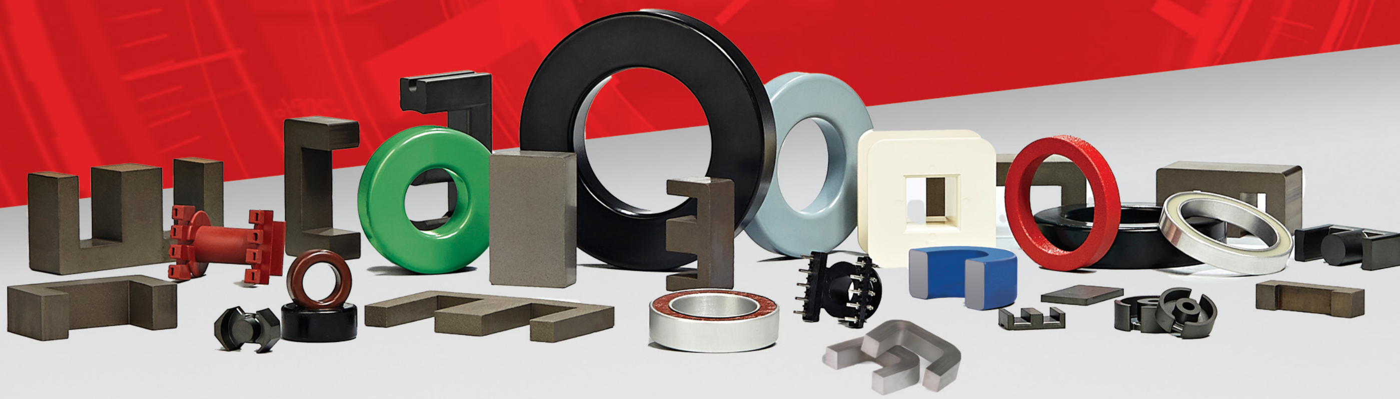
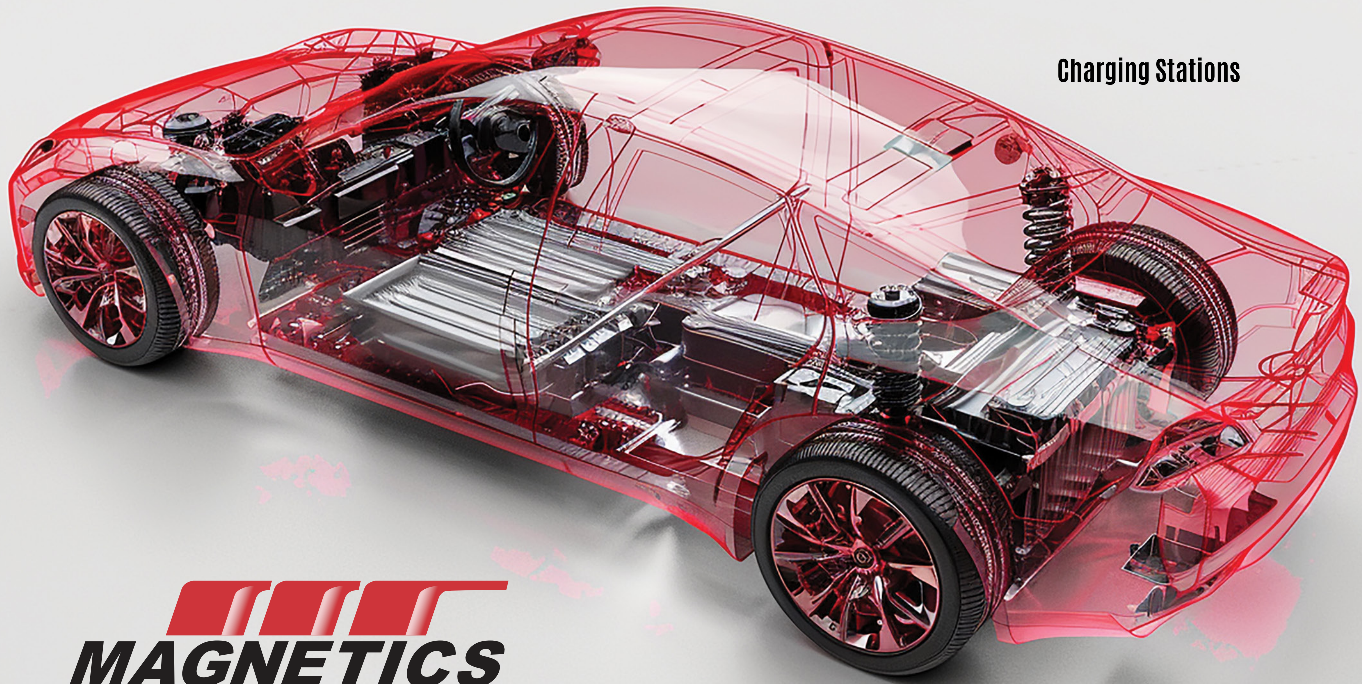
Cores for Automotive and E-Mobility

Soft magnetic cores are widely used in automotive applications for their ability to efficiently channel and control electromagnetic energy. Their primary roles include power conversion, signal conditioning, noise suppression, and electromagnetic interference (EMI) management.





