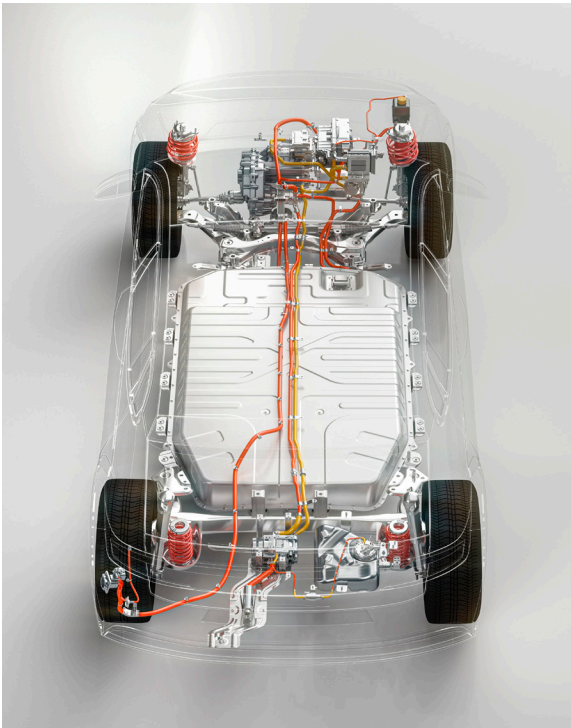




**Amphenol**



# EMOBILITY + BATTERY

Amphenol Electrification Solutions

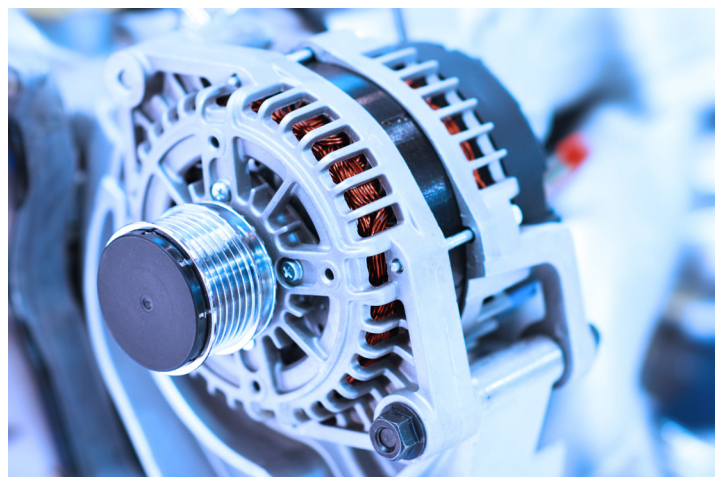
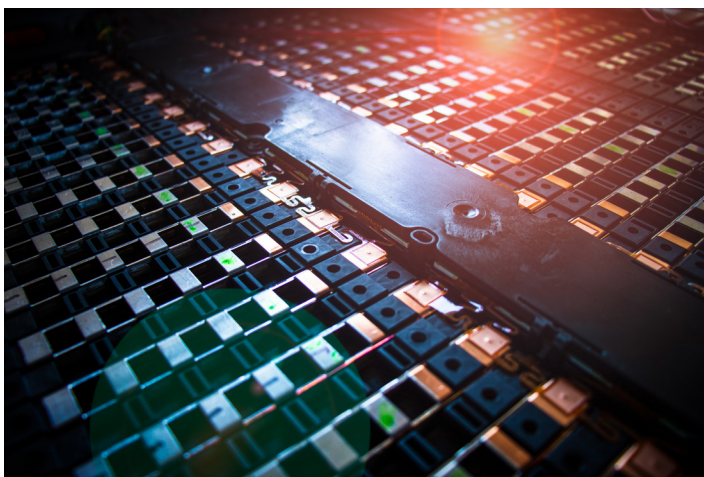


# AMPHENOL OVERVIEW

Amphenol is the **world leader** in connectivity and sensing solutions for electrified mobility.

As the second largest manufacturer in the world, Amphenol has over 125 manufacturing locations worldwide with engineering teams and businesses poised to deliver regionalized support, customization, and manufacturing, while also offering the steady supply and strategic impact of a global footprint.

