

SIL 19-EP-16
April, 2016
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SUBJECT: DPIM Component Overview, Gaskets, Screw Torques

MODELS AFFECTED: H 40/50 EP™ Transmissions

Introduction:

The Dual Power Inverter Module 2 (DPIM2) converts energy from a DC source (ESS) into three-phase AC that powers the H 40/50 EP™ Drive Unit motors. During conditions such as regenerative braking, the DPIM2 converts the AC power from the Drive Unit motors back to DC to charge the ESS.

Internal Component Overview:

Integral to the DPIM2 are many electronic circuit boards and components that control the power electronics as well as monitor the system and process inputs and outputs.

Bias Control Assembly (BCA) Circuit Cards

At the heart of the DPIM2 are two (2) BCA cards, one for each inverter. The primary function of the BCA card is to control the SKiM® modules in the DPIM2. The BCA cards also communicate on the CAN with other controllers, including the TCM and VCM, process the sensor data from the Drive Unit (speed and motor temperature) and current sensors, and monitor the High Voltage Interlock Loop circuit.

SKiM® Modules

There are six (6) SKiM® modules in the DPIM2, three (3) for each inverter. Each SKiM® module consists of a gate drive circuit card, capacitors, the insulated-gate bipolar transistors (IGBTs), and a heat sink.

Gate Drive Circuit Cards

The primary function of the gate drive card is to control the on/off switching of the IGBTs. The gate drive cards work with the BCA card to control the inverter.

Insulated-Gate Bipolar Transistors (IGBTs)

The IGBTs are the primary electrical components that convert the DC power into AC power and vice versa. There are six (6) IGBTs in each SKiM® module for throughput. The IGBTs quickly switch between positive and negative DC voltage to create an AC voltage to power the Drive Unit motors. The IGBTs also convert the AC voltage back into DC voltage when the Drive Unit motors are acting as generators. The high frequency switching of the IGBTs generates heat that dissipates through the heat sink and is carried away by transmission fluid.

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High Voltage Interlock Loop (HVIL) Circuit Card

The primary function of the HVIL card is to monitor the high voltage interlock loop, a series of switches in the H 40/50 EP™ components, to ensure that no access covers are removed where potentially hazardous electrical energy may exist. The HVIL card also reports the incoming DC voltage from the ESS to the BCA cards.

Signal Interface and Encoder Circuit Cards

The DPIM2 contains one (1) common 24-way signal interface card and two (2) 32-way encoder cards, one for each inverter. The 24-way signal interface card distributes the main 12V power and grounds, DPIM2 wake up and torque control signals, and the CAN interface to each of the inverters. The 32-way encoder cards pass the speed sensor and RTD output signals from the Drive Unit to the BCA cards.

Current Sensors

The DPIM2 contains six (6) current sensors, three (3) for each inverter, and one (1) for each AC phase. The current sensors measure the current flow and direction through the AC bus bars between the SKiM® modules and the Drive Unit motors. The sensor data is sent directly to the BCA card for the respective inverter.

Passive Discharge Resistor

The DPIM2 contains one (1) passive discharge resistor located under the HVIL circuit card on the inverter B side of the DPIM2. The passive discharge resistor dissipates stored electrical energy, in the form of heat, in the absence of active discharge.

The DPIM2 also contains a bank of large DC capacitors in the center located under the main DC bus bars. The DC link bus bars connect to the main DC bus bars through a choke. The main DC bus bars, laminated in white insulation, connect to the SKiM® modules. The AC link busbars attach to the SKiM® modules and to the main AC bus bars.

DPIM Service Note Regarding Water Intrusion:

Both DPIM1 and DPIM2 contain a number of electronic circuit boards that control the inverter, communicate with other components, and collect data from sensors in the H 40/50 EP hybrid system. As with any other electronic devices such as smartphones, laptop computers, or tablet devices, the DPIM1 and DPIM2 are sensitive to water which can create electrical shorts on any of the electronic components in the DPIM. Care must be taken to ensure the DPIM is protected from water intrusion.

