

Solar-Current.com

# Furl-Kit WT2012

Product Manual v1.1

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2012

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## Furl-Kit Overview

Solar-Current.com's Furl-Kit adds intelligent self-preservation and remote management to residential two axis sun tracking solar arrays. The Furl-Kit is designed to be an easy to operate appliance and simultaneously provide comprehensive management through a web interface.

Once a Solar-Array has been updated with the Furl-Kit Array CPU it will have the intelligence to automatically place itself into a self-preservation mode (Furled Mode) during high wind conditions. Once a Solar-Array has entered Furled Mode it will remain there until the Array mounted CPU detects the winds have diminished and it is safe to return to normal operation. With multiple Solar-Arrays (Solar-Array Farm) each array in the farm is fitted with a Furl-Kit providing independent intelligence to monitor the environment and Furl as required.

## System Components

A Complete Furl-Kit solution consists of two major components: the Solar-Array Supervisor and a Furl-Kit Array CPU mounted to each Solar Array in the farm. The Solar-Array Supervisor is optional and not required for the Furl-Kit Array mounted CPU to function.

### Furl-Kit Array CPU

The Furl-Kit Array CPU consists of three basic components:

1. Array CPU
  - a. Weather tight computer mounted outside on each Solar-Array in the farm.
  - b. Monitors the array mounted anemometer to observe wind speed at each array.
  - c. Connects to the Solar-Array's factory installed elevation control motor leads.
  - d. Monitors the furl detection switch to insure array is properly functioning.
  - e. Wirelessly communicates with the optional in-house Solar-Array Supervisor.



Figure 1(Furl-Kit Array CPU)

2. Gimbaled Anemometer
  - a. Mounted to the top of the array and connects to the Array CPU.
  - b. The gimbaled mount for the anemometer is manufactured from marine grade aluminum with stainless steel bearings.
  - c. The anemometer is placed at the highest point on the array providing the best access for detecting damaging wind.
3. Furl Detection Sensor
  - a. The Furl Detection Sensor is used to insure the Solar-Array has successfully furred when instructed to by the Array CPU.
  - b. The Furl Detection sensor is a sealed unit with no moving parts designed for harsh outdoor environments.

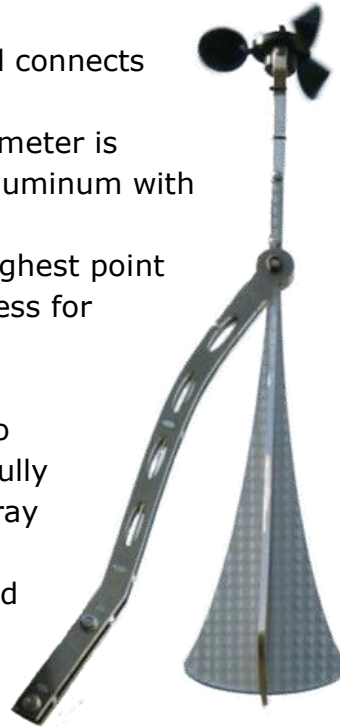


Figure 2 (Gimbaled Anemometer)

## Solar-Array Supervisor

The Solar-Array Supervisor is an optional in-house appliance that gives the user control of up to 5 Furl-Kit Array CPUs. The Solar-Array Supervisor wirelessly communicates with each Furl-kit mounted CPU over an encrypted IEEE 802.15.4 digital network.

Solar-Array Supervisor Key Features:

1. The Solar-Array Supervisor is a small appliance with simple easy to operate controls. The LCD display on the Solar-Array Supervisor will display the current status of the Solar Array Farm, as well as the current wind speed, daily high and all-time-high wind. A control switch conveniently located next to the LCD display allows the user to send Furl Now or Snow Dump commands to the entire Solar-Array farm.
2. The Solar-Array Supervisor wirelessly communicates with each Solar-Array CPU to securely send and receive telemetry over an encrypted 802.15.4 network. The wireless modules operate within the ISM 2.4 GHz frequency band and do not require a special FCC License. The modules have a range of 300' in a congested setting, to 1 mile with clear line of site. Each installation

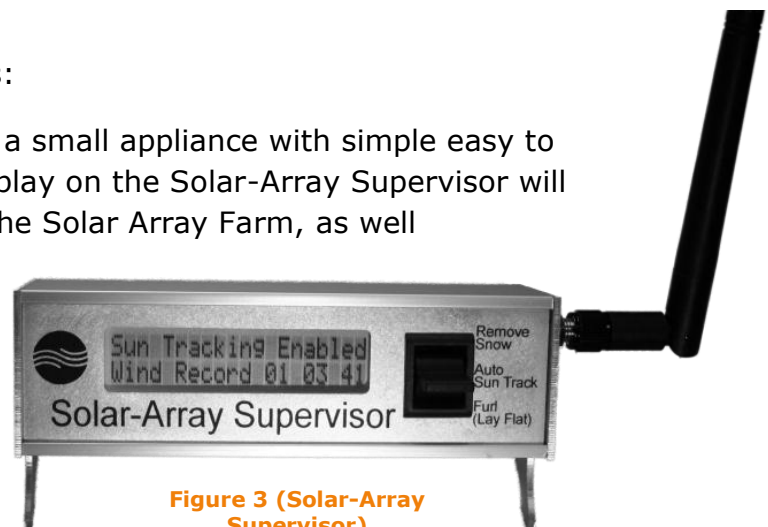
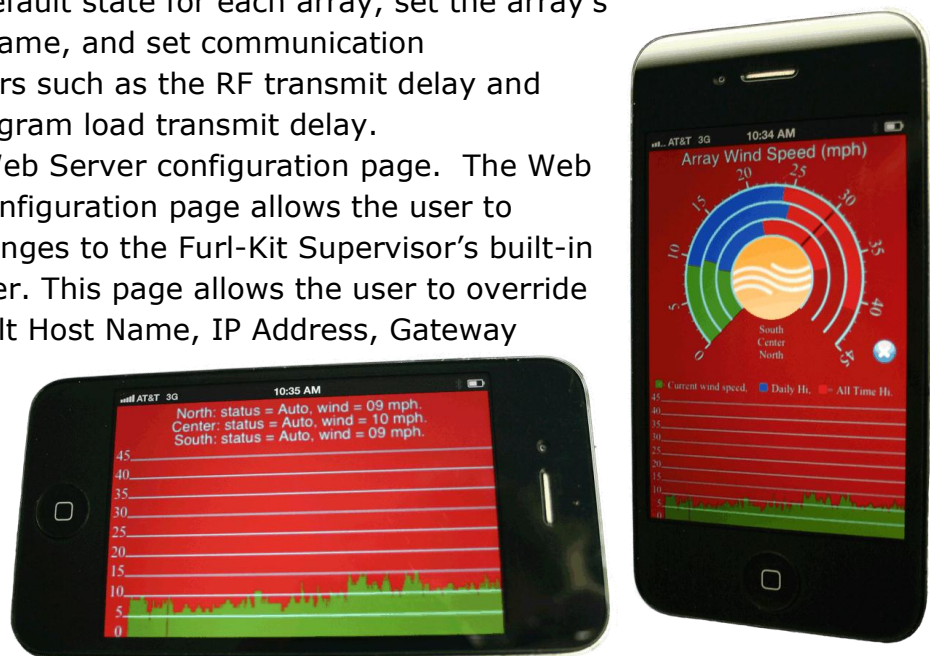


Figure 3 (Solar-Array Supervisor)

is setup on a unique PAN (Personal Area Network) to insure no interference from other nearby Furl-Kit installations.

3. The Solar-Array Supervisor has a built-in Ethernet RJ45 jack on the side that allows a connection to the user's home network. Once connected to the home network, users can view and change all configuration options for the Solar Array Farm through a robust web interface. The Web interface includes:

- a. Array Farm Status page. The Array Farm Status page will display the detailed status of each array in the farm. The data displayed for each array includes: friendly name, current wind speed, daily high wind, all time high wind, current status, last good RF packet, furl speed setting, last successful furl test and last reboot of the array CPU. This data is continually updated as long as the page is up in the browser. The Array Farm Status page also has buttons to initiate a temporary one hour furl or one hour snow dump for the Solar Array Farm.
- b. iPhone HTML app. An iPhone or other compatible smartphone can access the web-based iPhone app located on the Solar-Array Supervisor's web server. The iPhone app will graphically display the current wind at each solar array in the farm as well as the current status. With a tap of the finger the iPhone app allows the user to temporarily furl or dump snow off the whole farm. The iPhone app requires a home Wi-Fi network with access to the Internet.
- c. Array Configuration page. The Array Configuration page allows the user to set the high wind threshold (Furl wind Speed) for each array, set the default state for each array, set the array's friendly name, and set communication parameters such as the RF transmit delay and initial program load transmit delay.
- d. Furl Kit Web Server configuration page. The Web Server configuration page allows the user to make changes to the Furl-Kit Supervisor's built-in web server. This page allows the user to override the default Host Name, IP Address, Gateway Address, and Subnet Mask.



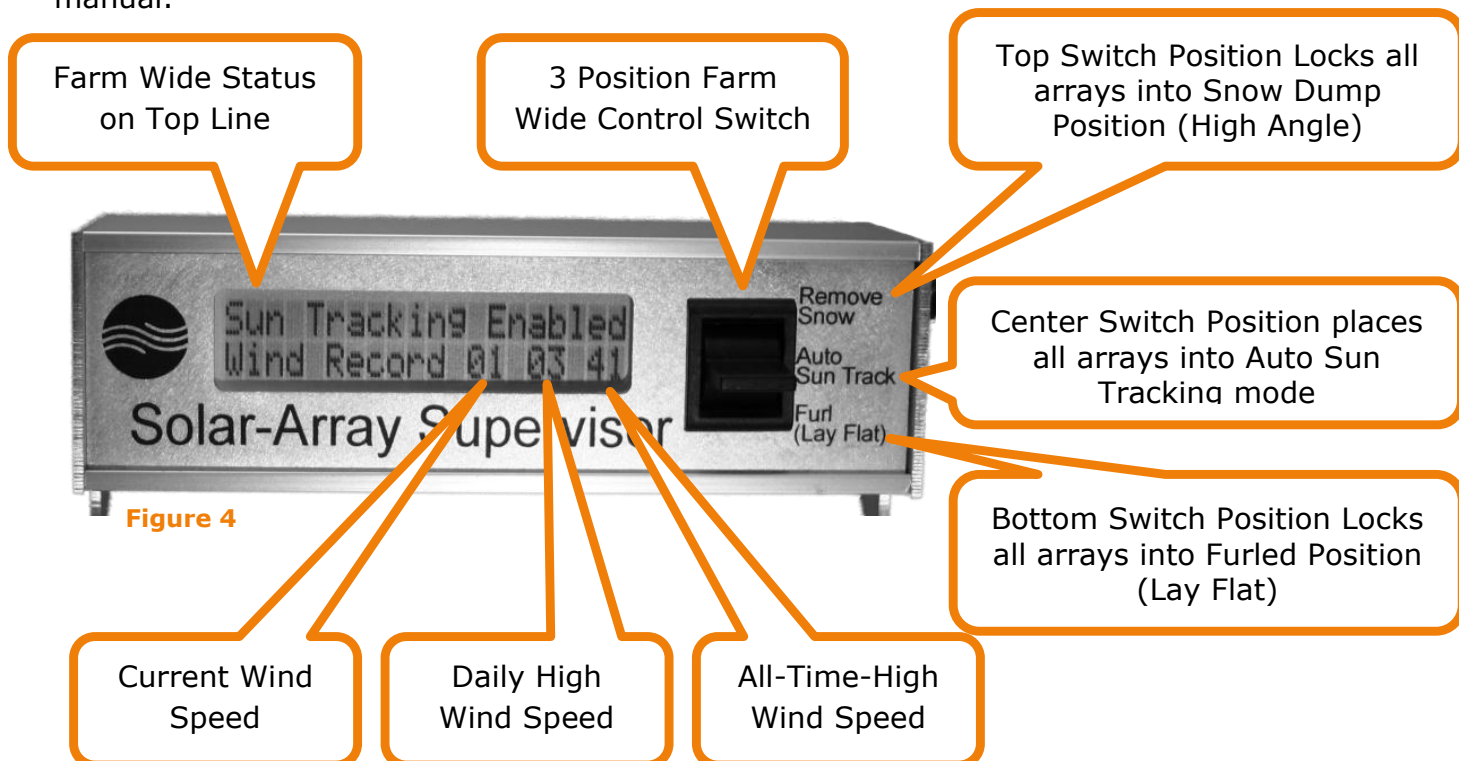
## Operations

### Furl-Kit Array CPU

The Furl-Kit Array CPU can be purchased as a stand-alone unit (no wireless communications) or part of a complete solution with wireless control from the in-house Solar-Array Supervisor. Regardless of the configuration, the Furl-Kit Array CPU does not have user configurable switches or jumpers. Once installed, the CPU continually samples the wind and will automatically furl the array during high-wind. The Furl Wind speed is set to 30mph at the factory. The CPU also conducts a weekly self-test of the furling circuit and elevation motor to insure proper operating conditions.

### Solar-Array Supervisor Controls and Display

The Solar-Array Supervisor's LCD display will display the operating status of all the Solar-Arrays in the farm, as well as, the current wind speed. If an error is detected with the system, an error message will be displayed. A complete list of error messages with an explanation can be found in the trouble shooting section of this manual.



The first line of the display will show a farm-wide status summary. If the arrays are in various states, for example: all arrays are in auto mode but one of them has detected high winds and is furling, the display will show the status of the furling array. To get more information and to see details about each array, you can connect to the Solar-Array Supervisor's built-in web server with your browser or smart phone.

