

SIL 27-EP-18
January, 2019
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SUBJECT: Replacing the DC Busbar Inside the Dual Power Inverter Module 2 (DPIM2)

MODELS AFFECTED: H 40/50 EP™ System Equipped With DPIM2

Tools Required

- J-51586 Tab Bending Tool
- Electrostatic Discharge Wrist Strap (Refer to [Figure 2](#))
- Pick or Small Flat Blade Screwdriver
- Torx Plus® T8 Bit
- Torx Plus® T10 Bit
- Torx Plus® T20 Bit
- Torx Plus® T25 Bit
- Torx Plus® T25 6in Bit
- 4mm Hex Key
- 6mm Hex Key
- 8mm Hex Socket
- Loctite® 242
- Loctite® 425

Introduction:

This Service Information Letter (SIL) announces the availability of the DC Busbar (P/N 29546818) and includes the procedure to replace the DC Busbar located inside the DPIM2. The availability of these parts eliminates the need for a complete DPIM2 replacement under certain failure conditions.



NOTE: Components and replacement procedures are the same for Inverter A and Inverter B. Refer to [Figure 21](#) for GATE Drive Card locations.

Refer to [Table 1](#) for related part numbers.

GJ / SL8213EN

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Please Note: Allison Transmission Service Information Letters are intended for use by professional, trained technicians, not for the "do-it-yourselfer." They are written to inform those technicians of conditions that may occur on some transmission models (or serial numbers ranges) or to provide information that could assist in the proper servicing of a specific Allison transmission. Properly trained technicians have the equipment, tools, safety instructions, and know-how to do a job properly and safely. If a condition is described, do not assume that the Service Information Letter applies to your transmission, or that your transmission has the condition described. Product evolution and information updates are inevitable. Please see your authorized Allison Transmission service dealer or distributor to understand if your particular transmission may benefit from the information contained within the Service Information Letter.

Table 1. DPIM2 Busbar Parts Information

Part Name	Part Number	Quantity
DC Busbar	29546818	1



NOTE: Perform the necessary diagnosis prior to ordering the DC Busbar P/N 29546818. Contact Allison TAC at (800) 252-5283 to confirm the DC Busbar failure.

Warranty Claim Information:

When a DC Busbar, P/N 29546818, is utilized to repair a failed DPIM2 under warranty, use DC Busbar part number 29546818 as the PFP and claim the part number in the Service Parts subsection of the AWAARE claim.

Diagnosis:

The DC Busbar may become damaged in various ways but typically it is due to high-voltage arcing when another component in the DPIM2 fails. Examples include the passive discharge resistor burning which released conductive particles into the DPIM2 housing. The conductive particles allow the DC+ and the DC- tabs connected to the SKiM module to short and melt. Loose screws in the SKiM module or at the HVIL card can cause arc damage (Refer to [Figure 1](#))

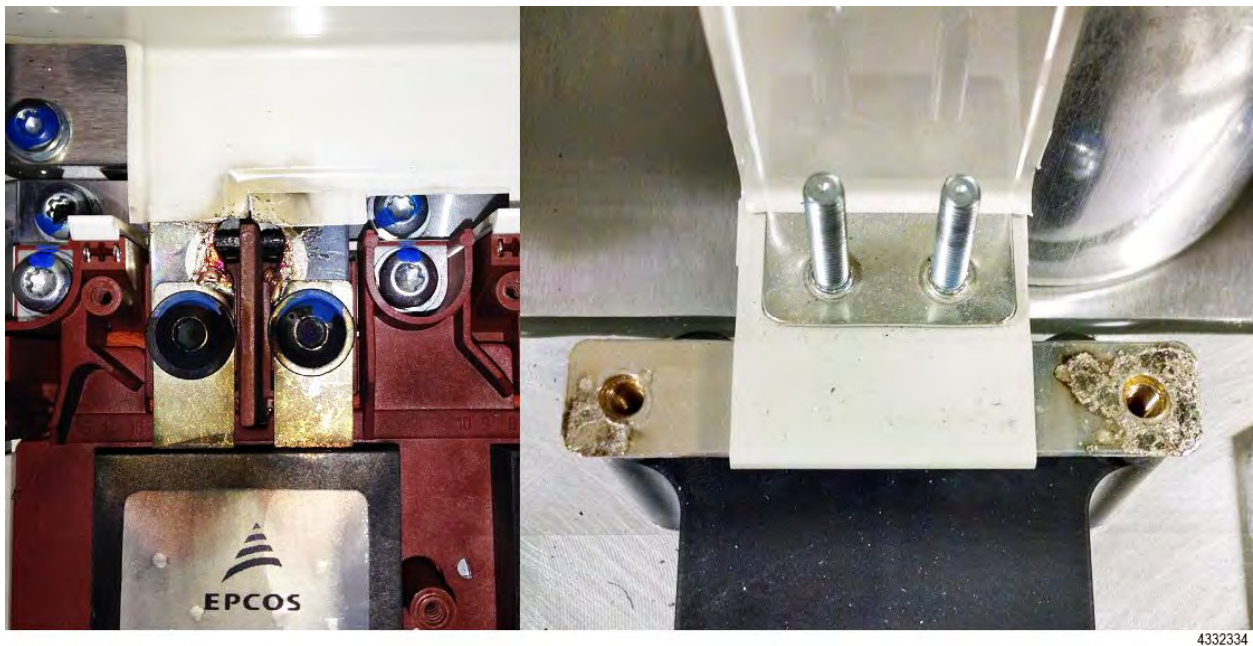


Figure 1. Busbar Damage from Arcing



WARNING: DO NOT rely on the High Voltage Interlock Loop (HVIL) or control systems to de-energize the system. Always perform the Electrical Disconnect Verification Procedure to be sure the system is discharged before servicing components.

DO NOT attempt to bypass any High Voltage Interlock for any reason. Tampering with the HVIL may result in injury. Failure to follow proper safety procedures may result in serious personal injury or death.



NOTE: Allison Transmission, Inc. requires that the DPIM be removed from the vehicle prior to component replacement. Prior to removal of the DPIM, refer to the H 40/50 EP™ System Troubleshooting Manual (TS5812EN) and perform the Electrical Disconnect Verification Procedure.



NOTE: The DC Busbar replacement should NOT be performed if excessive smoke and/or water damage are present.



NOTE: Refer to the attachment at the end of this SIL for information regarding the name and location of components within the DPIM2.

The procedures contained in this SIL are organized into the following sections:

- Section 1: Removal of Main Cover and HVIL Circuit Card
- Section 2: Removal of BCA Card Mounting Shelf
- Section 3: Removal of the GATE Drive Cards
- Section 4: DC Busbar Removal
- Section 5: Installation of DC Busbar
- Section 6: Installation of GATE Drive Cards
- Section 7: Installation of BCA Card Mounting Shelf
- Section 8: Installation of HVIL Circuit Card and Main Cover

Section 1: Removal of Main Cover and HVIL Circuit Card



NOTE: All circuit cards in the DPIM2 are sensitive to electrostatic discharge (ESD). ESD damage can be caused by voltage levels that cannot be felt by humans. When working on the DPIM2, ALWAYS wear an ESD wrist strap to ground any possible electrostatic charge. The strap should be worn around the wrist with the alligator clip securely attached to the DPIM chassis. Refer to [Figure 2](#).



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Figure 2. Electrostatic Discharge Wrist Strap (Typical)

1. Using a Torx Plus® T25 bit, remove twenty-six (26) M5x18mm machine screws that secure the Main Cover to the DPIM Housing (refer to [Figure 3](#)). Set the screws aside for reassembly. Remove the Main Cover. Discard the cover gasket.



421911

Figure 3. DPIM Main Cover

2. Exercising care, cut one (1) wire tie at location shown in [Figure 4](#). Do NOT remove any wire ties that pass through the HVIL Circuit Card. Leaving the severed wire ties in place will provide a visual aid for wire tie locations during installation of the replacement circuit card.



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Figure 4. HVIL Circuit Card – Wire Tie Location

3. Cut the two (2) wire ties at locations shown in [Figure 5](#) and remove them from the mounts. The wire tie mounts do NOT have to be removed from the DPIM Housing unless they interfere with the removal or installation of the HVIL circuit card.



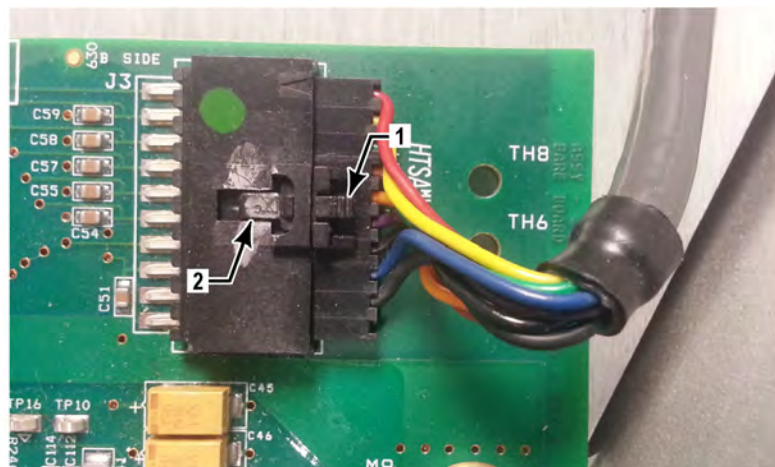
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Figure 5. HVIL Circuit Card – Two (2) Wire Tie Locations



CAUTION: Do NOT pull on the wires when removing connectors; doing so may pull the pins out of the connector.

4. When removing connectors, push down on the tab at Location 1 and push the harness out of the connector at Location 2 (refer to [Figure 6](#)).



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Figure 6. HVIL Circuit Card Connector Removal

5. Remove three (3) wire harness connectors from HVIL Circuit Card surface mount connectors by gently depressing the retaining tab with a pick or small flat blade screwdriver. Refer to [Figure 7](#).



NOTE: Use care to avoid bending or damaging the circuit card connectors.

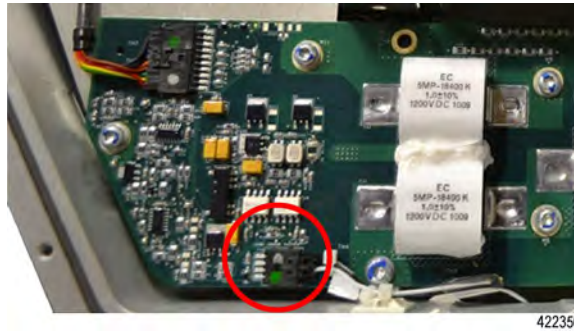


Figure 7. HVIL Circuit Card – Three (3) Harness Connector Locations



WARNING: Any conductive material (i.e. screws, bolts, nuts, etc.) can cause a short inside the DPIM that will result in permanent and irreversible DPIM damage. All hardware must be accounted for throughout the service procedure.

6. Using an 8mm socket, remove the four (4) M5 nut/washer assemblies as shown in [Figure 8](#). Disconnect the two (2) wire ring terminals from the studs.

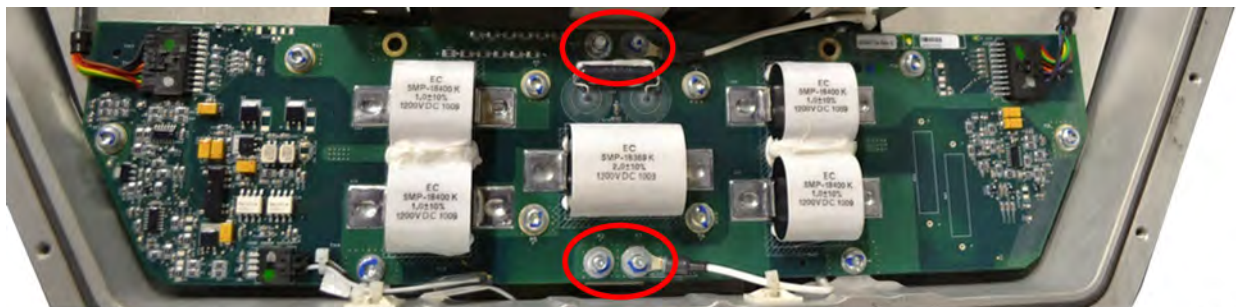
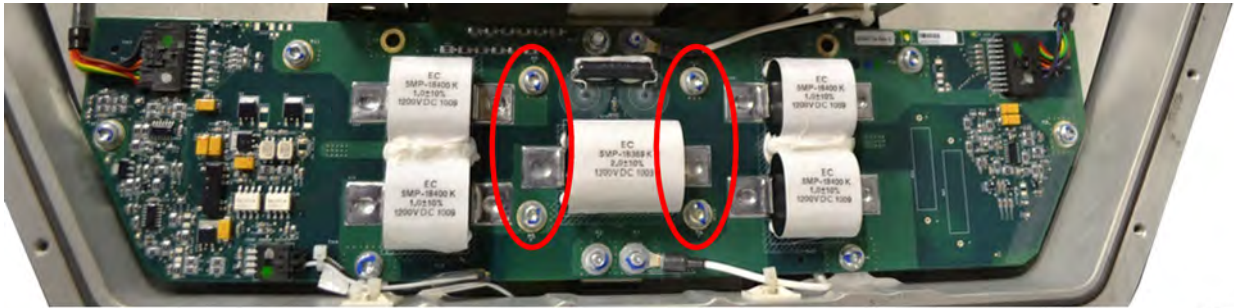


Figure 8. HVIL Circuit Card – Four (4) Mounting Nut/Washer Locations (M5)

7. Using a Torx Plus® T25 bit, remove the four (4) M5x30mm screws securing the HVIL Circuit Card as shown in [Figure 9](#).