It is important to replace gaskets on the DPIM1 and DPIM2 when the DPIM is serviced or removed/installed. [Table 1](#) includes a reference to gasket part numbers and [Figure 1](#) shows some of these gaskets. Refer to Parts Catalog PC3717 for more information.

- AC and DC lug box cover gaskets should be replaced each time the lug box covers are removed.
- The DPIM2 main cover gasket should be replaced each time the main cover is removed for internal service.
- The single-use gasket on all three (3) high voltage cable connections to the DPIM1 and DPIM2 should be replaced each time the cable flange is removed.
- The encoder and signal interface gaskets should be replaced each time they are removed from the DPIM2 housing.
- The gasket between the DC lug box and DPIM2 housing should be replaced when serviced.
- The gaskets between the two AC chokes and DPIM2 housing should be replaced when removed for service.

Table 1. DPIM2 Gaskets (See Figure 1)

Description	P/N	Quantity
DPIM Main Cover	29540714	1
AC Lug Box Cover	29540715	2
DC Lug Box Cover	29540614	1
Signal Interface	29540711	1
Encoders	29540712	2
DC Lug Box to Housing	29540615	1
AC Choke to Housing	29540716	2

When replacing any of the gaskets on the DPIM, it is important to install the hollow EMI gaskets properly and carefully to avoid damaging the new gasket. It is recommended to work the gasket into the cleaned groove in a motion perpendicular to the groove to avoid stretching or compressing the gaskets. Installing the gasket in a parallel motion to the groove risks stretching and ripping the hollow gasket which can result in an improper fit in the groove. It is not acceptable to seat the gasket into the groove using the cover and tightening the screws. Do not use a smooth socket or extension to roll the gasket into the groove. See [Figure 2](#) for examples of improper gasket installation.

Screw installation torque is also important in keeping water out of the DPIM. It is critical that all screws are properly torqued to the values listed in Tech Data. [Table 2](#) contains references for part numbers and torques; refer to the Parts Catalog PC3717 and Service Manual SM3602 Appendix E for more information. Screws that are broken or missing must be replaced to prevent water intrusion into the DPIM. Bosch thread repair kit J-51101 (detailed in SIL 21-EP-13) contains tools for repairing AC and DC lug box cover threads.

Table 2. Screw Torque Table

Screw Description	P/N	Torque	Quantity
DPIM Main Cover (M5 x 18mm)	29540732	3.1-3.5 N m (27-31 in-lb)	26
AC & DC Lug Box Cover (M4 x 12mm)	29540533	1.2-1.5 N m (10.6-13.3 in-lb)	28
High Voltage Cable Flange (M6 x 20mm)	n/a	5.3-6.0 N m (47-53 in-lb)	12
Signal Interface & Encoders (M4 x 14mm)	29540721	1.2-1.5 N m (10.6-13.3 in-lb)	12
DC Lug Box to Housing (M4 x 14mm)			12
AC Choke to Housing (M4 x 14mm)			20

Finally, it is important to ensure water does not enter the DPIM through the high voltage and low voltage connectors. The low voltage connectors provided by the OEM should be inspected for missing, worn, or damaged seals. Cavity plugs are to be installed in unpopulated pin locations in the low voltage harness to keep water from entering the DPIM. The single-use gaskets on the cable flanges and proper assembly of the flange assembly will keep water from entering the DPIM. [Table 3](#) shows part numbers for these seals, plugs, and gasket. [Figure 3](#) shows some of these parts. Refer to the Troubleshooting Manual TS5812 or TS3715 Appendix E for more information.

Table 3. Part Suppliers and Numbers

Description	Supplier	P/N	Quantity
High Voltage Cable Flange Gasket	Allison Transmission	29550771	3
Seal, 24-way	Delphi	12110403	1
Seal, 32-way	Delphi	15305333	2
Cavity Plug, 100W	Delphi	12129557	45

Service Parts:

It is important to remember that a DPIM2 is serviceable while a DPIM1 is not serviceable. [Table 4](#) shows service kits and the related SIL with parts ordering information and procedures. Refer to the Service Information Letters link on the Allison Extranet for more information and the latest SILs.

