



BC24 Solar Night Light Assembly and Operations Manual

August 2018

Revisions	4
Introduction	4
What are Grove Connectors?	5
Part List and Identification	6
Step By Step Assembly of the BC24 Solar Night Light Kit	11
Wire Colors	12
Initial Testing	18
What if I don't see the White LEDs?	19
Putting the BC24 Solar Night Light in a Waterproof Box	19
Mounting the BC24 on the Clear Panel	20
Mounting the SunAirPlus Board and the Multi-Solar Panel Connector Board inside the Box	20
Mounting the LiPo Battery	20
Mounting the Solar Panels	20
Seal all Holes	20
The 3D Printed Solar Bracket	20
Software on the BC24 Solar Powered Night Light	25
Setting Up Your WiFi	26
SmartConfig	26
WPS Button on AP	27
Local AP (192.168.4.1)	28
Once Connected	29
Resetting the BC24 Solar Night Light to Default Values	29
Using the REST Interface for your BC24 Solar Night Light	29
Finding your IP Number	29
Your First REST Command	30
The REST Commands	30
Variables	30
SolarNL LED Modes	31
Functions	31
How to Program Your BC24 Solar Night Light	33
Installation of the IDE	33
Download The Software	34

Revisions

None

Introduction

The BC24 Solar Night Light Kit is a flexible ESP32 based Wifi Connected Solar Powered NightLight that can do many things and is completely customizable.

Features:

- Solar Powered
- ESP32 based
- WiFi Connected
- Full featured REST interface - Do All sorts of things!
- Can read Solar Data from the device
- Has three modes of display. Rainbow, Clock and Fire
- Can be turned on during the daylight

Please check the product page on switchdoc.com for the latest information.

Parts included (SwitchDoc Labs SKU):

- BC24 (0600-BIGCIRCLE32-DSBT)
- SunAirPlus (0040-SAP-DSBT)
- Solar Panel - 330mA / 6V (0111-SC330-DSBT)
- Multi Solar Panel Connector Board (0230-MSPCB-DSBT)
- USB A to Micro Cable (0121-USBAM-DSBT)
- 1 Grove Female Headers to Grove Connector Cable (0074-GRVCABFEM-DSBT)
- Box of M3 120 PC Spacers (0670-M3NYLON-DSBT)
- UV 172mm Waterproof Enclosure (0674-BOX172-DSBT)

NOTE: The 3D Solar Panel Stand is not included in the kit. However, you can download the 3D Print files from the SwitchDoc Labs Solar Panel Night Light Kit product page to print your own.

We also sell a 3D Print of the Solar Panel holders for those without a 3D Printer.

<https://shop.switchdoc.com/products/copy-of-3d-print-for-bc24-solar-powered-night-light-kit>

NOTE: A LiPo battery is NOT included due to shipping restrictions. We suggest a 6600mAh battery with a JST2 connector such as:

<https://www.adafruit.com/product/353>

Smaller batteries will work too.

2000mAh - <https://www.adafruit.com/product/2011>

2200mAh - <https://www.adafruit.com/product/1781>

4400mAh - <https://www.adafruit.com/product/354>

The larger the battery, the longer the system will run after being charged. It will also last longer during cloudy conditions. However, if you aren't charging the big battery all the way during the day, it doesn't matter very much.

You can get all the Data to figure out for yourself which will work better. See the REST interface.

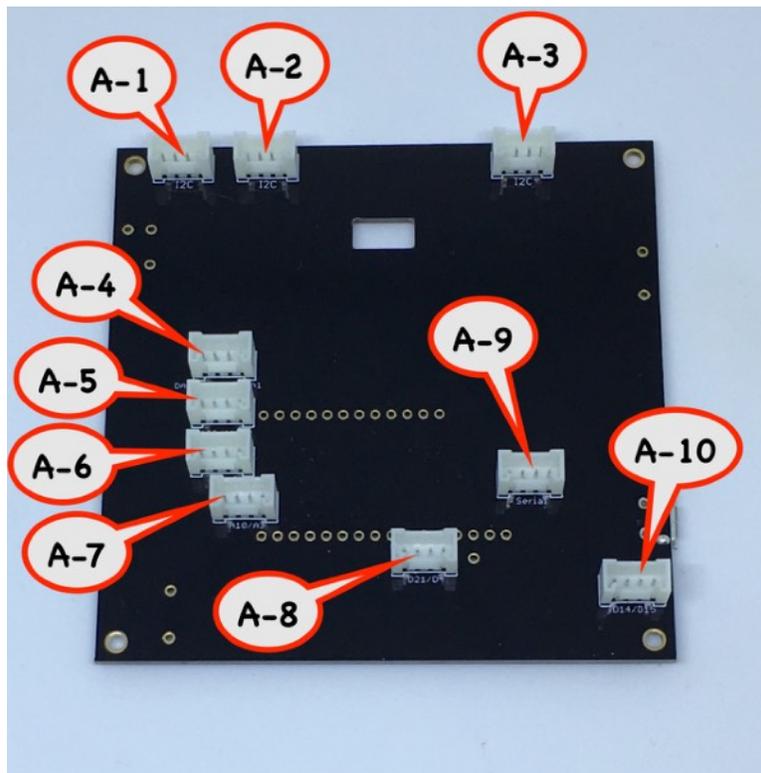
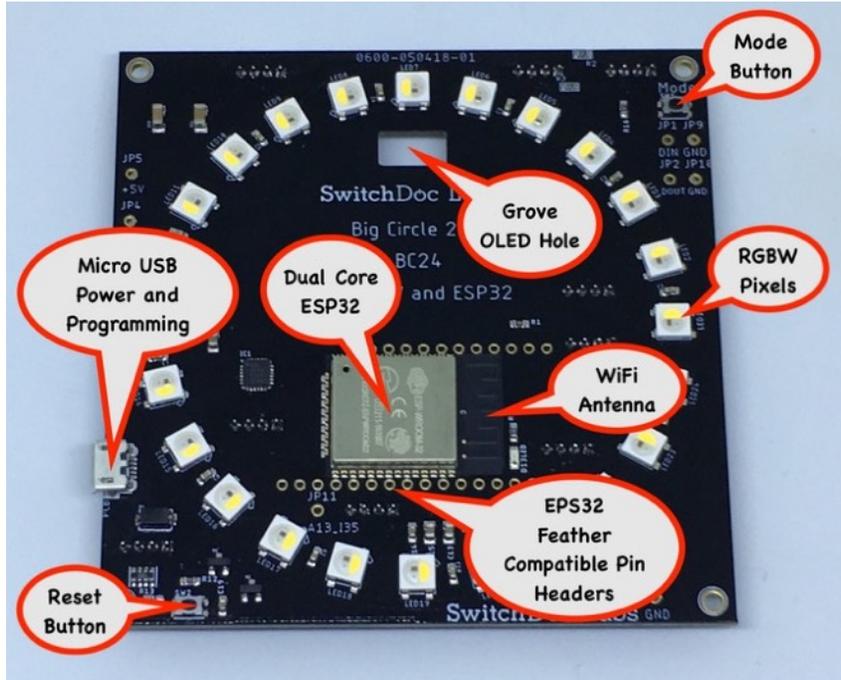
What are Grove Connectors?

