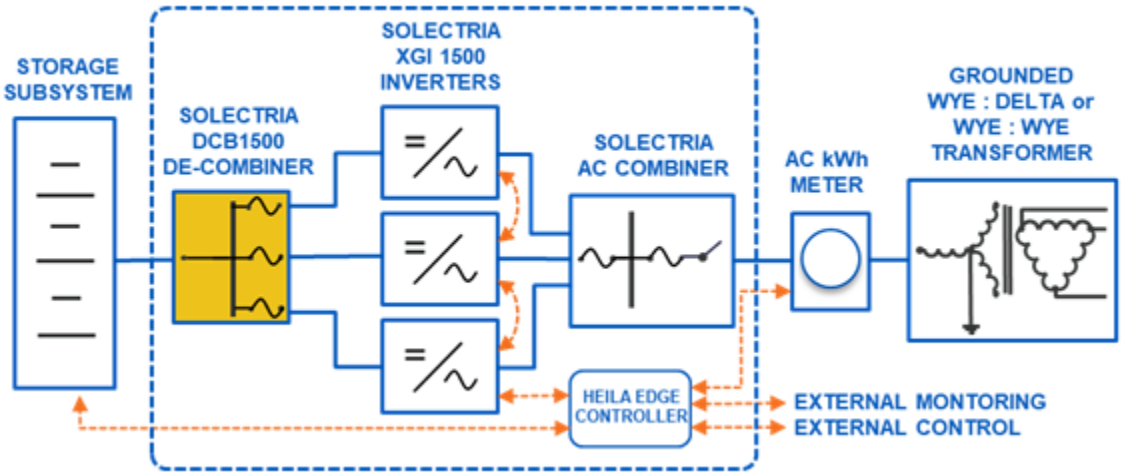
YASKAWA
SOLECTRIA SOLAR

ACS-500 AC-COUPLED STORAGE SYSTEM

User's Manual



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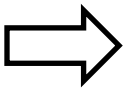


SAVE THESE INSTRUCTIONS

This manual contains important instructions for model:

ACS-500

The SOLECTRIA **ACS 500 AC-Coupled Storage System** comprises a factory- integrated set of US-manufactured and factory-integrated components that form the core of the system: 3 XGI 1500 Inverters, DCB1500-500 DC Bus De-Combiner, ACC1500-500 AC Combiner, and the Plant Master Controller (PMC). The storage system is complete with the addition of customer-selected battery system with enclosure, safety elements and controls.

This manual provides instructions for the operation of the ACS-500 AC Coupled Storage System. In addition, please read all instructions and warnings for the associated component equipment in their respective manuals.

This manual contains important instructions for operation of the ACS-500 AC-Coupled Storage System. To reduce the risk of electrical shock and to ensure the safe operation of the system, the following safety symbols are used to indicate dangerous conditions and important safety instructions.

Hazard Symbols

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

1.1

⚠ 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.

NOTICE!
Indicates a hazardous condition, which, if not avoided, could result in property damage.

INFO ✓
Indicates important supplementary information to use the product effectively.

Symbols on Labels

Table 1-1 Explanation of Symbols on Labels

SYMBOL	DESCRIPTION
	DC Signal
	AC Signal
	Equipment Ground
	Phase
	Off
	On
	Positive Connection Point Symbol
	Negative Connection Point Symbol
	Refer to Operating Instructions
	Instructions for Qualified Personnel Only
	Caution: Risk of Electric Shock Do not remove cover until 5 minutes after disconnecting all supply sources
	Caution: Risk of Electric Shock Timed Discharge
	Caution: Hot Surface Do Not Touch
	Warning: Hazardous voltage area under plastic cover. Do not open fuse holders under load. Proper PPE must be used while accessing fuses. For continued protection against risk of fire, replace only with same make and type of fuse.
	Information: For more information, please see the installation and operations manual

2. SYSTEM OVERVIEW

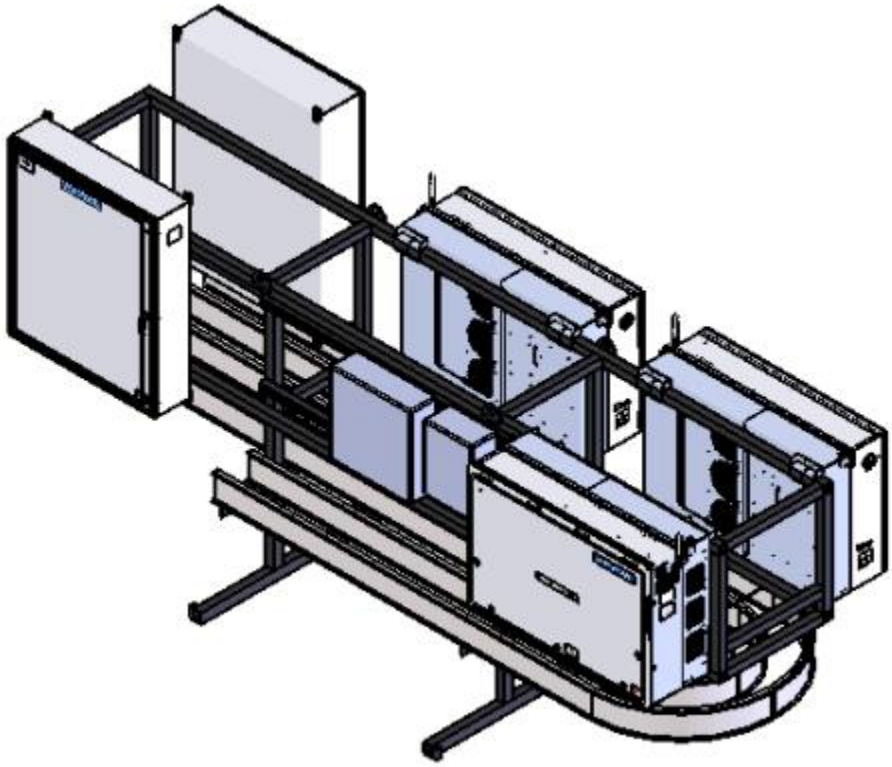


Figure 2-1 ACS-500 System Overview

The ACS-500 system is a redundant, modular energy storage solution that can be AC coupled with other generators, such as PV or wind. The ACS-500 system comes mounted on a rack and pre-wired from the factory. The ACS-500 can input or output 500kW and absorb or supply 300kVAr in up to 40C ambient temperature, controlled through the pre-programmed Plant Master Controller. It can be paired with any battery type with an equal DC voltage window. Please contact Yaskawa Solectria Solar application engineering to verify that the voltage window of your battery and that of the ACS-500 match.

