg. Geyser, plug circuits, light circuits etc).



“NOTE: that CT1 is the primary current sensor and MUST always be connected. It needs to be clamped around the main incoming electrical grid supply to the building. (i.e.: the main grid supply and not the PV generation supply)”

5.3) Three-Phase CT Installation:

- Each of the 3 clamps must be clamped around each of the three incoming cables corresponding to the three phases. Further, each of the voltage sensing Transformers L1, L2 & L3 MUST correspond to the appropriate current sensing cable CT1, CT2 & CT3 (i.e. L1 is the voltage sensing cable that corresponds to the DB board cable that CT1 is clamped to etc).

5.4) Voltage Sensors (VS):

- The voltage & frequency waveform of the mains supply is sensed via a Voltage Sensing Transformer Box (Part# EM-AcTr). These are so designed to only present a low voltage to the PiMx board that is then scaled and calibrated via the software. No high voltage is thus present on the PiMx board.

5.5) Single Phase VS Installation:

- Power to the PiGx is via a standard 230V plug point using the supplied PSU. This PSU supplies both the DC supply to the microprocessor *and* the voltage and frequency waveform sensing capabilities.

5.6) Three-Phase VS Installation:

- Each voltage sensor input (Volt L1, L2 & L3) needs to be routed via an AC Voltage Sensor Transformer (EM-AcTr) such that only low voltage AC is presented to the PiMx board. One sensor transformer is required per phase being monitored. Note that the high voltage side of the transformer is electrically isolated from the low voltage side.

6) STEP 1: POWERING UP YOUR PiMx

“Warning: If you have the HDMI display option, please plug in the HDMI display cable BEFORE powering up the PiMx. Note: It is NOT necessary to have a screen attached: The HDMI screen is optional.”

1.) Connect the PiMx to a DC Supply voltage source of +13.6Vdc to +60Vdc. The PiMx is supplied with a suitable AC adapter/power supply that can be plugged into any wall AC socket.

2.) Wait for approximately 2 minutes for the PiMx to boot up BEFORE moving to the next step.

3.) From your computer WiFi selection, look for an SSID device (WiFi Name) called “pigx_setup_xxxxxxxxxxx” where “xxxxxxxxxxx” is the SEM (Smart Energy Monitor) Identification of the unit.

e.g. Wifi SSID is: pigx_setup_b827ebf22f4x

Hence SEM Identification is as follows: b827ebf22f4x (see section 9, where this SEM reference is used to login to the Smart Energy Monitoring website www.SmartEnergyMonitor.co.za).

4.) Select the “Pigx_setup_xxxxxxxxxxx” wifi, and enter the password **“energy400all”** and wait for the computer to successfully login to the Access Point – this will be indicated on your computer Wifi signal.

5.) In your browser, type <http://172.24.24.1> (this is the default IP address of the PiMx Access Point) and the following PiMx Home Screen should then be visible in your browser:



If you have the HDMI optional attached display, the same screen should also be displayed.

7) STEP 2: WiFi SETUP OF PiGx ON YOUR OWN NETWORK

- 1.) Type (or click on) the command: <http://172.24.24.1:5000/wifi> in your browser
- 2.) You will be presented with a list of available WiFi SSID's in your area - as shown in the following example:

PiMx WiFi Setup

Please select wifi you would like to attach to:

SSID	Signal Quality	Frequency	Bandwidth	Encrypted	Encryption Type	Channel
CookieExpress	-45 65/70	2.412 GHz	1 Mb/s,2 Mb/s,5.5 Mb/s,11 Mb/s,6 Mb/s,9 Mb/s,12 Mb/s,18 Mb/s,24 Mb/s,36 Mb/s,48 Mb/s,54 Mb/s	true	wpa	1
ESP_08A3B6	-78 32/70	2.412 GHz	1 Mb/s,2 Mb/s,5.5 Mb/s,11 Mb/s,6 Mb/s,9 Mb/s,12 Mb/s,18 Mb/s,24 Mb/s,36 Mb/s,48 Mb/s,54 Mb/s	false	null	1
CookieHP	-38 70/70	2.467 GHz	1 Mb/s,2 Mb/s,5.5 Mb/s,11 Mb/s,6 Mb/s,9 Mb/s,12 Mb/s,18 Mb/s,24 Mb/s,36 Mb/s,48 Mb/s,54 Mb/s	true	wpa2	12

SSID:

Password:

Interface	IP address
eth0	
wlan0	

- 3.) From the listed networks, click on the SSID of the WiFi network you wish to connect to, and this will then populate the SSID window below the list.
- 4.) Enter your network Password into the next window that will then be highlighted in red, and click the "Submit" button. Now, wait about 10-20 seconds.
- 5.) Your PiGx should now be logged onto your own network where "yournetworkIPAddress" will be displayed in the "wlan0" window. Record this IP address for the next step below.

