SOLAR STIK®

OPERATION AND MAINTENANCE MANUAL FOR THE SOLAR VENTURE 320 W ARRAY

P/N 19-1000012

Updated: 20231129

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Revision History

Section	Page(s)	Description	Date
		Initial Release	June 2021
Stowing	24	Illustration and use of Hard Case	April 2022
All	all	Reduce content to 10 double sided pages.	April 2022
All	All	Overall editing	May 2023
All	All	Overall editing	Aug 2023

GENERAL INFORMATION, THEORY OF OPERATION, AND EQUIPMENT DESCRIPTION

The Solar Venture 320 W is designed to generate renewable power in expeditionary applications where weight, rugged design, and extreme portability are factors.

The Array can be deployed on any terrain, and can generate up to 320 watts of power for applications where independence from traditional power sources is required. The 320 W Array is modular and scalable, allowing users to tailor power generation capability to load requirements.

The mono-crystalline cells in the high efficiency Solar Panels are laminated onto a carbon-fiber structure, which combines extremely high PV performance with incredibly light material for an extraordinary watt-to-weight ratio. The Array offers a superior integration of technologies to provide the operator with highest power in the smallest renewable generator footprint.

Product Safety Information and Instructions

This manual contains important safety instructions that must be followed during the installation and operation of the Solar Array. Read all instructions and safety information contained in this manual.

Safety Information Labels

Your safety and the safety of others is very important. This manual provides guidance on safe operating practices and how to achieve maximum performance from the MEHPS-Solar Array. Always observe and follow all safety protocols outlined below:

This is the safety alert symbol. This symbol alerts you to potential hazards that can kill you or hurt you and others. All safety messages will follow the safety alert symbol and the word “DANGER”, “WARNING”, or “CAUTION”. These words are defined as:

DANGER Indicates a hazardous situation which, if not avoided, **will result in death or serious injury**.

WARNING Indicates a hazardous situation which, if not avoided, **could result in death or serious injury**.

CAUTION Indicates a hazardous situation which, if not avoided, **could result in minor or moderate injury.**

All safety messages will identify what the potential hazard is, how to reduce the chance of injury, and what can happen if the instructions are not followed.

Electric Shock Hazard Related to Solar Panels

WARNING

- Solar Panels produce electricity when exposed to sunlight.
- Live power may be present at multiple terminals.
- Never route the cables through standing water.
- All cables and connections should remain dry and should be inspected regularly to ensure safe operating conditions.
- Do not disconnect Solar Cables when under load.
- Eliminate Panel exposure to sunlight before disconnecting Solar Cables to prevent arcing.

Connecting and disconnecting Solar Cables may result in arc flash when the cables are under load (carrying current) from an active Solar Panel or Array.

Warnings to this effect are present at multiple locations on Solar Cables, connectors and the Solar Panel itself (Figure 1).

Figure 1. Solar Array safety labels

Equipment Description

Solar Array Kit Contents

Table 1. Solar Venture 320 W Array Kit (P/N 19-1000012) contents

Components of MEHPS-Solar Array	P/N	Qty	Image
Hard Case, Solar Venture 320W	14-1000035	1	
Panel, Solar Venture 320W	14-1000037	1	
Stand, Solar Venture	14-1000033	2	
Cable, Solar Venture	13-1000350	1	
Ground Securing Kit	12-1000009	2	See Table 2
Operation and Maintenance Manual	19-1000012	1	

Table 2. Ground Securing Kit (12-1000009) contents

Components of Ground Securing Kit	P/N	Qty / Kit	Qty / Array	Image
Mesh Hold Down, 30 Deg	08-1000086	1	1	
Mesh Hold Down, 60 Deg	08-1000087	1	1	
Sandbags	12-1000007	7	7	

OPERATOR INSTRUCTIONS

Solar Array Setup

1. Unpack and Inventory Solar Array Components

Remove Solar Array components from Soft Case. Inventory Components shown in Table 1 and Table 2. Two (2) Ground Securing Kits are packed together in Soft Case small compartment.

2. Extend and Lock Array Stand

Disconnect the velcro transport strap securing the foldable Array Stand (Figure 2A). Remove the two (2) locking pins (Figure 2B) to allow the Array Stand to expand. Expand the Array Stand (Figure 2C) and install the locking pins in the “deployed” position (Figure 2D) after the Array Stand is fully extended (Figure 2E).