Read our Grove Connector tutorial at:

<http://www.switchdoc.com/2016/02/tutorial-intro-to-grove-connectors-for-arduinoraspberry-pi-projects/>

Part List and Identification

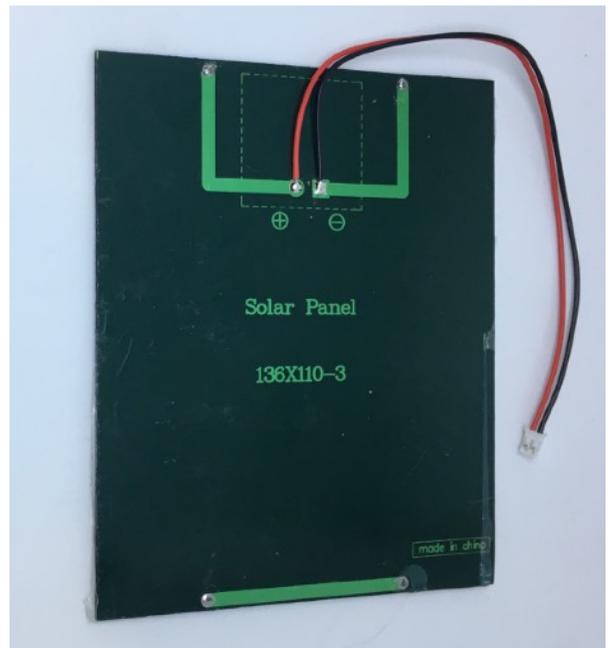
A - BC24



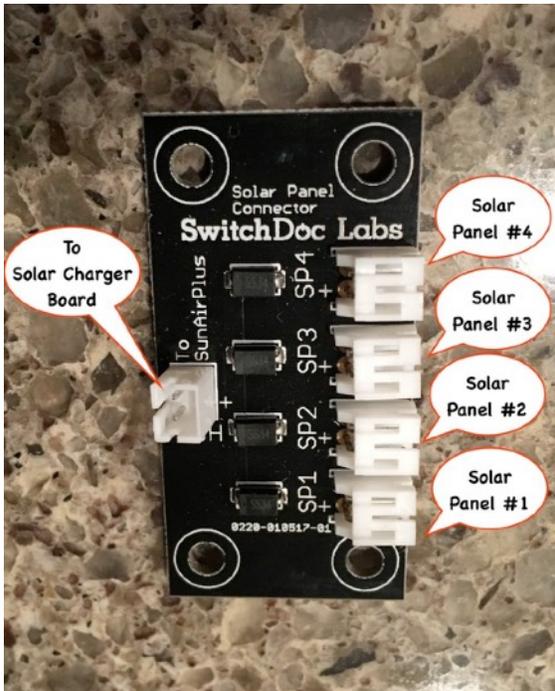
B - SunAirPlus



C - Solar Panels (two) 330mA / 6V



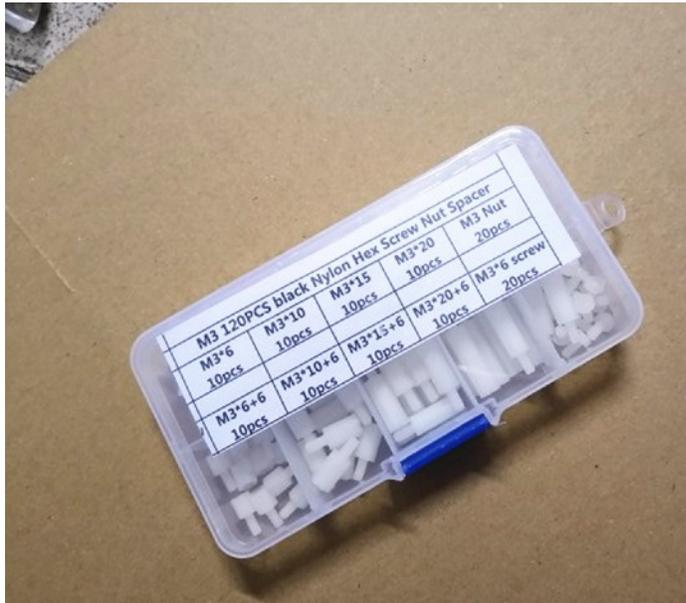
D - Multi Solar Panel Connector Board (includes 20cm female to female JST-PH 2 cable)



E - USB A to Micro Cable



F - 1 Box of M3 120 PC Spacers



G - 1 Grove Cable - Female Header to Grove Connector



H - Weather Proof Enclosure - 172mm X 172mm X 76mm



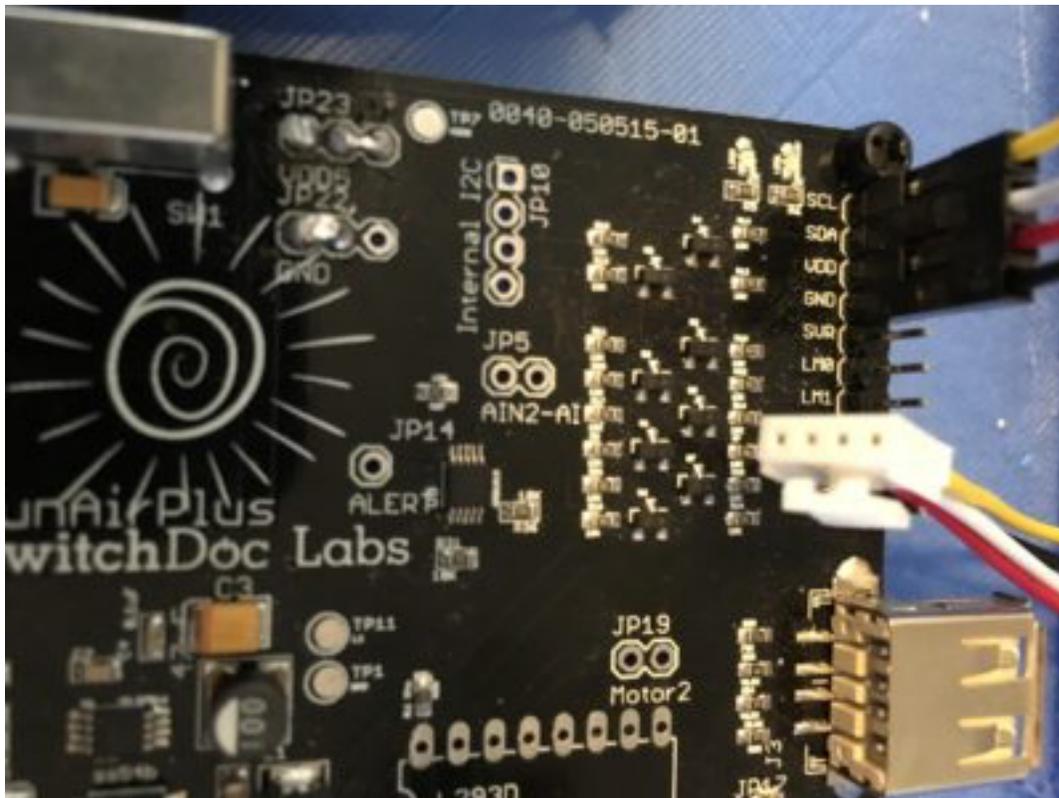
Step By Step Assembly of the BC24 Solar Night Light Kit

Step 1) Familiarize yourself with all of the parts A-H above.

