Safety information

Important information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

<table>
<thead>
<tr>
<th><strong>DANGER</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>DANGER indicates a hazardous situation which, if not avoided, <strong>will result in</strong> death or serious injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>WARNING</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>WARNING indicates a hazardous situation which, if not avoided, <strong>could result in</strong> death or serious injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CAUTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUTION indicates a hazardous situation which, if not avoided, <strong>could result in</strong> minor or moderate injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>NOTICE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTICE is used to address practices not related to physical injury.</td>
</tr>
</tbody>
</table>

Please note

Electrical equipment should be installed, operated, serviced and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.
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Section 1 Safety precautions

Installation, wiring, testing and service must be performed in accordance with all local and national electrical codes.

⚠️ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this device and the equipment in which it is installed before working on the device or equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.
Section 2  Introduction

Installation overview

Connect the incoming power

NOTE: A capacitor bank is a load. The only power cabling to be done is the incoming cable to the line side of the incoming breaker or incoming lugs.

CT and alarm connection

NOTE: You must use a CT if you are using the automatic capacitor banks.

Program the controller

Activate

Inspect

Physical installation

Receiving
This manual contains instructions for the proper installation, operation, and maintenance of VarSet™ low voltage capacitor bank equipment manufactured by Schneider Electric. The purchaser’s engineering, installation, and operating staff should familiarize themselves with this manual and become acquainted with the appearance and characteristics of each piece of equipment mounted or contained in the capacitor bank. This user manual covers the following enclosures:

- VLVAW2N
- VLVAW3N
- VLVAF4P
- VLVFF4P

These instructions and procedures apply to VarSet low voltage capacitor bank installation. When special features or non-standard components are incorporated in the capacitor bank, detailed instructions for these components are included in the instruction material holder.

**Document replacement**

Contact your nearest Schneider Electric field office to replace lost or damaged wiring diagrams and instruction sheets. Use the factory order number found on the nameplate for reference.
Section 3  Receiving, handling, and storing

Receiving

Upon receipt, check the packing list against the equipment received to ensure the order and shipment are complete. Also upon receipt, immediately inspect capacitor bank sections for any damage that may have occurred in transit. If damage is found or suspected, file a claim with the carrier immediately and notify the nearest Schneider Electric representative.

Handling

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZARD OF EQUIPMENT DAMAGE</td>
</tr>
<tr>
<td>Do not lay the equipment on its back, front, or sides.</td>
</tr>
<tr>
<td>Failure to follow these instructions can result in equipment damage.</td>
</tr>
</tbody>
</table>

Ensure that proper equipment such as an overhead crane is available at the installation site to handle the capacitor bank. This equipment will help avoid injury to personnel and damage to the capacitor bank.

Verify the lifting capacity of the equipment being used to handle the capacitor bank in accordance with the shipping weight of each shipping section. Keep the capacitor bank upright during handling.

Schneider Electric recommends using an overhead crane, lifting straps, and cables or chains to handle the capacitor bank. This method and alternative handling methods are discussed in this section.
Handling with lifting straps

Remove the equipment from its transport pallet using lifting straps as shown in the following table.

### Table 1: Lifting Conditions

<table>
<thead>
<tr>
<th>Type (VLVA2N and VLVA3N enclosures)</th>
<th>VLVA4P and VLVA4P enclosures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle (Option 1)</td>
<td>Option 2&lt;sup&gt;(1)&lt;/sup&gt; (2)&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Maximum (α) 60°</td>
<td></td>
</tr>
<tr>
<td>Maximum weight of enclosure</td>
<td>175 lb (80 kg)</td>
</tr>
<tr>
<td>(for reference only, subject to change without notice)</td>
<td>585 lb (265 kg)</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> Take necessary precautions while lifting to avoid tilting the equipment.
<sup>(2)</sup> In case slings are used, it is advisable to use all the hoisting rings on the equipment.

**NOTE:** You must remove the eyebolts after equipment is in its final place and mounted.

After moving the equipment, do the following:

1. Unscrew the eyebolts and collect the brackets from inside the enclosure.
2. Install plastic plugs contained within the gland plate bag.
Handling with a forklift

A forklift is an alternative method of handling the capacitor bank.

**NOTE:** Always check the fork lengths to ensure that the forks extend under the entire capacitor bank. Carefully balance the load and always use a safety strap when handling or moving a capacitor bank with a forklift.

**Figure 1: Forklift Safety Strap**

**NOTE:** You must remove the eyebolts after equipment is in its final place and mounted.

After moving the equipment, do the following:

1. Unscrew the eyebolts and collect the brackets from inside the enclosure.
2. Install the plastic plugs contained within the gland plate bag.
Storing

When storing the capacitor bank before installation, cover the top and openings of the equipment to protect the capacitor bank from dust and debris.

Do not store in an outdoor location even if covered by a tarp. If a capacitor unit is not installed and energized immediately, store it in a climate controlled building with adequate air circulation and protect it from dirt, airborne contaminants, and water. The acceptable storage temperatures are from -10°C (14°F) to 40°C (104°F).
Section 4  Equipment description

VLVAW2N and VLVAW3N systems

The VLVAW2N and VLVAW3N systems consist of capacitors controlled by contactors and a power factor controller to control the operation of the contactors. The power factor controller continually monitors the load power factor and automatically adjusts the number of capacitors connected to the line to regulate the reactive power compensation level to meet the power factor target. These non-detuned banks are for networks with low harmonic producing loads.

Two enclosure sizes are available depending on the power required. The systems are available with an incoming breaker as an option (suffix AB) or with a main terminal block (suffix AA).

Figure 2: VLVAW2N and VLVAW3N
VLVAF4P and VLVFF4P system

The VLVAF4P is a detuned capacitor bank that consists of capacitors and reactors controlled by contactors and a power factor controller to control the operation of the contactors. The power factor controller continually monitors the load power factor and automatically adjusts the number of capacitor/reactor stages connected to the line to regulate the power factor. The detuned reactors contained in this bank are three phase inductors dedicated to attenuating the amplification of harmonics on highly polluted networks while protecting the different components of the installation.