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Figure 9. HVIL Circuit Card – Four (4) Mounting Screw Locations (M5x30mm)

8. Using a Torx Plus® T25 bit, remove the two (2) M5x14mm screws securing the HVIL Circuit Card as shown in [Figure 10](#).



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Figure 10. HVIL Circuit Card – Two (2) Mounting Screw Locations (M5x14mm)

9. Using a Torx Plus® T25 bit, remove the four (4) M5x22mm screws securing the HVIL Circuit Card as shown in [Figure 11](#).



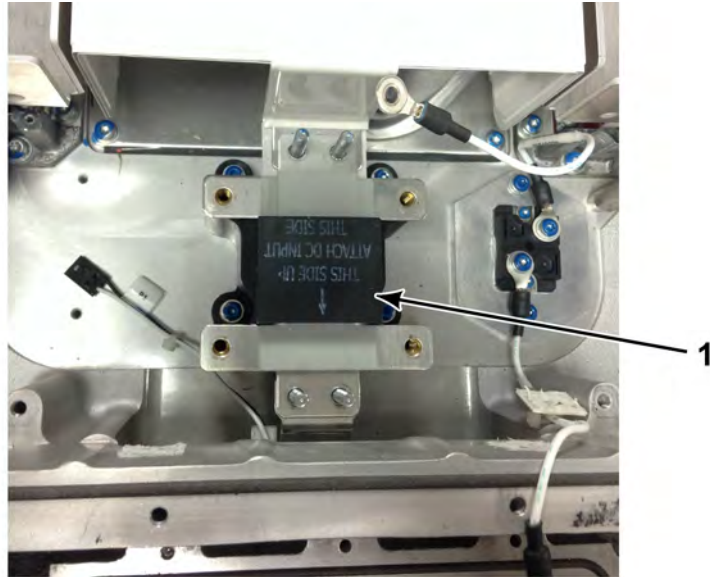
422586

Figure 11. HVIL Circuit Card – Four (4) Mounting Screw Locations (M5x22mm)

10. Lift the HVIL Circuit Card straight up and remove it from the DPIM Housing.
11. Verify that the choke is in place as shown in [Figure 12](#).



NOTE: The choke may have adhered to the underside of the HVIL Circuit Card when it was removed. If this has occurred, reinstall choke to its proper location as shown in Figure 12. The choke must be installed with the arrow pointing toward the DC lug box.



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(1) – Choke

Figure 12. Verification of Choke Installation

Section 2: Removal of BCA Card Mounting Shelf

1. Carefully cut and remove the wire ties retaining the wire harnesses (refer to [Figure 13](#)).



Figure 13. Wire Tie Locations



NOTE: Label the wires on connectors 2, 3, and 4 (refer to [Figure 14](#)) with the corresponding phase (A, B, C) as indicated by the circuit card connector labels (CURR A, CURR B or CURR C) for reinstallation.



CAUTION: Failure to properly label the current sensor harnesses may lead to improper reinstallation and cause the DPIM to not operate.

2. Remove five (5) wire harness connectors from circuit card surface mount connectors by gently depressing the retaining tab with a pick or small flat blade screwdriver (refer to [Figure 14](#) and [Figure 15](#)).



NOTE: Use care to avoid bending or damaging the circuit card connectors.

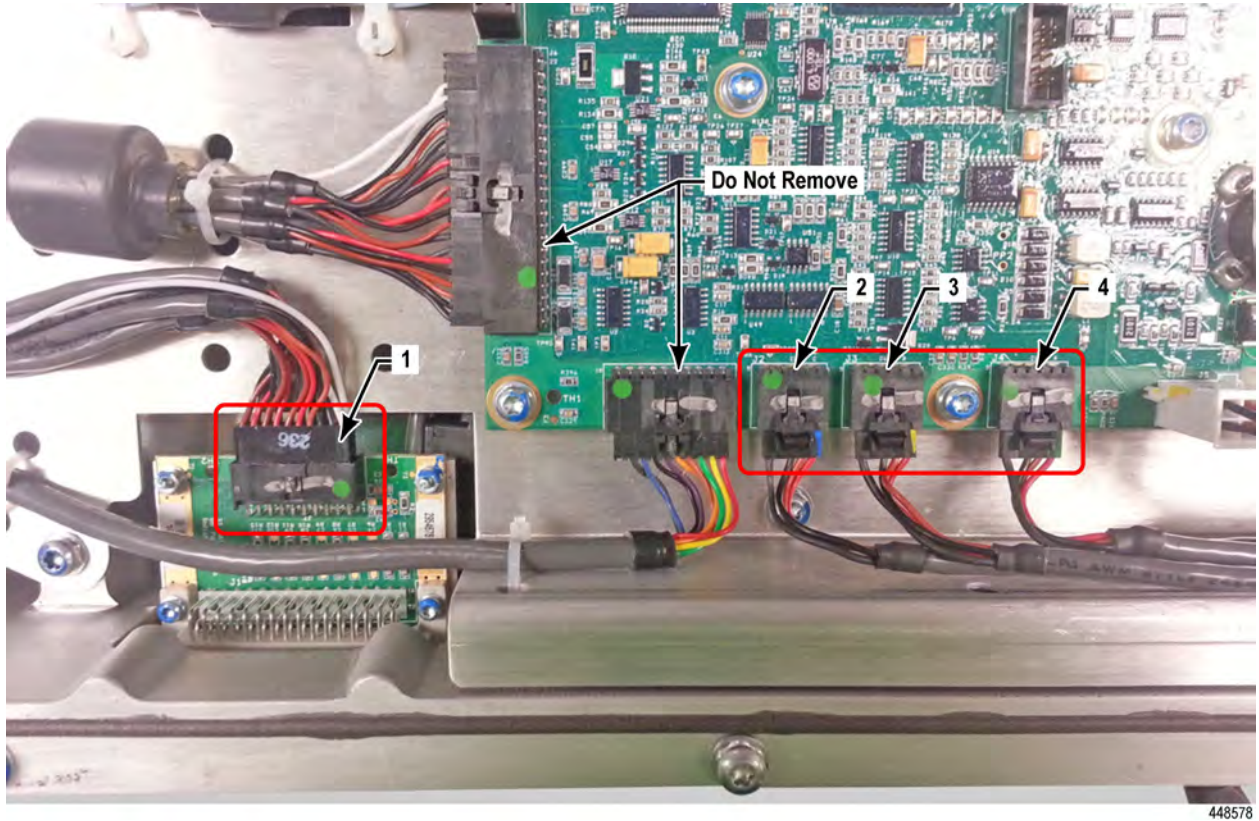


Figure 14. Wire Harness Connector Removal (4 Locations)

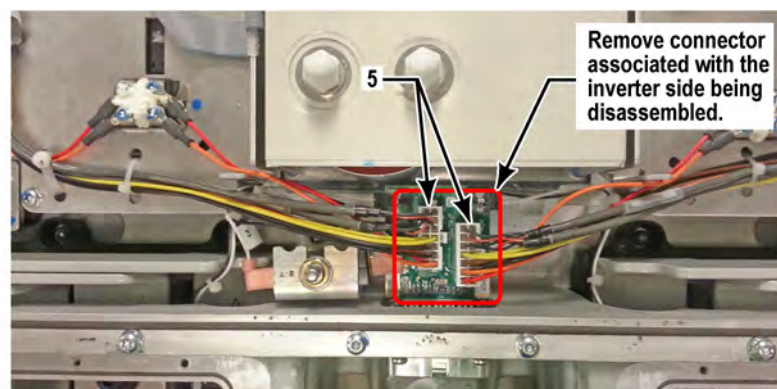
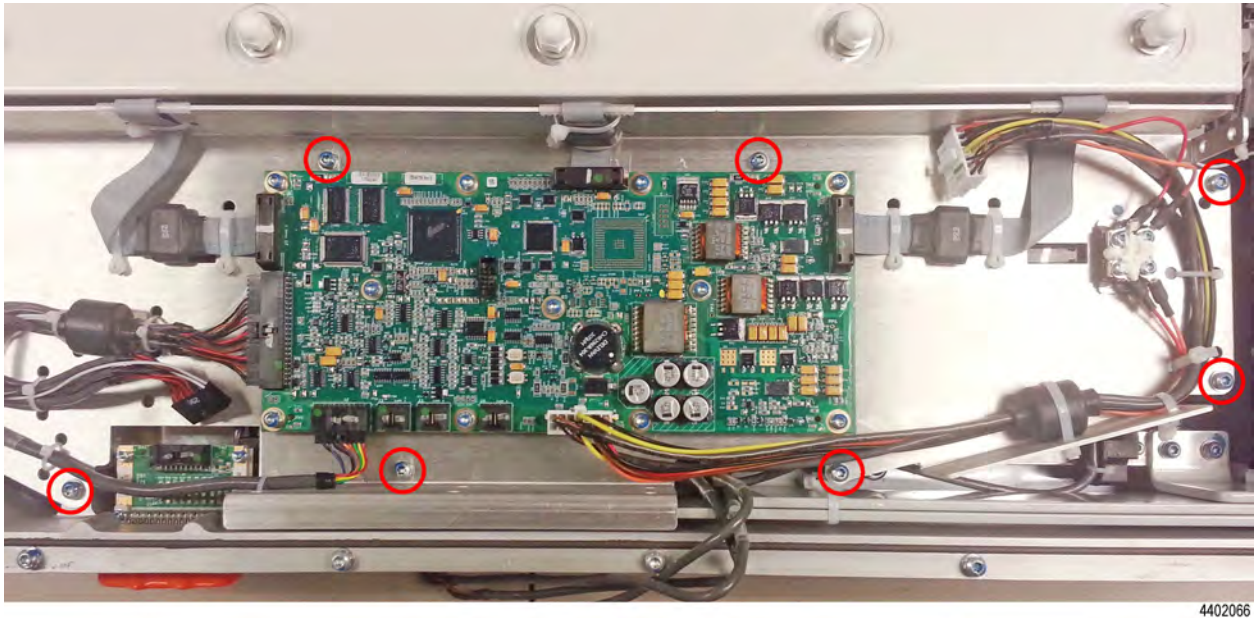


Figure 15. Wire Harness Connector Removal

3. Using a Torx Plus® T25 bit, remove the seven (7) M5x14mm screws securing the BCA Mounting Shelf (refer to [Figure 16](#)).



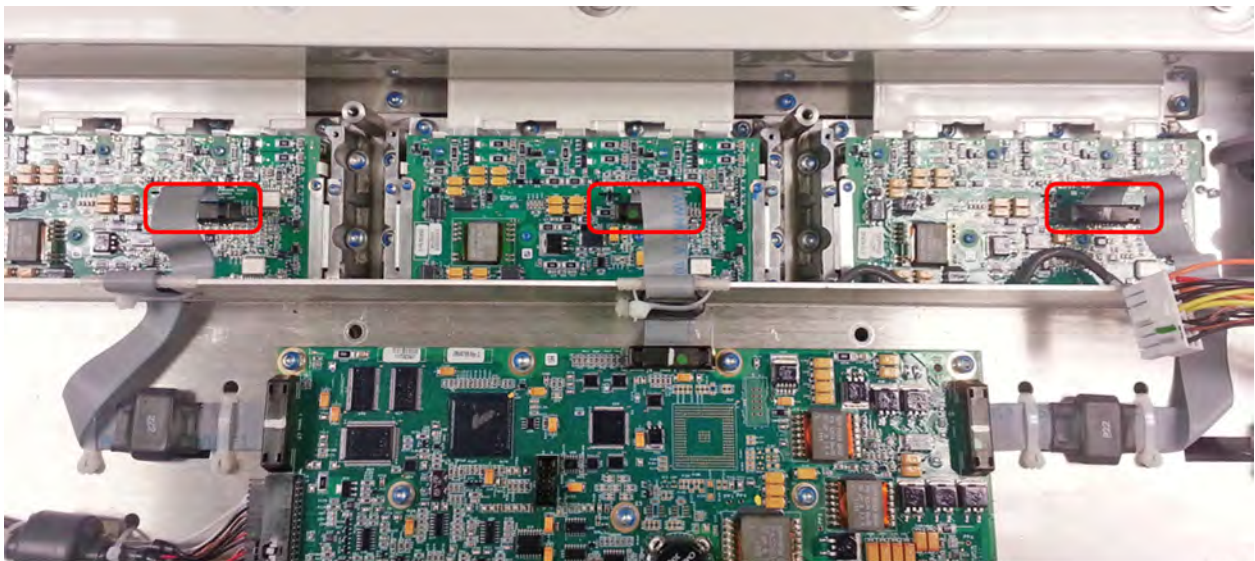
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Figure 16. BCA Mounting Shelf Fastener Locations

4. Carefully lift the BCA Mounting Shelf and set in on the side of the chassis as shown in [Figure 17](#).



NOTE: Three (3) harnesses are still connecting the BCA Card to the GATE Drive Cards. Do NOT relocate the BCA Mounting Shelf any farther than as shown in [Figure 17](#).



4402176

Figure 17. BCA Mounting Shelf Relocation

5. Remove three (3) ribbon cable connectors from the GATE Drive Cards (refer to [Figure 17](#)) as follows:
 - a. Use the handle of Tab Bending Tool J-51586 to disengage and remove the cable strain relief cap (refer to [Figure 18](#)).

