PiMx

EM-PiMx – Energy Monitor

EM-PiGX – Energy Controller

EM-PiRx – Load Management Controller

TABLE OF CONTENTS PAGE

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 (24V 1.5A)
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)

PiMx Sample Installation Diagram
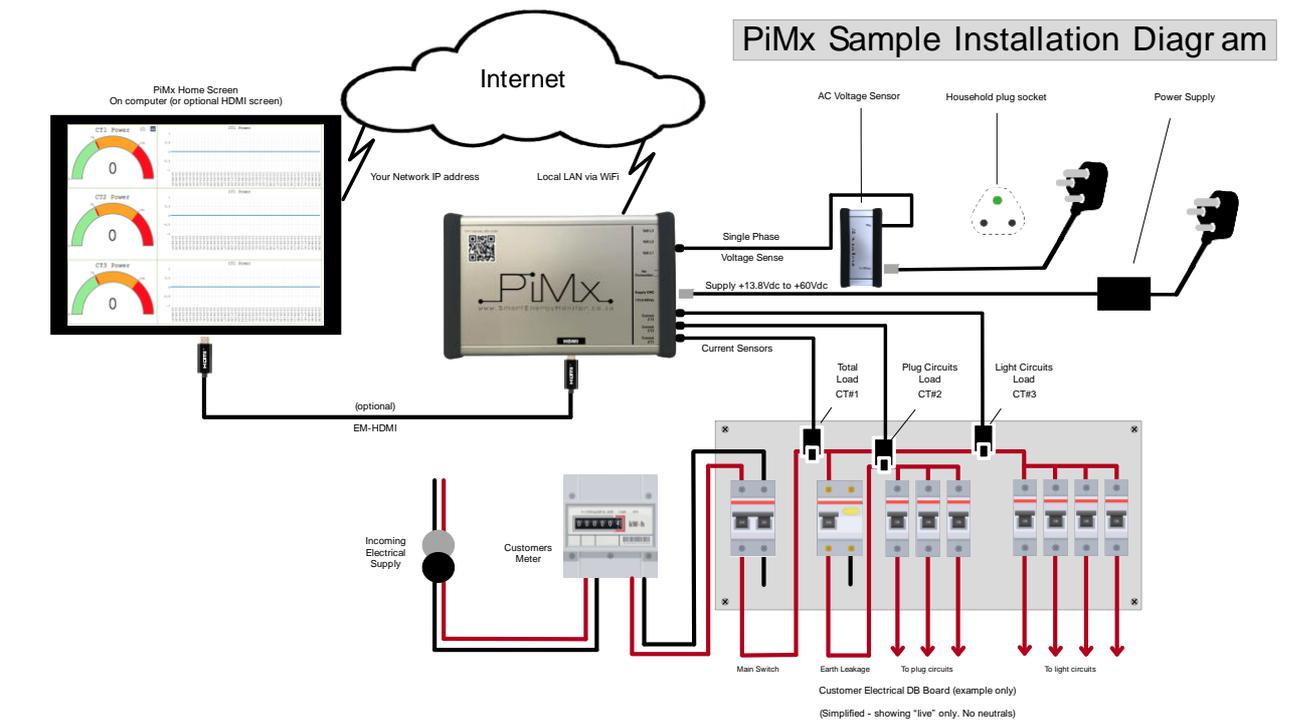
2) PiMx TECHNICAL SPECIFICATIONS

2.1) Connectivity:
- 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN.
- Gig Ethernet socket.
- 3 × 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 – Power Supply is 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
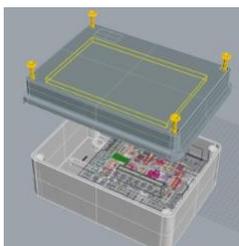
5) INSTALLATION