In the quick-shifting and rapidly growing world of electric transportation, we see our entrepreneurial spirit and breadth of custom and standard offerings as differentiators, offering individual components and assemblies from the drive train through to the charging station. An intentionally flat organization with a customer-centric approach, Amphenol stays dynamic and responsive to both large and small projects.



# EMOBILITY + BATTERY PRODUCT CATEGORIES

From high-voltage and low-voltage connectors, to flex and rigid busbars, to complex cable assemblies, Amphenol supports its customers with full system solutions in the electrification revolution.

**How to use this document:**

This is intended as a glimpse into Amphenol’s capabilities and standard catalog. Due to the large number of parts, configurations, specifications and details, only a small portion of Amphenol’s full portfolio can be presented in this format. For additional information and specific product requests, please use the contacts on page 15.

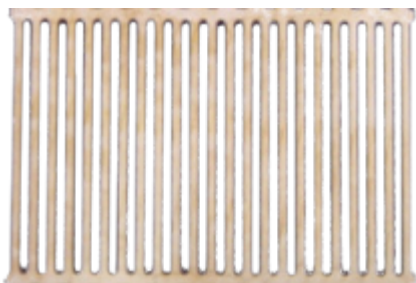
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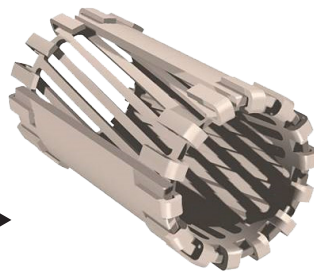
# RADSOK TECHNOLOGY

The core technology for any power connection system is the contact. The ability to ensure repeatable, symmetric and positive mating is critical for electrical and thermal performance of a connector. Amphenol Radsok® is an advanced series of contacts designed to maximize power delivery while minimizing space requirements. Radsok contacts feature a twisted grid hyperbolic structure, enabling long, symmetric contact along each lamella.

Radsok R8S is designed specifically for the automotive industry, minimizing the length and diameter required for a given current while maintaining excellent temperature response. Available in RoHS compliant, beryllium-free material, the contact is produced in a high-speed, precision stamping and bending process from only two components. Available in sizes up to 14mm, Radsok connectors are configurable and customizable for a variety of packaging and routing solutions. Amphenol is continuously improving connector solutions, and have a power solution for every requirement.



Flat Stamped Grid



Twisted, Hyperbolic Geometry



Socket Contacts



## Key Benefits

- Higher Amperage with Smaller Envelopes
- High Durability
- High Current Ratings
- Low Mating Force

## 4mm Radsok® -R8S

- Ideal for Board to Busbar Applications
- Snap-in Connection
- Temperature and Corrosion Resistance
- Self-cleaning Technology

## Radsok® Enduro

- High Cycle Life: Can be Mated and Unmated for 100k Cycles with Minimal Degradation
- Self-cleaning
- Field Replaceable
- Good for Fast Charging Applications

# HIGH VOLTAGE/HIGH CURRENT CONNECTORS

Amphenol offers a wide variety of ratings, configurations, pole counts and packaging form factors for all manners of Electric Vehicle. From light off road use to high power off highway vehicle applications, Amphenol has a standard connector to offer.

Rugged, dependable and field-proven in countless applications, Amphenol connectors hold up to the harshest environments. For high-volume automotive applications, Amphenol is adept at working with OEMs and Tier One suppliers to achieve the necessary form factors and specifications.



## Heavysok®

**2-3 Pole | 800V | 200-320A**

Available in 8mm and 14mm Radsok contact sizes, this connector family is a robust choice for DC traction power, transmission, and motor applications.

- HVIL
- Shielded
- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant



## Powersok® -2SC

**2 Pole | 1000V | 365A**

The Powersok® -2SC in 14mm and 90° achieves the highest power transmission with a conductor cross-section of 95mm<sup>2</sup>.

- New LPA and CPA
- 360° shielding
- HVIL
- Sealed, powerful connector (rated for IP67 and IP6K9K)
- LV 215 tested



## HVC 6-12mm

**1-3 Pole | 1000V | 220A**

A flexible solution for battery, inverter and other power connections, this Radsok contact system is available standard and compliant with USCAR and LV requirements. Available in alternative cable directions including 90°, 120°, 150°, and 180°.