**Table 1 (Possible Solar-Array Supervisor display messages)**

LCD Display Messages	Description
Sun Tracking Enabled	All arrays in auto sun tracking mode. This is the default status
Snow Dump Lock	One or more of the arrays are in Snow Dump Lock mode. When in this locked state the array will still furl if high winds are detected. Once the winds subside for one hour the array will return to this Snow Dump state.
Furl Lock	One or more of the arrays are in Furl Lock mode. When an array is in a locked state, it simply means this is the default state for the array (the array will return to this state if the power is lost and restored).
HIGH – WIND – FURL	One or more of the arrays have detected wind above the furl wind speed and are furling to enter survival mode.
Furl Testing	A weekly furl test has been initiated by the Furl-Kit array CPU or started by clicking the "Test Furl" button on the Array Configuration web page.
1 hour Snow Dump	One or more of the Solar-Arrays have entered a temporary one hour snow dump. After one hour the array will return to its default state. This process is initiated by clicking the "Dump Snow" button on the Array Farm Status web page or iPhone app.
1 hour Furl	One or more of the Solar-Arrays have entered a temporary one hour furl. After one hour the array will return to its default state. This process is initiated by clicking the "Furl Arrays" button on the Array Farm Status web page or iPhone app.
Arrays Furling	One or more of the Solar-Arrays are moving into furl position.



TEST – FAIL	The furl self-test has failed. See the <i>Troubleshooting</i> section on page 43 of this guide for possible remedies.
ERROR: Check Web Site	An error has occurred with one or more of the solar-arrays. Check the Furl-Kit Supervisor's built-in web site for more information. One common cause of this error occurs when a Solar-Array has not reported into the Furl-Kit Supervisor because of power loss to the Furl-Kit CPU.

The second line of the display shows a wind record in real time for the whole farm. This wind record includes the current wind speed, daily high, and all-time-high wind speed recorded by the farm. In a multiple solar array configuration these numbers represent the highest value from each array. For example if the current wind speed at array 1 = 5mph, array 2 = 5mph, and array 3 = 7mph the current wind speed will display the highest value of 7mph.

The three position farm wide control switch shown in figure 4 sends commands to every Solar-Array in the farm. It is used to control everything with one simple flick of the switch. For example if you know a storm is on the way you can be proactive and furl all the arrays ahead of time by pushing the switch down to the furl position. The Solar-Array Supervisor will send a wireless Furl command to each array in the farm and the display will changed to "Furl Lock On". All solar-arrays will be furled (lying flat) and remain in this position until the switch is moved to another position.

**Table 2 (Switch Position Description)**

Switch Position	Description
Remove Snow	All Solar Arrays in the farm will tilt up to the highest position allowed by the elevation motor's limit switch. This will create a very steep angle allowing the snow to slide off the arrays and help prevent more snow from settling. The array's azimuth motor will continue to move the array from East to West following the sun. It is perfectly fine to leave the switch in this position throughout the winter months. If a storm should approach with high winds the array's Furl-Kit CPU will temporally override this setting and furl the arrays until the storm passes.
Auto Sun Track	All Solar Arrays in the farm will be allowed to follow the sun with both axes. The arrays will move up or down and left or right as the sun moves across the sky. If high winds are detected the Solar-Array CPU will automatically furl the arrays until the wind has subsided for one hour. At this time the arrays will be allowed to resume normal



two axis tracking of the sun.

Furl Lay Flat	All Solar Arrays in the Farm will furl, lay flat, to reduce wind resistance and decrease the chances of being damaged during a severe storm. This setting can be selected if a severe storm is forecast, to be proactive. Another common use of this setting is to lay all the solar arrays flat so they can easily be mowed under.
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## Solar-Array Supervisor Web Interface

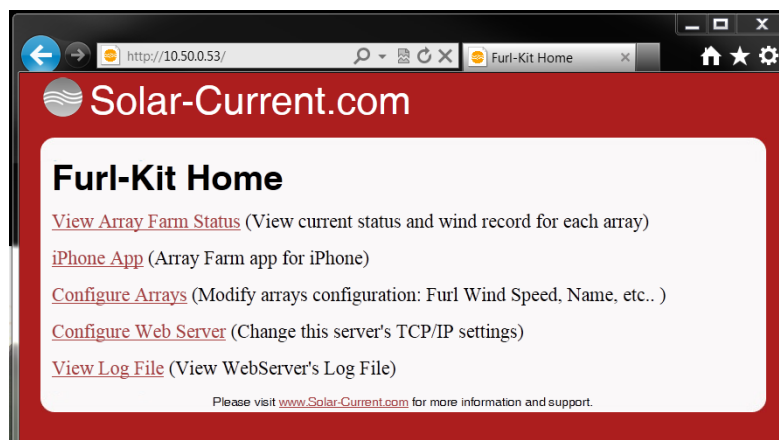
To access the Solar-Array Supervisor's Web interface, use your browser and for the URL, use the TCP/IP address assigned to your unit by your home network router. The TCP/IP address is displayed on the Solar-Array Supervisor's LCD display during the boot up process. To trigger this process, cycle the power by unplugging the Solar-Array Supervisor from the wall and plug it back in after a few seconds. Keep an eye on the display and note the IP address. The picture in Figure 5 shows a



**Figure 5 (IP Address Display)**

TCP/IP<sup>1</sup> address of 10.50.0.53 has been assigned to the Solar-Array Supervisor. To access the Solar-Array Supervisor's web site you would type in [HTTP://10.50.0.53](http://10.50.0.53) into your web browser.

**Figure 6 (Furl-Kit Home)**



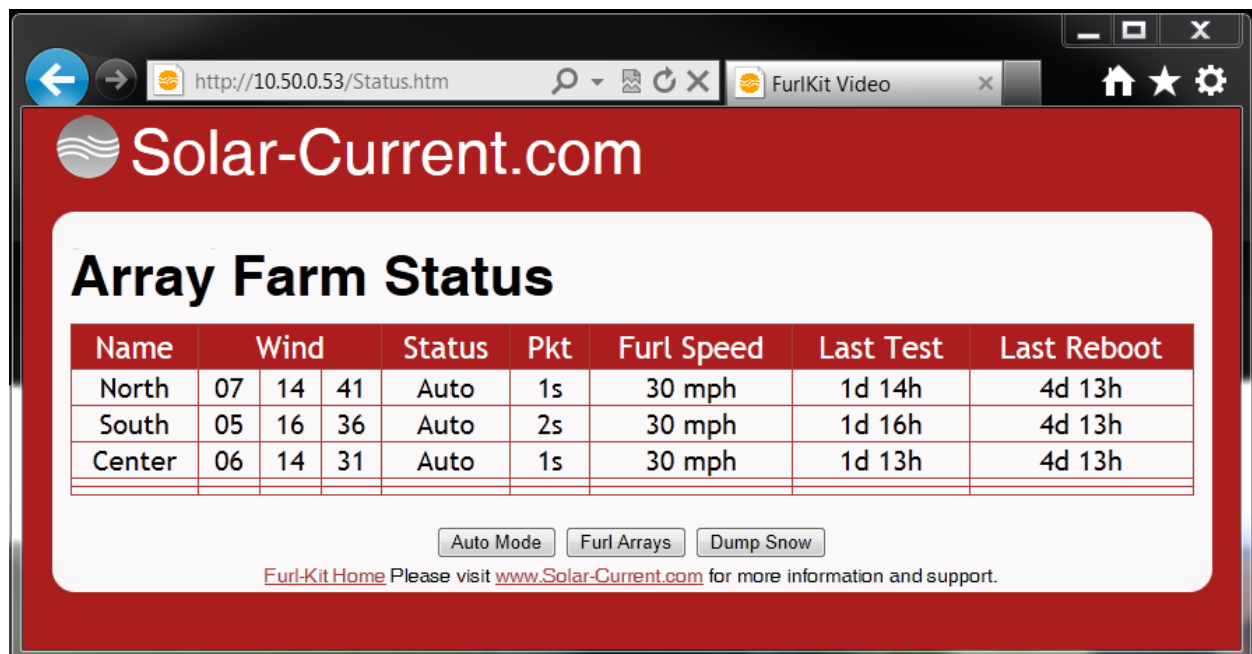
<sup>1</sup> Note: If this is the first time the Solar-Array Supervisor has been powered on you may notice the default address of 192.168.0.201 briefly appear on the LCD display. This address will be replaced by the new address obtained by your home router.

**Error! Reference source not found.** shows the default home Web page for the Furl-Kit Supervisor. From here you can select other pages allowing you to configure each array-mounted Furl-Kit CPU and monitor their status. It is a good idea to bookmark this page so you don't have to remember the TCP/IP address.

## View Array Farm Status

The View Array Farm Status page is used to view detail of each array in your Solar-Array Farm and allows you to send commands to Solar-Array Farm by clicking one of the three buttons at the bottom of the page.

**Figure 7 (View Array Farm Status)**



If you leave this page open on your desktop it will continue to update in the background and alert you to conditions of concern by color coding the columns in the table. For example if the Status column shows "Furl High Wind", it will have a red background making it stand out in the view.

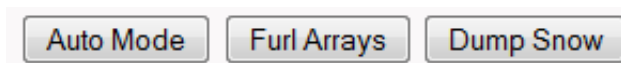
Please Note: By hovering the mouse over the column heading of the table a pop up box will give an explanation of that column. The following table discusses each column in detail.

**Table 3 (Farm Status Table Review)**

Column Heading	Description																										
Name	Descriptive name of each array in the farm. This should have been configured during installation. The default value is a "0".																										
Wind	The wind data for each array is displayed in three sub-columns. The first sub-column is the current wind speed the next is the daily high wind, and the last of the three sub-columns holds the all-time high wind recorded for that array.																										
Status	<p>Here you will see the current status of each Solar-Array. Possible status messages:</p> <table> <tr> <th>Status</th><th>Description</th></tr> <tr> <td>Auto</td><td>Normal Full Sun Tracking mode.</td></tr> <tr> <td>Snow Dump Lock</td><td>The Array is in Snow Dump mode initiated by the switch on the Solar-Array Supervisor.</td></tr> <tr> <td>Furl Lock</td><td>The Array is in Furl Lock mode initiated by the switch on the Solar-Array Supervisor.</td></tr> <tr> <td>Furl High Wind</td><td>The Array has successfully furled after high wind was detected at the array</td></tr> <tr> <td>Furl Test Complete</td><td>Successful Furl Test for the array has completed</td></tr> <tr> <td>Snow Dump 1Hr</td><td>The Array has entered a temporary one hour snow dump. This is initiated by pushing the "Dump Snow" button, described at the bottom of the next page.</td></tr> <tr> <td>Furl 1HR</td><td>The Array has successfully entered the temporary furl stat for 1 hour. This is initiated by pushing the "Furl Arrays" button at the bottom of this page.</td></tr> <tr> <td>Wind Fault</td><td>An error has been detected with the Gimbale Anemometer on the Solar-Array. This condition must be addressed. Please consult the troubleshooting section of this guide on page 43.</td></tr> <tr> <td>Return to Default</td><td>The Solar array has timed out of the temporary one hour snow dump or furl and is returning to the default state.</td></tr> <tr> <td>Furling</td><td>The Solar Array is moving to the furled position.</td></tr> <tr> <td>Test Fail</td><td>The furl self-test has failed. Initiate another test and check the array for movement. If not successful, see the trouble shooting section on page 43 of this guide.</td></tr> <tr> <td>Furl Error</td><td>A furl error has occurred. Initiate a furl test and check the array for movement. If not successful, see the trouble shooting section on page 43 of this guide.</td></tr> </table>	Status	Description	Auto	Normal Full Sun Tracking mode.	Snow Dump Lock	The Array is in Snow Dump mode initiated by the switch on the Solar-Array Supervisor.	Furl Lock	The Array is in Furl Lock mode initiated by the switch on the Solar-Array Supervisor.	Furl High Wind	The Array has successfully furled after high wind was detected at the array	Furl Test Complete	Successful Furl Test for the array has completed	Snow Dump 1Hr	The Array has entered a temporary one hour snow dump. This is initiated by pushing the "Dump Snow" button, described at the bottom of the next page.	Furl 1HR	The Array has successfully entered the temporary furl stat for 1 hour. This is initiated by pushing the "Furl Arrays" button at the bottom of this page.	Wind Fault	An error has been detected with the Gimbale Anemometer on the Solar-Array. This condition must be addressed. Please consult the troubleshooting section of this guide on page 43.	Return to Default	The Solar array has timed out of the temporary one hour snow dump or furl and is returning to the default state.	Furling	The Solar Array is moving to the furled position.	Test Fail	The furl self-test has failed. Initiate another test and check the array for movement. If not successful, see the trouble shooting section on page 43 of this guide.	Furl Error	A furl error has occurred. Initiate a furl test and check the array for movement. If not successful, see the trouble shooting section on page 43 of this guide.
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Pkt	This column shows the seconds since the last RF packet was received from the Solar-Array. If this box is red the Solar-Array may be powered down or there is a																										

	communication fault with that array.
Furl Speed	This is the wind speed in miles per hour that will cause this array to furl and enter survival mode. The default setting is 30 mph.
Last Test	This is the elapsed time since the last successful furl. An automatic furl test is run once a week so this value should not be greater than 7 days.
Last Reboot	This is the elapsed time since the last time the Solar-Array's Furl-Kit CPU was either reset or powered off and back on.

You will find the following three buttons at the bottom of page that allow you to send commands to all the Solar-Arrays in the farm.



#### Auto Mode button

Clicking the Auto Mode button will set all the arrays in the farm to their default state. The factory default state is "Auto Sun Tracking" but this can be changed by your installer or by selecting Furl or Remove Snow on the Solar-Array Console as shown in Figure 4.

#### Furl Arrays button

The Furl Array's button sends a 1 hour furl command to all arrays in the farm. After 1 hour the arrays will return to their default state. Once the arrays have completely furled the Auto Mode button can be used to cancel this selection before the 1 hour cycle is complete if desired. Once the arrays have furled this will count as a successful Furl Test and the last successful furl test counter will be reset to 0 seconds.

Some common uses of this button are to furl (lay the array's flat) for mowing under them, temporarily reducing wind resistance during the bad part of a storm, or it can simply be used as a quick test before an approaching storm. Please note with a heavy overcast sky the arrays may not move after the 1 hour furl is over since the sun is hidden by the clouds.

