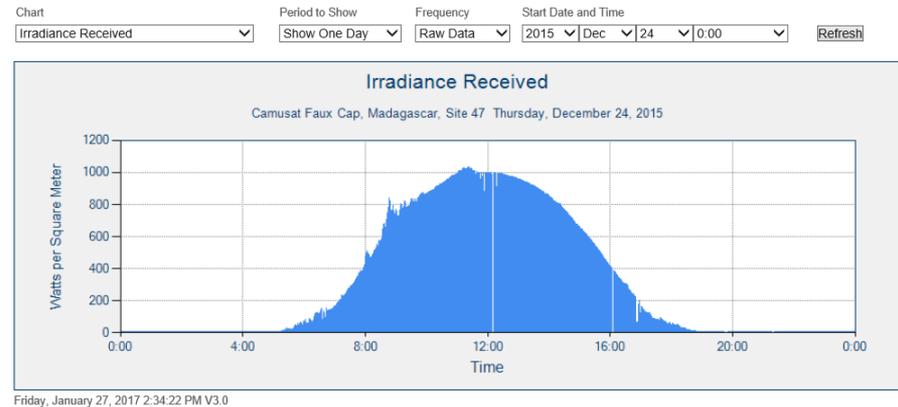
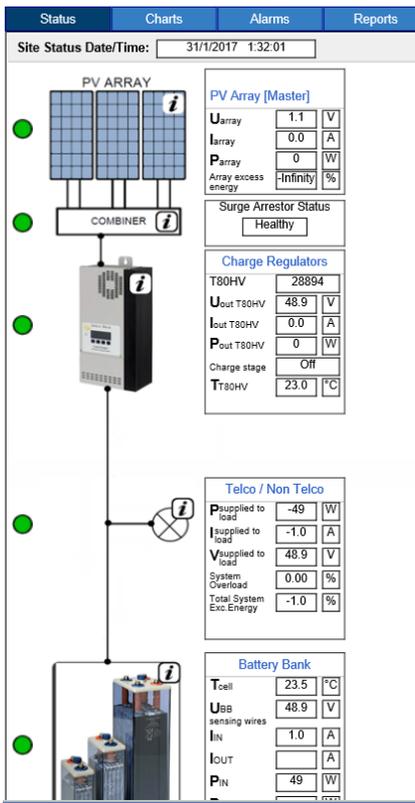




APOLLO SOLAR

Using Apollo Solar Remote Monitoring Software



Apollo Solar, Inc.
23 F. J. Clarke Circle
Bethel, Connecticut 06801
USA
+1 (203) 790-6400
www.ApolloSolar.com

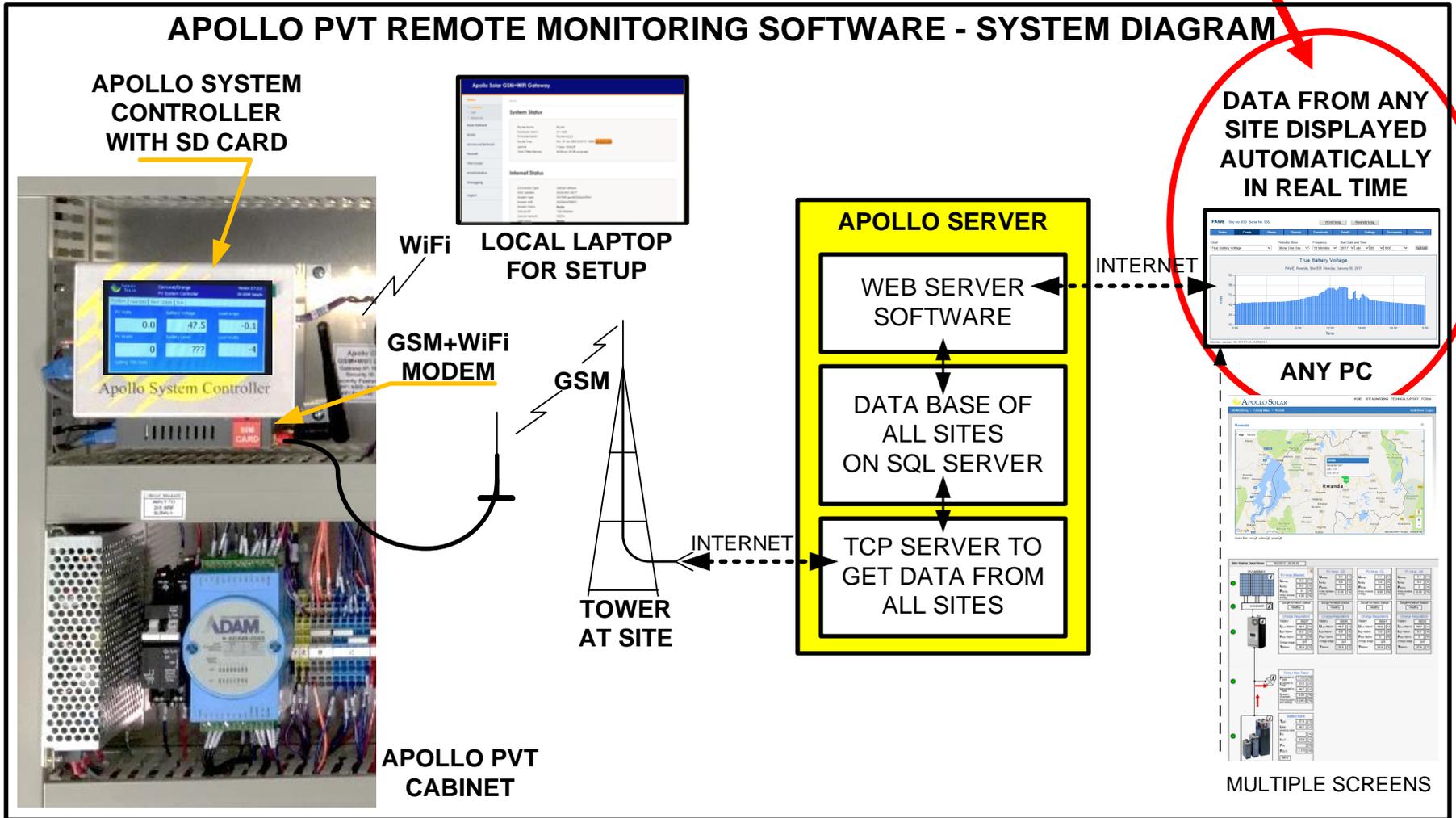
Using Apollo Remote Monitoring

Overview – We will see how all the components work for your benefit:

1. The System Block Diagram
2. Logging In
3. Selecting the Country
4. Selecting the Site from the Map – Warnings and Alarms are displayed
5. The Site Status Screen – All Values from the PV to the Load are displayed
6. Charts – The types are listed and several helpful graphs are described
7. The Data Base – Critical Site Data is stored for access by maintenance crews
8. Alarms – A log of all Alarms with time stamps
9. Drawings – The documentation can be available on line

