Smart Recombiners Installation Guide
for the Obvius A8332-8F2D Sensor Module

Introduction

Large roof and ground arrays connect the panels into stings that are merged together in combiner boxes. Each string will typically consist of 10-15 panels wired in series with 8-16 stings wired in each separate combiner box. The home run output from each combiner box near the arrays is heavy gage wire carrying the DC current to either a separate recombiner box or the inverter. With a meter that gives only total system energy output to the AC grid, it is difficult to detect a string with no output due to a blown fuse, broken wire or open connection. Inverters or recombiners equipped with recombiner sensing can be monitored by SolarVu to compare the output of each zone for detection of possible problems. Left undetected, the lost energy from a single string over the life of the system leads to significant revenue loss. Consequently, IPP owners will often pay for an expensive annual maintenance check of every string in the system. SolarVu can monitor each zone and provide an alarm if a fault is detected. Documentation identifying the location of each panel, string and combiner needed to quickly locate and repair a damaged panel or connection can be accessed online. This Smart Recombiners feature reduces operating costs and maximizes revenue through early warning of faults with troubleshooting aids for quick repair. It is ordered as an option for a SolarVu energy portal. This guide applies to recombiners equipped with an Obvius A8332-8F2D 8 zone module and matching current sensors.

Installation

Install and wire the Obvius A8332-8F2D 8 zone monitor module according to the manufacturer's instructions. If more than 8 zones are to be monitored, each module will need an RS485 serial connection and DC control power for the current measurement function as shown in figure 1. These are daisy chained together and connected to the SolarVu enclosure. DC current sensors with a 4-20mA output are connected to the zone monitor. The full current output corresponding to the 20mA output must be specified to ensure SolarVu displays current values correctly. Typical connections between the SolarVu K135 gateway and the Obvius zone monitor are shown in fig 2.

RS485 Serial: Connect Cat5e outdoor grade CMX cable from the SolarVu enclosure to the zone monitor in a daisy chain sequence matching wire colors for D+, D- and COM terminals as shown in Fig 2. Pay attention to the wire polarity of the D+ and D- RS485 connections to ensure successful communication. Each zone monitor must have a unique slave address and 9600 baud rate which is set by DIP switches to match the SolarVu K135 gateway configuration as specified in the supplied SolarVu configuration form and shown in fig 2.

Power Supply: 24Vdc control power for each recombiner can be provided from the SolarVu enclosure if ordered. This can be run in the same cat5e cable as the communication wire for short distances if the voltage drop from the #24 AWG pair is not excessive. Otherwise, use a separate #18AWG pair to supply power.