#### Dump Snow button

The Dump Snow button sends a 1 hour snow dump command to all arrays in the farm. After 1 hour the arrays will return to their default state. Please note: if a

high wind above the furl speed setting is detected during this 1 hour dump the Furl-Kit Array CPU will cancel the snow dump and the array will furl entering survival mode. Clicking the Auto Mode will cancel the 1 hour dump and return the arrays to their default state. Please note: with a heavy overcast sky the arrays may not move after the 1 hour snow dump is over since the sun is hidden by the clouds.

The most common use of this button is to dump the snow off the arrays. It is convenient since you can click it and walk away knowing the arrays will return to tracking the sun after an hour.

### iPhone App

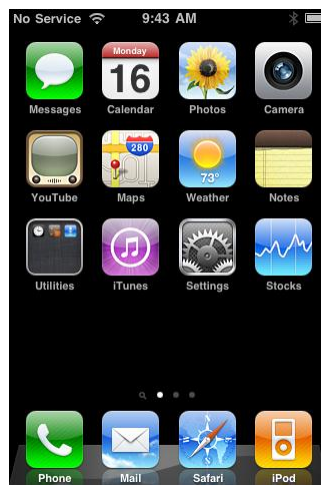
The iPhone App web page is a completely graphical view of all the arrays in the farm. It can be installed on the iPhone and looks and functions just like an app you bought from the iTunes store. You can view the iPhone App page with your pc based browser if your browser is up-to-date and supports HTML 5. Internet Explorer 9 and Firefox version 9 both support HTML 5 and can be used to view the iPhone App. However, to get full functionality the app must be accessed with your iPhone.

### Installing the iPhone App

To install the iPhone App from the Solar-Array's built-in web server, your iPhone must have access to your home network over a secure Wi-Fi connection. Please insure your Wi-Fi hub has security enabled or your neighbors will be able to connect to your Solar-Array Supervisor and control your farm. Please Note: your home network must have a connection to the Internet, as many of the program files used by the iPhone app are loaded from the Solar-Current.com web site. To install the app, follow the next 7 steps.

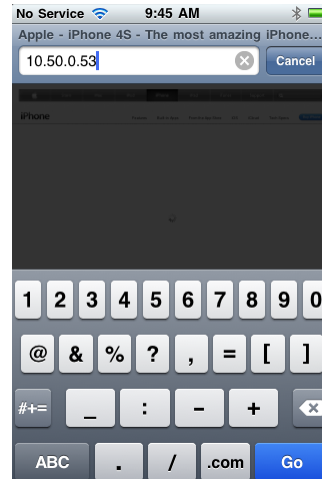
#### Step 1) Open Safari

Tap on the Safari icon from your iPhone's home screen.



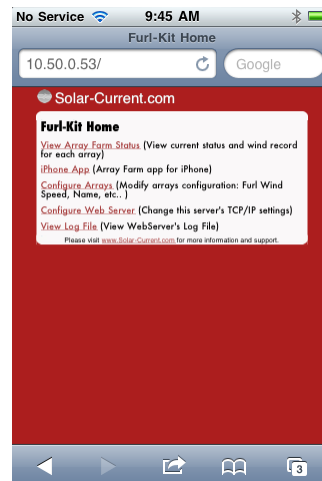
### Step 2) Enter IP Address of Supervisor

In the URL window type in the IP address of your Solar-Array Supervisor. See *Solar-Array Supervisor Web Interface* on page 8 if you need help finding the IP Address. Press the go button to load the Solar-Array Supervisor's home page.



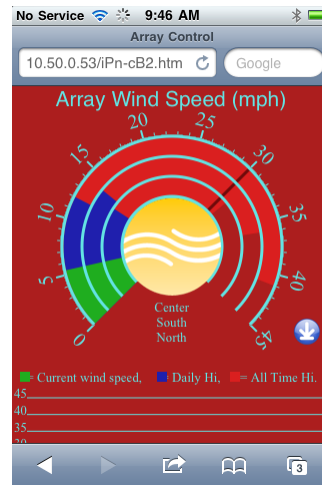
### Step 3) Load the iPhone App

Tap on the "iPhone App" link to load the iPhone app into your web browser.




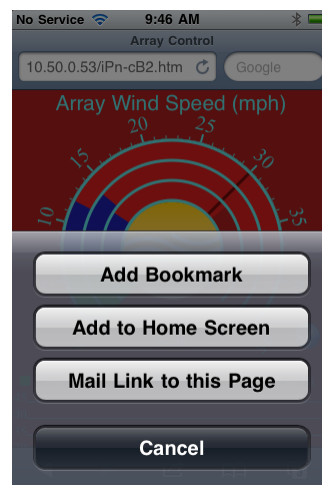
#### Step 4) Wait for App to load

The iPhone app will load but not quite fit on the screen. To complete the installation you must follow the remaining steps.



#### Step 5) Install App to Home Screen

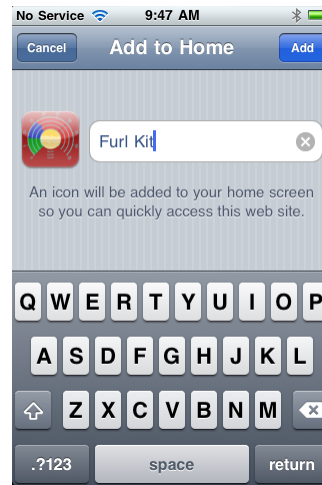
Install the app onto your home screen by tapping the  save link button at the bottom of your screen. This will bring up the following screen. Tap the "Add to Home Screen" button in the menu.






### Step 6) Name the App

Use the on screen keyboard to type in a descriptive name and tap on the "Add" button.



### Step 7) Click on the App from home screen to load

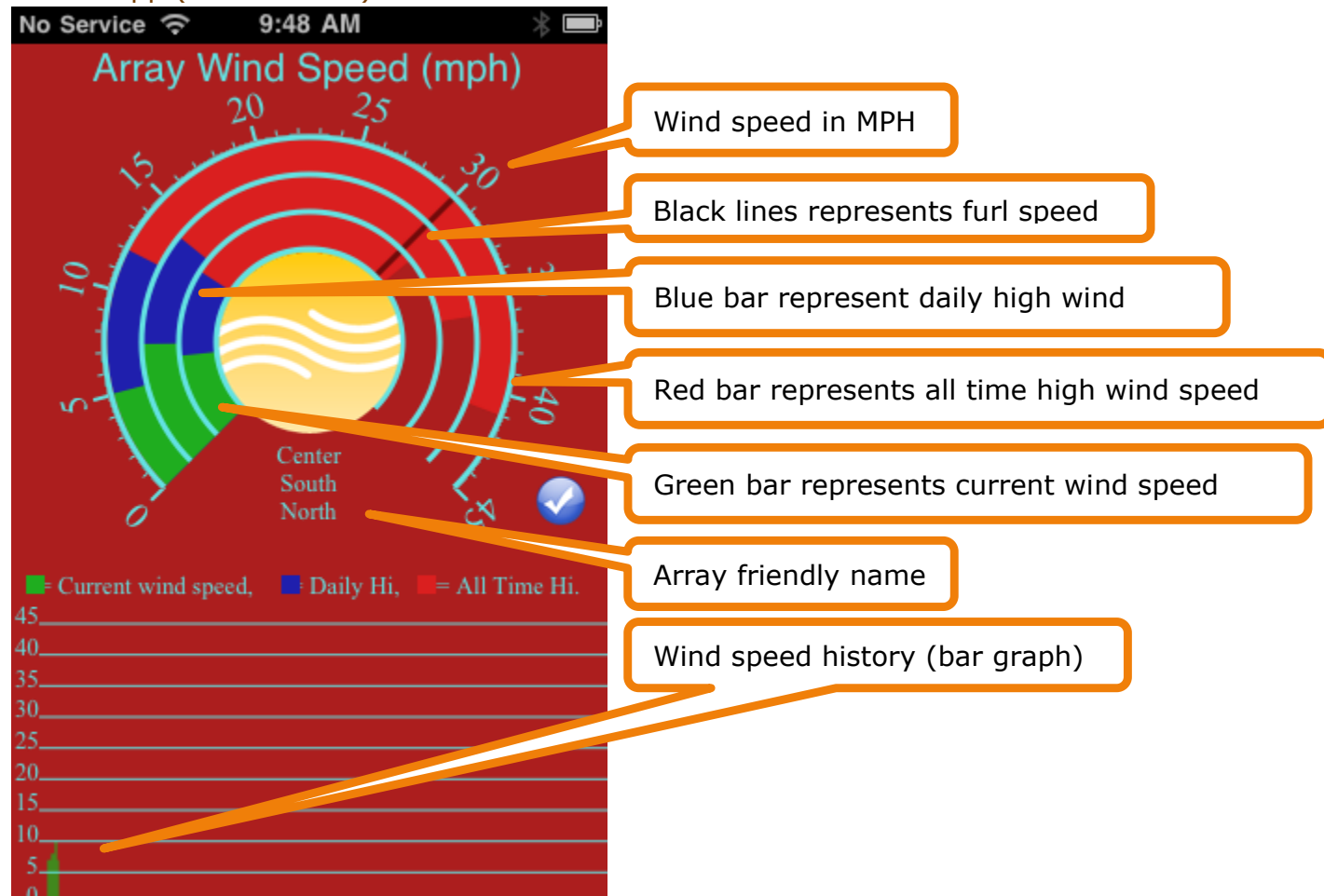
After you hit "Add" in the above step you will see a new app icon added to your home screen. Simply tap on the  icon to load the iPhone app from the Furl-Kit Supervisor.



## Overview of the iPhone App

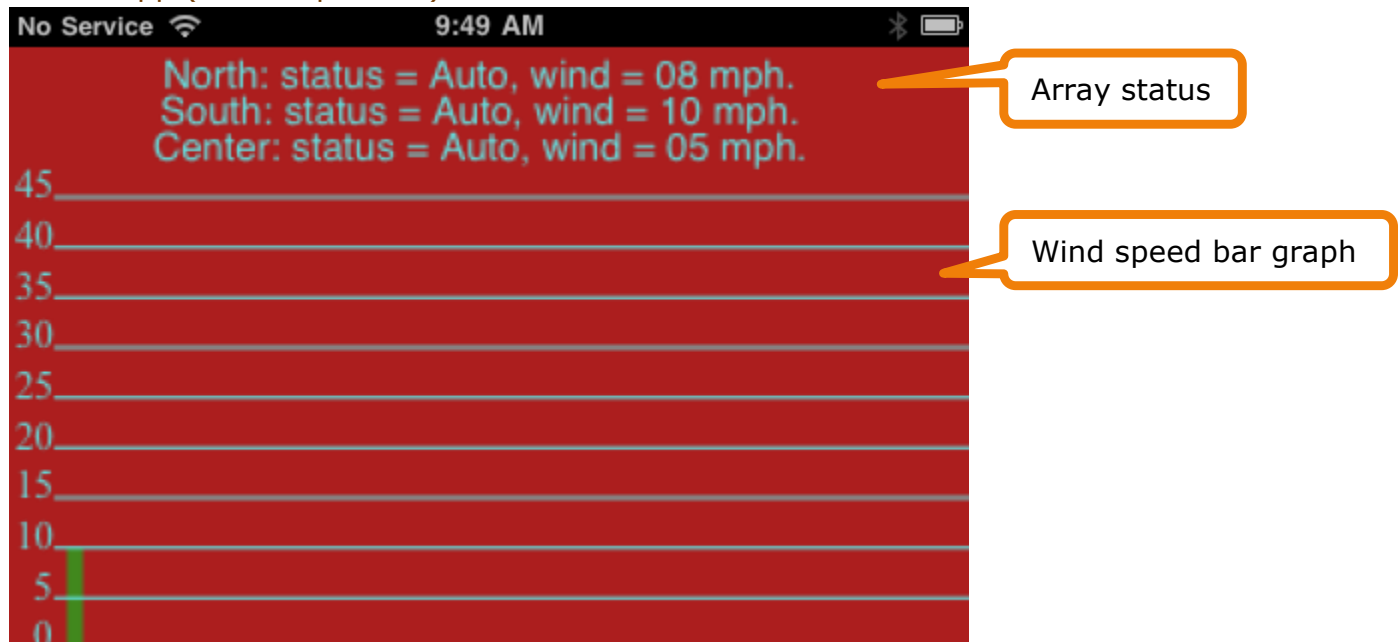
Once the Furl-Kit Supervisor's iPhone App has been installed onto your iPhone you can load it anytime by simply clicking on the icon on the home screen. You may see a brief flash screen as the application loads on your iPhone. Once loaded the app will connect to the Furl-Kit Supervisor and start downloading data about your Solar Array Farm. The data will be uploaded several times a minute and you will notice the color bars in the circular graph move as the wind speed changes on each array.

### iPhone App (Portrait view)



Your view may vary depending on the number of solar arrays in your farm and the max wind speed recorded at your site. If you have more solar arrays in your farm you will see more, thinner color bars than pictured here. If you have fewer arrays you will see fewer fatter color bars. The bar graph at the bottom is updated every time the app reads data from the Furl-Kit Supervisor. Each green line represents the max sampled wind at that point in time. Old data scrolls off to the left when new data is added on the right.