Step 2) Locate the SunAirPlus board (B) and the Grove Cable - Female Header to Grove Connector (G).

Step 3) Connect the Grove Cable Female Headers (G) to the SunAirPlus Board (B) as shown below. DO THIS STEP CORRECTLY!

You connect the included Grove to Female Pin Headers Adaptor Cable to the "From Computer" header as shown below.





Wire Colors

Wire colors on standard Grove Cables are always the same.

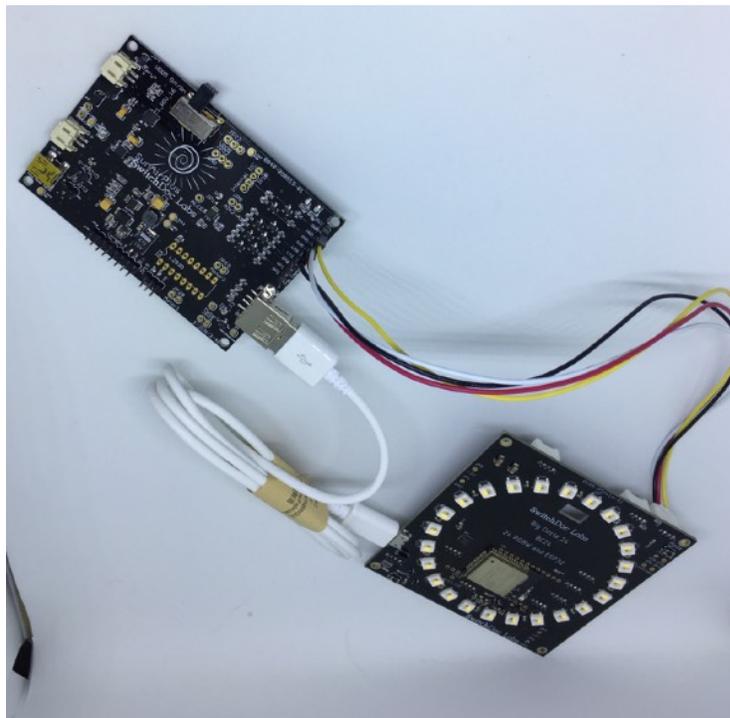
Pin 1 - Yellow SCL

Pin 2 - White SDA

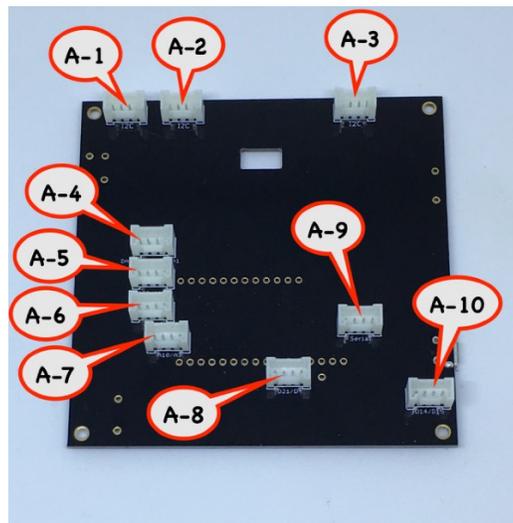
Pin 3 - Red - VDD

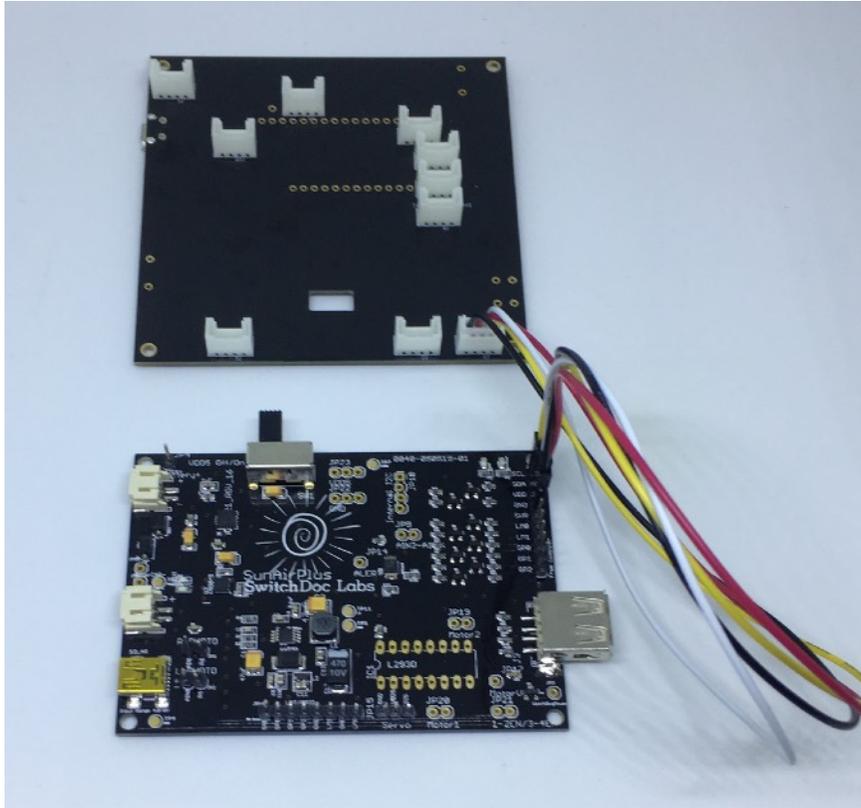
Pin 4 - Black - GND

Step 4) Check the Wire Colors connected to the SunAirPlus Board (B) and make sure they are correct. **You could damage the board and power supply if these are wrong!**



