Amphenol Sensors

Connecting your world through Sensor Innovations

Vehicle Electrification Solutions

Amphenol Sensors is a leading innovator in sensor technologies and measurement solutions. Offering the most diverse sensor portfolio of standard and customized products for the world's most demanding regulatory and industry-driven applications, Amphenol creates value by providing critical information for real-time decisions.

The advantages of Electric, Hybrid, and Fuel Cell Electric Vehicles have been long-known. To the everyday driver, they offer reduced fuel costs. For the environment, they utilize renewable energy and offer reduced emissions.

Challenges associated with vehicle electrification stem from a limited availability of technologies to enable the use of electricity or hydrogen as a fuel source in a safe and cost-effective manner.

With our vast automotive expertise, engineering resources and manufacturing capabilities, Amphenol Sensors offers various sensor solutions that enable automotive manufacturers to accelerate the electrification of vehicles around the world.

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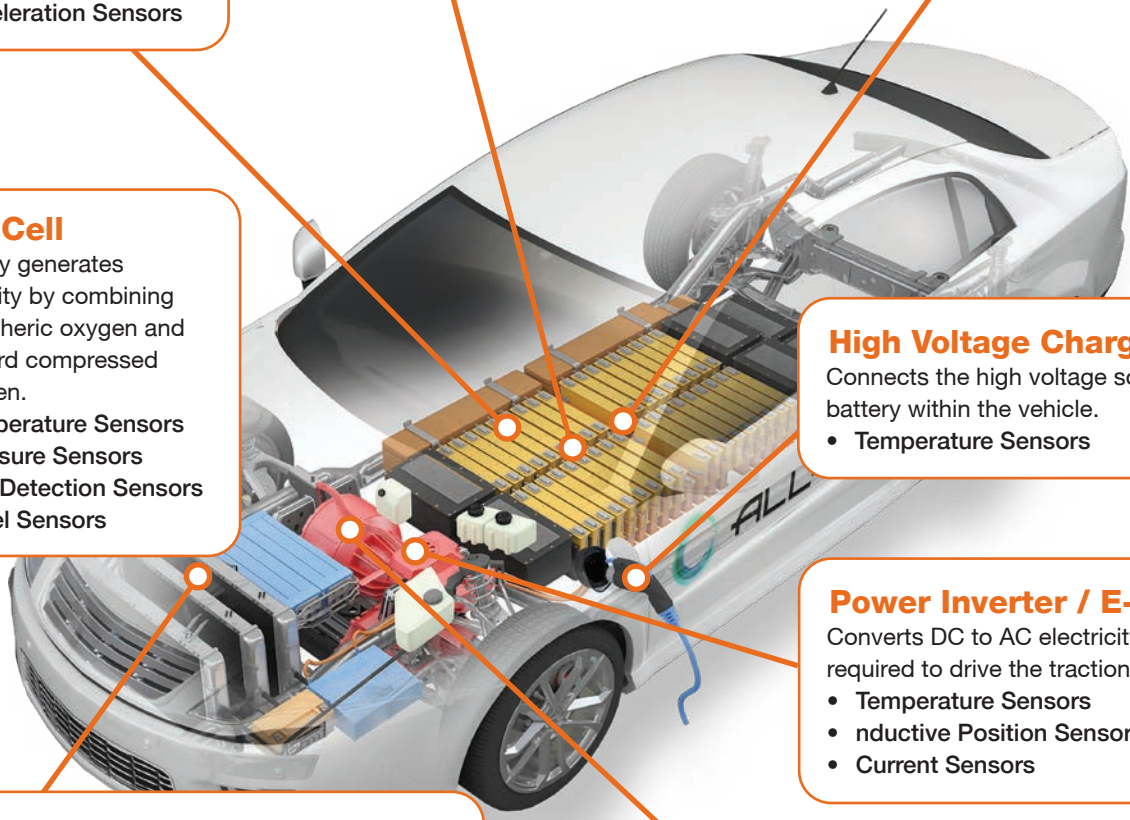
Vehicle Electrification Solutions

Battery Pack
Consists of a cluster of individual batteries that serve as the primary fuel source of the vehicle, replacing hydrocarbon fuels used in conventional ICE automobiles.
- Temperature Sensors
- Current Sensors
- Acceleration Sensors

Thermal Runaway
Occurs when battery cells exceed allowable operating temperature causing an explosion/fire, which then spreads, to other cells within the battery pack.
- Temperature Sensors
- Pressure Sensors
- Gas Detection Sensors