## iPhone App (Landscape view)

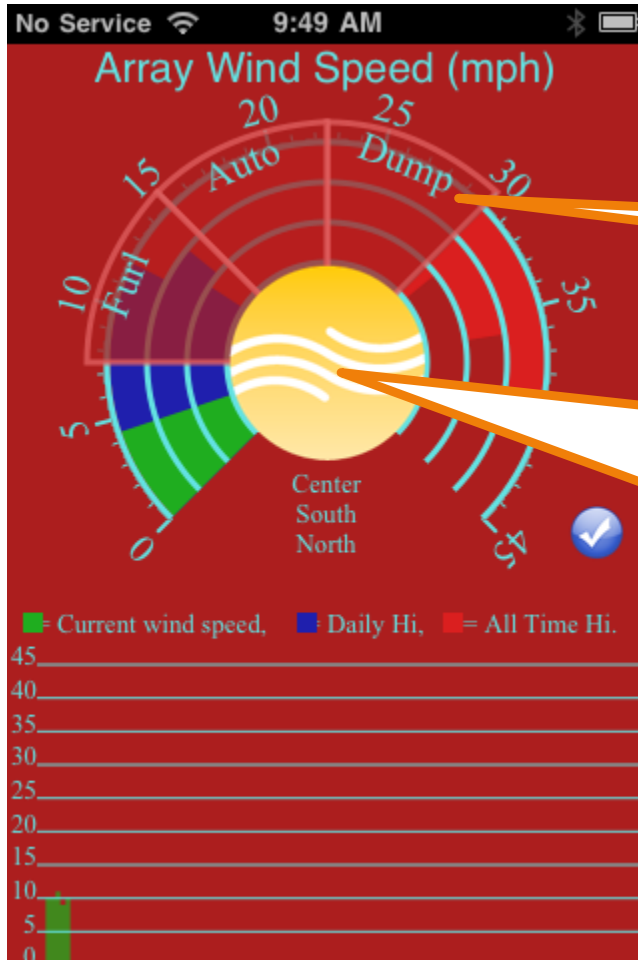


To access the "landscape view" of the iPhone app simply rotate your iPhone and hold it. The app will detect the rotation and change the screen as pictured above. This view shows the same bar graph data as in the portrait view, as well as, the current wind speed and status of each solar array in the farm.

The iPhone app can be left open on your iPhone to function as a portal to your Solar-Array Supervisor. Both the portrait and landscape views will continually update with current wind data from each Solar-Array in the farm. It is possible to install the app on multiple iPhones, but it is supported to have only one of them running the app at a time, due to the load placed on the Solar-Array Supervisor's web server.

### iPhone App (Command Menu)

To send commands to your farm from the iPhone, place a finger on the yellow center of the iPhone App and hold it there. A circular menu will pop up around your finger, allowing you to slide your finger over the option you desire. Once the command you would like to send is highlighted, remove your finger to send the command to all arrays in the farm.



Command Menu

To send a command place your finger on the yellow sun and hold it there until the command menu appears. Then, while keeping your finger down, slide it in the direction of the desired command and hold. Once the desired command is highlighted pick up your finger to send the command to all arrays in the farm.

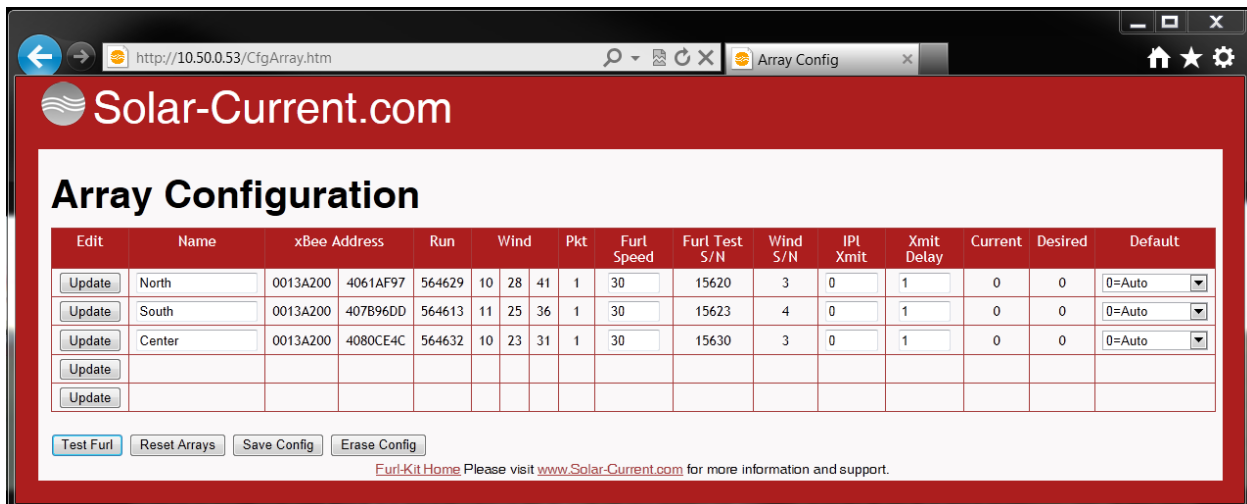
The command menu sends the same commands as the "Auto, Furl, and Dump" buttons discussed on page 11. After you release your finger, you may notice a delay as the command is being sent by Solar-Array Supervisor. Once the screen returns to its normal view, you can rotate your iPhone to the landscape position to see the status of each array.

## Configure Arrays

The Configure Arrays page is used to view and set the configuration of each array in your Solar-Array Farm. This page is used by your installer during installation to setup and test each Furl-Kit CPU in your Solar-Array farm. It can, also, be used to help troubleshoot problems and fine-tune your installation over time.

To access the Array Configuration, click on the "Configure Arrays" link from the Solar-Array Supervisor's home page. If you need help accessing this home page see the *Solar-Array Supervisor Web Interface* section on page 8.

**Figure 8 (Configure Arrays Page)**



Edit	Name	xBee Address	Run	Wind	Pkt	Furl Speed	Furl Test S/N	Wind S/N	IPI Xmit	Xmit Delay	Current	Desired	Default
<input type="button" value="Update"/>	North	0013A200 4061AF97	564629	10 28 41	1	30	15620	3	0	1	0	0	0=Auto
<input type="button" value="Update"/>	South	0013A200 407B96DD	564613	11 25 36	1	30	15623	4	0	1	0	0	0=Auto
<input type="button" value="Update"/>	Center	0013A200 4080CE4C	564632	10 23 31	1	30	15630	3	0	1	0	0	0=Auto
<input type="button" value="Update"/>													
<input type="button" value="Update"/>													

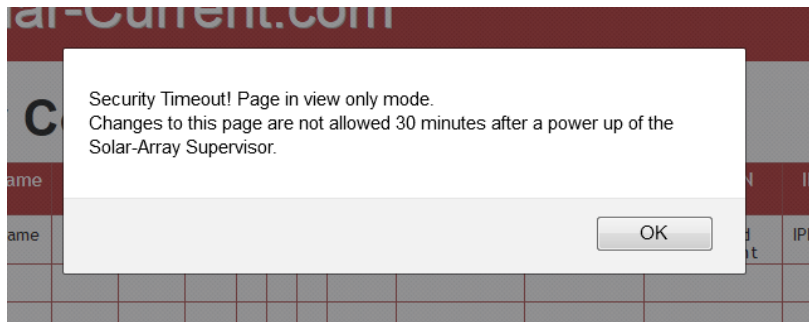
Furl-Kit Home Please visit [www.Solar-Current.com](http://www.Solar-Current.com) for more information and support.

The page will load and you will notice some of the fields have an edit window where you can click and type new values. If you need more information on what each column in the table is, hover your mouse over the column heading and a popup box will give you more information. Please note this page does not auto update. Use the refresh key F5 to refresh the contents of this page.

## Security Timeout Note:

You may see a security warning as shown in Figure 9, below, when you load this page. If it has been more than 30 minutes since the Solar-Array Supervisor has been powered up you will get this message and will have view-only access to this page. Since this page allows the user to change configuration information, for security reasons, it is only available to be edited for 30 minutes after the Solar-Array Supervisor is powered on. As noted in the installation section of this document, the Solar-Array Supervisor's web site must not be openly accessible from the Internet. It deploys a minimal security model and could be hacked from the Internet. However, it is possible to access the Solar-Array Supervisor's web site from the Internet over a VPN connection. See the support section of [www.Solar-Current.com](http://www.Solar-Current.com) for router requirements and configuration.

**Figure 9 (Security Timeout popup)**



To gain write access to this page, simply remove and restore the power to the Solar-Array Supervisor and repeat the process up to this point. The page will load and you will not see the Security time out message.

The following table provides a description of each column in the Array Configuration table.

**Table 4 (Array Configuration Table)**

Column Heading	Description
Edit	The Edit Column contains an "Update" button that will send the changes in that row to the Solar-Array Supervisor. The Solar-Array Supervisor in turn wirelessly sends the settings to the Furl-Kit CPU with the serial Number matching the last half of the address in the xBee column. Any time changes are made for an array, the update button must be pressed to submit the changes.
Name	Enter a descriptive name for this array (Max 15 characters). This should have been configured during installation. The default value is a "0". After you have set all the array's names push the "Save Config" button at the bottom of the page to store the names in the Solar-Array Supervisor's EEPROM (permanent memory). If you don't save them, they will be reset when the power is cycled to the Solar-Array Supervisor.
xBee Address	This is the unique hexadecimal address of the radio in the Furl-Kit CPU. The last 8 hexadecimal digits (2 <sup>nd</sup> half of the column) is also the serial number of the Furl-Kit CPU and is laser-etched onto the lid of each Furl-Kit CPU.
Run	This is the elapsed time in seconds since the last time the Solar-Array's Furl-Kit CPU was either reset or powered off and back on.
Wind	This column has three sub columns, one each for current wind, daily high and all-time high wind speeds. All wind speeds are reported in miles per hour. The daily high wind speed resets to 0 every 24 hours. The time it resets is exactly 24 hours from the time the array was last powered on or reset. For example if the Furl-Kit CPU was powered on at 3pm every day, at 3pm the daily high wind speed will be reset to 0. The all-time high wind speed is retained in EEPROM memory in the Furl-Kit CPU and cannot be erased even if power is removed.
Pkt	This is the elapsed time in seconds since the last good radio packet was received from the Furl-Kit CPU. If this number is consistently larger than the number in the Xmit Delay column, the Furl-Kit Supervisor may be dropping packets and may need to be located closer to the array farm.

Furl Speed	Enter the wind speed in miles per hour that will cause the Furl-Kit CPU to furl the array. The factory setting is 30 MPH. Each solar array can have a unique furl speed if desired.
Furl Test S/N	This is the elapsed time in seconds since the last furl test or last time the array has entered a furled state. If this number is larger than 604,800 (7 days), there may be a problem with this array's furl sensor.
Wind S/N	This is the elapsed time since the Furl-Kit CPU has received a wind pulse from the gimbaled anemometer on the array. If there isn't any wind, the number will start to count up until enough wind exists to spin the cups on the anemometer. If you notice that one of the arrays has a high wind S/N and the others are low there may be a problem with the anemometer. Check to make sure it is free to spin and still connected to the Furl-Kit CPU.
IPL Xmit	This is how long in seconds the Furl-Kit CPU will wait before it starts to transmit its data stream after a reboot. The factory setting is 0 and should not be changed.
Xmit Dealy	This is the time, in seconds, between transmission of data from each Furl-Kit CPU to the Solar-Array Supervisor. The factory default is 90 seconds. If the user is going to use the iPhone app or would like to receive close to real time data on the Solar-Array Supervisor's LCD display, it is recommend to set this delay at 1 to 5 seconds.
Current	This column contains a number representing the current reported state of the array. See Table 5 (Array-CPU State Numbers) for a description of the numbers in this column.
Desired	This column contains a number representing the desired state of the array. The Desired state may not match the current state. For example when the array is furling (moving to a furled position) the Desired state may be 6 (Furl 1hr) but the Current state will be 9 (furling) and remain a 9 until the Furl Kit CPU detects that the array has successfully moved to the furl position. At that time the current state will be changed to 6 (Furl 1hr).
Default	The Default column allows you to select the default state of each array. You can set it to Auto (Factory Default), Snow Dump or Furl Lock. This allows you to lock one of the arrays into a furl position if desired. Please note that this setting can be overridden by changing the switch on the Solar-Array Supervisor.



### Table 5 (Array-CPU State Numbers)

The Red, Green and Yellow boxes show the priority one state has over the other. Basically if the Furl-Kit CPU detects wind above the Furl Speed setting, the array is going to furl regardless of its default setting, a web based request or the setting on the Solar-Array Supervisor's console. Nothing is going to stop the array from furling during a high wind. It is the highest priority state!

You will find the following 4 buttons at the bottom of the Array Configuration page:



Test Furl button

Clicking the Test Furl button will send a test furl command to all arrays in the Farm. Each Array will start moving to the Furl position as soon as it receives the command. Once the furled sensor detects that the array has completed furling, the

Furl-Kit CPU will return the array to the default status. Please Note: any time an array successfully furls this is considered as a successful furl test and the furl test S/N will be reset to zero for that array.

#### Reset Arrays button

Clicking the Reset Arrays button will send a reset command to each Furl-Kit CPU in the farm. This will cause the CPU to reboot and will reset the Run Time seconds, Furl Test S/N, Wind S/N, and the Daily High Wind. Your installer may have you run this command to reset your Daily High Wind counter to a time that suits you. For example if you would like the daily high wind to be reset every evening at 9pm simply click on this button at 9pm and from that day forward (as long as the Furl-Kit CPU is not reset again) your daily high wind will be set to zero at 9pm.

#### Save Config button

Clicking the Save Config button will store the array names to permanent memory in the Solar-Array Supervisor. If this is not done, the names will be reset to their previously saved value if the power is cycled on the Solar-Array Supervisor.