The VLVAF4P system is available with an incoming breaker as an option (suffix AB) or a main terminal block (suffix AA).

The VLVFF4P is available as a variant of this system. It is a fixed capacitor bank with no power factor controller. The bank will operate continuously at full load regardless of network need.

Figure 3: VLVAF4P and VLVFF4P
Catalog numbering system

The following catalog numbering system provides the basic equipment information. Consult Schneider Electric for other number definitions.

**Figure 4: Catalog Numbering System**

VLVAW2N + 1 digit + 1 digit + 3 digits + 2 letters

- **Incoming suffix:**
  - AA - Main Lug
  - AB - Incoming Breaker

- **Power:**
  - kVAR in 3 digits (25 kVAR is 025)

- **Frequency:**
  - 6 = 60 Hz

- **2 - 240 V**
  - 6 - 480 V
  - 7 - 600 V

- **VLVAW2N** – Small non-detuned
- **VLVAW3N** – Large non-detuned
- **VLVAP4P** – Detuned reactor
- **VLVFF4P** – Detuned reactor fixed system
Correct installation of VarSet low voltage capacitor banks is essential for proper operation of all capacitor bank components. Study the associated instruction books and all drawings carefully.

**NOTE:** Do not stand on any part of the capacitor bank.

The location chosen for installation should provide working clearances complying with the appropriate section of the National Electrical Code® (NEC®) or the Canadian Electrical Code (CEC).

### DANGER

**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

**Failure to follow these instructions will result in death or serious injury.**

**NOTE:** If the bank is to be installed on a network with a backup generator, ensure that the harmonics generated by the generator do not exceed the recommendations for the capacitor banks. If they do exceed recommendations, ensure that the capacitor bank is on a separate circuit that will not be activated when the generator is running.

Capacitor banks require field connections including mains and ground to be accessible and maintainable from the front and should allow adequate space for the door from the equipment front. (See dimension D1, the maximum distance the door swings open, in “Section dimension and weight” on page 65.)

Capacitor banks are not designed to be placed in hazardous locations. The area chosen should be well ventilated, free from excess humidity, dust, and dirt. The unit can be used up to a maximum elevation of 2000 meters (6562 feet). The temperature of the area at any given moment should be no lower than -10°C (14°F) and no higher than 40°C (104°F). However, the amount of time in continuous operation should be limited to the following:

- 24 hour average: +40°C (104°F)
- 1 year average: +30°C (86°F)
Foundation preparation

The floor or foundation must be strong enough to support the weight of the capacitor bank without sagging. Weight specifications are provided in “Section dimension and weight” on page 69. The surrounding floor area should gently slope toward a drain.

Capacitor bank preparation

Remove dirt and debris from the foundation and surrounding area before moving the capacitor bank into the final position. Remove all packing and shipping materials.

Installation

Figure 5: Wall and Floor Mounting Installation

<table>
<thead>
<tr>
<th>Wall Mounting</th>
<th>Floor Mounting (against wall)</th>
<th>Floor Mounting</th>
</tr>
</thead>
<tbody>
<tr>
<td>With or without Plinth. Four points of fixation on the wall.</td>
<td>Two points of fixation on the wall. Two points on the floor for all models except VLVAF4P and VLVFF4P.</td>
<td>Four points of fixation on the floor. Valid for VLVAWF2N and VLVAWF3N models only.</td>
</tr>
</tbody>
</table>
Wall-mounted enclosures installation

WARNING

RISK OF THE ENCLOSURE FALLING

- Mount the equipment using the attachment points indicated below.
- Use fasteners adapted to the type of support and the weight of the equipment. Approximate weights are listed in “Section dimension and weight” on page 69.
- Ensure that the wall is adapted to support the necessary weight.
- Only use the mounting supports shipped with equipment.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Figure 6: Wall Mounting Installation

VLVAW2N and VLVAW3N enclosures
## Wall-mounting dimensions

### Figure 7: Wall Mounting Dimensions

<table>
<thead>
<tr>
<th>VLVAW2N</th>
<th>VLVAW3N</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram of VLVAW2N wall-mounting dimensions" /></td>
<td><img src="image2" alt="Diagram of VLVAW3N wall-mounting dimensions" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location of the screws</th>
<th>Location of the screws</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.89 (22.5) 0.89 (22.5)</td>
<td>0.89 (22.5) 0.89 (22.5)</td>
</tr>
<tr>
<td>29.7 (755) 34.4 (874.5)</td>
<td>37.6 (955) 48.2 (1245)</td>
</tr>
<tr>
<td>1.3 (34)</td>
<td>1.3 (34)</td>
</tr>
<tr>
<td>35.0 (888) 1.73 (44)</td>
<td>42.8 (1088) 1.73 (44)</td>
</tr>
<tr>
<td>0.37 (9.5)</td>
<td>0.37 (9.5)</td>
</tr>
</tbody>
</table>

### Detail of the mounting brackets

### Figure 8: Details of the mounting brackets

<table>
<thead>
<tr>
<th>Top of the enclosure</th>
<th>Bottom of the enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Diagram of VLVAW2N mounting bracket detail" /></td>
<td><img src="image4" alt="Diagram of VLVAW3N mounting bracket detail" /></td>
</tr>
</tbody>
</table>

Location of the screws
Floor-standing enclosures installation

Floor-standing installation is for any VarSet bank equipped with a floor-standing plinth.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>RISK OF THE ENCLOSURE TILTING</td>
</tr>
<tr>
<td>• Mount the equipment using the attachment points indicated below.</td>
</tr>
<tr>
<td>• Use fasteners adapted to the type of support and the weight of the equipment. Approximate weights are listed in “Section dimension and weight” on page 69.</td>
</tr>
<tr>
<td>• If mounting and attaching against a wall, ensure that the wall is adapted to support the necessary weight</td>
</tr>
</tbody>
</table>

Failure to follow these instructions can result in death, serious injury or equipment damage.