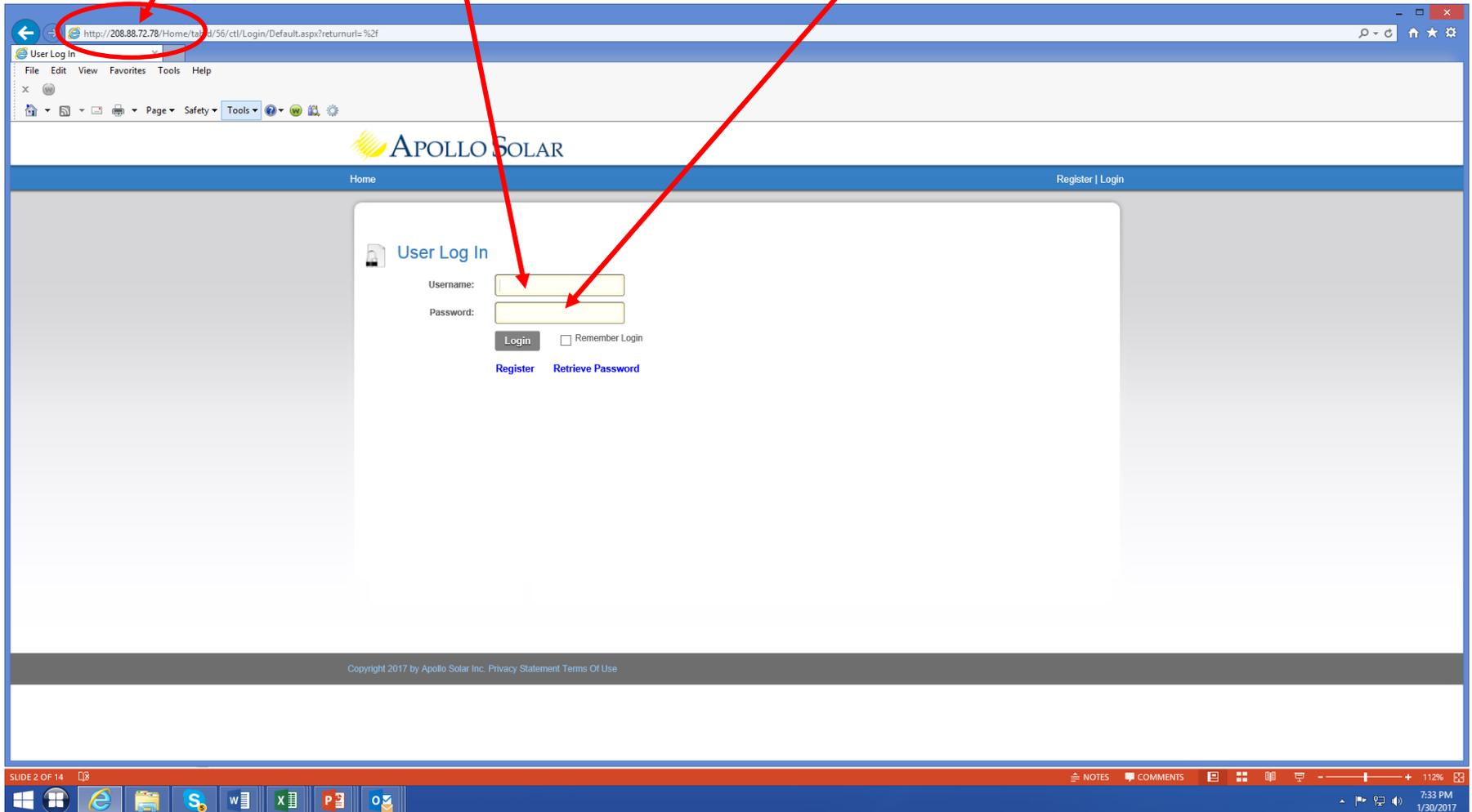
Apollo Remote Monitoring

We shall focus on USING the Remote Monitoring software on a PC.



Using Apollo Remote Monitoring

1. Using the bar at the top of the search engine screen, enter the MAC address:
208.88.72.78
2. Enter Username: **ApolloDemo**, Password: **ApolloDemo** (note the caps) and hit Login.



The screenshot shows a web browser window displaying the Apollo Solar User Log In page. The browser's address bar contains the URL <http://208.88.72.78/Home/1a3/3/56/ctl/Login/Default.aspx?returnurl=%2f>, which is circled in red. The page header features the Apollo Solar logo and navigation links for Home, Register, and Login. The main content area is titled "User Log In" and contains a login form with fields for Username and Password, a Login button, a Remember Login checkbox, and links for Register and Retrieve Password. Red arrows point from the instructions above to the URL bar and the Username and Password input fields.

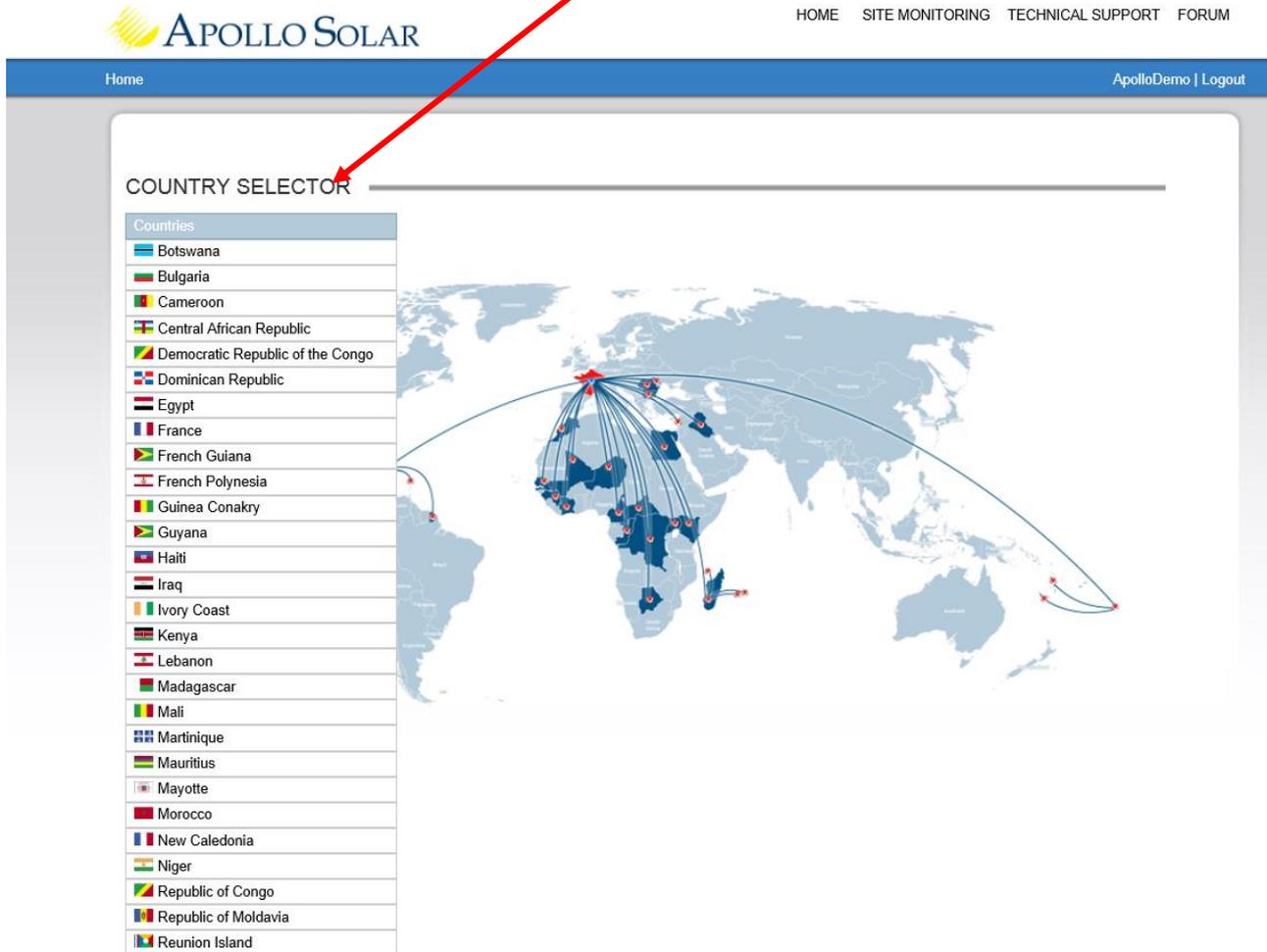
Using Apollo Remote Monitoring

3. You will see the screen shown below.

The screenshot shows a web browser window displaying the Apollo Solar remote monitoring interface. The browser's address bar shows the URL `http://208.88.72.78/`. The page features the Apollo Solar logo at the top left and navigation links for HOME, SITE MONITORING, TECHNICAL SUPPORT, and FORUM at the top right. Below the navigation bar, there is a "Home" link and a "ApolloDemo | Logout" link. The main content area is titled "COUNTRY SELECTOR" and contains a "Countries" button. Below the button is a world map with several red location markers and blue curved lines connecting them, representing remote monitoring sites. The Windows taskbar at the bottom shows the system tray with the time 6:26 PM and date 1/30/2017.