Cell Connection System (CCS)
Used as top cover of the battery pack to provide connectivity with the Battery Management System (BMS).
- Temperature Sensors
- Current Sensors



Fuel Cell
Typically generates electricity by combining atmospheric oxygen and on-board compressed hydrogen.
- Temperature Sensors
- Pressure Sensors
- Gas Detection Sensors
- Level Sensors

High Voltage Charger Connector
Connects the high voltage source to charge the battery within the vehicle.
- Temperature Sensors

Power Inverter / E-Motor
Converts DC to AC electricity that is required to drive the traction motor.
- Temperature Sensors
- nductive Position Sensors
- Current Sensors

Battery Coolant
Circulates around the battery cell to maintain optimum battery management and life.
- Temperature Sensors
- Pressure Sensors
- Combined Pressure & Temperature Sensors
- Ultrasonic Level, Conductivity, and Concentration Sensors
- Coolant Breach/Water Intrusion Sensors

Motor Coil
Generates torque on the motor's shaft through the interaction of magnetic fields of the stator and rotor.
- Temperature Sensors

Image courtesy of the U.S. Department of Energy.

THERMAL RUNAWAY

Temperature Sensors
Measure and monitor battery temperature to detect Thermal Runaway conditions.
- Capable of single or multiple cell detection

Pressure Sensors
Detect pressure change inside the battery cell that indicates Thermal Runaway conditions.
- Surface mountable
- Simple 3-command I^2C interface
- Very low current consumption: 35 µA

Gas Detection Sensors
Detect the out-gassing of Carbon Dioxide (CO_2) to indicate pre-combustion conditions.
- Single and dual channel configurations
- Self-calibration with patented ABC Logic™ Software

Gas Detection Sensors
Detect the presence of combustible gases.
- Sensitivity to multiple gases: $H_2/CO_2/NH_3/CO$
- Temperature / Humidity Sensor
- Pressure sensor (20 up to 250 kPa)
- Fast response time: <1 second
- IP6K7 rating

BATTERY PACK

Temperature Sensors
Measure and monitor surface temperature of the many batteries within the battery cell, which is critical to preserving the chemistry of the battery.
- Single point temperature sensors
- Rigid and flexible types
- Custom sensor packaging

Current Sensor
Measure and monitor current flowing from and to the battery.
- Hall effect, open loop current sensor
- Busbar or wire mounting
- Analog ratiometric output, 1 and 2 channels

Water Detection Sensors
Detects moisture leakage and feeds a signal to the Battery Management System.
- 510kΩ±3%
- Operating temp. range : -40 C to +85 C
- RoHS Compliance (Directive 2011/65/EU)

Accelerometers
Mechanical testing of battery pack.
- Electrically isolated sensors
- Wide frequency range
- High sensitivity with low noise

CELL CONNECTION SYSTEM (CCS)

Temperature Sensors
Provide temperature and voltage sensing to monitor the state of charge of the battery cells.
- High current circuit for battery cell connectivity
- Available styles: Wire Harness and Flexible Printed Circuit (FPC)

Current Sensor
Measure and monitor the state of charge of the battery cells.
- Busbar, wire mounting, and integrated busbar
- Analog ratiometric output

HIGH VOLTAGE CHARGER CONNECTOR

Temperature Sensors
Detect over-temperature conditions during charging.
- Installed within the connector

MOTOR COIL

Temperature Sensors
Measure and monitor temperature of the motor coil to provide feedback on the operating conditions of the electric motor.
- Field-proven design
- Variety of lead lengths, terminal and connector options

BATTERY COOLANT

Temperature Sensors
Measure and monitor fluid temperature of inlet/ outlet battery coolant to provide indication of battery cell temperature.
- No leak path - Sensor cavity and tube are one piece
- USCAR sealed connection system
- Various part geometries available

Coolant Breach/Water Intrusion Sensors
Detect the presence of coolant/water in the battery pack.
- Operates based on conductivity of the fluid being sensed
- Easy to install
- RoHS compliant

Pressure Sensors
Measure the pressure in the cooling system to control pump capacity.
- Internal metal sealing for media compatibility and no leakage
- Customized calibration for high accuracy

Combined Pressure & Temperature Sensors
Measure pressure in the cooling system, while, at the same time, measure temperature of the coolant for optimum thermal management.
- Available versions: R1234yf (up to 35 bar) and R744 (up to 200 bar)
- Tested LIN 2.1 conformity
- Automatic address assignment within LIN network