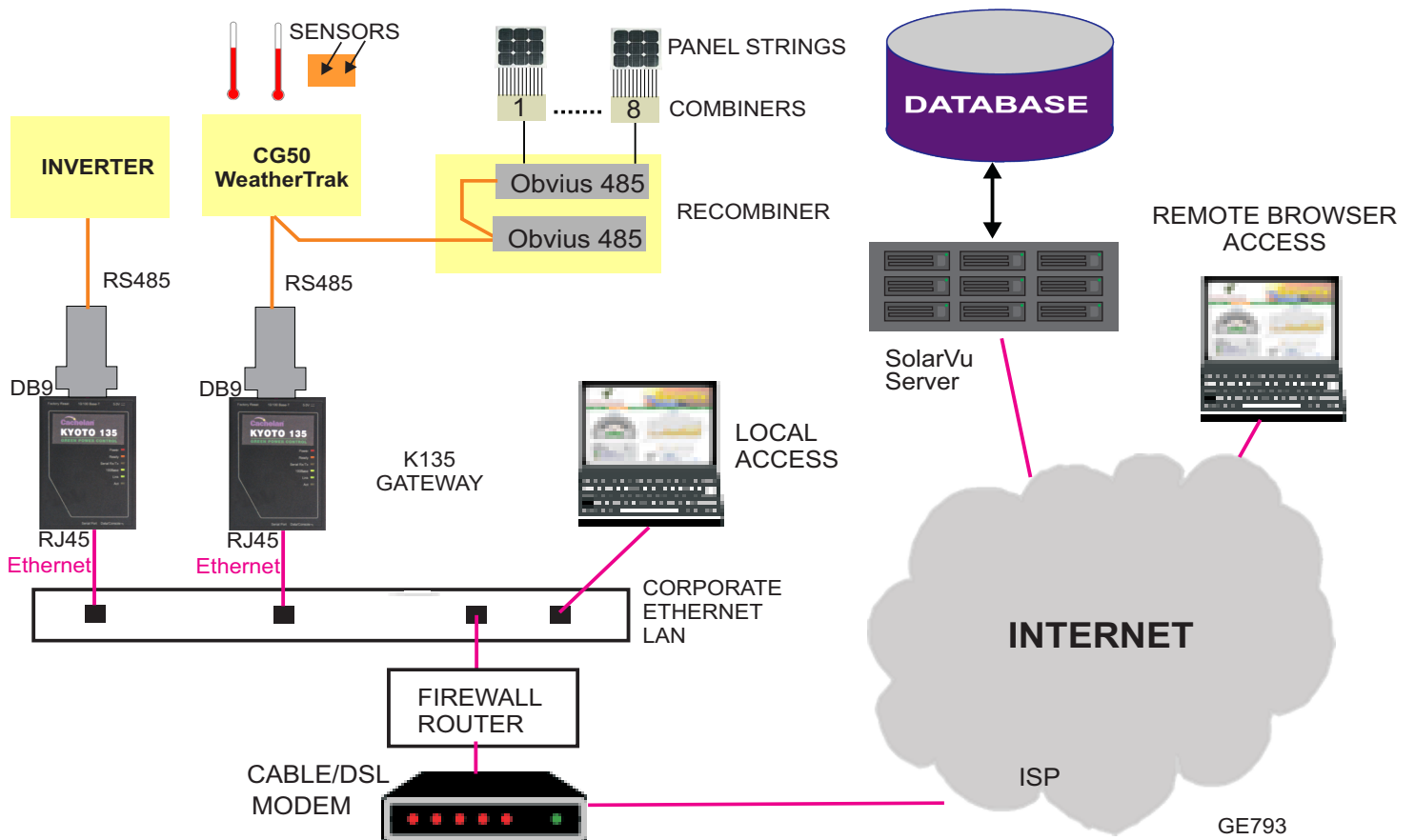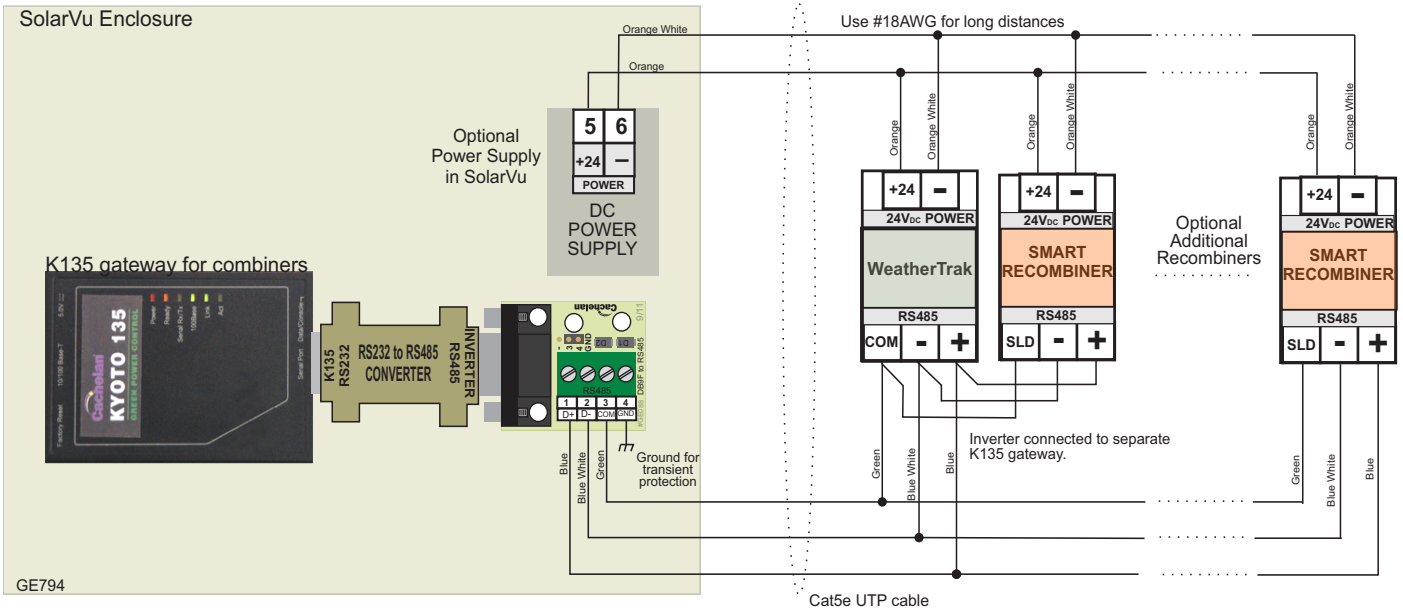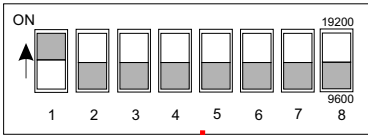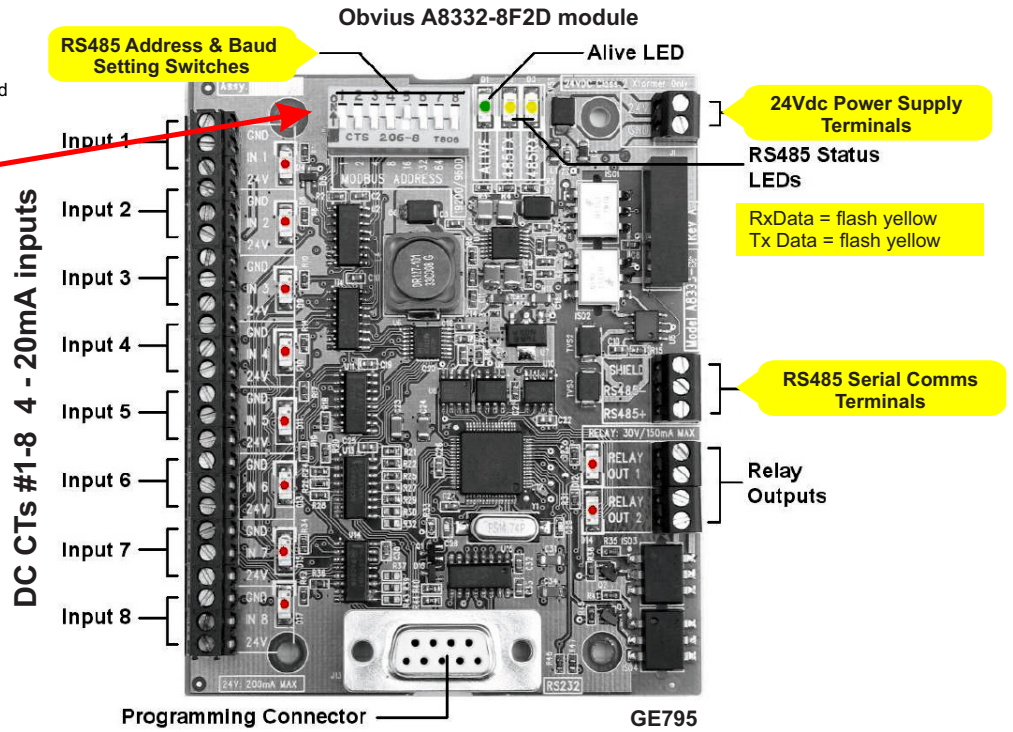*Fig 1 System connection for smart combiners*