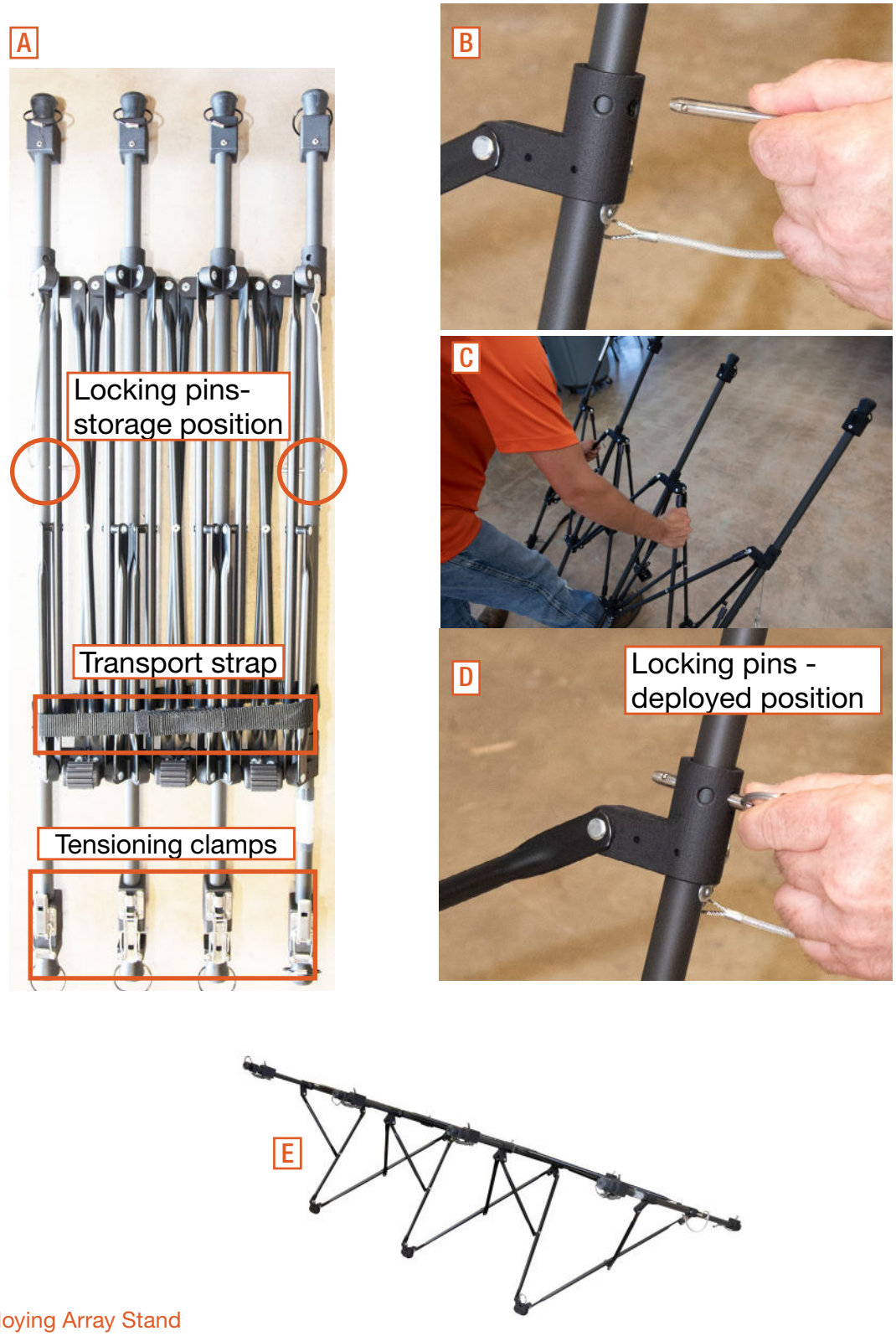

Figure 2. Deploying Array Stand

3. Install 30º Mesh Hold Down

The 30º Mesh hold down attachment has three (3) clips on the short side and four (4) on the long side (Figure 3A). The clips on the short side connect to the rings on the three (3) cleats (Figure 3B) of the Array Stand. Connect the four (4) clips on the long side of Mesh to the wire loops (Figure 3C) at the low end of the support frame bar (Figure 3D). The Mesh will be stretched tight when all of the connections are made.