PiMx WiFi Setup

Please select wifi you would like to attach to:

SSID	Signal Quality	Frequency	Bandwidth	Encrypted	Encryption Type	Channel
CookieExpress	-46 64/70	2.412 GHz	1 Mb/s,2 Mb/s,5.5 Mb/s,11 Mb/s,6 Mb/s,9 Mb/s,12 Mb/s,18 Mb/s,24 Mb/s,36 Mb/s,48 Mb/s,54 Mb/s	true	wpa	1
ESP_08A3B6	-78 32/70	2.412 GHz	1 Mb/s,2 Mb/s,5.5 Mb/s,11 Mb/s,6 Mb/s,9 Mb/s,12 Mb/s,18 Mb/s,24 Mb/s,36 Mb/s,48 Mb/s,54 Mb/s	false	null	1
CookieHP	-39 70/70	2.467 GHz	1 Mb/s,2 Mb/s,5.5 Mb/s,11 Mb/s,6 Mb/s,9 Mb/s,12 Mb/s,18 Mb/s,24 Mb/s,36 Mb/s,48 Mb/s,54 Mb/s	true	wpa2	12

SSID:

Password:

Interface	IP address
eth0	
wlan0	192.168.50.170



"NOTE: Write down this IP address for ease of future reference. If you click on the IP address shown in the "wlan0", you will be taken back to the PiMx Home Screen."

8) STEP 3: COMMANDS ACCESS

All *commands* that follow (as described in the following sections) will then be accessed using the following browser address protocol in your browser:

[http://\[yournetworkIPAddress\]:5000/\[command\]](http://[yournetworkIPAddress]:5000/[command])

- 1.) Where **[yournetworkIPAddress]** is the IP address of your network (eg: 192.168.50.170 in the above example).
- 2.) Where **[command]** can be one of the following allowable commands:

- **(blank)** = Live Data Display (eg: <http://192.168.5.238:5000/>) – the data shown here is mostly reserved for the PiGx version of the Smart Energy Monitor.
- **calibrate** = Calibration Settings for the AC sensors (eg: <http://192.168.5.238:5000/calibrate/>) – see section 10.
- **guage** = Displays a graphical indication of the power usage in real-time.
- **vrn** = reserved for use for PiGx

“NOTE: The PiGx system date/time is set automatically once the device is connected to the internet.”

9) CALIBRATION OF THE AC SENSORS

[Command: calibrate]

Command: [http://\[yournetworkIPaddress\]:5000/calibrate](http://[yournetworkIPaddress]:5000/calibrate)

Note: The PiMx is setup and accurately calibrated before shipping. The following process is only needed for changing the default calibration – if required. This process should be done by a competent person and with a highly accurate multimeter as a reference.

Calibration

Warning: do not adjust these values without correct reference

ICAL:	<input type="text" value="0.081"/>	<input type="text" value="4.76A"/>
ICAL2:	<input type="text" value="0.081"/>	<input type="text" value="10.92A"/>
ICAL3:	<input type="text" value="0.081"/>	<input type="text" value="0.06A"/>
VCAL:	<input type="text" value="1.95"/>	<input type="text" value="239.7V"/>
VCAL2:	<input type="text" value="1.81"/>	<input type="text" value="239.7V"/>
VCAL3:	<input type="text" value="1.86"/>	<input type="text" value="239.7V"/>
Temp Cal:	<input type="text" value="0.0"/>	<input type="text" value="0.0 °C"/>
<input type="button" value="Submit"/>		

You can increase/decrease the values of each parameter by clicking on the Up/Down arrows in the calibration window for that parameter.

“NOTE: The calibrated relative values are shown in the window. Real Values are shown in the last column. Calibration figures are only saved after the “Submit” button is clicked.

Nomenclature:

Ical	Current CT1 calibration
I2cal	Current CT2 calibration value
I3cal	Current CT3 calibration value
Vcal	Voltage L1 calibration value
Vcal2	Voltage L2 calibration value
Vcal3	Voltage L3 calibration value
TempCal	Temperature calibration value

10) VIEWING DATA ONLINE

Your PiMx will stream data to the online storage and graphical facility.

Please visit the following site: <http://www.smartenergymonitor.co.za>

Your User Login will be the SEM identification as indicated in section (6.3) above.

Your password will initially be defaulted to the following: ENERGY

*** END ***