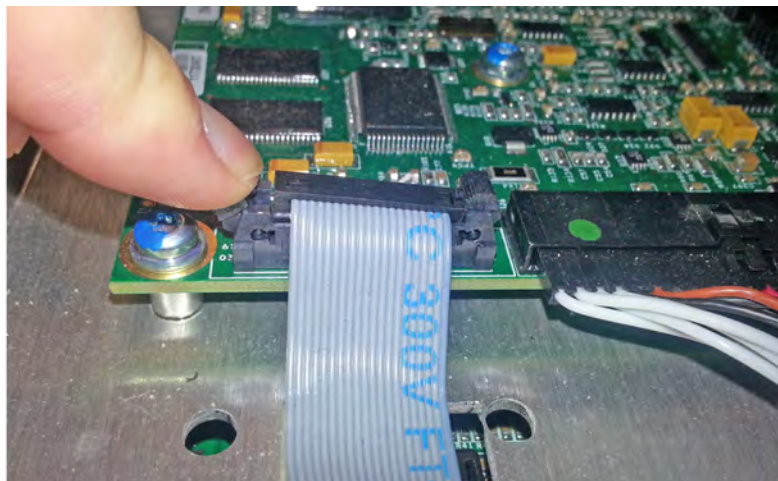
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Figure 18. Cable Strain Relief Cap Removal (BCA Cable Card Connector Shown for Clarity)

- b. Press the tabs down on both sides of the GATE Drive Card Connector to release the ribbon cable connector (refer to [Figure 19](#)).



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Figure 19. Releasing the Ribbon Cable Connector (BCA Cable Card Connector Shown for Clarity)

6. Remove the BCA Mounting Shelf from the DPIM to gain access to the three (3) GATE Drive Cards.

Section 3: Removal of the GATE Drive Cards



CAUTION: The spring pins (refer to [Figure 20](#)) located in the SKiM module that contact the bottom of the Gate Drive Card are NOT available for replacement if lost or damaged. Extreme caution must be used during removal of any Gate Drive Cards to ensure no spring pins are damaged or lost.

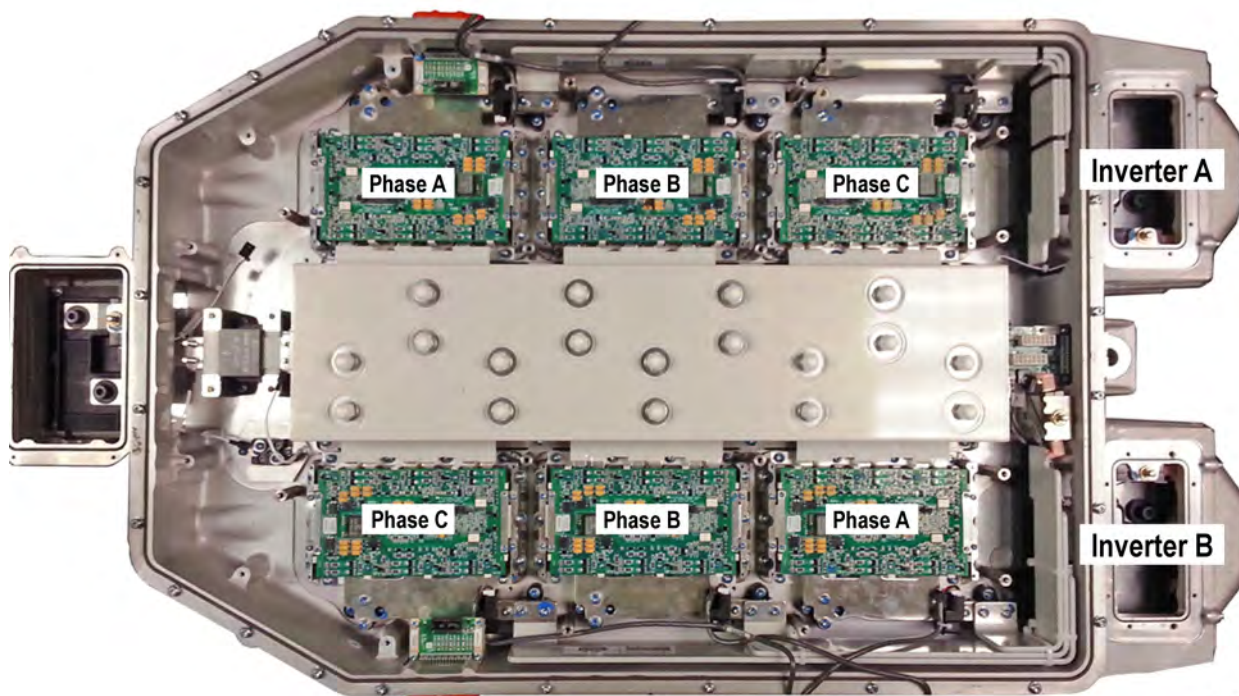


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Figure 20. SKiM Module Spring Pin



NOTE: Refer to [Figure 21](#) for DPIM2 Phase Locations.



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Figure 21. DPIM2 Phase Locations

1. Using a Torx Plus® T8 bit, remove the twelve (12) M3 x 8mm (coarse thread) screws from each of the six (6) GATE Drive Cards (refer to [Figure 22](#)).

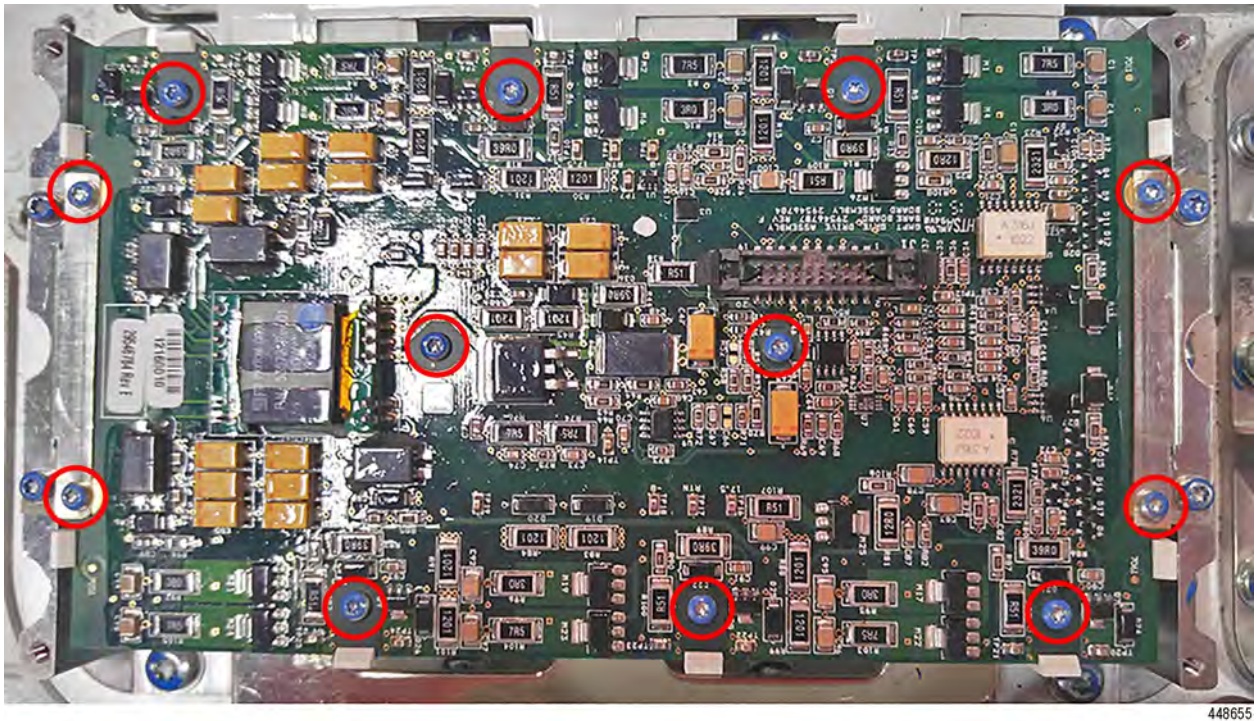
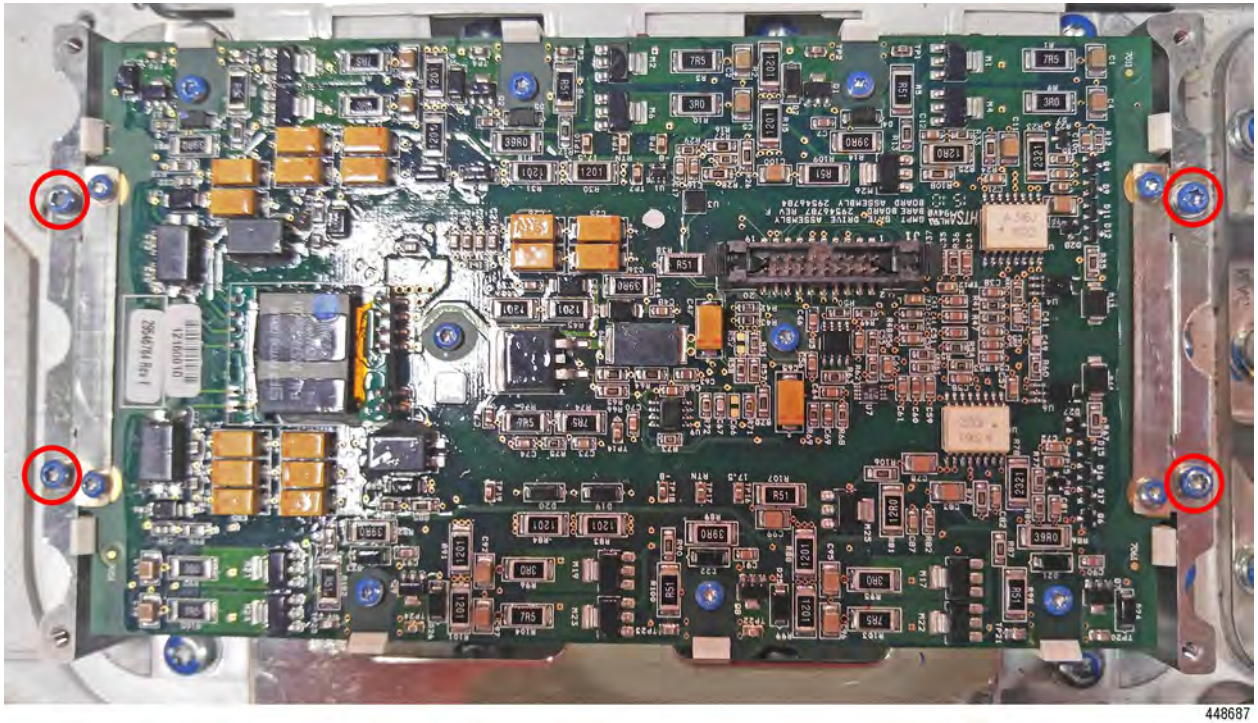


Figure 22. GATE Drive Card Fastener Locations (M3 x 8mm Coarse Thread – Quantity 12)

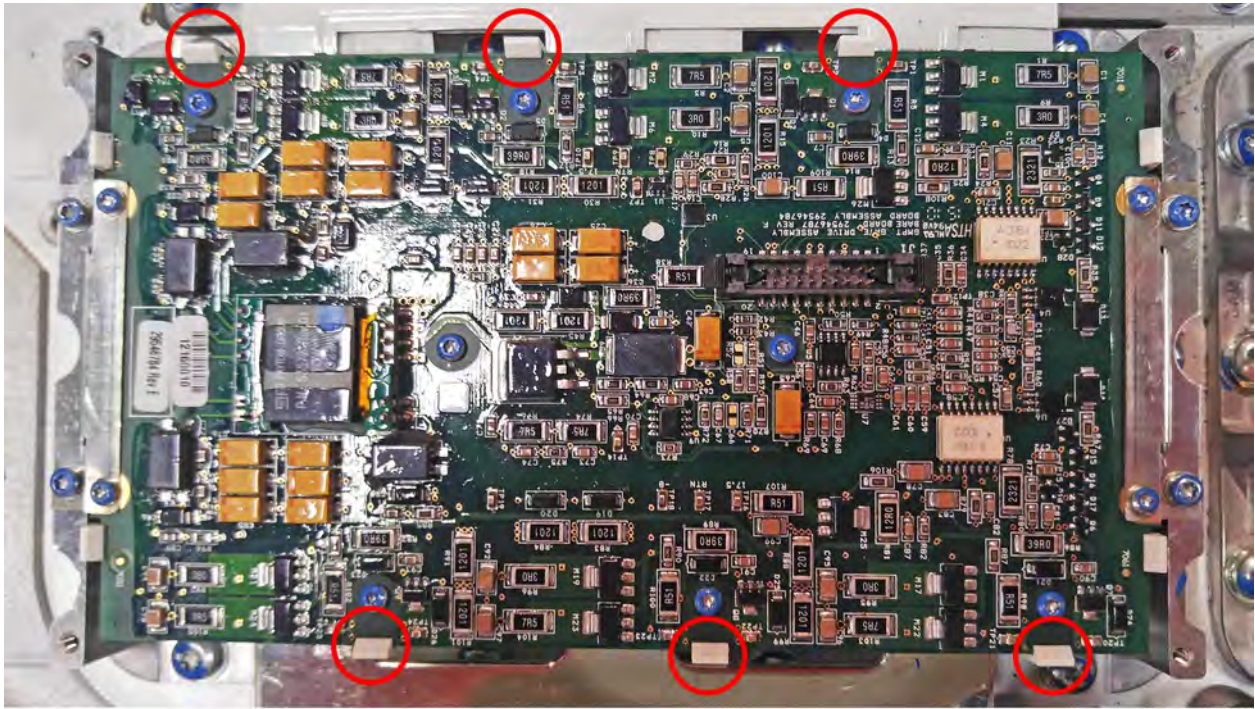
2. Using a Torx Plus® T10 bit, remove the four (4) M3 x 8mm (fine thread) screws and two (2) grounding brackets from each of the six (6) GATE Drive Cards (refer to [Figure 23](#)).



