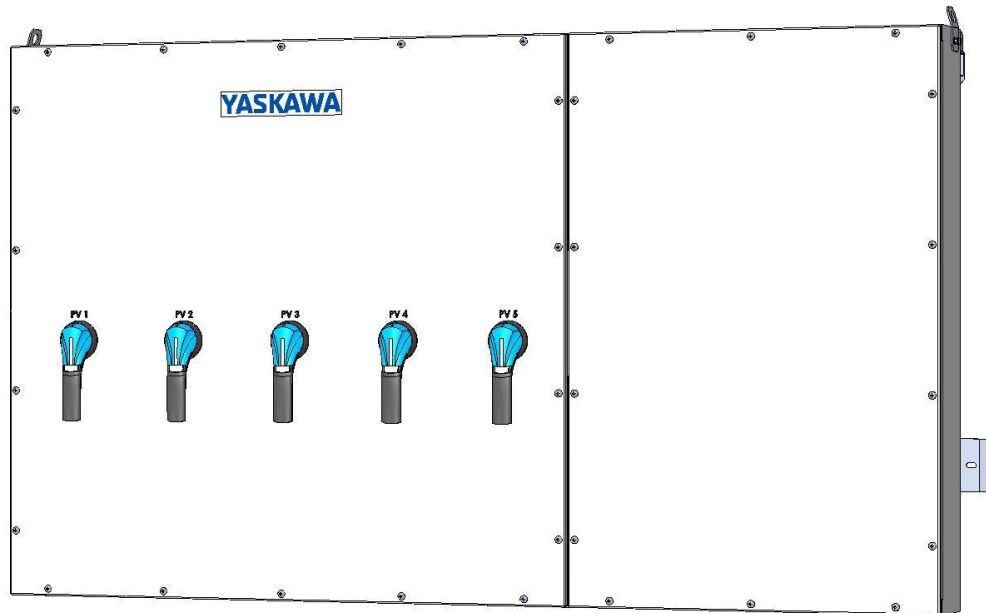


DCR-1500 RE-COMBINER

User's Manual



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1. IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

The SOLECTRIA DC Re-Combiner, DCR-1500-500, is exclusively compatible with the SOLECTRIA PVS-500 Energy Storage System. The DCR-1500 Re-Combiner is only sold as a component part of the PVS-500 DC-Coupled Energy Storage System and is not for use in any other application.



Populate the DC Re-Combiner with up to 5 PV Output (Source) Circuits.

Before using the DCR-1500 Re-Combiner, please read all instructions and caution warnings in this manual and on the Re-Combiner, as well as all other instructions and warnings for associated equipment.

This manual contains important instructions that must be followed during installation and operation of the DCR-1500 Re-Combiner. To reduce the risk of electrical shock and to ensure the safe installation and operation of the Re-Combiner, the following safety symbols are used to indicate dangerous conditions and important safety instructions.



WARNING
Could Injure
Personnel or
Damage Equipment



Instructions
for Qualified
Personnel Only



Positive
Connection
Point Symbol



Negative
Connection
Point Symbol



Ground
Connection
Point Symbol



DC Electrical
Connection
Point Symbol



WARNING: Disconnect all PV modules or completely cover the surface of all PV modules with opaque (dark) material before wiring. PV arrays produce dc voltage when exposed to light and could create a hazardous condition. Always verify the absence of voltage before performing work on the Re-Combiner.



WARNING: Connecting PV output circuits to the input of the Re-Combiner and making the connection to the Dynapower DC/DC Converter (DPS-500) and battery subsystem, must only be done after receiving approval from the utility company and AHJ, and should only be performed by qualified persons.



WARNING: The DCR-1500 Re-Combiner is designed and listed for use exclusively as a component in the SOLECTRIA PVS-500 DC-Coupled Energy Storage System; the DCR-1500 Re-Combiner must not be used in any other application.

2. PRODUCT OVERVIEW

The DCR-1500 Re-Combiner functions as the DC bus in the SOLECTRIA PVS-500 DC-Coupled Energy Storage System and is designed and listed exclusively for use in the SOLECTRIA PVS-500. Refer to the illustration in Figure 1.1 showing its general usage within the SOLECTRIA PVS-500.

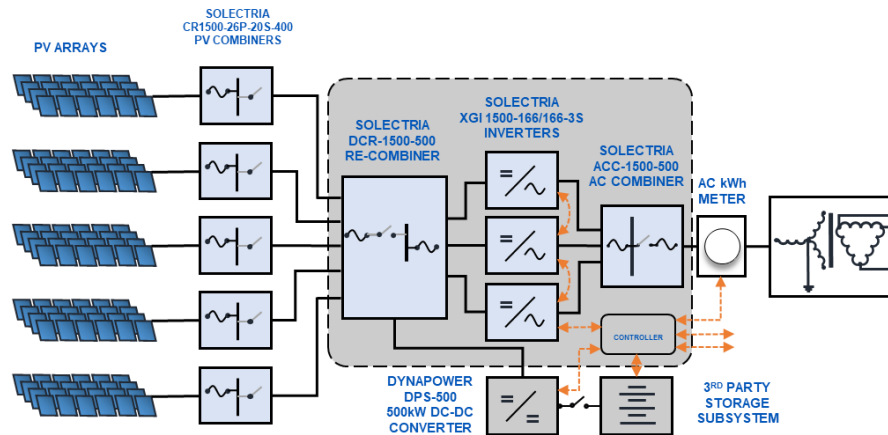


Figure 2.1– Illustrated Usage of the DCR-1500 Re-Combiner in the SOLECTRIA PVS-500 Energy Storage System

The DCR-1500 Re-Combiner (see Fig 2.2) performs the following basic functions:

(1) PV Output (Source) Circuit Connections:

- Disconnect switches for 5 separate PV Output (Source) Circuits (originating in Solectria CR1500-400 PV Source Circuit Combiners located in the PV array field)
- Provisions on the disconnect switches for field-wired connections
- Overcurrent protection fuses
- Connection from all PV Output (Source) Circuits to the DC bus in the Re-Combiner

(2) Solectria XGI 1500 Inverter Connections:

- Connection from the main DC bus to overcurrent protection sized expressly for the three XGI 1500 inverters. Note that three XGI 1500-166/166-3S inverters (498 kWac), or three XGI 1500-125/125-3S inverters (375kWac) may be used.
- Terminal blocks for the factory wiring connections from the Re-Combiner to the three XGI 1500 inverters.