- HVIL
- Shielded
- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant



## HVSL800

**2 Pole | 1000V | 180A**

Standard battery and power distribution connector, offering short lead times and low cost production.

- HVIL
- Shielded
- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant

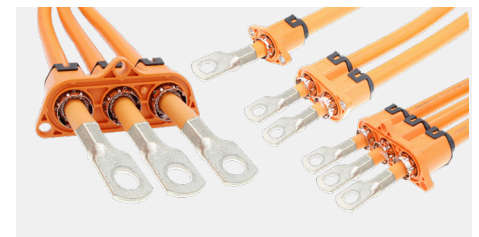


## MSD

**800V-1500V | Up to 630A**

Manual Service Disconnects available in several form factors, fused and unfused, and various current and voltage rating combinations. Amphenol engineers will work with your current profile to ensure compatibility.

- HVIL
- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant



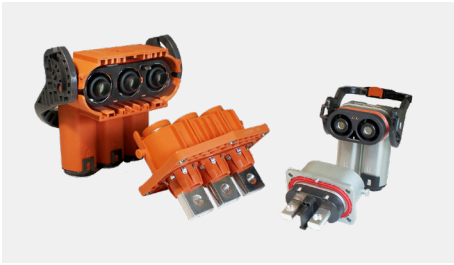
## HVPT

**1-3 Pole | 25-70mm<sup>2</sup> cable**

Passthroughs available in multiple orientations and sealing combinations, stackable and configurable to fit your terminations and bend requirements.

- 360 Degree Shielding
- Sealed IP6k9k

# HIGH VOLTAGE/HIGH CURRENT CONNECTORS



## HVSL1000

1-3 Pole | 1000V | 250A

Inline and header mount versions available, this connector family offers excellent flexibility and standard part availability.

- HVIL
- Shielded
- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant

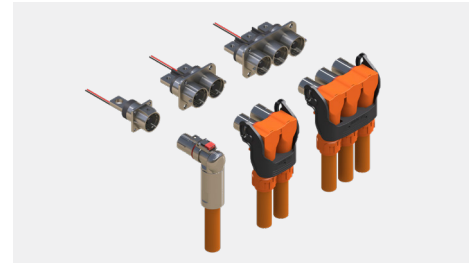


## HV - AC Eyelet Connector

3 Pole | 50mm<sup>2</sup> wire

Automotive flange connection offers a robust solution- form factors and packaging customization is our specialty.

- 360 degree shielding
- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant



## PowerLok

1-3 Pole | 1000V | 20-500A

One of our most popular bus and truck connectors, PowerLok offers a robust and high-performing connection for high power applications.

- HVIL
- Shielded
- Sealed IP67
- Metal housing

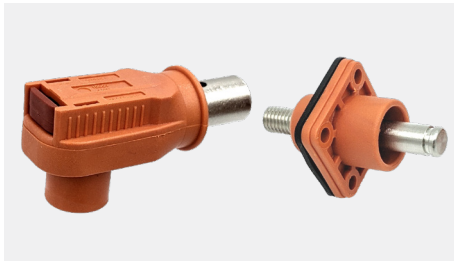


## PowerLok G2

1-3 Pole | 1500V | 20-500A

Updated design for the popular Powerlok connector series, the new generation features improved shielding, sealing, and vibration performance with automotive-style features such as CPA.

- HVIL
- Shielded
- Sealed (IP67/IP6k9K)
- Metal Housing



## RadLok

1 Pole | 1000V | 70-500A

A low cost solution while maintaining high electrical and thermal performance, RadLok connectors feature Radsok technology in a compact package.

- Mechanical Latching without Tool
- Quick Connect Replacement for Bolt-down Lug



## HVMC 12mm

1-3 Pole | 1500V | 350A

High power 12mm Radsok contacts allow for strong thermal performance, while the housing provides for a robust, durable connector with excellent shielding.

- HVIL
- Shielded
- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant

# HIGH VOLTAGE/HIGH CURRENT CONNECTORS



## SurLok Plus

1 Pole | 1500V | 120-500A

The SurLok Plus compression lug is a field installable, high reliable alternative to common compression lugs. Now available in options up to 1500V and 500A in a USCAR and LV compliant package.