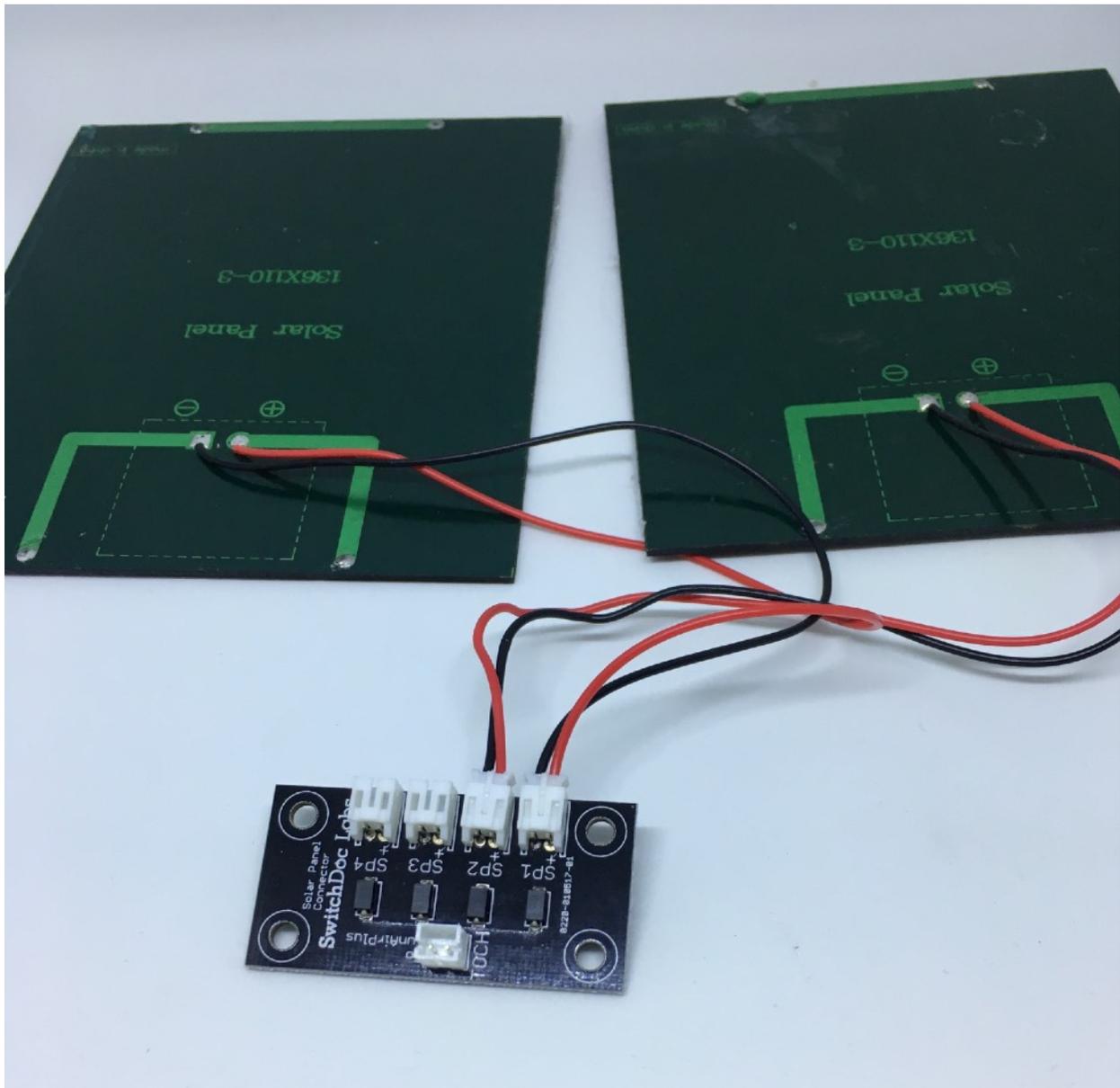
Step 5) Take the White Plug End of the Grove Cable (G) and Plug it into the Grove Connector A-1 on the BC24 Board (A)



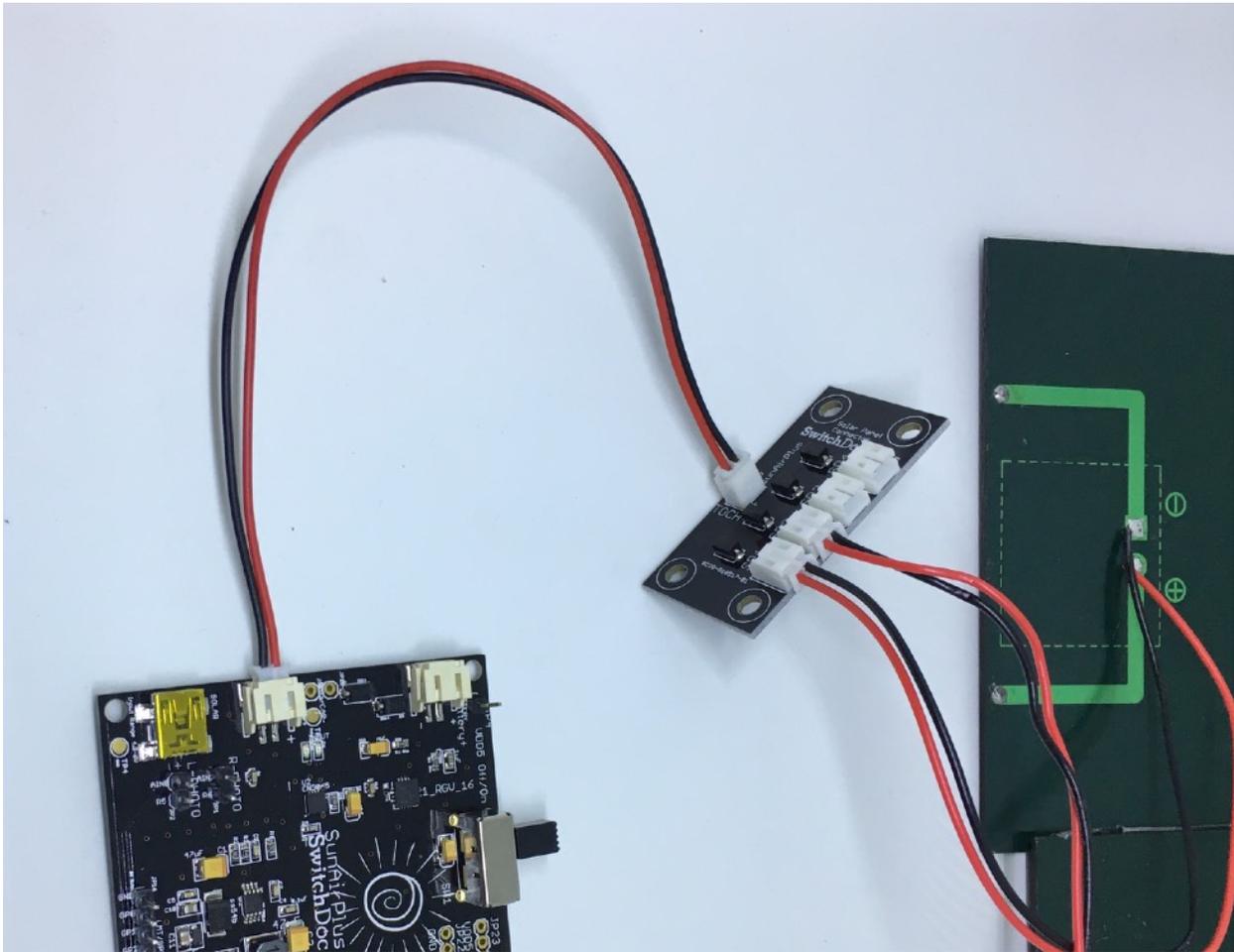


Step 6) Take your USB A/Micro Cable (E) and plug the A end into SunAirPlus (B). Then take the Micro end of the Cable (E) and plug it into the BC24 (A) USB Connector.