Using Apollo Remote Monitoring

4. Hover the cursor over the **COUNTRY SELECTOR**.
5. The drop down bar will show a list of countries.



The screenshot displays the Apollo Solar website interface. At the top, the logo "APOLLO SOLAR" is on the left, and navigation links "HOME", "SITE MONITORING", "TECHNICAL SUPPORT", and "FORUM" are on the right. Below the navigation bar, there are links for "Home" and "ApolloDemo | Logout". The main content area features a "COUNTRY SELECTOR" dropdown menu on the left, which is open to show a list of countries. A red arrow points from the text in the instructions to the "COUNTRY SELECTOR" label. To the right of the dropdown is a world map with several red satellite icons and blue lines representing signal paths connecting to various locations across Africa, Europe, and Asia.

APOLLO SOLAR

HOME SITE MONITORING TECHNICAL SUPPORT FORUM

Home ApolloDemo | Logout

COUNTRY SELECTOR

Countries

- Botswana
- Bulgaria
- Cameroon
- Central African Republic
- Democratic Republic of the Congo
- Dominican Republic
- Egypt
- France
- French Guiana
- French Polynesia
- Guinea Conakry
- Guyana
- Haiti
- Iraq
- Ivory Coast
- Kenya
- Lebanon
- Madagascar
- Mali
- Martinique
- Mauritius
- Mayotte
- Morocco
- New Caledonia
- Niger
- Republic of Congo
- Republic of Moldova
- Reunion Island

Using Apollo Remote Monitoring

6. Scroll down to select **Rwanda**.

COUNTRY SELECTOR

Countries
Botswana
Bulgaria
Cameroon
Central African Republic
Democratic Republic of the Congo
Dominican Republic
Egypt
France
French Guiana
French Polynesia
Guinea Conakry
Guyana
Haiti
Iraq
Ivory Coast
Kenya
Lebanon
Madagascar
Mali
Martinique
Mauritius
Mayotte
Morocco
New Caledonia
Niger
Republic of Congo
Republic of Moldova
Reunion Island
Romania
Rwanda
Senegal
Uganda
United States
Vanuatu

Using Apollo Remote Monitoring

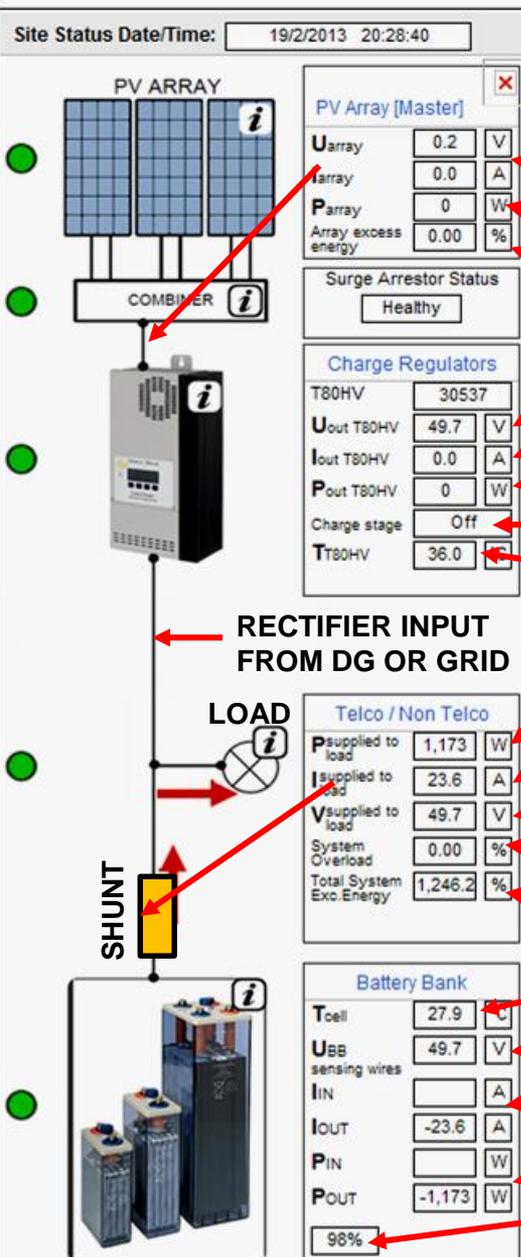
7. The Map of Rwanda will open showing a PIN at the location of every site.
8. Use the cursor to click on the PIN for the site of interest.

The screenshot displays the Apollo Solar web application interface. At the top, the Apollo Solar logo is on the left, and navigation links for HOME, SITE MONITORING, TECHNICAL SUPPORT, and FORUM are on the right. Below the navigation bar, a breadcrumb trail reads "Site Monitoring > Country Maps > Rwanda". The main content area features a map of Rwanda with various geographical features and site markers. A red arrow points from the instruction text to a green site marker labeled "B38" near the city of Goma. A popup window is open over this marker, displaying the following information:

Coviba	
Serial No:	957
Lat:	-1.97
Lon:	30.10

At the bottom of the map, there is a status filter section with three checked options: red, yellow, and green. The map data is attributed to ©2017 Google.

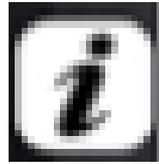
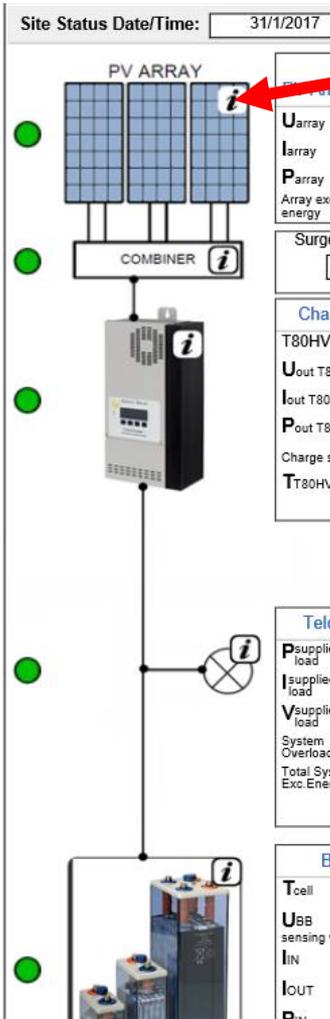
Using Apollo Remote Monitoring Energy Flow Diagram on the Status Screen



1. PV Voltage and Current from PV to T80 measured at the T80 input.
2. Power from PV Array to T80 is calculated (V x I).
3. Array excess energy is not implemented.
4. T80 Output (Battery Voltage on chart) is measured inside the T80.
5. Output Current measured inside the T80.
6. The Power is calculated.
7. Charge State is either Bulk, Absorb, Float or Off.
8. Heat Sink Temperature inside this T80.
9. The Load Power is calculated.
10. The Load Current is calculated as the difference between the T80 Output Current and the Battery Current measured at the Shunt.
11. The True Battery Voltage is measured at the Battery Terminals.
12. System Overload is displayed if the load is increased by surprise.
13. Total System Excess Energy is not fully implemented.
14. The Battery Temperature is measured using a sensor on the battery.
15. The True Battery Voltage is measured at the Battery Terminals.
16. The Amps In and Out of the Battery Current measured at the shunt.
17. The Watts either In or Out is calculated using battery current above.
18. The State of Charge % (SOC) is calculated using the coulomb counter inside the T80. It is also used on the SOC Bar Graph.

