Packard Electrical/Electronic Architecture
Hybrid & Electric Vehicle Portfolio
Connection Systems, Electrical Centers, Wiring Assemblies and Charging Solutions
Hybrid and electric vehicles present unique challenges when it comes to electrical/electronic (E/E) architecture. They demand performance requirements including shielding to protect against electromagnetic interference, sealing to prevent short circuits and arcing, and the incorporation of a hazardous voltage interlock loop, or HVIL. To help keep drivers and service technicians safe in high-voltage environments, a number of complex factors in the electrical system must be addressed and engineered for reliability and peak performance.

Delphi’s extensive HEV/EV product portfolio offers a complete range of E/E architecture systems and components for every high-power, high-voltage application, whether off-the-shelf or customized. Delphi has E/E architecture technologies specific for battery-powered transportation, including harness protection systems such as bent aluminum tubes or molded channels, battery monitoring devices, plug-in charging, and a new series of connection systems that incorporate the shielding, sealing, and high-voltage safety interconnects required for high-voltage/high-power applications.

Delphi’s vast systems knowledge, innovative automotive component design and integration skills helps reduce costs, provide peak performance and offer a robust portfolio of hybrid and electric vehicle components and systems.

We are where you need us to be

Delphi has a strong global engineering team with Global Hybrid Development Centers dedicated to Electrical/Electronic Architecture in Champion, Ohio USA, Wuppertal, Germany and Shanghai, China. Our exclusive Velocity Tool Suite™ of proprietary analysis, design and simulation tools allow us to look at all the options, seamlessly import customer data, and speed development through virtual testing and validation, wherever we are around the globe.

We have custom, optimized E/E architecture solutions that offer significant benefits for today’s hybrid and electric vehicles, including:

- Greater functionality
- Reduced mass and packaging space
- Cost savings
- Improved reliability
- Environmental friendliness
At Delphi, we recognize the importance of vehicle manufacturers offering more comfort, more efficiency, more fuel economy and more environmentally friendly cars and trucks accessible to more consumers. We believe in working together to create the most value for our customers. Our systems knowledge, innovative automotive component design and integration skills extend through our entire organization. This helps us reduce costs, provide peak performance and offer a robust portfolio of hybrid and electric vehicle components and systems including:

- Charging Systems
- Connection Systems
- Electrical Centers
- Energy Storage Systems
- Power Electronics
- Powertrain Systems
- Service Solutions
- Thermal Systems
- Wiring Assemblies

For more information, visit www.delphi.com/hybrid
## Delphi Shield-Pack™ Application Guideline

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<td>Main Power Output</td>
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<td>Manual Service Disconnect</td>
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<td>DC Input</td>
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<td>1W Filtered/1W Unfiltered 200A</td>
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<td>AC Input</td>
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Part numbers, specifications, dimensions and performance data in this catalog are for general reference only and are subject to change without notice. To verify product information, please contact a Delphi representative.
Delphi Shield-Pack™ High-Power Connection Systems

Delphi Shield-Pack™ connection systems have been specifically designed for high-voltage applications used on hybrid and electric vehicles. They provide power terminal isolation for 600V applications, finger proof/touch safe protection, and HVIL circuit integration into the connection system design. The Shield-Pack™ family comes in three series to cover high-voltage applications up to 250 amps. The HV280 series is suitable for applications up to 40 amps, HV1000 up to 145 amps, and HV2000 up to 250 amps. The Delphi Shield-Pack™ family provides customers with one of the largest globally available connection systems portfolios for HEV/EV system optimization.

Special attention is required for high-voltage connection systems. All applications of Delphi Shield-Pack™ series should be discussed with Delphi to ensure proper application of the connection system. Please consult Delphi for technical support.
Shield-Pack™ HV280
HVIL Shunt in Header, Face Seal to Device

Application
High-voltage accessories connection system

Description
• Sealed connection system
• Panel mount to device with face seal
• Two HV power circuits (2.8mm terminal)
• HVIL shunted-in header with five-second time delay
• Flange size: 43mm x 49mm
• Finger proof/touch safe
• Cable range: 2mm² to 5mm² power circuit; 0.5mm² HVIL circuit
• Three keys/indexes

Performance
• Current capacity: 40A continuous at 85°C
• Voltage: 600V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K
• Electrical protection: IP2XB

Part Number Information

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<th>Key/</th>
<th>Header Connector</th>
<th>Mating Device Detail</th>
<th>HV Connector</th>
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*Part numbers in parentheses to be replaced in 2011. Contact Delphi for details.