Step 7) Take your Two Solar Panels (C) and plug the two solar panels into the Multi-Solar Panel Connector Board (D) into SP1 and SP2 using the JPT-PH-2 attached cables (attached to the Solar Panels (C)).



Step 8) Plug the 20cm JST-PH-2 Female to Female cable (included in Multi-Solar Panel Connector (D)) from the Multi-Solar Panel Connector (D) connector marked TOCH to the SunAirPlus (B) connector marked “Solar” as in the picture below. MAKE SURE TO CONNECT THIS CORRECTLY!



Step 9) Take your LiPo Battery (NOT INCLUDED IN KIT) and plug the JST-PH-2 plug from the LiPo Battery into the JST-PH-2 female plug on SunAirPlus (B) market Battery as below. MAKE SURE TO CONNECT THIS CORRECTLY!

You have now completed the assembly of the Kit. Next, we proceed to initial testing.



Initial Testing

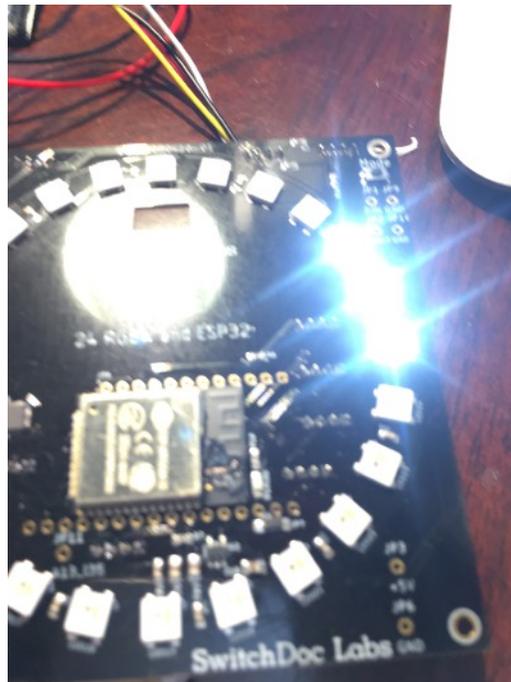
Look at the switch on top of SunAirPlus (B). If it is pushed to the Left (look at SunAirPlus with the Main Text facing you), then the system is turned off. SunAirPlus will still charge your battery. This switch just turns off the power to the BC24.

Turn the slide switch to the Right. Assuming you have a charged LiPo Battery, the BC24 will boot up and will start flashing 3 white LEDs as below. If you see these lights, you have completed initial testing.

What if I don't see the White LEDs?

Turn off the switch (to the left) and go back and check all your wiring for errors. Then check to see if your LiPo battery is charged (most are shipped charged). You can also plug in another USB to Mini plug in the Mini USB cord and charge the battery that way. Check out the SunAirPlus specification on shop.switchdoc.com for details.

Next proceed to putting your box in the waterproof box, or go to the **Software on the BC24 Solar Powered Night Light** section below to explore the software.



Putting the BC24 Solar Night Light in a Waterproof Box

While we supply the WaterProof Box (H) and the M3 Standoff screws and pylons (F), we are not giving a step by step instruction manual for this part of the kit. Instead we will give general directions and suggestions.

Mounting the BC24 on the Clear Panel

Center the BC24 on the front panel and mark and drill four holes. Use the pylons and screws to put the BC24 behind the panel.

Mounting the SunAlrPlus Board and the Multi-Solar Panel Connector Board inside the Box

You can either drill holes for the pylons to mount these boards or super glue the pylons to the box. A good way of doing this is to mount the pylons on the boards using the included screw pylons and bolts and the super glue all four mounts to the back of the box by themselves.

Mounting the LiPo Battery

We would suggest using Velcro to mount the battery to the inside of the back of the box.

Mounting the Solar Panels

Drill a Hole for the two Solar Panel wires to exit the back of the box towards the top of the box. Route the wires through this hole.

Seal all Holes

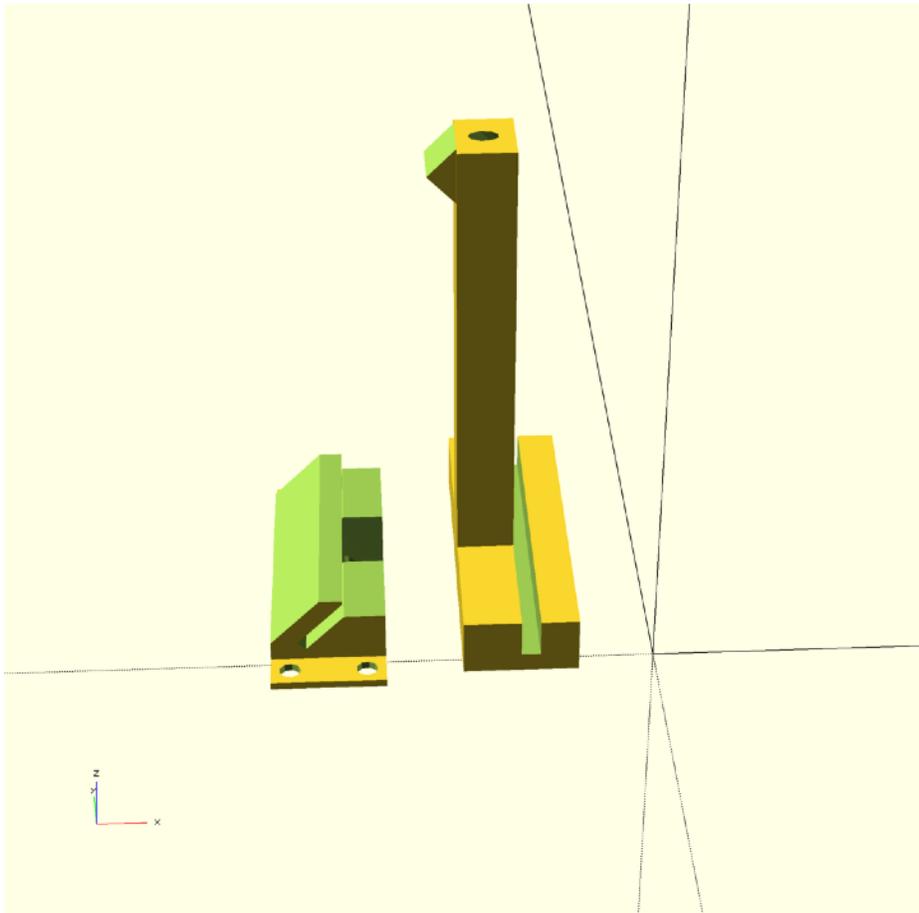
Using Clear 100% Waterproof Silicon Caulking, such as below (Not Included) to seal all of the holes you have cut into the box (including the screw holes for the solar bracket below).