- Sealed IP6k9k
- CPA
- HVIL



## SurLok Plus EMI

1 Pole | 1000V | 150-250A

All the benefits of the SurLok Plus with the addition of EMI shielding and HVIL options.

- HVIL
- Shielded
- Sealed IP67



## HVC 12mm

1 Pole | 1000V | up to 250A

12mm flat contacts able to maximize the connection space thanks to right angle design.

- Shielded
- HVIL
- Sealed IP6k9k



## ePower

2-3 Pole | 1000V | 200-700A

Our most rugged and highest power EV-specific connector, utilized in extreme conditions where maximum power delivery is essential.

- HVIL
- Shielded
- Sealed IP67



## ePower Lite

2-4 Pole | 800V | 70A

A lower power solution with many features, ePower Lite features Radsok technology to minimize footprint and maximize current delivery.

- HVIL
- Shielded
- Sealed IP67



## HVMC 14mm

2 Pole | 1000V | 450A

Amphenol's highest power battery connector, this automotive compliant two pole connector mates high power output with robust, lasting design.

- HVIL
- Shielded
- Sealed IP6k9k



# HIGH VOLTAGE AUXILIARY CONNECTORS

Electrification requires shifting conventional auxiliary loads from an engine to traction battery power. To accommodate strict packaging requirements and decreased current needs, Amphenol has a wide variety of single to six pole connectors with both blade style and circular RADSOK style contacts.



## HVC 4way

4 Pole | 800V | 75A

High voltage auxiliary connection with innovative packaging solutions.

- HVIL
- Shielded
- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant



## HVSLW 282/362/633

2,3 Pole | 1000V | 32-80A

A light-weight, waterproof version of the HVSL connector with soldered pins for PCB board.

- HVIL
- Shielded
- IP67 unmated, IP6k9k mated, IP2XB (Touch-proof)
- USCAR 2&37
- Designed for Automation



## HVSL 362-6

2-6 Pole | 1000V | 40-95A

Low cost circular terminals designed to consolidate multiple loads into one connector.

- HVIL
- Shielded
- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant



## HVBI Mono

1 Pole | 1000V | 120-250A

A more robust, low cost solution for single pole applications.

- HVIL
- Shielded
- IP6k9k
- USCAR 2&37, LV 215 Compliant



## ePower Lite

2-4 Pole | 800V | 70A

An auxiliary power solution with many features, ePower Lite features Radsok technology to minimize footprint and maximize current delivery.

- HVIL
- Shielded
- Sealed IP67



## HVC4P

4 Poles | 1000V | up to 50A

High voltage & high current module for small wire gage.

- Shielded
- CPA
- Sealed IP6k9k

# 48V HYBRID ARCHITECTURE CONNECTORS

Amphenol is a key partner in offering solutions for 48V Hybrid System with established products able to supply power to different sub-systems, including options for sealed and unsealed designs, CPA and TPA. As with all Amphenol power connectors, Radsok contact technology allows reliable, high performance.

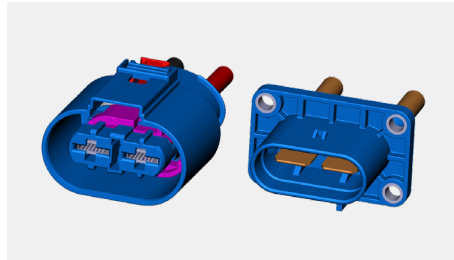


## Active Pinlock

1 pole | <60V | up to 300A

Radsok contact technology is applied to 48V systems and is a cost-effective, quick connecting established solution in the market.

- 8mm and 14mm Radsok R8S
- From 16 to 95mm<sup>2</sup>
- Push-button for Disassembly



## 48V Interfaces

2-5 poles | up to 150A

Cost efficient solutions for transmitting high currents in automotive 48V infrastructure also with combined HV/LV ports.