The ACS-500 system comprises 4 parts:

- DC Bus De-Combiner
- AC Combiner
- Heila PMC (optional)
- Three (3) ***XGI 1500–166/166-3S*** 166kW storage-ready inverters

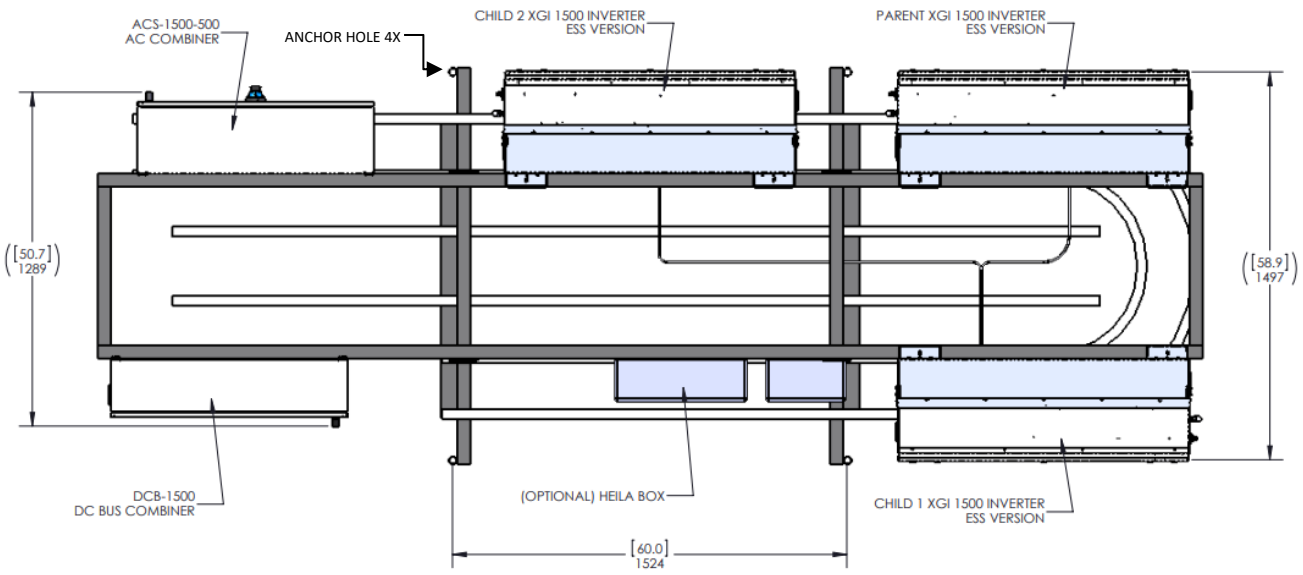


Figure 2-2 ACS-500 System Components

The customer connects the positive and negative connection of the battery system to the common bus bars in the DC Bus De-Combiner. The DC Bus De-Combiner connects the DC to the three inverters with the appropriate fusing. See the Chapter on *DC wiring* for more details.

The AC Combiner connects the AC output of the three inverters together with the appropriate fusing. The customer connects the grounded low-voltage side of the MV transformer to bus bars in the AC combiner. See the Chapter on *AC wiring* for more details.

The Heila Edge PMC controls the flow of active and reactive power through the three inverters and monitors the state of charge (SOC) of the battery through MODBUS TCP/IP messaging. The Heila Edge PMC draws its supply power from a 346V/120V single phase transformer and is protected by a UPS, to be able to communicate with the ACS-500 system and the battery in case of a power outage. For more information consult the Heila Edge PMC manual and the Chapter on *Communications*.

The three Solectria XGI 1500-166/166-3S inverters control the second-to-second conversion of DC power to AC power and vice-versa. They are connected in a parent-child topology though CAN bus, where the children follow the parent's set points instantaneously. The system is arranged in a fully redundant fashion; when one inverter encounters a problem the two others continue operating and take over its load, until a repair has taken place.

3. INSTALLATION

Delivery

Check for Damage: Yaskawa Solectria Solar thoroughly inspects and rigorously tests all rack-mounted components in the ACS-500 AC-Coupled Storage System before shipment. On rare occasions damage may occur during shipping. Upon receipt of the ACS-500 system, please do the following:

3.1

- ✓ Inspect all ACS-500 system as received, pre-mounted and pre-wired on the rack.
- ✓ If damage is observed, take digital photos to document the damage and immediately report the damage to the shipping company.
- ✓ If the recipient has any question about the potential shipping damage, contact Yaskawa Solectria Solar (see Section 6 for contact information).
- ✓ If Yaskawa Solectria Solar determines that any component of the ACS-500 needs to be returned, obtain an RMA number from Yaskawa Solectria Solar and instructions for returning the unit.

Placement and Anchoring

3.2

To anchor the ACS-500 to a concrete pad, secure anchor bolts at the four anchoring provisions located at the ends of the horizontal support bars. These anchor points have an internal diameter opening of 1" (see Figure 2-2 ACS-500 System Components). Failure to secure the rack with anchoring bolts will render the warranty of the ACS-500 void.

Please refer to the following installation diagram for anchoring point locations and customer conduit locations:

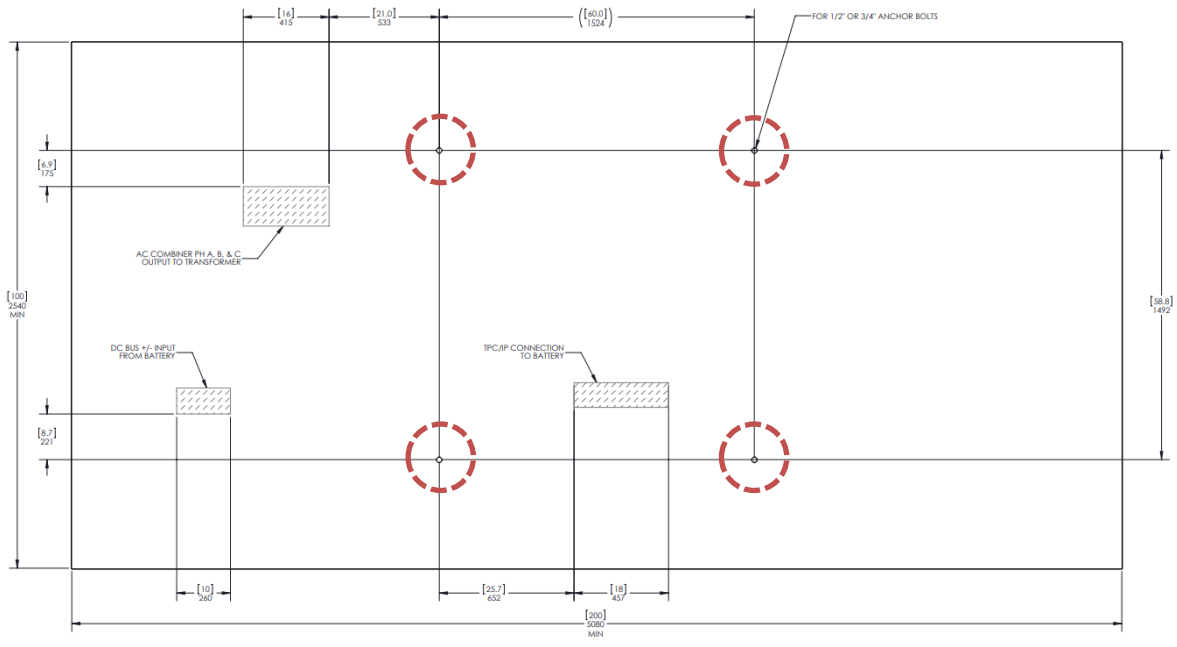


Figure 3-1: Installation Diagram showing Areas Available (shaded) for Conduit

AC Wiring

All AC Wiring is completed at the factory, within the ACC-1500-500 AC combiner box that is pre-mounted to the ACS-500 rack.