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Shield-Pack™ HV280
HVIL Shunt in Header, Bore Seal to Device

Application
High-voltage accessories connection system

Description
• Sealed connection system
• Sealed to device case through bore seal
• Two HV power circuits (2.8mm terminal)
• HVIL shunted-in header with five-second time delay
• Flange size: 43mm x 49mm
• Finger proof/touch safe
• Cable range: 2mm² to 5mm² power circuit; 0.5mm² HVIL circuit
• Three keys/indexes

Performance
• Current capacity: 40A continuous at 85°C
• Voltage: 600V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K
• Electrical protection: IP2XB

Part Number Information

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Shield-Pack™ HV280
2 Way Connection System Without HVIL

Application
• High-voltage accessories connection system when no HVIL is required

Description
• Sealed to device case
• Two HV power circuits (2.8mm terminal)
• Finger proof/touch safe
• Cable range: 2mm² to 5mm² power circuit
• One key/index

Performance
• Current capacity: 40A continuous at 85°C
• Voltage: 600V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K
• Electrical protection: IP2XB

Part Number Information

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<tr>
<th>Key/Index</th>
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*Part numbers in parentheses to be replaced in 2011. Contact Delphi for details.

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To verify product information, please contact a Delphi representative.
Shield-Pack™ HV280
2 Way Connection System With Multiple HVIL Options

Application
- High-voltage accessories connection system

Description
- Sealed to device case
- Two HV power circuits (2.8mm terminal)
- HVIL available in two configurations: pass-through header, shunted-in header
- HVIL with five-second time delay
- Finger proof/touch safe
- Cable range: 2mm² to 5mm² power circuit; 0.5mm² HVIL circuit
- Three keys/indexes

Performance
- Current capacity: 40A continuous at 85°C
- Voltage: 600V
- Temperature range: -40°C to +125°C
- Sealing protection: IP67, IP6K9K
- Electrical protection: IP2XB

Part Number Information

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<th>Header with HVIL Pass-Through to Module</th>
<th>Mating Information</th>
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*Part numbers in parentheses to be replaced in 2011. Contact Delphi for details.

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Shield-Pack™ HV280
2 Way Inline Connection System With HVIL Shunt

Application
• Inline connection system for high-voltage accessories

Description
• Sealed connection system
• Two HV power circuits (2.8mm terminal)
• HVIL with five-second time delay
• Finger proof/touch safe
• Cable range: 2mm² to 5mm² power circuit; 0.5mm² HVIL circuit
• Two keys/indexes

Performance
• Current capacity: 40A continuous at 85°C
• Voltage: 600V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K
• Electrical protection: IP2XB

Part Number Information

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<th>Female Connector</th>
<th>HVIL Connector</th>
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*Part numbers in parentheses to be replaced in 2011. Contact Delphi for details.
Shield-Pack™ HV2000
2 Way Right Angle Connection System With Internal HVIL; IP2XB Harness Connector Only

Application
- High-voltage/high-current modules: inverter, battery

Description
- Panel mount to device with face seal to module
- Header available with or without terminals
- Internal HVIL
- Harness connector mates in right angle direction
- Finger proof/touch safe harness connector only
- Cable range: 25mm² to 50mm²
- One key/index

Performance
- Current capacity: 250A continuous at 85°C
- Voltage: 600V
- Temperature range: -40°C to +125°C
- Sealing protection: IP67, IP6K9K
- Electrical protection: IP2XB harness connector only

Part Number Information

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<th>Header with Terminal</th>
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Power Pack Unshielded High-Current Connection Systems