- Shielded
- Sealed IP6K9K
- LV214-215

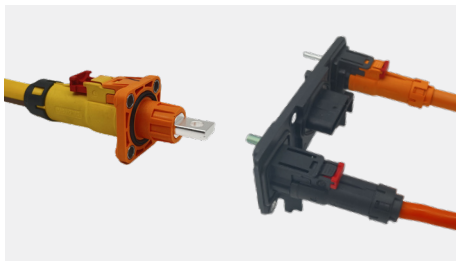


## 48V – 8mm Radsok inline connection

1 pole | <60V | up to 240A

Radsok contact technology is featured as in-line plug to plug connection as reliable solution for LV power application.

- 8mm Radsok R8S
- CPA
- IP6K9K
- LV214 Compliance



## HVSC1P80

1 Pole | 1000V | 180A

A sealed, USCAR and LV compliant connector, this is a cost effective solution when EMI is not a strong concern, but a standard part with important safety features is needed.

- Sealed IP6k9k
- USCAR 2&37, LV 215 Compliant



## 8mm Smartsok-1S

1 pole | <60V | up to 240A

Radsok R8S features an optimized power-density and sophisticated high current applications challenging minimal space environment

- 8mm Radsok R8S
- Up to 50mm<sup>2</sup>
- CPA

# SIGNAL CONNECTIONS

Amphenol offers a wide range of signal connectors able to match any customer requirements. Options include multi-density insert arrangements, sealed and touch-proof solutions, EMI protection, circular and rectangular shape, various installation method and crimp style.



## A Series™

Sealed heavy duty, multi-pin plastic and metal connections include a wide range of products serving many applications.

- Up to 47 Pins
- Sealed IP67/IP69K



## HC32 Series

HC32 Series is a 32 pin sealed and plastic connection.

- 32 Pins
- 13A max
- IP68 (1m/48h) and IP6k9k



## Ecomate Series

Circular, sealed multiway metal and plastic connectors able to cover high-density insert arrangements.

- Bayonett or rapid coupling systems
- From 5 to 300A
- IP65 to 69K

# HYBRID (POWER + SIGNAL/DATA) CONNECTIONS

Secure transmissions of data, signals and power are crucial in industrial applications. Amphenol consistently accomplishes these through its modular interconnect systems in versatile interfaces.



## X-Lok Series

Transmission of data & power in a limited space; push-lock installation, blind-mating with audible feedback.

- Power/Data/Hybrid up to 3+8 (50A+1.5A)
- Sealed IP68/IP69K
- Push-Lock mini: Metal 360° Shielded, <33 contacts, up to 10Gbps Transmission
- UL1977 and 2238+50e, mini is EN61373/SAEJ2839 Shock and Vibration Approved



## 3-3-3 Single Pair Ethernet

Designed in three mechanical mating interfaces; supports 1000Base-T1 (IEEE 802.3 bp)

- 3 Mechanical (Screw Thread/Push Lock/ Push Pull)
- 3 Thread Size Options: M5, M8, M12
- 3 Prices to Fit Your Needs
- Sealed IP68/IP69K



## M Series Sensor

M series is designed for industrial process measurement and control according to IEC standard; offers secure and reliable data and power transmission performance.

- Range of Products: M5, M8, Guided M8, M10.5, M12 7/8" and M23
- Ideal for Compact Designed where Environmental Protection and Stable Connections are Key.

# EV CHARGING

Amphenol serves customers charging anything from passenger to fleet electrified vehicles. Our charging gun and inlet offerings cover the spectrum of standards available in the market, from CCS (SAE J1772, IEC 62196, EN 17186, UL 2251, CE ) to MCS (SAE J3271, IEC 61851). Liquid-cooled options available.



## GB/T

- AC up to 80A
- DC +500A
- Combo Inlet Optional



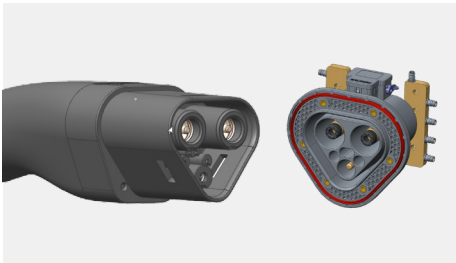
## CCS1 SAE DCFC

- AC up to 80A UL
- DC up to 350A UL
- HPC DC up to +500A UL
- Inlet up to 150mm<sup>2</sup> (500A)