(3) Dynapower DC-DC Converter (DPS-500) Connections:

- Factory pre-made internal connections.
- Overcurrent protection and a connection to the main DC bus. Note that a dc switch is located between the Dynapower DC-DC Converter and the storage subsystem.

(4) **IMI Functionality:** the DC Re-Combiner contains

- Sensors and circuitry for the XGI 1500 inverters' Isolation Monitor Interruptor functionality
- Factory-wired communications cable from the IMI circuitry to each of the XGI 1500 inverters

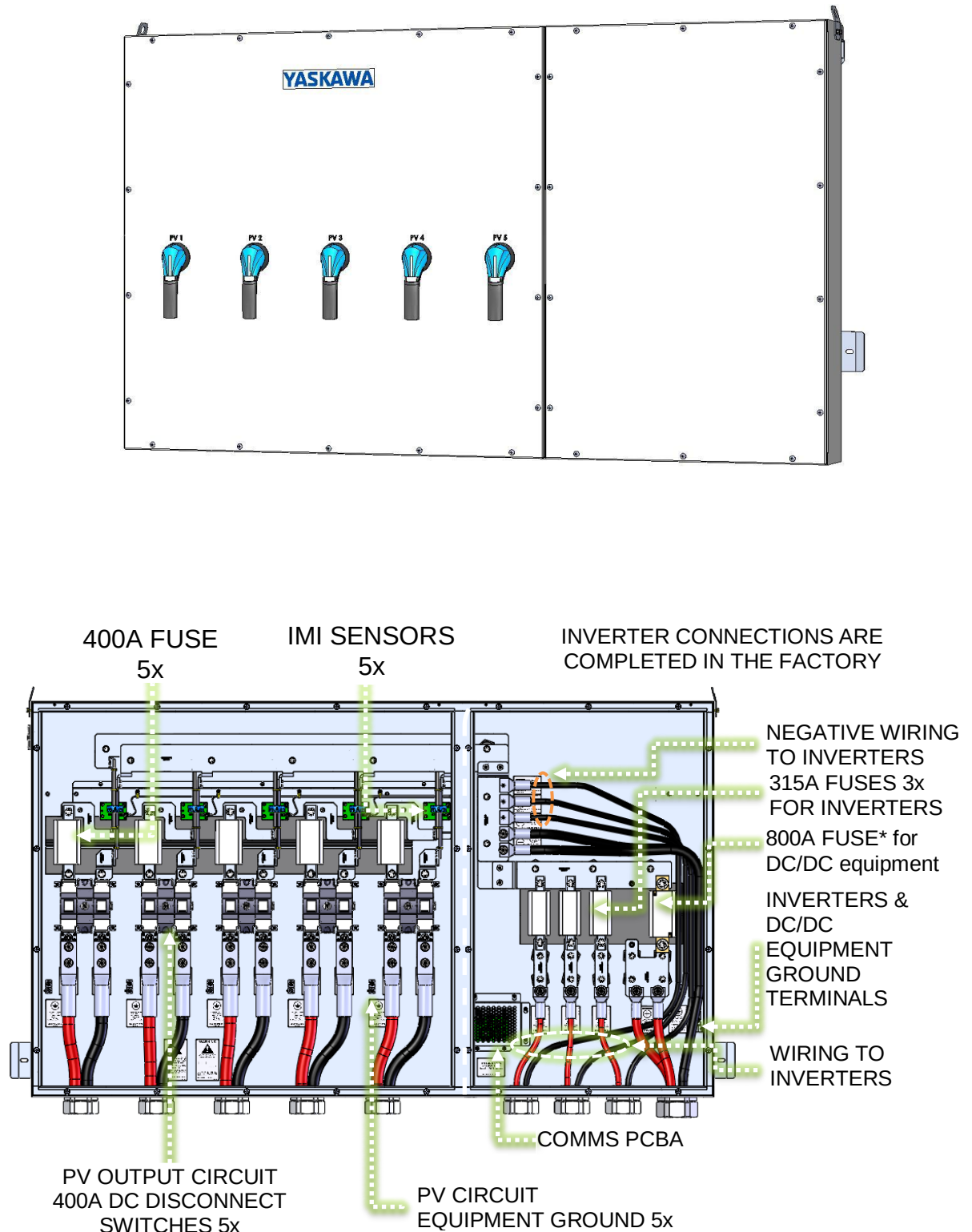


Figure 2.2- The DCR-1500 DC Re-Combiner Components

RATINGS AND SPECIFICATIONS

3. Specifications

DCR-1500-500 SPECIFICATIONS	
PV OUTPUT (SOURCE) CIRCUITS (<i>FIELD WIRED from PV Source Circuit Combiners</i>)	
Maximum Wire Size Compatibility	Cu: 1 or 2 cond, 500 kcmil; 1 cond, 750 kcmil Al: 1 or 2 cond, 500 kcmil; 1 cond, 750 kcmil EGC: 14 AWG – 2 AWG
Overcurrent Protection	400A Fuse, positive polarity only
Maximum Voltage	1500 VDC
Maximum Circuit Current of each PV Input (Source) Circuit <i>[Calculated per NEC 690.8(A)(1)]</i>	Indiv Max Circuit Current 305 A
Number of PV Input Positions	5 Input Positions with switch & fuse
DC Disconnect Switch	Integrated 400A, 2-pole, 1500 VDC
XGI 1500 INVERTERS (<i>FACTORY PRE-WIRED and tested</i>)	
Applicable Models (use 3 of either model)	XGI 1500-166/166-3S XGI 1500-125/125-3S
Wire Size	Conductors: 4/0 AWG Cu EGC: 4 AWG Cu
Inverter AC Output Overcurrent Protection	315A fuse
Maximum DC Voltage	1500 VDC
DC-DC CONVERTER (<i>FIELD-WIRED</i>)	
Maximum Wire Size Compatibility	Note: 2 conductors per pole (+ & -) Cu: 2 cond, 500 kcmil Al: 2 cond, 500 kcmil EGC: 1/0 AWG Cu, or 3/0 AWG Alum
Overcurrent Protection	DPS-500: 800A Positive polarity only
DC-DC Converter: DC Disconnect Switch	Located on the DC-DC Converter
MECHANICAL, ENVIRONMENTAL, SAFETY	
Ambient Temperature Range	-40°F to 140°F (-40C to +60C)
Safety Certification & Listing / Certification Agency	TÜV Rheinland, UL1741
Standard Warranty	5 Years standard; 10 Year optional
Enclosure Dimensions	Height: 43.3 in. (1100 mm) Width: 74.8 in. (1900 mm) Depth: 6.65 in. (169 mm)
Enclosure Rating, Material, Weight	UL Type 3R, Polyester Powder-Coated Aluminum 192 lbs (87 kg)

3.1 Temperature De-Rating

The DC Recombiner, DCR-1500-500, has an operating maximum current rating of 1,093 Amps. This rated combined current would only be experienced if both of these conditions occur at the same time:

- three XGI 1500-166/166-3S inverters are operating at full power, and
- the maximum dc current is flowing from the DC Recombiner to the DynaPower DPS-500 DC-DC converter and into the battery subsystem.