Figure 9: Floor Mounting Installation

<table>
<thead>
<tr>
<th>VLVAW2N enclosures</th>
<th>VLVAW3N enclosure</th>
<th>VLAF4P and VLVFF4P enclosures</th>
</tr>
</thead>
</table>

[Images of enclosures]
Floor-standing dimensions

Figure 10: Floor Standing Dimensions

<table>
<thead>
<tr>
<th>VLVAW2N</th>
<th>VLVAW3N</th>
<th>VLVAF4P and VLVFF4P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of the screws</td>
<td>Location of the screws</td>
<td>Location of the screws</td>
</tr>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
<tr>
<td>4 x Ø12 mm</td>
<td>4 x Ø12 mm</td>
<td>5 x Ø12 mm</td>
</tr>
<tr>
<td>1.4 (35)</td>
<td>1.4 (35)</td>
<td>1.4 (35)</td>
</tr>
<tr>
<td>11.8 (300)</td>
<td>11.8 (300)</td>
<td>11.8 (300)</td>
</tr>
<tr>
<td>28.9 (735)</td>
<td>36.8 (935)</td>
<td>28.9 (735)</td>
</tr>
</tbody>
</table>

**NOTE:** For installation against a wall you must also use two wall-fixing brackets as described in “Wall-mounted enclosures installation” on page 23.
Assembly of plinth (when purchased as an accessory)

Figure 11: Plinth Assembly
To attach the equipment to the floor:

1. Position the equipment at the chosen location.
2. Unclip the covers from the corners of the base.
3. Mark the fixing points; see dimensions above.
4. Remove the equipment.
5. Drill holes into the floor (diameter of the mounting hole: 15 mm [0.59 in]) and position the mounting brackets (diameter: 12 mm [0.47 in]).
6. Position the equipment in its location, install and tighten the mounting screws.

**NOTE:** Do not install modules in a "U-shaped" space. At least one side must have open space.
**WARNING**

**RISK OF THE ENCLOSURE TILTING**
- Mount the equipment using the attachment points indicated below.
- Use fasteners adapted to the type of support and the weight of the equipment.
- Only use the floor plinth/pedestal that comes with the equipment or that is ordered as an accessory from the VarSet catalog.

Failure to follow these instructions can result in death, serious injury or equipment damage.

**Figure 14: Ground Mounting**

1. Mount the equipment using the attachment points indicated below.
2. Use fasteners adapted to the type of support and the weight of the equipment.
3. Only use the floor plinth/pedestal that comes with the equipment or that is ordered as an accessory from the VarSet catalog.

Failure to follow these instructions can result in death, serious injury or equipment damage.
Grounding

Run a grounding conductor from the grounding electrode at the installation site to the grounding connector (ground lug) located near the incoming gland plate and attached to the mounting plate. Select the material and size of this grounding conductor to comply with the NEC or CEC and install it as specified. Refer to “Incoming wiring” on page 63 for grounding lug sizes.

Cable pulling

VarSet low voltage capacitor banks are provided with a gland plate for top-feed connection only. Capacitor bank section components are arranged to give proper cable clearance and bending space for cables entering the capacitor bank section as specified on the equipment drawing.

Observe these guidelines when pulling cables:

⚠️ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Ensure that the equipment is attached to the wall and/or floor before beginning the power cabling procedure.

Failure to follow these instructions will result in death or serious injury.

- Use only cable sizes suitable for a proper fit with the corresponding terminal blocks. Refer to “Lug and wire size information” on page 57 for lug accepted wire sizes.
- Pull the proper size and number of cables according to appropriate local standards and NEC or CEC.
  NOTE: Wire size must be at least 135% of the nominal current rating.
- Position the cables inside the capacitor bank section so that they are not subject to physical damage.
- Maintain the maximum possible bending radii and proper clearance to bus bars and grounded parts. If any cables are laying or bearing on structural members, support them to relieve this condition or place suitable protective material at the bearing point to protect the cable insulation.
- Be certain to run all phase conductors through the same opening where cables enter or leave the capacitor bank section or pass through any metal that has magnetic properties. Otherwise, overheating can result.

The items in this illustration below require wiring/adjustment during the installation described in the following pages. Exact location/size of components may vary between models.
NOTE: A capacitor bank is a load. The only power cabling to be done is the incoming cable to the line side of the incoming breaker or incoming lugs.
1. Remove the gland plate.

2. Use drills or punches (depending on the diameters of the holes to be made) to allow the routing of:
   - three incoming power cables
   - the two wires of the current transformer (for models with automatic power factor correction)
   - the two wires for the alarm connection (for models with automatic power factor correction)
   - the grounding cable
   - the communication cable (depending on the version).

3. Run the cables through the gland plate using cable glands (not supplied) that are rated for the protection index of the equipment.

**Figure 17: Gland Plate Removal**

**DANGER**

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Keep away from the enclosure or the cubicle when drilling to prevent shavings from falling into the equipment.

Failure to follow these instructions will result in death or serious injury.
Cable terminations

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH</td>
</tr>
<tr>
<td>• Maintain adequate clearances when terminating cables. Do not leave more than 12 mm or 0.5 inch of bare copper extending beyond the lug.</td>
</tr>
<tr>
<td>• Ensure proper engagement between the bus bar, terminal, and cable when installing on a main lug type.</td>
</tr>
</tbody>
</table>

Failure to follow these instructions will result in death or serious injury.

When terminating cables:

• Use a proper insulation stripping tool to strip a length of insulation from the end of the cable sufficient to fit into the full length of the lug barrel. Be careful not to nick or ring the strands.

• Make the main lug connection between the cable and lug and bus bar all at the same time. Ensure that all parts are solidly connected before torquing.

• For main lug installation, loosen the lugs and insert each cable corresponding to the correct phase.

• With cables in place, torque each lug to the value given in “Torque values for connections” on page 55.