## CCS2 IEC DCFC

- AC up to 63A (1 or 3 Phases)
- DC up to 400A IEC
- HPC DC +500A IEC
- Inlet up to 150mm<sup>2</sup> (500A)



## MCS

- Level 1: +350A
- Level 2: +1000A
- Level 3: 3000A
- 1250V



## AC SAE J1772

- AC up to 80A UL
- DC up to 350A UL
- HPC DC up to +500A UL
- Inlet up to 150mm<sup>2</sup> (500A)



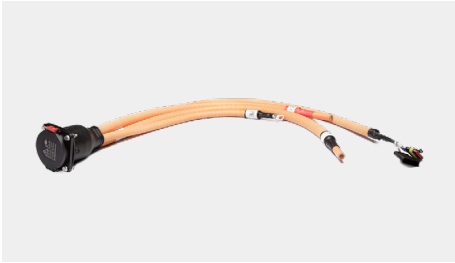
## AC IEC

- AC up to 63A (1 or 3 Phases)
- DC up to 400A IEC
- HPC DC +500A IEC
- Inlet up to 150mm<sup>2</sup> (500A)



# CABLE ASSEMBLIES

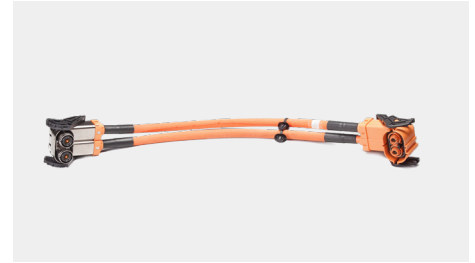
Amphenol offers harness solutions based standard or custom requirements, integrating and complementing the wide range of EV/HEV full interconnect systems.



Expertise in simple and complex cable assembly and harnessing with large variety of cable and connector types. Able to assemble both aluminum and copper wires using Amphenol branded cable or a supplier of the customer's choosing.



Amphenol has deep knowledge of every method of termination, allowing optimized and repeatable high power designs. Amphenol specializes in mechanical crimping, ultrasonic welding, resistance welding, soldering, laser welding and more.

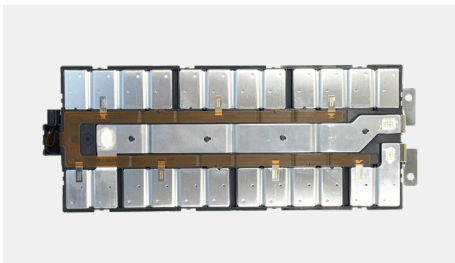


As a value-add service, Amphenol has cable assembly facility throughout every major market. These facilities allow for local production, including BAA compliance in the US. Several low-cost options are available based on delivery location

## CELL CONNECTION SYSTEMS

Cell Connection Systems (CCS) integrate sensors, inter-cell busbars and the associated harnessing structure into the cover of a battery module and pack. The CCS provides temperature and voltage sensing at the cell and busbar level, and ensures low resistance power connectivity to each cell across the pack.

Amphenol has a long and deep history with both CCS design and manufacturing. With assembly facilities worldwide, Amphenol offers a local supply chain solution for this vital and complex battery assembly.



### CCS - FPC solution

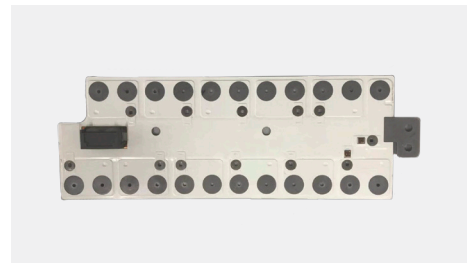
Flexible printed circuits are used to reduce wiring assembly and system costs by integrating many elements into a single flex design. This single component replaces individual fuses, thermistors, voltage sensors and harnessing, among other components. FPC allows for a very compact, vibration resistant design.



### Z-connectors® - FPC/FFC/WTB Connector

Low profile for blind mating, error-proof and ease of assembly with audible feedback.

- 8-40 Pin, 0.9, 1.8, 2.7mm Pitch
- 120 VDC and 1A per Pin
- LV214 Compliant



### Laminated Busbar

A low-profile, safety oriented solution for intercell connection, Amphenol has integrated laminated busbar technology into the battery pack system. Saving space, cost, and assembly time, this is an effective solution in multiple applications.