Ultrasonic Level, Conductivity, Concentration, and Temperature Sensors
Continuously monitor fluid level for early detection of coolant leakage.
- Level accuracy: ±2mm
- Temperature accuracy: ±2.5 C
- Output protocol offerings: Analog, PWM, SENT, CAN, LIN
- Input voltage options: 5V / 12V / 48V

POWER INVERTER / E-MOTOR

Temperature Sensors
Measure and monitor operating temperature of the power inverter to provide feedback on unsafe conditions.
- Fast response time
- Pigtail connector

Inductive Position Sensors
Provide data on the angular position of the rotating motor shaft to optimize control . of the motor inverter.
- Compact and lightweight alternative to resolvers
- Robust against magnetic flux and external stray fields
- Flexible integration in on-axis and off-axis configuration

Current Sensor
Measure and monitor current to the motor.
- Hall effect, open loop current sensor
- Busbar mounting, 1 phase and 3 phase housing
- Analog ratiometric output

FUEL CELL

Temperature Sensors
Monitor temperature in various areas of a fuel cell vehicle to enable safety and efficiency throughout the system, e.g., Battery, Fuel Cell, Cooling System, Transmission and Converter.
- Moisture proof construction
- Fast Response time
- High temperature monitoring

Gas Detection Sensors
Measure the concentration of H_2 and humidity.
- Sensitivity to H_2 gases
- Temperature / humidity sensor
- Fast response time: <1 second
- IP6K7 rating

Water Level Sensors
Ultrasonic Switch indicates water level in the steam / water separation tank.
- Single point ultrasonic switch
- Microprocessor controlled analog output (voltage)
- All-plastic design (PPS) eliminates opportunity for metal ionization

Pressure Sensors
Robust sensors for fuel-cell applications, specifically designed to withstand the harsh conditions in hydrogen environments.
- High accuracy and performance
- Wide pressure range
- Custom options

Sensor Technologies

MAJOR MARKETS SERVED	**Thermometrics, Inc.** Temperature	**Telaire** Gas & Moisture	**NovaSensor** Pressure	**Protimeter** Moisture Meters	**Kaye** Thermal Validation	**SGX Sensortech** Gas	**Piher Sensing Systems** Position, Speed, Current	**Wilcoxon Sensing Technologies** Vibration	**Piezo Technologies** Ultrasonic	**i2s** Pressure & Temperature	**All Sensors** Ultra Low Pressure	**SSI Technologies** Level, Concentration, Speed & Pressure	**Exa Thermometrics** Temperature	**PCB Piezotronics** Vibration, Pressure, Force & Acoustics	**Endevco** Vibration, Pressure & MEMS	**Temposonics** Position, Velocity, Level
Aerospace (Commercial)	●		●			●	●				●	●	●	●	●	●
Agriculture	●	●		●		●	●			●	●	●	●	●		●
Air Quality (Indoor)	●	●	●	●		●	●	●			●	●	●	●		
Automation	●	●					●	●			●		●	●		●
Automotive	●	●	●			●	●			●		●	●	●	●	●
Construction & Restoration				●								●		●		●
VEHICLE ELECTRIFICATION	●	●	●			●	●			●		●	●	●	●	●
Battery Coolant	●		●							●		●	●			
Battery Pack	●						●						●	●	●	●
Cell Connection System (CCS)	●						●									
Charger Connector	●															
Motor Coil	●												●			
Power Inverter / E-Motor	●						●						●			
Thermal Runaway	●	●	●			●										
Fuel Cell	●					●				●		●				
Energy	●					●		●	●		●		●	●		●
Environmental Monitoring					●	●					●					●
Heavy Vehicle & Off-Road (HVOR)	●		●			●	●			●		●	●	●	●	●
HVACR	●	●	●			●	●	●		●	●	●	●	●		
Industrial	●	●	●	●		●	●	●		●	●	●	●	●		●
Marine	●					●	●	●			●	●		●		●
Medical	●	●	●		●	●	●		●		●	●				●
Military	●		●			●		●	●		●	●		●	●	●
Non-Destructive Testing (NDT)									●							
Oil & Gas	●		●			●	●	●	●		●	●	●	●		●
Pharmaceutical & Biotech					●	●					●	●		●		●
Process Control	●	●	●			●	●	●		●	●	●	●	●		●
Railway	●					●		●			●	●	●	●	●	●
Thermal Validation					●											

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www.amphenolsensors.com

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