The DCR-1500-500 is subject to temperature de-rating, based on the temperature de-rating behavior of the DynaPower DPS-500 and the XGI 1500-166/166-3S inverters, as in Figure 3.1 below

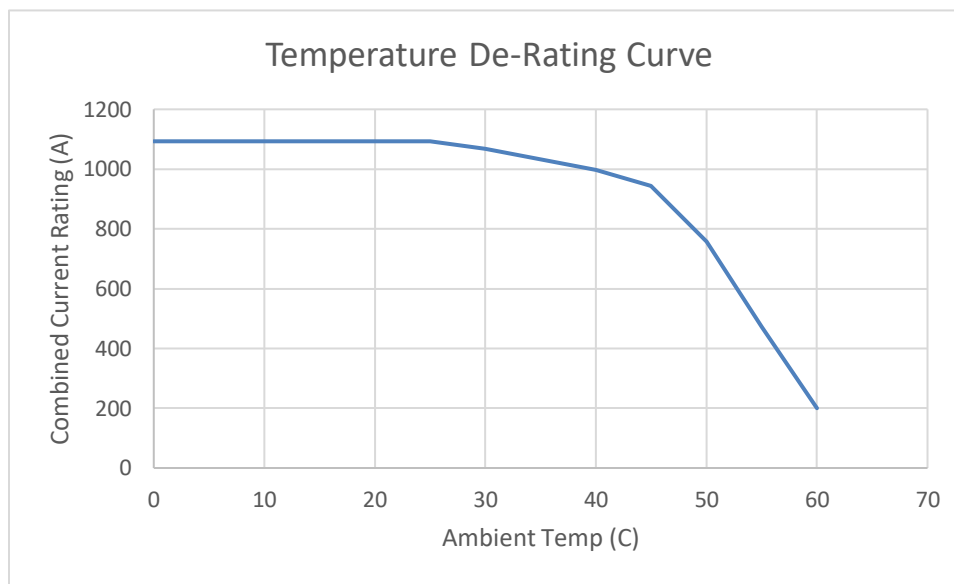


Figure 3.1 DCR-1500-500 Temperature De-Rating Curve

Safe Design and Operation Guidelines



To maintain safe operation of the DC Re-Combiner, users should follow this guideline.

Confirm that all PV circuits input to the DC Re-Combiner have a Maximum Circuit Current calculated via either method in NEC Article 690.8 Circuit Sizing and Current, that is no larger than the current limits provided in Table 3.1.

4. MECHANICAL DETAILS

The DCR-1500 Re-Combiner comes pre-integrated as a component in the Solectria PVS-500 DC-Coupled Storage System. See Figures 4.1 – 4.3. The PVS-500 comprises an engineered rack that holds the DCR-1500 Re-Combiner, three XGI 1500 inverters, the AC Combiner Panel, and a Plant Master Controller (not shown). Except for the required field-wiring connections, the components on the rack are pre-wired and tested in the factory.