Fig 2 Smart recombiner serial connections and settings for Obvius A8332-8F2D sensor module

Set slave address & baud rate

Unique slave address must be set to match K135 master
Switches shown for recombiner slave address 1, 9600 baud

SWITCH NUMBER							
Address	1	2	3		5	6	7
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF
3	OFF	ON	ON	OFF	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF	OFF	OFF
5	ON	OFF	ON	OFF	OFF	OFF	OFF
6	OFF	ON	ON	OFF	OFF	OFF	OFF

Obvius A8332-8F2D module

RS485 Address & Baud Setting Switches

Alive LED

24Vdc Power Supply Terminals

RS485 Status LEDs

RxData = flash yellow
Tx Data = flash yellow

RS485 Serial Comms Terminals

Relay Outputs

DC CTs #1-8 4 - 20mA inputs

Input 1
Input 2
Input 3
Input 4
Input 5
Input 6
Input 7
Input 8

Programming Connector

GE795

Once the communication settings have been set on the DIP switches and control power to the recombiner modules is connected, access the SolarVu energy portal online. View the recombiner screens by clicking ANALYZER --> Zones for a graphical view and ANALYZER --> Recombiners for tabular data. Interpretation of each screen and alarm setup is described in the next few sections. If any combiners appear not to be communicating check the power indicator on the sensor module, communication connections and slave address settings. If assistance is needed contact Cachelan Technical Support.