Figure 18: Main Lug Connection

<table>
<thead>
<tr>
<th>For main lug connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top edge of plastic housing snug against busbar.</td>
</tr>
<tr>
<td>Left edge of plastic housing straight against support.</td>
</tr>
</tbody>
</table>
Current transformer (CT)

NOTE: The CT is only necessary for automatic capacitor banks.

The CT provides a feedback signal required for the operation of the power factor controller. The CT is available as a separate reference in the VarSet catalog. The CT secondary rating must be 5 A, for example, with a ratio such as 2000/5, 1200/5, etc. Position the CT in the power system according to the diagrams in “Current transformer position” on page 35. Install it according to its installation instructions.

CT shorting bar

The CT terminal block in the capacitor unit has a CT shorting bar. Until the system is commissioned, the shorting bar should be pushed to the “up” position and tightened in place. This will short the CT secondary circuit.

DANGER
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH
An open circuit CT secondary may develop lethal voltage. Short the CT terminals before and while working on CT circuits.

Failure to follow these instructions will result in serious injury or death.

Figure 19: CT Terminal Shorting Bar Positions

NOTE: The CT shorting bar must be in the DOWN position for the Automatic capacitor bank to operate.
Current transformer position

Refer to the following single-line and three-line diagrams. The CT must be located:

- On Phase A (which corresponds to the left-hand-side incoming cable terminal in the bank).
- Close to the substation transformer, on the line side of the main bus, ahead of all the loads and the capacitor bank.

Install CT wiring into terminal blocks K and L located within the equipment. Refer to the Three-line diagram below. Use properly rated wiring according to local codes and standards, environment, and length considerations.

**Figure 20: Single-Line Diagram**

![Single-line diagram of a typical installation](image-url)
The CT should be installed with the correct polarity.

**Alarm connection**

For units with automatic power factor correction, there is a normally open contact that is closed under alarm conditions. This includes anytime the controller loses power as well as when any of the various alarms integrated into the controller are triggered. Normally, this includes Alarm 9: Overtemperature and Alarm 10: High THD (Total Harmonic Discharge). It is mandatory to connect to this alarm to externally monitor the status of the equipment.

**Sizing the overcurrent protection device**

A short circuit and overcurrent protection device must be provided upstream from the capacitor bank. Consult the appropriate section of the NEC or CEC for more information about overcurrent protection, cable ratings, and wire size determination.
Section 6  Startup and commissioning

Instruments required for commissioning

- Voltmeter or multimeter
- Clamp-on ammeter
- Megohmmeter

Pre-energizing procedure

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.

Conduct a complete inspection before the capacitor bank section is energized.

Complete every step of the pre-energizing procedure listed before energizing the capacitor bank section.

1. Ensure that the capacitor bank is de-energized. Ensure that the external upstream main breaker feeding the capacitor bank is open. Make sure the lock-out, tag-out procedure is followed.
2. Open the front door of the capacitor bank and test for line voltage, L-L, L-Ground at the bottom of F1, F2, F3 (control fuses). There should be no voltage (0 V).

![Fuse View](image)

3. Repeat the test above at the top of F1, F2, F3. There should be no voltage (0 V).

4. Verify visually that the ground connection has been made at the ground lug. Verify electrical continuity between the ground lug and the accessible grounding studs on the door and fan(s).

5. Visual Inspection: Using a flashlight, inspect incoming cables, cable lugs, vertical bus, insulators, line and load side breaker cables, line and load side contactor cables, line and load side reactor cables (where applicable) and cables to the capacitors.

6. Ensure that all instruction material has been removed from the equipment (if desired) or placed securely in the document pocket provided.

7. Manually open and close all stage circuit breakers. Check for correct alignment and free operation. Leave all circuit breakers in the open (OFF) position.

8. Confirm that the CT has been installed on phase A of the main incoming bus or main breaker. Refer to “Single-line diagram of a typical installation” on page 35 for the correct CT location.
9. Inspect the CT shorting terminal block mounted in the middle of the control section. Make sure that the CT shorting bar is in the “Up” position. Confirm by taking current readings with a clamp-on meter. Only the customer supplied wires to the top of the CT shorting terminals should read current in the range of 0-5 A. If wires read in excess of 5A, verify cabling and connection points as well as CT size selection. If readings are still in excess of 5 A, call Schneider Electric for assistance.

Figure 23: Shorting Bar Inspection
10. Open circuit all control fuses F1, F2, and F3. Check these fuses for continuity. DO NOT REPLACE THE FUSES. Retain them outside the capacitor bank for the next series of steps. If a fuse is blown, investigate the cause and dispose of that fuse.

11. Inspect the rear of the controller for damage. Disconnect all wiring plugs from the rear of the controller.

12. Vacuum to remove any dust, scrap wire, or other debris.

13. Using the megohmmeter (max 1000 V), perform an insulation resistance test on the 3-phase main bus bars or incoming lugs L-L and L-Ground. Record all measurements.

14. Using the megohmmeter (max 1000 V), perform an insulation resistance test on the bottom cables of the stage breakers) L-L and L-GND. (Cables run from the bottom of the molded case circuit breaker to the top of respective phase of stage contactor). Record all measurements.

15. Using the megohmmeter (max 1000 V), perform an insulation resistance test on the cables on the bottom side of all 3-phase stage contactors (Line to Ground only). Record all measurements.

NOTE: All resistance values should be 100 MΩ or greater.

16. If the resistance reads less than 100 MΩ while testing with the branch circuit devices in the open position, the system will need further investigation. Consult Schneider Electric for assistance.

17. Replace all covers; check for any pinched wires, and close doors. Make certain all enclosure parts are aligned properly and securely fastened. Keep stage breakers in the OFF/Open position. Retain fuses outside of the capacitor bank for the next set of steps.

The capacitor bank is ready for startup. Refer to “Startup procedure” below.

Startup procedure

DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

• Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.

• This equipment must be installed and serviced only by qualified electrical personnel.

• Turn off all power supplying this equipment before working on or inside equipment.

• After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.

• Always use a properly rated voltage sensing device to confirm power is off.