The 3D Printed Solar Bracket

Go to the product page on shop.switchdoc.com for the BC24 Solar Powered Night Light Kit 3D files for the Solar Bracket and print out the solar bracket on a 3D Printer. PLA will work, but ABS will last longer in the direct sunlight.



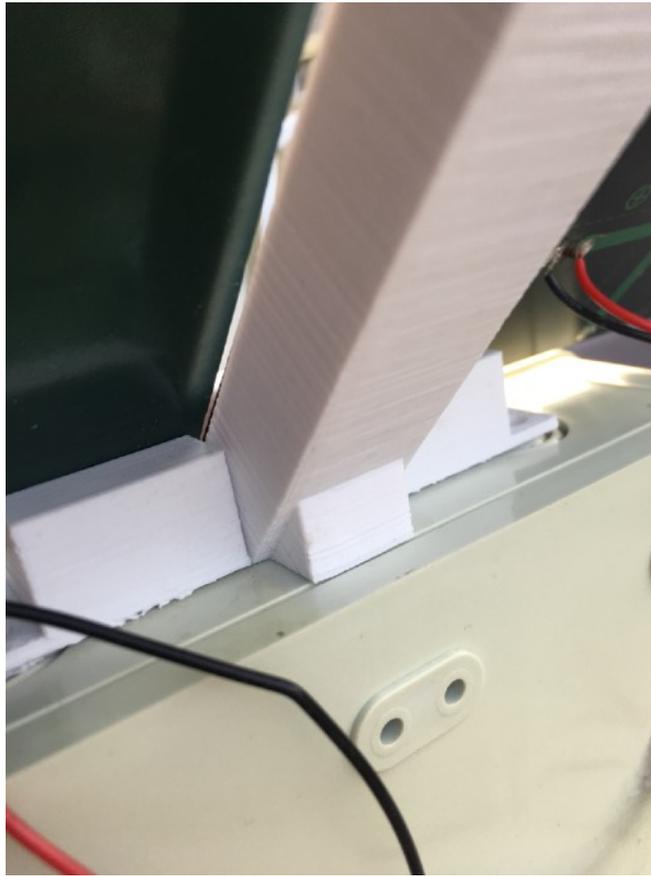
If you do not have a 3D Printer, you can purchase a 3D Print of the solar bracket here at:
<https://shop.switchdoc.com/products/copy-of-3d-print-for-bc24-solar-powered-night-light-kit>
The Bracket comes in two pieces. The bracket bottom and the bracket top.



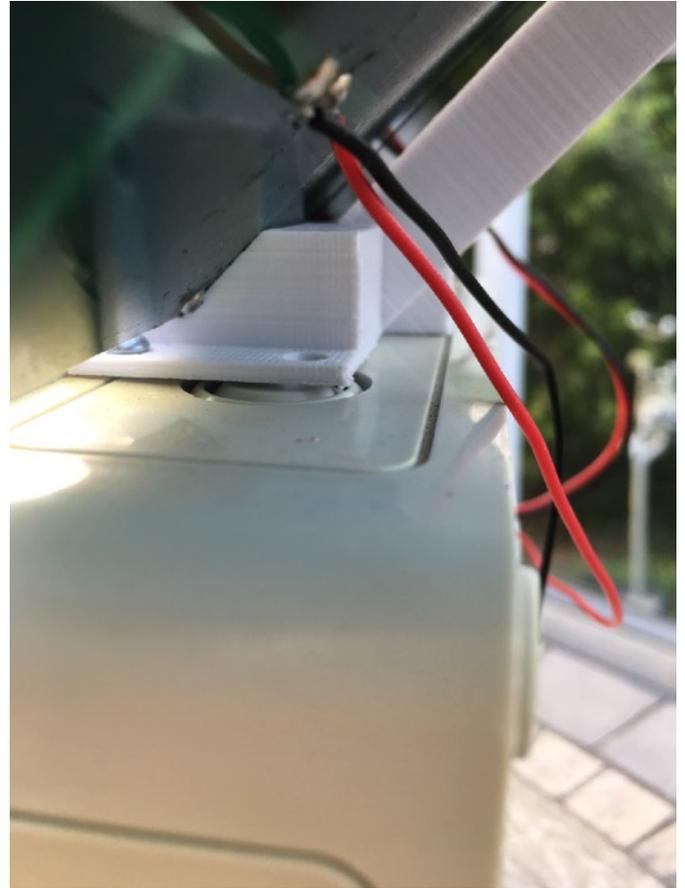
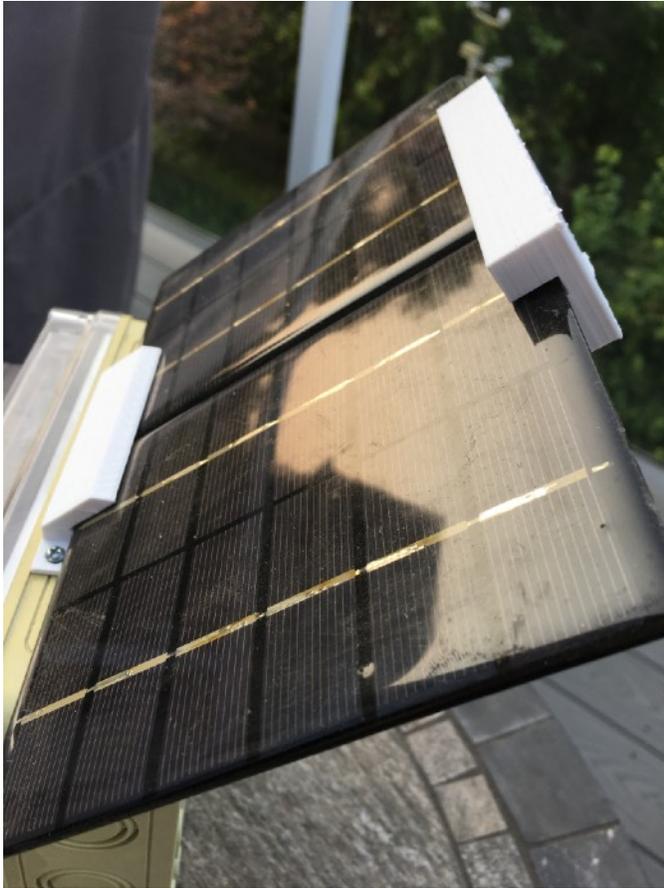
First install the lower bracket with screws into the top of the box. See completed photos below.