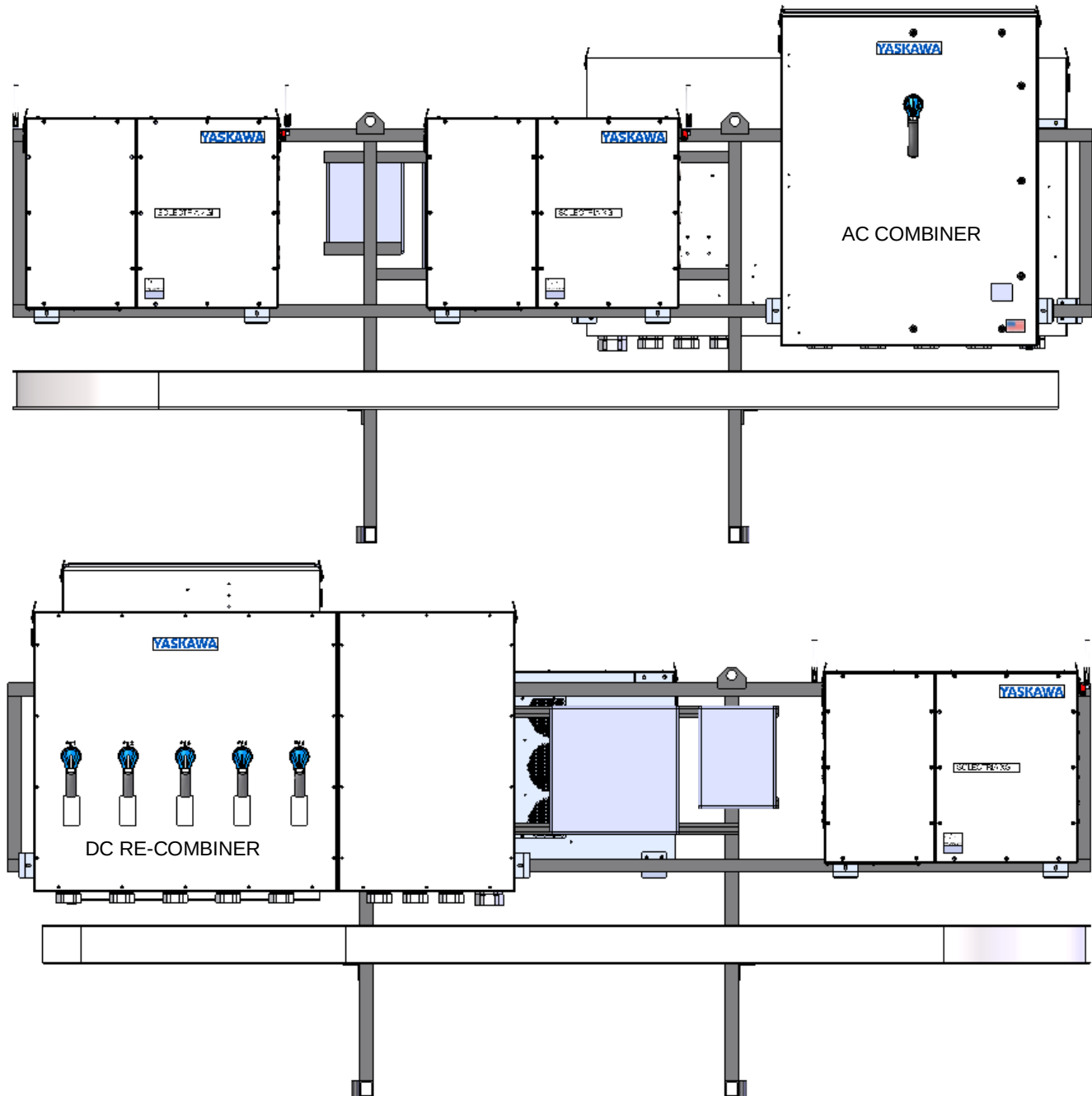


Figure 4.1 Front and Back of the PVS-500 Rack-Mounted Equipment: AC Combiner, DC Re-Combiner, Plant Master Controller and Power Supply (not shown), and three XGI 1500 Inverters (factory wiring not shown)

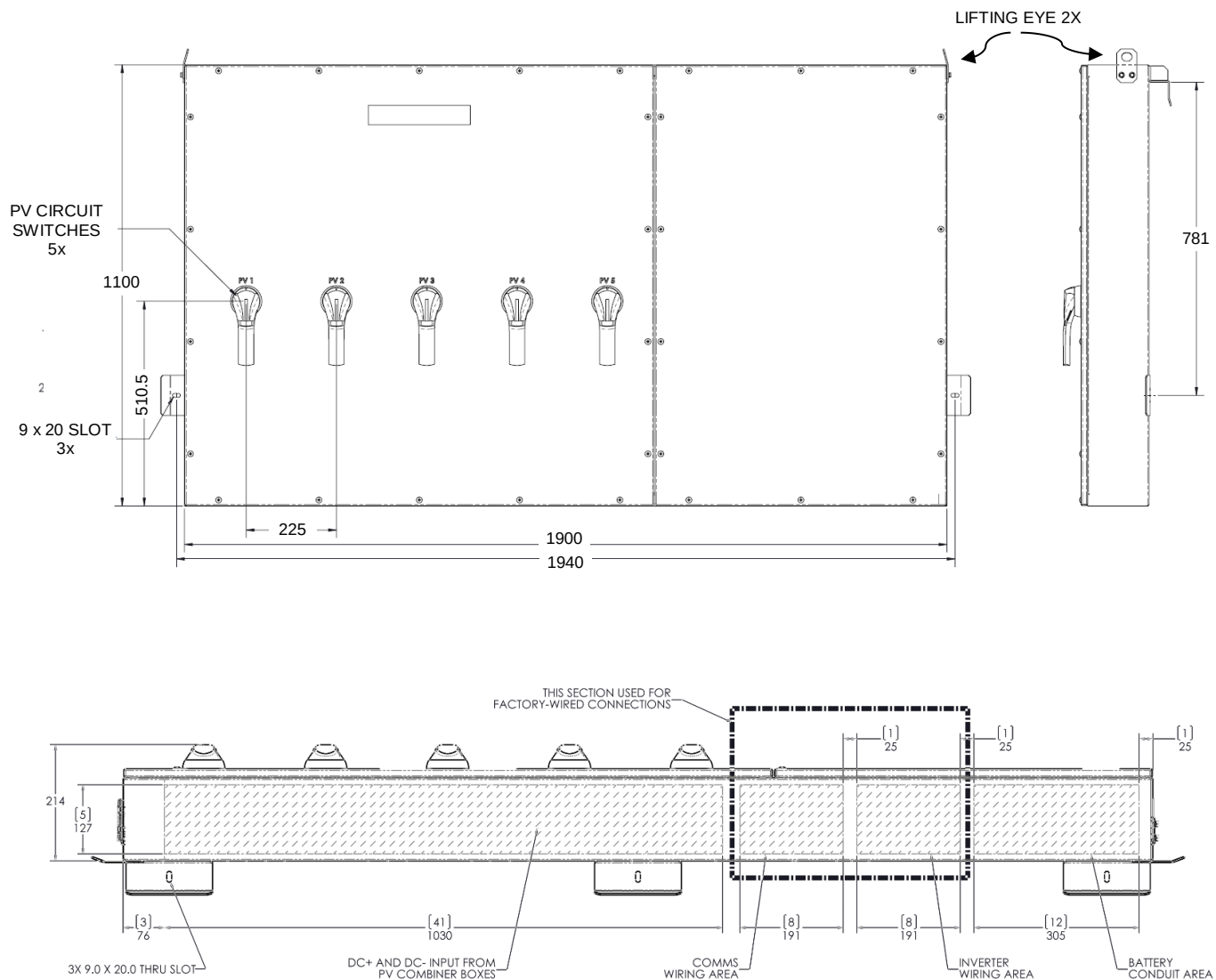


Figure 4.2 - DC Re-Combiner Dimensions (mm), Front, Side and Bottom Views

5. INSTALLATION and WIRING



Do not attempt to make connections to the DC Re-Combiner if not qualified for electrical work.

Completing the installation of the DC Re-Combiner (see Figure 5.1) requires: (1) field wiring from the PV Output (Source) Circuits, originating in CR1500-400 PV Source Circuit Combiners in the PV array field, to the terminals in the DC Re-Combiner and (2) field wiring from the terminals in the DC Re-Combiner to the terminals in the Dynapower DC/DC Converter. In addition, the DC Re-Combiner has two factory pre-wired connections: DC power from the DC Re-Combiner to the DC input of the XGI 1500 inverters, and the communications wiring harness that also connects the DCR-Combiner to the XGI 1500 inverters. Figure 5.1 shows the maximum wire compatibility for the field-wired connections, and the as-delivered factory-wired conductor specifications.

