RaVolt Installation Guidelines

Generation 2

Version 1.0 Dated 12/19/2022

Installation to be conducted by qualified personnel only

Table of Contents

All information contained below shall be used as a guide and not intended as complete instructions.

All installation activities shall be carried out by a qualified and properly trained electrician and all personnel must wear appropriate PPE.

All installation means and methods shall be per Scope of Work (SOW), stamped Design Documents and manufacturer installation guides.

For further support please contact the RaVolt team.

Service Line: 1 (844) RAVSERV/ 1 (844) 728-7378

Email: service@ravolt.com

1.) Recommended Tools & Materials

The following list of tools and materials are recommended, but not required. Installations may require additional materials based on design.

Tools:

1.) Hand Tools

- Phillips head screwdriver
- Flat head screwdriver
- Small precision screwdriver
- 5/16” nut driver
- Wire strippers
- Cable cutters
- Linesman pliers
- Crimpers
- Shovel
- Tamper
- Level
- Hammer
- 6 foot ladder
- Meter
- Ground rod attachment

2.) Power Tools

- Knockout set or hole-saw set
- Cordless hammer drill
- Bandsaw or Sawzall
- Impact gun

3.) Rigging

- 6’ rigging straps
- Shackle

4.) Anchoring

- Refer to *RaVolt Anchoring Diagram*

Materials:

1.) Conduit

- PV Input to DC Disconnects (1 list per string)
  - (1) 1" weatherhead
  - (1) 1" sch. 40 cut to length (roughly 12-18")
  - (1) 1" TA/MA
  - (1) 1" bushing
  - (1) 1" locknut
- Generator Circuit
  - (1) 2" non-metallic flexible conduit cut to length (roughly 6')
  - (1) 2" sch. 40 cut to length (roughly 4')
  - (1) 2" sch. 40 to be placed in trench
  - (2) 2" 90° sch. 40 fittings
  - (2) 2" flexible straight fittings
  - (2) 2" flexible 90° fittings
  - (2) 2" locknuts
  - (2) 2" bushings
- AC Output Circuit
  - (1) 2" MA/TA
  - (1) 2" expansion joint
  - (1) 2" locknut
  - (1) 2" bushing
  - (1) 2" 90° sch. 40 fitting
  - 2" sch. 40 to be placed in trench to AC disconnect according to design

2.) Miscellaneous Materials

- Unistrut hardware
- Unistrut straps
- Colored electrical tape
- All weather code-compliant conduit glue

2.) Installation Overview

The RaVolt installation follows a standard process consisting of the following steps:

1.) Unloading Equipment-Trucks will arrive with a palleted enclosure, palleted generator, concrete pads, and batteries. It is recommended to level and set pads first, and then set the enclosure and generators directly off the truck.

2.) Placing the Enclosure & Generator Pads-Choosing a desired location for both pads, typically on the northern side of the array, about 6 feet apart. This step also consists of leveling and compacting the designated pad locations.

3.) Placing the Enclosure & Generator- Using slings and shackles on a capable machine (skid steer, mini excavator, or tractor), rig and place the equipment on their dedicated concrete pads.

4.) Trenching & Conduit- There will be 2 main trenches, the AC Out trench and the generator circuit. The AC Out trench will be from the load center on the side of the unit, to the AC disconnect on the side of the home. The generator circuit will be from the generator to the enclosure.

5.) Terminations- The RaVolt unit arrives with pre-installed and pre-configured equipment. There are roughly 10 additional terminations to make on a standard project.

6.) QA/QC, Commissioning, Photos- Installers will inspect the work using the QA/QC guidelines. There is a short commissioning process to ensure process functionality, followed by some photos for product warranties.

These 6 steps are broken down in greater detail throughout this installation guide.

3.) Unloading Equipment

Recommended Tools & Materials: Weight rated slings, weight rated shackles, ratchet strap.

1. Determine a safe, flat location for the truck to park for unloading.
2. The truck will arrive with the RaVolt enclosure banded to a pallet, a palleted concrete pad, and any additional batteries in crates.
3. **Operator must ensure sufficient lifting capacity of the machine to be used.**

   Estimated equipment weights are below:

   a. Estimated weight without batteries-600 lbs

   b. Estimated weight with batteries-1100 lbs

   c. Unit will usually arrive to site with batteries installed (1100 lbs)

4. If using a mini excavator for unloading the equipment, utilize properly weight rated slings and properly weight rated shackles. The unit will arrive with 4 lifting points present on the top of the enclosure. Operator must use extreme caution to not bend or break these lifting points, which may interfere with the enclosure's NEMA 3R rating. If using a forklift

or skid steer for unloading the equipment, utilize properly rated 4 foot forks for lifting the pallets.

