# S&C PureWave® SMS-250 Storage Management System

Power Conversion System

263 kW/263 kVA, 380 V


# Installation

## Table of Contents



Supersedes Instruction Sheet 657-525 dated April 6, 2015

October 3, 2016

## Qualified Persons

**⚠ WARNING**

The equipment covered by this publication must be installed, operated, and maintained by qualified persons who are knowledgeable in the installation, operation, and maintenance of energy storage equipment along with the associated hazards. A qualified person is one who is trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages and arc flash levels to which the qualified person will be exposed
- The proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

## Read this Instruction Sheet

***NOTICE***

Read this instruction sheet thoroughly before operating and maintaining the PureWave SMS-250 Storage Management System. Familiarize yourself with the Safety Information and Safety Precautions on pages 3 through 5. The latest version of this instruction sheet is available online in a PDF format at **sandc.com/Support/Product-Literature.asp**

## Retain this Instruction Sheet

This instruction sheet is a permanent part of your power conversion system (PCS). It does not include instruction sheets from the original battery manufacturer. Information sheets such as this one can be placed inside a compartment in the PCS enclosure, where they it can be easily retrieved for future use.

## Proper Application

**⚠ WARNING**

The equipment in this publication must be selected for a specific application. The application must be within the ratings furnished for the equipment. Refer to S&C General Brochure 659-G358 for the S&C PureWave SMS-250 Storage Management System. Failure to do so can result in damage to equipment.

## Warranty

The warranty and/or obligations described in S&C's standard conditions of sale, as set forth in Price Sheet 150, plus any special warranty provisions, as set forth in the applicable product-line specification bulletin, are exclusive. The remedies provided in the former for breach of these warranties shall constitute the immediate purchaser's or end user's exclusive remedy and a fulfillment of all seller's liability. In no event shall the seller's liability to the immediate purchaser or end user exceed the price of the specific product that gives rise to the immediate purchaser's or end user's claim. All other warranties, whether express or implied or arising by operation of law, course of dealing, usage of trade, or otherwise, are excluded. The only warranties are those stated in Price Sheet 150, and THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY EXPRESS WARRANTY OR OTHER OBLIGATION PROVIDED IN PRICE SHEET 150 IS GRANTED ONLY TO THE IMMEDIATE PURCHASER AND END USER, AS DEFINED THEREIN. OTHER THAN AN END USER, NO REMOTE PURCHASER MAY RELY ON ANY AFFIRMATION OF FACT OR PROMISE THAT RELATES TO THE GOODS DESCRIBED HEREIN, ANY DESCRIPTION THAT RELATES TO THE GOODS, OR ANY REMEDIAL PROMISE INCLUDED IN PRICE SHEET 150.

## Warranty Qualifications

The seller's warranties are contingent upon the installation and adjustment of the S&C PureWave SMS-250 Storage Management System in accordance with S&C's applicable instruction sheets, data sheets, and/or data bulletins.

## Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels attached to the PCS. Familiarize yourself with these types of messages and the importance of these various signal words:

**⚠ DANGER**

"DANGER" identifies the most serious and immediate hazards that *will likely* result in serious personal injury or death if instructions, including recommended precautions, are not followed.

**⚠ WARNING**

"WARNING" identifies hazards or unsafe practices that *can* result in serious personal injury or death if instructions, including recommended precautions, are not followed.

**⚠ CAUTION**

"CAUTION" identifies hazards or unsafe practices that *can* result in minor personal injury if instructions, including recommended precautions, are not followed.

***NOTICE***

*"NOTICE"* identifies important procedures or requirements that *can* result in product or property damage if instructions are not followed.

## Following Safety Instructions

If you do not understand any portion of this instruction sheet and need assistance, contact your nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C's website **sandc.com**. Or call S&C Headquarters at (773) 338-1000; in Canada, call S&C Electric Canada Ltd. at (416) 249-9171.

***NOTICE***

Read this instruction sheet thoroughly and carefully before installing or operating your S&C PureWave SMS-250.

## Replacement Instructions and Labels

If you need additional copies of this instruction sheet, contact your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

## Location of Safety Labels


*A*

**⚠ DANGER**

**KEEP OUT. RISK OF ELECTRIC SHOCK.**

Hazardous voltage inside. Can shock, burn, or cause death.

This equipment is energized by batteries even when the AC power input is disconnected.

This unit is to be serviced by trained personnel only.

PE-70479-1

*B*

**NOTICE**

**Cabinet requires a minimum 18" rear clearance.**

Area behind cabinet must remain clear.