ANALYZER

RECOMBINERS When a system is equipped with the smart recombiners option, digital and graphical zone current screens are available in the Analyzer pulldown menu. Use this feature to quickly identify under performing panels which are difficult to detect with only total system energy metering but if left unnoticed, could cost thousands of dollars in lost revenue over the system lifetime.

1. **RECOMBINERS** Use the Analyzer pulldown box and select Recombiners to see digital zone current, power and alarm status. For a graphical view select Zones in this box or go direct using the Zones button ❶❸.

2. **RECOMBINER ID:** Recombiner name and serial address ID as defined in SETUP are shown for identification. The physical combiner boxes can be labelled with these names for easy matching to this online view.

3. **DC CURRENT:** Actual DC zone current measured in the recombiner box. Total current of all zones feeding the recombiner output to the inverter is shown in ❻

4. **% RELATIVE** Normally under any combination of irradiance and temperature, all zones with the same number of panels and orientation will have the same current. To identify problem strings, the highest output zone is assigned a % REL value of 100% and the other zones are shown as the variation % from the maximum zone in the recombiner box. An alarm threshold ❽ is entered in SETUP to warn when one zone is too low ❼.

5. **DC VOLTS & DC POWER** Combiner bus DC voltage and zone power (amps * volts). Total DC output power for the recombiner box is shown at the bottom of the column ❻

6. **TOTAL CURRENT & POWER** Total current from all zones and power (common DC bus voltage * total current). Average current and average zone power are also shown.

7. **ALARM WARNING** If current in any zone falls below the alarm trigger setting and the minimum threshold is exceeded ❽ the zone row will be highlighted in red for easy identification of a potential problem. This will also trigger an alarm email to be sent.

8. **ALARM SETTINGS** After observing the normal variation of zone currents for a new system, the alarm trigger should be set to be outside this range to send a warning without causing nuisance alarms. A zone current of less than 90% of the maximum zone is a good starting point. To prevent spurious alarms at the beginning / end of the day or under low light conditions when large variations are expected, the maximum zone current must exceed the alarm threshold setting or alarms are blocked. Typically this will be set to 50% or more of expected peak capacity. Click the EDIT button to adjust these values in SETUP if necessary.

9. **SENSORS** Available values measured by the recombiner box such as internal temperature are shown in this panel. Parameters may vary with combiner boxes from different vendors.

10. **STATUS** If any alarms are detected for the recombiner box, the number of alarms will be shown in red. Otherwise Recombiner OK in blue indicates everything is normal. Scroll down to check the status of each recombiner box separately (if more than one installed).

11 LAST UPDATE INDICATORS

Last Communication - Shows the last time a data message was received from the recombiner boxes gateway. If the gateway has successfully established an internet connection this indicator will be green even if there is no connection to the recombiner. If flashing red, check ethernet connection, IP settings and ensure the gateway is powered on. A single gateway is typically shared by all recombiner boxes. Click the LISTEN button to determine cause.

Last Data Update - Once the gateway is successfully communicating to the recombiner and sending data, this indicator will show if the data is valid. For normal operation, both indicators are green. If this indicator is red, check the connection between the recombiner box and the gateway, that the recombiner box is powered on and that the correct serial ID has been entered into each recombiner box module. A separate status indicator is provided for each recombiner box for quickly identifying connection issues to any device. See SolarVu installation instructions for further details.