5.) If using a forklift or skid steer for unloading the equipment, utilize a ratchet strap to secure the equipment to the mast of the machine when transporting.

6.) Place equipment in a flat, safe location until the crew is ready to progress.

4.) Placement of Enclosure Pad

RaVolt Enclosure Pad Dimensions: *4' L x 3' W*

Recommended Tools & Materials: Shovel, rake, hand tamper, crushed gravel, 4 foot level.

1. Determine the best location for the placement of the RaVolt enclosure. Refer to the project specific design documents when determining the general location. The precise location should be flat and protected from erosion and other weather factors.
2. Level and compact the determined location for the concrete pad. It is recommended to utilize gravel or crushed stone for compaction to create a firm base. (See below photos.)
3. Using a two-man lift, place the concrete pad on the level and compacted location.

Notes:

Pads can be placed in any homeowner-desired orientation. Units are usually installed on the north side of the solar array for ground mount applications, or near the meter for rooftop applications.

Installer must ensure the enclosure placement is outside of the minimum distance required by code from an existing gas line or propane tank.

Installer must ensure placement allows for a 4-foot serviceable radius in front and on the sides of the RaVolt enclosure. If there will be a generator present, ensure that there is 4 feet between the enclosure and the generator.

5.) Placement of Enclosure

Recommended Tools & Materials: Slings, shackles, straps, snips

1. After the pad has been placed in its determined location, operator will begin to properly rig and lift the enclosure for placement. It is recommended to transport the unit on its pallet to the determined location, before removing bands for lifting and placing.
2. Using all 4 lifting eyes on the RaVolt unit and appropriate rigging, lift the RaVolt enclosure off the shipping pallet and place the enclosure on top of the placed or poured pad.
3. Installers must ensure the unit is centered on the concrete pad.
4. Utilize the provided anchoring hardware to secure the unit to the pad.
5. Install the supplied drip edge after the enclosure has been set to ensure the NEMA 3R rating is upheld. The drip edge will fit in the three holes on the top of the enclosure, on both the front and back of the unit.
6. These T30 bolts are already installed on the enclosure. Simply remove these bolts, place the drip edge so the holes line up on the enclosure, and replace these bolts.

6.) Trenching & Conduit

It is a requirement to contact diggers hotline prior to any excavations and confirm location of any unmarked utility or private owned utilities.

1.) After placement of the enclosure and other project components, utilize a trencher or mini excavator for trenching.

2.) Trenches will be in three main locations:

Generator/Grid Input: RaVolt Enclosure to Generator or Service Disconnect

AC Output: RaVolt Enclosure to the AC Disconnect at the home

PV Input: RaVolt Enclosure to the Solar Array (if necessary)

3.) Install 2" sch. 40 conduit within the trench, utilizing a 90° fitting to stub up to the above locations prior to backfilling. Ensure that all-weather code-compliant conduit glue is being used for connections.

4.) The following locations typically use these fittings to land into the RaVolt Enclosure:

Generator/Grid Input: Conduit stub->Female adapter->Straight flex fitting->Flexible conduit->90° flex fitting->Bushing & locknut into disconnect on RaVolt Enclosure

AC Output: Conduit stub->Female adapter-> Straight flex fitting-> Flexible conduit-> Straight flex fitting->Bushing & locknut into loadcenter on RaVolt Enclosure

PV Input (Underground): Conduit stub->Coupler->Sch. 40 conduit cut to length->LB fitting-> Sch. 40 conduit cut to length ->Male adapter->Bushing & locknut into the DC disconnects on the RaVolt Enclosure

PV Input (Weatherhead): 1" Weatherhead->1" Conduit cut to length->1" Male adapter->Bushing & locknut into DC Disconnect

Notes:

Installers can use either flexible conduit or sch. 40 for all incoming conduit connections, material lists will vary slightly.

Trenches must be 18”-24” deep, per code.

Installers must use warning tape above place conduit or direct burial cable before backfilling.

Trenches must be backfilled with clean fill, free of large rocks or sharp objects.

Conduit should be secured per NEC code.

