



User Manual

INTERCONNECT SYSTEM™ WIRE HARNESS



Shoals Technologies Group, LLC.

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WIRE HARNESS

Rev. B - 08/19/2022

**IMPORTANT SAFETY INSTRUCTIONS
SAVE THESE INSTRUCTIONS**



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■ IMPORTANT SAFETY INSTRUCTIONS



WARNING

YOU MUST FOLLOW ALL THESE INSTRUCTIONS DURING INSTALLATION AND/OR MAINTENANCE OF THESE WIRING HARNESES.

The installation, adjustment, or repair of PV wiring harnesses involves risk of contact with potentially lethal voltages and currents.

Preventing Serious Injury or Death

- For your safety, all instructions must be followed during installation and/or maintenance of these wiring harnesses.
- No attempt to install or service the system should be made by anyone who is not a qualified trained technician familiar with this type of electrical equipment.

Preventing Injury or Equipment Damage

Installers should be advised:

- These installation instructions are for use by qualified personnel only. The equipment contains lethal DC voltages.
- The inverters contain energy storage devices that require 15 minutes in order to safely discharge their lethal voltages.
- Do not install the combiner box in wet conditions (i.e. in the presence of rain, snow or ice).
- PV arrays produce electrical energy when exposed to light and thus create an electrical shock hazard.
- Any system work that occurs within six feet of a roof edge must be performed by workers equipped with fall protection.
- Additional equipment may be required to connect the output of this wiring harness to an inverter, charge controller or other similar device. Installations utilizing this equipment shall comply with NEC articles 690 and 705.
- This equipment is not suitable for disconnection while under load.
- The wiring harness shall be installed in an inaccessible location or in a NEC compliant raceway. When the wiring harness is installed on ground-mounted racks it may be secured to a mounting surface with wire ties listed under category ZODZ and rated for outdoor use.
- For field connections to this product, the same manufacturers mating model of connectors should be used.

Installers must reference the National Electric Code (NEC) ANSI/NFPA 70 to ensure proper system wiring and grounding compliance. In addition, all state and federal Occupational Safety and Health Administration (OSHA) guidelines and regulations must be followed.

- The provisions in NEC article 690.7 for Maximum Photovoltaic System Voltage apply to this product. The rated maximum system voltage shall be multiplied by the correction factor provided in Table 690.7. Some photovoltaic module technologies may be rated as requiring a different multiplying factor than provided in the table. For modules so rated, the manufacturers multiplying factor shall be used for this purpose.
- The provisions in NEC article 690.8(A) 1 for Calculation of Maximum Circuit Current apply to this product if used with Photovoltaic devices or circuits. Accordingly, the value of ISC marked on modules used with this wiring harness should be multiplied by a factor of 1.25 when determining size of controls connected to the PV output. Some photovoltaic module technologies may be rated as requiring a different multiplying factor than 1.25. For modules so rated the manufacturer's multiplying factor shall be used for this purpose.
- The provisions in NEC article 690.8 (B) for sizing of conductors and overcurrent devices apply to this product. The circuit conductors and overcurrent devices are considered to be continuous and shall be sized to carry not less than 125% of the maximum currents as calculated in 690.8(A), unless an overcurrent device which is specifically rated for continuous use at 100% of its rating is used.
- If the requirements of 690.8(A) and (B) (1) both apply to this product, the resulting multiplication factor is 156%.
- The provisions in NEC article 690.9 for provision of overcurrent protection apply to this product. Photovoltaic modules are required to be provided with overcurrent protection for each series string of modules. The maximum value for the overcurrent protection provided shall be as per the manufacturer's rating for the modules used.

Compliance

The Shoals BLA harness has been designed and constructed in compliance with the following standards:

- UL9703 - Outline of Investigation for Distributed Generation Wiring Harnesses

Calculations

Note: N = the number of strings connected

I_{sc} = PV module nameplate Short Circuit Current

$F_{harness}$ = the actual fuse being used for the harness

$F_{max\ series}$ = the Maximum Series Fuse (PV module rating)

$F_{series\ fuse}$ = the actual series fuse being used

- To calculate the maximum current for any branch of this wiring harness use the following formulas:

- If individual string fuses are not provided:

$N \times 1.56 \times I_{sc}$ must be equal to or less than $F_{harness}$.

AND

The PV module Maximum Series Fuse rating must be greater than:

$(N-1) \times 1.25 \times I_{sc} + F_{harness}$.

- If individual string fuses are provided:

Each string fuse ($F_{series\ fuse}$) must be at least equal to $1.56 \times I_{sc}$, but equal to or less than the PV module Maximum Series Fuse rating.