Power Pack Connection Systems meet the increasing demand for high-current/high-power, hand-pluggable connections. The patented Power Pack portfolio offers two product sizes—the Power Pack 1000 for current demand to 145 amps, and the Power Pack 2000 for current demands to 250 amps. The highlight of the Power Pack family is the terminal system, which allows Power Pack connectors to mate in either inline or right-angle direction, which enables easy routing of large cables typical in high-current applications.
Power Pack 1000
2 Way Inline Connectors

Application
• High-current wiring harness inline

Description
• Sealed connection system
• Silver-plated, multi-contact terminal system
• Cable range: 6mm² to 25mm²
• Two keys/indexes

Performance
• Current capacity: 145A continuous at 85°C
• Voltage: 12V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K

Part Number Information

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Power Pack 1000
2 Way Device Connectors

Application
- High-current device applications

Description
- Sealed connection system
- Silver-plated, multi-contact terminal system
- Cable range: 6mm² to 25mm²
- Two keys/indexes

Performance
- Current capacity: 145A continuous at 85°C
- Voltage: 12V
- Temperature range: -40°C to +125°C
- Sealing protection: IP67, IP6K9K

Part Number Information

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Power Pack 2000
1 Way Inline Connectors

Application
• Inline connections up to 250A

Description
• Sealed system
• Silver-plated, multi-contact terminal system
• Cable range: 19mm² to 62mm²
• One key/index

Performance
• Current capacity: 250A continuous at 85°C
• Voltage: 12V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K

Part Number Information

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Power Pack 2000
1 Way Device and Pass-Through Connectors

Application
• Device connections up to 250A
• Sealed pass-through header

Description
• Sealed system
• Silver-plated, multi-contact terminal system
• Cable range: 19mm² to 62mm²
• One key/index

Performance
• Current capacity: 250A continuous at 85°C
• Voltage: 12V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K

Part Number Information

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Application Specific High-Power Products

Delphi Application Specific Connection Systems are uniquely designed for the Input/Output (I/O) needs of various power electronic modules. Delphi’s Application Specific Connection Systems include on-board charger connections to address the high-voltage/unshielded circuit isolation, 14V high-current, filtered headers to protect other vehicle systems from interference, shielded pass-through systems to motors or other devices. Delphi also provides custom design solutions to specific system requirements. Contact Delphi to discuss your specific system needs.
HV150 On-Board Charger Connectors
3 Way High-Voltage Unshielded Connection System

Application
• High-voltage unshielded system for on-board charger applications (Level 1)

Description
• Sealed connection system
• 1.5mm terminal
• Unshielded with terminal spacing for HV applications
• Finger proof/touch safe
• Cable range: 2mm²
• One key/index

Performance
• Current capacity: 16A continuous at 85°C
• Voltage: 600V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K
• Electrical protection: IP2XB

Part Number Information

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*Part numbers in parentheses to be replaced in 2011. Contact Delphi for details.
HV150 On-Board Charger Connectors
3 Way Unshielded With HVIL

Application
• High-voltage unshielded system for on-board charger applications
  (Level 1)

Description
• Sealed connection system
• 1.5mm terminal
• Unshielded with terminal spacing for HV applications
• Finger proof/touch safe
• Cable range: 2mm²
• Two keys/indexes

Performance
• Current capacity: 16A continuous at 85°C
• Voltage: 600V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K
• Electrical protection: IP2XB

Part Number Information

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<th>Key/ Index</th>
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High-Voltage Pass-Through
Bolted Pass-Through Connections

Application
• High-voltage/High vibration connections for motors or power electronics

Description
• 1 Way sealed and shielded
• Ring terminal bolted to device
• Shield bolted to device case
• Cable range: 25mm² to 35mm²
• Three keys/indexes

Performance
• Continuous current: 250A continuous at 85°C
• Voltage: 600V
• Temperature range: -40°C to +125°C
• Sealing protection: IP67, IP6K9K

Part Number Information

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Hybrid & Electric Vehicle Charging Systems & Components