PE-70482-1

*C*

**⚠ DANGER**

**ARC FLASH AND SHOCK HAZARD. APPROPRIATE PPE REQUIRED**

Follow ALL requirements in NFPA 70E for safe work practices and for Personal Protective Equipment.

Hazardous voltage inside. Can shock, burn, or cause death.

This equipment is energized by batteries even when the AC power input is disconnected.

This unit is to be serviced by trained personnel only.

## Reorder Information for Safety Labels

| Location | Safety Alert Message | Description | Part Number |
|---|---|---|---|
| A | ⚠ DANGER | KEEP OUT. RISK OF ELECTRICAL SHOCK … | PE-70479-1 |
| B★ | *NOTICE* | REAR CLEARANCE … | PE-70482-1 |
| C | ⚠ DANGER | ARC FLASH AND SHOCK … | PE-70483-1 |

★ Label is on the left and right sides of the PCS enclosure.

## Symbols and Terminal Markings

| | |
|---|---|
| I | The "I" symbol represents the power on button. When the "I" button with the symbol is pressed, the breaker places the equipment into a fully-powered state |
| ⏚ | Equipment grounding conductor. |
| O | The "O" symbol represents the power off button. When the button with the "O" symbol is pressed, the breaker disconnects the load side from the power source. The dc breaker disconnects the SMS-250 from the battery. The ac breaker disconnects the ac output to the load. |
| ⎓ | Direct current, also indicated as dc. |
| ∿ | Alternating current, also indicated as ac. |

## ⚠ DANGER


**The PureWave SMS-250 operates at hazardous voltage. Failure to observe these precautions below will result in serious personal injury or death.**

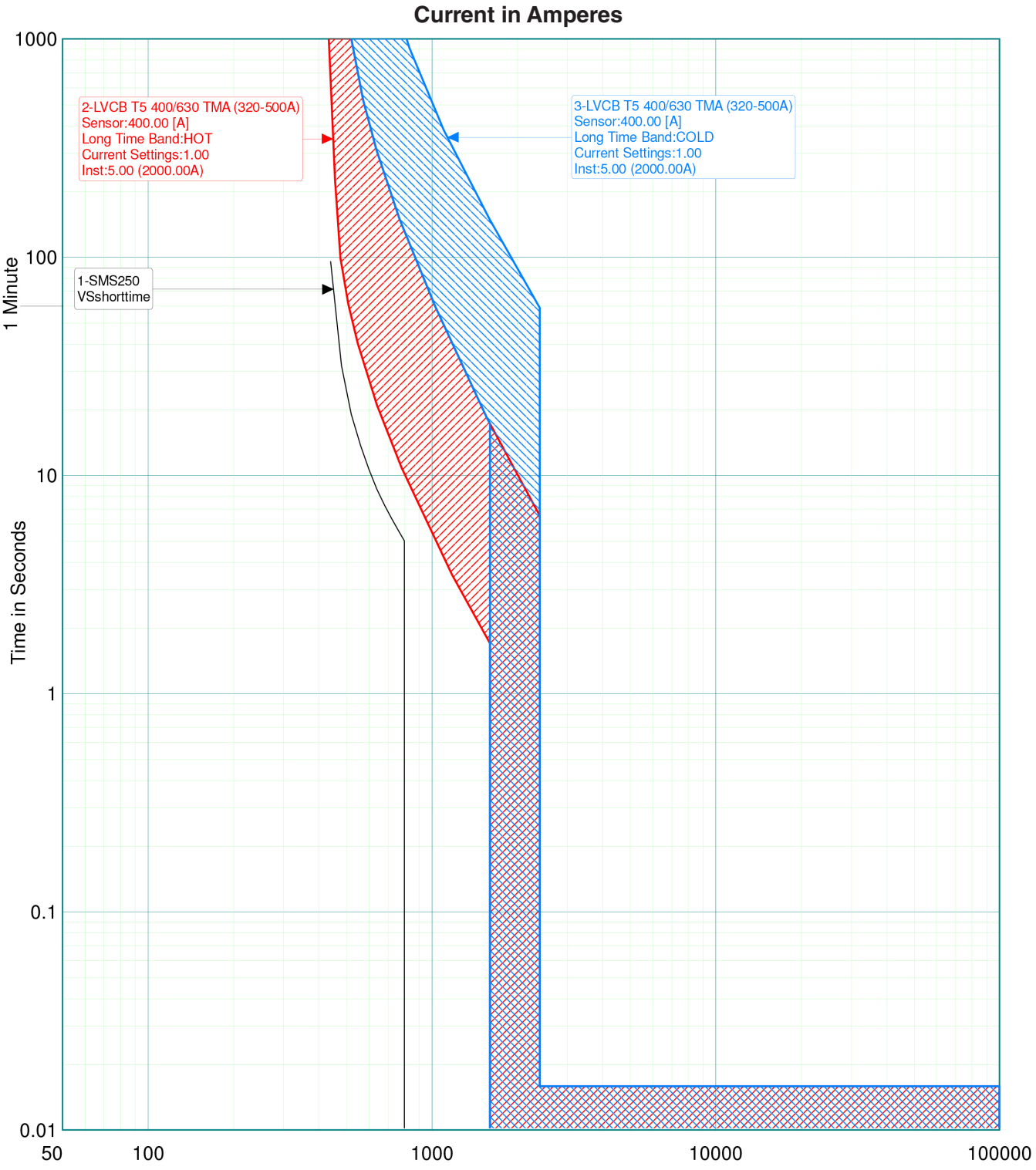
Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