STEP 1: Confirm that all wiring and associated components are de-energized

3.3

- ✓ Confirm that the AC switch on the AC Combiner is in the OFF position.
- ✓ Confirm that the AC switch on the XGI 1500 inverters (on the rack with other equipment in the ACS-500 AC-Coupled Storage system) are in the OFF position (Fig 4.1).
- ✓ Confirm there is no voltage at the terminals for the XGI 1500 inverters' AC output conductors in the ACC1500-500 AC Combiner.

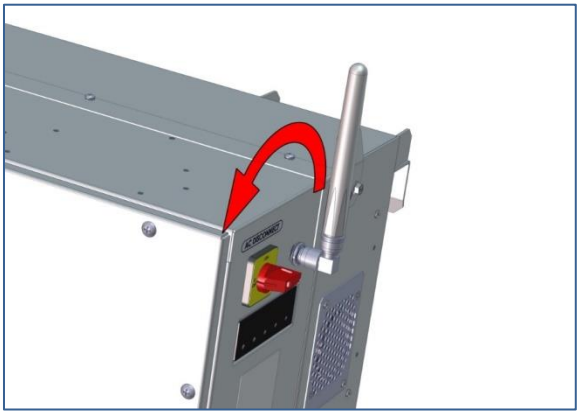


Figure 3-2: Rotate the XGI 1500 Inverter AC Disconnect to the "Off" position

DANGER

Electric Shock Hazard: Components with hazardous voltage and energy will electrocute operator. Operator shall avoid touching live components with hazardous voltage and energy. Verify the absence of voltage using an appropriately rated multimeter.

STEP 2: Prepare the Enclosure for Conduits

- ✓ Note the target area for conduit connections for the combined AC Output Circuit, in the conduit installation diagram. Only the shaded area indicated should be used.
- ✓ Add the holes for the conduit and fittings to the shaded area of the bottom of the AC combiner. The AC combiner provides adequate space for 2" – 3" conduits for the 3-phase 600VAC conductors.
- ✓ Remove all metal shavings and debris from the inside of the AC Combiner.

⚠ WARNING

Remove all metal shavings and debris from the inside of the ACC1500-500 AC Combiner enclosure.

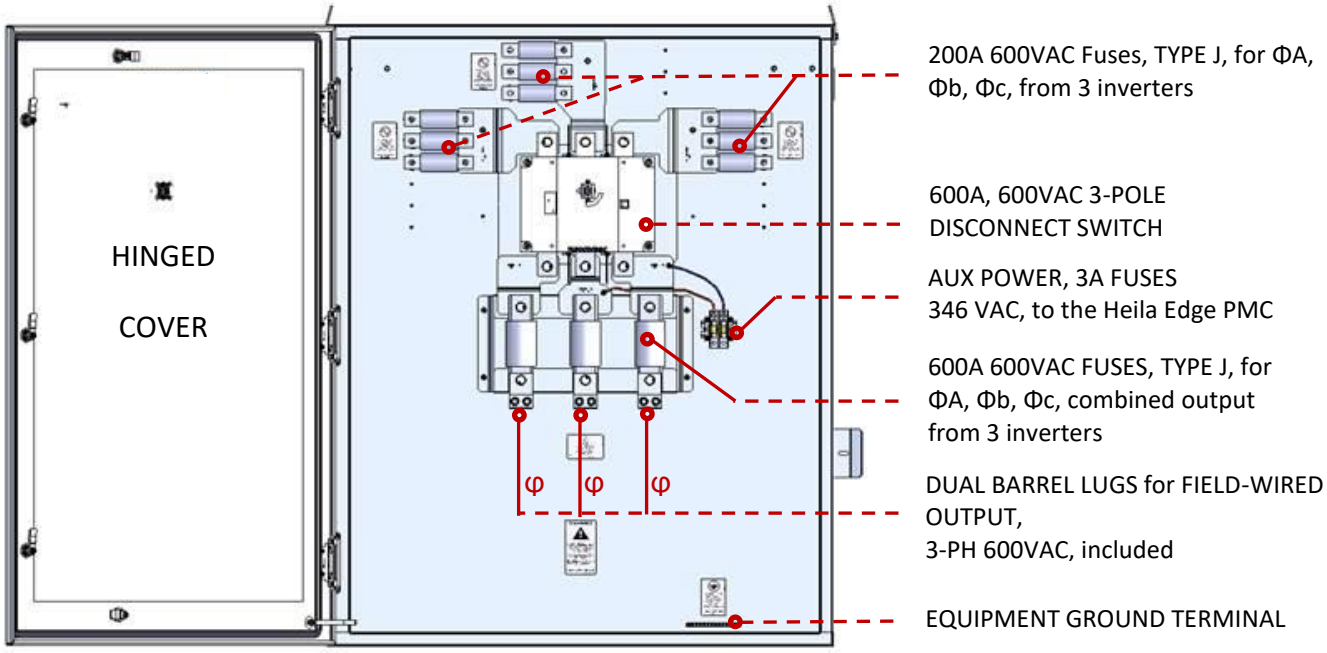


Figure 3-3: Interior of the ACC1500-500 AC Combiner

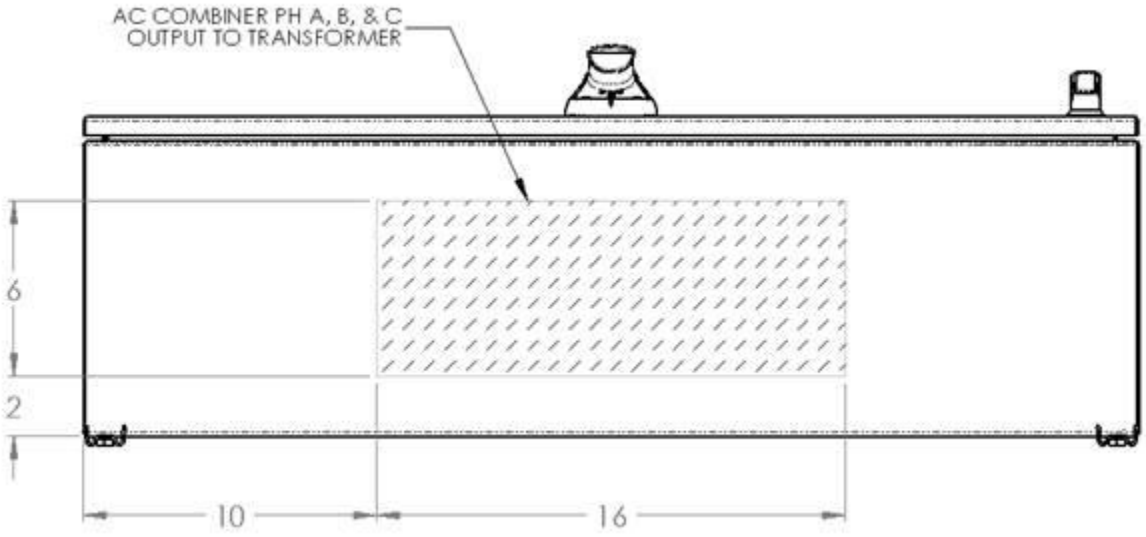


Figure 3-4 Bottom of the ACC1500-500 AC Combiner Showing Area Available for Conduit (shaded)

STEP 3: AC Output Circuit Connections

⚠ CAUTION

Do not attempt to make connections to the ACC-1500-500 AC Combiner if not qualified for electrical work.