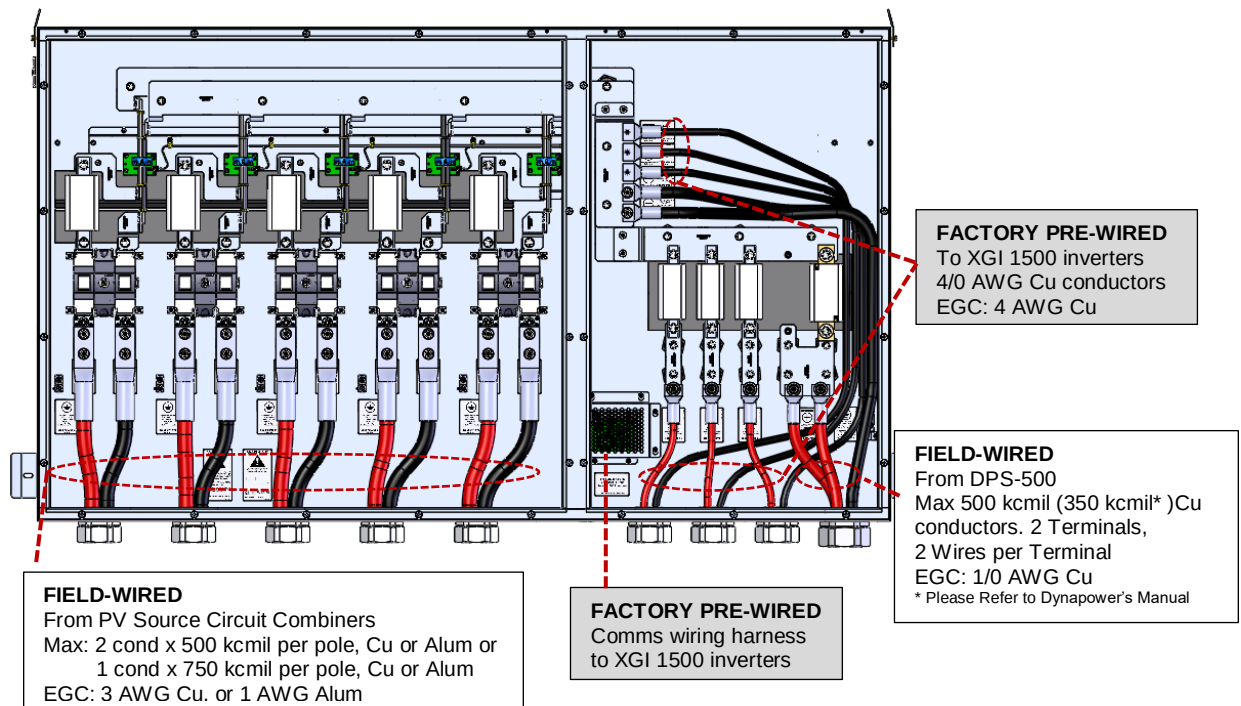


Figure 5.1 – Specs for Field Wiring to the DCR-1500 Re-Combiner

STEP 1: Disconnect all Equipment Before Wiring to the DC Re-Combiner

BEFORE removing the DC Re-Combiner's covers:



- ✓ Open all five DC switches on the Re-Combiner, and
- ✓ Open the DC switch between the Dynapower DC/DC Converter and the Battery Subsystem, to disconnect the batteries from the system.

STEP 2: De-Energize the PV Conductors



PV arrays can create hazardous DC voltages. Do not attempt to connect the PV circuits to the DC Re-Combiner until all PV conductors are confirmed to be de-energized.

1. Use a multi-meter to check for DC voltage and confirm that the PV Output Circuit conductors, coming from the CR1500-400 PV Source Circuit Combiners in the array field, are de-energized.
2. If DC voltage is present, locate the PV Source Circuit Combiners and open all DC disconnect switches, then re-measure.
3. DO NOT PROCEED until the conductors are confirmed to be de-energized.

STEP 3: Prepare the Enclosure for Conduits

1. Remove the left-side cover from the DC Re-Combiner; save all fasteners for later re-installation.
2. Note the target area for conduit connections for the PV circuits on the bottom face of the Re-Combiner, as shown in Figure 5.2.
3. Add the necessary holes for the conduits for PV Output Circuit entries. The Re-Combiner accepts up to 5 separate PV Output Circuits.
4. Be sure to remove any metal shavings and debris from the inside of the Re-Combiner.

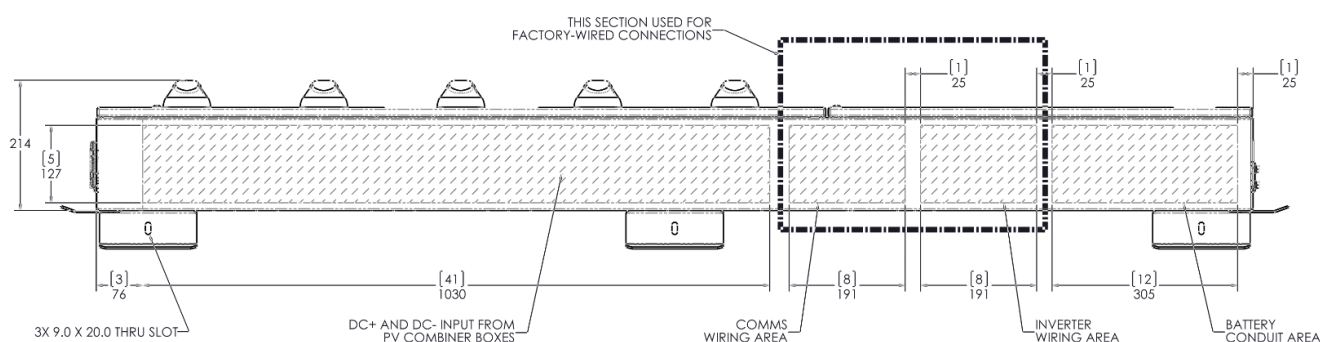


Figure 5.2 – Bottom face of the DC Re-Combiner, showing the area for conduit connections for the PV circuits, and the area with the factory-wired Communications Cable, and DC +/- to the XGI 1500 Inverters. All dimensions in millimeters.

SPECIAL INSTRUCTIONS

PRECAUTIONS FOR ALUMINUM WIRE AND CONDUIT SEALING

Aluminum Conductors



Aluminum oxidizes quickly when exposed to the atmosphere. An oxidized layer is a poor conductor that could lead to thermal issues, production loss, or damage to the Re-Combiner.

When using aluminum conductors, follow these steps to prepare the conductors.

1. Prepare one wire at a time.
2. Remove the appropriate insulation from the wire.
3. Using a wire brush, remove the oxidized outer layer from the aluminum conductors.
4. Immediately apply a neutral dielectric grease, such as Ideal NOALOX® anti-oxidant compound, and connect the aluminum cable to the terminal.
5. If the connection is not made within 30 seconds of applying the compound, repeat this process, as an oxidized layer may have formed on the conductor.