1. **QUALIFIED PERSONS.** Access to the PureWave SMS-250 must be restricted only to qualified persons. See "Qualified Persons" on page 2.
2. **SAFETY PROCEDURES.** Always follow safe operating procedures and rules.
3. **PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, and flame retardant clothing, in accordance with safe operating procedures and rules.
4. **SAFETY LABELS.** Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "*NOTICE*" labels.
5. **ENCLOSURE.** Do not open access doors unless the system is offline or otherwise authorized by S&C Electric Company.
6. **MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components, ensuring the dead-front access panels are in place after maintenance or before operation.
7. **HAZARDOUS VOLTAGES.** Hazardous dc voltage is present even without utility power connected. Hazardous voltages should also be expected in all interconnecting components and lines.

   To maintain safety, the user should use a padlock on the door of the power conversion system (PCS) enclosure. The door and the use of the padlock provide protection against inadvertent contact with hazardous voltages.
8. **GROUNDING.** For grounding purposes, the proceeding must be followed:
   - The power conversion system base ground bar in the cable-termination area must be connected to a suitable earth ground for testing before energizing the unit and at all times when energized.
   - The overall ground system should be sufficient to limit the Ground Potential Rise (GPR), step voltage, and touch voltage to acceptable limits as determined by the utility's practices and the National Electric Safety Code.
9. **ENERGIZED COMPONENTS.** Always consider all parts live until de-energized, locked open, and tested.
10. **ADDITIONAL CONNECTIONS.** The user should not attempt to connect any additional logic controls or power connections to the PureWave SMS-250 (beyond the connections shown on the interconnect drawing) without having received written approval from S&C Electric Company.
11. **INSULATED HAND TOOLS.** To use insulated hand tools, the proceeding must be followed:
    - Insulated hand tools are required when working on or around any energized equipment. Use only properly rated tools for the energy present.
    - Tool inventories should be kept to ensure that all tools that enter the system enclosure are removed prior to energizing the system.
12. **EMERGENCY PROCEDURES AND EQUIPMENT.** For emergency procedures:
    - The owner should develop policies and procedures for handling emergency situations.
    - It is the responsibility of the owner to develop site-specific emergency action plans for response to such situations.
13. **ADDITIONAL SAFETY INSTRUCTIONS.** Consult the battery supplier for additional safety instructions and procedures regarding the battery used in the PureWave SMS-250.

## Breaker Protection Curves

The power conversion system has a fixed output. The ac and dc breakers are configured at the factory with the following protection curve:



## Packing

The power conversion system enclosure ships in one piece. See Figure 1.

**NOTICE**

The Human Machine Interface (HMI) computer and batteries for the PureWave SMS-250 are shipped separately.

## Location of Mounting Hardware

The mounting brackets and hardware can be found bagged and in the front lower lip of the PCS enclosure between the bottom dead-front access panel and the bottom part of the enclosure. See Figure 2.

**NOTICE**

Find and install all mounting hardware before starting up the PureWave SMS-250. Failure to do so can result in equipment damage.


**Figure 1. Power conversion system enclosure.**


**Figure 2. Location of mounting brackets and hardware.**

## Inspection

Examine the shipment for external evidence of damage as soon after receipt as possible, preferably before removal from the carrier's conveyance. Check the bill of lading to make sure all shipping skids and containers listed thereon are present.