See NEC Articles 310 and 690 for proper conductor sizing. The phase lugs are shown in Figure 3-5 and their specifications in Table 3-2.

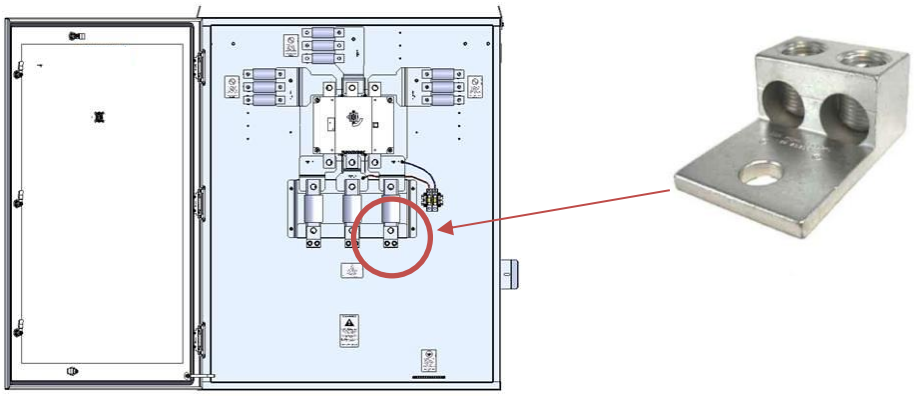


Figure 3-5: Phase Lugs (one per phase)

Table 3-1 Phase Lug Specifications

PHASE LUGS SPECIFICATIONS	
CONDUCTOR COMPATIBILITY	6AWG – 350kcmil Copper and Aluminum
CONDUCTOR TYPE	2-Barrel
TEMPERATURE RATING	90C
TORQUE	350kcmil to > 2 AWG: 375 in-lb 6 AWG to ≤ 2 AWG: 275 in-lb

Follow these steps when making conductor connections in the AC Combiner:

- ✓ Verify absence of voltage on all conductors.
- ✓ Run the AC Output Circuit conductors into the AC Combiner through appropriate conduit and fittings.
- ✓ Connect the phase conductors to the lugs and apply torque per the specifications in Table 3-2.
- ✓ Connect equipment ground conductors to the equipment ground terminals.

STEP 4: Equipment Ground Wire Connections

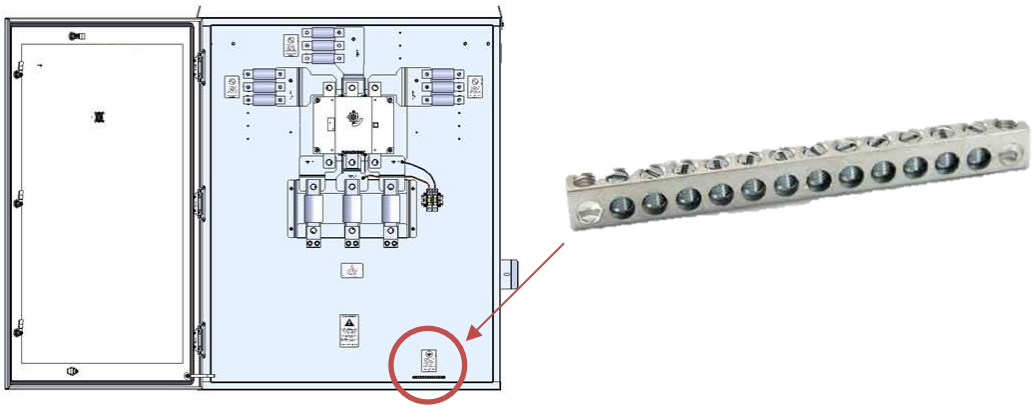


Figure 3-6: Equipment Ground Bar

Terminals are provided in the Combiner for all Equipment Grounding Conductors (EGCs). Torque each EGC per the specifications in the Table below.

Table 3-2: Ground Bar Specifications

GROUND BAR SPECIFICATIONS	
POSITIONS	12
CONDUCTOR COMPATIBILITY	12 (Al) / 14 (Cu) AWG – 4 AWG
TEMPERATURE RATING	90C
TORQUE	20 in-lb, flat-head screwdriver

STEP 5: Final Steps

INFO ✓
Verify the proper phase sequence of each conductor. The ACS 500 System will not turn on if the phases are in reverse sequence. Check the AC Combiner for tools and debris; ensure that the unit is clean and orderly.

- ✓ Verify that all connections meet the requirements of this User's Manual.
- ✓ Secure the ACC-1500-500 AC Combiner cover, ensuring that all ¼-turn fasteners are secured.
- ✓ Consult the startup and commissioning procedures for the ACS-500 AC-Coupled Energy Storage system before energizing.

⚠ WARNING

Do not operate the disconnect handle switch with the AC Combiner door open.

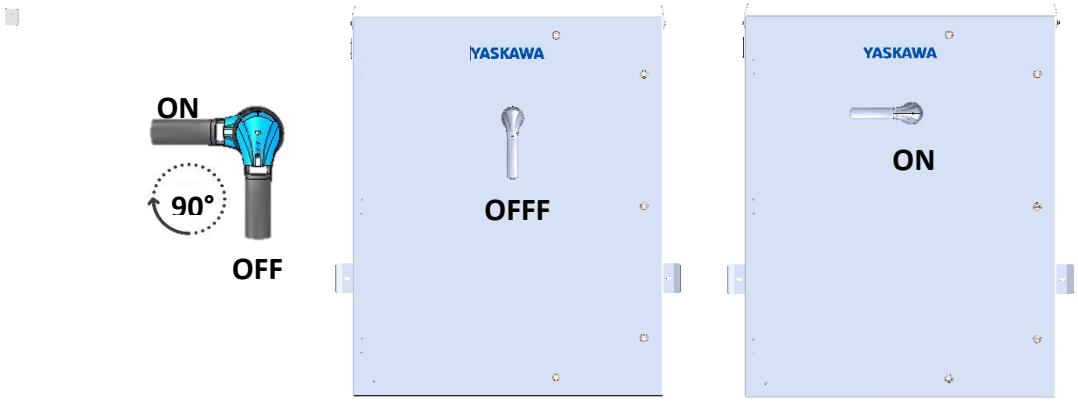


Figure 3-7 Switch Handle Positions for OFF (left) and ON (right)

The ACC-1500-500 AC Combiner contains a user-operable AC disconnect switch. When this disconnect switch handle is in the OFF position, the circuit is open between the input Inverter AC Output Circuit conductors and the combined AC Output Circuit conductors. The disconnect handle can be locked in the OFF position with user-supplied safety locks. The plastic tab on the face of the disconnect handle can be lifted to reveal the locking provisions.