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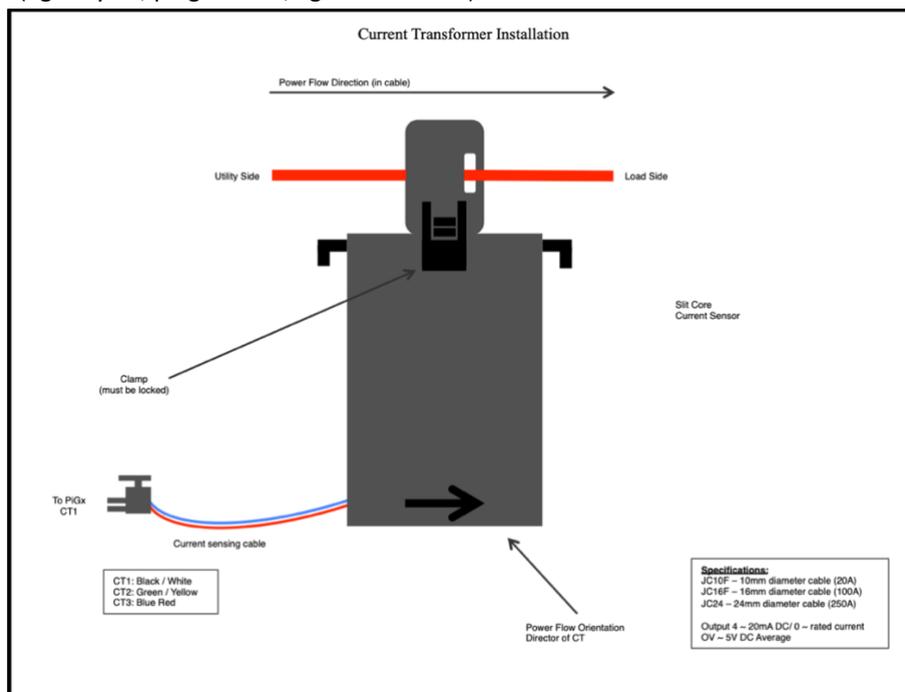
"NOTE: that CT1 is the primary current sensor and MUST always be connected. It needs to be clamped around the main incoming electrical grid supply to the building. (i.e.: the main grid supply and not the PV generation supply)"

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) <u>STEP 1:</u> **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. Power on your PiMx by inserterting the power cable that was supplied
2. Wait for approxamitely 2 minutes before moving onto the next setup
3. Connect your PiMx to a computer by inserting any RJ45 UTP/Ethernet Cable.
4. In your FireFox/Chrome or Safar browser insert "venus.local" into the address bar

You will then see a screen similar to this:
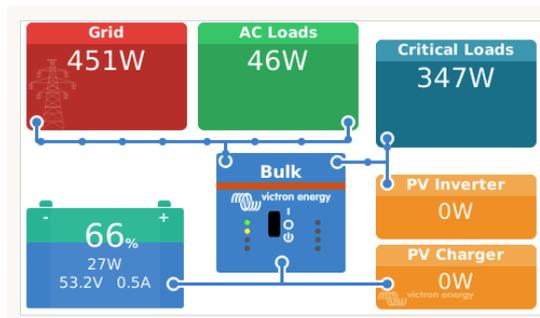
**7)** <u>STEP 2:</u> **WiFi SETUP OF PiGx ON YOUR OWN NETWORK**

1.) Use the arrow keys to navigate into the settings Menu, go down and click on "Settings"
2.) Scroll down to the "WiFi" section, it will look like this:
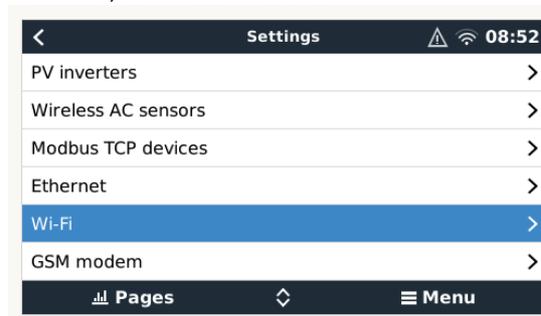
3.) You will then see a list of available WiFi Networks in your area, nagivate to your Netowrk name, there will then be a section called "Password" Insert your password here in order to connect your unit to the wifi

4.) While in the "Wifi" section, scroll down to "IP Address" please save this IP Address for your reference in order to access this menu in the future, without this IP Address, you will not be able to access this menu again.
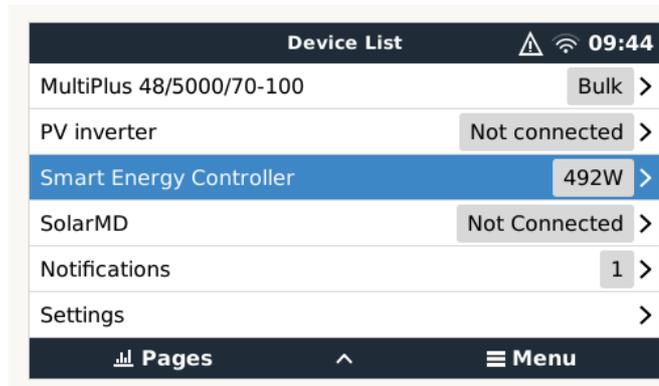
8.) Setting the Date and Time:

8.1) In the same Menu as the "Wifi" there will be an option called "Date and Time" like the picture shown below:
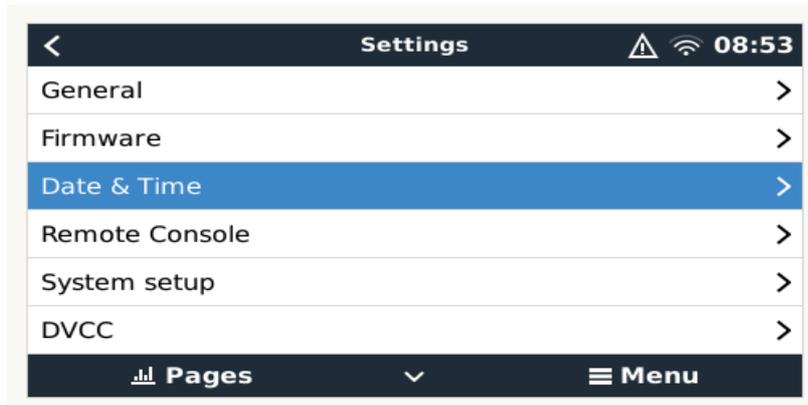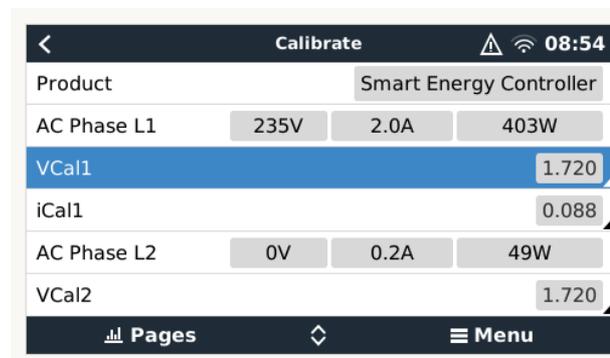

8.2) Once there, you can manually set the time and timezone

9) CALIBRATION OF THE AC SENSORS

9.1) When Calibrating the AC Sensors, navigate to the Main Menu and go to "Smart Energy Montitor" like shown in the picture below:

9.2) Scroll down to "Settings" then choose "Calibrate" then scroll down to the settings called "VCal and Ical" like shown in the picture below:

9.3) VCal   - Increase or decrease this value until your voltage matches.

9.4) Ical   - Increase or decrease this value until your Ampherage matches.

PiMx

10.) Using the Web Portal

To access the web portal, please use the following address:
http://smartenergymonitor.co.za

A login name and password are available from your supplier.
The login name is supplied win the box with the other components.
The password is by default – one4you

Should you not have a login name, you can view the live demo using the following:
User Name: demo
Password: demo4you

The Web Portal gives a graphical representation of your electrical usage habits and includes live and historical views of the data recorded.

NOTE: **Only** Internet Explorer later than 9.3 will support the html5 canvas correctly. Otherwise anything else including ipad, iphone, Firefox, Chrome, safari etc. will work.