Using Apollo Remote Monitoring

THE DATA BASE ALLOWS ACCESS TO ALL INFORMATION ABOUT EVERY SITE



This “i” button is for information. Hitting the “i” button on the Site Status screen will bring up a dialog box of details about each item such as manufacture, part number, serial number and major specifications.

A general format for each item is provided. The data is entered by the installation company or Network Operator.

Typical displays for the PV Array and Battery Bank are shown below.

Guy058 PV Array Configuration	
PV panels nominal power (STC):	300 W
Brand:	
ModelNo:	
Number of PV panels:	9
Configuration of PV panels:	
In series (String)	3
In parallel (Strings)	3
Active Area	m ²
PV Array STC COND total Power:	2700 W

Guy058 Battery Bank Configuration	
Type / Brand:	
Capacity of battery cell C120:	1000 AHr
Number of battery cells:	144
Configuration of battery bank	String - 24 Branches - 6
Total capacity of battery bank C120:	6000 AHr
Nominal battery bank voltage:	48 V

Using Apollo Remote Monitoring

9. The **STATUS** page will load showing the useful current parameters at the site selected.
10. You can also select **CHARTS** from the bar near the top of the STATUS screen.

FAWE Site No. 839 Serial No. 956

World Map Rwanda Map

Status Charts Alarms Reports Downloads Details Settings Documents History

Site Status Date/Time: 31/1/2017 1:32:01

PV ARRAY

PV Array [Master]

U _{array}	1.1	V
I _{array}	0.0	A
P _{array}	0	W
Array excess energy	-Infinity	%

Surge Arrestor Status

Healthy

Charge Regulators

T80HV	28894	
U _{out T80HV}	48.9	V
I _{out T80HV}	0.0	A
P _{out T80HV}	0	W
Charge stage	Off	
T _{T80HV}	23.0	°C

Telco / Non Telco

P _{supplied to load}	-49	W
I _{supplied to load}	-1.0	A
V _{supplied to load}	48.9	V
System Overload	0.00	%
Total System Exc. Energy	-1.0	%

Battery Bank

T _{cell}	23.5	°C
U _{BB sensing wires}	48.9	V
I _{IN}	1.0	A
I _{OUT}		A
P _{IN}	49	W

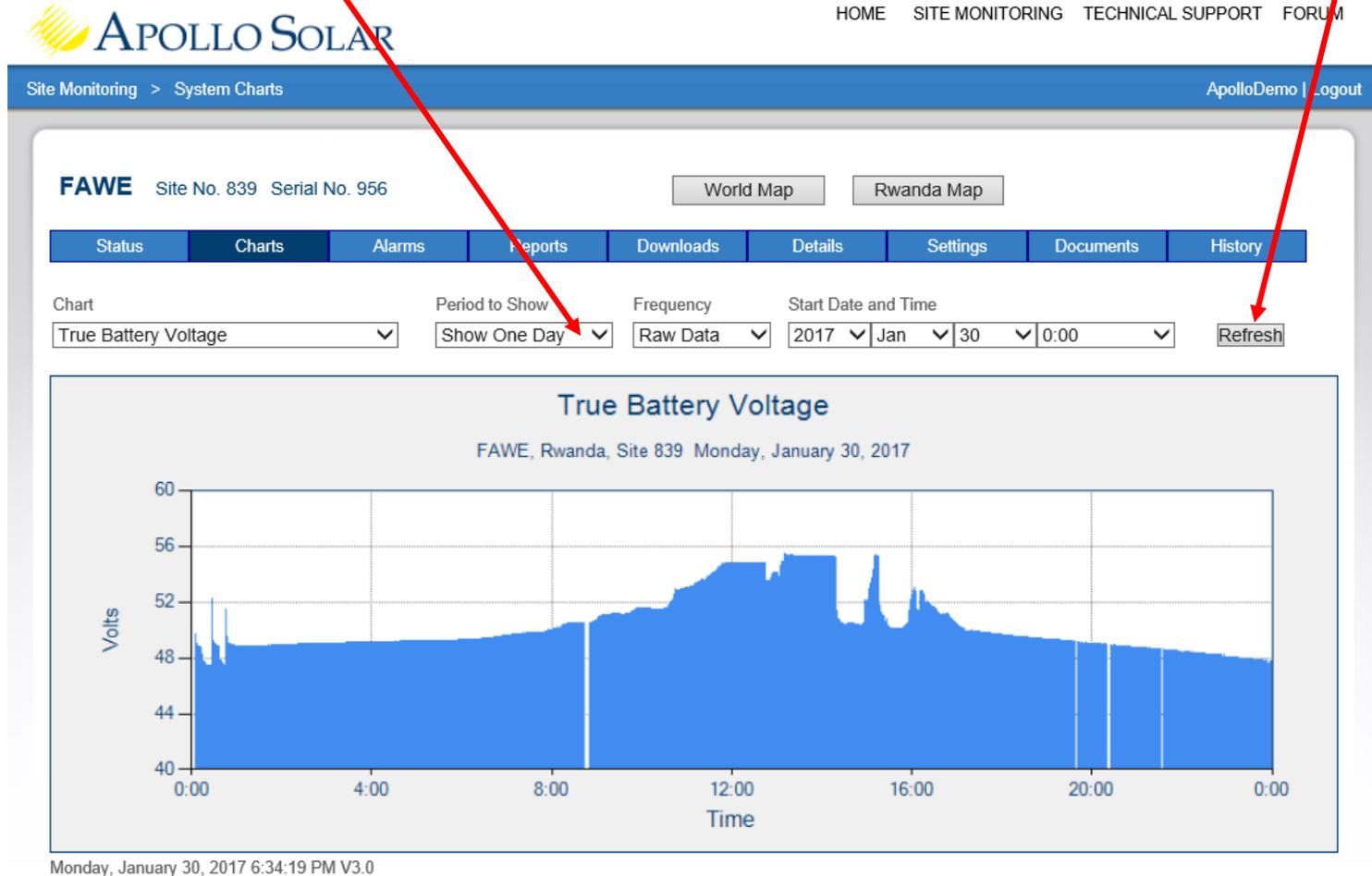
Using Apollo Remote Monitoring

- 11. The chart below is TRUE BATTERY VOLTAGE. Use the CHART menu to see others.
- 12. Select the Start Date and Time to see the day you want. Hit **REFRESH** to update.