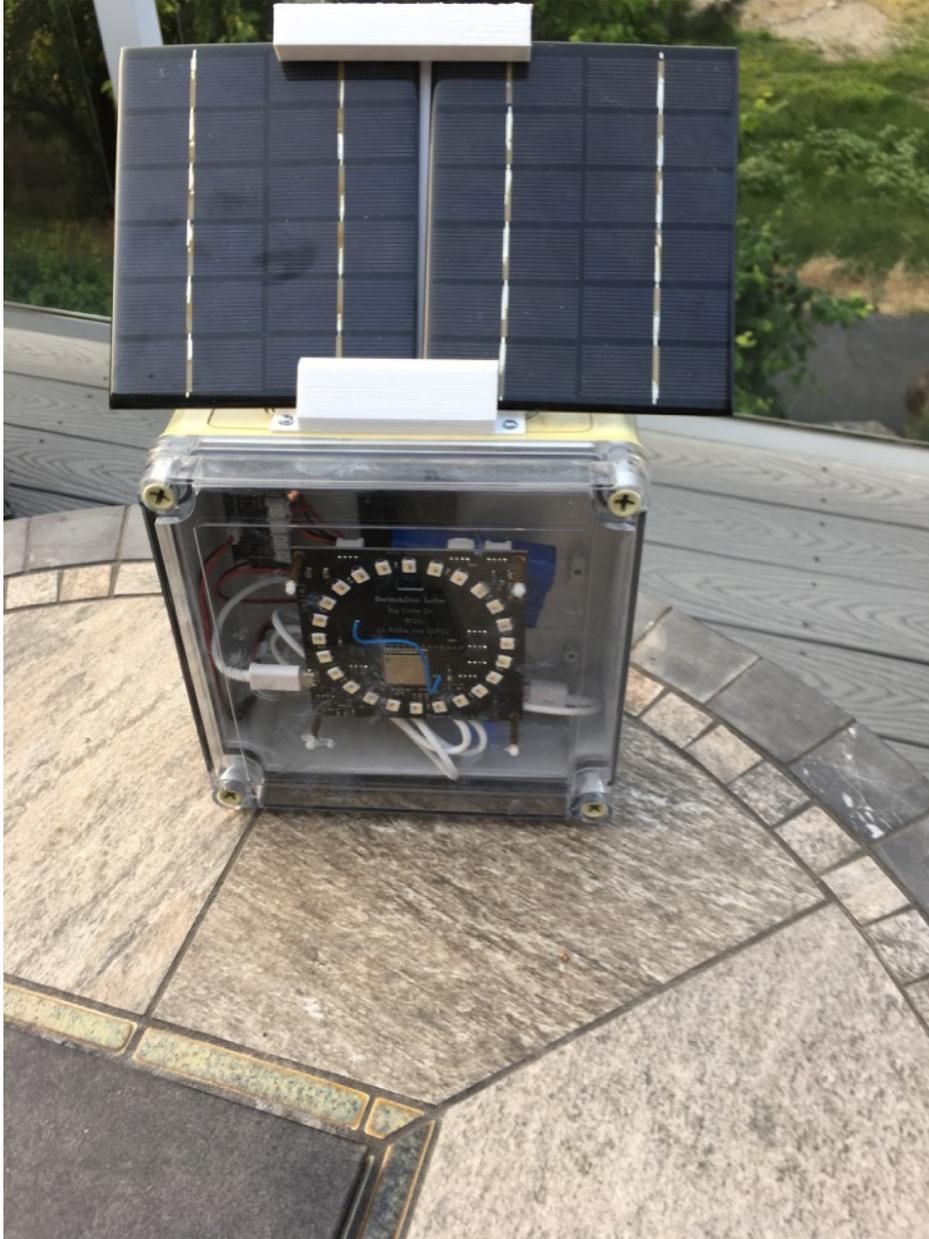
The complete bracket fits together as below. Secure with a screw into the Box.



Here is the installed bracket with the solar panels slid in from each side. Note the triangle from the top bracket is flush on the Box. Supports the panel better (and seems to make PLA work better).



Seal your holes and you are done!



Software on the BC24 Solar Powered Night Light

Usually, the first step to using the BC24 SOLARNL software is to setup your WiFi connection.

Setting Up Your WiFi

WiFi Connection Sequence - Provisioning

The BC24 Weather has three methods for getting an IP from your Wireless Access Point.

These are:

- SmartConfig
- WPS Button on AP
- Local AP on ESP32 (192.168.4.1)

Note: This was developed for the BC24 ESP32 Based 24 RGBW Pixel LED Board

SmartConfig

This method uses the TI method of provisioning "SmartConfig" was invented by TI. You can refer to it here:

<https://community.particle.io/t/smart-config-the-missing-manual-now-available/442>

In order to do SmartConfig, you need a smartphone or tablet (Android or iOS) that connected to WiFi network (which you want ESP32 to connect to) and installed a special application. On this application, you just supply the ssid and password of WiFi network so that the application can use, encode them and then broadcast (via UDP) encoded ssid and password (under packet format) over the air. When this software is being run, the ESP32 (with the SmartConfig software loaded) will capture these packets, decode back ssid and password and use them to connect to Wifi network.

After connecting to WiFi, the ESP32 will use mDNS to multicast a message to the application to notify that it has successfully connected to WiFi.

The source code of special application is supplied by Espressif. You can download at:

<https://github.com/EspressifApp/EsptouchForAndroid>

<https://github.com/EspressifApp/EsptouchForIOS>

This application is also available on App Store. You can use it to test SmartConfig feature.

- For Android, this application is available under name "IOT_Espressif" or another application "ESP8266 SmartConfig" (this is for ESP8266 but you can use it for ESP32):

<https://play.google.com/store/apps/details?id=com.cmmakerclub.iot.esptouch>

<https://play.google.com/store/apps/details?id=com.espressif.iot>

- For iOS, this application is available under name "Espressif Esptouch":

<https://itunes.apple.com/us/app/espressif-esptouch/id1071176700?mt=8>

There is also another app on the iOS Appstore, search on "SmartConfig"

Color sequence

Default Time: 15 seconds to hit Smart Config on app, 30 seconds timeout on response

- Three White Lights
- Three Red on failure
- Three Green on success

WPS Button on AP

Wi-Fi Protected Setup (WPS; originally, Wi-Fi Simple Config) is a network security standard to create a secure wireless home network.

Introduced in 2006, the goal of the protocol is to allow home users who know little of wireless security and may be intimidated by the available security options to set up Wi-Fi Protected Access, as well as making it easy to add new devices to an existing network without entering long passphrases.

This library will wait 60 seconds (in the example) for the WPS packets to be received by the ESP32.

A major security flaw was revealed in December 2011 that affects wireless routers with the WPS PIN feature, which most recent models have enabled by default.

This software does not use the PIN feature.