10.1) Live Mode
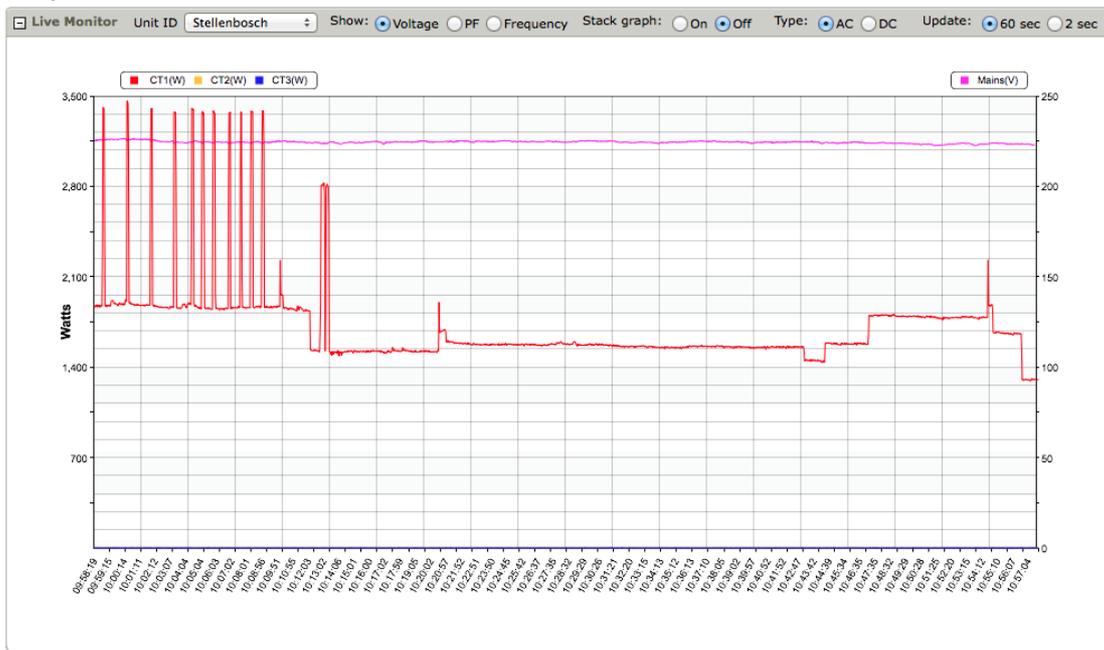
When looking at the data in Live Mode, you can watch new data come in from the energy monitor in 60 second intervals for the last hour, or 2 second intervals for the last 5 minutes. This can be set using the option at the top of the open window. You can also change from AC to DC mode, to see the live DC data. (There will only be DC data if you have the DC kit installed with the energy monitor.
By default, the supply voltage is shown on the graph, along with the readings from the three CT clamps. This can be changed to show the power factor (PF) or frequency of the supply voltage.
Live mode is also where the user can select different units if they have more than one linked to their account. This is done by selecting the drop down menu on the top left of the viewing window and selecting the unit to be viewed. All viewing done will now be for the selected unit. The user can also change to a different unit while viewing in Daily Mode.

