



Electric vehicle charging systems solutions

Developing an enhanced technological future together



acalbfi.com

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Who are we?

Acal BFi are leaders in the development of technology solutions for electronics and photonics applications.

Bringing pioneering products to market, we specialise in offering a range of core technologies including magnetics, power supplies, wireless connectivity, sensors, imaging, and photonics.

Our Technology Centres are driving our pursuit of continued excellence. We support customers' new designs with a range of services including component design and realisation of prototypes, and volume production.



Our approach

Together, with our Field Sales engineers, we can support you at every stage of your design process, from concept to production, creating a unique electric vehicle charging system to meet the industries growing needs. Our approach to achieving this is simple: Consult. Design. Integrate delivered with the support of our Technology Centres.

We have access to market-leading customised magnetic components manufacturer specialists such as Myrra, Flux, and Noratel. You will receive the same technical support and competitive prices. Our in-depth experience with customised power supplies and magnetic components is a clear advantage when designing products for EV charging applications.

Whatever your approach, we can help

An electric vehicle (EV) charging system's core design is the power conversion module. Some customers have the expertise and capability to design and produce the power module, others buy directly from an experienced partner.

In either approach, there will be a system design that includes all the necessary features for effective charging management. We offer a portfolio of specialist magnetic, power, wireless, sensors, imaging, and photonics technologies from carefully selected partners.

Designing the power conversion section

The key components in designing the power conversion module are inductors and transformers, and the selection of the right magnetic core is extremely important to achieve the best efficiency of the converter.

We can also offer SMD power inductors, EMI filters, current sensors, temperature sensors, thermally conductive products, and frequency controllers. This segment of the brochure covers all these components for power modules.

Magnetic cores for inductors and transformers

When designing inductive components like transformers and inductors, choosing the right material is the first challenge. There are over a dozen material classes, with a huge variety of sub-classes, brands, grades, and types.

A developer needs to match their application's requirements with the parameters of each material and give consideration to the cost implications. Our portfolio covers a wide range of specialist soft magnetic materials including EDGE, XFlux, Kool Mu Max from Magnetics Inc., Iron Powder from Micrometals (as focus materials for inductors), Amorphous, nanocrystalline from our Acal BFi kOr product line, and ferrites from Ferroxcube for transformers. We can help you select, source, customise, stock, and integrate soft magnetic cores.



Magnetic cores for inductors and transformers



Nanocrystalline Acal BFi kOr (120 & 122)

- High saturation, flat hysteresis loop (F-loop)
- High linearity $\mu(\text{DC})$ and $\mu(\text{f})$
- Low losses
- High operational temperature (up to 200°C)
- Adjustable permeability up to 200K
- Toroidal and custom shapes are available

Edge

- High saturation flux density 1.5T
- 40% lower losses with respect to high flux
- 30% higher DC bias
- FeNi composition



Iron powder for power conversion

- Most cost-effective magnetic materials, high saturation
- Moderate losses
- Permeabilities up to 100

Kool Mu Max

- Supercharged sendust with 50% better DC bias
- Very low losses
- 14 to 60 permeabilities
- AlSiFe powder



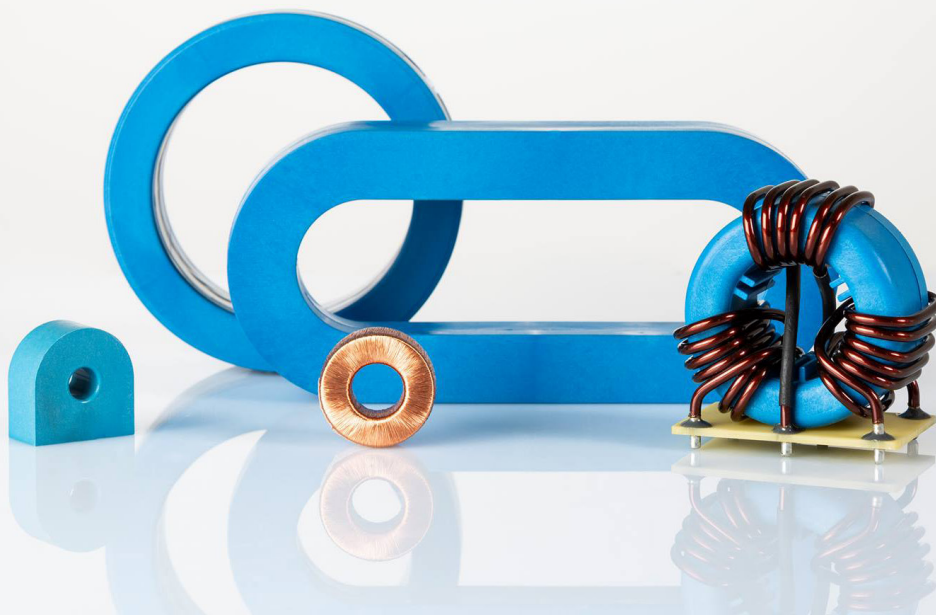
Common mode chokes for EMI filters - cores and components