The screenshot displays the Apollo Solar remote monitoring interface. At the top left is the Apollo Solar logo. The navigation menu includes 'HOME', 'SITE MONITORING', 'TECHNICAL SUPPORT', and 'FORUM'. The current page is 'Site Monitoring > System Charts'. The site information is 'FAWE Site No. 839 Serial No. 956'. A navigation bar contains 'Status', 'Charts', 'Alarms', 'Reports', 'Downloads', 'Details', 'Settings', 'Documents', and 'History'. The 'Charts' tab is highlighted with a red circle. Below the navigation bar, there are controls for the chart: 'Chart' (set to 'True Battery Voltage'), 'Period to Show' (set to 'Show One Day'), 'Frequency' (set to 'Raw Data'), and 'Start Date and Time' (set to '2017 Jan 30 0:00'). A 'Refresh' button is located to the right of these controls. The chart itself is titled 'True Battery Voltage' and shows the voltage in Volts over a 24-hour period. The y-axis ranges from 40 to 60 Volts, and the x-axis shows time from 0:00 to 0:00. The voltage starts at approximately 48V, rises to a peak of about 56V around 12:00, and then gradually declines back to 48V by 20:00. A red arrow points from the 'Charts' menu to the 'True Battery Voltage' dropdown, and another red arrow points from the 'Refresh' button to the 'True Battery Voltage' dropdown.

Using Apollo Remote Monitoring

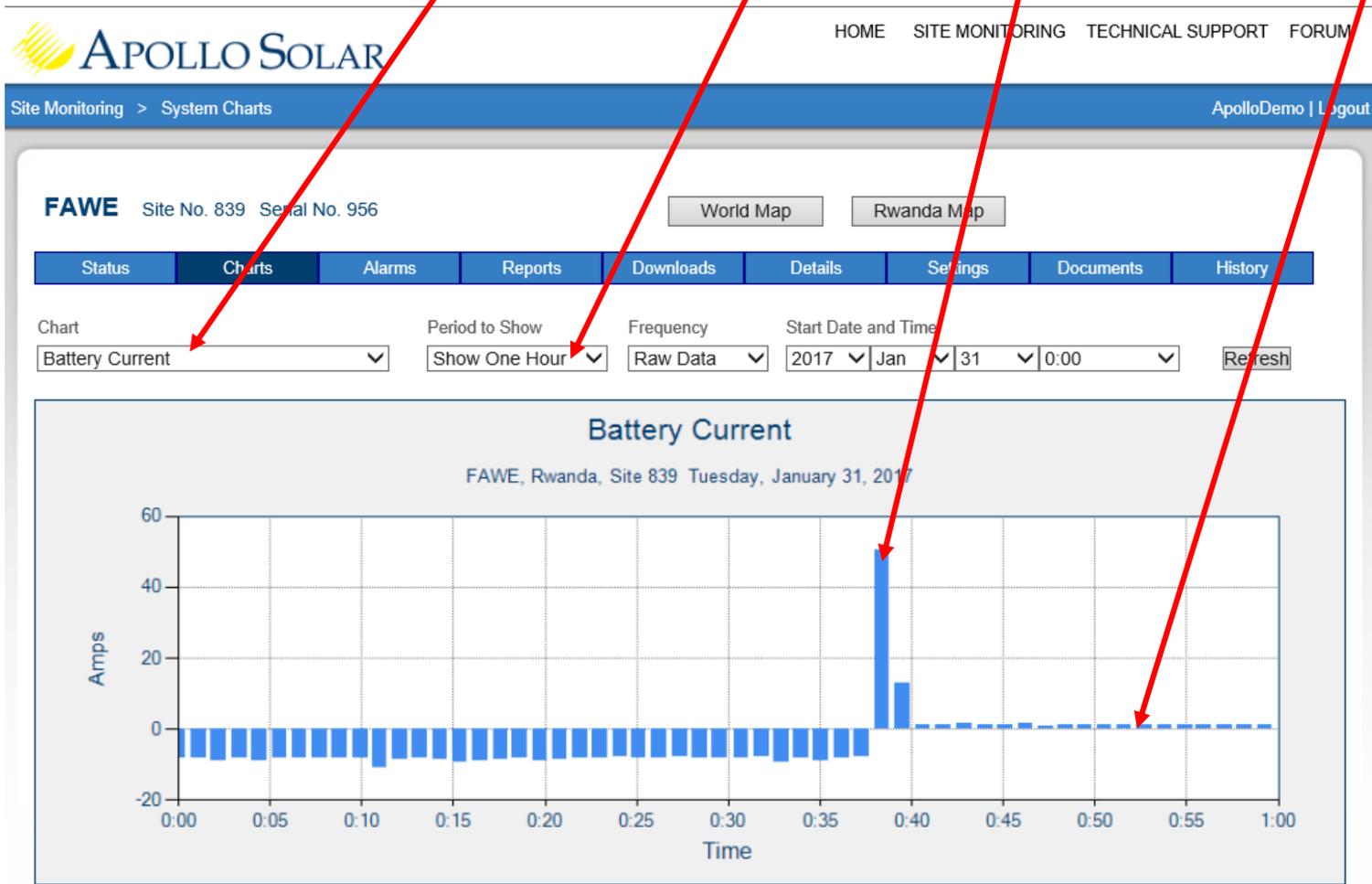
13. The **PERIOD of One Day** very useful, but you can also view 1 hour, 1 month, or 1 year.
14. Whenever a change is made, to update the data being viewed, use the **REFRESH** button.



Monday, January 30, 2017 6:34:19 PM V3.0

Using Apollo Remote Monitoring

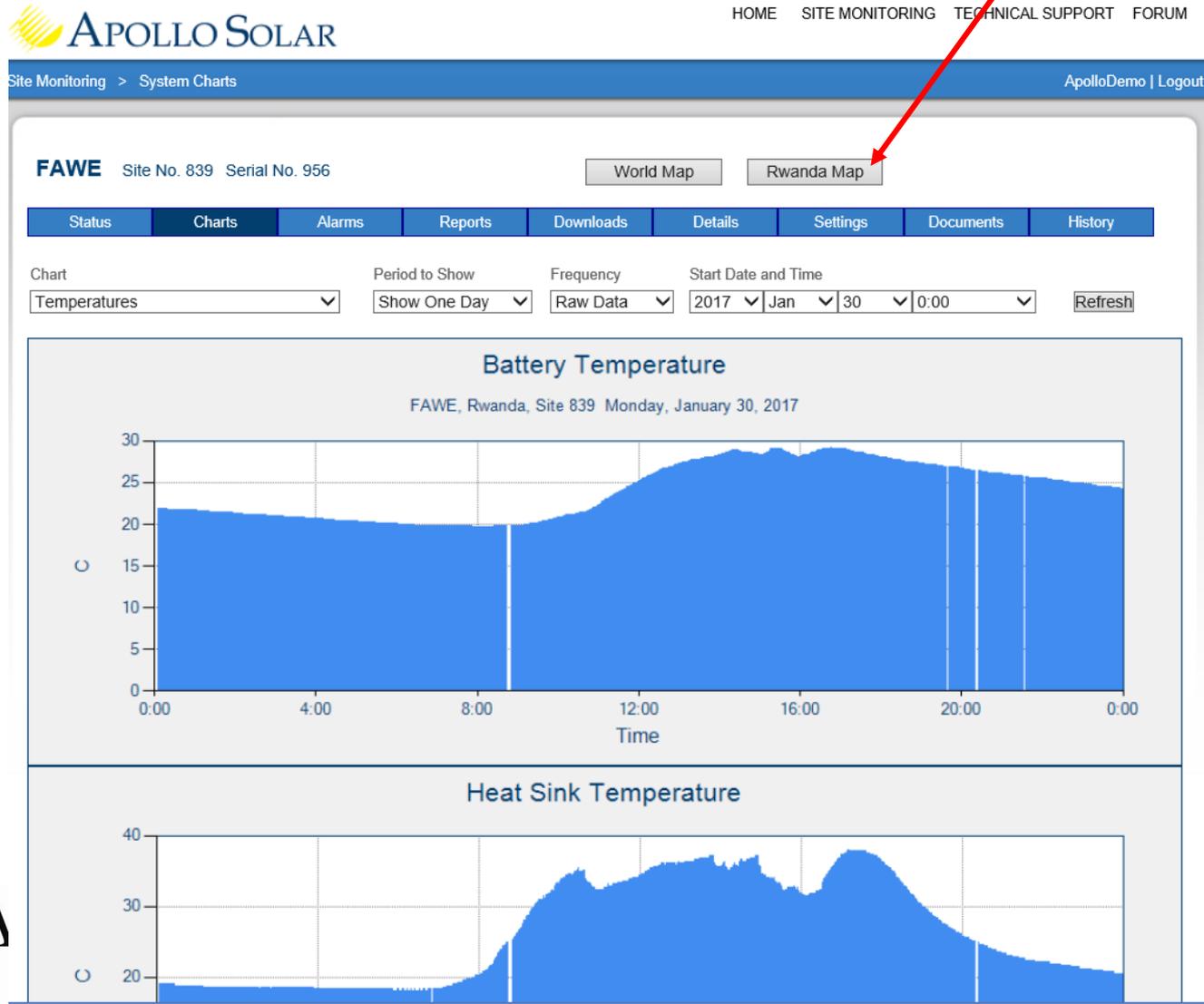
15. This chart shows the **Battery Current** for **One Hour**. The battery current is negative 8 Amps during discharge. During charging, the current is +50 Amps and then +1 Amp.