COMBINER/STRING LAYOUT

12

Combiner # - Serial #	1 - 11606		2 - 11607		3 - 11608		4 - 11609		5 - 11610		6 - 11611	
Modbus Address	109	111	13	17	15	18	19	20	14	16	108	110
Strings	1.1	1.9	2.1	2.9	3.1	3.9	4.1	4.9	5.1	5.9	6.1	6.9
	1.2	1.10	2.2	2.10	3.2	3.10	4.2	4.10	5.2	5.10	6.2	6.10
	1.3	1.11	2.3	2.11	3.3	3.11	4.3	4.11	5.3	5.11	6.3	6.11
	1.4	1.12	2.4	2.12	3.4	3.12	4.4	4.12	5.4	5.12	6.4	6.12
	1.5		2.5		3.5	3.13	4.5		5.5		6.5	6.13
	1.6		2.6		3.6		4.6		5.6		6.6	
	1.7		2.7		3.7		4.7		5.7		6.7	
	1.8		2.8		3.8		4.8		5.8		6.8	

ROOF SOLAR PANELS LAYOUT
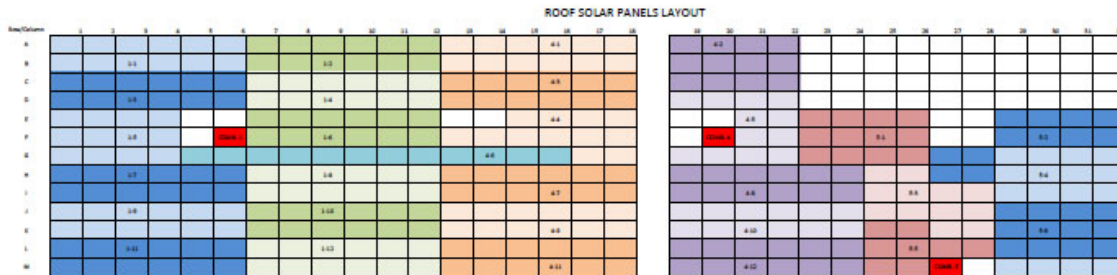
12 LAYOUT DOCUMENTATION To expedite commissioning for faster payment and to assist in identifying a bad panel when a string alarm is received, it is helpful to have design documents handy showing combiner ID / string # and the physical location of the associated panels. This documentation, typically a PDF file created from original design drawings, can be uploaded in SETUP to be available anytime for download by clicking the Layout button. Multiple pages can include other useful references like warranties, contacts etc.

13 ZONES Click the Zones button for a graphical view of zone currents. These can be sorted by recombiner, the entire roof, actual current, peak current and power. Alarms are displayed in red for a quick visual analysis of the entire system.

ANALYZER

ZONES When a system is equipped with the smart recombiners option, digital and graphical zone current screens are available in the Analyzer pulldown menu. Use this feature to quickly identify under performing panels which are difficult to detect with only total system energy metering but if left unnoticed, could cost thousands of dollars in lost revenue over the system lifetime. The zones screen is graphical for comparing relative panel output while the Recombiners screen ❶ is in text format for detailed analysis.
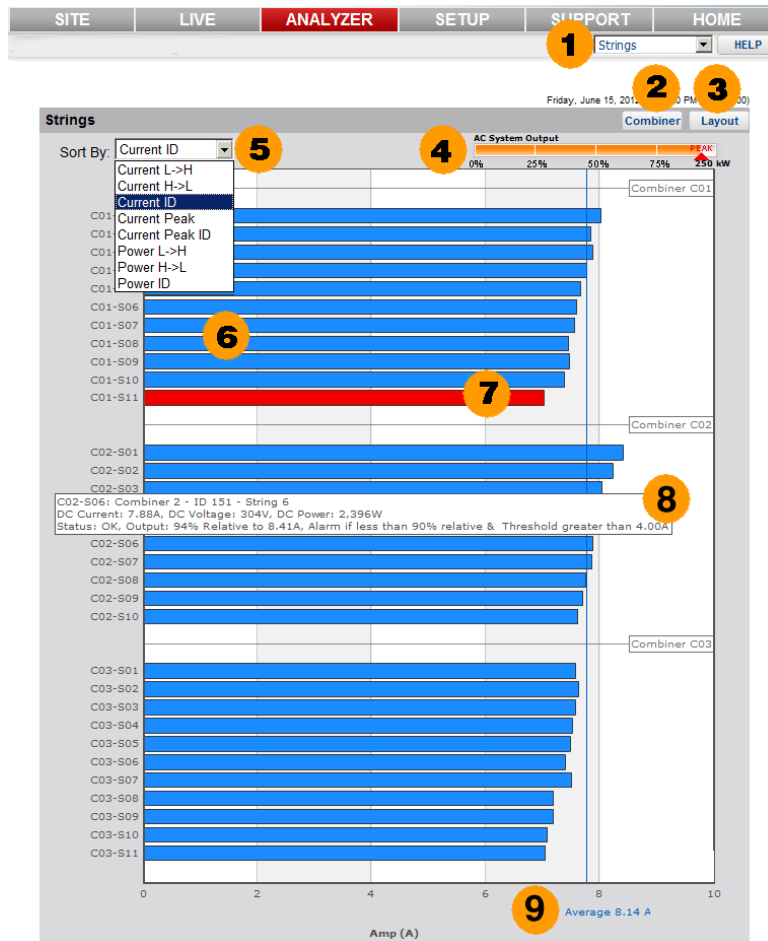
1   **ANALYZER - ZONES:** Select Zones in the ANALYZER tab selection menu, for a graphical view of zone currents and power.