If there is visible loss and/or damage:

1. Notify the delivering carrier immediately.
2. Ask for a carrier inspection.
3. Note the condition of shipment on all copies of the delivery receipt.
4. File a claim with the carrier.

If concealed damaged is discovered:

1. Notify the delivering carrier within 15 days of receipt of shipment.
2. Ask for a carrier inspection.
3. File a claim with the carrier.

Also notify S&C Electric Company in all instances of loss and/or damage.

## Handling

**NOTICE**

The PCS enclosure shall be lifted according to lifting drawing **PEA-1610-4-IN** and any other project-specific lifting drawings supplied with the PureWave SMS-250. Lifting equipment such as spreader bars and hoist sling straps are provided by others.

To avoid damaging the PCS enclosure when placing it at the desired location, observe normal recommended procedures as well as the following general instructions.

**⚠ CAUTION**

The PCS installer must ensure ALL lifting equipment, beams, slings, chains, spreader bars, and apparatus are properly rated for the identified load. Failure to do so can result in equipment damage and personal injury.

**NOTICE**

Before to lifting the PCS enclosure, ensure that all doors are closed and locked. The doors contribute to the structural integrity of the system and, if left opened, increase the risk of damage to the enclosure during lifting.

**⚠ WARNING**

When handling the PCS enclosure with an overhead hoist, observe standard lifting practices as well as the following general instructions. Failure to follow these procedures can result in serious personal injury and equipment damage.

### Step 1

To lift and place the PureWave SMS-250 PCS, follow these procedures:

(a) If spreader bars are used for lifting, make sure the spreader bar(s) are secured.

(b) Arrange the hoist slings so the lifting forces are distributed equally. See Figure 3 for an illustration of lifting the PCS enclosure. The equipment must be lifted with a crane or forklift.

(c) Avoid sudden starts and stops when lifting.

(d) Properly place the PCS on the concrete pad. See Figure 4 for the location of cable entry conduit and mounting bracket installation areas. For further details, refer to drawing PEA-1610-4-IN and the other project specific lifting drawings supplied with the PureWave SMS-250.

(e) Remove the sling straps.