#### Erase Config button

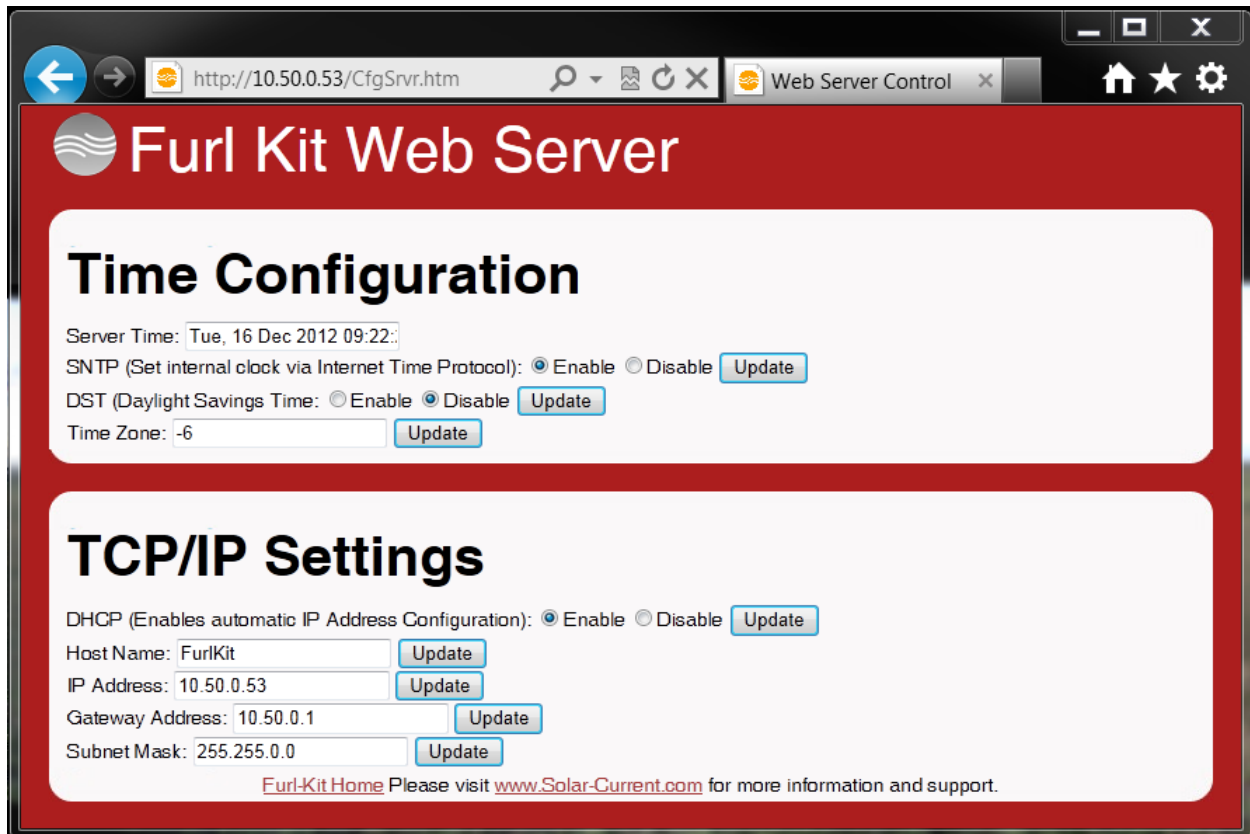
Clicking Erase Config will set all the array names back to their factory default of "0". This will also cause the Solar-Array Supervisor to forget all the arrays and only list the ones that are currently transmitting data. Your installer may use this to reset your list of arrays if he has replaced a Furl-Kit CPU and needs to remove the old one.

## Configure Web Server

The Configure Web Server page is used to view and set the configuration of the Solar-Array Supervisor. This page is used by your installer to setup the time and TCP/IP settings of the Solar-Array Supervisor.

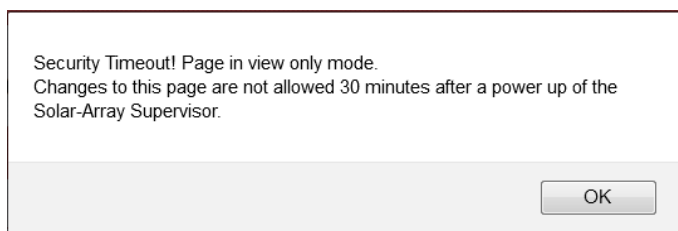
To access the Configure Web Server page click on the "Configure Web Server" link from the Solar-Array Supervisor's home page. If you need help accessing this home page, see the *Solar-Array Supervisor Web Interface* section on page 8.

**Figure 10 (Furl Kit Web Server page)**



If you see the security Timeout message (Figure 11) when you access this page refer to the Security Timeout Note: on page 19 for a description and steps on how to gain write access to this page.

**Figure 11**



The Furl Kit Web Server page contains two sections: one for the time configuration of the Solar-Array and the second is for the TCP/IP configuration.

The following two tables provide a description of the Time Configuration and TCP/IP Settings sections.

**Table 6 (Furl Kit Web Server Time Configuration)**

Configuration Item	Description
Server Time	This is a view-only window of the current time on the Solar-Array Supervisor. The time is set at the factory and is automatically updated through the Internet but is not editable by the user or installer.
SNTP	If this setting is enabled, SNTP is used to set the internal clock of the Solar-Array Supervisor every time it is powered on. SNTP is a time protocol used on the Internet to set the time of devices based on a very accurate time source. To take advantage of this protocol the Furl-Kit Supervisor must be connected to a home network that allows Internet access. The radio buttons are used to enable or disable the automatic setting of time. The default is enabled. To change this setting select your option and click on the Update button to store it in the Solar-Array Supervisor's memory.
DST	Enable or Disable this option if your location is currently in daylight savings time. To change this setting select your option and click on the Update button to store it in the Solar-Array Supervisor's memory.
Time Zone	Enter the time zone for your location. <ul style="list-style-type: none"> <li>• East Coast, Time Zone = -5</li> <li>• Central, Time Zone = -6</li> <li>• Mountain, Time Zone = -7</li> <li>• West Coast, Time Zone = -8</li> </ul> To change this setting enter your time zone number and click on the Update button to store it in the Solar-Array Supervisor's memory.

**Warning!** Changes to the TCP/IP section of this page may cause your Solar-Array Supervisor to stop responding from your home network! This situation is not covered under warranty.

**Table 7 (Furl Kit Web Server TCP/IP Settings)**

Configuration Item	Description
DHCP	Enable or Disable the automatic setting of the Web Server's TCP/IP configuration. When enabled (default setting), the home network router will assign a TCP/IP address to the Solar-Array-Supervisor's web server. This address will appear during power up of the Solar-Array Supervisor.
Host Name	This is the host name used when registering with a DHCP server or router. Max size of 20 characters. The default setting is FurlKit. If you add a second Solar-Array Supervisor to your network make sure to change its host name. For example if you add a 2 <sup>nd</sup> Solar-Array Supervisor in your bedroom you could name it FK-BedRoom.
IP Address	This is the IP address used to access the Solar-Array Supervisor's internal Web Server. The default IP address from the factory is 192.168.0.201. However, this address will be automatically changed by your router. It is possible to give the Furl-Kit Supervisor a static address. To do this type in the desired IP address in dot format ie: ###.###.###.### and hit Update. Also, disable the DHCP setting so the address is not changed after a reboot.

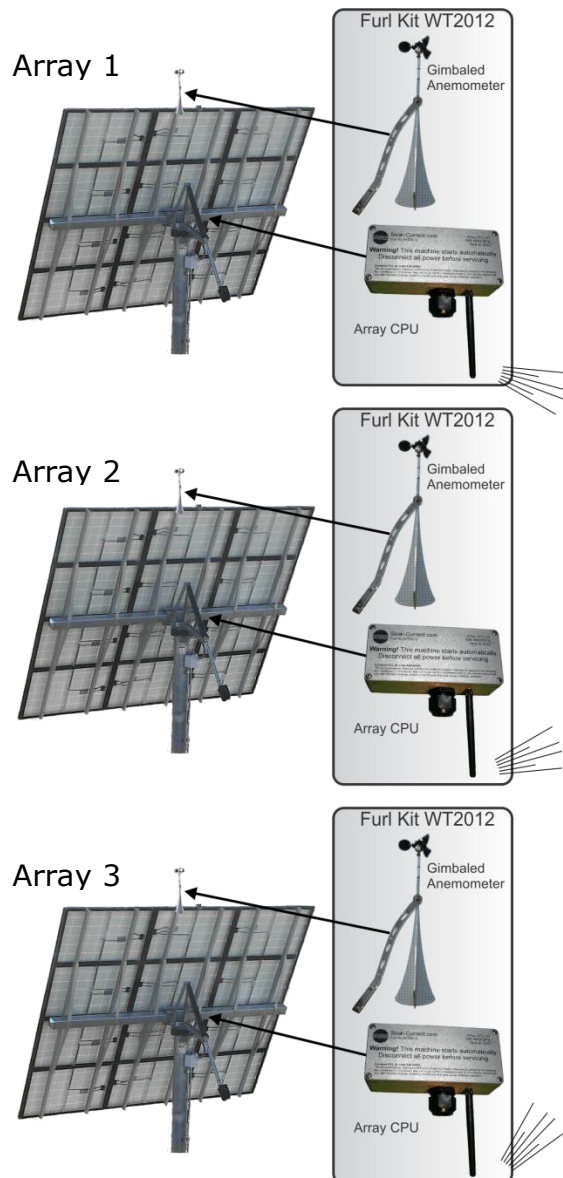
	You must reboot the Solar-Array Supervisor in order for this change to take effect.
Gateway Address	This is the address of your router or gateway to the Internet. The Solar-Array Supervisor must have access (outbound only) to the Internet for the iPhone app and the SNTP time setting features to work properly. This gateway address is set automatically by your router and the factory default setting is 192.168.0.1. If you are assigning a static address (see IP Address above) you must enter a valid gateway or router address in this field and hit update before you reboot.
Subnet Mask	The Subnet mask is also set by your DHCP enabled router. The factory default is 255.255.255.0 and for most cases this will be what you see in your configuration. Like the IP Address and Gateway Address this field can be statically set if desired.

Please note that all changes to this page require a reboot of the Solar-Array supervisor before they take effect. **Warning! It is possible to enter an invalid configuration on this page rendering your Solar-Array Supervisor inaccessible from your home network! The Solar-Array Supervisor will have to be sent back to the factory for reprogramming if this happens.** Only qualified technicians should make changes to the TCP/IP section of this web page.

## Installation and Setup

In Figure 12 we show the components for a 3 solar array system with the Furl Kit installed on each array. Up to 5 solar arrays are supported with one Solar-Array Supervisor. For an overview of the Furl-Kit's components see the *Furl-Kit Overview* on page 2 of this document.

**Figure 12**



In a multi-array installation each solar array will have a Furl Kit Array CPU and Gimbaled Anemometer installed. This insures accurate independent wind measurements at each array and provides a baseline of wind data used by the Solar-Array Supervisor to detect system problems. The Furl Kit Array CPU is designed to run off the same 5 amp 24 volt dc power source used by the Array's tracker controller, **No** new wires are required to the array.



The Solar-Array Supervisor communicates with the Array mounted Furl Kits wirelessly; no new trenching or conduit is required for communication or power wiring.

Multiple Solar-Array Supervisors may be installed if desired. This will allow control of the arrays from multiple rooms.

The Furl Kit CPU and Solar-Array Supervisor should be installed by a qualified dealer / technician. There are dangerous voltages and moving parts on the Solar-Array and great care must be taken during installation. The Furl-Kit WT2012 is designed to work on the Wattsun Tracker AZ-225 Dual-Axis Solar tracker only.

## Solar-Array Supervisor Installation

The Solar-Array Supervisor is installed inside the user's home and wirelessly communicates with each Furl-Kit CPU. The user can have multiple Solar-Array Supervisors installed in the house if desired. If multiple Solar-Array Supervisors are to be installed, make sure they are ordered with the same PAN as the Furl Kit CPU. Install one, at first, adding the other supervisors later after the Furl Kit CPU's have been installed.

### Site Preparation

- Physical location of the Solar-Array Supervisor
  - Select a location inside the house close to the Solar-Arrays to be monitored.
  - The Solar-Array Supervisor will need to plug into 110 volt ac wall plug as well as a RJ-45 network jack on the back of a router or hub.
  - The Solar-Array Supervisor is quiet (no fan) and small, only 5" wide by 3" high and can easily sit on a counter in the kitchen or night stand.
- Home Network
  - The user's home network should have a router supporting DHCP and an available IP address for the Solar-Array Supervisor. Most routers will do this by default.
  - The Solar-Array Supervisor doesn't require a connection to the Internet for the core features to function. However, if the user plans on using the iPhone app, a connection to the internet is required. Again most common routers will provide connection to the Internet.
  - Security: The Solar-Array Supervisor is not designed to sit directly on the Internet or have its web interface exposed to the Internet. The Solar-Array Supervisor employs a minimum security model to make it user friendly. Most home routers are setup by default to allow outbound connections, only, and prevent access from the Internet to your home network. As long as the user's home router meets this requirement the system will be safe.
  - The Solar-Array supervisor will work very well over the user's Wi-Fi network. In fact Wi-Fi is required to use the iPhone app. If the user has a home Wi-Fi network, make sure it is using security (WEP or better).



## Solar-Array Supervisor Step by Step

### Step 1) Unpack and Inspect

Unpack the Solar-Array Supervisor and make sure you have the following items:

- Solar-Array Supervisor
- 5v dc power supply
- Cat5e cable
- 2.4ghz antenna

Note the information on the back side of the Solar-Array Supervisor.

**Figure 13 (Solar-Array Supervisor's backside label)**



The most important item to check at this time is the PAN ID. This number must match the PAN ID on each of the Furl-Kit Array CPUs or they will not communicate over the wireless network. This number is set at the factory and any new Furl-Kit Array CPUs or Supervisors must be ordered with the same PAN number.

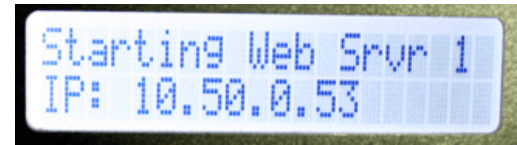
### Step 2) Connect Cables

1. Connect the antenna to the right side of the Solar-Array Supervisor.
2. Connect the Cat5e cable to the home network router and RJ45 jack on the right side of the Solar-Array Supervisor as shown. Make sure the home router is powered on.
3. Make sure the three-way switch on the front right of the Solar-Array Supervisor is set to the center Auto position.
4. Plug in the DC connector to the right side of the Solar-Array Supervisor and then plug it into an 110v wall pug.