When designing modern and often complex integrated systems, engineers must consider the possibility of electromagnetic interference (EMI), which affects the performance of the system and can lead to a failure to meet regulatory standards.

To contain conducted emissions the usual solution is to add a filter at the input stage of your system and common mode chokes (CMC) are the basic component of the filter. This allows the target signal to pass unaffected, whilst filtering out undesired signals.

The expertise within our in-house Magnetics Products Technology Centre enables us to select the right material and design the best core to build your common mode choke. We offer nanocrystalline (see inductors and transformers section) and ferrite cores.

We can also offer a list of ready-made common mode chokes from our suppliers Magnetec and Laird.



Common mode chokes for EMI filters - cores and components

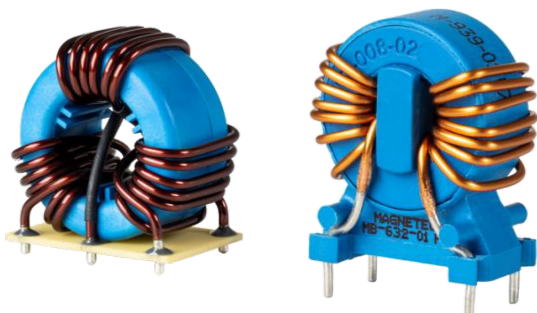


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Ferrites

- Lowest cost magnetic materials, low saturation
- Low losses
- Permeabilities up to 15000
- Very wide range of geometries and sizes



Common mode chokes from Magnetec

- Made of Nanoperm, proprietary nanocrystalline cores
- 60% size reduction compared with ferrites
- Standard tolerance of the nominal inductance: +50%/-30%

Common mode chokes from Laird

- Made of ferrite and nanocrystalline cores
- Cost-efficient solution
- Operating temperature: -40°C to 125°C



Designing custom magnetics

When designing a power conversion module for a charging application, magnetic components are vital and need to be designed using the competencies of soft magnetic cores, wires, insulation, plastics, and heat dissipation.

With a well structured team of technical support specialists in Europe, we are able to design with you custom solutions for magnetic cores or components within power conversion applications.

Our Magnetism Products Technology Centre can develop a solution to achieve your goals, whether your need is simple or complex.

- Consultancy on soft magnetic cores. We not only select the best technology for you, but we can also design the best-suited core for your application

- Starting from your basic specifications, we design the inductive component and produce rapid prototypes to test the concept
- Manufacturing of the components
- Set up a dedicated logistic strategy to secure your supply chain

Typical products we can develop are common mode chokes, PFC chokes, transformers, EMI filters, and 50Hz safety and monitoring components (current transformers and RCDs).



Thermally conductive products

High current power conversion produces heat that must be dissipated safely to avoid overheating, which can cause EMI issues or even premature failure of electronics inside the application.

We offer market-leading thermal interface materials from MTC, that combine high thermal conductivity and low viscosity whilst maintaining insulating properties.

This customisable range includes:

- Thermal conductive paste
- Gap filler
- Thermal conductive tapes
- Thermal conductive insulators
- Phase change material
- Graphite foil

Common characteristics of all these materials are:

- UL-94-V0 certified
- Thermal conductivities in the range of 1.0 W/mK up to 20.0 W/mK
- Die-cut and kiss-cut parts upon request
- Silicon free gap fillers
- R&D capabilities for temperature modelling



Current sensors

Crocus Technology's revolutionary TMR (Tunnel Magneto-Resistance) technology provides superior magnetic sensing performance.

TMR is based on different physics phenomena. The magneto-resistance effect is the property of a device to change its electrical resistance value under the influence of an external magnetic field, therefore allowing enhanced electrical detection of magnetic fields. TMR current sensors can replace many Hall Effect, AMR and GMR technology based sensors with increased performance at similar price levels.

- Excellent working dynamic range
- Typical total output error of less than +/-0.5%
- Capable of sensing current as low as 5mA

... an innovative and unique solution ...