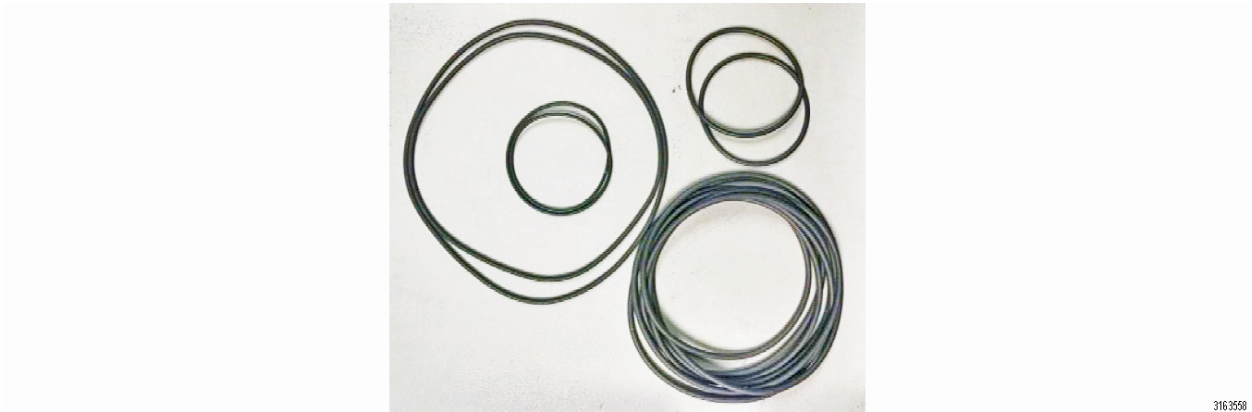
Table 4. SIL List

Description	SIL
HVIL Card	03-EP-14
Passive Discharge Resistor	04-EP-15
BCA Card	02-EP-16
Current Sensors	12-EP-14
SKiM® Modules	01-EP-15

[Table 5](#) provides a reference to recently released DPIM2 parts available for service. Refer to Parts Catalog PC3717 for more information and a complete parts list.