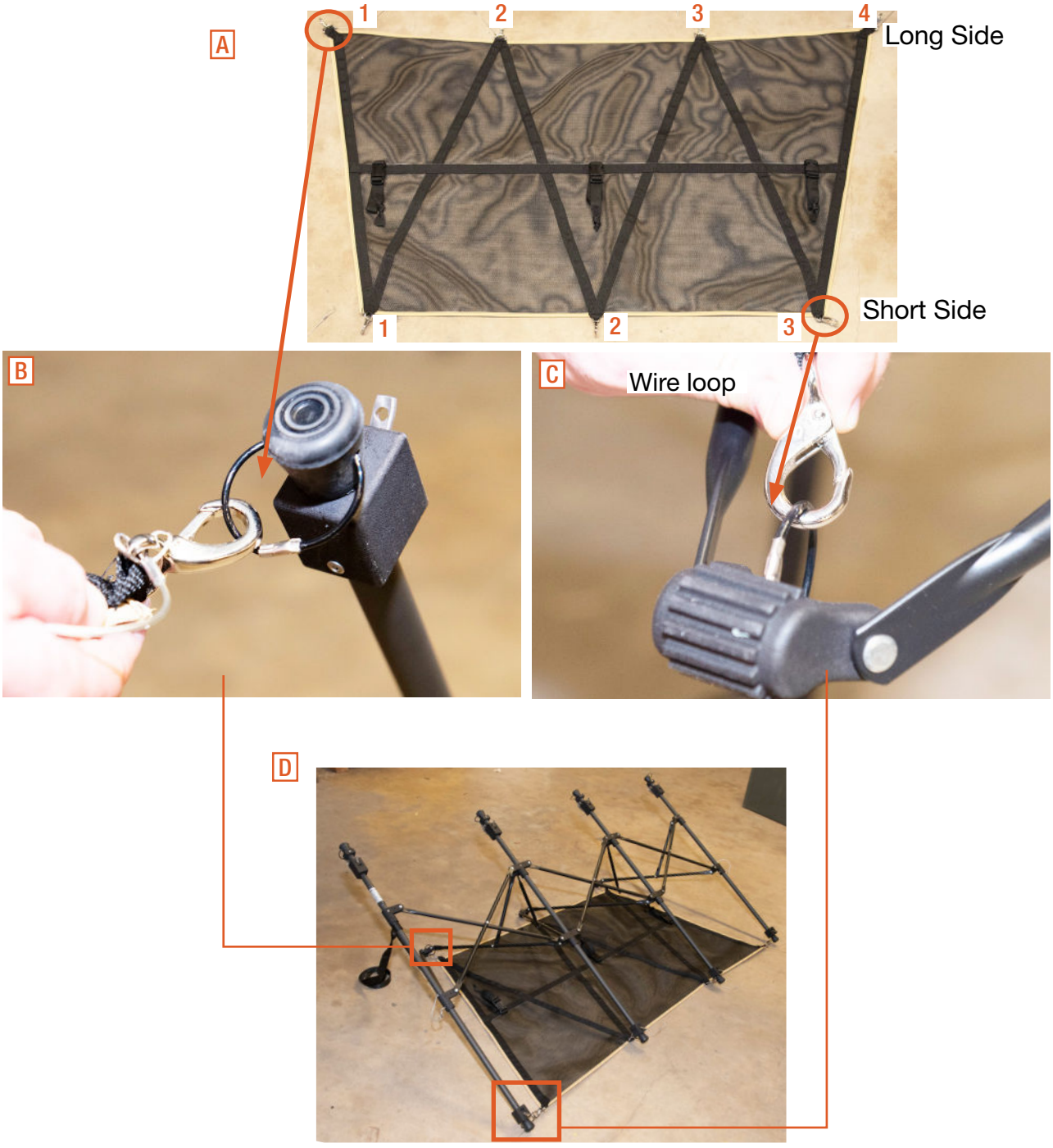

Figure 3. 30º Mesh Hold Down installation

4. Install 60º Mesh Hold Down

The 60º Mesh Hold Down has three (3) clips on the short side and four (4) on the long side (Figure 4A). The clips on the long side connect to the wire rings (Figure 4B) on the round feet associated with the tensioning latch. The three (3) clips on the short side connect to the three (3) support frame cleats (Figure 4C).