The disconnect switch is rated for 600A, 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.

DC Wiring of the DC Bus De-Combiner

All DC wiring from the DC Bus De-Combiner to the three XGI 1500 Inverters is completed in the factory. The De-Combiner DC bus fusing distributes 3 separate DC outputs to the 3 inverters on the ACS-500 rack.

The *DCB-1500-500-3X166* DC Bus De-Combiner (see Figure 3-8) performs the following basic functions:

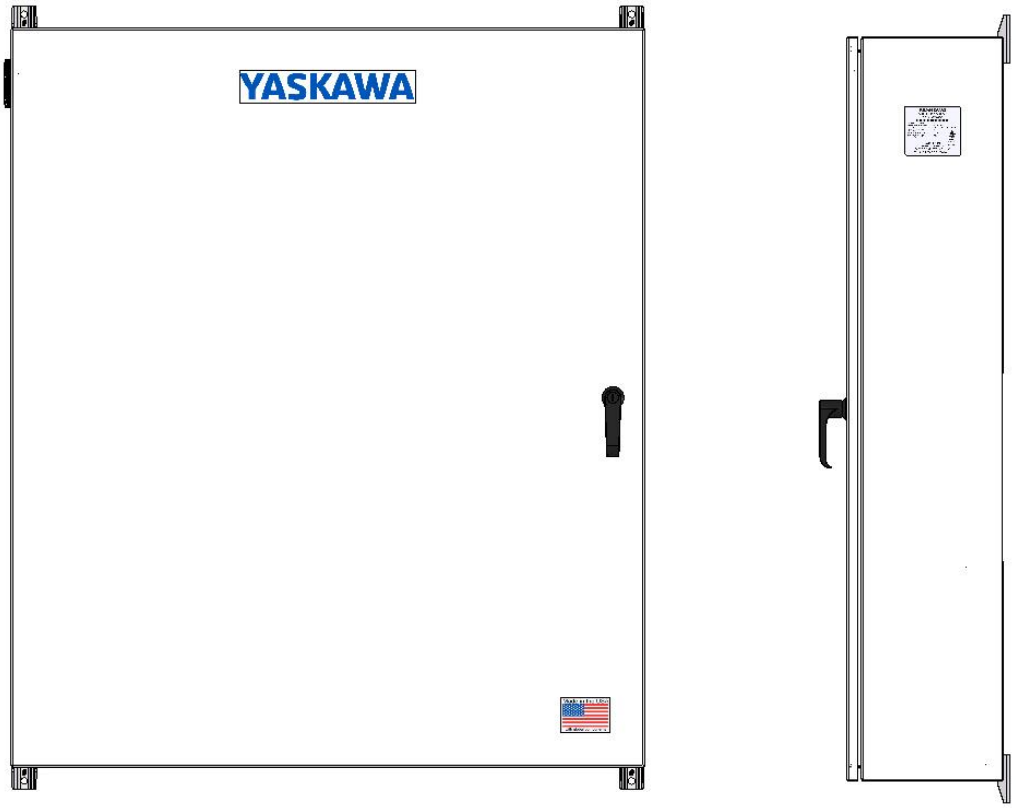
3.4

(1) **Storage Subsystem Connections**:

- Termination for conductors from the Storage Subsystem

(2) **Solectria XGI 1500 Inverter Connections**:

- Connection from the main DC bus to overcurrent protection sized for the three XGI 1500 inverters.
- Stud terminals for the factory-wired connections from the De-Combiner to the XGI 1500 inverters.



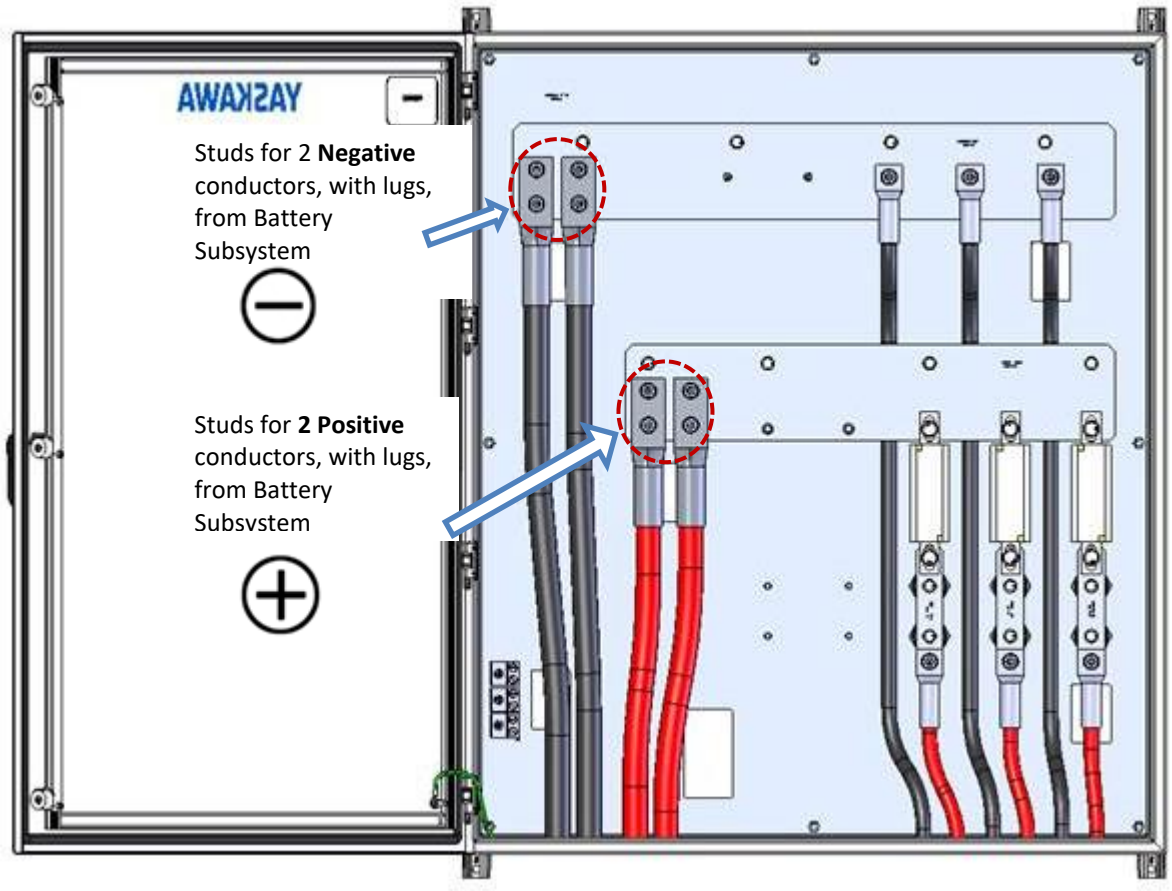


Figure 3-8 The DCB-1500-500-3X166 DC De-Combiner Components

STEP 1: Disconnect all Equipment before Wiring to the De-Combiner

The De-Combiner arrives installed on the rack, with pre-wired conductors to the XGI 1500 inverters on the rack. The only wiring to complete are the conductors between the De-Combiner and the Battery Storage System. Before beginning to run these conductors:

- ✓ Open the DC switch or breaker(s) located with the Battery Subsystem, to de-energize the field-wiring terminals at the Battery Subsystem
- ✓ Open the AC switch on all XGI 1500 inverters, to de-energize the factory-wired conductors between the XGI 1500 inverters and the De-Combiner.