Conduit Connections



Conduits connected to an outdoor enclosure can introduce water vapor into the enclosure and lead to the formation of condensation inside. Failure to follow these guidelines can result in water intrusion into the unit through the conduit connections and may void the warranty.

Follow these instructions and best practices when securing conduits to the DC Re-Combiner.

1. Use UL514B certified water-tight conduit fittings and proper installation methods to provide a water-tight connection that will maintain the UL Type 3R rating of the enclosure.
2. Use an appropriately-rated sealant and seal the conduits fully to prevent the exchange of air between the conduit and the enclosure. Sealing the conduit will help prevent condensation in the enclosure.

WARNING



Condensation and Water Ingress Will Cause Damage: The DCR-1500-500 has a NEMA 4X, IEC IP66 enclosure. If not properly installed, or if not properly maintained during extended periods of sitting idle (non-operating), all NEMA 4X, UL Type 3R, IEC IP66 enclosures are susceptible to water ingress and condensation that will damage critical components.

IMPORTANT: After sealing the conduit entrances, the risk of condensation increases when the system is inoperative for an extended period of time. ESS sites are often sit idle for an extended period between the initial installation and the commencement of normal, autonomous daily operation. Follow these guidelines:

Manage Moisture During Extended Down-Time (non-operating system for more than 1 week)

- Extended periods of down-time can occur, for example, if turn-on/start-up is delayed more than one week following initial installation, or if the inverter is idle for more than a week during a service event. For any reason, if a system will be idle for longer than one week without power flow through the DCR, install a desiccant pack inside the DCR.
- For long idle periods, visit the DCR at least once per month to inspect the desiccant, remove all moisture inside the inverter, and replace the desiccant pack as necessary.
- Before turn-on/start-up following a period of down-time, inspect the DCR, remove all moisture inside the enclosure, and remove the desiccant pack and any debris.
- Desiccant packs are only intended to protect the DCR from moisture during periods of down-time, and *should not be left inside an operating system*.
- Do not let system be idle for longer than 6 months. If left idle for more than 6 months a Yaskawa Solectria Technician will need to inspect equipment prior to energization.

Recommended Desiccant
Dry & Dry 500gram SPECIAL
Orange Indicating Packets
www.dryndry.com



Figure 5.3 Desiccant Pack

WATER INGRESS WILL VOID WARRANTY: It is the responsibility of the installer to maintain a dry, moisture-free DCR enclosure; water ingress is not covered under warranty.

STEP 4: PV Output Circuit Wiring Terminations in the DC Re-Combiner

The PV Output Circuit conductors terminate on tabs extending from the DC switch. The tabs are factory-supplied with dual studs to maintain conductor alignment. Figure 5.3 illustrates the terminations and the sections below identify the relevant specifications. Note that users must supply the Crimp Lug and Fasteners as defined.

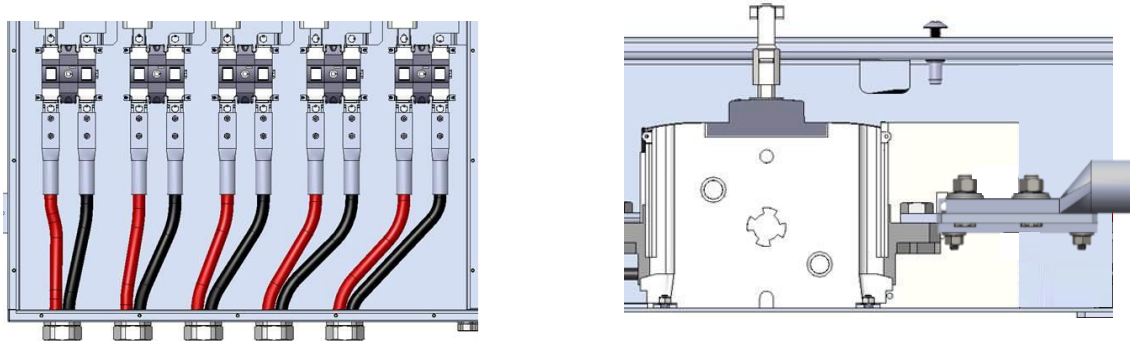
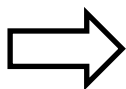


Figure 5.4 – PV Output Circuit Conductors Terminations



Positive polarity conductors (red wires in Fig 5.3) connect to a fuse. Confirm polarity and fuse connection for positive conductors.

Lugs

Compression lugs are NOT provided with the DC Re-Combiner. The lugs must conform to the specifications given in the table below:

Lug Type	Plating & Material	Max. Tongue Width	Hole Size	Temp Rating
Two-Hole	Tin Plated Cu	1.95 in	for M8 stud	90C
Max distance from hole center to end of lug			14 mm	

Conductors

Max Allowable Conductor Size	Cu or Alum, 90C temp rating 1 or 2 cond at 500 kcmil 1 cond at 750 kcmil
------------------------------	--

Conductor Termination

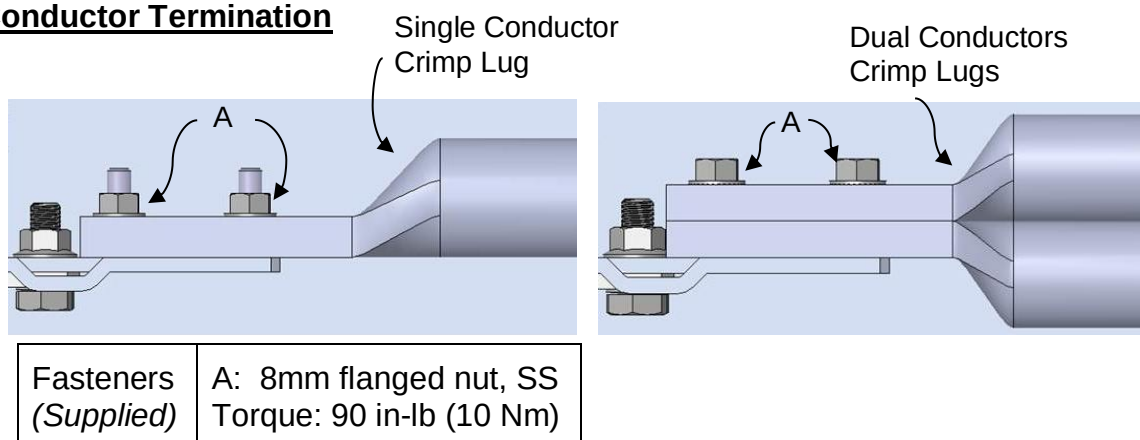
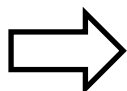