• Replace all devices, doors, and covers before turning on power to this equipment.

• Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.
The following are steps to start up and commission the capacitor banks:

1. Record nameplate details on “Capacitor bank information” on page 59 for future reference.

2. Ensure that the capacitor bank is de-energized. Ensure that the external upstream main breaker feeding the capacitor bank is open. Make sure the lock-out, tag-out procedure is followed.

3. Test for line voltage, L-L, L-Ground at the bottom of F1, F2, and F3 control fuses. There should be no voltage (0 V).

4. Repeat the test above at the top of F1, F2, and F3. There should be no voltage (0 V).

5. Reconnect all controller plugs on the rear of the controller. Insert all control fuses, F1, F2, and F3.

6. Close up the capacitor bank unit. Close and engage the front door lock and door bolts.

7. Re-energize the capacitor bank unit by closing the main disconnect device. Program the VarPlus Logic power factor controller following the step listed in “Power Factor Controller Setup” on page 43. If installing a fixed capacitor bank, skip the programming and proceed to “Inspect and activate the capacitor bank” on page 55.
Power Factor Controller Setup

**DANGER**

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Never reduce the steps’ connection time under 50s.

**Failure to follow these instructions will result in death or serious injury.**

**NOTICE**

RISK OF DEGRADATION OF EQUIPMENT PERFORMANCE

The controller is configured in the factory for normal or optimal operation. The user is liable for any modification of these parameters.

**Failure to follow these instructions will lead to the total or partial loss of the equipment and non-availability of the installation.**

Although the regulator installed in your VarSet capacitor bank had been pre-configured with your equipment it remains following settings to define:

- target cos φ setting
- current transformer ratio value (allows to display the measured value correctly).

**NOTE:** For more detailed information on the controller, please refer to the device manual supplied with the equipment.

**IMPORTANT:**

- If supplied by a summing CT (installation with several CTs), the sum of the ratios of the different CTs must be taken into consideration.
- For an installation equipped with a generator set, the capacitor bank must be taken out of circuit, by breaking the supply to the controller, before switching to the generator set.
<table>
<thead>
<tr>
<th>Figure 24: External view of the VarPlus Logic Controller</th>
<th>Figure 25: Display</th>
<th>Figure 26: Navigation keys</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="VarPlus Logic Controller" /></td>
<td><img src="image" alt="Display" /></td>
<td><img src="image" alt="Navigation keys" /></td>
</tr>
</tbody>
</table>

1. Display  
2. Navigation keys  
3. Digital display for measurement  
4. Displacement Power Factor (DPF)  
5. Inductive or capacitive DPF (lagging or leading)  
6. Units of measurement  
7. Step information  
8. Indicates automatic mode  
9. Indicates manual operation of steps mode  
10. Indicates set up menu mode  
11. Flashing indicates alarm is activated  
12. Step number illuminated when activated  
13. Displayed measurement  
14. Indicates exporting power to grid  
15. Indicates secondary DPF target is activated  
16. Increase Values  
17. Open Menu  
18. Decrease Values  
19. Exit Menu
Simple Commissioning of VarPlus Logic Controller

**NOTE:** Before configuring the controller, please ensure that the jumper on KL terminals is removed.

Go to SETUP 100:

1. Setup CT ratio (Ct), cos φ (CP1).
2. If the controller display is showing PFC OFF, set the PFC parameter to ON, before launching Ai.
3. Launch automatic initialization (Ai) by pressing “Ai” from “OFF” to “ON.”

The Ai automatically detects the capacitor steps connected and checks if the phase connection (angle between voltage and CT position) is correct. The Ai sequence switches the steps on and off several times. It will take several minutes to complete this process, and later the relay will stabilize.

During this sequence the controller will display “Ai.”

### Minimum requirements to launch an Ai

<table>
<thead>
<tr>
<th>Minimum requirements to launch an Ai</th>
<th>For a successful Ai step detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage must be within tolerance</td>
<td>CT ratio dimensioning must be in accordance with the transformer dimension</td>
</tr>
<tr>
<td>CT must be connected</td>
<td>Size of the smallest step not too small</td>
</tr>
<tr>
<td>Capacitor protection must be close</td>
<td>Level of loading when Ai is launched</td>
</tr>
<tr>
<td>Input current not too low</td>
<td>Load variation during the Ai sequence</td>
</tr>
</tbody>
</table>

At end of “Ai,” the controller will move to “Auto” mode.

### Successful Ai sequence info

- If phase wiring is swapped (incorrectly wired), the controller automatically corrects the phase angle inter ally and moves to normal mode. “Auto” is displayed.

### Unsuccessful Ai sequence

**[“Abrt” (abort) error]**

- If unsuccessful, run the Ai again. If the Ai aborts again, the phase connection (angle between voltage and CT position) cannot be detected. The control will move to PFC off mode and phase connection must be set manually. See user manual.

### Final check of step detection:

- Go to SETUP 100 -> OUT -> open (right arrow) and check if the status of all steps are correct according to the PFC bank configuration (FIX OFF = Step not detected. AUTO = Step detected).
- If necessary, change the OUT status to expected value.
Controller management

Messages displayed by the regulator and solutions

The diagnosis of a problem, during equipment commissioning, generally can be done from the display of the regulator.

- ALARM fl ashes when there is a alarm.
- Alarm menu lists the 5 last alarms logged.