### Step 3) Note the IP Address

Once the Solar-Array Supervisor powers up, it will query the home network router for a valid TCP/IP address. To do this, it briefly boots up under its default IP address of 192.168.0.201 and then will quickly reboot when it gets the new address from the home router. This new address is displayed on the LCD display for 10 seconds. Jot this address down it will be used to connect to the Web interface. The

Address in this example is 10.50.0.53 but your address will not be the same, this is just a sample of what it will look like on the display. If you don't get it all written down just remove the power and plug it back in to see the address again.



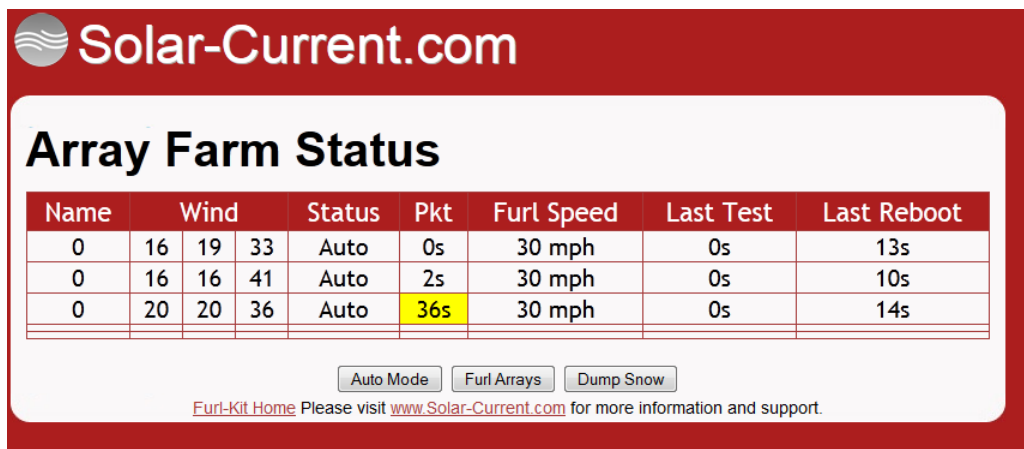
Note: If the address doesn't change from the default of 192.168.0.201 the Solar-Array Supervisor didn't receive an IP address from the router. Check the network connection and try again. If it still didn't change, refer to the troubleshooting section of this guide.

## Step 4) Connect to the Web Server interface

Connect to the Web Server interface by using the IP address displayed on your LCD as your browser's URL, [HTTP://10.50.0.53](http://10.50.0.53). See the *Solar-Array Supervisor Web Interface* section on page 8 of this document for more information.

From the Furl-Kit Home page Click on the View Array Farm Status page. This will load the Array Farm Status page and list the Furl-Kit Servers connecting the Solar-Array Supervisor. This page will continually poll the Solar-Array Supervisor and update the table with the latest information.

**Figure 14**



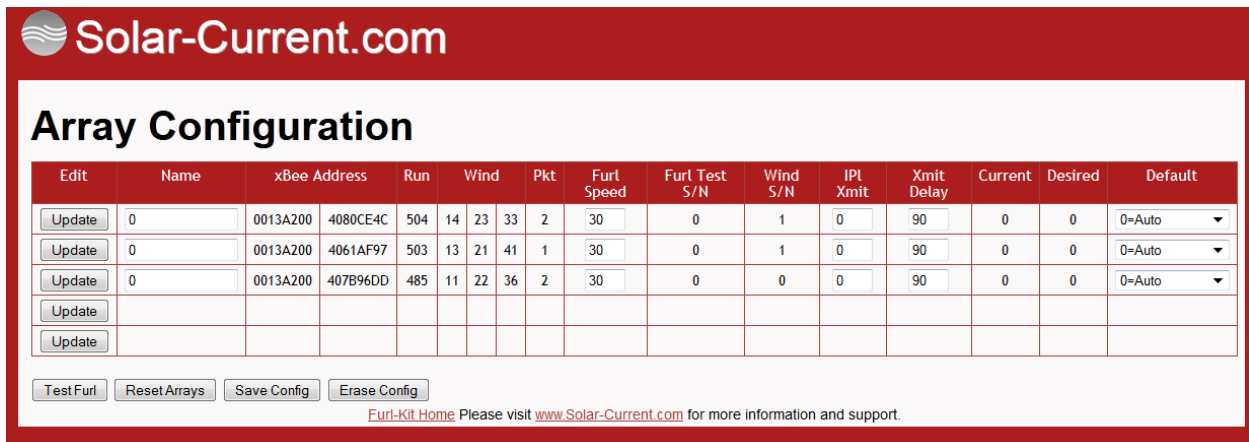
If you haven't installed the Furl-Kit CPU on the array(s) you will not see any arrays listed on this page (see Figure 14). It is now a good time to stop and Install the Furl-Kit CPUs and return to this page and continue with Step 5) when they are all installed and listed in this view.

## Step 5) Configure the Furl-Kit CPUs

After all the Furl-Kit CPU's have been installed, you should see a line in the table of Figure 14 for each array in your farm. The example in Figure 14 shows three arrays have been found by the Solar-Array Supervisor.

To configure the Furl-Kit CPUs click on the Furl-Kit Home link to return to the home page and click on "Configure Arrays" link. The Array Configuration page will appear as shown in Figure 15.

**Figure 15**



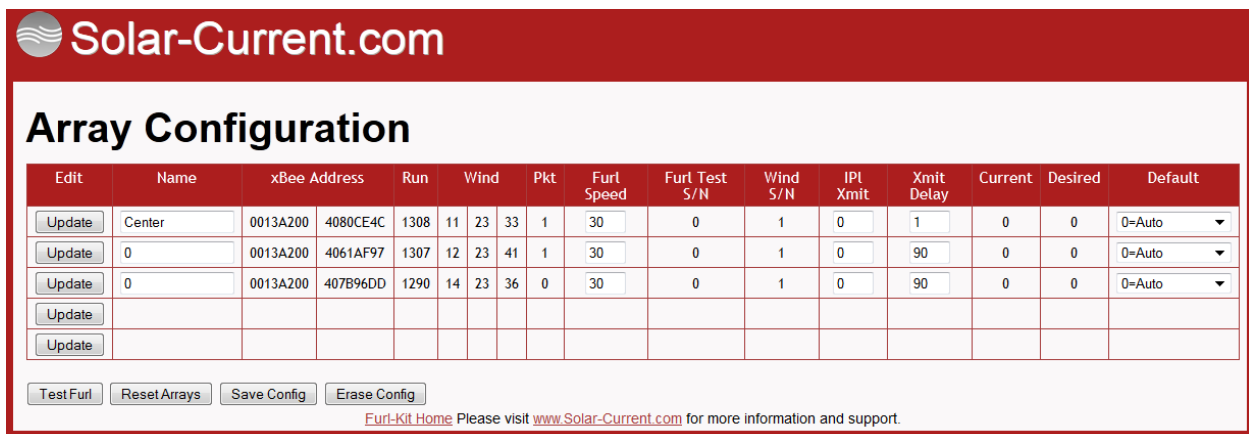
Edit	Name	xBee Address	Run	Wind	Pkt	Furl Speed	Furl Test S/N	Wind S/N	IPI Xmit	Xmit Delay	Current	Desired	Default
<input type="button" value="Update"/>	0	0013A200 4080CE4C	504	14	23	33	2	30	0	1	0	90	0 0 0=Auto
<input type="button" value="Update"/>	0	0013A200 4061AF97	503	13	21	41	1	30	0	1	0	90	0 0 0=Auto
<input type="button" value="Update"/>	0	0013A200 407B96DD	485	11	22	36	2	30	0	0	0	90	0 0 0=Auto
<input type="button" value="Update"/>													
<input type="button" value="Update"/>													

Furl-Kit Home Please visit [www.Solar-Current.com](http://www.Solar-Current.com) for more information and support.

Two changes should be made for each array, change the array's name and change the Xmit delay to a lower value from 1 to 15. See the *Configure Arrays* section on page 19 of this document for more information on the settings of the Array Configuration page.

For example, using the xBee Address column you can determine which solar array is represented by the 4080CE4C address. This is the Serial Number etched on the case of the center solar-array's Furl-Kit CPU. This happens to be the Center array in our line of three so we will type in "Center" for the name field. Next we will change the Xmit delay from 90 to 1 second and hit the update button for that line in the table. After we hit refresh (F5) in the browser, the table will look like the table in Figure 16.

**Figure 16**



Edit	Name	xBee Address	Run	Wind	Pkt	Furl Speed	Furl Test S/N	Wind S/N	IPI Xmit	Xmit Delay	Current	Desired	Default
<input type="button" value="Update"/>	Center	0013A200 4080CE4C	1308	11	23	33	1	30	0	1	0	1	0 0 0=Auto
<input type="button" value="Update"/>	0	0013A200 4061AF97	1307	12	23	41	1	30	0	1	0	90	0 0 0=Auto
<input type="button" value="Update"/>	0	0013A200 407B96DD	1290	14	23	36	0	30	0	1	0	90	0 0 0=Auto
<input type="button" value="Update"/>													
<input type="button" value="Update"/>													

Furl-Kit Home Please visit [www.Solar-Current.com](http://www.Solar-Current.com) for more information and support.

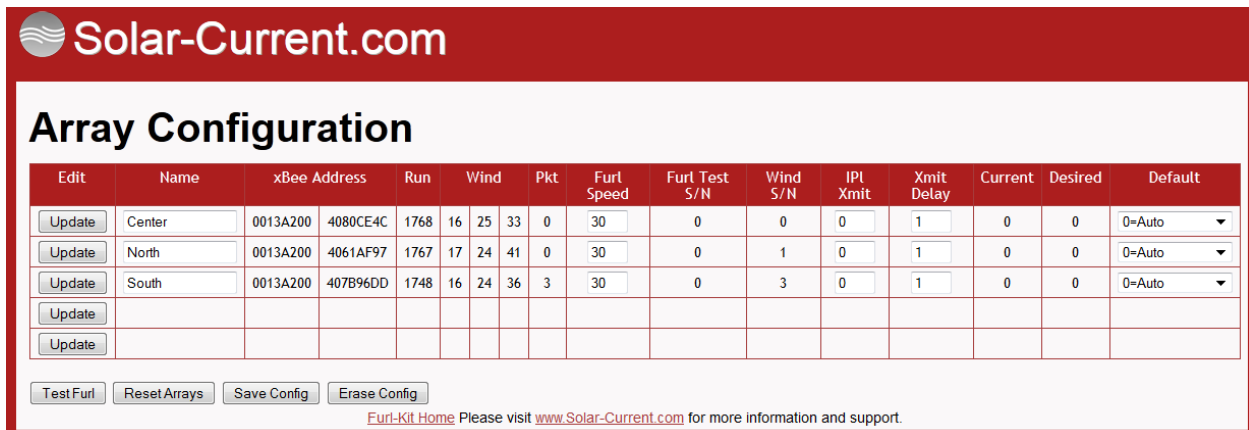
Repeat the process for the remaining two lines of the table, typing in the name for each array, the Xmit value and pressing the update button. Once all the arrays have been updated push the Save Config button to save the configuration on the Solar-Array Supervisor.

### Step 6) Test and Check Results

After step 5 is complete, each Furl-Kit CPU is configured and ready for final testing.

Hit the refresh key to reload the Array Configuration page and you should see all the arrays with the name fields filled in for each array and the proper "Xmit Delay" as shown in Figure 17.

**Figure 17**



Edit	Name	xBee Address	Run	Wind	Pkt	Furl Speed	Furl Test S/N	Wind S/N	IPI Xmit	Xmit Delay	Current	Desired	Default
<input type="button" value="Update"/>	Center	0013A200 4080CE4C	1768	16 25 33	0	30	0	0	0	1	0	0	0=Auto
<input type="button" value="Update"/>	North	0013A200 4061AF97	1767	17 24 41	0	30	0	1	0	1	0	0	0=Auto
<input type="button" value="Update"/>	South	0013A200 407B96DD	1748	16 24 36	3	30	0	3	0	1	0	0	0=Auto
<input type="button" value="Update"/>													
<input type="button" value="Update"/>													

Furl-Kit Home Please visit [www.Solar-Current.com](http://www.Solar-Current.com) for more information and support.

The first thing to check is the wind speed. Each array should have a value for the daily high wind (unless no wind has been blowing since the install) and the value for the "Wind S/N" column should be similar in value. If you don't see wind speed values above 0, check the connection of the anemometer for that array to insure it is properly connected to the Furl-Kit CPU.

Next, click on the "Test Furl" button at the bottom of the Array Configuration page. After a few moments you will notice all the arrays in the farm starting to lay flat. Once they completely lay flat for one full minute, that will complete the furl test and they will return to tracking the sun. Hit the refresh key on your browser and notice that Furl Test S/N will start to increment as it is now counting the seconds since a successful furl has occurred.

**Figure 18**

### Array Configuration

Edit	Name	xBee Address		Run	Wind			Pkt	Furl Speed	Furl Test S/N	Wind S/N	IPL Xmit	Xmit Delay	Current	Desired	Default
<input type="button" value="Update"/>	Center	0013A200	4080CE4C	2730	17	27	33	0	30	56	5	0	1	0	0	0=Auto ▼
<input type="button" value="Update"/>	North	0013A200	4061AF97	2728	13	26	41	1	30	24	4	0	1	0	0	0=Auto ▼
<input type="button" value="Update"/>	South	0013A200	407B96DD	2711	15	27	36	1	30	33	4	0	1	0	0	0=Auto ▼
<input type="button" value="Update"/>																
<input type="button" value="Update"/>																

Furl-Kit Home Please visit [www.Solar-Current.com](http://www.Solar-Current.com) for more information and support.

If any of the arrays fail their furl test (Furl Test S/N = 0) check that array's installation to insure the furl sensor is adjusted close enough to the magnet that triggers the sensor. You also may have to hit refresh several times as the Array Configuration web page does not auto refresh.

Once all the arrays have passed their furl test and are reporting wind data the system is ready for operation.

#### Step 7) Review with users

As a final step, review the Solar-Array Supervisor's web site and the operation of the switch and LCD display with any users of the system. It is also a good idea to bookmark Furl-Kit Home page in the browser to make it easy to access. The View Array Farm Status page can be kept open in a browser window and it will continue to update with the current wind data and farm status.