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Figure 23. GATE Drive Card Fastener Locations (M3 x 8mm Fine Thread) – Quantity 4

3. Carefully pry back the ten (10) white locking tabs (refer to [Figure 24](#)) to release each GATE Drive Card from its mounting location and gently lift the cards straight up and away from the DPIM.



448974

Figure 24. GATE Drive Card Locking Tab Locations



NOTE: If the spring pin sticks to the underside of the card, do not attempt to dislodge the spring from the card until the card has been completely removed. No loose pins should be left in the DPIM.

4. Verify that all fifteen (15) spring pins are still present in each SKIM module (refer to [Figure 25](#)).

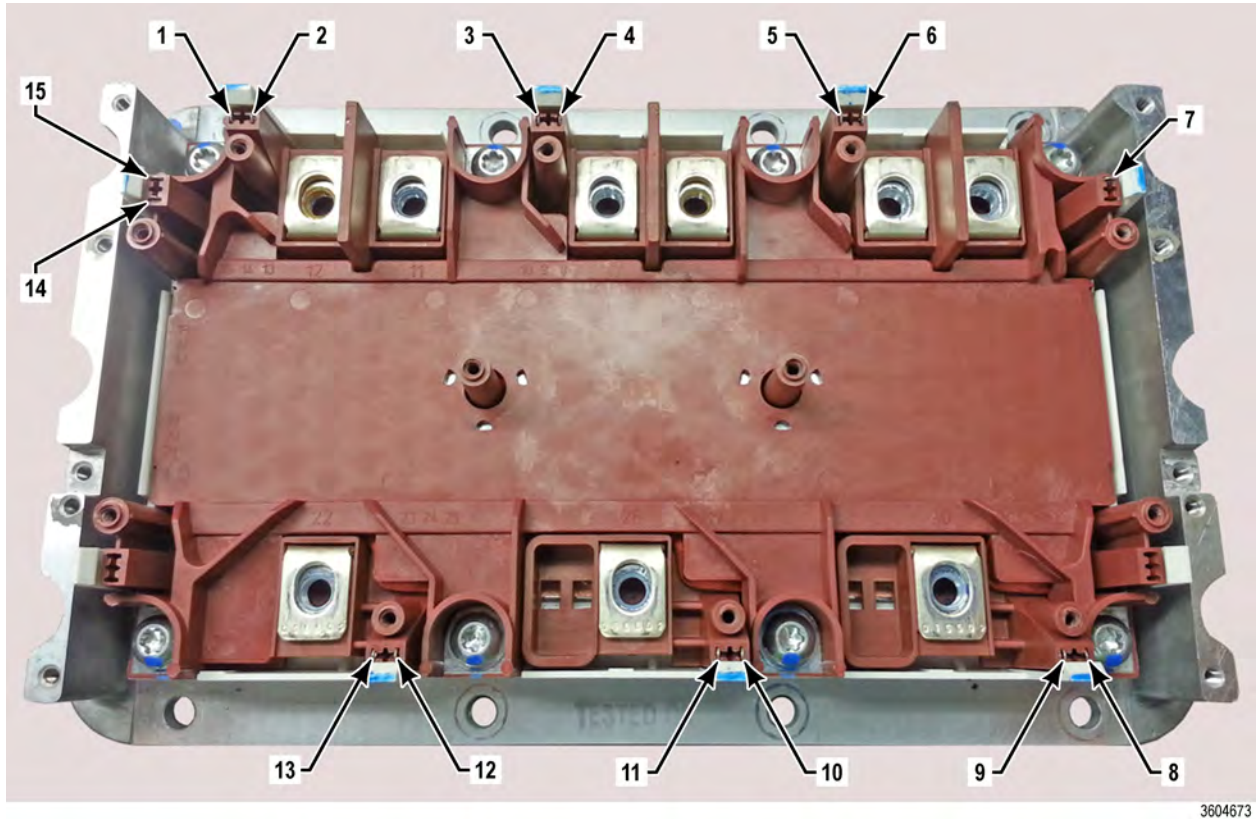


Figure 25. SKiM Spring Pins Locations

5. If any spring pins are stuck to the bottom of the card (refer to [Figure 26](#)), remove them from the solder pad taking care not to bend or lose the pin. Reinstall the spring pin into the corresponding hole in the SKiM module (refer to [Figure 25](#)).

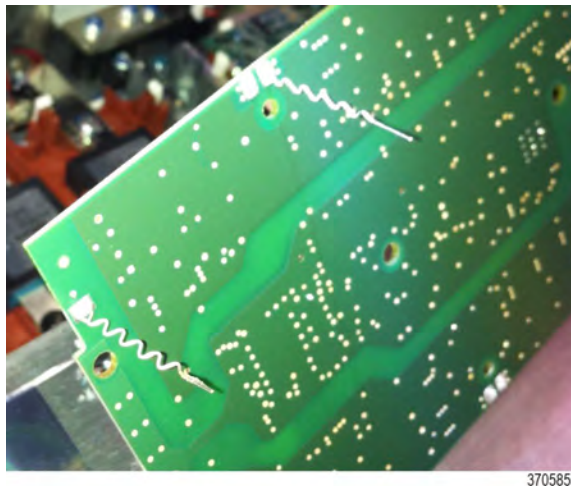
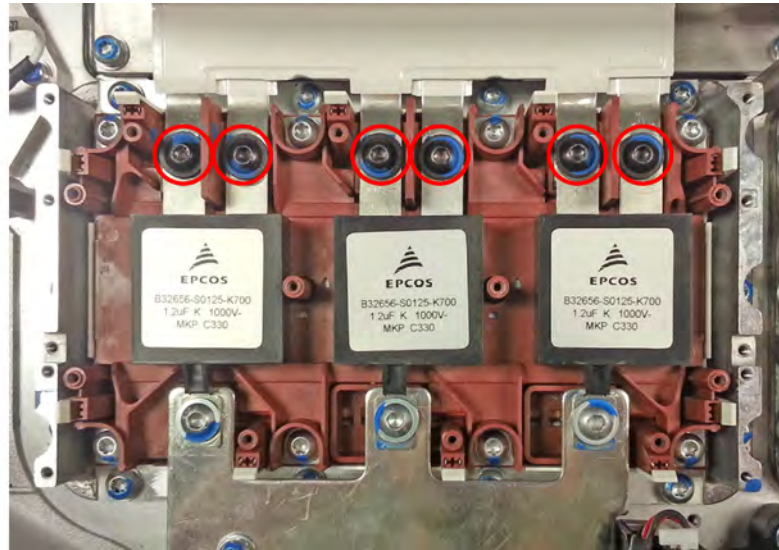


Figure 26. Spring Pins Stuck to GATE Drive Card Solder Pads

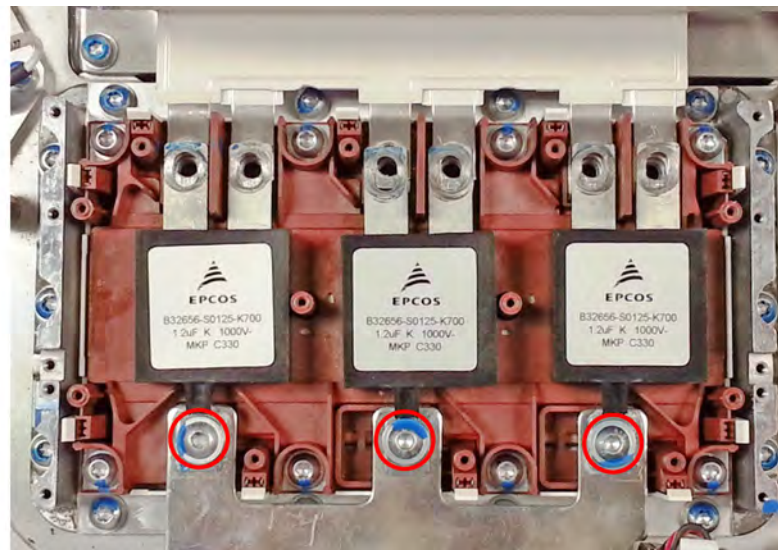
6. Using a 4mm hex key, remove the six (6) black M6x10mm screws from each SKiM Module (refer to [Figure 27](#)).



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Figure 27. SKiM Module Fastener Locations

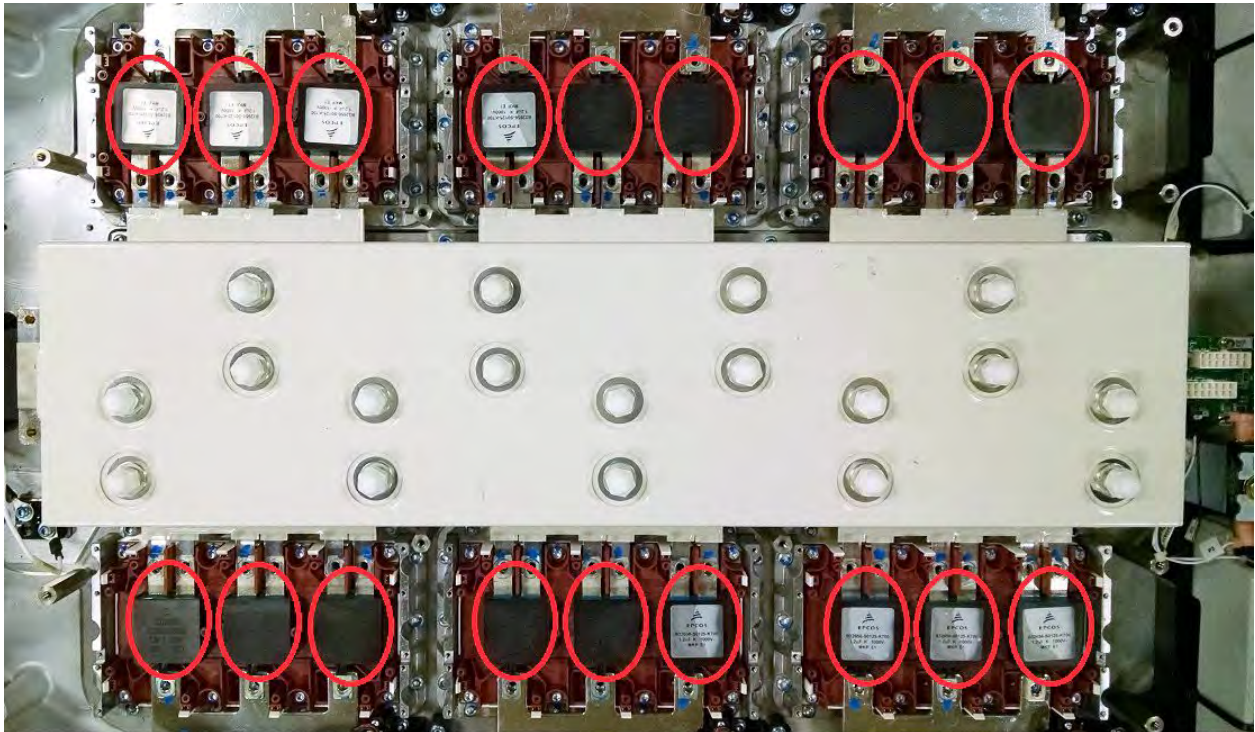
7. Using a 4mm hex key, remove the three (3) silver M6x12mm screws from each SKiM Module (refer to [Figure 28](#)).



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Figure 28. SKiM Module Fastener Locations

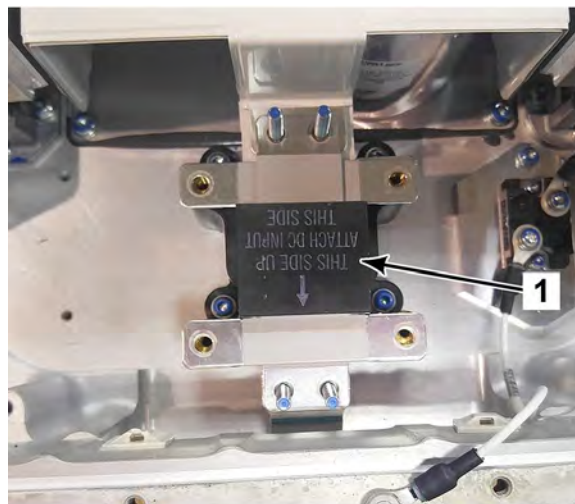
8. Remove all eighteen (18) capacitors from the six (6) SKiM modules and set them aside (refer to [Figure 29](#)).