AND

$N \times 1.56 \times I_{sc}$ must be equal to or less than $F_{harness}$.

- The equations for harnesses without individual string overcurrent protection:

- To calculate the maximum value for "N":

$N \leq (F_{max\ series} - F_{harness}) / (1.25 \times I_{sc}) + 1$ (round result downward to the nearest whole number)

$N \leq (F_{harness}) / (1.56 \times I_{sc}) + 1$ (round result downward to the nearest whole number)

Calculate both equations and use the smaller value for "N" as the maximum number of strings which can be connected to the harness.

- To calculate the required value for $F_{harness}$:

$F_{harness} = 1.56 \times I_{sc}$ (round any fractional value upward to the nearest standard fuse size)

$F_{harness} = F_{max\ series} - [1.25 \times (N-1) \times I_{sc}]$ (round any fractional result upward to the nearest standard fuse size)

- The equations for harnesses with individual string overcurrent protection:

- To calculate the maximum value for N:

$N \leq F_{harness} / (1.56 \times I_{sc})$ (round result downward to the nearest whole number)

- To calculate the required value for $F_{harness}$:

$F_{harness} = N \times 1.56 \times I_{sc}$ (round any fractional result upward to the nearest standard fuse size)

SPECIFICATIONS

The Shoals wiring harness with in line fuses has been patented and provides a means of combining multiple PV arrays into a single DC source. The Shoals harness contains patented interconnect joints to reduce the amount of wire required by combining the wires in the harness prior to the combiner box. The Shoals wiring harness enables the installer to not have to make any electrical connections other than plugging the male connector on the harness to female connectors on the panels. The wiring harness is designed and sized for each installation. Use only the harnesses supplied for the recommended installation. The harnesses are designed per NEC articles 690.8 (A) & (B) to handle the current. The harness is designed for a maximum of 600V, 1000V, or 1500V per the customer

Models

The Shoals wire harness is made of several components the model number is based on which components are used for each harness. The model number is STG.PH.T.B.C.JOINT.FUSE.CUSTOMER, where:

- PH is the harness type. PH=positive 600V, NH=negative 600V, W=whip 600V, PHK=positive 1000V, NHK=negative 1000V, WK=whip 1000V, PHM=positive 1500V, NHM=negative 1500V, W15M=whip 1500V.
- T is the trunk wire gauge optionally followed by "HF" if high flexibility cable is required for the non-rigid applications. For copper, 1=14 AWG, 2=12 AWG, 3=10 AWG, 4=8 AWG, 5=6 AWG, 6=4 AWG, 7=3 AWG, 8=2 AWG, 9=1 AWG, 10=1/0, 11=2/0, 12=3/0, 13=4/0, 14=250 MCM, 15=300 MCM, 16=350 MCM, 17=400 MCM. For aluminum, A=4 AWG, B=3 AWG, C=2 AWG, D=1 AWG, E=1/0, F=2/0, G=3/0, H=4/0, I=250 MCM, J=300 MCM, K=350 MCM, L=400 MCM, M=500 MCM, N=600 MCM, O=750 MCM.
- B is the branch gauge. 0=no branch, 1=1 AWG, 2=12 AWG, 3=10 AWG, 4=8 AWG.
- C is the connector type. 1=Shoals S4, 2=Multi-Contact MC4, 3=Amphenol, 4=Tyco, 5=SMK, 6=Yamachi, 7=Friends, 8=Sunter, 9=Longi, J=Jinko. If multiple connectors are used C-C will be used.
- JOINT is the joint type and number. The types of joints are T, Y, X, or I (straight)
- FUSE is the fuse type. A=600V, B=1000V, C=1500V, D=1000V (Gen2), E=1500V (Gen 2), F=1000V (dual fuse), G=1500V (dual fuse).
- CUSTOMER is an optional customer unique ID.

Component List

The STG wiring harness may contain the following components:

- Positive Connector – Electrical connector to mate with the PV panel.
- Negative Connector – Electrical connector to mate with the PV panel.
- PV wire – Wire used to transmit the power from the solar array to the combiner box. All wire is rated for PV use and 90°C rated.
- I (straight) joint – Shoals developed interconnection at the intersection of two wires.
- T or Y joint – Shoals developed interconnection at the intersection of three wires.
- Cross joint – Shoals developed interconnection at the intersection of four wires.
- In Line Fuse – Shoals fuse assembly with the required fuse rating included.