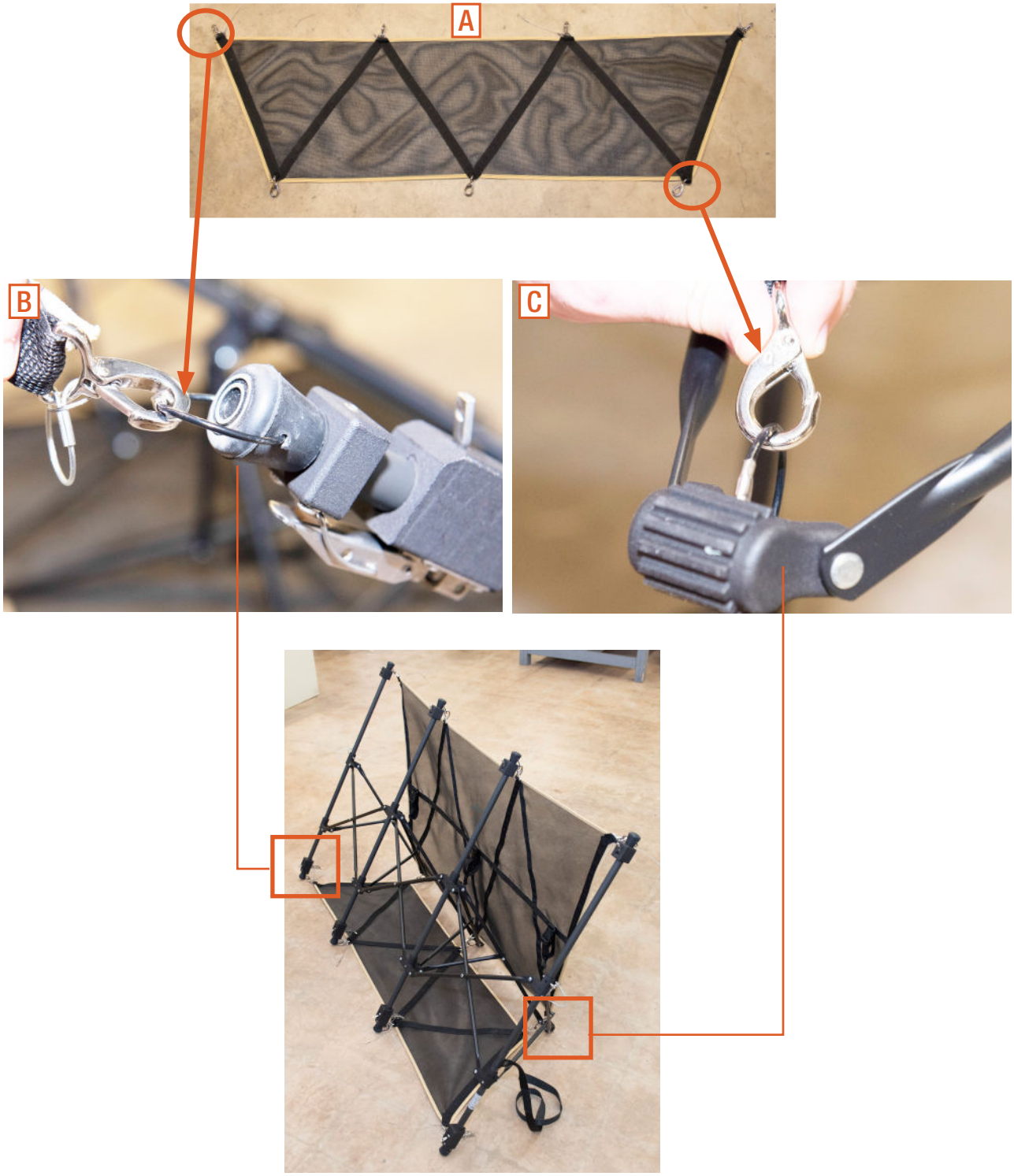

Figure 4. 60º Mesh Hold Down installation

5. Mesh Configuration for 30º and 60º Deployments

Connect the large and small Meshes as shown in Figure 5 to deploy the Array at 30º (A) or at 60º (B).

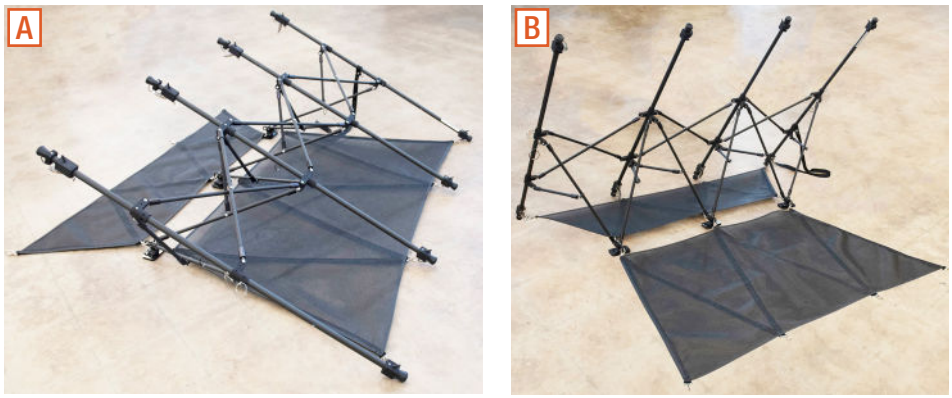

Figure 5. Ground-securing Mesh configuration for 30º and 60º Array deployment

6. Install Panel onto Array Stand

Each Panel has eight (8) grommet-reinforced holes, four (4) on the top and four (4) on the bottom (Figure 6A, orange circles). The Array Stand has eight (8) complementary Panel mounting hooks (Figure 6B). The latching mechanism on this side of the frame is fixed. Connect the Panel to this row of fixed mounting hooks first (Figure 6B). Mount Panels onto Array Stands in the same orientation.

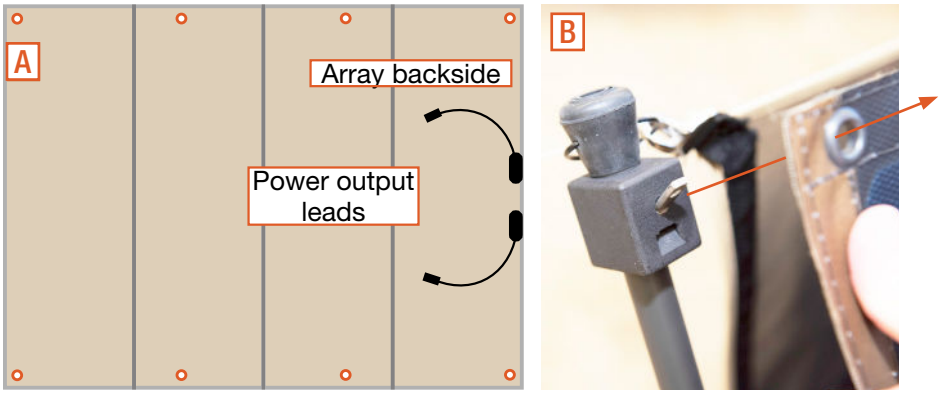

Figure 6. Connecting Array to Array Stand

The hooks on other side of the Panel are part of a sliding tensioning clamp. Figure 7A shows the Array Stand in the storage configuration with tensioning clamps in locked and unlocked positions. Unlock the clamp lever to allow the hook to slide (Figure 7B). Place the hook into the hole, then tighten (Figure 7C) and lock the clamp (Figure 7D). Repeat for each of the four (4) mounting holes until the Array is secured to the support frame.