2   **RECOMBINERS:** Alternate between graphical and text screens to view the information in different formats. Select Recombiners in the Analyzer pulldown box or go directly from this screen using the Recombiners ❷ button to see digital zone current, power and alarm status.

3   **LAYOUT:** In SETUP upload a diagram of the panel locations by string and combiner on the roof for easy identification. Click the Layout button to view or print the saved drawing when doing commissioning or troubleshooting. The physical combiner boxes can be labelled at the site for easy matching to the online view.

4   **AC SYSTEM OUTPUT:** Total AC system output similar to the LIVE screen is shown. When system output is very low, the individual zones may vary significantly but when running near capacity, the individual zones will normally closely match unless there is a problem.

5   **SORT BY** Compare zones in different ways for a better understanding of performance. Zones are sorted relative to the largest string in the group to provide a meaningful comparison under any combination of irradiance and temperature.

Current L-->H: All zones in the system are sorted from lowest to highest. Alarms will normally show up as a low relative value and hence appear at the top of the screen.

Current H-->L: Similar to CURRENT L-->H except the order is reversed sorting from high to low with the largest current at the top.

Current ID: Panels of different ratings or in different areas of the roof may be connected to separate combiner boxes for better matching. This view compares relative zone values within each separate recombiner box. Although the zone current values may be quite different between recombiner boxes, within the same recombiner box they should be similar.

Current Peak: To analyze trends over time, the peak value since reset for all zones is continuously recorded and displayed. This selection sorts peak current values by all zones on the roof from highest to lowest. Reset the peak value in SETUP-->Equipment-->Combiners-->System to start a new measurement period. Hold the mouse over the peak area of the string bar for a popup showing the peak value and date when it last occurred.

Current Peak ID: Similar to current peak, but this screen sorts peaks by individual recombiner boxes for easier comparison due to panel matching or different areas of the roof.

Power L-->H: If bus voltage is available from the recombiner box output to the inverter then power can be displayed instead of current. When sorted from low to high for the entire roof, the zones with alarm conditions will usually appear at the top of the screen if enabled in SETUP.

Power H-->L: Similar to Power L-->H except sorted from highest to lowest with the highest output zone appearing at the top. Scroll over with the mouse for details.

Power ID: When panels are arranged in zones with different ratings or on parts of the roof with different slopes then comparing zone power by combiner box ID is a better than arranging them into a single group.

6   **ZONE:** Zone name is entered in SETUP with the format C01-Z02 where Z01 is the prefix for recombiner 01 and the name, shown here as Z02, can be entered by the user for easier identification. Blue indicates current, orange indicates power and red indicates an alarm condition for quickly identifying which zones need attention. By physically labelling the combiner boxes at the site, this online identification will assist in quickly locating the panel or combiner that needs to be checked.

7   **ALARM:** Separate alarm trigger levels and holdoff thresholds can be set for each recombiner box in SETUP --> Equipment -->Combiners. Alarms are set relative to the maximum zone for valid comparisons under any combination of sunlight and temperature. Quickly scan for red alarm bars and scroll over the bar with the mouse for more details. Change the alarm trigger level in SETUP if normal variations are generating false alarms.

8   **DETAILS POPUP:** Hold the mouse pointer over any zone for details of current measured values, alarm settings and status. This is useful for analyzing individual zones. Click the Recombiner button ❷ for a text screen of similar information.