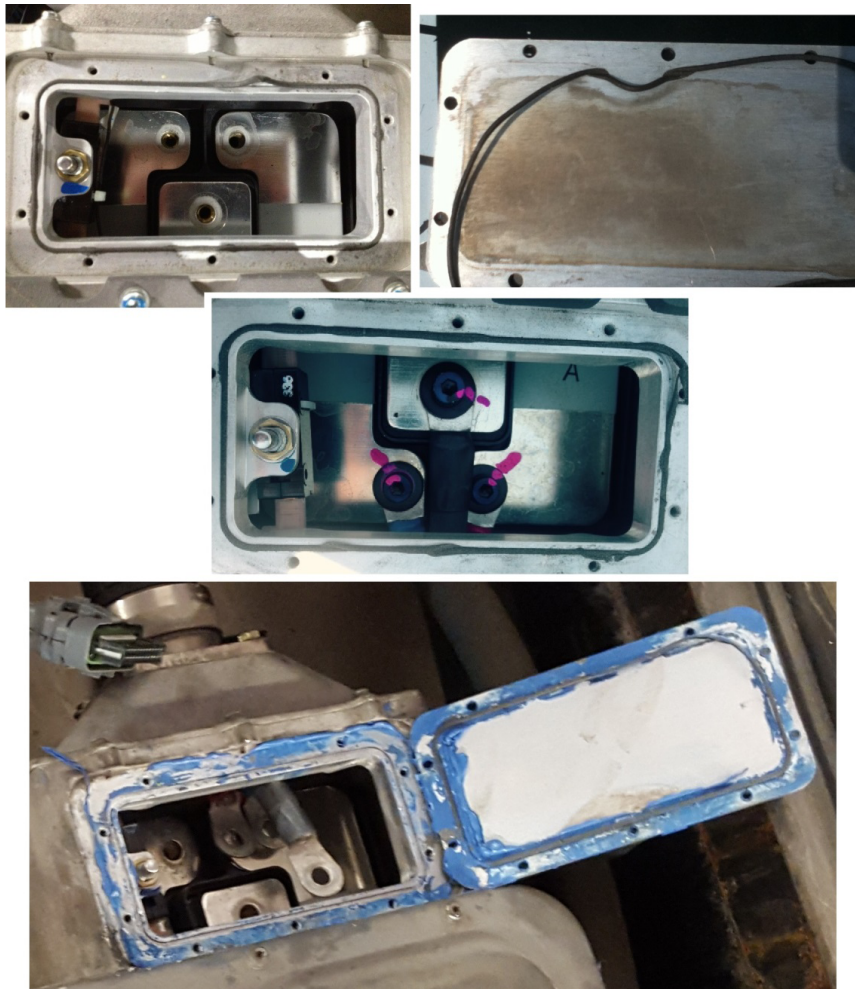
Table 5. DPIM2 Parts Available

P/N	Description	P/N	Description
29540559	Cover, White, DC Capacitor	29546803	Harness, Signal Interface to BCA
29540604	Terminal Block, DC	29546806	Terminal Block, AC
29540711	Signal Interface Gasket	29546996	Choke, AC
29540736	Caution Label, HV Cover	29547434	Encoder Card, Inverter B
29546732	Busbar, DC Link	29547435	Signal Interface Card
29546737	Choke, DC	29546461	Encoder Card, Inverter A
29546764	AC Busbar, Inverter B	29549263	Shelf, BCA, Inverter B
29546765	AC Busbar, Inverter A	29549264	Shelf, BCA, Inverter A
29546766	Harness, Inverter A, HVIL to BCA	29549340	HVIL Support
29546767	Harness, Inverter B, Encoder to BCA	29549656	Diode, Signal Interface, Indicator
29546768	Harness, Inverter B, HVIL to BCA	29549915	Busbar, AC Link
29546769	Harness, Inverter A, Encoder to BCA		



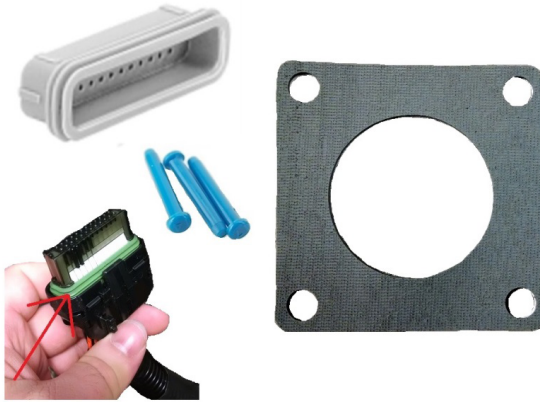
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Figure 1. Various DPIM Gaskets



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Figure 2. Improper Gasket Installations



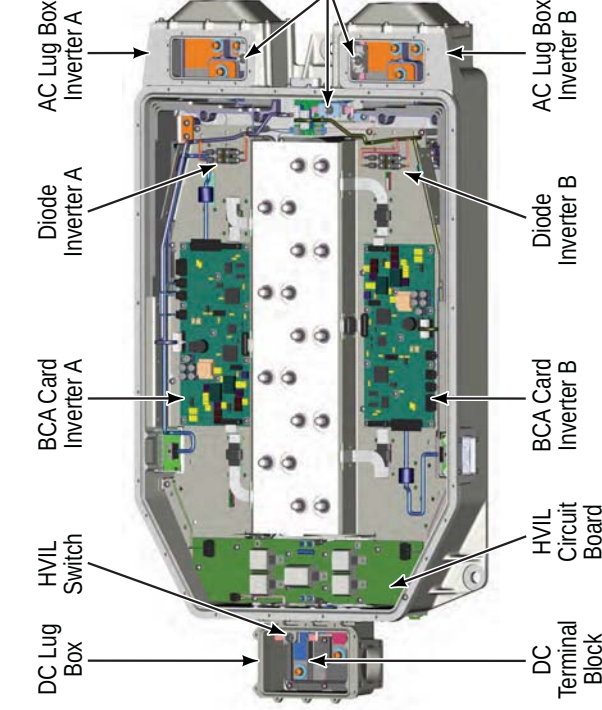
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Figure 3. High Voltage and Low Voltage Gaskets and Plugs

