eMobility

Prax & EV Chargers

Power Magnetic Component Solutions for Efficient and Reliable **Electric Vehicle Chargers**

"The number of fast and superfast electrical car chargers is exponentially increasing. Maximum power density, excellence in thermal management, high reliability components always assuring a cost driven design are the key requirements that the market is demanding. Our solutions are helping EV charger manufacturers meet these requirements"

Marc Maneja, VP Sales & Marketing and eMobility Solutions Specialist, PRAX

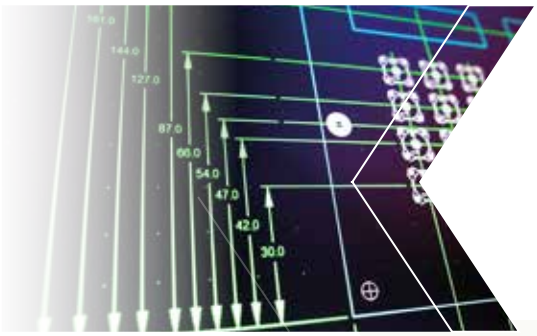
At Prax we design and manufacture inductive components for power electronics applications, creating added value through customized solutions that help our clients in the industrial and automotive sectors to create reliable and high-quality products.

Prax core competencies are magnetic components and filtering technologies combining a high level of customization possibilities with a comprehensive range of standard components. With a special focus on design support to our customers' engineering teams, prototypes and specifications are released within a short time frame.

Global customers need global solutions. Besides our outstanding design support, PRAX strives to be a strategic partner by providing global service and support. With a multi-site manufacturing approach, PRAX offers flexible operations, allowing us to establish customized supply chains according to customer requirements.

With our long experience in design and industrialization of inductive components and EMC filters, PRAX offers services based on component specifications, cost analysis, materials selection and pre-industrialization analysis.

Your needs



Maximum electrical performance in minimum space.

Excellent thermal management to ensure the high quality standards of your end customer.

A partner able to support you from the design phase to the industrialization, matching customers' expectations, assuring flexibility in the demand management.

Working with many EV Charger Manufacturers we have found that the following considerations are fundamental at the time of designing Power Electronics:

Strategic needs:

- Design flexibility with components that guarantee maximum adaptation to your requirements
- Know-how ownership
- Full control of the power electronics design
- Go beyond inherent limitations of usage of externally designed power modules
- Design focused on Maximum Uptime
- Reliable partner/supplier over the project lifetime
- Cost driven design

Design needs:

- Maximum power density and minimum losses
- High reliability components
- Optimized layout for heat dissipation with forced air or cool plate
- Excellent thermal management
- Cutting-edge technology chargers with innovative switching topologies
- Experienced design partner in critical components including custom magnetics

What we propose

Custom as standard:
Customized solutions industrialized as standard.

Maximum power density, minimum losses, and excellent thermal management thanks to our innovative technology xgap.

Flexible, reliable and agile partner over the project lifetime with early involvement in the desing activities.

Achieving the optimal solution is possible by balancing the following keys:

- Custom optimized solutions for most advanced resonant topologies
- Complete magnetic components range for EV Chargers
- Single transformer and inductor solutions up to 30kW
- Transformer + resonant inductor integrated in one component or in one assembly
- Small footprint
- Extended thermal and mechanical protection with different potting solutions
- Magnetic components designs minimizing losses
- Custom mechanical solutions
- Support since the early beginning of the project
- High performance designs with xgap multigap technology solutions
- Smooth transition to production with own manufacturing facilities
- Cost effective design focus
- Losses and thermal performance simulations
- Quick turn samples/prototypes
- IEC-61851 compliance
- IATF 16949 quality procedures

Complete magnetic component solutions for your DC chargers

As an R&D Engineer you expect:

- Outstanding support during the design phase of the components
- Quick turn samples
- Advanced simulation capabilities for optimal customization and performance