STEP 2: Prepare the Enclosure for Conduits

1. Note the target area for conduit connections for the Battery Subsystem conductors on the bottom face of the De-Combiner, as shown in Figure 3-9.
2. Add the necessary holes for the conduits for the Battery Subsystem conductor entries.
3. Be sure to remove any metal shavings and debris from the inside of the De-Combiner.

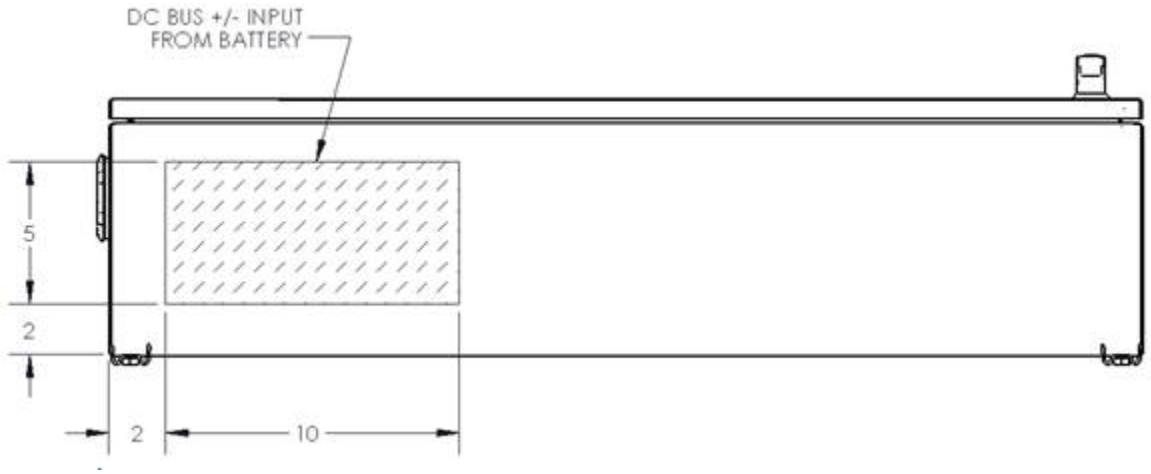


Figure 3-9: Bottom face of the De-Combiner, showing the area for conduit connections for the Battery Subsystem.

STEP 3: Battery Subsystem Conductor Termination

⚠ CAUTION

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

Compression lugs are NOT provided with the DC De-Combiners. Lugs must conform to the specifications below:

Table 3-3 Lug Specification

LUG TYPE	PLATING & MATERIAL	MAX. TONGUE WIDTH	STUD SIZE	TEMP RATING
TWO-HOLE 1.75 IN. C-C SPACING	Tin Plated Cu	2.1 in.	M10 (3/8 in.)	90C

MAXIMUM DISTANCE FROM FURTHEST HOLE CENTER TO END OF LUG IS 65MM.

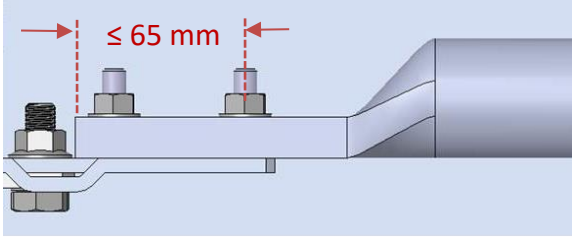


FIGURE 3-10 DC LUG DETAIL

Table 3-4 Conductors

CONDUCTOR REQUIREMENTS	
MAX ALLOWABLE CONDUCTOR SIZE	Cu or Al, 90C temp rating 1 conductor at 600 kcmil
CONDUCTORS PER LUG	1

The *DCB-1500-500-3X166* has a maximum DC operating current of 593A (197.7A per inverter).

3.4.1 Fastening Lugs to the Studs

Arrange the fasteners as shown in the image: flat washer, lock washer, and nut.

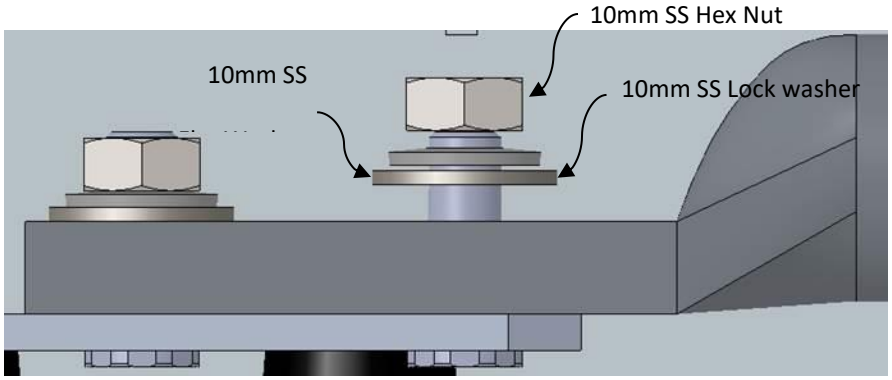


Figure 3-11: DC lug hardware stack mounting detail

Table 3-5: Required DC lug fastening hardware

FASTENERS ***(CUSTOMER SUPPLIED)***	4pcs 10mm SS Hex Nut 4pcs 10mm SS Lock washer 4pcs 10mm SS Flat Washer Torque: 178 in-lb (20 Nm)

STEP 4: Equipment Ground Wiring

Three dual-position mechanical lugs are provided in the De-Combiner for Equipment Grounding Conductors (EGCs) associated with the Battery Subsystem and XGI 1500 inverters.

INFO ✓
The De-Combiner comes from the factory with the XGI 1500 inverters' Equipment Ground Conductors pre-wired to the ground lugs. Torque each EGC per the specifications below.

Table 3-6: Equipment Grounding Lug

EQUIPMENT GROUND LUG (3X)

CU OR AL CONDUCTORS **MIN: 14 AWG** **MAX: 2/0 AWG** **90C TEMPERATURE RATED** **TORQUE TO 20 IN-LB**

STEP 5: Final Steps

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

INFO ✓
Check the De-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 De-Combiner cover, ensuring that all fasteners are in place.
3. Consult the startup and commissioning procedures for the system before energizing.

Precautions for Aluminum Wire

INFO ✓
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 De-Combiner.

3.5

When using aluminum conductors on the AC or DC side of the ACS-500, 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

NOTICE!
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.

3.6

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

1. Use UL514B certified water-tight conduit fittings and proper installation methods to provide a water-tight connection that will maintain the 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.