Figure 5.5 - Single and Dual Conductor Terminations

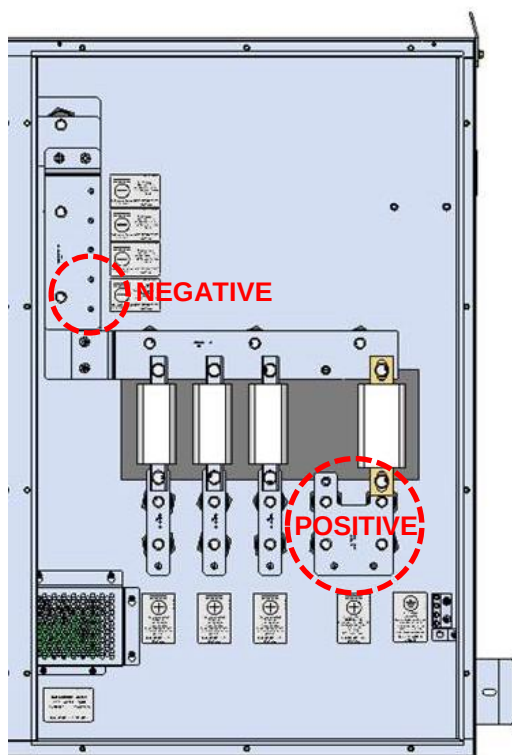
STEP 5: DynaPower DC/DC Converter Conductor Termination

The Re-Combiner provides terminals for the conductors to the Dynapower DPS-500 DC/DC Converter. The user is responsible to route, secure and properly terminate these conductors to the Dynapower DC/DC Converter.



See the DynaPower DPS-500 DC/DC Converter Installation User Manual for making connections to that unit.

Conductors



Max Input / Output Current	DPS-500: 500 A
DC Re-Combiner No. of Terminals	2 Pos , 2 Neg Terminals (2 Wires per Terminal)
Terminals	Negative: 2 x 8mm Stud 40mm wide plate Positive: 2 x 10mm Stud 35mm wide plate
Max Conductor Recommendation	500kcmil (350kcmil*), 90C rated 2 Wires per Terminal * Please Refer to Dynapower's Manual

Figure 5.6 – DynaPower DPS-500 DC/DC Converter Conductor Terminations inside the DC Re-Combiner



WARNING: Connecting any components other than the Dynapower DC/DC Converter (models DPS-500 or DPS-375) to the PVS-500 will result in voiding the warranty (including DCR, ACC and Inverters).

STEP 6: Equipment Ground Wiring

Terminals are provided in the DC Re-Combiner for all Equipment Grounding Conductors (EGCs) associated with the PV Source Circuits, DynaPower DPS-500 DC/DC Converter and XGI 1500 inverters. NOTE: the DC Re-Combiner comes from the factory with the XGI 1500 inverters and Dynapower DPS-500 DC/DC Converter Equipment Ground Conductors pre-wired to ground lugs. Torque each EGC for the PV Source Circuits per the specifications below.

PV Equipment Ground Lugs (5x)

14 AWG – 2 AWG Torque to 20 in-lb, Slotted Screw Cu or Al Conductors

Final Steps



Verify the proper polarity of each conductor. Polarity reversal can lead to dangerous conditions capable of harming personnel and equipment.



Check the DC Re-Combiner for tools and debris; ensure that the unit is clean and orderly.

1. Verify that all connections meet the requirements of this User's Manual.
2. Secure the DC Re-Combiner cover, ensuring that all fasteners are in place.
3. Consult the startup and commissioning procedures for the PVS-500 before energizing.

6. OPERATING INSTRUCTIONS

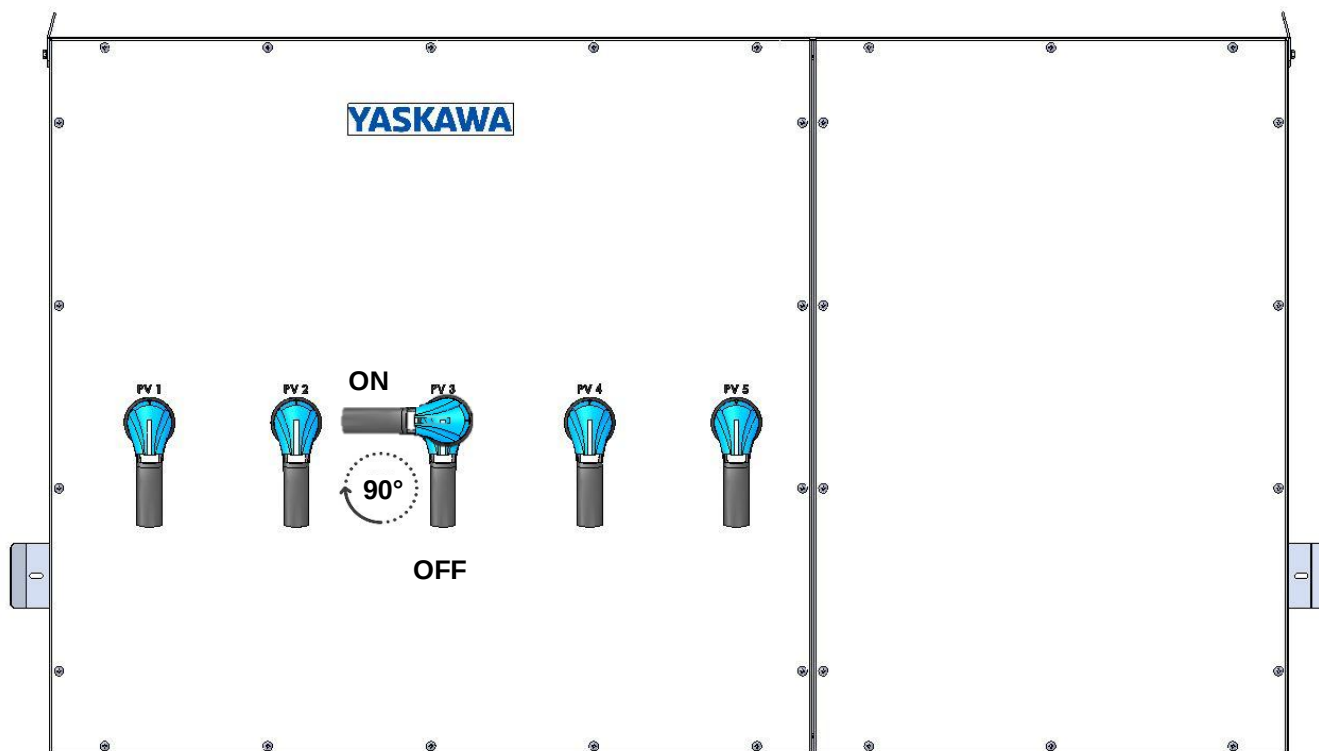


Figure 6.1 – Re-Combiner Switches On/Off Positions

The Re-Combiner contains five user-operable disconnect switches for the PV Source Circuit inputs (see Fig. 6.1). When the disconnect switch handle is in the OFF position, the circuit is open between the PV Source Circuit and the DC bus in the DC Re-Combiner. Conversely, when the disconnect switch is in the ON position, the circuit is closed between the PV Source Circuit and the DC Bus in the DC Re-Combiner.