Temperature sensors

Temperature sensors are used across a range of applications in electric vehicles, such as temperature monitoring of the charging cable, charging pile and Battery Management System (BMS).

These applications call for sensors that are suited to harsh environments, accurate measurement, fast detection of a change in temperature, enhanced reliability and quality.

With Shibaura's high-quality glass encapsulated thermistors, which provide superior performance, quality and reliability, our temperature sensors are able to withstand high voltages and temperatures up to 1000°C.



Shibaura MP3 series



Shibaura's MP3 thermistor sensor with Fluorocarbon sealing

Heat, oil and solvent proof, making them ideal for motor coil temperature detection applications.

Shibaura EP2 series



Shibaura's EP2 thermistor sensors with a glass encapsulated thermistor

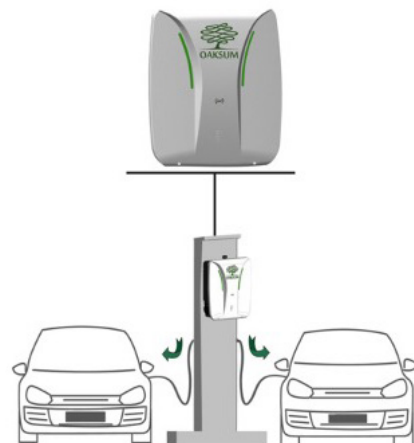
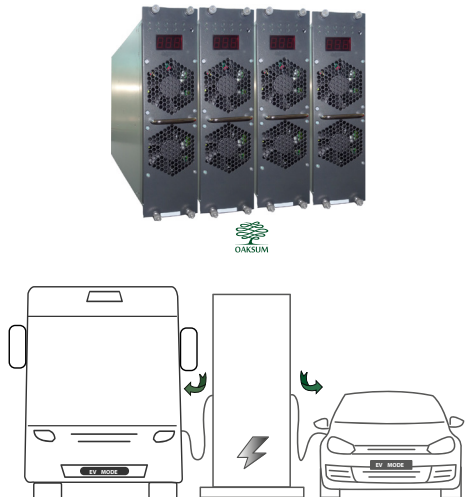
Ideal for EV charging applications, with customisable cable lengths to suit your specific application. Wide operating temperature range and able to withstand high voltages.

Designing the full system

When designing a charging solution by integrating blocks, fast DC-charging modules, AC/DC converters, high-power transformers, EMI filters and shielding, current transformers and power supplies are some of the products we offer.

Payment services and user interfaces: 2G/3G/LTE modules, LoRa, Wi-Fi, Bluetooth®, and RFID technologies are also available for system design solutions.

DC and AC power conversion



DC charger

These modular AC/DC power-dense converters are specifically designed for fast DC charging for E-cars and buses, service vehicle operators, EV manufacturing lines, EV workshops, and EV fleet operators.

- High efficiency $\geq 95\%$
- Power factor ≥ 0.99

AC charger

OAKSUM's smart AC EV chargers are designed for maximum charging performance combined with high energy efficiency.

The IP65 casing gives a robust and compact weather-proof construction.

- Power ratings from 3.6kW up to 22kW
- Charging speeds up to 8x faster than standard models