If the iPhone application is going to be used follow the steps in the *Installing the iPhone App* on page 12 of this manual.

## **Furl Kit CPU Installation**

Each Solar Array to be managed by the Solar-Array Supervisor must have a Furl Kit CPU installed. This requires the installation of 3 key components:

1. Furl Kit CPU
2. Furl Sensor
3. Gimbaled Anemometer

The Wattsun Tracker should be installed and verified to be in proper working order before the installation. The Furl Kit CPU does not replace the Wattsun Tracker Controller; it simply connects between the Controller and the Solar Array's elevation motor.

## **Site Preparation**

- Verify that the existing Wattsun Tracker is in full operating condition and able to accurately follow the sun with both axes.
- Verify that the array's elevation motor can freely travel from one extreme to other without hitting any obstacles and that the limit switches are set correctly stopping the motor before it reaches its mechanical stall position.
- The array must have a permanent grid-tied or regulated battery bank providing 24 Volt 5 Amp DC power. It is not supported to run the Furl Kit Array CPU directly from the solar panels. The Furl Kit can share the power source in use by the AZ 225 tracker if it meets these requirements.
- Review the proper Shutdown procedures of the customer's Solar-Arrays. All Solar-Arrays should be completely shutdown before installing the Furl-Kit.
- Special tools required
  - #8 – 32 Tap
  - Number 29 Drill Bit
  - Portable electric drill
  - Soldering iron to tin leads

## Setup Discussion

The following two diagrams, Figure 19 and Figure 20, depict a before and after view of the Furl Kit WT2012 installation.

**Figure 19**





**Figure 20**

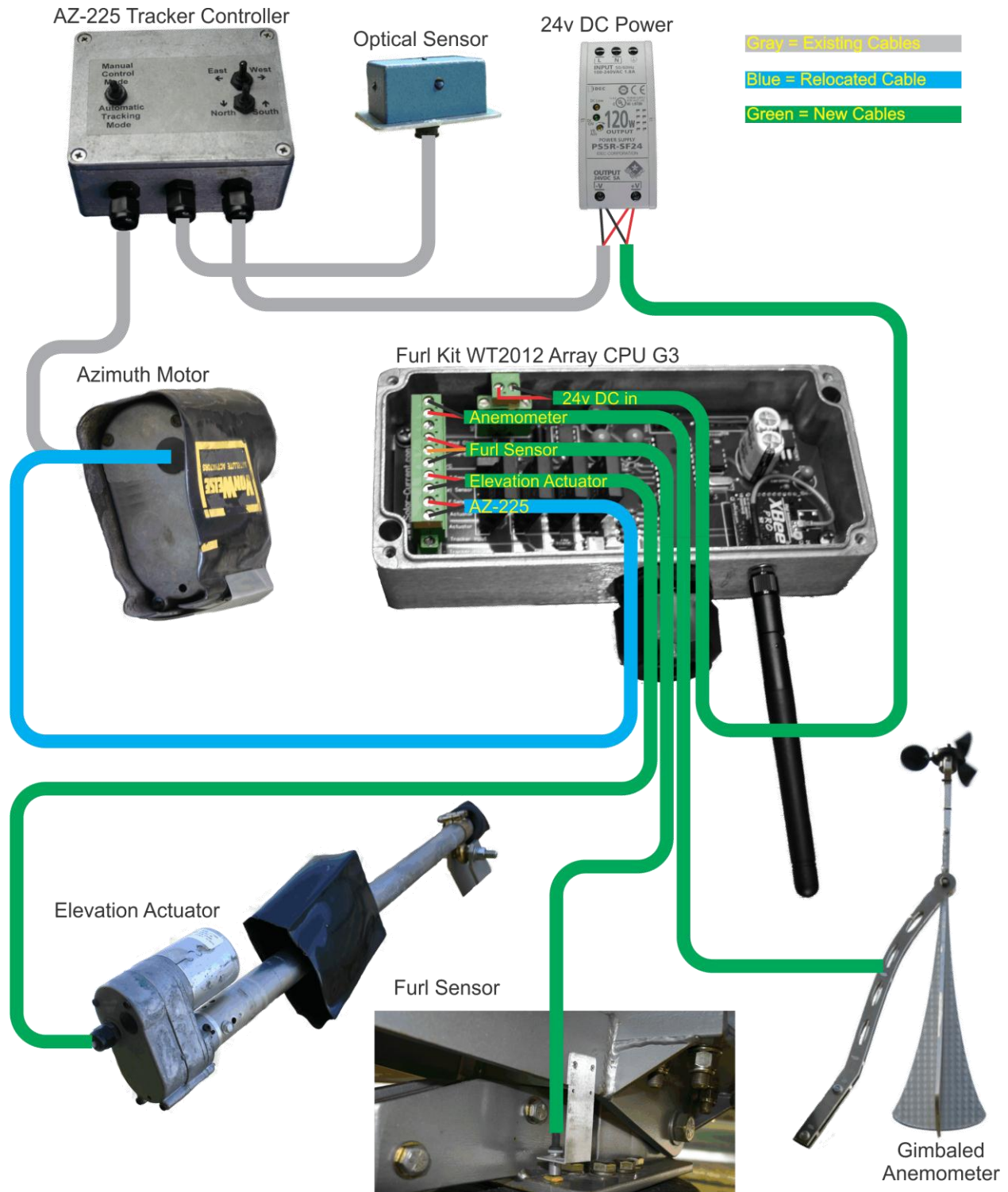


Figure 19 above shows a typical Wattsun Solar Tracker installation. Notice that the Elevation Motor control cable (blue cable) runs from the AZ-225 controller through

the Azimuth Motor housing to get to the Elevation Actuator. In Figure 20 you will see that the blue cable has been disconnected from the Elevation Actuator and moved to the two terminals marked "Tracker Input" on the Furl Kit CPU. This cable is the only direct connection between the AZ-225 Controller and The Furl Kit CPU.

To complete the installation four new (green) cables will be required connecting the Furl Kit CPU to Power, the Anemometer, the Furl Sensor and the Elevation Actuator.

### Furl-Kit CPU Step by Step

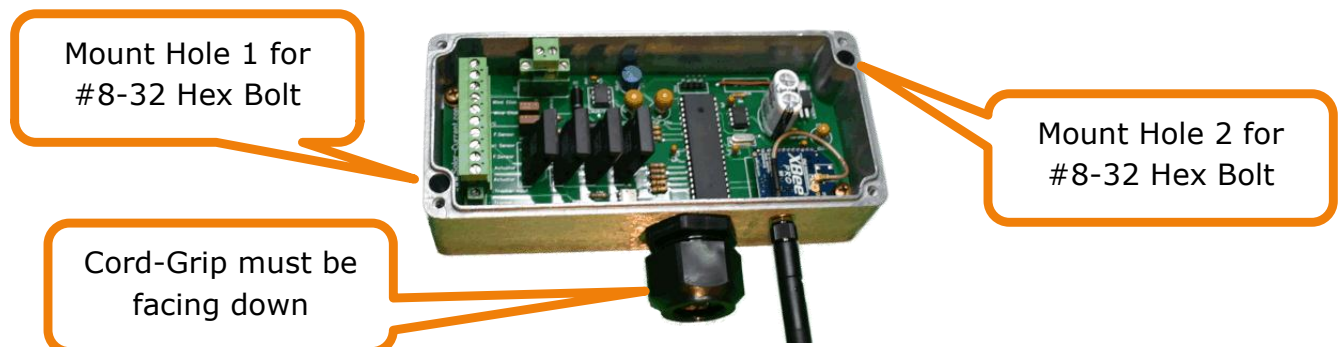
#### Step 1) Power Shutdown

Using the manual controls, lay the array flat all the way back. Once the Array is flat disconnect or switch off the power to the Wattsun Tracker. Switch off the solar-array according to array's shutdown procedures. If this array is part of an array farm connected to a combiner box, insure it is isolated from the other arrays by switching off the master disconnect and removing it's fuse according to the site's shutdown procedure. **Make sure all power is disconnected before installing the Furl-Kit!**

#### Step 2) Mount the Furl-Kit Array CPU

Select a location for the Furl-Kit Array CPU's water tight enclosure on the Torque Tube next to the AZ-225 Saddle Clamp Assembly. Make sure the cord-grip is on the bottom and accessible for routing cables as shown in Figure 21. Using the enclosure, mark the location for the two mount holes and drill and tap using number 29 bit and #8-32 tap.

Figure 21

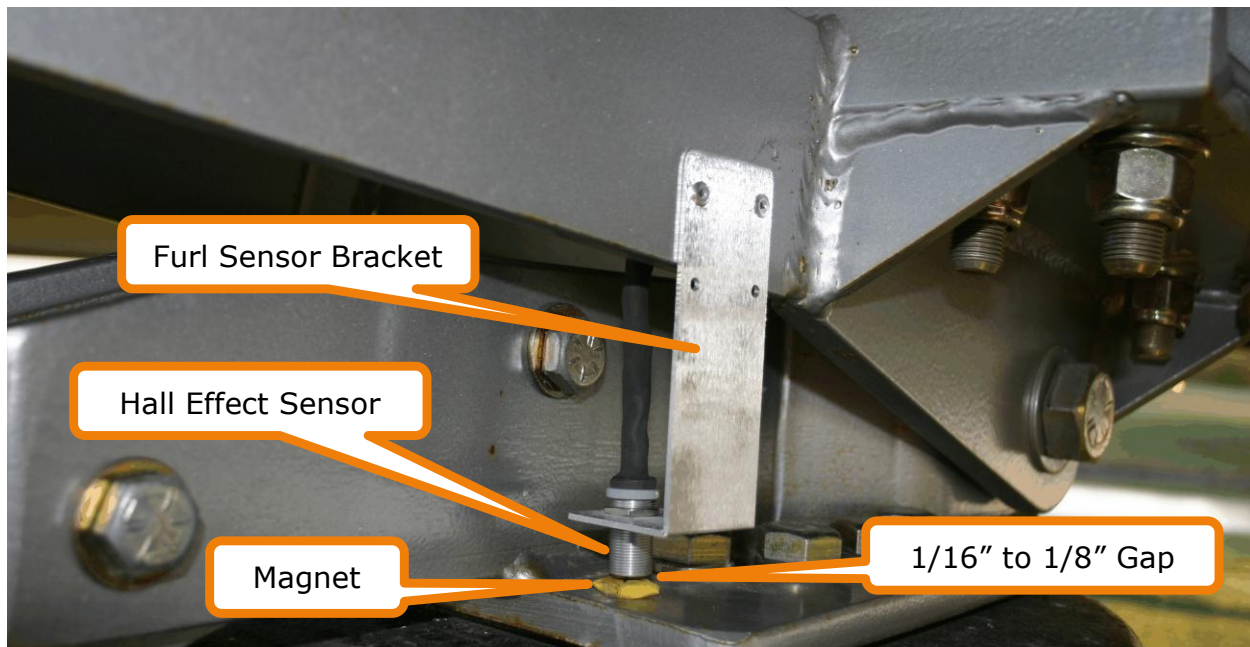


After the Torque Tube has been tapped, mount the enclosure to the Torque Tube and replace the lid to keep foreign materials out during the remaining installation steps.

### Step 2) Mount the Furl Sensor

The Furl sensor is a Hall Effect sensor that senses the array has furled by proximity to a magnet on the array.

Figure 22

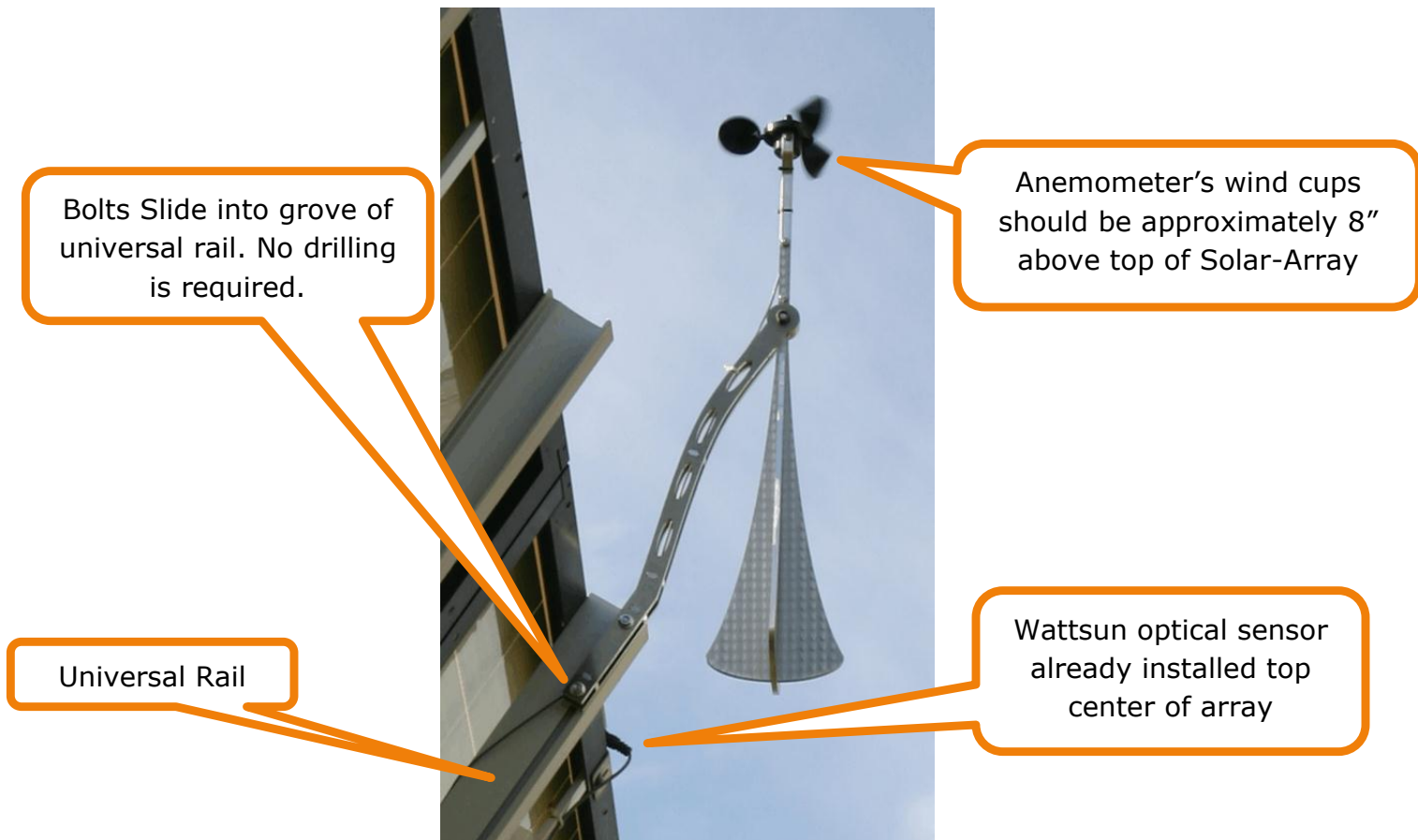


Mount the Furl Sensor bracket to the right side of the bottom half of the saddle clamp as shown in Figure 22. Place the supplied magnet on the steel frame of the tracker just under the location of the Hall Effect Sensor. Hold the bracket so there is approximately 1/8 to 1/16 of an inch clearance between the Hall Effect Sensor and Magnet, then mark two mounting holes. Drill and tap the two marked holes with a number 29 bit and #8-32 tap. Attach the sensor bracket and realign magnet and sensor. Route the attached cable to the Furl-Kit CPU making sure it has freedom to move and is clear of pinch points as the array's elevation changes. Push the cable up through one of the 5 holes in the cord grip and cut to size. Strip the insulation off each of the wires, tin and connect as shown in Figure 20. The red wire will connect to the screw terminal marked "+ F.Sensor", the bare wire to the terminal marked "Furl Sensor", and the black wire to the "- F.Sensor".