MAGNETICS®

Electromagnetic Interference (EMI) Suppression

Electromagnetic interference (EMI) is a significant issue in modern automotive electronics, especially in electric vehicles (EVs) and hybrid electric vehicles (HEVs) due to high-power switching components. EMI suppression requires high-performance magnetic cores to filter out unwanted high-frequency noise while maintaining efficiency. Different core materials—Ferrite, Nanocrystalline, Amorphous, and Powder Cores—are used based on frequency range, permeability, and thermal stability.

Common-Mode Chokes (CMC) for EMI Filters

- **Nanocrystalline** and **ferrite cores** reduce high-frequency noise in power electronics

DC-DC Converters for EMI Filters

- **Nanocrystalline** and **ferrite cores** are used in common-mode chokes for input/output filtering
- **Powder cores** may be used in differential-mode filters and inductors due to low loss at high currents

On-Board Charger (OBC) EMI Suppression

- **Amorphous cores** may be used in high-power PFC EMI filters due to their high saturation flux density (~1.6T)
- **Nanocrystalline** and **ferrite cores** provide better suppression of common-mode noise at low to medium frequencies

Traction Inverter EMI Suppression

- **Nanocrystalline** and **ferrite cores** reduce high-frequency noise in power electronics

Electric and Hybrid Vehicle Power Systems

Electric and hybrid vehicle (EV/HEV) power systems require high-efficiency, compact, and thermally stable magnetic components for energy conversion and EMI suppression. The choice of core material depends on factors like operating frequency, power level, efficiency, thermal management, and cost.

DC-DC Converters (48V/12V or high-voltage systems)

- **Ferrite cores** are used in transformers for isolated converters
- **Powder cores** are used to handle high currents in boost/buck inductors

On-Board Chargers (OBCs)

- **Ferrite, amorphous,** and **nanocrystalline cores** may be used in resonant converters
- **Powder cores** are used in power factor correction (PFC) inductors

Traction Inverters (Motor Drives)

- **Nanocrystalline** and **ferrite cores** in common-mode chokes for EMI filtering and high-frequency noise reduction
- **Amorphous cores** may be used in high-power transformers for isolated gate drive circuits
- **Powder cores** appear in motor control inductor applications

Charging Stations

In electric vehicle (EV) charging stations, different types of magnetic cores are used in transformers, inductors, and filters to optimize power conversion, efficiency, and electromagnetic interference (EMI) suppression

DC-DC Converters

- **Ferrite cores** can be used in switching inductors in buck and boost stages
- Both **ferrite** and **nanocrystalline cores** may be used in common mode chokes to reduce switching noise
- **Nanocrystalline, ferrite**, and **amorphous cores** are used in high-frequency isolation transformers in fast-charging DC-DC stages
- **Powder cores** can be used in output chokes for isolation and voltage regulation, as well as boost inductors in PFC circuits

Filtering and Voltage Regulation

- **Powder cores** are the optimal choice for use in output filter inductors (LC or LCL filters) to reduce current ripple
- **Nanocrystalline** and **ferrite cores** are used in common mode chokes for EMI compliance

DC Link Chokes and Output Chokes

- **Nanocrystalline** and **powder cores** are used in DC link chokes to reduce voltage ripple
- **Powder cores** are often used in output chokes to smooth DC voltage to the EV

Ignition Systems and Sensors

Soft magnetic materials enable efficient energy transfer in ignition systems and sensor technology.

Ignition Coil Transformers

- **Ferrite cores** store and rapidly discharge energy for spark generation and are often used in conventional ignition coils
- **Amorphous cores** provide higher B_{sat} and better temperature stability than ferrite, making them ideal for high-performance ignition coils

Inductive Sensors

- Crankshaft & Camshaft Sensors: Both **ferrite** and **powder cores** can be used in inductive position sensors, with powder cores preferred for high-temperature applications
- ABS Wheel Speed Sensors: **Ferrite** and **nanocrystalline cores** are used to concentrate the magnetic field and provide improved signal sensitivity for high-speed detection
- Current Sensors: **Nanocrystalline** and **amorphous cores** measure current in EV battery systems and motor drives

One Supplier. Every Solution.

As a long-standing leader of soft magnetic components for the automotive industry, Magnetics is known for precision, consistency, and ethical manufacturing. Magnetics is the only global supplier to offer powder cores, ferrite cores, tape wound cores, nanocrystalline cores, and amorphous cores, allowing engineers to innovate in a wide range of frequencies and temperatures without the hassle of vetting new suppliers.

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