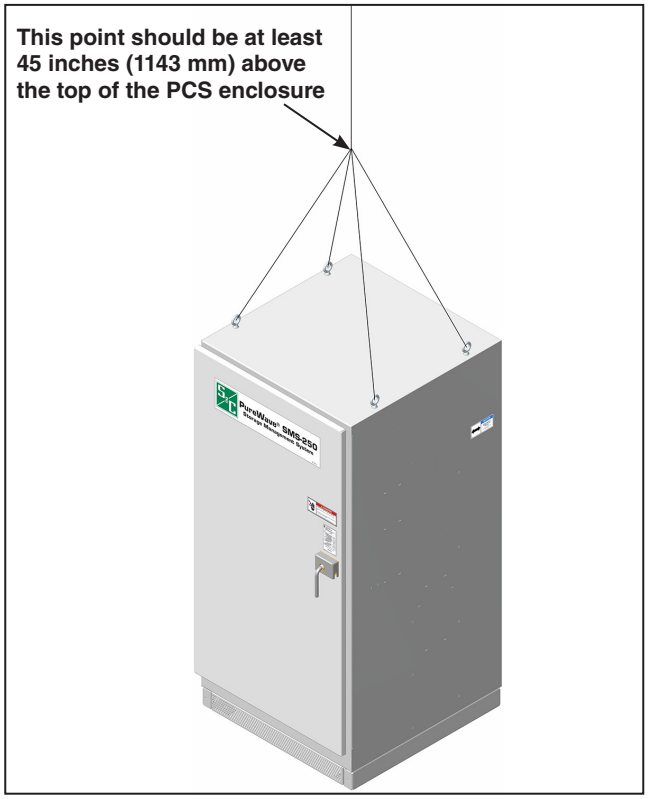



**Figure 3. Proper lifting of the power conversion system enclosure.**

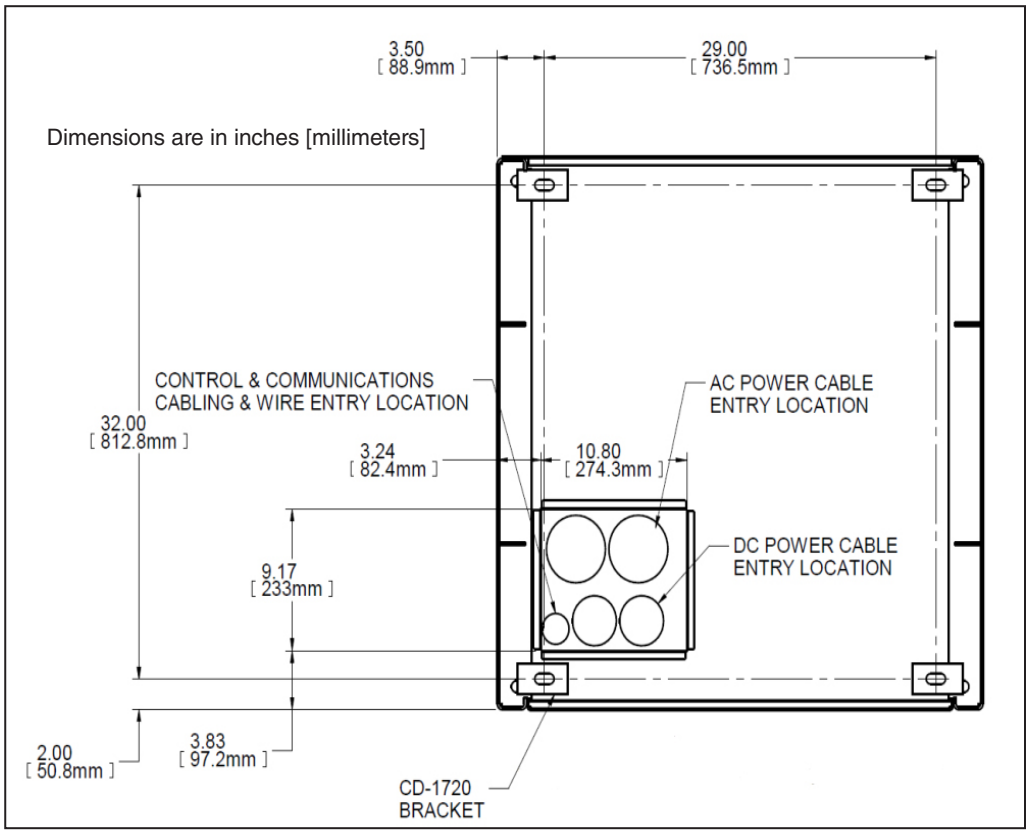



**Figure 4. Conduit and bracket measurements for pad-mounting.**

## System Design

The PureWave SMS-250 is a storage management system, that can be connected to 380 Vac directly or, using an auto transformer, to 400, 415, or 480 Vac, 3-phase, 50/60 Hz (to match system frequency), 380-Vac delta primary, 265 kVA.

The storage management system consists of a 263-kW/263-kVA power converter housed in a weatherproof enclosure suitable for outdoor or indoor mounting on a concrete or equivalent pad, which can be applied either with or without a 618- to 850-Vdc battery pack, depending on the application-specific requirements. For specific applications that do not require a battery pack, the PureWave SMS-250 assembly will be supplied without the dc circuit breaker, dc EMI filter and dc bus terminations.

The PureWave SMS-250 can use a modular design capable of parallel operation to achieve a rating of up to 526 kW/526 kVA.

## Concrete Pad Specifications

**NOTICE**

The concrete pad is provided by others.

The concrete pad on which the PCS enclosure will be placed should be sized to accommodate the unit and its external mounting brackets. The pad should be poured with a maximum pitch of ½ degree and should have a flatness within ⅛ inch (3.175 mm).

The pad should extend beyond the edge of the enclosure by an adequate amount to prevent the pad from cracking or breaking when the Hilti Kwik Bolt TZ anchor bolts are installed to bolt the PCS enclosure to the pad.

## Pad Requirements

### *General Requirements*

The concrete pad contractor shall provide and be responsible for determination and execution of the methods of construction and for all safety precautions taken during construction. Site visits by the structural engineer will not include inspection of the means of construction. All construction shall be in accordance with local code requirements. Please contact S&C Electric Company for recommendations in accordance with equipment requirements.

### *Pad Dimensions and Mounting Provisions*

The concrete pad contractor is responsible for pad design and dimensions. Reference the separately supplied drawing for the footprint dimensions and stub-up locations. Both ac and dc cable boxes are required to be supplied and installed by the installer for the power conductor connection compartment to aid in conductor terminations and connections.

**Step 2**

## Shimming, Grouting, and Caulking the PCS Enclosure

To shim, grout, and caulk the PureWave SMS-250 PCS enclosure, follow these procedures:

(a) After placing the PCS enclosure at the desired location, check whether there are any gaps between the enclosure and the concrete pad.