7.) Terminations

1. Install ground rod(s) at the enclosure. Ground and bond to NEC code at the disconnect.
2. After all trenching and conduit has been completed, pull wire to all designated locations according to design. Ensure wire sizing is per NEC code based on system sizing.

   IMPORTANT: Power output to load from RaVolt enclosure MUST be protected at the home service entrance or prior to connecting to a load with a circuit breaker of NO MORE THAN 200AMPS. Failure to do so could result in fire, damage, injury or death.

Generator/Grid Input:

1. Ensure there is no power on the grid/generator cables using a voltmeter.
2. Remove screws and remove the front plate from the disconnect.
3. All external AC power sources will be terminated within the disconnect on the side of the RaVolt enclosure. This external AC power can be from the grid, a generator, or a combination of the two.
4. After cable has been pulled from the service disconnect or the generator to the disconnect on the side of the RaVolt enclosure, begin to make terminations in the appropriate locations, per NEC code. ***Utilize the one line document for detailed termination direction.***
5. Label the incoming cable and ensure the two hot legs have been terminated in the correct lugs. Ensure the lugs have been torqued to manufacturer specifications.

6. Ensure both the neutral and ground have been terminated in their correct locations and torqued to manufacturer specifications.
7. If there will be both a grid and generator input, land the grid input on the line side of the disconnect. The generator input will be terminated on the "GEN" breaker on the Sol-Ark.
8. The RaVolt enclosure arrives pre-wired and pre-configured to allow the load side of this disconnect to flow through the inverter, into the load center and into the home. After landing the grid and/or generator inputs, this disconnect is complete.

AC Output:

1. Ensure there is no power to the load center using a voltmeter.
2. Remove screws and remove the front plate from the load center.
3. After cable has been pulled from the load center on the RaVolt enclosure to the AC disconnect on the side of the home or dwelling, begin to make terminations in the appropriate locations within the load center.
4. Ensure cables have been labeled and terminated on the load side of the 200 A breaker according to the manufacturer specifications, and per NEC code.
5. Ensure both the neutral and ground have been terminated in the correct locations within the load center.
6. The RaVolt enclosure arrives pre-wired and pre-configured to connect the load center to the inverter. After terminating this AC out cable, this load center is complete.

PV Input:

1. Ensure there is no power on the incoming PV cable. *DO NOT MAKE MC4 HOME RUN CONNECTIONS BEFORE TERMINATING THIS DC DISCONNECT.*
2. Ensure cables have been correctly labeled to clearly indicate different strings, positive and negative.
3. Run PV cables from the array, into a drip loop, into the weather head. This will run directly into the DC disconnect on the side of the enclosure.
4. Place the switch in the "off" position and remove the screws from the DC disconnect cover. Remove the cover.
5. Begin to make terminations within the DC disconnect according to the manufacturer specifications. ***Refer to the one line document for detailed termination instructions.***
6. After terminations are made and verified, replace screws and DC disconnect cover.

7. The RaVolt enclosure arrives pre-wired and pre-configured to connect the DC disconnects to the MPPT's on the Sol-Ark inverter. After the incoming wires have been terminated, these disconnects are done.

Two Wire Start:

1. If a generator is present, it will likely need a two wire start circuit. This circuit will typically consist of 2 #10 AWG THHN/THWN wires.
2. Run these wires from the generator, through the disconnect, and into the RaVolt enclosure.
3. Ensure there is no power to the Sol-Ark.
4. Terminate these wires on the Sol-Ark inverter using pin terminals at terminal blocks 7 +8. Please refer to the Sol-Ark manual for further instruction if necessary.
5. Terminate the generator side of the two wire start circuit at the designated two wire start terminals. Refer to the generator's manufacturer manual and specifications for specific instructions.

Trickle Charge Circuit

1. If a generator is present, it will likely need a trickle charge circuit to continuously charge the battery of the generator. This circuit will typically consist of 3 #10 AWG THHN/THWN wires.
2. Run these wires from the generator, through the disconnect, and into the RaVolt enclosure.
3. Ensure there is no power to the terminal blocks within the RaVolt enclosure.
4. Label these wires and terminate at the terminal blocks at the top right corner of the RaVolt enclosure. The hot wire will be terminated at block 1, neutral at block 2, ground at block 3.
5. Terminate the generator side of the trickle charge circuit at the designated 120 VAC input location. Refer to the generator's manufacturer manual and specifications for specific instruction.