The wire harness will be rated based on the wire size of the branch cables and the trunk cable. Branch lengths must be 12, 10 or 8 AWG copper wire.

Electrical Rating Based on Wire Size

Copper Wire

Wire Size AWG or kcmil (MCM)	Max. System Voltage (Vdc)	Max. Trunk Current (Output) (Adc)	Max. Branch Current (Taps) (Adc)	Max. Overcurrent Protection	Max. Ambient Temp. (°C)
14	600/1000/1500	20	20	20	50
12	600/1000/1500	20	20	20	50
10	600/1000/1500	45	32	32	50
8	600/1000/1500	66	32	32	50
6	600/1000/1500	86	32	32	50
4	600/1000/1500	115	N/A	N/A	50
3	600/1000/1500	135	N/A	N/A	50
2	600/1000/1500	156	N/A	N/A	50
1	600/1000/1500	180	N/A	N/A	50
1/0	600/1000/1500	213	N/A	N/A	50
2/0	600/1000/1500	246	N/A	N/A	50
3/0	600/1000/1500	287	N/A	N/A	50
4/0	600/1000/1500	332	N/A	N/A	50
250	600/1000/1500	373	N/A	N/A	50
300	600/1000/1500	410	N/A	N/A	50
350	600/1000/1500	467	N/A	N/A	50
400	600/1000/1500	504	N/A	N/A	50

Electrical Rating Based on Wire Size (continued)

Aluminum Wire

Wire Size AWG or kcmil (MCM)	Max. System Voltage (Vdc)	Max. Trunk Current (Output) (Adc)	Max. Branch Current (Taps) (Adc)	Max. Overcurrent Protection	Max. Ambient Temp. (°C)
4	600/1000/1500	94	N/A	N/A	50
3	600/1000/1500	107	N/A	N/A	50
2	600/1000/1500	123	N/A	N/A	50
1	600/1000/1500	144	N/A	N/A	50
1/0	600/1000/1500	168	N/A	N/A	50
2/0	600/1000/1500	193	N/A	N/A	50
3/0	600/1000/1500	221	N/A	N/A	50
4/0	600/1000/1500	258	N/A	N/A	50
250	600/1000/1500	291	N/A	N/A	50
300	600/1000/1500	324	N/A	N/A	50
350	600/1000/1500	365	N/A	N/A	50
400	600/1000/1500	394	N/A	N/A	50
500	600/1000/1500	447	N/A	N/A	50
600	600/1000/1500	504	N/A	N/A	50
750	600/1000/1500	557	N/A	N/A	50

INSTRUCTIONS

Installation Procedure

NOTE: In addition to these instructions, installers must reference the specific site scope and project drawings for additional information and considerations, including the system layout and any related electrical drawings.

1. Connecting wires to the solar panels

Class 1 wiring methods are to be used for field wiring connections to terminals of a Class 2 circuit.

1. Roll out the negative harnesses.
2. Attach the positive connectors to the negative connectors of the solar panel array.
3. Roll out the positive harnesses. There may be a separate harness for each array or there may be some harnesses with multiple connectors.
4. Attach the negative connectors to the positive connectors on the array.
5. The wire harness should be attached to the solar rack with wire ties or clips at three foot intervals to support the wire harness.
6. The Photovoltaic System Grounding shall be installed per the requirements of Sections 690.41 through 690.50 of the National Electrical Code, ANSI/NFPA 70 and is the responsibility of the installer.

2. Connecting wires to the Combiner Box

WARNING: Assure that the fuses are not installed in the fuse holders.

1. Strip 1/2" from all wires
2. Terminate all positive wires into the corresponding fuse holder or terminal block.
3. Terminate all negative wires into the corresponding fuse holder or terminal block.
4. Use the torque guidelines from the Combiner Box manual to torque all of the terminals to the proper specifications
5. Refer to the local codes to identify the correct wire and conduit and pull the wire from the Combiner to the inverter or DC switch.
6. System grounding-if required by Sections 690.41 and 690.42 of the National Electric Code, ANSI/NFPA 70-is the responsibility of the installer.