(b) If there are gaps, install shims until the enclosure is level.

(c) Apply grout at the bottom of the enclosure as necessary to prevent entry of insects or debris into the enclosure. The grout should be recessed sufficiently to permit a bead of caulk between the enclosure base and concrete pad.

(d) Apply a bead of caulk (S&C part number 6943-010, DAP Premium Polyurethane Waterproof Concrete & Masonry Sealant 300 ml Gray) around the outer edge of the bottom flange (where it meets the concrete pad) to provide a seal around the base of the PCS. The purpose of the caulk is to further prevent ingress of insects and debris into the enclosure.

**Step 3**

## Mounting

(a) Anchor the PCS enclosure to the concrete pad. Use ⅜-inch diameter × 2-inch embed Hilti Kwik Bolt TZ anchors for each bracket. The anchor brackets should be located at each corner, as shown in Figure 5. Tighten the bolts again three to five days after the initial installation.

**NOTICE**

If seismic rating is required, ⅜-inch diameter × 2-inch embed Hilti Kwik Bolt TZ anchors ***must*** be installed at each mounting bracket location. Failure to do so can result in damage to equipment.

(b) After pulling the cables, seal all conduit entrances on the outside with room temperature vulcanization silicone sealant and on the inside with duct seal foam to prevent water from entering the PCS enclosure.

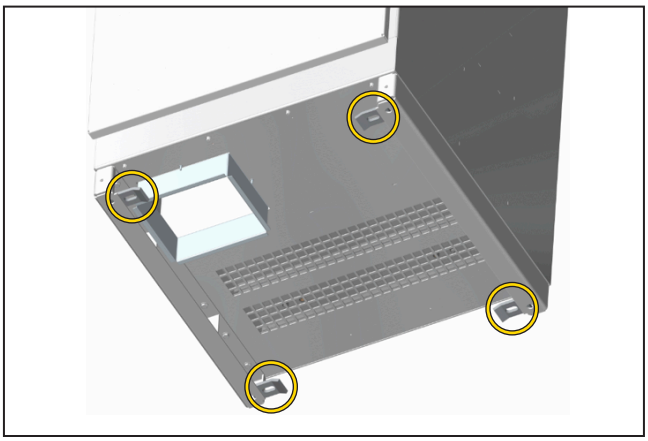


**Figure 5. Mounting points.**

## Cable Terminations

**NOTICE**

For internal bus and cabling connections, refer to installation drawing **PEA-1610-4-IN** and any project specific drawings supplied with the PureWave SMS-250. See Figure 6 for the location of the cable termination area .

**Step 4**

## Battery Connection

The battery must be supplied with an adequate protection fuse and a disconnect breaker. The battery-protection fuse must be sized correctly for the short-circuit current capacity of the battery. The battery supplier shall include the battery disconnect switch in the battery module.

Terminate the dc cables from the separate battery pack (if supplied) to the dc inputs in the cable-termination area. The positive terminal of the battery must connect to the positive terminal on the PureWave SMS 250. The negative terminal of the battery must connect to the negative terminal on the PureWave SMS 250.

Note that battery voltage is floating from the earth reference. The battery enclosure must be bonded as indicated in the Earth Reference and Bonding section.

## Power Connections

Terminate the ac cables to the line inputs (L1, L2, and L3) in the cable-termination area.

## Wiring Methods

All wiring methods must be in accordance with the National Electrical Code and ANSI/NFPA 70.

## Lugs for Battery and Power Connections

Use the following recommended lugs or equivalent:

- Panduit LCA4/0-12-X (COPPER)
- T&B CTL40L-12 (COPPER)

**Figure 6. Location of the cable termination area.**

## Earth Reference and Bonding

### *Earth Reference Requirements:*

A low-impedance earth reference connection is required for the PureWave SMS-250 equipment. The earth (ground) reference system should be tailored to reflect the characteristics of the site and the requirements of the facility and shall use a grounding interface that meets the needs of the local electric utility's system and that complies with all applicable national and local electrical codes and standards. The PureWave SMS-250 uses power converters that switch at frequencies up to 5 kHz. For S&C PureWave SMS-250 equipment and systems rated less than 1000 kVA, the resistance of the SMS-250 earth reference connection to earth is required to be 25 ohms or less at both the nominal power frequency of 50 or 60 Hz, and at the 5-kHz switching frequency of the SMS-250 power conversion system.