## SENSORS

Amphenol advanced sensing technology provides rapid and precise feedback for component and system level control requirements. Amphenol carries a large line of sensors for a variety of applications. Thermal monitoring is essential in EV drivetrain and other applications throughout the vehicle. Inline, probe, ring terminal and clip-on style thermistor products demonstrate Amphenol's flexibility with packaging.

Pressure, air quality, and advanced sensors are subject to continuous improvement. Pressure, leak detection, level indication and rotational position are just a snapshot of Amphenol's advanced sensing technologies.



## Temperature Management Sensors

Available in multiple packages for different applications, these thermistors provide quick response to coolant temperature in well-sealed or non-invasive ways.

- Inline, probe, clip-on packages
- Sealed connection
- Variety of RVt curves and platings



## Contact and Non-Contact Temperature Sensors

Amphenol Advanced Sensors NTC thermistor provides high reliability, stability and accuracy for vital battery temperature feedback.

- 1st in industry infrared-based HV temp sensing
- Multiple terminations available
- Configurable RvT curves
- Rated up to 210 degrees C
- Can sense temperature at a distance: charging station cabinets, cables within enclosure...



## Position Sensors

Rotary and linear position indication available using Hall Effect and inductive technologies.

- Various outputs, digital and analog
- High accuracy and precision
- Sealed housings available



## Thermal Runaway Detector

A detection solution for slow and fast thermal runaway is available using novel detection methods from proven sensors, re-purposed for the demanding automotive battery industry

- Flammable gas sensing for early cell venting detection
- Available for mobile and stationary applications



## Resolver

High speed inductive position sensor replaces the resolver in EV motors.

- Greater than 50% weight and 80% size savings vs. traditional resolver
- Low copper content, no magnetic content
- Configurable and scalable
- ASIL compliant



## Coolant Leak/Water Intrusion Sensor

Low-profile, cost effective method of detecting liquid accumulation in a battery pack or other enclosure.

- Fast response to liquid presence
- OBD compliant

# AUTOMOTIVE R&D AND TEST SENSORS

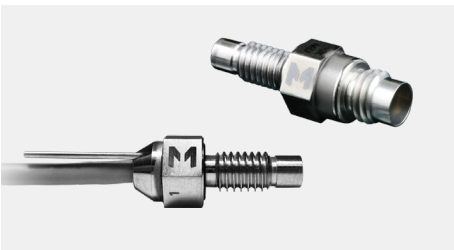
Since 1967, PCB Piezotronics has been a premier supplier of precision sensors and instrumentation for major industries. Our design, engineering, and production teams draw upon state-of-the-art manufacturing capabilities to continually provide better sensing solutions worldwide.

Product lines including sensors for the measurement of acceleration, acoustics, force, load, pressure, shock, strain, torque, and vibration are backed by our Total Customer Satisfaction guarantee. In a global marketplace driven by innovation and improvement, PCB® has a sensor for every stage of product development.



## Vibration

PCB Piezotronics manufactures precision accelerometers to measure vibration, shock, acceleration, and motion for monitoring, control, and NVH testing applications. ICP®, piezoelectric, MEMS, and capacitance sensing technologies are used to fulfill a wide assortment of measurement requirements for field testing, factory production and design, as well as in R&D labs to acquire NVH data.



## Pressure

PCB® and Endevco manufacture miniature pressure transducers with broad frequency response, perfect for ABS and airbag testing.



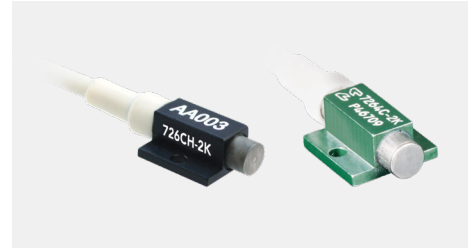
## Acoustics

PCB® designs microphones for automotive testing to measure sound power and sound quality. Our mics are used for NVH testing, cabin noise measurements, and noise source location.