Heila PMC Communications (option)

If the Heila option is chosen for the PMC, the inverter MODBUS TCP/IP network and the Heila Edge controller are prewired to the network switch inside the Heila control cabinet. Install two separate Cat 6 Ethernet cables to the network switch inside this cabinet, one with access to the internet, one connecting to the battery management system. If the customer is providing their own PMC, call Yaskawa Solectria Solar for correct installation.

3.7

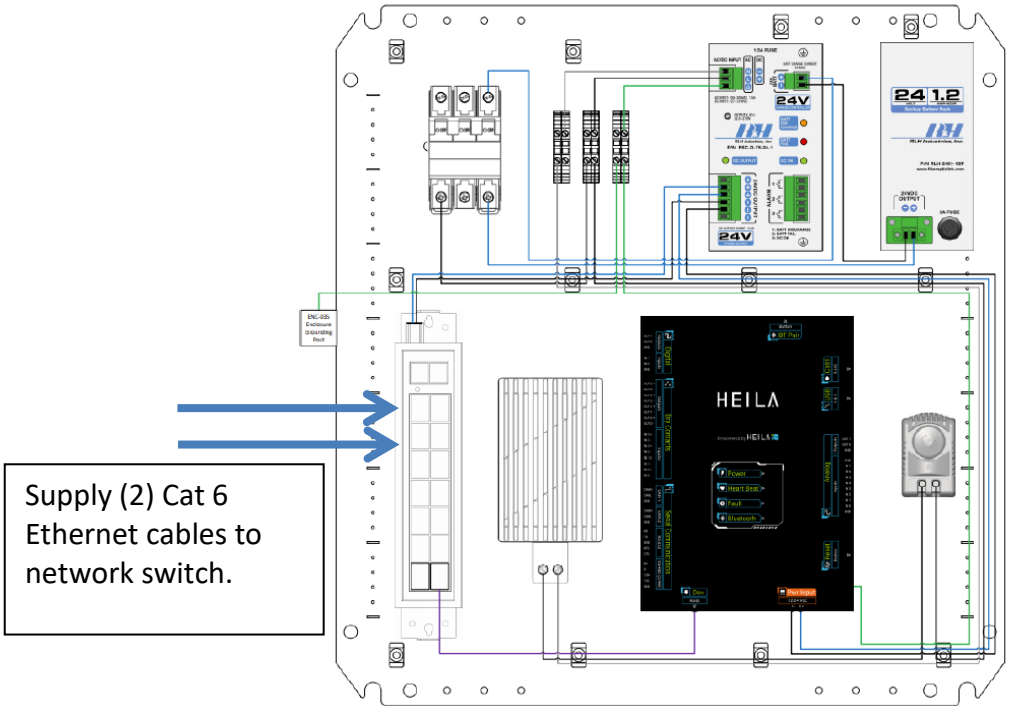


Figure 3-12: Heila Control Cabinet Components

3.8

Connection to the Internet

Connection to the Internet is strongly recommended for SOLECTRIA XGI 1500 inverters. An internet connection will provide the user with several important features, including:

- ✓ Automatic firmware updates.
- ✓ Remote diagnostics & troubleshooting.
- ✓ Access for Yaskawa Solectria Solar Technical Support & Service.
- ✓ Access to the user interface via the Remote Access Portal (RAP) (with subscription, optional).

Never run communication conductors in the same conduit as power conductors. It is important to keep communication conductors away from power conductors to reduce noise. If power conductors must intersect with communication conductors, it is preferable to have the intersection at a 90 degree angle.

4. System Operation

Following the installation of all equipment and confirmation of all connections and terminations, system commissioning should commence.

Initial Commissioning Procedure

- ❑ Turn OFF and lock out AC source to AC Combiner
- ❑ Turn OFF and lock out battery source
- ❑ Turn OFF all three of the XGI-1500 red on/off switches on the right side of the inverter
- ❑ Turn the disconnect handle on the AC combiner to the OFF position
- ❑ Remove DC De-Combiner cover and verify absence of voltage from all sources
- ❑ Verify all cabling in the DC De-Combiner is installed correctly and torqued appropriately
- ❑ Replace DC De-Combiner cover
- ❑ Remove AC Combiner cover and verify absence of voltage from all sources
- ❑ Verify all cabling in the AC Combiner is installed correctly and torqued appropriately
- ❑ Replace AC Combiner cover
- ❑ Open all three inverter covers, one by one
- ❑ Check for moisture on all internal surfaces. If moisture is found, remove all standing water and condensation where accessible.
- ❑ Leave covers off and allow all condensation to be dried by the environment. Once fully dried, wait at least an additional 1/2hr before re-installing covers.
- ❑ Close all three inverter covers
- ❑ Turn ON source of power to the AC combiner
- ❑ Turn the disconnect handle on the AC combiner to the ON position
- ❑ Turn ON all three of the XGI-1500 red on/off switches on the right side of the inverter, in any order.
- ❑ Energize the battery, according to its instructions
- ❑ Using a laptop, log on to the network and confirm network access to inverters and PMC controller. Please consult the PMC's manual on how to perform this step.
- ❑ Conduct a test run (charge/discharge) of the battery system

4.1

System OFF Procedure

To turn off the ACS-500, the following turn-off sequence is recommended, to avoid unnecessary wear of the components:

4.2

- ❑ Turn OFF all three of the XGI-1500 red on/off switches on the right side of an inverter, in any order.
- ❑ Turn the disconnect handle on the AC Combiner to the OFF position.
- ❑ De-energize the battery, according to its instructions

System ON Procedure

To turn on the ACS-500, use the following turn-on sequence:

4.3

- ❑ Turn the disconnect handle on the AC Combiner to the ON position
- ❑ Turn ON all three of the XGI-1500 red on/off switches on the right side of an inverter.
- ❑ Energize the battery, according to its instructions

4.4.1 Defining the Maximum and the Minimum Battery Operational Voltage

In addition to the battery's own safeguards to prevent overcharge and under discharge, the inverters have high and low safety limits for the DC voltage. If operating outside that voltage band, the inverters will be idling. The voltage rails need to be set up only once by the PMC through MODBUS TCP/IP messaging:

4.4

Table 4-1 Battery Voltage Modbus Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
MINIMUM BATTERY VOLTAGE	40897	Float32	-
MAXIMUM BATTERY VOLTAGE	40899	Float32	-

The minimum/maximum battery voltages are adjustable. The default values are set to the maximum limits:

Table 4-2 Battery Voltage Minimum and Maximum Limits and Default Values.

			DEFAULT
DEFAULT VOLTAGE	**MINIMUM**	**BATTERY**	860V
DEFAULT VOLTAGE	**MAXIMUM**	**BATTERY**	1300V

Please refer to your battery manual to find out what the safe voltage limits are.

4.4.2 Constant communication between PMC and inverters

In order to prevent an accidental under discharge or overcharge of the battery, by loss of communication between PMC and inverters, a changing (in its value) heartbeat message from the PMC needs to be received by the parent inverter at least every 20s. If the parent inverter has not received an updated heartbeat message in the last 20s, it will take all inverters offline.