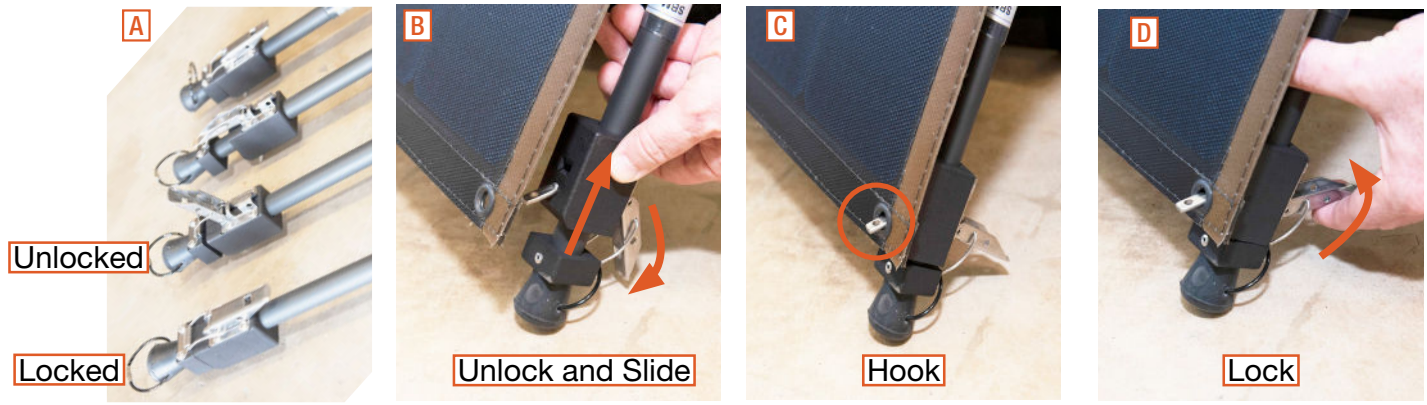

Figure 7. Locking the Array into place on the Array stand

7. Secure Array to Ground

Do not secure the Array to the ground before establishing proper location and orientation.

Before the Array are secured to the ground, be observant and take care to ensure the support frame is not twisted. If the support frame is twisted, the Array will be exposed to torsional strain, which can cause damage to the cells.

⚠ WARNING

Failure to properly secure Array(s) to ground with sandbags could result in Array damage, personnel injury, or death in high winds. Wind damage can render Array nonfunctional or significantly reduce their functional life expectancy. Array must be properly secured to the ground even in low-wind environments.

⚠ CAUTION

DO NOT DAMAGE THE ARRAY SUPPORT FRAME.
DO NOT DROP SANDBAGS ONTO THE ARRAY SUPPORT FRAME.

The Array must be secured with sandbags (Figure 8) to reduce the potential for displacement or damage in high winds. Each 320 W Array kit provides 7 sandbags. Wind-testing data indicate that the Array will withstand displacement in winds of 60 mph (97 kph) when weighted with seven (7) sandbags for the entire Array. Use the best available information when determining how many sandbags to use.

Sandbags should weigh a minimum of 50 pounds (23 kg) each. Place sandbags on the ground-securing Mesh under the Panel and on the Mesh behind the Panel as shown below (Figure 8).

a. Ground-securing for 30º and 60º Deployments

Configure the Mesh for the desired angle of deployment (Figure 4 & Figure 5). Ensure the Array is oriented for maximum energy harvesting and that the Solar Cable will reach the Power Hub. Generally speaking, the lower angle (30º) will harvest energy more efficiently in the summer when the sun is overhead. During the winter, the steep angle (60º) will be more efficient.

Place seven (7), 50-lb (23 kg) sandbags on the Mesh as shown below. Sandbags are illustrations and not to scale.

30º - Best for summer

60º - Best for winter

Figure 8. Sandbag placement for 30º and 60º Array deployment

b. Mesh Configuration and Ground-securing for Flat (0º) Deployments

The Array Stand is not used when deploying the Array at 0º, or flat. Instead, the 30º and 60º Mesh pieces are connected to the back side of each Solar Panel and then to each other to form a "pouch" into which sandbags are inserted. The number of sandbags required to secure the Array will vary by terrain and environmental conditions.

DO NOT kneel on or place weight on the Solar Panel while installing the ground securing Mesh as Panel cells may be damaged. If a suitable working surface is not available, connect the Meshes with Panels standing on edge.

1. Place Panel solar cell-side ("face") down on a surface that will not damage the solar cells/Panel. Place the ground-securing Mesh (nylon strap side up) on the back of the Panel as shown in Figure 9B. The smaller of the two Meshes must be on top of the larger one.

2. Slide the looped wire through the grommet then secure in the clip (Figure 9A). Repeat step for each of the eight (8) points of connection [four (4) on each section of Mesh; orange boxes in B].