Color sequence

Default Time: 30 seconds timeout if no WPS button sent from AP

- Three White Lights
- Two White Lights during search
- Two Red Lights on failure
- Two Green on success

Local AP (192.168.4.1)

For the third provisioning method, the ESP32 is set up as an access point (192.168.4.1) - look at your list of WiFi APs on your computer when it is running. A small web server is started that will allow you to select the AP that you want the ESP32 to connect to and then you can enter the password for the access point. It runs for 60 seconds by default.

Color sequence

Default Time: 60 seconds timeout if No completed Webform returned

- One Blink of single White Light
- One Blinking White Light during AP page active
- One Red Light on failure
- One Green on success

Remember that all of these features may fail and have to be repeated. Nature of the beast.

Once Connected

Once the WiFi Connection has been made, the BC24 Solar Night Light software will blink Green.

The BC24 remembers your last connection.

Resetting the BC24 Solar Night Light to Default Values

To reset the BC24, hold down the mode button while hitting the reset button. This will clear the WiFi credentials as well as reset other values to default values.

Using the REST Interface for your BC24 Solar Night Light

The BC24 Solar Powered Night Light contains a fully functional REST interface for control and reporting information.

Finding your IP Number

Use an IP Scanning program (Angry IP Scanner for Mac or Windows) and look for a new IP Address. You can switch your unit on and off if you aren't sure which IP Number it is.

 192.168.1.143	11 ms	[n/a]	[n/s]	HonHaiPr	
 192.168.1.154	54 ms	[n/a]	[n/s]	[n/a]	
 192.168.1.2	[n/a]	[n/s]	[n/s]	[n/s]	

That will be your IP address. You can also check your AP Access Point (Router) for the address (under something like attached devices - it depends on your router. Check the manual).

Some routers won't report new IP devices immediately. Power cycle your router to force the detection.

Write down your IP #. It will probably not change very often depending on your router.

We will use the IP# above, but yours will definitely vary from this #.

Note: If the BC24 is not powered up (battery too low or such), then the REST interface will not respond.

Your First REST Command

Open a browser (Safari or Chrome has been tested) and type:

<http://192.168.1.154/>

you will get (assuming you have the right IP Address)

```
{"variables": {"solarVoltage": 1.52, "batteryVoltage": 4.14, "solarCurrent": 0.00, "batteryCurrent": 2.40, "loadCurrent": 1.20, "loadVoltage": 4.97, "currentLEDMode": 0, "darkLight": 0, "Version": "005"}, "id": "", "name": "SDL_ESP32_BC24_SOLARNL", "hardware": "esp32", "connected": true}
```

You are connected!

All of the BC24 Solar Power Night Light commands return fully formatted JSON data which makes it easy to parse and get the values you want.

The REST Commands

Variables

To retrieve the value of a specific variable, type:

<http://192.168.1.154/solarVoltage>

where “solarVoltage” is the variable name. Case matters.

for example:

<http://192.168.1.154/solarVoltage>

returns:

```
{"solarVoltage": 1.58, "id": "", "name": "SDL_ESP32_BC24_SOLARNL", "hardware": "esp32", "connected": true}
```

returns current Solar Panel Voltage in Volts

BC24 Solar Powered Night Light REST Variables	
solarVoltage	Solar Panel Voltage in Volts
batteryVoltage	Battery Voltage in Volts
solarCurrent	Solar Panel Current in mA
batteryCurrent	Battery Current in mA
loadCurrent	Load (BC24) Current in mA
loadVoltage	Load (BC24) Voltage in mA
currentLEDMODE	Numeric Value of current LED Mode for the BC24 (see below)
darkLight	State of the darkLight Variable - 0 for dark, 1 for light. Only affects Clock brightness in V004
Version	Returns the version of the software, formatted as "VXXX" (V004 for example)

SolarNL LED Modes

As of V005, here are the numeric constants for the currentLEDMODE value

```
RAINBOW  0
FIRE     1
CLOCK    2
```

Default Administration Password

The default password is "admin". You can change this with the "setAdminPassword Below

Functions

Functions are called with Parameters in the following form, for example (where the admin password is "admin"):

<http://192.168.1.154/clock?params=admin>

and it returns

```
{"return_value": 1, "id": "~f", "name":
"SDL_ESP32_BC24_SOLARNL", "hardware": "esp32", "connected":
true}
```

REST Commands

Function	Desc	Parameters	Returns
setAdminPassword	reset Administration Password	http://192.168.1.118/ setAdminPassword? params=oldpassword,newpa ssword Parameters are old and new password, separated by a “,”	return_value will be 1 if the command succeeded and 0 if it did not (such as invalid password)
clock	Sets the mode for the BC24 Clock Display.	http://192.168.1.154/clock? params=adminpassword	return_value is 1 if it succeeds or 0 if the password fails.
rainbow	Sets the mode for the BC24 Rainbow Display.	http://192.168.1.154/ rainbow? params=adminpassword	return_value is 1 if it succeeds or 0 if the password fails.
fire	Sets the mode for the BC24 Fire Display.	http://192.168.1.154/fire? params=adminpassword	return_value is 1 if it succeeds or 0 if the password fails.
setDarkLight	Sets the BC24 LEDs Darker (0) or Brighter (1)	http://192.168.1.154/ setDarkLight? params=adminpassword, mode First Parameter is administration password. Second parameter is “0” or “1” As of V005, only affects Clock Brightness	return_value is 1 if it succeeds or 0 if the password fails.

REST Commands			
setClockTimeOffsetToUTC	Sets Time Offset to seconds from UTC. For example, Pacific Standard Time is -25200	http://192.168.1.154/ setClockTimeOffsetToUTC? params=adminpassword, offset Parameter is administration password	return_value is 1 if it succeeds or 0 if the password fails.
setTurnOn	Overrides the check for Solar Panel Voltage < 2.0V	http://192.168.1.154/ setTurnOn? params=adminpassword, mode Parameter is administration password	return_value is 1 if it succeeds or 0 if the password fails.
led	Sets the LED Connected on the BC24 to On ("0") or Off ("1") Note - V005 will also blink this LED when the ESP32 is running	http://192.168.1.154/led? params=1	Return value is 1. Values other than 0 and 1 have no effect.

How to Program Your BC24 Solar Night Light

The BC24 ESP32 comes programmed with the released version of the software when the BC24 boards are programmed.

Download the Arduino IDE 1.8.5 (or higher) to start from arduino.cc

Installation of the IDE

See the Tutorial on:

<http://www.switchdoc.com/2018/07/tutorial-arduino-ide-esp32-bc24/>

Download The Software

Download and Install the software below in your Arduino IDE. If you don't know how to do this read one of the many tutorials on how to copy sketches into the Arduino IDE for your machine type.

https://github.com/switchdoclabs/SDL_ESP32_BC24_SOLARNL

Settings for Alexa and BC24 Solar Night Light

Not Released Yet