8.) Enclosure Labeling

1. The RaVolt enclosure will arrive with a packet of required labels. Ensure the labels are present and not damaged.
2. Place the labels at their appropriate locations on the RaVolt enclosure. See the below photo for location references.

This is the minimal labeling required, please confirm with AHJ and local utility that all labeling requirements have been met. Please see the last page of guidelines for additional labeling that may be required.

RaVolt Unit Labeling

RaVolt Unit Labeling (Field Crew)

AC Disconnect Labeling

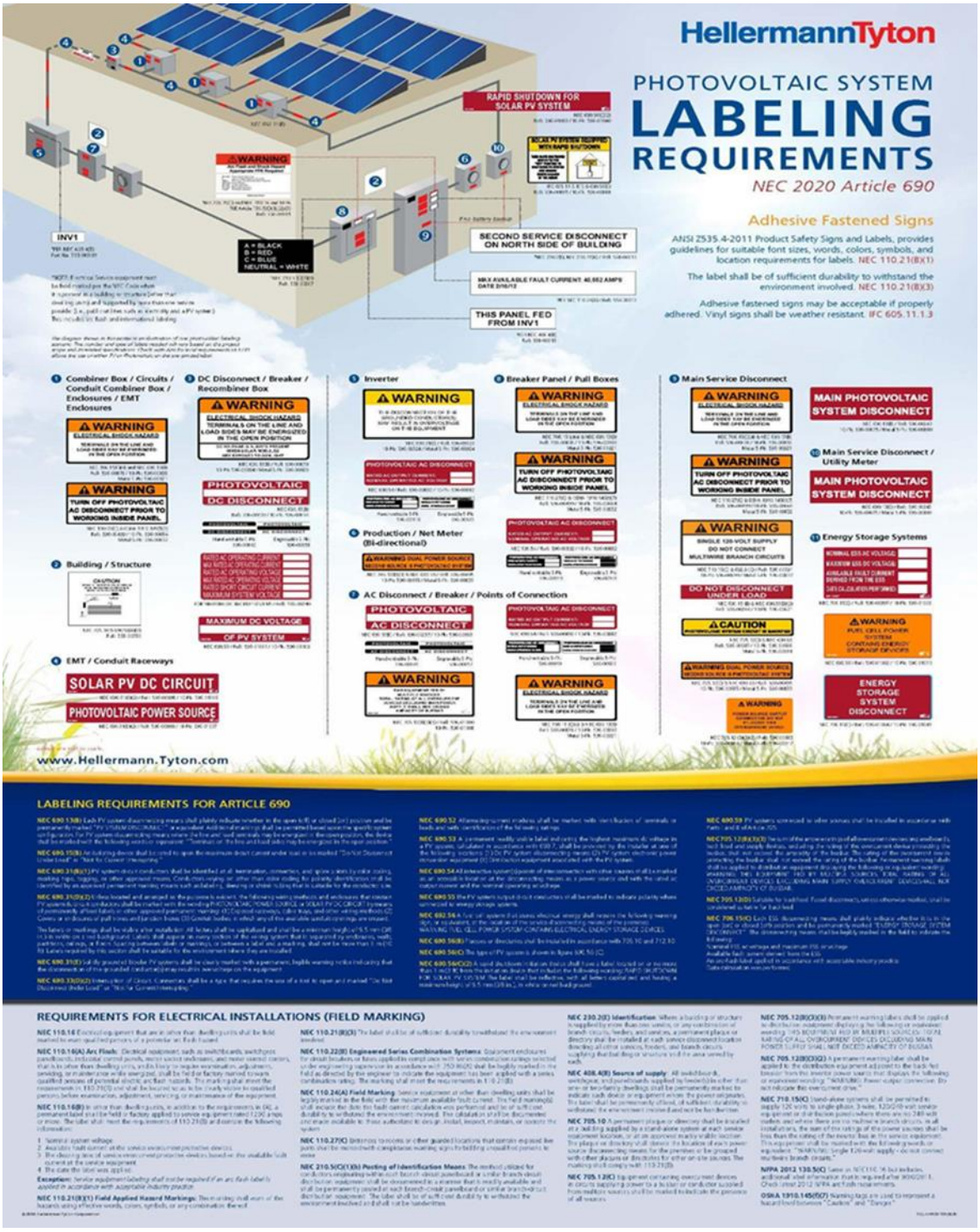
Meter Labeling
(ONLY REQUIRED ON GRID TIED SYSTEMS)