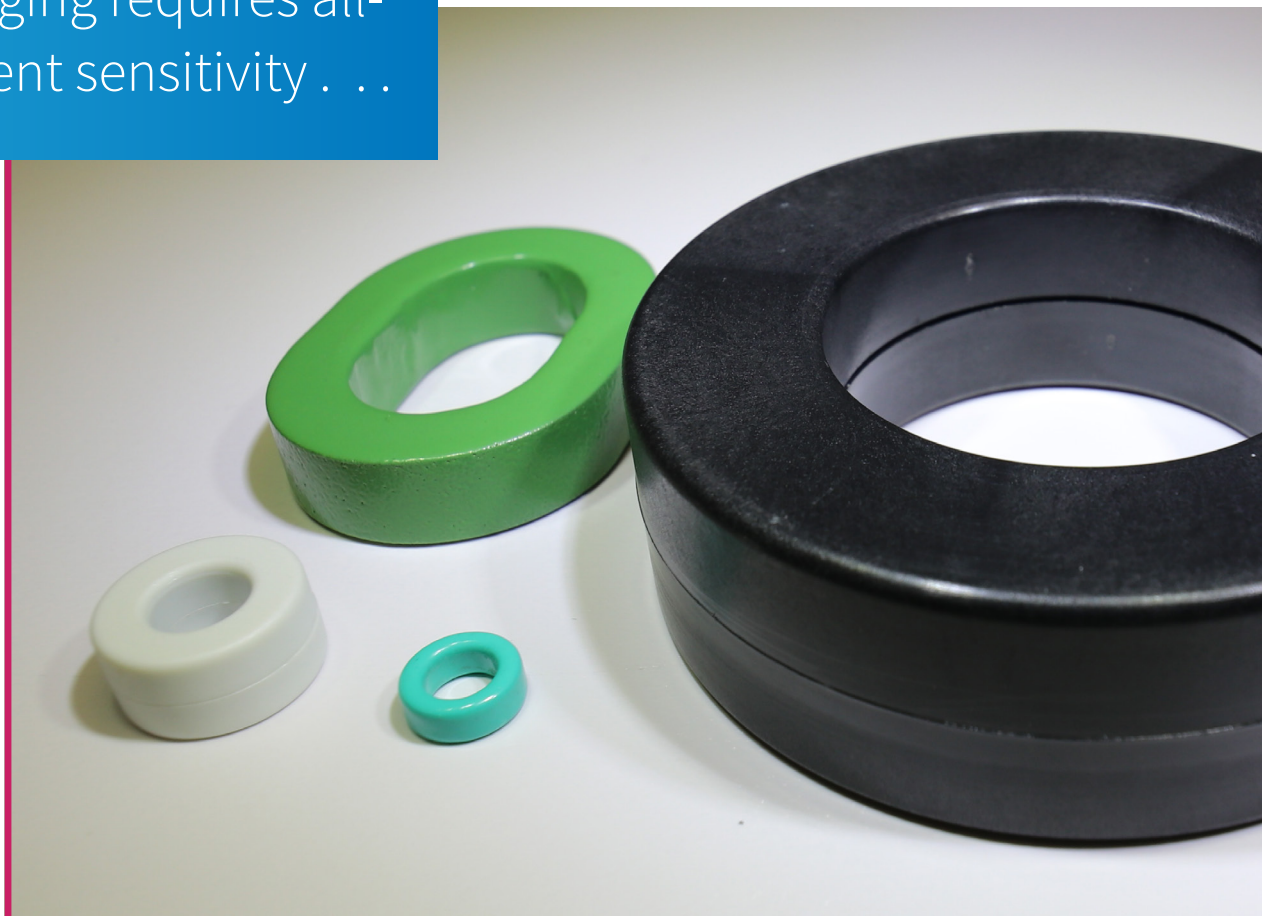
Current sensitivity components

Electric vehicle charging systems require the capability to measure current to detect uncontrolled situations which may cause permanent system failures.

Our Magnetics Products Technology Centre offers cores for different types of RCDs (Residual Current Devices). Electric vehicle charging requires all-current sensitivity, detecting pure DC currents and any currents with higher frequencies above 50Hz. We are able to tune properties (hysteresis loop shape, permeability, and temperature behaviour) of nanocrystalline cores (Acal BFi kOr 118 and 120).

- Optimum combination of high linearity and highest permeability
- Negative temperature coefficient $\mu(T)$ (as standard)
- Plastic case or epoxy coated for example as RCCB core: $B_{dyn}/B_{sin} > 0.85$ at $\mu_{max} = 150.000$ and >0.80 at $\mu_{max} = 200.000$

Electric vehicle charging requires all-current sensitivity . . .



Protecting users from your EV charging system

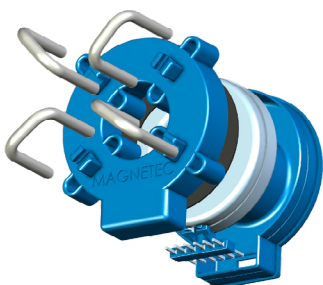
When installing an EV charger in a domestic environment, consideration of how to protect users from possible DC current leakage through connecting cables from the EV charger to the vehicle is paramount.

Protection can come from either a costly Type B Residual Current Circuit-Breaker (RCCB) sensor or integrating a cost-effective differential current sensor into the in-cable control box or wall box.

Test function

Residual Current Device (RCD) sensors are the best solution for being compliant with the latest safety requirements (IEC62752). These sensors are available within various applications to fulfil your design requirements.