## Force

PCB®'s quartz, piezoelectric force and strain sensors are durable measurement devices that possess exceptional characteristics for the measurement of high frequency dynamic force and strain events. Typical measurements include dynamic and quasi-static forces as encountered during actuation, compression, impact, impulse, reaction, and tension used in fatigue testing applications.



## Auto Safety

PCB® and Endevco set the industry standard for crash test accelerometers, and offer a complete family of products for auto safety testing needs. Our legacy undamped 7264C model is the only accelerometer that meets the NHTSA standard for certification tests, with repeatable results trusted by generations of crash test engineers. Our new multi-mode damped accelerometers have little to no resonance in the frequency range of interest and offer the highest sensitivity available for excellent signal-to-noise ratio. We offer many package types suitable for on-vehicle crash testing, including miniature sizes for hard-to-reach locations.

# BUSBARS

Amphenol offers deep experience, modelling capabilities and manufacturing options for all types of busbars. Recognized experts in simulations concerning current flow, thermal response and induction mitigation, Amphenol utilizes and provides empirical feedback to leading software firms.

A wide variety of manufacturing facilities complement the modelling capabilities. In Europe, North America and Asia, Amphenol offers extensive manufacturing and engineering capabilities for all ranges of busbar projects.



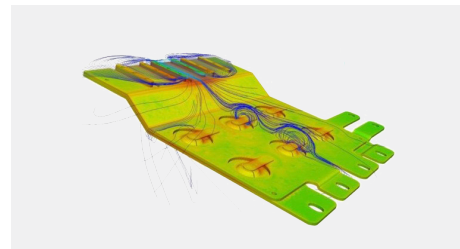
## Power Distribution

Available in multiple layers with various powder coating, lamination and other dielectric options. Rigid and flexible busbars are available in copper or aluminium and can include a variety of platings and terminations, including Radsok power contacts.



## Power Conversion

High frequency and advanced inverters and converters require low inductance and rigorous thermal and current routing to minimize cost, cooling requirements and size. Amphenol offers a full engineering and manufacturing service for these busbars



## Expert Simulation

Masters of modelling and simulations, Amphenol has a long history of engineering high performance busbars. Thermal, inductive, mechanical and topology optimization are highlights.

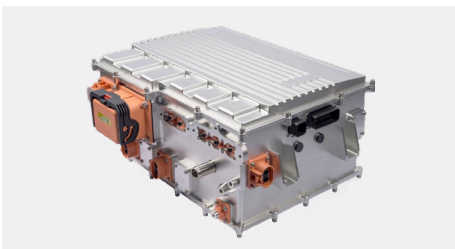
# VALUE-ADD SERVICES

Most Amphenol divisions provide additional services to create a total solution and enhance the quality and overall value of the products delivered. Ranging from simple assembly to more complex system integration, Amphenol works with customers on a case-by-case basis to optimize value for both partners.



## Cable Assembly

Amphenol owns appropriate tools for a variety of wire brands to ensure high quality crimps and terminations of cable assemblies.



## Junction Box Assembly

When appropriate, such as a significant portion of the BOM is comprised of Amphenol products, Amphenol offers assembly service on the complete enclosure.



## Advanced Power Solutions

Whether hotel loads or bi-directional charging, Amphenol engineers unique solutions for electrification throughout the vehicle



# MARKETS SERVED

## **Automotive:**

Amphenol supports high volume, custom applications as it pertains to passenger and light vehicle markets. Optimized for geographic proximity, cost and efficiency, Amphenol has manufacturing and engineering centers in every major market.

## **Industrial:**

Off- and on-highway applications are served for heavier requirements, as well as charging infrastructure for both passenger and fleet vehicles. Connector requirements may or may not fall in LV or USCAR bins, but all connectors are tested to high levels of ruggedness. Connectors range from auxiliary level currents up to 1,000 Amps.

## **Storage:**

Grid and local auxiliary storage applications present their own unique set of requirements. Amphenol has a broad array of connectors and sensors designed to accommodate this growing market.

## **Other Lithium Based Applications:**

Marine, aviation, space, rail and mass transit all present unique challenges and opportunities for the electrification space. Amphenol leverages its extensive experience in each of these industries to identify solutions and work with customers as needed to remain on the cutting edge.



# CONTACTS

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