Any associated battery equipment must have its own direct earth reference connection. It is not permitted to only ground the battery equipment through the PureWave SMS-250 earth reference connections.

### *Bonding Requirements:*

Besides the importance of creating an earth reference, bonding is required between interconnected electrical equipment to establish a low impedance path that minimizes the potential difference between two metallic objects, minimizes electric shock hazards, provides lightning protection, and establishes references for electronic signals.

All cable tray, conduit, and raceway systems installed to interconnect power, control, and communications wiring to and from the S&C PureWave SMS-250 shall be electrically continuous by bonding together at each individual section. Each individual cable tray, conduit, and raceway section, including pull boxes, junction boxes, and outlet boxes, shall be bonded to the facility earthing system within 2 feet (600 mm) of each end and at intervals not exceeding 50 feet (15 meters) along the run. All cable trays, conduits, and raceways shall be securely bonded to all brackets, hangers, and structural members to which they are attached. The resistance of each bonding connection shall not exceed 5 milliohms. The total bonding resistance between the PureWave SMS-250 cabinet and any battery cabinet/enclosure shall be no more than 1 ohm.

## Communications Signal Reference Requirements

All communications systems that interface with the PureWave SMS-250 equipment must be designed for operation in a multipoint earth (ground) reference system.

See examples of ground plan diagrams in Figures 7 and 8.

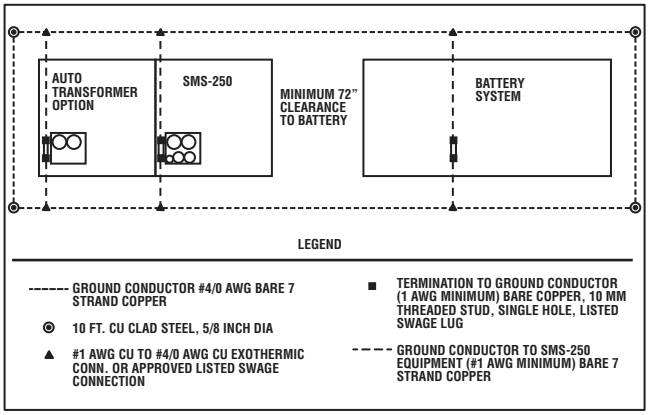



**Figure 7. Example of a ground plan diagram showing the S&C PureWave SMS-250 cabinet, the SMS-250 autotransformer option, and a battery system.**

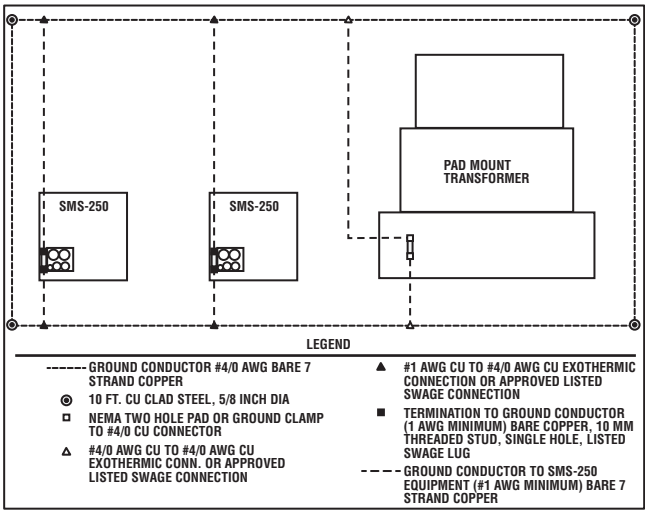



**Figure 8. Example of a ground plan diagram showing two S&C PureWave SMS-250 cabinets and a pad-mount isolation transformer (var-only application—no battery system).**

**Step 5**

## Control and Grounding Connections

For control and grounding connections:

(a) Install control and communication cabling using the entry location in the cable termination area.

(b) Attach the ground bus of the PCS to the system ground in accordance with the installation drawing.

(c) Seal the conduits with duct-sealing compound to prevent water from entering the system through the conduits.

## Connection Checks

Check all field-installed cables and wiring to the power conversion system by performing a "point-to-point" check on all of the wiring to verify the system is wired, labeled, and terminated per drawing **PEA-1610-4-IN** and any project-specific drawings supplied with the PureWave SMS-250. Note any problems found and corrective actions applied.

## Torques

Check all factory and field-bolted electrical connections inside the PCS enclosure and verify they are torqued to the proper tightness. See Table 1 for torque requirements.