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Figure 29. Capacitor Removal

9. Remove the DC choke and set it aside (refer to [Figure 30](#)).



3358637

Figure 30. Choke Removal

Section 4: DC Busbar Removal

1. Remove the eighteen (18) white protective caps from the capacitor studs (refer to [Figure 31](#)).

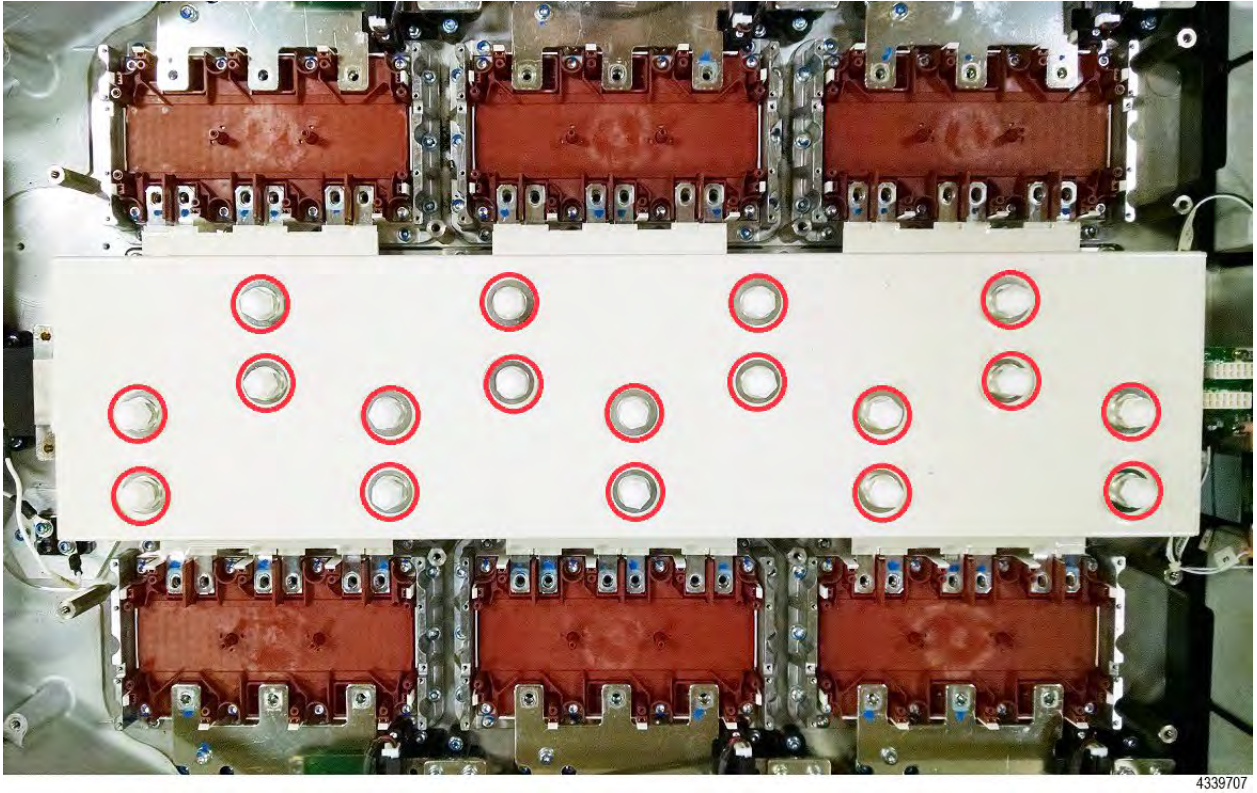


Figure 31. Protective Cap Removal

2. Using a 13mm hex socket, remove the eighteen (18) 8mm hex nuts, the eighteen (18) lock washers, and the eighteen (18) flat washers from the capacitor studs (refer to [Figure 32](#)).

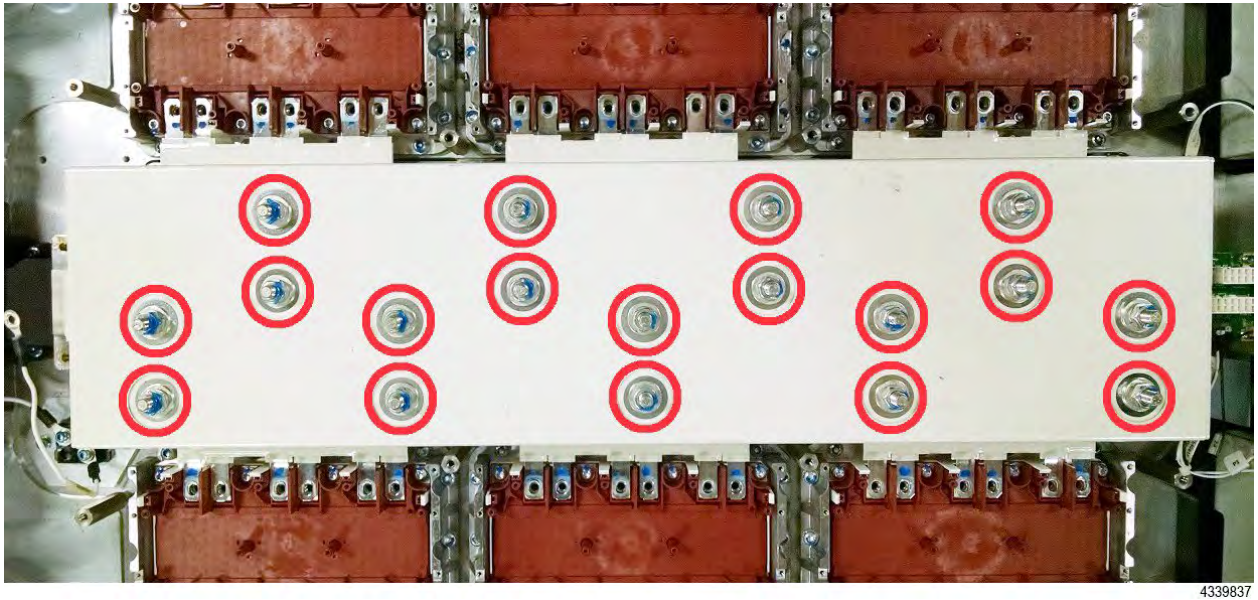


Figure 32. Capacitor Stud Hardware Removal

3. Lift the DC Busbar up evenly and off the capacitor studs. Use care to prevent any debris from falling into the DPIM during removal.
4. With the DC Busbar removed and wearing the electrostatic discharge wrist strap, use a vacuum to remove any dust, dirt, or debris from the DPIM. Save any loose hardware parts that may be under the DC busbar in between the capacitors (refer to [Figure 33](#)).

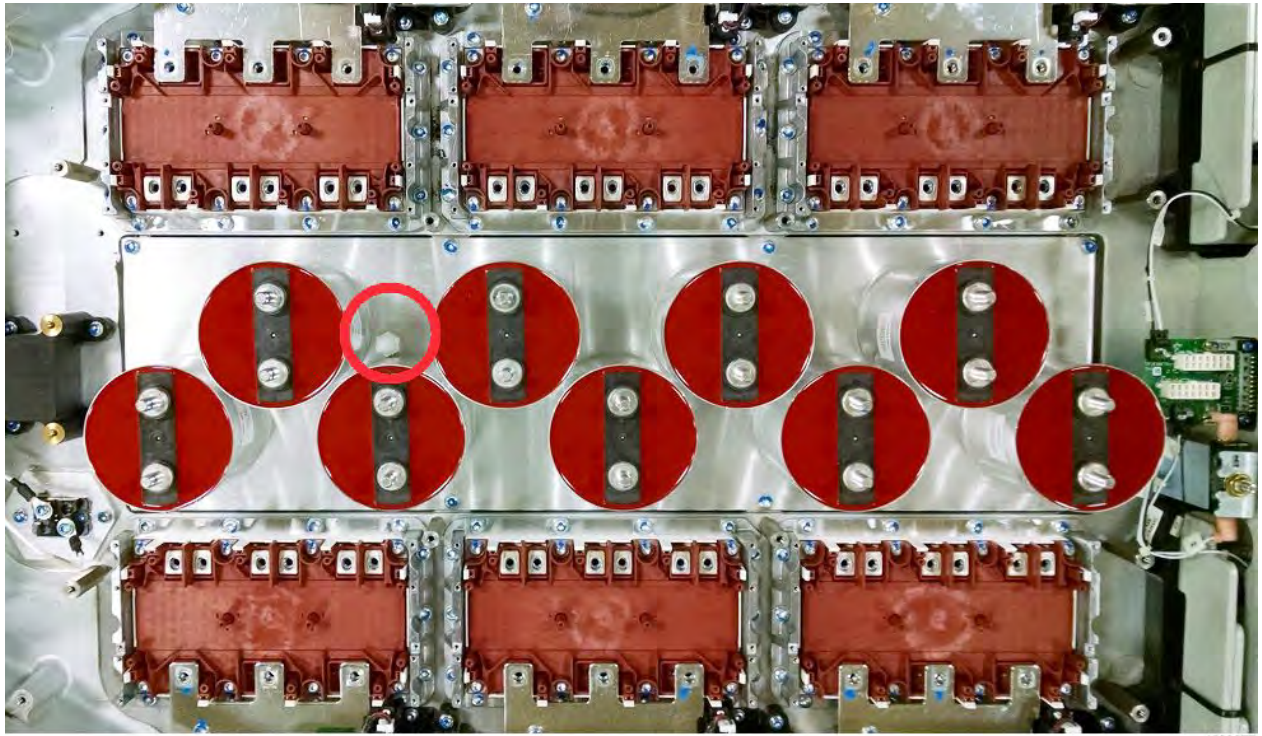


Figure 33. Loose Hardware Under DC Busbar (White Cap)

Section 5: Installation of DC Busbar

1. Align the DC busbar over the capacitor studs and evenly lower the DC busbar onto the capacitors. Ensure that the tabs are aligned with the SKiM modules and the DC Busbar is positioned properly.



CAUTION: Remove any debris that may have been created when installing the DC Busbar onto the capacitor studs. Any conductive material left in the DPIM could cause permanent damage to the DPIM.

2. Install eighteen (18) flat washers onto the capacitor studs. If there is a burr sticking up from the flat washer, install the side with the burr face-down against the DC busbar (refer to [Figure 34](#)) to prevent the burr from coming loose in the DPIM.



Figure 34. Burr on Flat Washer

3. Install eighteen (18) lock washers and 8mm hex nuts onto the capacitor studs. Using a 13mm hex socket and starting at the center studs, torque the eighteen nuts to 6.8-7.9 N·m (60-70 lb in) in an expanding pattern (refer to [Figure 36](#)).



CAUTION: Failure to properly torque the capacitor nuts could cause permanent damage to the DPIM.

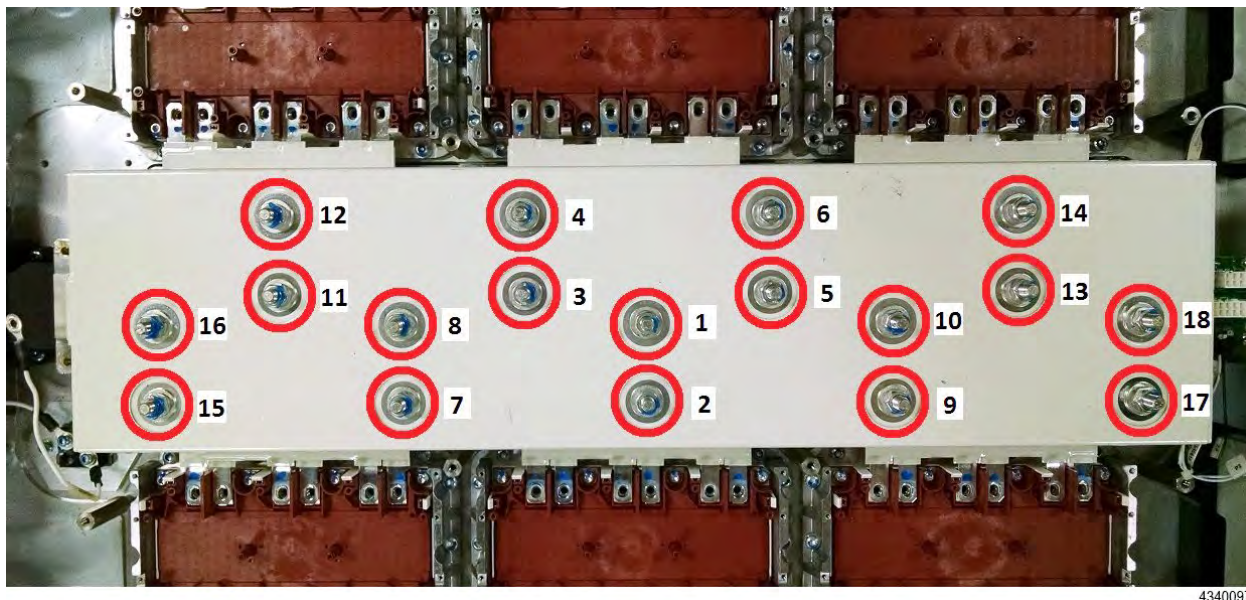


Figure 35. DC Busbar Torque Pattern

4. Install eighteen (18) white protective caps over the capacitor studs (refer to [Figure 36](#)).

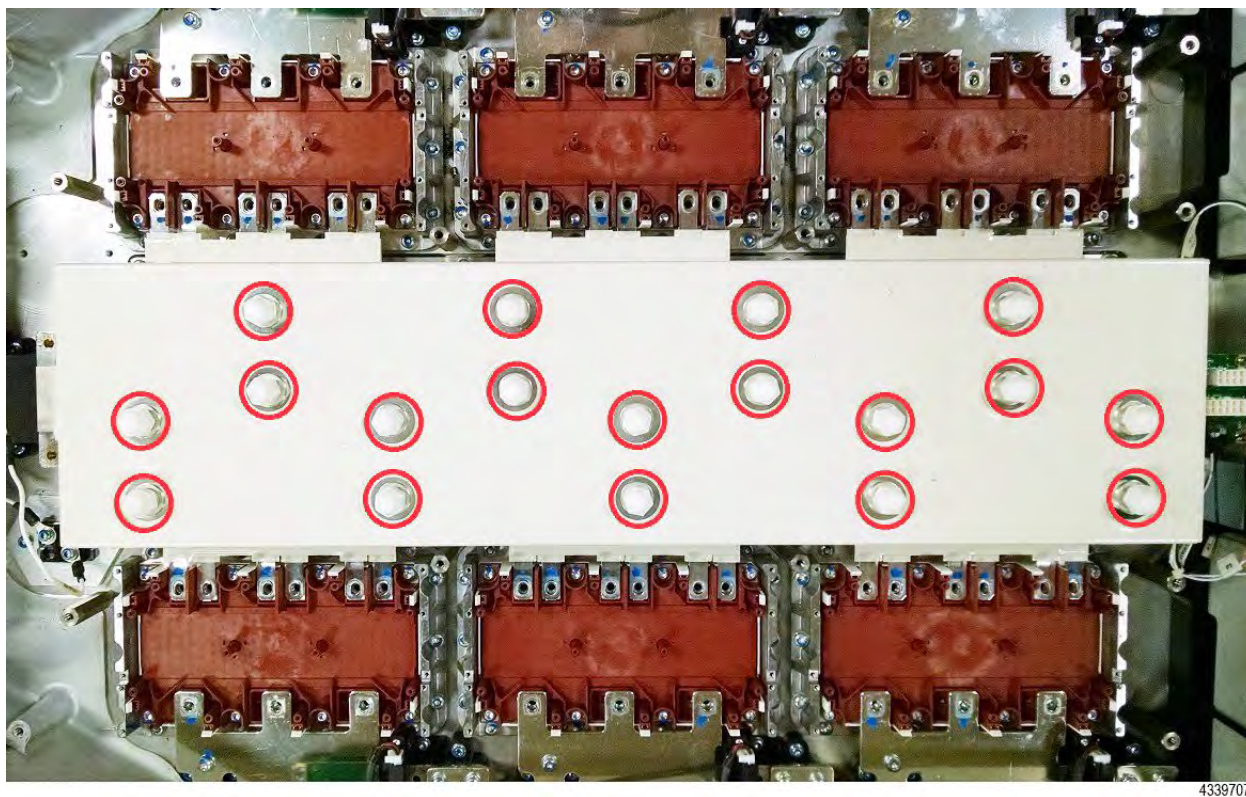


Figure 36. Protective Cap Installation

5. Install the DC choke as shown in [Figure 37](#) below. The choke must be installed with the arrow pointing toward the DC lug box and the arrow label facing up.