- Protect against hazardous situations with fault currents and preserve RCCBs Type A from saturation
- Small footprint which allows integration into compact IC-CPD
- Suitable for harsh environmental conditions due to a robust mechanical and electrical design
- Electrical safety at lower cost (compared to RCCB Type B)
- Test winding included for self-monitoring and test functions



Transformers

When power management ratings increase, you may need 50/60Hz transformers to connect your charger system to the grid. We offer a specialist range of transformers designed for smoothing in rectifiers, reducing short-circuit currents, AC filtering, and high-frequency switching.

These transformers are manufactured according to a customer's exact requirements. Noratel is able to design and produce anything from small single-phase toroidal to large tri-phase EI transformers with heavy current coils for larger electric vehicle charging installations, with everything developed in close co-operation with the customer.

- Power range from 0.1 KVA – 300 KVA
- Isolating transformers
- Transient suppression transformers
- Three-phase transformers
- Toroidal transformers



EMI shielding

For safety and reliability, it is critical that charging stations meet the industry's full requirements. Electric vehicle charging stations equipped with advanced capabilities such as power electronics and cloud-based communications fall under the class of devices that require EMC testing and certification.

To help protect your device we offer a broad range of components and materials for the shielding of EMI, such as:

- Fabric-over-foam (FoF) gaskets, electrically conductive foams, elastomers, tapes, and contact springs
- Shielded windows, metal honeycomb vent panels, and fan vents
- Metal contact springs and pads
- FOF made of aluminium foils or copper-nickel fabric



Infrared sensors

Teledyne FLIR's infrared sensors have a proven history of being used for human detection and security applications due to their low power consumption and their effectiveness at both night and day.



However, in an electric vehicle application, they can be used to optimise system management, detecting heat spikes and they can be used to improve the accuracy of vehicle detection in automated electric vehicle charging facilities.

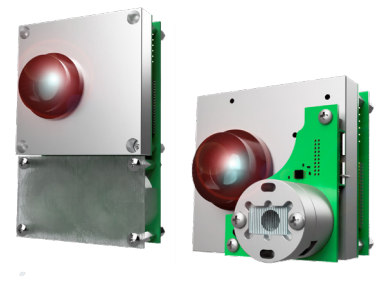
Teledyne FLIR offers a range of SWIR, MWIR, and LWIR infrared sensors to provide accurate data managing your electric vehicle charging system. Need help with a custom IR sensor? Our infrared specialists offer personalised and responsive support at every stage of a project, providing samples and technical support. We also offer an exclusive range of specialist lenses that can be integrated and configured by our Infrared Imaging Technology Centre.

LiDAR

Our specialist products provide the electric vehicle charging systems and vehicles with precise, real-time and distance measurements.

The multi-segment optical sensing technology provides narrow to wide fields of view with lateral discrimination, enabling multiple object detection and distance measurements.

We work with LeddarTech to offer a LiDAR range that includes products with no moving parts for additional reliability, so they are ideal to be designed into electric vehicle charging systems.



Fibre optic temperature probes

Advanced Energy Luxtron's FOT probes (Fibre Optic Temperature probes).

Suitable for eliminating weak insulation points within electric motors/ generators, understanding precise temperature limits and behaviour of battery cells within Li-Ion battery packs, temperature testing within charging ports and power cables, and direct temperature measurement of power electronics.

Advanced Energy Luxtron FOT probes are self-calibrated and immune to EMI, Microwave and RF radiations.



Intelligent wireless connectivity

Electric vehicle charging infrastructure requires the highest level of performance to overcome the connectivity and logistical challenges of deploying across large areas.

Using the right technology is key for critical applications such as remote operation, predictive maintenance, payment, and energy control functions by overcoming the difficult coverage, capacity, and cost barriers for multiple locations at any one time.

With modules designed specifically for remote device deployment, you can design using best-in-class ready-to-connect, future-proofed modules that provide SIM connectivity to devices anywhere in the world.



Cellular modules

Sierra Wireless AirPrime® RC series

Offering low-cost and extremely low-power technology, covering worldwide 2G/3G/4G networks.

- Optimised 4G LTE Cat-1 connectivity with 3G fallback
- Compact CF3 design to migrate between technologies
- Ready-to-connect
- Embedded SIM for global coverage
- TCP/IP Stack – embedded stack to easily communicate over the internet
- VoLTE – Voice over LTE
- Cloud-connected – for secure collection of data and remote management of IoT deployments with integrated AirVantage services



Fibocom FM160 series

Offering highly integrated 5G wireless communication modules which come either in a M.2 form factor interface or a solder-down LGA variant.