9   **SCALE:** Scroll to the bottom of the screen to view the horizontal axis units if there are too many zones for the graph to completely fit on one screen. For easy readout, alternating gray and white vertical bands are used. A vertical colored line shows the average value for all zones.
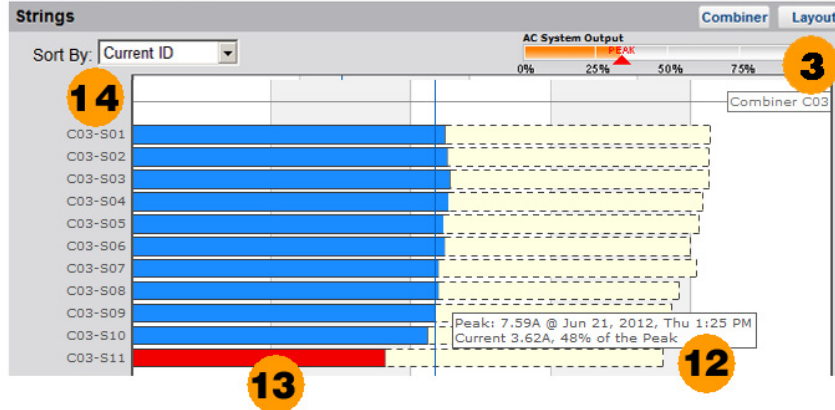
SETUP

Equipment - Recombiners When a system is equipped with the smart recombiners option, digital and graphical zone current screens are available in the Analyzer pull down menu. Use this feature to quickly identify under performing panels which are difficult to detect with only total system energy metering but if left unnoticed, could cost thousands of dollars in lost revenue over the system lifetime. Enter parameters to display on the screens here including recombiner and zone names. Upload a file showing string layouts for easy retrieval to locate bad strings and combiners. Set alarms to warn of under performing zones for early detection. Reset the peak current recorder to start a new measurement period.

1   **SETUP - Equipment - Combiners:** Access the setup panels for all combiners by selecting this tab sequence. At the top are settings for the site. Scroll down to access each separate combiner box.

2   **BUTTON CAPTION:** A button with the default name Layout is provided on the string and combiner screens for downloading a layout drawing that has been previously uploaded ❸ If desired, change the name to something else here.

3   **UPLOADED FILE / ALBUM:** Combine string layout drawings into a single PDF file and upload them for access from the String and Combiner screens for troubleshooting ❸. Multiple files such as wiring diagrams can instead be grouped together into an album using WebFilm (SETUP -->Site-->Site Appearance-->WebFilm). Download the stored file or album using the Layout button.

4) **PEAK RECORDER:** SolarVu saves the peak current on each zone and the date when the peak log was started. Click Reset to start a new Peak recording period. The old peak values will be erased. This is useful for observing maximum output during different seasons or to observe if the system is no longer producing the same output as previously. SolarVu also records the lifetime maximum current which displays when scrolling over the peak bar in the Zones screens. ❶❷ Compare lifetime maximum to current peak to determine degradation over the life of the system due to aging. Lifetime maximum can only be factory reset.

5) **SAVE:** Periodically click the Save button to store entered values in the SolarVu server.

6) **RECOMBINER ID:** Each combiner has a default name of R01, R02... and a zone default name Z01, Z02... For example R03-Z12 is recombiner #3 zone #12. This name is shown on the zone and recombiner screens. ❶❹ The type and slave address of each recombiner is factory programmed and shown here for reference but cannot be changed.

7) **RECOMBINER NAME:** For easier identification, each recombiner can be assigned a user name. Label the physical recombiner box with the name entered here that shows on SolarVu screens ❶❺ to assist the maintenance electrician is identifying each recombiner box and zones inside when locating bad panels.

8) **SHOW ZONES:** Not all zones in a recombiner box may be used. To prevent nuisance alarms for unused zones and a misleading graphical display in the zones screen, uncheck any zones that are not connected.