Delphi believes that in order for hybrid and electric vehicles to become mainstream, they need to be made accessible and practical for the average consumer. That’s why we are investing in technology to help facilitate a global charging infrastructure. From the Delphi Charge Coupler Connector with Cable for integration into Electric Vehicle Supply Equipment (EVSE), to the UL recognized Portable Electric Vehicle Charger and SAE J1772 Charge Inlets, hybrid and electric vehicles can be powered safely and efficiently at home or away. We’re developing a Delphi Wireless Charging System for EVs to offer the utmost in comfortable, convenient charging. We can help you deliver the fast, safe, reliable charge today’s EV drivers are looking for.
Charge Coupler Connector
Level 1 & Level 2 Charging Cable Assembly

Application
• SAE J1772 cable assembly for integration into charging stations or portable cordsets per customer requirements

Description
• SAE J1772 compliant connection
• Flashlight for easy mate in dark conditions
• Wiring crimps sealed from environment
• Rubber grip on handle for ergonomics
• Available with or without flashlight
• UL recognized
• AC Level 1 (15A @ 120V) and Level 2 (30A @ 240V)

Performance
• Current capacity: 15A and 30A
• Voltage range: 120V and 240V
• Temperature: -40°C to +60°C
• Validation: UL 2251

Available Options
• Call for additional configurations

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Charge Inlet
Level 1 & 2 Vehicle Charging Inlet

Application
- Plug-in hybrid and electric vehicle charge inlet

Description
- Interface complies with SAE J1772 and IEC 62196-2 Type 1 standard
- Panel mounts to vehicle
- Protective grommet/wire dress mounts to inlet
- Available with latching cover or without cover
- Cover mounting features allow latch to open left or right

Performance
- Supports: AC Level 1 (15A, 120V) and AC Level 2 (30A, 240V)
- Voltage: 600V maximum rating
- Temperature: -40°C to +85°C
- Validation: UL recognized, Delphi GTP
- Electrical protection: IP2XB
- Design life: 10,000 mating cycles

Part Number Information

<table>
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<tr>
<th>Configuration</th>
<th>Assembly Part Number</th>
<th>Mating Information</th>
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<tbody>
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<td>No cover</td>
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<tr>
<td>With latching cover, opens left</td>
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HV Electrical Centers

Delphi High-Voltage Electrical Centers help provide safe power distribution of high-voltage circuits. Delphi provides electrical centers designed specifically for managing battery power. Delphi battery electrical centers integrate contactors, pre-charge resistors, circuit protection for auxiliary loads, and current sensors to meet system requirements. Delphi also provides custom shielded electrical centers integrating devices such as contactors, high-voltage fuses, bussing, and I/O managed through Shield-Pack™ Connection Systems.
Application
• High-voltage battery electrical center

Description
• Battery pack mounted contactor and sensing device
• Provides galvanic isolation of the high-voltage battery
• Pre-charge protects contactors from high-current in-rush
• Sensing of battery current and voltage
• Provides circuit protection for auxiliary loads
• Size: 268mm L x 200mm W x 78mm H

Application
• High-voltage electrical center

Description
• Custom solutions to system requirements
• Integration of terminal, contactor, and/or HV fuses
• Shielded and sealed system
• Harness connections through Shield-Pack™ connection systems
• Venting for pressure variations
Delphi’s High-Voltage (HV) Wiring Assemblies integrate Shield-Pack™ Connections and HV electrical centers, providing customers with an optimized design. Delphi’s High-Voltage Wiring Assemblies are developed with the customer to meet their specifications. Our HV harnesses are available with both shielded and unshielded cables, addressing the full range of HEV/EV product requirements. Delphi has years of experience in the processing of HV wiring assemblies. All Delphi High-Voltage Wiring Assemblies are tested to verify the cable sealing, ensuring quality and providing safety. Delphi’s High-Voltage Wiring Assemblies can be used for applications that range from 36V to 600V and cable sizes as large as 103mm².
Delphi has made every effort to ensure that the information contained in this document is accurate. We recommend that you use this catalog as a guide only.

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