Table 4-3 Heartbeat Modbus Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
HEARTBEAT	40894	uInt16	-

Control of Active Power

Active power can be controlled by the PMC via MODBUS messages at the output of the ACS. The flow of active power into the battery has a negative sign, the flow of active power out of the battery has a positive sign.

Table 4-4 Active Power Modbus Addresses

4.5

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
ACTIVE POWER SET POINT %	40985	Float32	-

The total energy exported by each inverter can be read though a Modbus variable. No variable exists to measure the imported energy.

Table 4-5 Real Lifetime Energy Exported Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
REAL LIFETIME ENERGY EXPORTED	40249	Acc64	1000

4.5.1 Active Power Limit

The active power set point can be further curtailed by the PMC via a MODBUS message for the active power limit. This feature applies to the charging as well as the discharging of the battery, and is used to limit the charge rate of the inverters, for instance in very cold weather.

Table 4-6 Active Power Modbus Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
INSTANTANEOUS REAL POWER LIMIT [W]	40295	Float32	-

4.5.2 Volt-Watt configuration

If the Volt-Watt feature is enabled, the inverters will first reduce the amount of active power that they output, and then actively absorb the power from the grid. This feature overrides the active power set point and is not meant to run constantly, but rather as an emergency function to reduce the voltage at the point of interconnection temporarily. The Volt-Watt-delay feature allows customers to coordinate the voltage response with other voltage regulating assets on the grid. Your local utility can help you with the correct settings. The following MODBUS messages can be controlled by the PMC:

Table 4-7 Volt-Watt Modbus Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
VOLT-WATT ENABLE/DISABLE	40997	uInt16	-
VOLT-WATT REFERENCE MODE	31653	uInt16	-
VOLT-WATT DELAY [S]	31409	Float32	-
VOLT-WATT CURVE, VOLT PTS [V%NOM]	41008-41026 (even)	uInt16	10
VOLT-WATT CURVE, WATT PTS [W%MAX]	41009-41027 (odd)	Int16	10

4.5.3 Frequency-Watt configuration

If the Frequency-Watt feature is enabled, the inverters will first reduce the amount of active power that they output, and then actively absorb the power from the grid (within the active power limit and the upper voltage limit). This feature overrides the active power set point and is not meant to run constantly, but rather as a supplementary function to help keep the power flow in the interconnection stable. The Frequency-Watt-delay feature allows customers to coordinate the frequency response with other frequency regulating assets within the same interconnection. Your local ISO can help you with the correct settings. The following Modbus messages can be controlled by the PMC:

Table 4-8 Frequency-Watt Modbus Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
FREQUENCY-WATT ENABLE/DISABLE	41063	uInt16	-
FREQUENCY-WATT REFERENCE MODE	41126	uInt16	-
FREQUENCY -WATT DELAY [S]	31401	Float32	-
FREQUENCY -WATT CURVE, HZ PTS [HZ%NOM]	41073-41091 (odd)	uInt16	10
FREQUENCY -WATT CURVE, WATT PTS [W%MAX]	41074-41092 (even)	Int16	10

4.6 Control of Reactive Power

Reactive power can be controlled by the PMC via Modbus messages at the output of the ACS. The absorption of reactive power has a negative sign, the insertion of reactive power to the grid has a positive sign. If none of the three reactive power modes are turned on, the flow of reactive power is zero.

The total reactive energy absorbed and provided by each inverter can be read by summing up two of the four Modbus variables:

Table 4-9 Reactive Power Modbus Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
TOTAL REACTIVE ENERGY CTR QUADRANT 1 (VARH)	40257	Acc64	-
TOTAL REACTIVE ENERGY CTR QUADRANT 2 (VARH)	40261	Acc64	-
TOTAL REACTIVE ENERGY CTR QUADRANT 3 (VARH)	40265	Acc64	-
TOTAL REACTIVE ENERGY CTR QUADRANT 4 (VARH)	40269	Acc64	-

One of these three methods to control the flow of reactive power can be chosen:

4.6.1 Method 1: Volt-VAr configuration

The Volt-VAr feature is meant to run permanently, if desired. When enabled, the inverters absorb or provide a certain amount of reactive power to keep the AC terminal voltage within limits, independently from the real power output, while limited to the allowable power factor limit. The Volt-VAr function competes directly with the production of Watts and has the priority. The Volt-VAr-delay feature allows customers to coordinate the voltage response of the inverter with other voltage regulating assets on the grid. Your local utility can help you with the correct settings.

Table 4-10 Volt-VAr Modbus Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
VOLT-VAR ENABLE/DISABLE	40931	uInt16	-
VOLT-VAR AUTO ENABLE	30707	uInt16	-
VOLT-VAR RESPONSE DELAY [S]	31649	Float32	-
VOLT-VAR REFERENCE [V]	30705	Float32	-
VOLT-VAR REFERENCE DELAY [S]	30708	uInt16	-

VOLT-VAR CURVE, VOLT PTS [V%NOM]	40942-40960 (even)	uInt16	10
VOLT-VAR CURVE, VAR PTS [Q%MAX]	40943-40961 (odd)	Int16	10

4.6.2 Method 2: Constant Power Factor Configuration

The Constant Power Factor feature is meant to run permanently, if desired. When enabled, the inverters absorb or provide an amount of reactive power instantaneously, in proportion to the real power output. The settable Constant Power Factor range is +/-0.80. In most applications, a positive power factor will help counteract the voltage rise at the terminals, induced by the flow of active power into the grid.

Table 4-11 Constant Power Factor Modbus Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
CONST PF ENABLE/DISABLE	40304	uInt16	-
PF SET POINT [-0.80 … 0.80]	40300	Int16	100

4.6.3 Method 3: Constant Reactive Power configuration

The Constant Reactive Power feature is meant to run permanently, if desired. When enabled, the inverters absorb or provide a constant amount of reactive power instantaneously with priority that is independent of the flow of active power. This feature can mimic a capacitor bank or be used to control the amount of reactive power that a bigger plant consumes.

Table 4-12 Constant VAr Modbus Addresses

MESSAGE	MODBUS ADDRESS	DATA TYPE	SCALE FACTOR
CONSTANT VAR ENABLE/DISABLE	40312	uInt16	-
VAR SET POINT	40306	Int16	10

For more information on Modbus over TCP/IP messaging, contact the Yaskawa Solectria Solar application engineering team.

5. Specifications

Table 5-1 ACS-500 Specifications

SOLECTRIA ACS-500 SPECIFICATIONS	
ABSOLUTE MAXIMUM INPUT VOLTAGE	1500Vdc
BATTERY VOLTAGE RANGE	860Vdc – 1300Vdc
MAXIMUM OPERATING BATTERY CURRENT	+/-593Adc
NOMINAL AC VOLTAGE	600Vac
CONTINUOUS REAL / APPARENT POWER	498kW / 498kVA
MAXIMUM AC CURRENT	480 Aac
AC FUSE SIZE	600 Aac
EFFICIENCY	98.5%

6. WARRANTY & RMA INSTRUCTIONS

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

8. APPENDICES

Appendix A – Contact Information

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