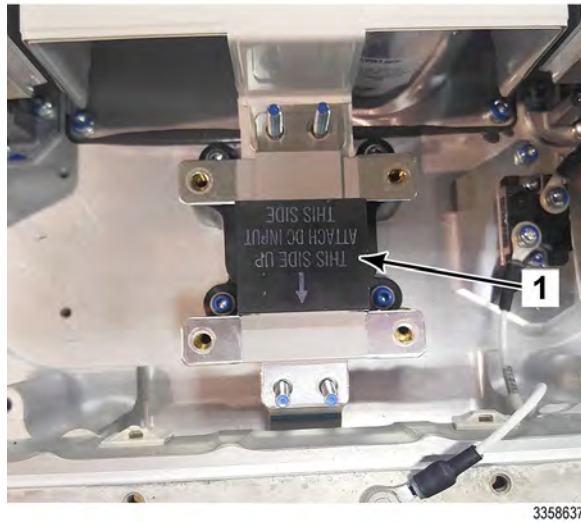
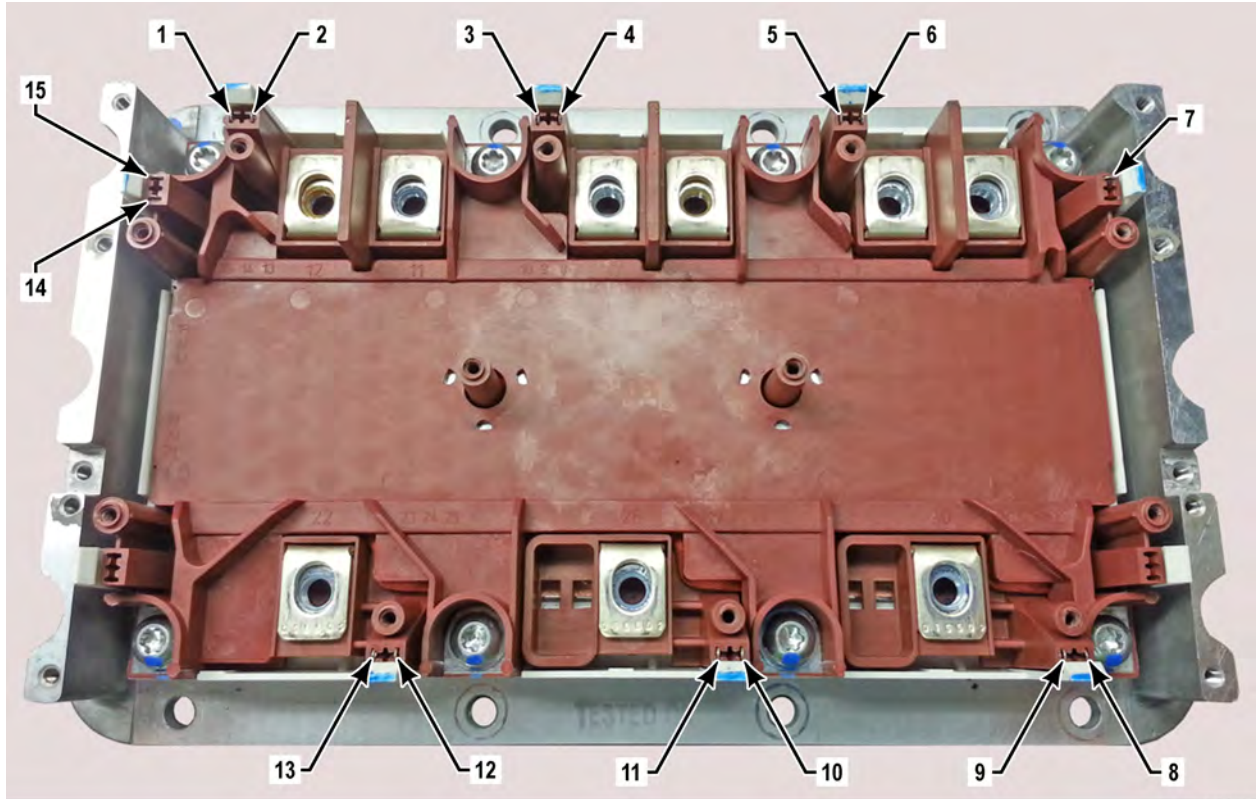


Figure 37. DC Choke Installation

Section 6: Installation of GATE Drive Cards



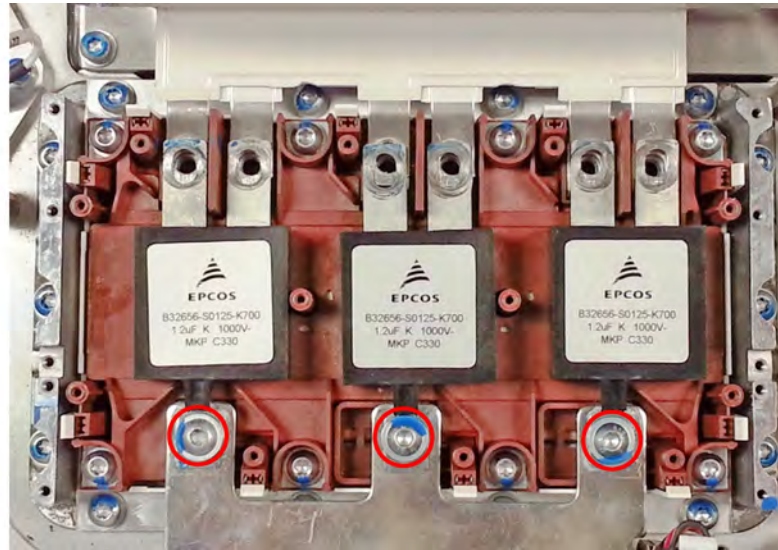
NOTE: Prior to installing the GATE drive card, ensure all fifteen (15) spring pins are properly located (refer to [Figure 42](#)).



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Figure 38. SKiM Spring Pins Locations

1. Position the eighteen (18) capacitors on the SKiM Modules. Apply one drop of Loctite® 425 or 242 threadlocking compound to the ends of the external threads of each silver M6x12mm screw. Using a 4mm hexkey, install the eighteen (18) M6x12mm screws (refer to [Figure 39](#)). Torque the screws to 6.8-7.3 N·m (60.2-64.6 lb in.).



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Figure 39. SKiM Module Capacitor Installation

2. Apply one drop of Loctite® 425 or 242 thread locking compound to the ends of the external threads of each black M6x10mm screw. Using a 4mm hex key, install the thirty-six (36) M6x10mm screws to the SKiM Module (refer to [Figure 40](#)). Torque the screws to 6.8-7.3 N·m (60.2-64.6 lb in.).



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Figure 40. SKiM Module Fastener Locations

3. Position each GATE Drive Card over the locating hubs on the SKiM module (refer to [Figure 41](#)). Carefully press each GATE Drive Card straight down over the ten (10) white locking tabs (refer to [Figure 42](#)) so the card is fully seated.



NOTE: There are 6 locating hubs on the SKiM module; two (2) on each end of the SKiM module and two (2) in the center.



CAUTION: Failure to mount the card on the locating hubs correctly can prevent the card from seating completely causing the card to flex which can cause damage.

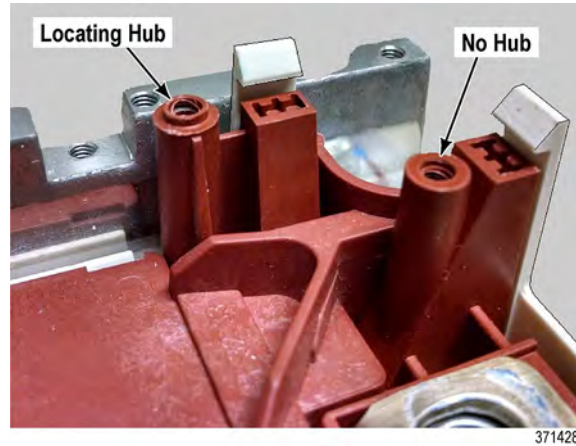


Figure 41. Locating Hub Identification on SKiM Module

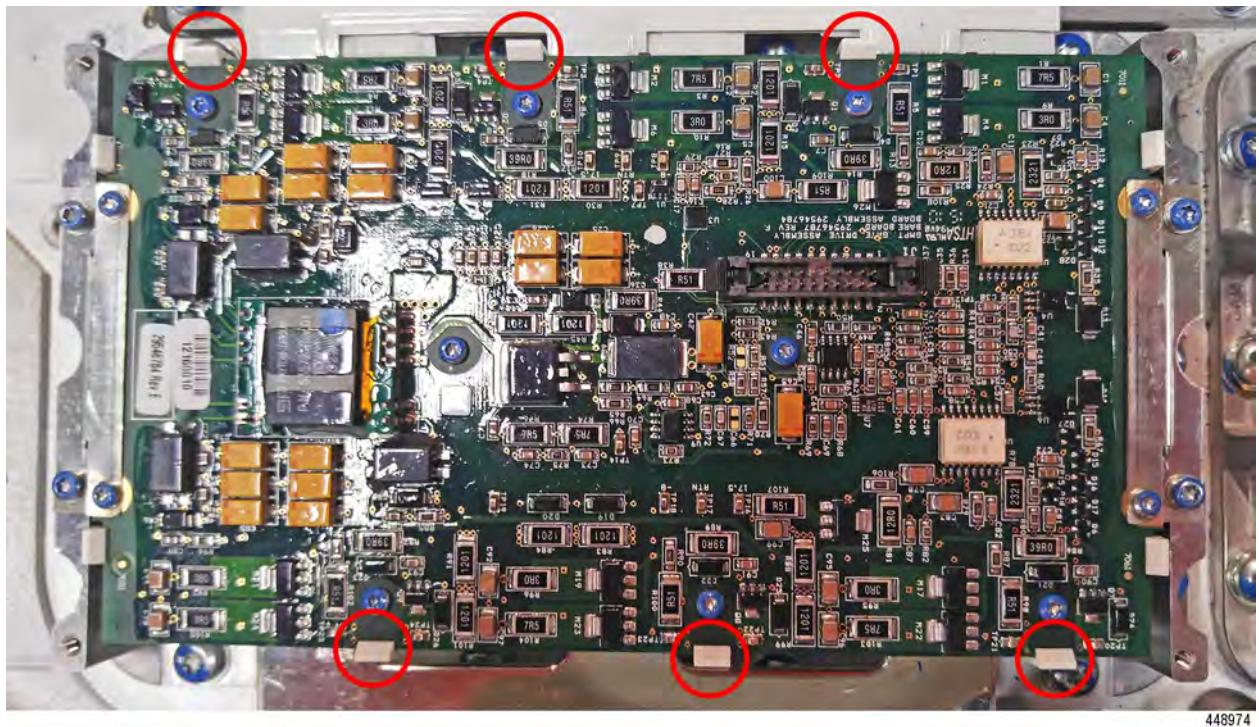


Figure 42. GATE Drive Card Locking Tab Locations

- Place the two (2) grounding brackets into position on each of the SKiM modules. Using a Torx Plus® T10 bit, install the four (4) M3x8mm (fine thread) screws to each GATE Drive Card (refer to [Figure 43](#)). Torque all twelve (12) M3x8mm (fine thread) screws to 0.6-0.8 N·m (5.3-7.1 lb in.).