### Step 3) Mount the Gimbaled Anemometer

The Gimbaled Anemometer is bolted to the top of one of the center two Universal Rails. The supplied bolts will slide into the groove as shown in Figure 23 and are tightened with a ½" wrench.

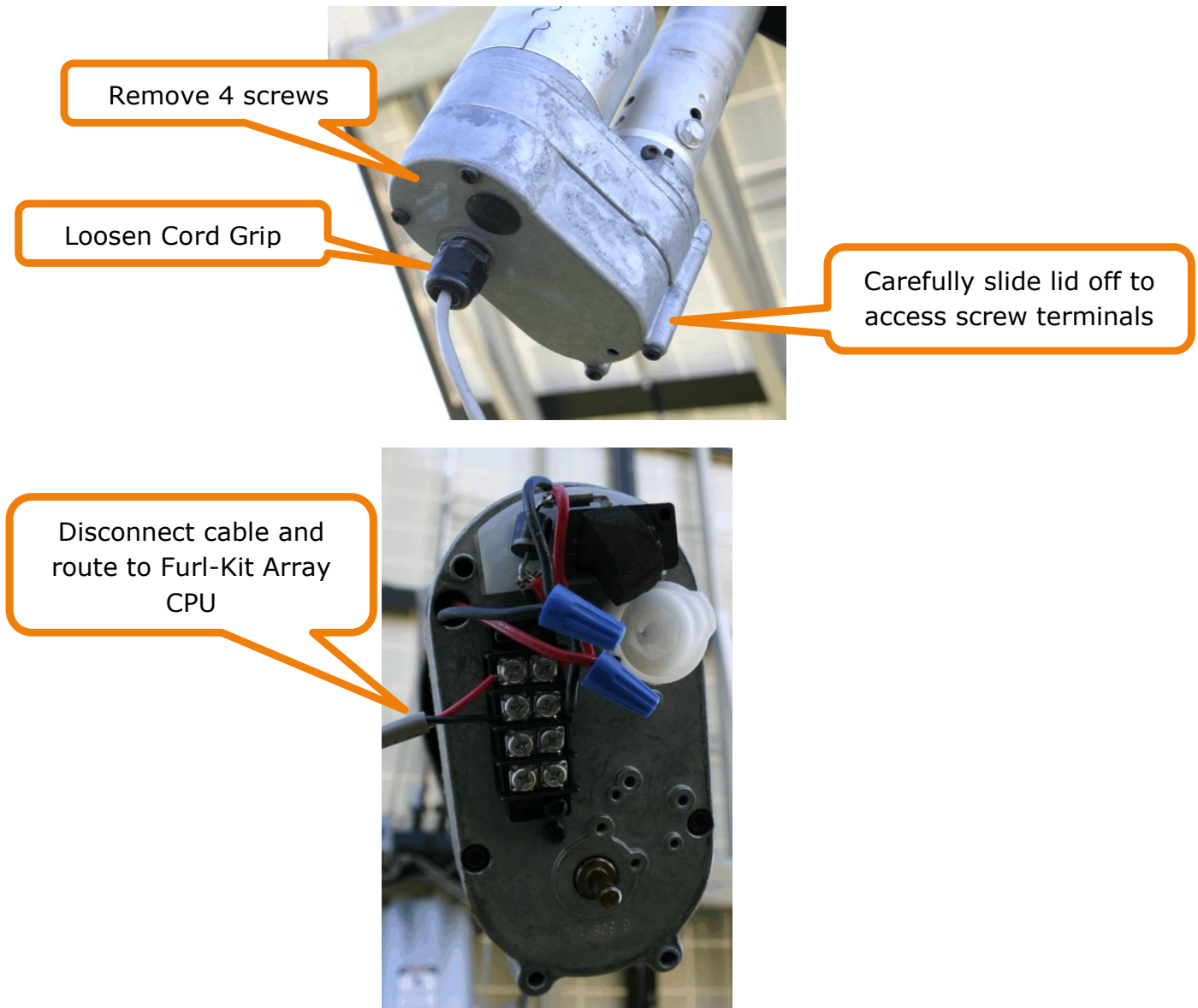
Figure 23



Route the anemometer's attached cable to the Furl-Kit CPU making sure it has freedom to move and is clear of pinch points as the array's elevation changes. Push the cable up through one of the 5 holes in the cord grip and cut to size. Strip the insulation off each of the two wires, tin and connect as shown in Figure 20. The red wire will connect to the screw terminal marked "+ Wind Click" and the black wire to the "- Wind Click".

**Step 4) Connect the Wattsun Tracker to Furl-Kit**

The Wattsun Tracker's elevation actuator cable is directly connected to the Furl-Kit CPU as shown in Figure 20. If the Furl-Kit CPU was mounted close to the center of the Torque Tube, there is a very good chance the existing cable connecting the elevation actuator can be moved and reconnected to the Furl-Kit CPU.

**Figure 24**

Disconnect the existing cable from the Elevation Actuator and reroute to the Furl-Kit CPU making sure it has freedom to move and is clear of pinch points as the array's elevation and azimuth changes. Push the cable up through one of the 5 open holes in the cord grip and cut to size. Strip the insulation off each of the two wires, tin and connect as shown in Figure 20. The red wire will connect to the



screw terminal marked "+ Tracker Input" and the black wire to the "- Tracker Input".

### Step 5) Connect the Elevation Motor

Connect a new cable to the elevation terminals in Figure 24 above making sure the red wire is across from the red wire and the black wire is across from the black wire on the adjacent side of the screw terminal. Route through the elevation actuator cord grip and replace the lid on the actuator. Continue routing the new cable to the Furl-Kit CPU making sure it has freedom to move and is clear of pinch points as the array's elevation changes. Push the cable up through one of the open holes in the cord grip and cut to size. Strip the insulation off each of the two wires, tin and connect as shown in Figure 20. The red wire will connect to the screw terminal marked "+ Actuator" and the black wire to the "- Actuator".

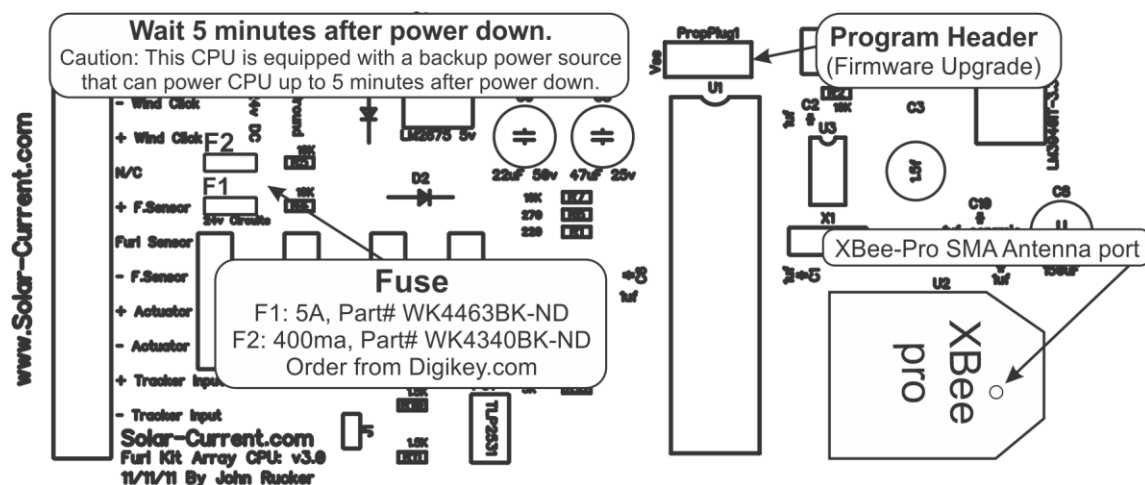
### Step 6) Connect DC Power to Furl-Kit CPU

The Furl-Kit CPU requires very little power and can easily run off the same 24VDC 5A power supply feeding the Wattsun Tracker. Route a new cable from the array's 24VDC 5A Power supply to the Furl-Kit CPU making sure it has freedom to move and is clear of pinch points as the array's elevation and azimuth changes. Push the cable up through the last open hole in the cord grip and cut to size. Strip the insulation off each of the two wires, tin and connect as shown in Figure 20. The red wire (+24vdc) will connect to the screw terminal marked "24v DC" and the black wire will connect to the "Ground".

### Step 7)

Please note on the backside of the Furl-Kit CPU's lid, there is a laser etched schematic that shows the placement and part numbers of the two fuses on the CPU circuit board as well as various other components.

Figure 25 (Furl-Kit CPU inside lid markings)



Make sure the small antenna cable inside the enclosure is still connected to the xBee RF modem (See Figure 25). Adjust the wires so they won't be pinched and place the lid on the Furl-Kit CPU making sure the rubber gasket is sitting in its channel. Tighten the four screws on the lid and tighten the cord grip.

Double check all cables are neat and secure, free of pinch points and obstacles. Restore power to array and wait a few minutes for the Furl-Kit CPU to boot up and come on-line. Using the Wattsun Tracker's elevation switch, move the arrays elevation from one extreme to the other making sure the cables are free from pinch points and secure. Place the Wattsun Tracker into "Auto" and continue on with the installation of the Solar-Array Supervisor.

## Troubleshooting

The following table contains possible error conditions and remedies. For a more complete list refer to the troubleshooting section of <http://Solar-Current.com>

Error or Problem	Description
Array will not pass Furl Test	If the array moves and lays flat but the Solar-Array Supervisor doesn't show a successful furl has occurred there may be a problem with the Furl Sensor. Check that the sensor is 1/8" to 1/16" from the magnet and that the magnet is directly under the sensor with the "UP" letters facing up. Refer to Figure 22 on page 38 for proper alignment.
Wind Fault	<p>The "Wind Fault" error will be displayed when the Furl-Kit Array CPU has not received a valid wind measurement from the anemometer. This may happen if you have had several hours of no measurable wind. If this is the case check again after the wind has kicked up to make sure everything is okay.</p> <p>This error may also appear if something has fallen against the Array Mounted Anemometer and is keeping the cups from spinning. Check the Array to make sure the gimbaled anemometer is still connected and free to spin. If it is cycle the power to the Furl-Kit Array CPU.</p> <p>The "Wind Fault" error will be displayed when the Furl-Kit Array CPU has not received a valid wind measurement from the anemometer. This may happen if you have had several hours of no measurable wind. If this is the case check again after the wind has kicked up to make sure everything is okay.</p> <p>This error may also appear if something has fallen against the Array Mounted Anemometer and is keeping the cups from spinning. Check the Array to make sure the gimbaled anemometer is still connected and free to spin. If it is cycle the power to the Furl-Kit Array CPU.</p>



## Limited Warranty

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Solar-Current.com Inc. warrants the Furl-Kit WT2012 including (the Solar-Array Supervisor, Gimbaled Anemometer, Furl-Kit Array CPU, and Furl Sensor) to the original consumer purchaser that it will repair, or replace at Solar-Current.com's option, any Furl-Kit WT2012 component that is determined to be defective in material or workmanship for the following terms:

One year from date of purchase on all components including the Solar-Array Supervisor, Gimbaled Anemometer, Furl-Kit Array CPU, and Furl Sensor.

To be eligible for repair or replacement under this warranty, the part in question must be sent to Solar-Current.com within the warranty period and the original consumer purchaser must comply with the following conditions:

- Furl-Kit component must not have been modified or altered in any way by an unauthorized source.
- Furl-Kit component must have been installed in accordance with the installation instructions including DC power supply requirements and polarity.

This limited warranty does not cover:

- Damage due to improper installation;
- Accidental or intentional damage;
- Misuse, abuse, corrosion or neglect;
- Damage due to improper packaging or return shipment;
- Products impaired by severe conditions, such as excessive wind, lightning, or other natural occurrences;
- Damage from use on a non Wattsun AZ-225 tracker.

Any and all labor charges for troubleshooting, removal or replacement of Furl-Kit WT2012 components are not covered by this warranty and will not be honored by Solar-Current.com Inc.

Return shipping is to be paid by the original consumer purchaser. Solar-Current.com Inc. will pay the standard return ground UPS shipping charges within the continental US only.

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