Monday, January 30, 2017 7:09:26 PM V3.0

Using Apollo Remote Monitoring

16. The **Temperatures** charts show 3 items. The Battery, the T80HV Heat Sink. Scroll down to view the T80HV internal PC Board temperature history.
17. You can return to the STATUS page, or go back to the Rwanda Map to change sites.



Using Apollo Remote Monitoring

18. The FREQUENCY selector provides averaging of data over 10 minutes, 1 hour, or 1 day or 1 month. The cursor will read out the average data over each bar.

FAWE Site No. 839 Serial No. 956

World Map

Rwanda Map

Status Charts Alarms Reports Downloads Details Settings Documents History

Chart

Period to Show

Frequency

Start Date and Time

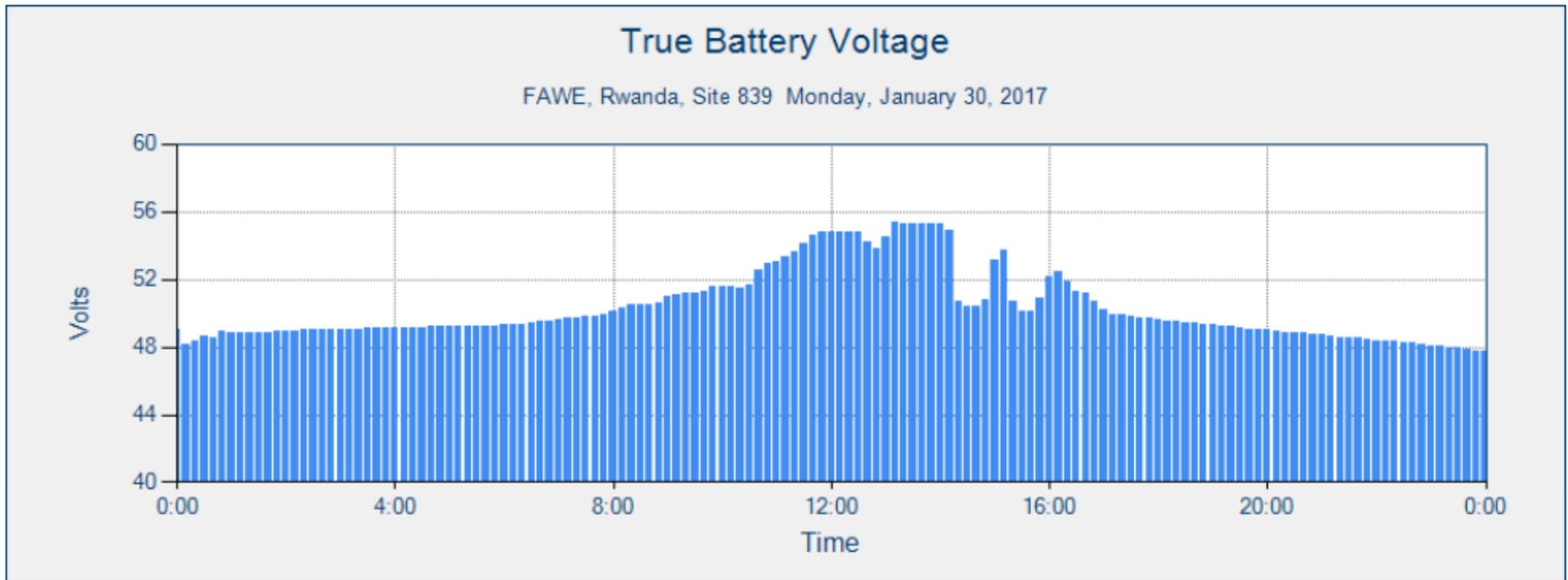
True Battery Voltage

Show One Day

10 Minutes

2017 Jan 30 0:00

Refresh



Monday, January 30, 2017 7:45:49 PM V3.0

Using Apollo Remote Monitoring

Choices of Charts

DC Energy Record
Irradiance Received
Battery Energy Flows
Battery Voltage
Maximum Power Received by Battery
Maximum Power Received From the Battery
Estimated Solar Power Potential
Power From PV Array to T80
Current from PV to T80
True Battery Voltage
Battery Current
PV Voltage
Battery Voltage Max,Avg,Min
Temperatures

- The Pull Down Menu shows the choices of charts.
- The active and most useful charts are described below.
- Not all the charts are implemented in the current version.

1. **DC Energy Record** – The Energy Harvested by the T80s and the Energy used by the Load
2. **Irradiance Received** – Reads the Apollo Irradiance Sensor which is mounted to the top of the PV array. Shows the irradiance in Watts per square meter.
3. **Battery Energy Flows** – Not implemented
4. **Battery Voltage** – Measured at the terminals in the T80HV. Min, Avg and Max displayed over each other. Useful if the more accurate the True Battery Voltage is not available.
5. **Maximum Power Received by Battery** – The instantaneous current multiplied by the battery voltage at that instant.

Using Apollo Remote Monitoring

Choices of Charts - continued

6. **Maximum Power Received from Battery** – The Power flowing out of the Battery.
7. **Estimated Solar Power Potential** – The Irradiance multiplied by the size of the PV Array
8. **Power from PV Array to T80** – The Power harvested by the T80HVs and used by the Battery and the Load. Note that after the Battery is fully charged, it will stop using Power.
9. **Current from PV to T80** – The Current into the T80HV which is needed by the Battery and the Load.
10. **True Battery Voltage** – Accurate Voltage measured at the Battery terminals
11. **Battery Current** – Measured at the Shunt. Current into the battery is shown as positive. Current out of the battery and therefore into the Load is displayed as negative.
12. **PV Voltage** – Measurement at the input of the Master T80HV.
13. **Battery Voltage, Max, Avg, Min** – The Max, Avg and Min Battery voltage are all shown.
14. **Temperatures** – The Battery Temperature Sensor, the Heat Sink Temp Sensor and the Internal Temp Sensor in the Master T80HV are displayed in 3 separate graphs.