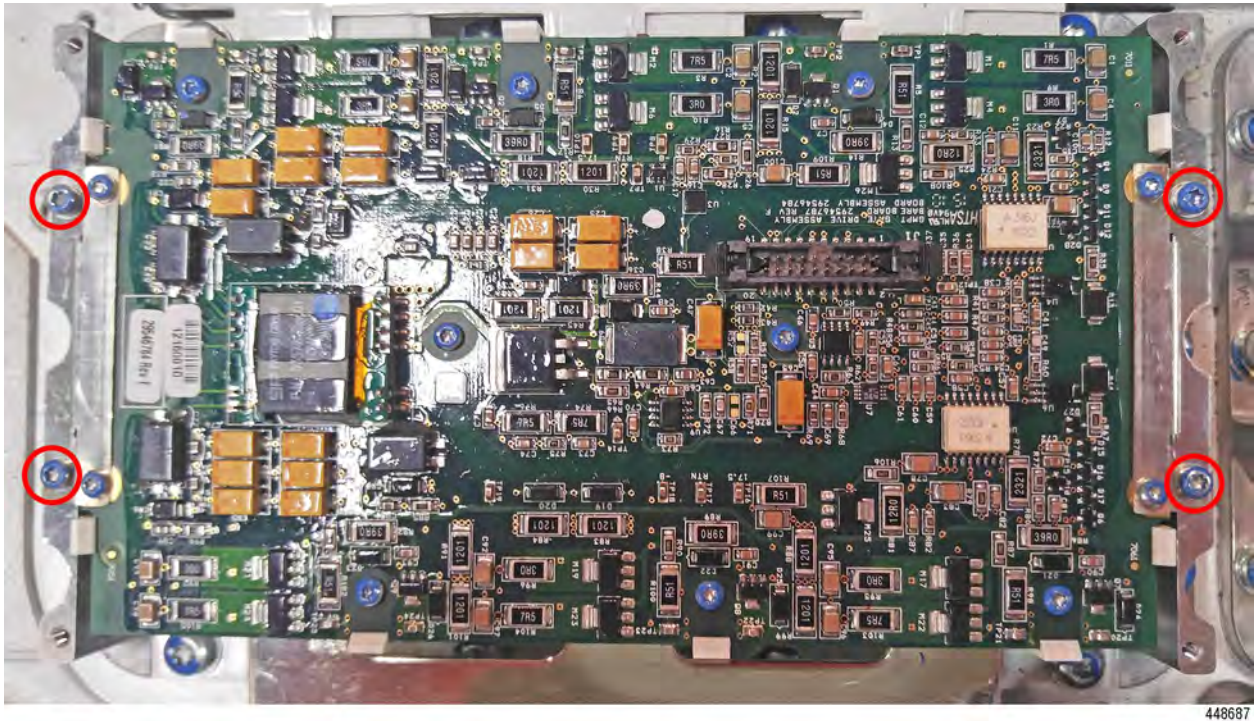
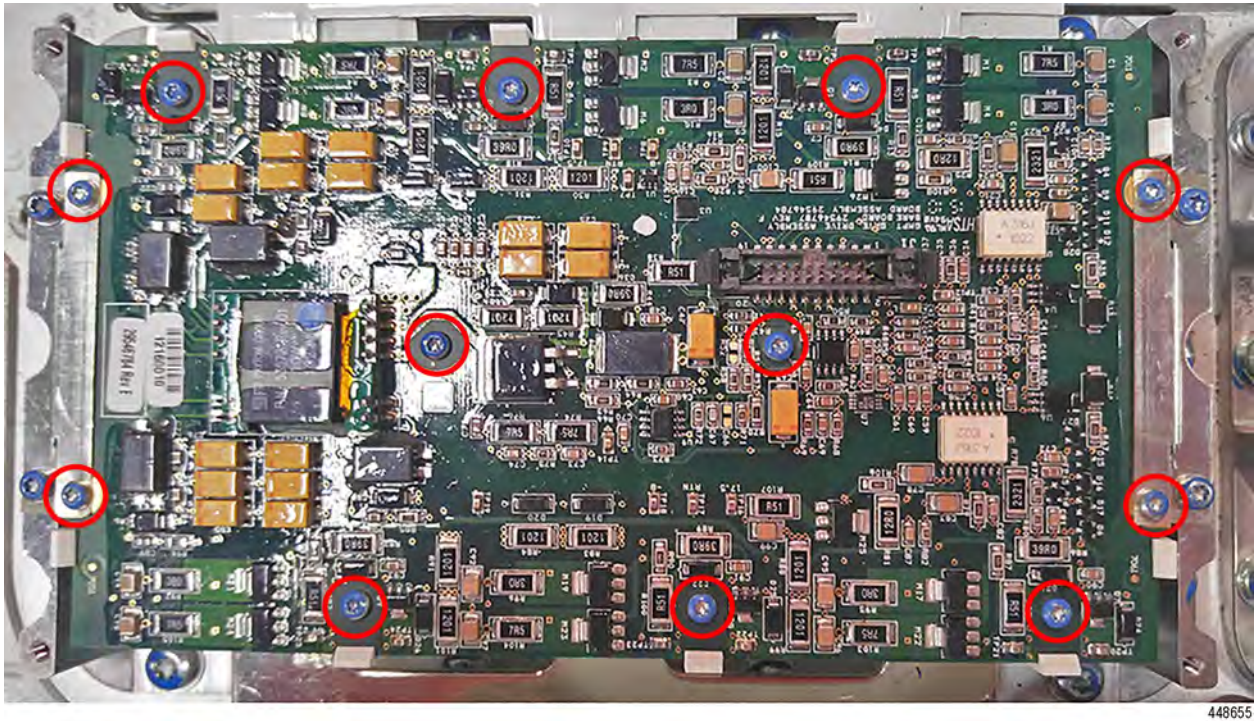


Figure 43. GATE Drive Card Fastener Locations (M3x8mm Fine Thread) – Quantity 12

5. Using a Torx Plus® T8 bit, install the twelve (12) M3x8mm (coarse thread) screws to each GATE Drive Card (refer to [Figure 44](#)). Torque all seventy-two (72) M3x8mm (coarse thread) screws to 0.3-0.6 N·m (2.7-5.3 lb in.).

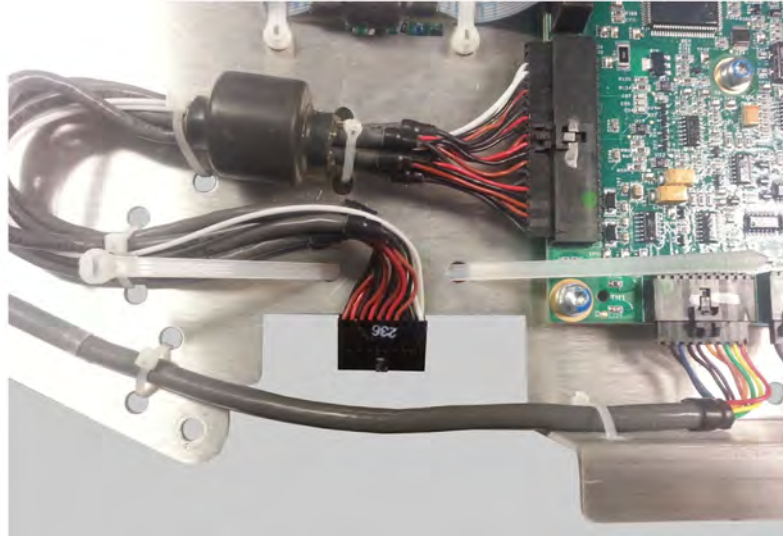


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Figure 44. GATE Drive Card Fastener Locations (M3x8mm Coarse Thread – Quantity 72)

Section 7: Installation of BCA Card Mounting Shelf

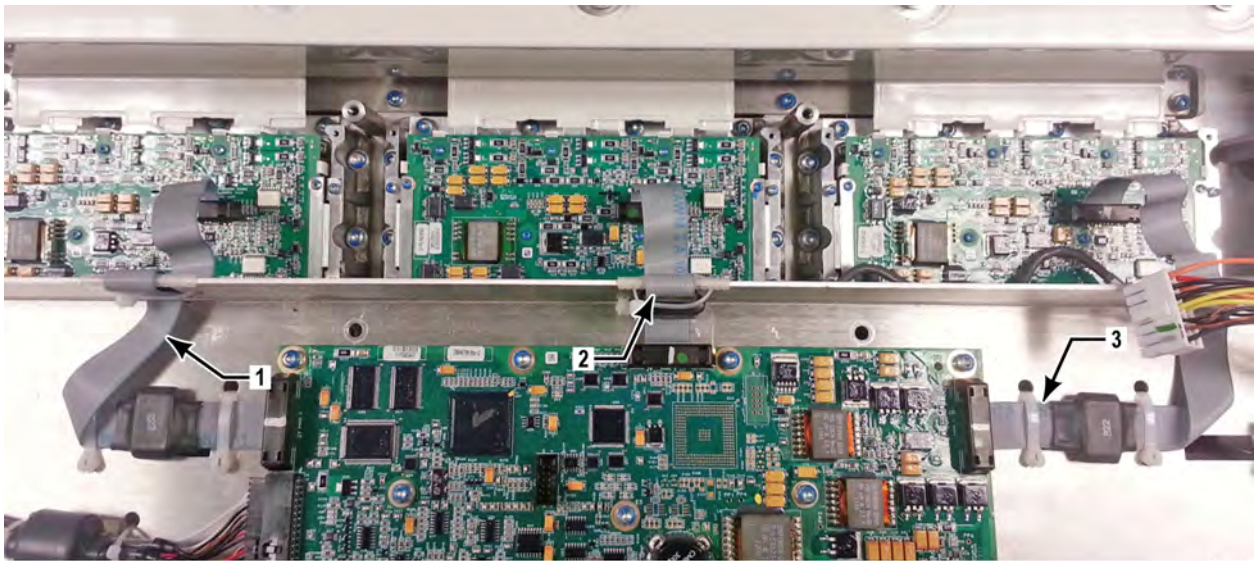
1. Feed all tie wraps through the BCA Card Mounting Shelf (refer to [Figure 45](#)).



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Figure 45. BCA Card Mounting Shelf tie Wrap Location

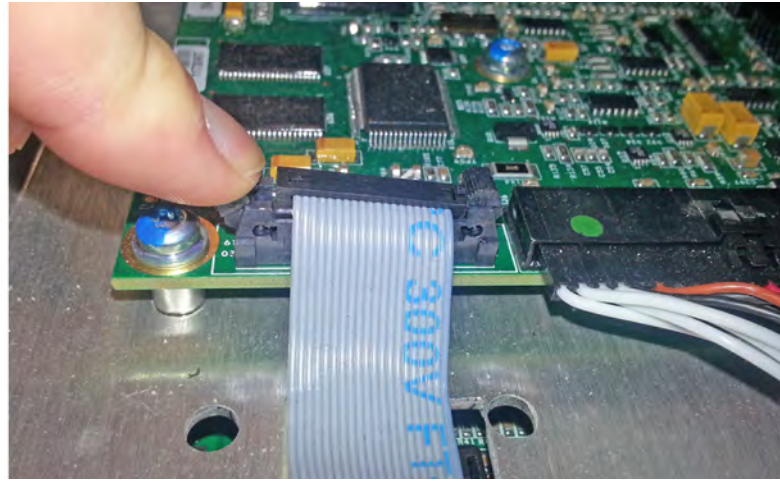
2. Place the BCA Mounting Shelf onto the side of DPIM chassis as shown in [Figure 46](#).



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Figure 46. BCA Mounting Shelf (GATE Drive Card Cable Connectors Shown Circled)

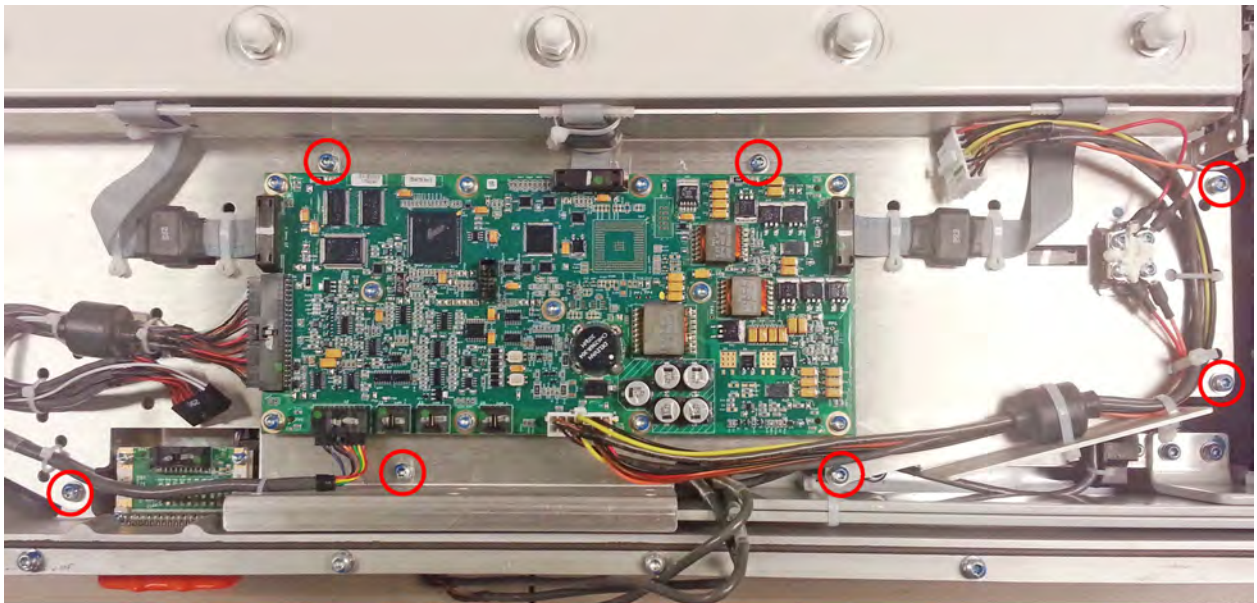
3. Connect three (3) GATE Drive Card Connectors to three (3) GATE Drive Cards (refer to [Figure 47](#)) and install the cable strain relief caps.