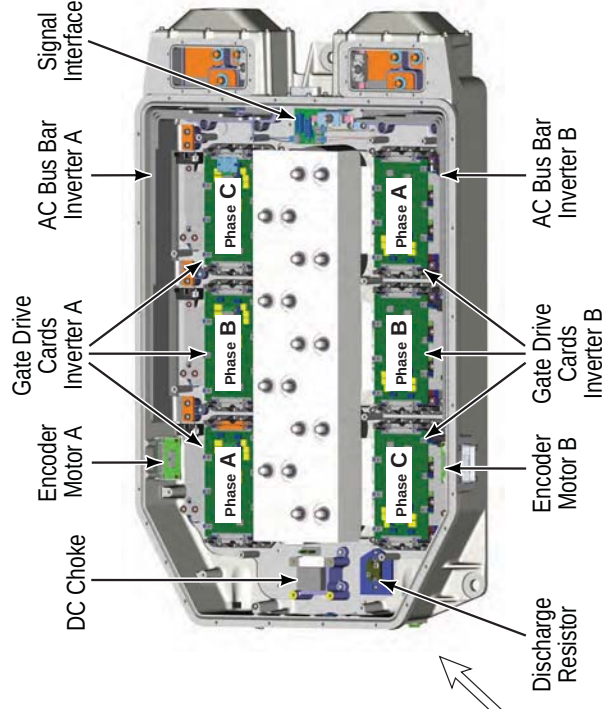
NOTE: This illustration is to be used for identifying the name and location of components within the Dual Power Inverter Module 2 (DPIM2). It is not intended to be used for disassembly and assembly procedures.

DPIM2

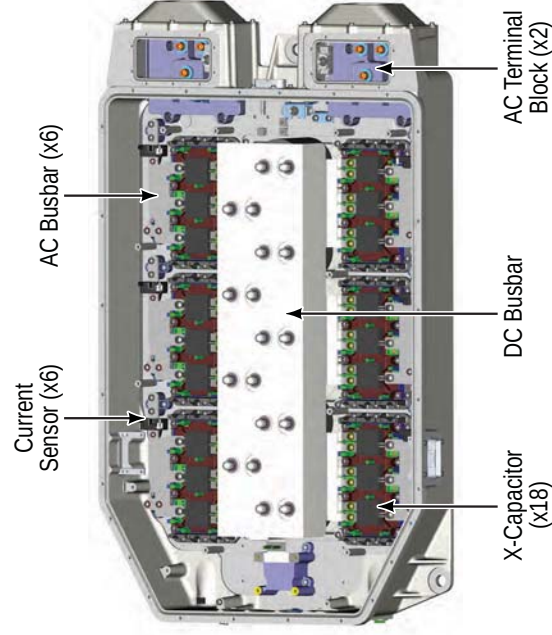
Levels of Assembly



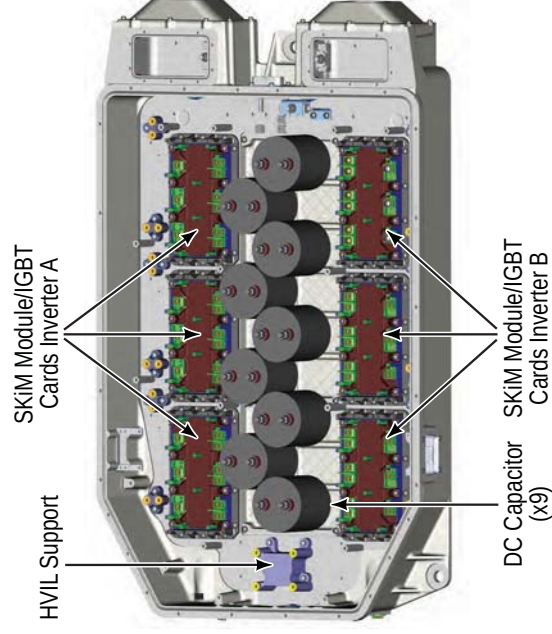
Level 1



Level 2



Level 3



Level 4