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI/Abt ALARM</td>
<td>Abort of auto-initialization</td>
<td>Variations in the load or too small measured current signals may abort Auto initialisation.</td>
</tr>
<tr>
<td>U ALARM</td>
<td>Measured voltage is outside the voltage tolerance.</td>
<td>Check settings for nominal voltage and voltage transformer.</td>
</tr>
<tr>
<td>I LO ALARM</td>
<td>Measured current is too low (CT current &lt; 15 mA)</td>
<td>Connection error of CT; short-link of CT is not removed; CT ratio is too high compared to real current; no current.</td>
</tr>
<tr>
<td>I HI ALARM</td>
<td>Measured current is too high.</td>
<td>Load is too high or Improper CT selection.</td>
</tr>
<tr>
<td>PFC ALARM</td>
<td>The controller cannot achieve the target cos φ. Or under compensation.</td>
<td>Check if all steps are correctly defined and working.</td>
</tr>
<tr>
<td>HAr ALARM</td>
<td>THDU limit is exceeded. Controller disconnects the steps to correct THDU.</td>
<td>Check installation, THD U too high or possible resonance.</td>
</tr>
<tr>
<td>Step/Fly ALARM (faulty step is blinking)</td>
<td>One or more steps are defective (detected as faulty after connecting the step 3 times without any measurements),</td>
<td>Check steps connection, molded-case circuit breakers (MCCBs) or fuses position and capacitor status.</td>
</tr>
<tr>
<td>SPL/Nr ALARM</td>
<td>Step detected with remaining power less &gt; 75 % of initial value.</td>
<td>Check settings and check capacitance of the capacitor.</td>
</tr>
<tr>
<td>Thi ALARM</td>
<td>The alarm temperature limit is exceeded.</td>
<td>Check fans and ambient temperature.</td>
</tr>
<tr>
<td>OPH ALARM</td>
<td>Set limit for max. allowable operation hours limit is exceeded.</td>
<td>Check the MCCBs/Fuses, contactors and capacitors in the step. Check the capacitance value and replace capacitors if the capacitance has fallen below tolerance limit.</td>
</tr>
<tr>
<td>OPC/Nr ALARM</td>
<td>Set limit for max. allowable operation cycles limit is exceeded.</td>
<td>Check the MCCBs/Fuses, contactors and capacitors in the PFC Bank. Check the capacitance value and replace capacitors if the capacitance has fallen below tolerance limit.</td>
</tr>
<tr>
<td>OL ALARM</td>
<td>Limit of Capacitor overload current ratio (based on THDU calculation) is exceeded.</td>
<td>Check installation, THD U too high, or possible resonance.</td>
</tr>
<tr>
<td>HU ALARM</td>
<td>One or more steps are detected in hunting mode. Step number and error code will fl ash.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anomaly</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTO</td>
<td>Relays do not switch.</td>
<td>In SETUP/100 menu, the selection for PFC is set to OFF or HOLD; CT ratio is not set; temperature is too high; current is 15 mA; voltage, THD U, or overload current ratio is out of tolerance.</td>
</tr>
<tr>
<td>EXPORT</td>
<td>kW export.</td>
<td>If there is no real kW export, check the voltage and current connections to the controller.</td>
</tr>
<tr>
<td>Wrong cos φ indication</td>
<td>Wiring does not correspond to controller settings.</td>
<td>Check voltage and current connections to the controller.</td>
</tr>
<tr>
<td>All steps are set to “Fix off”</td>
<td>Size of capacitors is not completely detected/capacitors are inoperable.</td>
<td>Check size of capacitor in INFO menu.</td>
</tr>
</tbody>
</table>

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Section 7 Preventive maintenance (PM)

The interval between maintenance checks can vary depending upon the amount of usage and environmental conditions of each installation. The following preventative maintenance procedure should be carried out by qualified personnel three months after commissioning of the new unit, and at least once every 6-12 months thereafter.

First scheduled PM (three months after commissioning)

1. Check the controller display to confirm it is active and there are no alarm conditions. (Refer to the VarPlus Logic user manual for alarm details.)
   - Alarm A9: Indicates the internal temperature has exceeded the thermal limit of 122°F (50°C).
   - Alarm A10: Indicates the maximum THD (7%) has been exceeded.

2. Check to confirm that the cubicle ventilation fans are active. (When the unit is in operation for at least two hours with full load, the fans are normally on). If the fans are not on, you may verify by temporarily adjusting the thermostat 1 inside. To do so, power down the upstream main breaker, wait 5 minutes, then open the equipment and adjust ST1 to below room temperature. Re-close the door and secure it before re-engaging the main circuit breaker. Once the functionality has been verified, repeat the procedure to reset the thermostat dial back to 95°F (35°C).

3. Check to confirm that all ventilation openings are clear.

4. With the unit in full operation (all stages on), listen and identify the source of any loud noise, i.e. >50 dB. Those identified noise sources are possible maintenance items which require further investigation. If nothing is found and the noise persists, contact Schneider Electric.

5. Open the disconnect to de-energize the capacitor bank. Ensure that the external upstream main breaker feeding the capacitor bank is open. Make sure the lock-out,
tag-out procedure is followed and wait five minutes before opening the door to the capacitor bank.

6. Open the front door of the capacitor bank and test for line voltage, L-L, L-Ground at the bottom of F1, F2, and F3 (control fuses). There should be no voltage (0 V).

![Figure 27: Fuse Control](image)

7. Manually trip all stage breakers and then reset to ON.

**NOTE:** Signs of over-temperature on components are changes in appearance of their surface, such as duller, shinier, cracked, brittle, or burnt. Any change of color or appearance that differs from other identical components should be investigated.

8. Close and engage the front doors locks and door bolts.

If the section internal temperature exceeds 122°F (50°C), the controller and/or the thermostat will initiate a thermal trip function shutting down the entire unit. If there is an incoming circuit breaker, it will need to be reset in this instance.
Regularly scheduled PM (every 6-12 months)

1. Repeat steps outlined in “First scheduled PM (three months after commissioning)” on page 47.

2. Use the procedure in “STEP.TST” on page 58 to manually turn the first stage on. Measure and record line to line voltage on “Voltage and stage current record” on page 63.

3. Use the procedure in “STEP.TST” on page 58 to manually turn one stage on at a time. With the stage energized, measure the stage’s 3-phase line currents and record the results on “Voltage and stage current record” on page 63. Manually turn the stage off before turning on the next stage. Repeat the measurement for each stage as above.

4. Open the main disconnect device to de-energize the capacitor bank and wait five minutes.
5. Open the front door of the capacitor bank and test for line AC voltage, LL, L-Ground at the bottom of F1, F2, and F3 (control fuses). There should be no AC voltage (0 V).