9) **ZONE NAME:** Zone ID is in the format R01-Z02 where Z01 is the prefix for recombiner box 01 and Z02 is zone position 2 within the recombiner box. A user zone name can be assigned to each zone for matching to the assignments in the site layout drawing for easier identification. This name will appear in the Recombiner and Zone Analyzer screens. ❶❺

10) **ALARMS:** With hundreds of panels operating over many years under varying weather conditions, a visual using the graphical strings screen with alarms highlighted will quickly identify strings needing attention. This also reduces the need for expensive annual maintenance checks of the entire system. If automatic alarms are desired, adjust the settings here after commissioning. Each recombiner box has individual settings to allow for differences such as number of strings per combiner, location and panels installed with different ratings. Some experimentation with settings may be required to eliminate false alarms while still detecting real faults. Simulate a fault by temporarily disconnecting a combiner box or string and check that the settings pick up the reduced output to verify an alarm is received. Zones with an alarm condition are highlighted in red on the Zones screen ❶❸ and pink ❶❸ on the Recombiners screen.

Alarm Trigger: Since the output current will vary from 0-100% of rated capacity under different irradiance and temperature conditions, all zones within the same recombiner are compared as a percentage of the maximum zone output. Assuming identical panels, equal panel count per string and similar orientation then theoretically all zones would be the same or 100% Rel (relative) to the maximum. In practice, due to manufacturing tolerances, aging and other factors expect a normal variation of 10-15% under varying conditions. Set the Alarm Trigger to be less than this value to prevent nuisance alarms but high enough to detect a significant deviation such as a string or disconnected combiner. To disable alarms completely, set the alarm trigger to 0% Rel on each recombiner box. On a large system, if one recombiner is not responding and requires maintenance or is waiting to be commissioned, temporarily uncheck the Show box ❶⓿ so it will not continuously report alarms.

Alarm Threshold: At the beginning and end of the day or during overcast conditions when the system is operating at very low output, the zones will show large variations relative to each other. To prevent nuisance alarms under these conditions, the alarm threshold is used to block alarms until the system is operating at normal levels. Enter a typical value of 50% of zone system capacity eg 35 amps for a zone with 70 amps maximum output.

11) **Actual Output:** To assist in selecting suitable alarm settings for each separate recombiner box, the actual values under current conditions are displayed. If the system is operating normally with no faults, then set the Alarm Trigger outside this value. For example if the range is 90%-100% a setting of 85% might be low enough to prevent nuisance alarms but still detect if a combiner has lost a string or is shut down.

ANALYZER --> Strings

Strings [Combiner] [Layout]

Sort By: [Current ID ▼]

AC System Output

(14) **(3)**

Combiner C03

C03-S01	
C03-S02	
C03-S03	
C03-S04	
C03-S05	
C03-S06	
C03-S07	
C03-S08	
C03-S09	
C03-S10	
C03-S11	

0%   25%   50%   75%

Peak: 7.59A @ Jun 21, 2012, Thu 1:25 PM
Current 3.62A, 48% of the Peak

(13) **(12)**

ANALYZER --> Combiners

C01: Combiner 1 - ID 151 [Strings] [Layout]

(14) **(3)**

ID	String Name	DC Current	DC Voltage	DC Power	Rel
C01-S01	String 1	4.29 A	355 V	1,523 W	100 %
C01-S02	String 2	4.14 A	355 V	1,470 W	97 %
C01-S03	String 3	4.05 A	355 V	1,438 W	94 %
C01-S04	String 4	4.09 A	355 V	1,452 W	95 %
C01-S05	String 5	4.03 A	355 V	1,431 W	94 %
C01-S06	String 6	4.00 A	355 V	1,420 W	93 %
C01-S07	String 7	3.98 A	355 V	1,413 W	93 %
C01-S08	String 8	3.91 A	355 V	1,388 W	91 %
C01-S09	String 9	3.85 A	355 V	1,367 W	90 %
C01-S10	String 10	3.81 A	355 V	1,353 W	89 %
	Total	40.15 A		14.3 kW	
	Average	4.02 A	355 V	1,425 W	

(15) **(13)**

Alarm	Threshold	> 4.00 A AVG	Trigger	< 90 % of Rel	[Edit]
Sensors	Internal Temp.	22.7°C			
ID	Modbus Address	151	Serial Number	07333	
STATUS	1 low current alarm				

[Listen] 🟢 Last Data Updated: Jun 22, 2012, Fri 9:05 AM (GMT -5:00)
[Listen] 🟢 Last Communication: Jun 22, 2012, Fri 9:05 AM (GMT -5:00)

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