**10.1.1) Live mode (version 7 – Grid Tie limiter)**
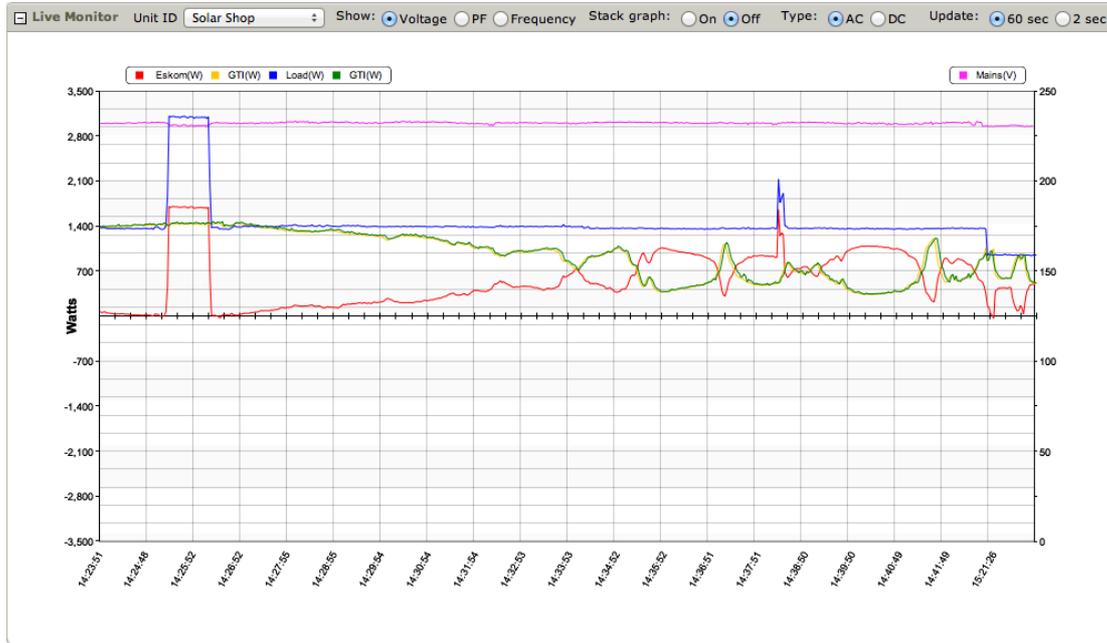
For grid tie limiters, data is read and logged from the grid tie inverter. Therefore a 4th power reading called GTI(W) is shown by default. This is shown for all subsequent reports.
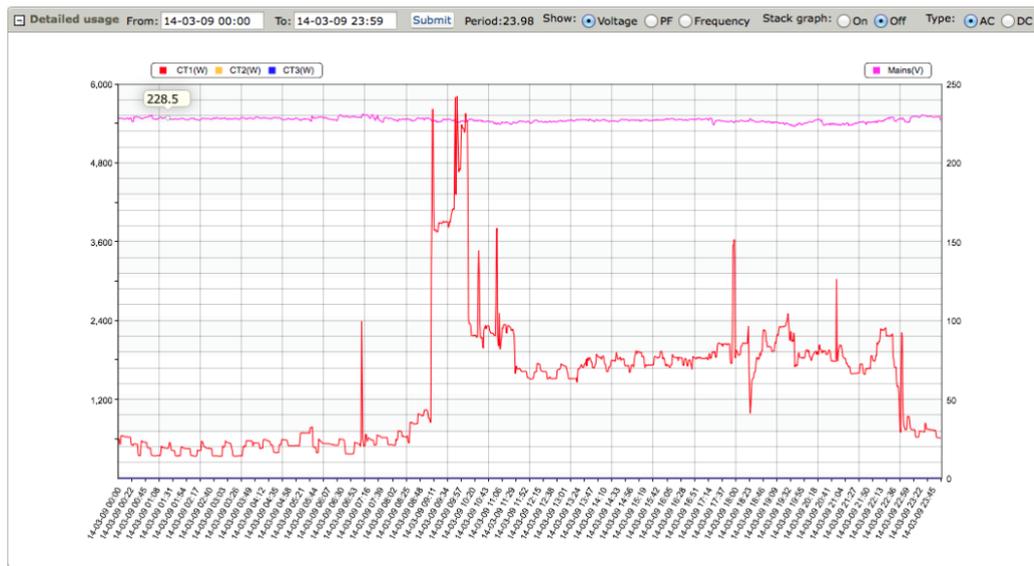
10.2) Daily Mode
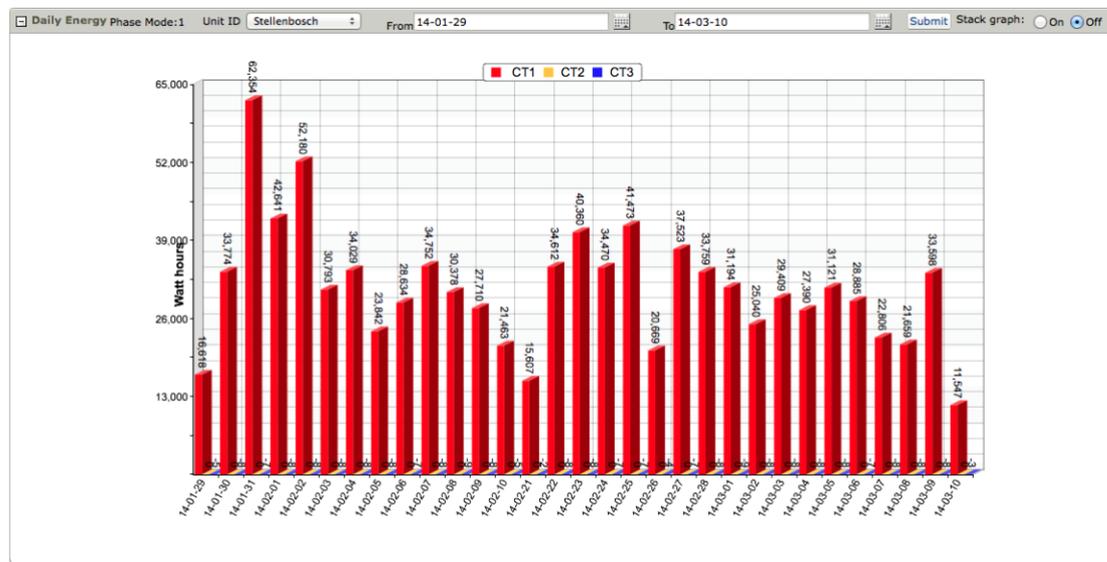
Changing to daily mode viewing can be done by clicking on the "Daily" tab on the top of the viewing window. In Daily Mode, the viewing area shows your daily usage over the past month, for each current transformer. You can view a single day's usage by clicking on the data for a particular day. When clicking on a particular day, a small window will appear to show an overview of the day's usage, with the date on top of the small window. Clicking on the date in the small window will open a view with an expanded vie for the day selected, with accurate readings for each transformer.
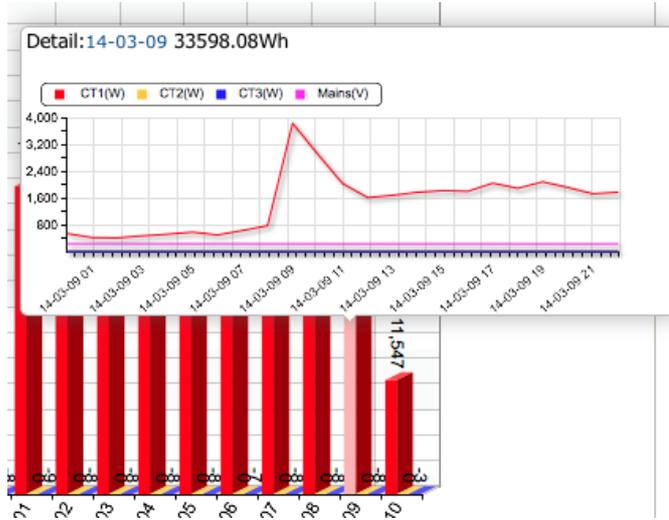
Clicking on the link next to "detail" you will enter the daily detailed view:

When in daily mode, you can zoom in to a selection of data by clicking at one point of the data you wish to zoom in to, and then clicking on another point to select the area for zooming.
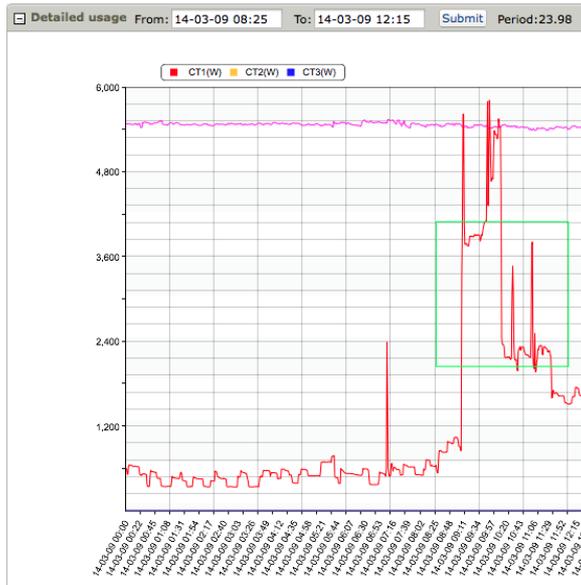
Clicking Submit on top of the viewing window will then update the daily graph with just the region of the data you selected. This can also be done by manually inputting the dates and times on top of the viewing window and clicking submit.

The same options apply for daily mode as in live mode, whereby you can choose to show the frequency of the voltage supply, or the power factor, or see the DC data for that particular selected period of time.

10.3) Settings Menu

In the Settings Menu, the different CTs used can be given names. This is useful when you are monitoring different loads, and you want to have the name of that load appear on the usage graphs. Each customer is given their own unique Vendor ID, or VID. Each energy monitor unit that the customer has is given a Unit ID, or UID, This allows customers with multiple energy monitors to keep track of all their data.

Each energy monitor can be given a name, such as the name of the customer using the energy monitor. To change a name of a unit, CT and the like, click on the small pencil next to the items current name. You can now give the item a new name, and confirm this by clicking the green check mark.

You can also change the colours of the graphs, on the bottom of the settings window there is an option to select a colour for each CT.

10.4) Uploading Data

Should there ever be an interruption of data transmission between the communication modules (WiFi, Ethernet or GSM) and our server, it is possbile to manually upload the data to our server. This can be done by removing the SD card from the energy monitor (the unit will continue to operate and transmit data to the server) and inserting it into a computer with internet access. Logon to our server at www.SmartEnergyMonitor.co.za with your assigned login details and then select the "Upload Data" tab on top of the viewing window. You can now select the appropriate data file on the SD card by clicking "choose file" and navigating to the data file on the SD card. The files are stored according to the date and time they were created. A new file is created every time the unit is turned on. With the correct file identified and selected, select "Upload File". Depending on the speed of your internet connection, the upload could take some time. Should you upload duplicate data, our server will only display a single record for any particular date stamped record.