The disconnect switch is rated for 400A, is fully load-break rated and can be safely operated under normal operating conditions when installation is per this User's Manual and all warnings and ratings are observed.

- ➡ All Disconnect Switches must be OFF before working on the DC Re-Combiner.
- ➡ See also the User's Manual for the **PVS-500 Energy Storage System**.

6.1 Replacement Fuses

Fuses in DC Re-Combiner

Only replace the fuses in the DCR-1500-500 DC Recombiner with appropriately-rated fuses. The specification for the fuses in the DC Re-Combiner are in **Table 6.1** below.

Table 6.1 DC Re-Combiner Fuse Specifications

Fuse	Rating	Part Number
PV Output Circuit	400A, 1500VDC Time-Delay	Mersen Z1048684 
Inverter DC Inputs	315A, 1500VDC Time-Delay	Mersen X1048682 
DC/DC Converter	800A, 1500VDC Time-Delay	Littelfuse PSX3XLUB0800X 

7. Maintenance

7.1 Regular Preventative Maintenance

Warranty terms require regular preventative maintenance. Regular preventative maintenance must include visual inspections and cleaning of the inside of the enclosure. Yaskawa Solectria Solar recommends that preventative maintenance be performed annually, with additional inspections as needed if site conditions are more severe. It may be prudent to perform preventative maintenance more frequently, depending upon specific site conditions. Performing these preventative maintenance activities will help ensure proper system operation, avoid preventable failures, and extend the useful life of the system. Damage or failure attributed to a lack of regular preventative maintenance may not be covered by the product warranty.

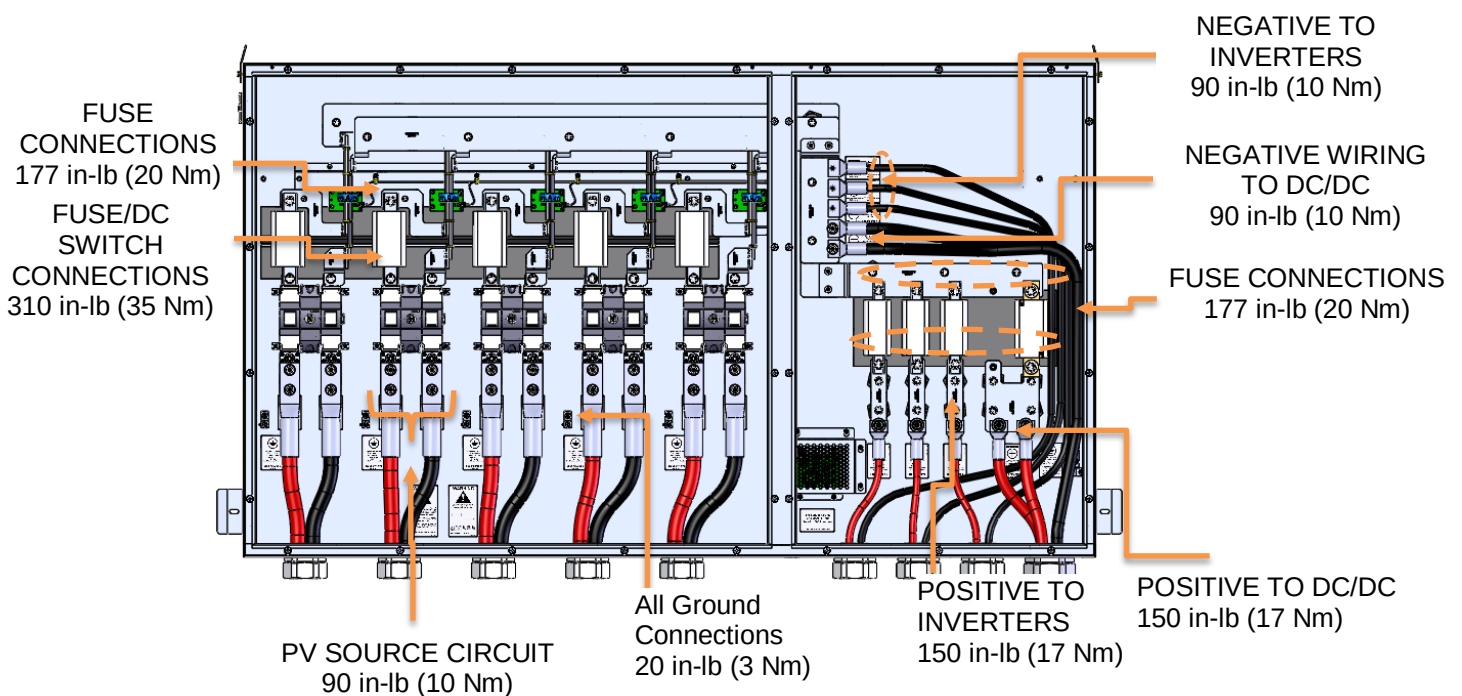
7.1.1 Visual Inspection

Perform a visual inspection of the enclosure to verify it is free of foreign debris and moisture intrusion. Assess all terminations and conductive interfaces for thermal discoloration, insulation degradation, or other indicators of overheating.

If any locations show signs of overheating, contact support.

7.1.2 Verify Connections

Verify all connections are torqued properly. Verify all connections are torqued to manufacturer-specified values using a calibrated torque tool. Refer to the diagram below for correct termination points and torque requirements.



8. WARRANTY & RMA INSTRUCTIONS

For warranty information, please visit: <http://solectria.com/support/documentation/warranty-information/grid-tied-inverter-warranty-letter/>

9. APPENDICES

Appendix A – Contact Information

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Fax: 978.683.9702

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Customer Support: 978-683-9700 x2
Website: www.solectria.com