3. Install fuses

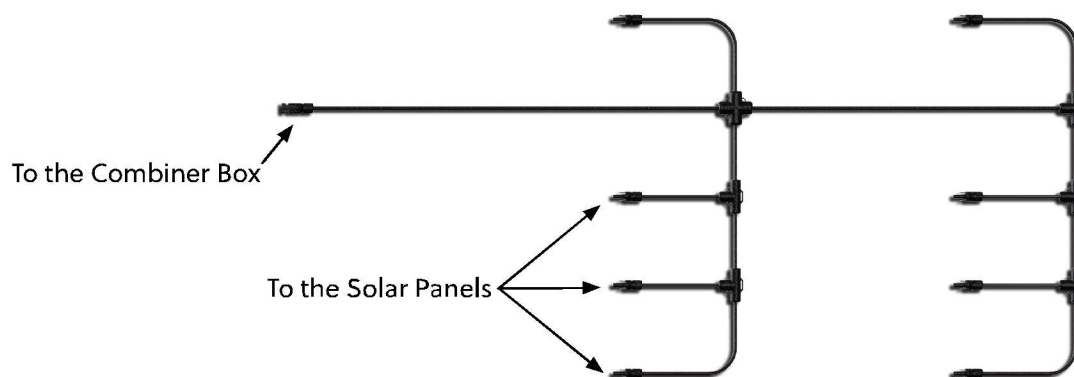
1. Open all fuse blocks and insert the specified fuse into each. Be sure to use only fuses of the proper rating. The fuse will be sized based on the panel power and array layout. Fuses should be sized based on the NEC article 690.7 for Maximum Photovoltaic System Voltage.

4. Finalizing the installation

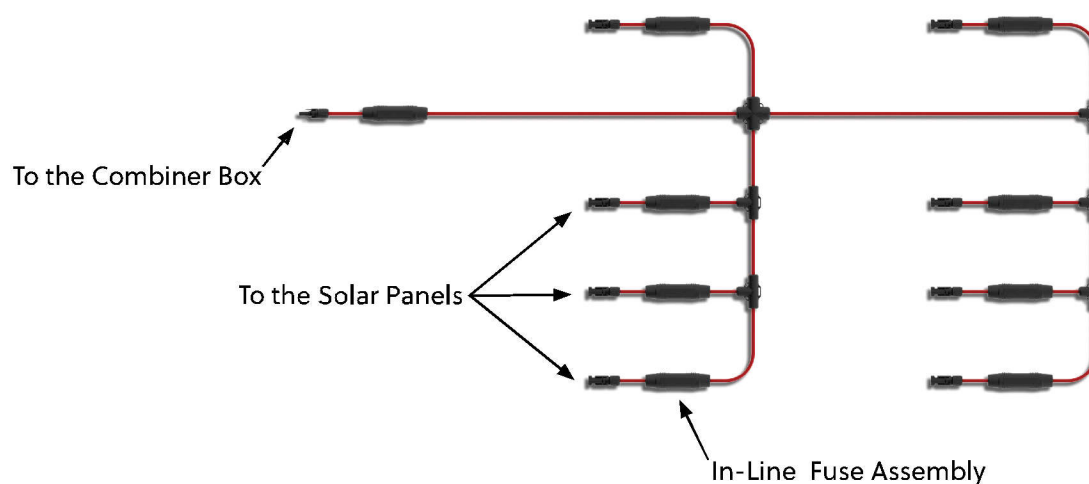
1. Be sure the inverter has been turned off.
2. Verify that the appropriate disconnect between the combiner box output and the inverter or the AC line is opened.
3. Verify that all DC sources are disconnected.
4. Close all fuse holders

Harness Assemblies

Typical harness with branches

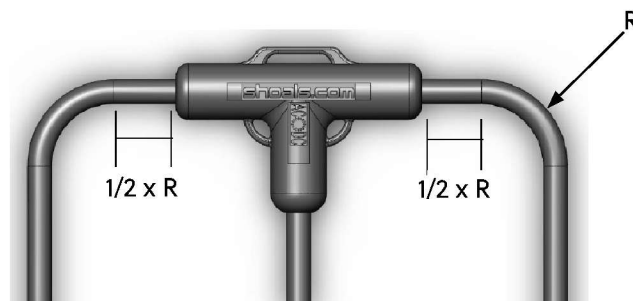


Typical harness with in-line fuses



Cable Routing

Cable should be straight from the connector for a distance equal to $\frac{1}{2}$ the bend radius. Refer to cable manufacturer's specification for minimum bend radius. Standard bend radius is 8X cable outside diameter (for example 10 AWG – 2.2", 2/0 AWG – 5.2").



Warranty, Decommissioning, and Disposal

This Wire Harness is warranted against manufacturing defects for the period of 5 years. Please contact Shoals Technologies Group at (615) 451-1400 for replacement parts. Should this unit require removal from service, the installation instructions above should be followed in the reverse order to safely disconnect the unit from the power line. The unit should then be disposed of by taking to a local recycling center for disassembly and recycling.

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