3. Secure the nylon strap into the clip (Figure 9C). Repeat step for each of the three (3) points of connection in the middle of the Panel (orange circles in B)

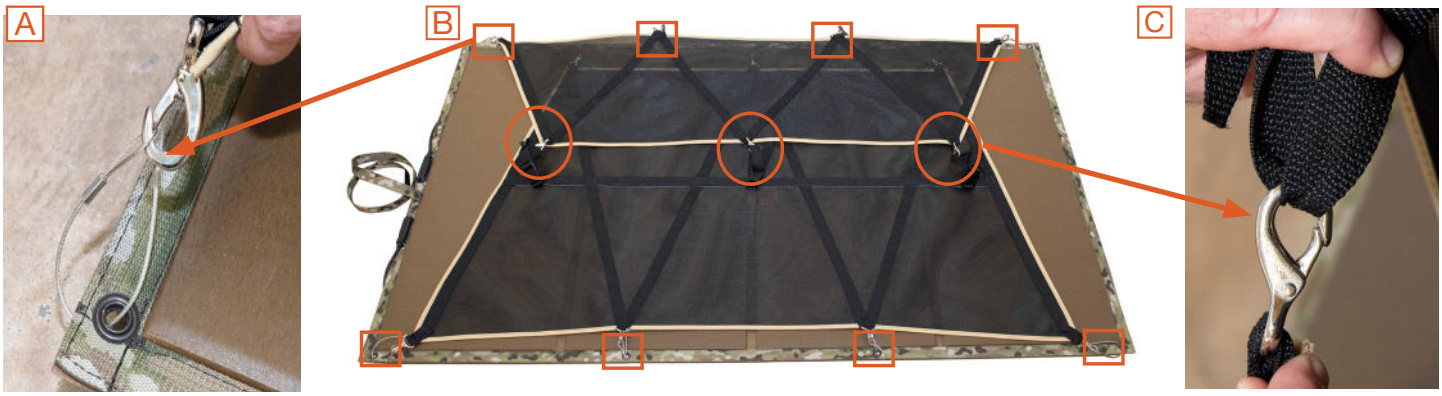

Figure 9. Configuring ground-securing Mesh for flat (0º) deployment

4. Flip over Panel so Mesh is on underside.

5. Place sandbags between Mesh and Panel.

Figure 10. Sandbags placement for 0º deployment

8. Connect Solar Cable to Solar Array Leads

Connect the leads on each Panel to the Solar Cable as illustrated below in (Figure 11). The connectors on both ends of the Cable are polarized to prevent improper connection.

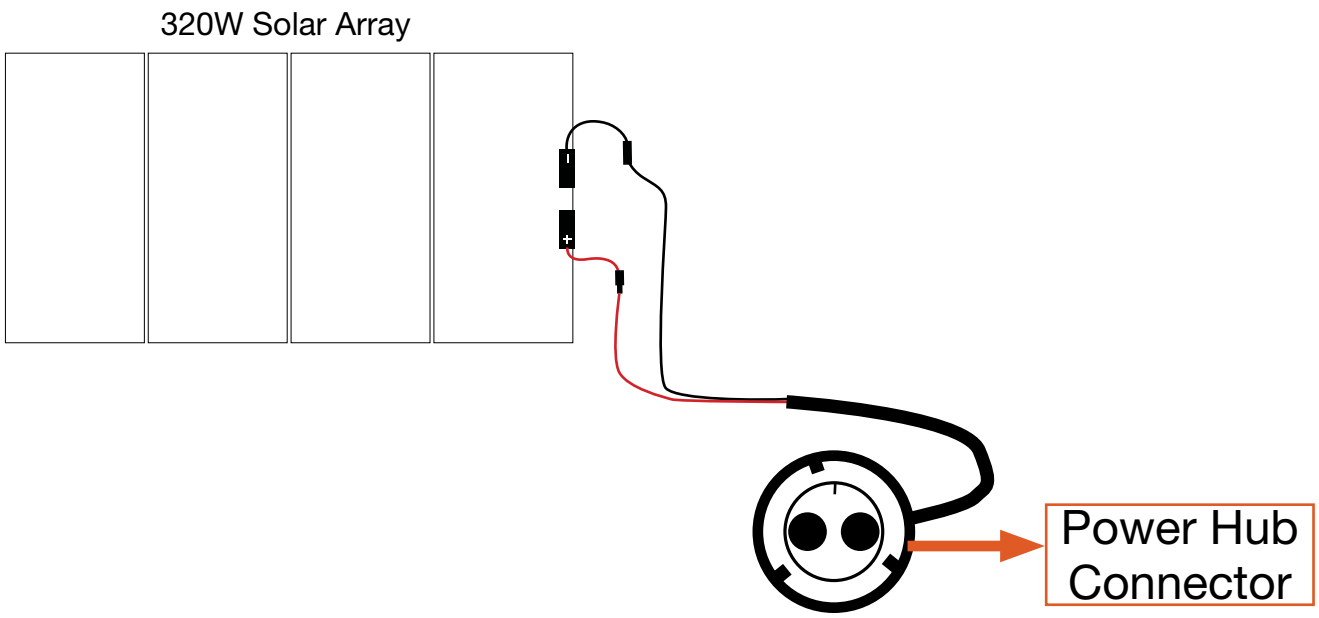

Figure 11. Connecting Array to Solar Cable.

9. Connect Array(s) to Power Hub

Connect Solar Cable to the solar power input ports on the side of the Power Hub. The Solar Array must be within 35 ft. of the Power Hub as this is the length of the Solar Cable (32 ft. Solar Cable plus 3 ft. of cable connected to each of the panels). Do not secure Array to the ground until adequate cable length to the Power Hub has been verified and Array have been oriented optimally toward the sun.