***Utility must always be consulted to confirm if there are any Utility Specific labeling requirements. These additional labels are generally placed on the meter unless otherwise specified

DC Conduit Labeling

*** When multiple inverters are installed this sticker is required on every DC Conduit entering the inverters

DC Disconnect Labeling
(Rooftop Jobs Only)


HellermannTyton
PHOTOVOLTAIC SYSTEM
LABELING
REQUIREMENTS
NEC 2020 Article 690
Adhesive Fastened Signs
ANSI Z535.4-2011 Product Safety Signs and Labels, provides guidelines for suitable font sizes, words, colors, symbols, and location requirements for labels. NEC 110.21(B)(1)
The label shall be of sufficient durability to withstand the environment involved. NEC 110.21(B)(3)
Adhesive fastened signs may be acceptable if properly adhered. Vinyl signs shall be weather resistant. IFC 605.11.1.3
RAPID SHUTDOWN FOR SOLAR PV SYSTEM
SECOND SERVICE DISCONNECT ON NORTH SIDE OF BUILDING
THIS PANEL FED FROM INV1
INV1
A = BLACK
B = RED
C = BLUE
NEUTRAL = WHITE
1 Combiner Box / Circuits / Conduit Combiner Box / Enclosures / EMT Enclosures
2 DC Disconnect / Breaker / Recombiner Box
3 Inverter
4 Breaker Panel / Pull Boxes
5 Main Service Disconnect
6 Production / Net Meter (Bi-directional)
7 AC Disconnect / Breaker / Points of Connection
8 Building / Structure
9 EMT / Conduit Raceways
10 Main Service Disconnect / Utility Meter
11 Energy Storage Systems
WARNING
TURN OFF PHOTOVOLTAIC AC DISCONNECT PRIOR TO WORKING INSIDE PANEL
PHOTOVOLTAIC DC DISCONNECT
MAXIMUM DC VOLTAGE
OF PV SYSTEM
PHOTOVOLTAIC AC DISCONNECT
MAIN PHOTOVOLTAIC SYSTEM DISCONNECT
SINGLE 120-VOLT SUPPLY DO NOT CONNECT MULTIWIRE BRANCH CIRCUITS
DO NOT DISCONNECT UNDER LOAD
CAUTION
ENERGY STORAGE SYSTEM DISCONNECT
SOLAR PV DC CIRCUIT
PHOTOVOLTAIC POWER SOURCE
www.Hellermann.Tyton.com
LABELING REQUIREMENTS FOR ARTICLE 690
REQUIREMENTS FOR ELECTRICAL INSTALLATIONS (FIELD MARKING)

9.) QA/QC Walkthrough

1. After all conduit, trenching, terminations and labeling has been completed to a satisfactory level, begin the QA/QC walkthrough using the "RaVolt QA/QC Inspection Sheet".
2. Thoroughly inspect all aspects of the completed work. The inspection sheet highlights all important components to be inspected.
3. The "RaVolt QA/QC Inspection Sheet must be completed and signed off on by a representative of the install team for warranty registration.
4. Correct any issues seen during the inspection and document these corrections on the inspection sheet.

10.) Commissioning & Photos

Take photos of the following items for documentation:

1. RaVolt enclosure and pad placement
2. Installed anchoring hardware
3. Drip edge installed on top of enclosure
4. All conduit connections
5. All grounding & neutral to ground bond
6. Load center terminations (AC Output-2 hot, 1 neutral, 1 ground)
7. Disconnect terminations (Grid/Gen Input-2 or 4 hot, 1 or 2 neutral, 1 or 2 ground)
8. DC Disconnect terminations (Each PV string within disconnect)
9. Two wire start termination at Sol-Ark inverter
10. Trickle charge termination at terminal blocks within RaVolt enclosure
11. Battery communication cables
12. Heater setting
13. Fan setting
14. Any notable issues or blemishes on equipment
15. All placed labels
16. All communication connections
17. Functioning Wi-Fi dongle
18. Any additional RaVolt options (Project specific details)

Commissioning Steps

1.) After all terminations are made and the QA/QC walkthrough has been successfully completed, the RaVolt system is ready to be turned on. Follow the steps in order to ensure equipment is safe and functional.

2.) Make sure ALL breakers and disconnects are set to OFF prior to powering up any aspect of the system.

PV Commissioning

3.) Make the MC4 home run connections on string one at the array to provide DC power to the DC disconnect.

4.) Use a voltmeter to measure voltage on string one.