- M.2 formfactor (dimensions: 30 x 52 x 2.3mm)
- Compatible with Fibocom's FM150 family
- LGA version FG160-EAU available
- LGA dimensions: 41 x 44 x 2.75mm
- Multi-constellation GNSS receiver
- Maximum downlink rates: 3.5Gbps
- Uplink rates up to 900Mbps
- Operating temp: -30°C - +75°C
- Power supply: 3.1 – 4.4V



LoRaWAN

SparkLAN WLRA-590 LoRa IoT module

Designed to enable very low-power, long-range devices for highly sensitive communication to easily be conveyed at regional, national, and even global levels.

This also provides significant advantages in both blocking and selectivity over conventional modulation techniques, solving the traditional design compromise between range, interference immunity, and energy consumption.

- Based on Semtech SX1276
- STM32L073xZ ARM Cortex-M0+
- Support for 868MHz and 900MHz
- SiP module
- Dimensions: 13 x 11mm



Insight SiP iSP4520 series – built-in combo LoRa and BLE modules

Offering a unique combination of two leading IoT radio technologies in one class-leading miniaturised package.

With integrated BLE and LoRa, these modules offer the long-range capability of LoRa for data transmission across distances, combined with the high-throughput flexible service of BLE for a short-range connection

- Optimised 4G LTE Cat-6 IoT connectivity with 3G fallback for America and EMEA
- Delivers up to 300 Mbps download speed
- Supports most EMEA and NAM bands on a single SKU





EV charging plug and connector systems*

IEC62196-2 combo charging plug



The Excel|mate CC – IEC combo developed by Amphenol meets the IEC 62196-2 standard for charging systems enabling the vehicle to be charged with AC and DC power.

The combo plug includes 2 DC power contacts enabling rapid charging in public areas and are equipped with a temperature sensor and a coloured LED to monitor charging status.

- Compliant to IEC 62196-3
- Rated current: 200 A
- Rated voltage: 1000V
- Mating cycles > 10.000
- Ambient temperature: -30° to 50°C
- Protection class: IP 44 (mated)

High voltage EV connector systems

Supporting EV and HEV platforms with ratings up to 1000V @ 350A.

Connector ranges include types for drive motors, battery systems, power distribution, and control units. Both the Amphenol HVSL and MSD product families feature EMI shielding, touch-proof, interlock, and second lever locking.

- HVSL series rated to 1000V with current 350A (2W) 250A (2W) 46A (6W)
- MSD series rated to 1000V with current 300A (MSD XL)



*EV charging plug and connector systems are only available in UK

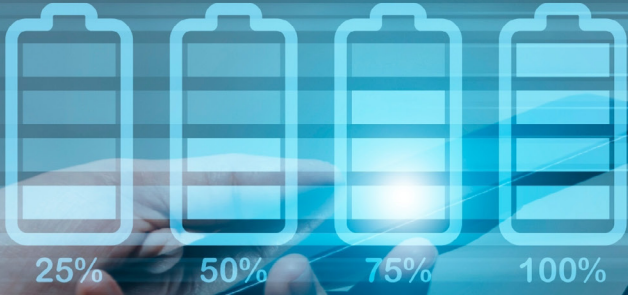
Supporting you throughout every stage of your design

Our Technology Centres are fundamental within our consultative, design-led approach. At each facility, we have a team of highly experienced industry experts in their respective fields ready to accelerate and enhance your electric vehicle application.

When designing an AC/AC or AC/DC EV charger, we can collaboratively work with you throughout each project stage.

- Advice and recommendations on components, wiring harnesses, and PCB design and layout, through to the integration of subsystems including power modules, connectivity modules or security features
- Designing inductive components, power supplies, and connectivity modules. Our focus on customer service, combined with our expertise, experience, and specialist equipment means we translate your requirements into a reliable, cost-efficient design, whether starting from scratch or modifying an off-the-shelf product. We can then extensively test and verify these designs with the required test equipment
- Support during the certification phase, by designing or supplying EMI shielding and filters or IP protection gaskets. Our pre-compliance ensures that your design will meet the appropriate standards
- Management of production and complete supply chain including quality assurance. With a choice of certified manufacturing partners to enable a best fit for your unique requirements, we provide the most efficient capabilities matching your design, volume, and destination





Developing an enhanced technological future together

To benefit from our expertise and in-house capabilities, it's important that you contact us at the earliest stage possible within your project to ensure you don't needlessly spend or use resources and to enable us to identify all the hidden improvement potential from the start.

You can connect with our experts immediately online or face-to-face when initial project details are available. Design proposals, budget quotes and prototypes are available within a few days.

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