6. Repeat the test above at the top of F1, F2, and F3. There should be no AC voltage (0 V).

7. Using a DC voltage meter or multimeter set to DCV (1000 VDC capable), test each capacitor stage for residual DC voltage:
   - At the bottom of each stage contactor (load side), measure line to line and line to ground voltages (A-B, A-C, B-C, A-GND, B-GND, C-GND).
   - If any reading is higher than one volt, the capacitor is not fully discharged and should be isolated for further investigation.

8. Inspect the capacitor bank for any signs of overheating. Discoloration and flaking of insulation or metal parts are indications of overheating.

   NOTE: If overheating occurs, be sure that all conditions that caused the overheating have been corrected. Loose or contaminated connections can cause overheating.

9. Check all field-installed bus bar connections. Torque values are listed in “Torque values for connections” on page 55.

10. Check all terminal lugs for any pitting, corrosion, or discoloration resulting from high temperatures or subjection to high fault conditions. If any damage has occurred, the lugs must be replaced. Call Schneider Electric for assistance.

11. Verify visually that the ground connection is still solid. Perform an electrical continuity check between the grounding lug and grounding studs on the door and fan.

12. Use a screwdriver to ensure all contactor armatures have full travel and do not bind at any time.

13. Check to ensure that all contactor charge resistors (VLVAW only) are intact. There are six soft charge resistors mounted between each of the main phase contacts and the corresponding phase of each auxiliary contact block. Visually inspect all capacitors for cracked or split tubes. A flashlight and mirror may be required. As an alternative, run your fingers along the surface of the capacitor tubes to feel any cracks or splits.
14. Vacuum to remove any dust or other debris.

15. Check the capacitor bank interior carefully for moisture, condensation build-up, or signs of any previous wetness. Moisture can cause insulation failures and rapid oxidation of current-carrying parts. Inspect all conduit entrances and cracks between the enclosure panels for dripping leaks. Condensation in conduits may be a source of moisture and must not be allowed to drip onto live parts or insulating material.

16. Take the necessary steps to eliminate the moisture and seal off all leaks.

17. Check for any pinched wires and close doors. Make certain all enclosure parts are aligned properly and securely fastened.
Replacement of components

### DANGER

**HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

**Failure to follow these instructions will result in death or serious injury.**

During maintenance, if any capacitor step is found to be losing capacitance, the capacitor must be replaced. During normal operation conditions, the following components must also be replaced at these intervals:

---

### Table 2: Years of Continuous Use

<table>
<thead>
<tr>
<th>Component</th>
<th>Years of continuous use (Ambient 35°C [95°F] or not measured)</th>
<th>Years of continuous use (Ambient 25°C [77°F])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitor</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Contactor</td>
<td>7</td>
<td>10</td>
</tr>
</tbody>
</table>

To replace the capacitor:

1. Open the disconnect to de-energize the capacitor bank. Ensure that the external upstream main breaker feeding the capacitor bank is open. Make sure the lock-out, tag-out procedure is followed and wait five minutes before opening the door to the capacitor bank.

2. Open the front door of the capacitor bank and test for line voltage, L-L, L-Ground at the bottom of F1, F2, and F3 (control fuses). There should be no voltage (0 V).

3. Manually trip all stage breakers

4. Remove wires from all three phases of the capacitor.
5. Remove two M8 nuts and washers from the capacitor plates.

6. Carefully lift the capacitor plate out from the bank. Avoid scratching or damaging other components when removing. The maximum weight of two capacitors and the plate is 25 lbs (11.34 kg).

7. Remove the capacitor by undoing the single nut and washer on the bottom of the capacitor plate. Remove and replace, torquing according to specifications in the instruction bulletin provided with the new capacitor.

8. Replace the device plate and M8 nuts and washers.

9. Re-cable and torque according to specifications in the capacitor instruction bulletin.
## Section 8  Torque values for connections

### Table 3: Incoming Connection Lug Torque Values

<table>
<thead>
<tr>
<th>Lugs</th>
<th>Ib-in</th>
<th>N•m</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-75 kVAR</td>
<td>71-89</td>
<td>8-10</td>
</tr>
<tr>
<td>100-200 kVAR (480 V)</td>
<td>106-133</td>
<td>12-15</td>
</tr>
<tr>
<td>100-250 kVAR (600 V)</td>
<td>266</td>
<td>30</td>
</tr>
</tbody>
</table>

**Incoming Circuit Breaker**

| PowerPact H (AL150HD) | 50 for #14-10 awg wire and 120 for #8-3/0 |
| PowerPact J (AL175JD) | 225 |
| PowerPact J (AL250JD) | 25 |
| PowerPact L (AL600LS52K3) | 442 |

### Table 4: Contactor Connection Torque Values

<table>
<thead>
<tr>
<th>Contactor Type</th>
<th>Ib-in</th>
<th>N•m</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC1DWK</td>
<td>79</td>
<td>9</td>
</tr>
<tr>
<td>LC1DMK</td>
<td>22</td>
<td>2.5</td>
</tr>
<tr>
<td>LC1D80</td>
<td>79</td>
<td>9</td>
</tr>
<tr>
<td>LC1D32</td>
<td>22</td>
<td>2.5</td>
</tr>
<tr>
<td>Control Connection - all types</td>
<td>10.5</td>
<td>1.1</td>
</tr>
</tbody>
</table>

### Table 5: Capacitor Connection Torque Values

<table>
<thead>
<tr>
<th>Capacitor Type</th>
<th>Ib-in</th>
<th>N•m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stud-Type (50 kVAR 480 V)</td>
<td>107</td>
<td>12</td>
</tr>
<tr>
<td>Clamp-tite (25 kVAR or below)</td>
<td>22</td>
<td>2.5</td>
</tr>
</tbody>
</table>