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Figure 47. GATE Drive Card Cable Connector Installation (BCA Card Cable Connector Shown for Clarity)

4. Move BCA Mounting Shelf to its final location. Using a Torx Plus® T25 bit, install the seven (7) M5x14mm screws that secure the BCA Mounting Shelf (refer to [Figure 48](#)). Torque the seven (7) M5x14mm screws to 3.1-3.5 N·m (27.4-31.0 lb in.).



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Figure 48. BCA Mounting Shelf Fastener Locations

5. Install five (5) wire harness connectors to circuit card surface mount connectors (refer to [Figure 49](#), [Figure 50](#), and [Figure 51](#)).

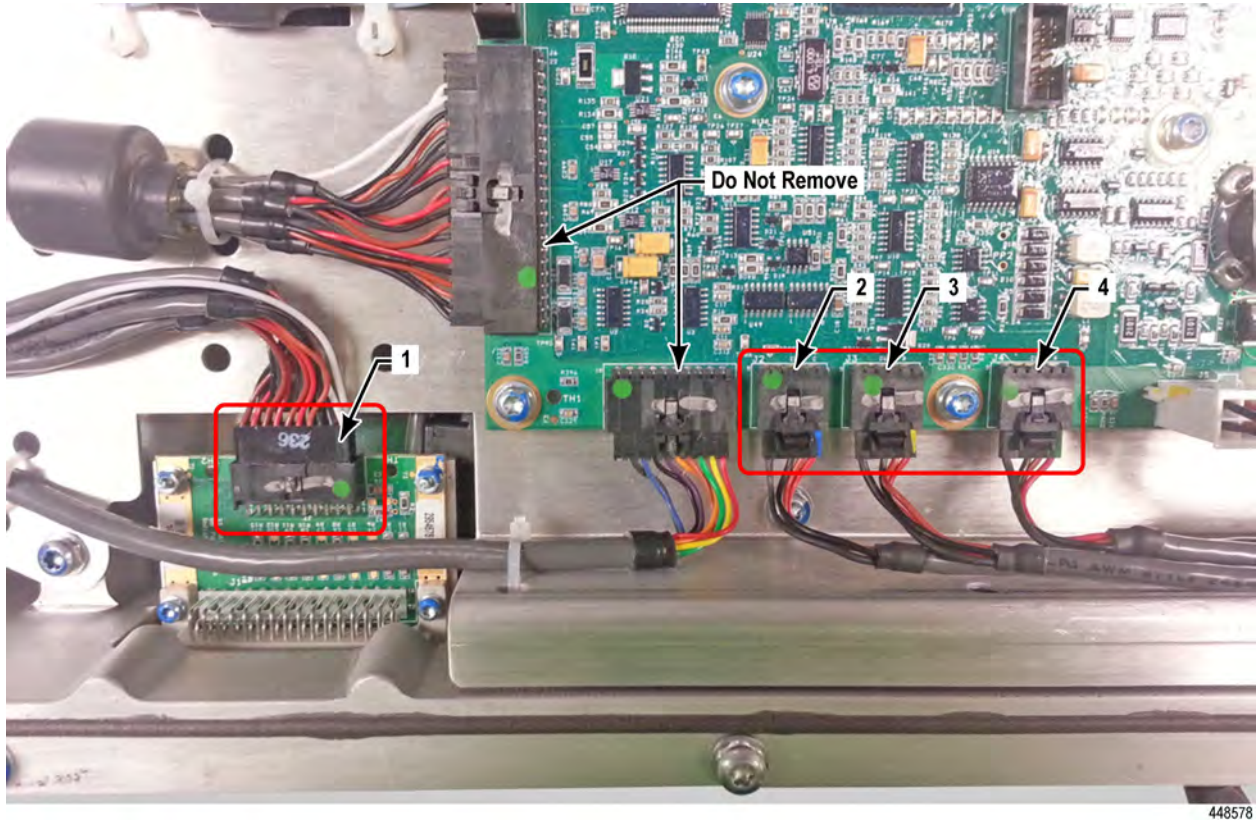


Figure 49. Wire Harness Connector Removal (4 Locations)

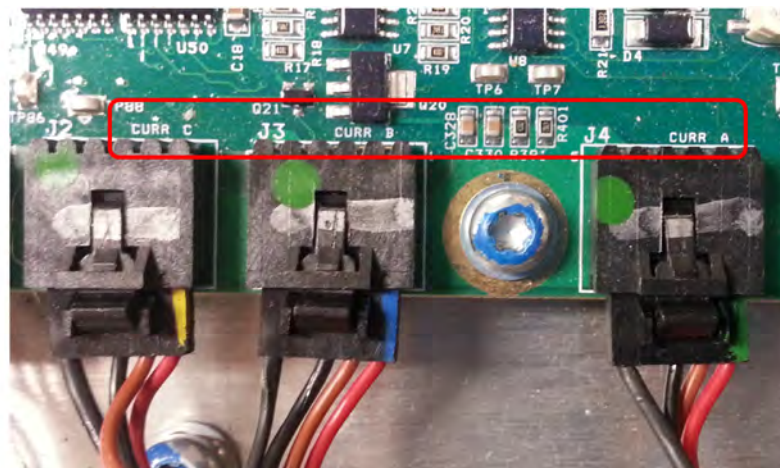


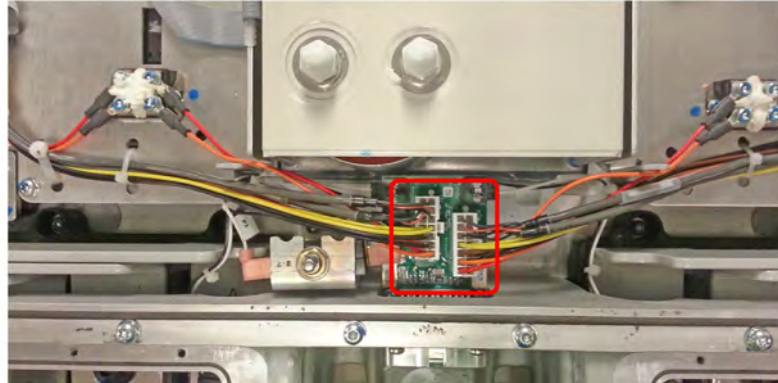
Figure 50. Current A, Current B, and Current C Locations



NOTE: Each current sensor phase (A, B, and C) MUST be plugged into the appropriate connector (CURR A, CURR B, CURR C).



CAUTION: Permanent damage to the H 40/50 EP™ Drive Unit or DPIM can occur if the current sensor harnesses are plugged into the wrong connectors.



448591

Figure 51. Wire Harness Connector Installation

6. Install NEW wire ties to retain the wire harnesses (refer to [Figure 52](#)).



448567

Figure 52. Wire Tie Locations

Section 8: Installation of HVIL Circuit Card and Main Cover

1. Insert one (1) new wire tie into the new HVIL Circuit Card at the same location as shown in [Figure 53](#).



NOTE: To ease assembly, the new wire tie must be inserted through the hole in the circuit card prior to installation in the DPIM Housing.

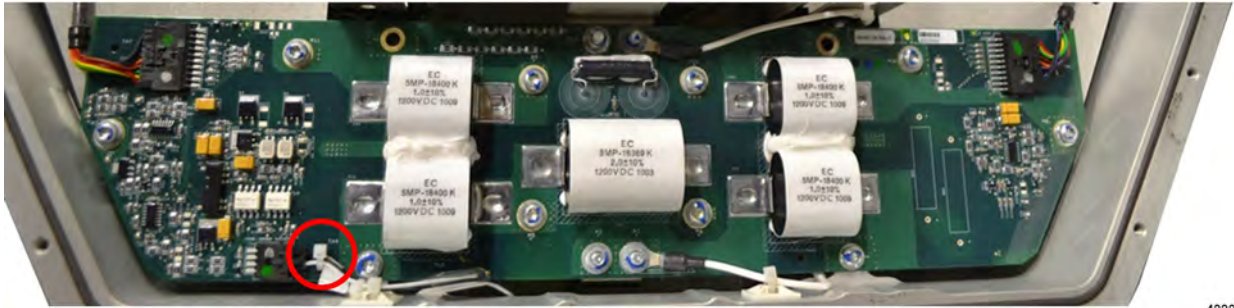


Figure 53. HVIL Circuit Card – Wire Tie Location

2. Install HVIL Circuit Card into the DPIM Housing.



NOTE: Ensure that the wire harnesses and individual wires are NOT pinched under the circuit card during installation.

3. Connect the three (3) wiring harness connectors at locations shown in [Figure 54](#).

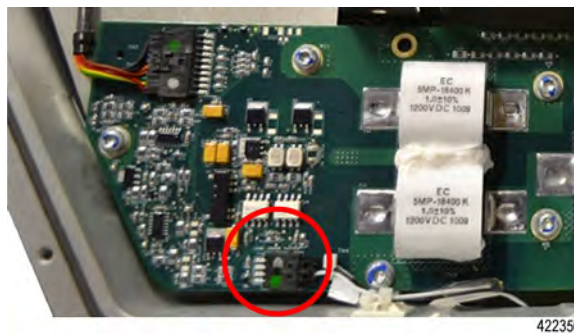
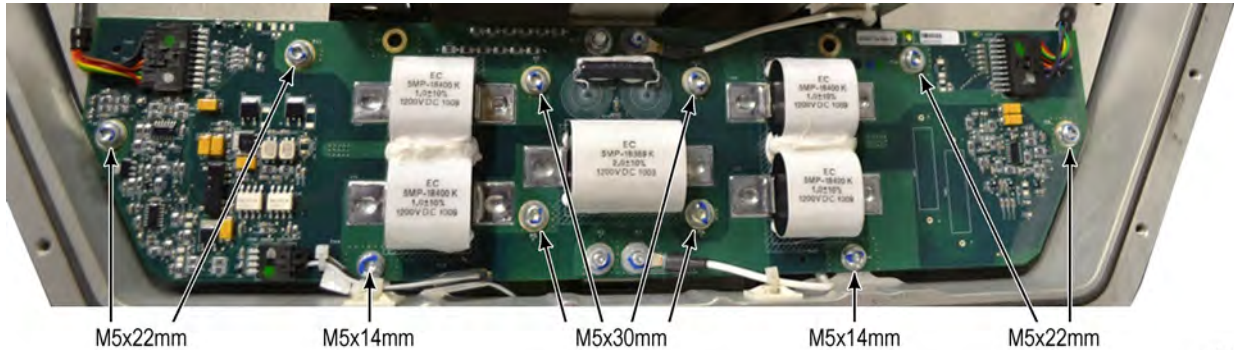


Figure 54. HVIL Circuit Card – Three (3) Harness Connector Locations

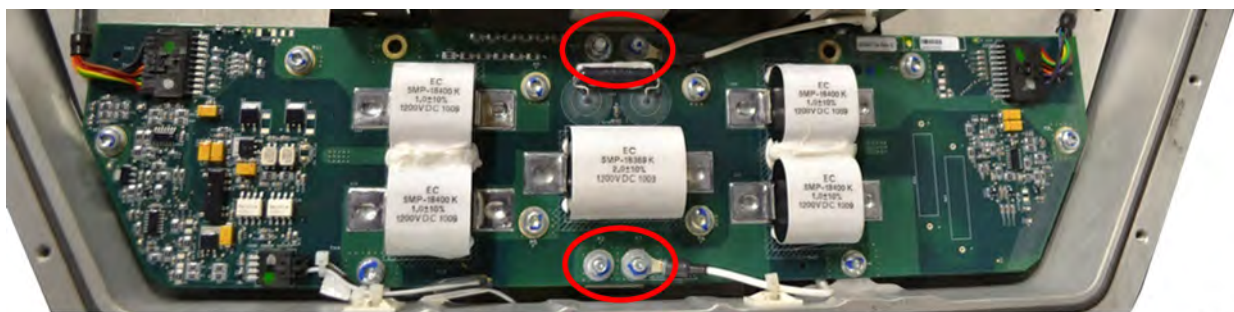
4. Using a Torx Plus® T25 bit, install and finger tighten the ten (10) M5 screws that secure the HVIL Circuit Card to the DPIM Housing. Torque all M5 screws to 3.1-3.5 N·m (27-31 lb in). Refer to [Figure 55](#) for fastener sizes and locations.



422663

Figure 55. HVIL Circuit Card – Fastener Sizes/Locations

5. Install the two (2) wire ring terminals onto the studs at locations shown in [Figure 56](#). Using an 8mm socket, install four (4) M5 nut/washer assemblies onto the studs as shown in the same figure. Torque the nuts to 3.1-3.5 N·m (27-31 lb in).



422390

Figure 56. HVIL Circuit Card – Four (4) Mounting Nut/Washer Locations (M5)

6. Secure wiring with new wire ties and clip excess length as required. Refer to [Figure 53](#) and [Figure 57](#) for wire tie locations.



422327

Figure 57. HVIL Circuit Card – Two (2) Wire Tie Locations



NOTE: Verify that all eighteen (18) white protective caps are installed over the capacitor studs in the center of the DPIM. Reinstall or replace any missing caps as necessary.

7. Install new Cover Gasket P/N 29540714, included in Electronic Service Kit P/N 29556119. Using a Torx Plus® T25 bit, install and finger tighten the twenty-six (26) M5x18mm machine screws that secure the Main Cover to the DPIM Housing as shown in [Figure 58](#). Torque the screws to 3.1-3.5 N·m (27-31 lb in).



421911

Figure 58. DPIM Main Cover



NOTE: For additional information refer to H 40/50 EP™ System Service Manual SM3602EN Appendix E.

8. Complete the DPIM check sheet again to verify the repair before installing the DPIM on the bus.

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