Using Apollo Remote Monitoring

The Charts provide an easy method for checking the performance of sites.

For Example: We can check the sizing of the PV Array and the Battery relative to the Load. These charts are all 1 day.

The Irradiance shows that the sun was strong all day giving us a solid baseline.

The Battery Current shows the correct increase as the sun gets stronger and the battery charges, but then peaks at begins to fall of at 9:00AM.

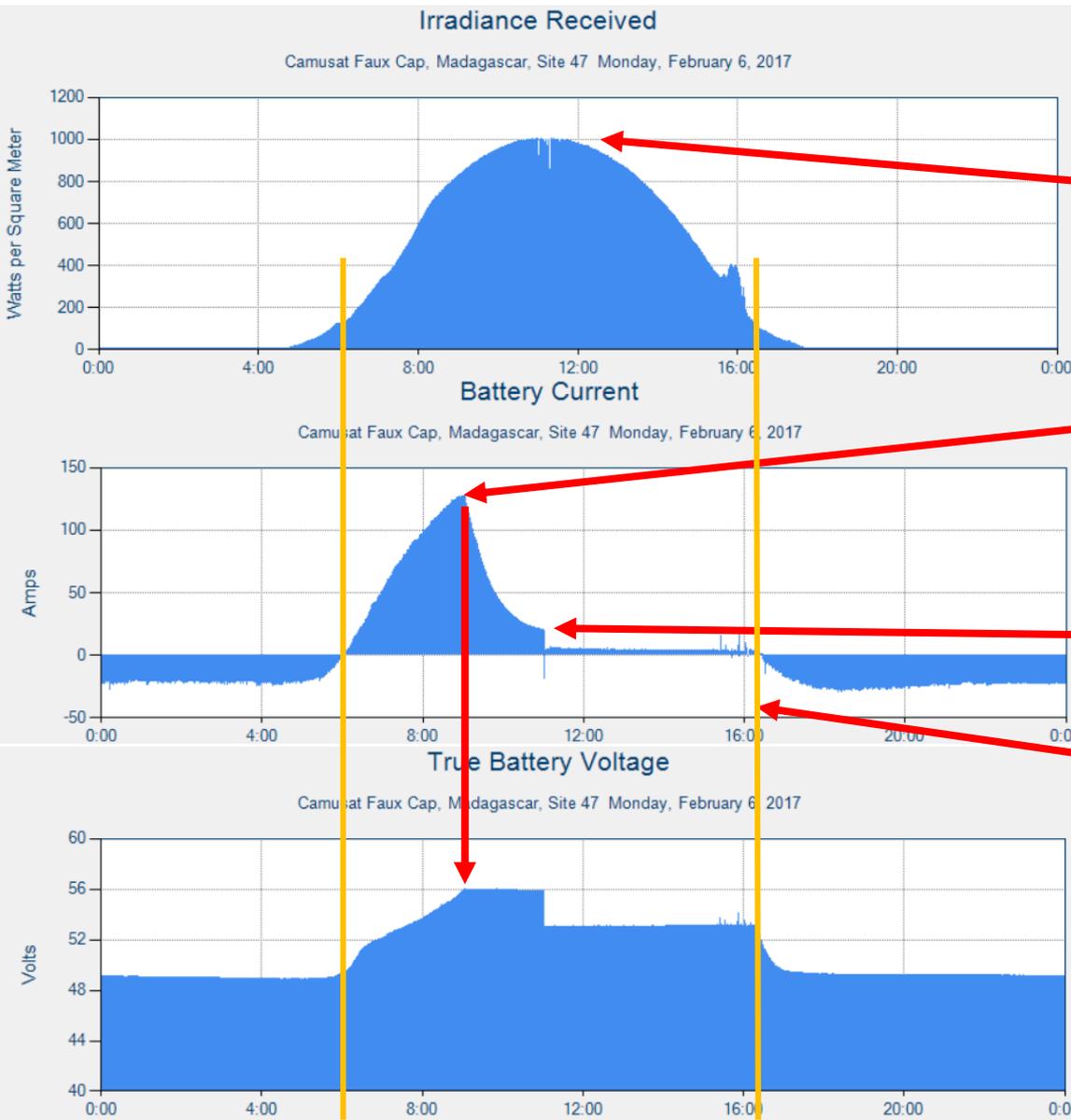
This shows that the battery reaches the Absorb voltage (56 volts) and charging current falls off during the next stage.

At 11:00, the current drops again when the Chargers go into Float Mode.

We can see that the Load is powered by PV from 6:00 AM to after 16:00.

These charts show us that the PV is large enough to completely charge the battery before noon on a clear day.

The battery is large enough because the voltage does not drop below 48 volts at any time.



Using Apollo Remote Monitoring

THE DATA BASE ALLOWS ACCESS TO ALL INFORMATION ABOUT EVERY SITE



HOME SITE MONITORING TECHNICAL SUPPORT FORUM

Site Monitoring > System Charts

ApolloDemo | Logout

FAWE Site No. 839 Serial No. 956

World Map

Rwanda Map

Status

Charts

Alarms

Reports

Downloads

Details

Settings

Documents

History

The ALARMS tab shows the log of every Alarm that has occurred with a time stamp.

Hardware Alarms currently implemented on the standard Apollo cabinet include:

- Cabinet Door is OPEN.
- One or more Battery Breaker is turned OFF. A dry contact is provided for bkr TRIPPED.
- One or more Load Breaker is turned OFF or TRIPPED. A dry contact is also provided.
- One of more MOVs in the Surge Protectors in the Combiner Box is at end of life.
- The PV Array Theft Alarm wire is OPEN circuit indicating that the wire is cut or missing.
- The ESSENTIAL Load is Disconnected. The contactor is open.
- The NON-ESSENTIAL Load is Disconnected. The contactor is open.
- The Battery Voltage is LOW. (The low voltage threshold is set in the SETTINGS tab.)