10. Position Array for Optimal Power Generation

The setup location should have good exposure to sunlight and be away from other structures or potential hazards such as vehicle thoroughfares.

Array Orientation for Optimum Power Generation
Power generation requires direct sunlight for maximum performance. Optimal power generation is achieved by orienting all Array in the same direction and at the same angle.

> **Note:** Harvesting energy will not improve by orienting subsets of Array to capture morning, midday, and evening sun. In the Northern Hemisphere, the Array should be positioned so that they face the noon sun, which is usually true south in the Northern Hemisphere and true north if in the Southern Hemisphere. The Array may also be deployed flat and aimed straight up when conditions warrant.

Seasonal Adjustment of Array Tilt to Improve Output
Array performance may be improved by adjusting the tilt and orientation of the Panels seasonally. The angle of the Array, relative to the sun, can be adjusted to 0°, 30° or 60° prior to securing to the ground. In the Northern Hemisphere, the sun is higher overhead during the summer and lower on the horizon during the winter.

Power output of Array can be monitored in real time on the Power Hub User Interface. (See Power Hub Operator Manual for instructions.) Monitoring the power output while orienting and choosing the best tilt angle for the Panels will assist in finding and maintaining optimum power output throughout the year.

Shading
The Array must be positioned so they are not shaded. During periods of inclement weather or if the Array is not positioned optimally, daily power generation levels may be reduced.

Derating, Solar Loading, and Airflow

Derating occurs when the power output is diminished below rated values. Array may accumulate excessive amounts of heat due to solar loading and lack of airflow, resulting in derating.

Locate Array where airflow is unobstructed to reduce the impact of solar loading–induced derating.

Disconnecting Array

To disconnect MC4 connectors, squeeze locking tabs and pull apart. Solar Panels should not be disconnected when under load because doing so could produce arc flash. Solar Panels produce electricity when exposed to light. Options for eliminating the load include: placing panel “face down” on an a flat surface, waiting until night time, or covering the panel with an opaque material. If none of these is a reasonable option, disconnect the MC4 connectors very slowly while wearing insulated gloves and protective eye wear. Disconnecting slowly significantly reduces the potential for arc flash and ensures that if it occurs, it will be contained within the insulating shield of the MC4 connector.

Stowing Array

Pack Solar Array components into the hard case as illustrated below.

1. Place Solar Panel in bottom of compartment.
2. Place Solar Array Stand on top of Solar Panel.
3. Place Quick Reference on Array Support Frames.
4. Place Solar Cable in compartment on left.
5. Place Ground Securing Kit components into indicated compartments.
   a. Large Ground Securing Mesh (x1)
   b. Small Ground Securing Mesh (x1)
   c. Sandbags (x7)
6. Close and lock case lid.

Figure 12. Packing Solar Venture 320 W Array

MAINTENANCE

- Check panels daily to ensure they are generally free of dust, dirt and debris. Spray the panels with water or remove dust and dirt using a wet, clean microfiber cloth once a month or as needed. The panels may require more frequent cleaning in extremely dirty environment. Do not use any chemicals when cleaning the panels.
- Position Array for maximum daily sunlight exposure.
- Secure Solar Cables and provide strain relief at locations where cables are stressed.
- Check the integrity of electrical connectors monthly.
- Maintain adequate airflow around Array to minimize derating.

TROUBLESHOOTING

The Solar Venture 320 W Array provides regulated power via the Power Hub. The contribution of solar power generation should be monitored over time to ensure optimal performance of the Array. If a decrease in performance is observed during normal operation, the source of the issue may be determined by measuring the voltage of each Array independently using a handheld multimeter (Figure 13).

It is important to remember that the charging current from the Array reported at the Power Hub will be low, even in full sun, when the System batteries are at or near a full charge. This is a normal operating condition.

Measuring Array Voltages: Background

Voltage “open circuit” (V_{oc}) is unregulated Array voltage and is measured directly from the leads of an Array when not connected to a “load” such as a charge controller (Power Hub). The rated V_{oc} of the Solar Venture 320 W Array is approximately 62 V under standard test conditions (STC).

When the Array is connected to the Power Hub (i.e., the Array is connected to a “load”), it is more likely the operator will see voltages around 45–55 Voltage Max Power (V_{mp}) reported on the User Interface.

The V_{oc} and V_{mp} should be measured for each Solar Array in “ideal” conditions if possible. This means the Array should be oriented directly at the sun and unshaded on a clear day to measure V_{mp} and V_{oc}.

Procedure to Measure Array and Panel V_{oc} with a Multimeter

To measure Panel V_{oc}, disconnect the Solar Cable from Array leads and carefully place the meter probes into the Array lead connectors (orange boxes in Figure 13A).