**Table 1. Torque requirements.**

| ASSEMBLY | PART | HARDWARE | TOOL | TORQUE [N-M] | TORQUE [FT-LBS] |
|---|---|---|---|---|---|
| Dead-Front Access Panels | Panels | M8 Serrated Flange | 13mm Socket | 13.6 | 10 |
| | EMI Fasteners | M5x12 Screw | #2 Phillips | 3.9 | 2.9 |
| Bus Connections | N/A | M10 Flange Nut/Bolt | 15mm Socket | 54.2 | 40 |
| Islanding Tray | Tray | M8 Serrated Flange | 13mm Socket | 13.6 | 10 |
| | CT Terminal Block | #10-32 Terminals | Slot Driver | 2 | 1.5 |
| | Terminal Blocks | M4 Terminals | Slot Driver | 1.7 | 1.25 |
| | Programmable Logic Controller | M3 Mounting | #1 Phillips | 1.1 | 0.8 |

## Base Covers

Install the base covers (if not already installed) at the front and back forklift entries of the enclosure. They are typically stored on the inside of the enclosure door. See Figure 9.

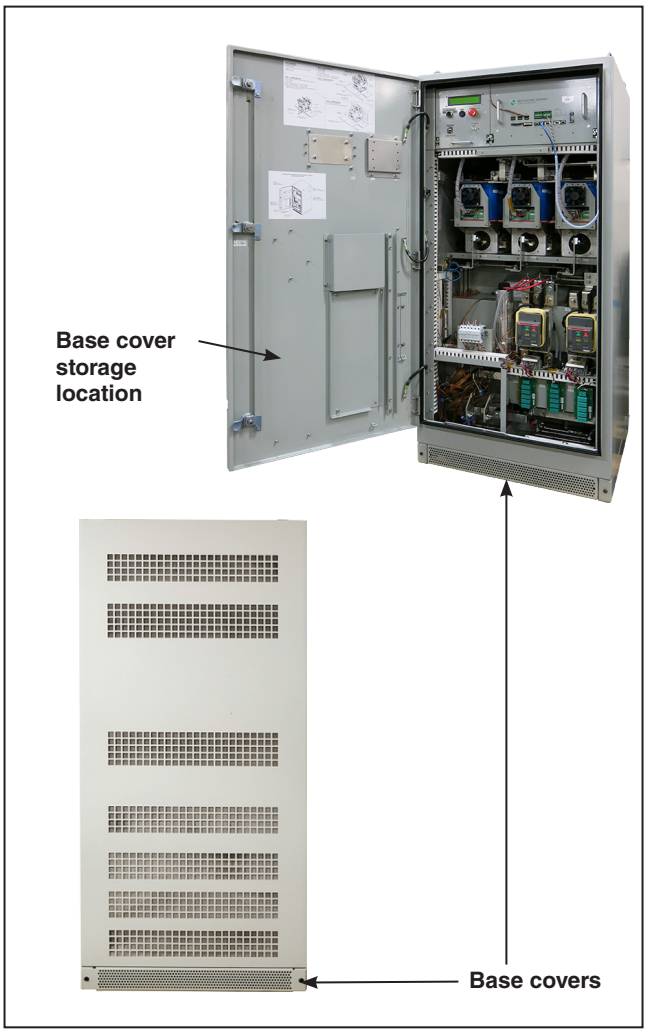



**Figure 9. Location of base covers.**

**Step 6**

## Before Completing the Installation

Before completing the installation:

(a) Replace and secure the dead-front access panels.

(b) Close and lock the door of the power conversion system (PCS) enclosure(s).

(c) Wipe down the exterior of the PCS enclosure(s) with a clean damp cloth. Refinish any scratches or abrasions.

If touch-up paint is in-hand, the area to be touched up should be cleaned to remove all oil and grease. Sand the area, removing any traces of rust that may be present, and make sure all edges are feathered before applying primer.

## Pre-Startup Checklist

The pre-startup checklist will be provided and should be reviewed and filled out by the installing contractor. The document must be signed and faxed to S&C Electric Company at (414) 423-8766.

## Annual Inspections

After the PureWave SMS-250 is commissioned and the unit is online, inspection and maintenance should be scheduled for the PCS on an annual basis to ensure the proper operation of the system. Schedules for maintenance should be reviewed by the customer based upon the given site conditions and, if required, the frequency of the recommended maintenance should increase to ensure the reliability of their PureWave SMS-250.