Using Apollo Remote Monitoring

THE DATA BASE ALLOWS ACCESS TO ALL INFORMATION ABOUT EVERY SITE



HOME SITE MONITORING TECHNICAL SUPPORT FORUM

Site Monitoring > System Charts ApolloDemo | Logout

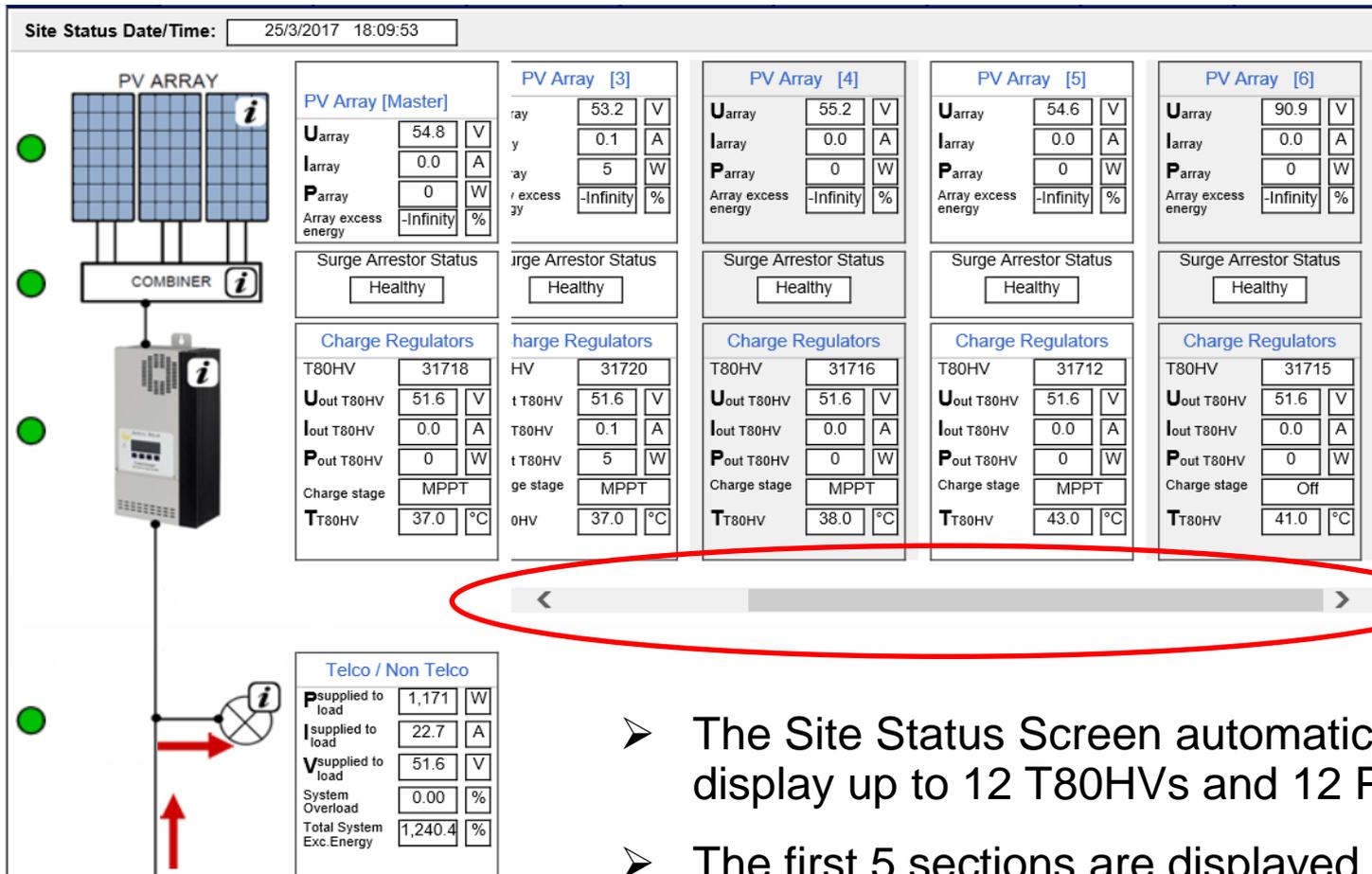
FAWE Site No. 839 Serial No. 956 World Map Rwanda Map

Status Charts Alarms Reports Downloads Details Settings Documents History

In addition to the CHARTS, the Data Base has stored many other items which can be selected for viewing from the Main Menu Bar shown above.

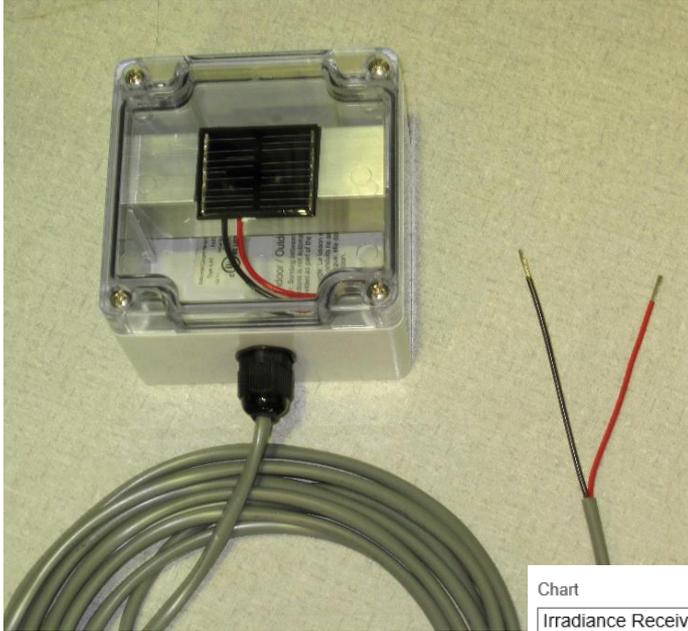
- The ALARM tab shows the log of every Alarm that has occurred with a time stamp.
- The DOWNLOADS tab provides CSV files with diagnostic details from the T80HVs.
- The DETAILS tab has a listing of the location, name and serial numbers for this site.
- The SETTINGS page displays the thresholds for the battery disconnects and the alarms.
- The DOCUMENTS tab allows drawings to be stored for maintenance and support.

The Site Status Screen for Larger Systems



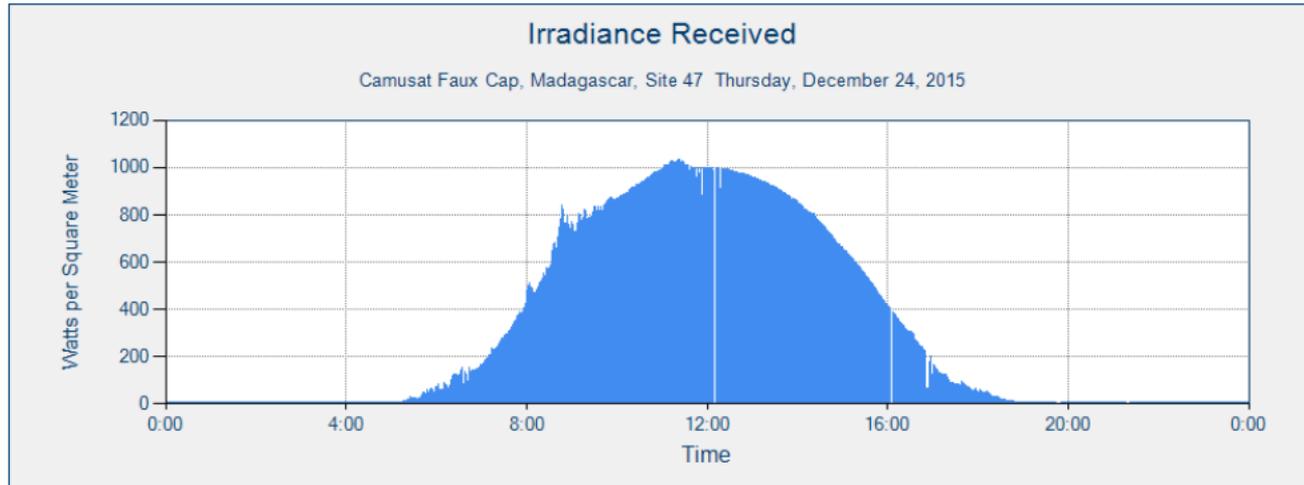
- The Site Status Screen automatically expands to display up to 12 T80HVs and 12 PV Sub-Arrays.
- The first 5 sections are displayed on the screen.
- If additional sections are installed, the upper portion of the screen scrolls left and right to allow display of each section.

Apollo Irradiance Sensor



- The Apollo Irradiance Sensor is mounted on top of the PV Array.
- The ASC uses it to calculate the amount of solar energy available each day.
- This sensor is not effected by any actions taken by the Charge Controllers, the battery or the load.
- One of the charts available shows the results.

Chart: Irradiance Received | Period to Show: Show One Day | Frequency: Raw Data | Start Date and Time: 2015 Dec 24 0:00 | Refresh



Friday, January 27, 2017 2:34:22 PM V3.0