### Table 6: Reactor Connection Torque Values

<table>
<thead>
<tr>
<th>Reactor Type</th>
<th>Ib-in</th>
<th>N•m</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 kVAR or 50 kVAR Reactor (M6 bolt)</td>
<td>89</td>
<td>9</td>
</tr>
</tbody>
</table>

### Table 7: Control Voltage Transformer Connection Torque Values

<table>
<thead>
<tr>
<th>Connection type</th>
<th>Ib-in</th>
<th>N•m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformer tap and grounding screw (6-32)</td>
<td>9</td>
<td>1.0</td>
</tr>
<tr>
<td>Fuse connector (8-32)</td>
<td>16</td>
<td>1.8</td>
</tr>
<tr>
<td>Other torque values</td>
<td>lb-in</td>
<td>N·m</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------</td>
<td>-----</td>
</tr>
<tr>
<td>Control power connections</td>
<td>10.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Ground connection</td>
<td>89</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 9: Incoming Lug and Wire Size Information

<table>
<thead>
<tr>
<th>Lugs</th>
<th>Wire Size Accepted</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-75 kVAR</td>
<td>10 awg - 2/0 awg</td>
<td>71-89 lb-in (8-10 N•m)</td>
</tr>
<tr>
<td>100 kVAR</td>
<td>(1) 2 awg - 250 MCM</td>
<td></td>
</tr>
<tr>
<td>125-200 kVAR (480 V)</td>
<td>(2) 2 awg - 250 MCM</td>
<td>106-133 lb-in (12-15 N•m)</td>
</tr>
<tr>
<td>125-250 kVAR (600 V)</td>
<td>(2) 2 awg - 250 MCM</td>
<td></td>
</tr>
<tr>
<td>225-300 kVAR (480 V)</td>
<td>(2) 250 MCM - 600 MCM</td>
<td>266 lb-in (30 N•m)</td>
</tr>
</tbody>
</table>

Main Circuit Breaker

<table>
<thead>
<tr>
<th>PowerPact H (AL150HD)</th>
<th>14 awg - 3/0 awg</th>
<th>50 lb-in (5.5 N•m) for #14-1#10 awg wire and 120 lb-in (14 N•m) for #8-3/0</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerPact J (AL175JD)</td>
<td>4 awg - 4/0 awg</td>
<td>225 lb-in (25 N•m)</td>
</tr>
<tr>
<td>PowerPact J (AL250JD)</td>
<td>3/0 awg - 350 MCM</td>
<td>225 lb-in (25 N•m)</td>
</tr>
<tr>
<td>PowerPact L (AL600LS52K3)</td>
<td>(2) 2/0 - 500 MCM</td>
<td>442 lb-in (50 N•m)</td>
</tr>
</tbody>
</table>

Grounding Connection

<table>
<thead>
<tr>
<th>0-100 kVAR</th>
<th>14 awg - 4 awg</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;125 kVAR</td>
<td>6 awg to 1/0 awg</td>
</tr>
</tbody>
</table>

**NOTE:** Wire must be sized to carry 135% of nominal current. Increase size appropriately to comply with all local standards and environmental conditions as well. Use 90°C (194°F) Copper wire.
## Section 10 Maintenance records

### Equipment information

Record the equipment nameplate information here.

### Table 10: Capacitor Bank Information

<table>
<thead>
<tr>
<th>Capacitor bank information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory Number</td>
</tr>
<tr>
<td>Equipment Type</td>
</tr>
<tr>
<td>Voltage Rating</td>
</tr>
<tr>
<td>Maximum kVAR Installed</td>
</tr>
<tr>
<td>Current Rating (Amps)</td>
</tr>
<tr>
<td>$I_{eff}$</td>
</tr>
<tr>
<td>Smallest Step Size (kVAR)</td>
</tr>
</tbody>
</table>
**Installation and maintenance log**

Record installation and maintenance activities performed on the unit here.

<table>
<thead>
<tr>
<th>Date</th>
<th>Task description</th>
<th>Name/initials</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>
Main bus insulation resistance record

Record dielectric resistance measurements for the main bus insulation here.

Table 12: Main Bus Insulation Resistance Records

<table>
<thead>
<tr>
<th>Date</th>
<th>Main bus phase to ground</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a-ground MΩ</td>
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</tbody>
</table>
Contactor insulation record

Record dielectric resistance measurements for the contactor insulation here.

Table 13: Contactor Insulation Record

<table>
<thead>
<tr>
<th>Date</th>
<th>Contactor number</th>
<th>Contactor phase to ground</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>a-ground MΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b-ground MΩ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c-ground MΩ</td>
</tr>
</tbody>
</table>
Voltage and stage current record

Record voltage and stage current here.

Table 14: Voltage and Stage Current Records

<table>
<thead>
<tr>
<th>Date</th>
<th>Stage number</th>
<th>Va-b</th>
<th>Va-c</th>
<th>Vb-c</th>
<th>Ia</th>
<th>Ib</th>
<th>Ic</th>
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<tbody>
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</tbody>
</table>
Section 11  Dimension and weight information

The typical VarSet weight for the largest power rating per enclosure is listed in the following table.

Table 15: Dimension and Weight Information

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
<th>D1</th>
<th>Weight (max)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inch</td>
<td>mm</td>
<td>Inch</td>
<td>mm</td>
<td>Inch</td>
</tr>
<tr>
<td>VLVAW2N</td>
<td>33.5¹</td>
<td>850¹</td>
<td>31.5</td>
<td>800</td>
<td>15.7</td>
</tr>
<tr>
<td>VLVAW3N</td>
<td>47.2¹</td>
<td>1200¹</td>
<td>39.4</td>
<td>1000</td>
<td>15.7</td>
</tr>
<tr>
<td>VLVAF4P</td>
<td>51.2</td>
<td>1300</td>
<td>51.2</td>
<td>1300</td>
<td>15.7</td>
</tr>
</tbody>
</table>

¹Does not include plinth, optional on VLVAW2N and VLVAW3N, which adds 100 mm (3.9 in) to height.

**NOTE:** Weight information is approximate and subject to change without notice.