5.) Disconnect string one and repeat this process on all available pv strings coming to the DC disconnect.

6.) Once all string voltages are verified and correct, replace the DC disconnect cover and make all MC4 homerun connections at the array.

7.) Turn the DC disconnect dial from the "OFF" position to "ON". This will send power to the Sol-Ark inverter.

8.) Turn the PV disconnect switch on the Sol-Ark inverter from the "OFF" position to "ON". (Disconnect switch is "ON" in the horizontal, depressed position. "OFF" is the vertical position.)

9.) The inverter should recognize the incoming DC voltage and light up the screen. Verify the voltage reading on the inverter are the same voltages verified with the voltmeter. The PV voltages can be seen by pressing the battery icon on the Sol-Ark.

Battery Commissioning

10.) Ensure all battery switches are in the "OFF" position. Also check to make sure all communication cables are connected.

11.) Turn one battery on and verify the voltage using a voltmeter. Check to make sure the Sol-Ark is reading a similar voltage.

12.) Turn the battery off and repeat this process with all batteries in the cabinet.

13.) Balance all batteries individually to within one tenth of a volt (.1 V) using the incoming solar, making sure that the inverter is charging all batteries at an equal rate.

Disconnect Commissioning

14.) Turn off all batteries and the Sol-Ark. Remove the cover from the disconnect.

15.) With all disconnects, breakers, and equipment off, turn on the incoming power to the disconnect. This may be a generator or the grid, test individually if both.

16.) With the disconnect set to "OFF" use a voltmeter to check the incoming voltage on the line side of the disconnect. Check both phase to ground and phase to phase voltage to ensure the incoming voltage is balanced.

17.) After voltages are verified from both the grid and gen inputs at the disconnect, turn the power back off to the disconnect. Replace the cover to the disconnect.

18.) Turn the power on to the disconnect. After power is on, throw the disconnect switch to allow power to the Sol-Ark.

19.) Flip the "Grid" and "Gen" disconnects on the Sol-Ark to "ON". The Sol-Ark should recognize the power and turn on.

20.) Verify voltage readings on the Sol-Ark screen coming from the grid and gen.

21.) With the battery disconnect off, turn the batteries on individually.

22.) Turn the battery disconnect on and verify that the grid and/or gen input is charging the batteries.

IMPORTANT! Ensure that neutral and ground are bonded together at exactly ONE location in the entire electrical system. This will be in the disconnect on the side of the RaVolt enclosure.

Load Center Commissioning

23.) Remove the cover of the load center.

24.) Using a voltmeter, measure the voltage of the load side. Measure both phase to ground and phase to phase voltages to verify that the voltages are balanced.

25.) Operate the manual bypass switch of the load center and verify the voltages of the feed thru lugs to verify load side voltage.

26.) Replace the cover of the load center.

Grid Connected Generator Function

In a Grid connected scenario the generator is available as a backup (for charging batteries only) in instances where the grid becomes unavailable. In standard operation where the grid is present the grid will be used as the power source to recharge the batteries as necessary. The generator will only supply power to the RaVolt system/home when the batteries are at a low charge during a grid outage scenario. With this configuration, the generator cannot power the house directly without passing through the inverters.

Generator/Grid Battery Charging

27.) Manipulate settings within the Sol-Ark to a grid start & gen start value slightly below the current battery charge. Turn the time of use setting off.

28.) Set the PV disconnects to “OFF”.

29.) Ensure that the system is running off only battery power.

30.) Run loads at the house or the enclosure until the state of charge drops to the grid/gen start values. This should cause the inverter to call for the generator and charge the batteries.

31.) Once it is verified that the generator or grid has been called for charging the batteries, change the settings back to their original state.

Wi-Fi Dongle Set-Up

32.) Follow directions within the Sol-Ark manual for detailed instructions.

33.) Using a phone or computer, enter the Wi-Fi settings section of the device. Connect to a network titled “EAP-####”. This will be the dongles network.

34.) Enter the password “12345678”.

35.) Open the browser on the device and search “10.10.10.1”. This will bring you to the dongle’s menu.

36.) Scroll to the bottom of the screen and find the Wi-Fi list. Press “Scan” if the local network you are trying to connect to does not appear.

37.) Click on the name of the local network and enter the password. It will say “Set Success!”, and the dongle will be online.

Settings

38.) The RaVolt unit will arrive to site pre-configured with settings. Verify that all settings match the customer’s needs. Contact the RaVolt team for further help if necessary.