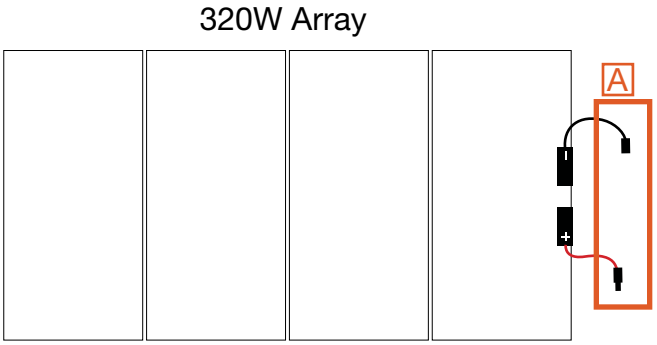

Figure 13. Measuring Solar Panel and Array open circuit voltage V_{oc}

Array and Panel Short Circuit Current.

The Short Circuit Current (I_{sc}) is the value of current measured with a multimeter connected to the positive and negative terminals of a Solar Array. This is the highest current the Solar Array will produce under standard test conditions.

TECHNICAL SPECIFICATIONS

General	
Solar Panel Construction	Back Side: Tan fabric Panel Support: Carbon fiber composite
Panel Stand Construction	Stainless steel/Aluminum/Injection molded plastic
Transport Soft Case Construction	Hard Case: Durable MIL-SPEC plastic with foam inserts and carrying handles Soft Case: Water resistant nylon fabric with carrying strap
Ground Securing	Nylon meshes with tie downs under sandbags
Solar Cable	6AWG wire with MIL-SPEC connectors
Deployment Angles	30º, 60º
Certifications	Berry Amendment compliant Solar modules designed to UL 1703 and IEC-61215 Designed to MIL-STD-810H
Warranty	1-year materials and workmanship

Solar	
Rated Power	320 W (+/-2W)
Rated Voltage (V_{MP})	58.75 V
Open Circuit Voltage (V_{OC})	68.45 V
Rated Current (I_{MP})	5.79 A
Short Circuit Current (I_{SC})	6.28 A
Cell Type	Monocrystalline silicone
Cell Efficiency	> 24.1%
# of Solar Cells	96
Power Circuitry	Series
Bypass Diode	16 embedded
Blocking Diode	1 in junction box
Temperature Co-efficiency	-0.3%C

Solar Panel	(1) MC4 male and (1) MC4 female
Solar Cable	(1) MC4 male and (1) MC4 female for connection to solar panel (1) Bayonet for solar array output

Environmental	
Operating Temperature	-25 ºF to +140 ºF (-31.7 ºC to +60 ºC
Storage Temperature	-40 ºF to +160 ºF (-40 ºC to +71.1 ºC)
Maximum Wind Load	30° front, up to 75 mph 30° back, up to 65 mph 60° front, up to 70 mph 60° back, up to 60 mph

Weights and Dimensions (L x W x H)	
Solar Panel Weight	12.9 lb (5.86 kg)
Solar Panel Dimensions	Deployed (Open): 65.125 x 43.25 x 0.2 in (165.4175 x 109.855 x 0.508 cm) Stowed (Folded): 16.5 x 43.25 x 1.5 in (41.91 x 109.855 x 3.81 cm)
Panel Stand Weight	13.0 lb. (5.91 kg)
Panel Stand Dimensions	Deployed @ 30º: 65.25 x 36 x 23.5 in (165.735 x 91.44 x 59.69 cm) Deployed @ 60º: 65.25 x 23.5 x 36 in (165.735 x 59.69 x 91.44 cm) Stowed: 47 x 13.375 x 3.5 in (119.38 x 33.97 x 8.89 cm)
Deployment Footprint	16.3 square feet @ 30º 10.65 square feet @ 60º
Transport Weight	Hard case: 64 lb (29.03 kg) Soft case: 40 lb (18.14 kg)
Transport Dimensions	Hard Case: 49.7 x 21.5 x 8.87 in (126.24 x 54.61 x 22.53 cm) Soft Case: 50 x 17 x 8 in (127 x 43.18 x 20.32 cm)

Includes

(1) 320W Foldable Solar Panel (PN: 14-1000037)
(1) Solar Venture Array Stand (PN: 14-1000033)
(1) 30' Solar Cable (PN: 16-0800102)*
(1) Ground Securing Kit (PN: 12-1000009)**
(1) Transport Case (hard or soft case)
    Hard Case, Solar Venture (PN: 14-1000035)
    Soft Case, Solar Venture (PN: 14-1000040)

** Solar Cables in different lengths, sizes, and types also available*
*** Includes (1) 30º mesh, (1) 60º Mesh, and (7) sandbags*

ABOUT SOLAR STIK, INC.

Mission Statement
Saving lives across the globe through innovative power solutions.

STIKopedia
STIKopedia is a compilation of everything you would ever want to know about portable Hybrid Power Systems, including the philosophy and mechanics of high-efficiency circuits, and the individual technologies used to create them.

Solar Stik Training and Education

- **Solar School (St. Augustine, FL)** provides an introduction to the design and support of small-scale, renewable-energy, power generation systems, with detailed explanation of system components. Advanced configuration options with hands-on deployment of actual systems will enhance student understanding.

- **Solar Stik New Equipment Training (on site)** teaches Hybrid System configuration options with hands-on deployment of actual systems to enhance student understanding.

Solar Stik Training Courses are tailored to the specific needs of the students. To schedule Solar Stik Training or to learn more about the curriculum, please contact us.

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