As a Supplier Quality Engineer you expect:

- Reliable supplier
- APQP design processes
- FMEA
- IATF16949
- ISO 9001
- ISO 14001

As a Commodity Manager you expect:

- Cost-effective components
- Flexible supply chain
- Reliable lead times
- Consignment stock, Kanban, JIT sourcing

heynen

Technology and Product Overview

Prax introduces xgap technology as an optimal solution for EV magnetic components

The use of xgap technology allows for the creation of cost-effective solutions with maximum power density thanks to the reduction of core volume around 30%, while overall size reductions up to 20%. xgap technology also minimizes losses and offers optimal heat dissipation of windings in all type of cooling systems. All of these advantages match the requirements of magnetic components in EV applications.

What is xgap technology based upon?

A gap is a portion of air inside a magnetic core path. It is used for two main purposes:

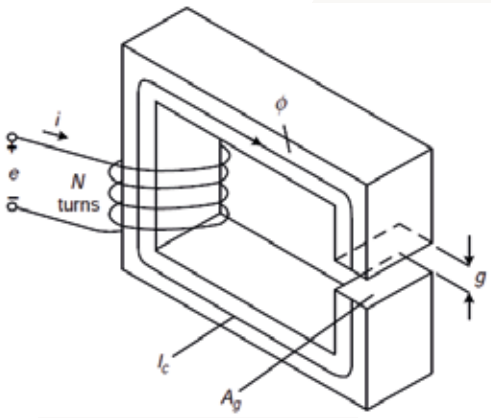
1. Energy storage in inductors or chokes

The energy stored in an inductor depends on current and inductance factor.
A gap or distributed airgap is commonly needed in cores to store such energy.

2. Inductance value and tolerance reduction

Introducing a gap decreases magnetic core permeability, which reduces its inductance factor.
Non-gapped cores inductance tolerance is around ±25%, while gapped cores can be reduced to ±10%

$$E = \frac{1}{2} \cdot L \cdot I^2$$

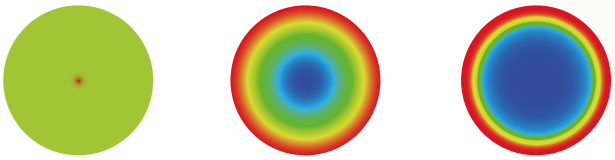


$$L = N^2 \cdot A_L$$

Main effects generating losses due to high frequency in windings

1. Skin effect

An isolated round conductor carrying AC current generates a concentric alternating magnetic field which induces Eddy Currents.
These currents oppose to normal current flow in the center of the conductor, increasing the effective current closer to the conductor surface.
The overall effect is that total current flows in a smaller perimetral area. This effect intensifies as frequency increases. Current flow concentrates in an equivalent perimetral cylinder at the surface of the conductor. This cylinder thickness δ is known as skin depth.

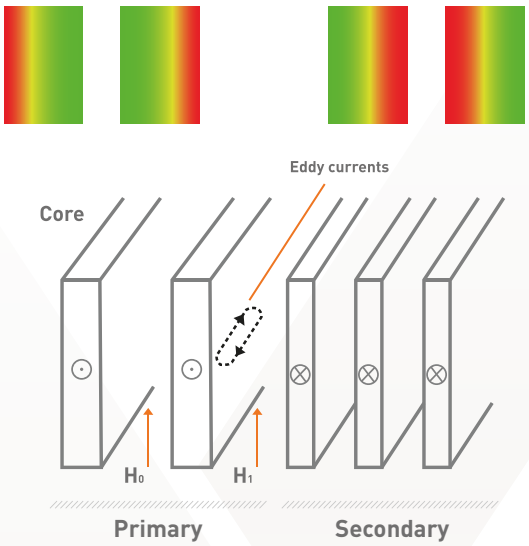


10 kHz | 100 kHz | 1 MHz

2. Proximity effect

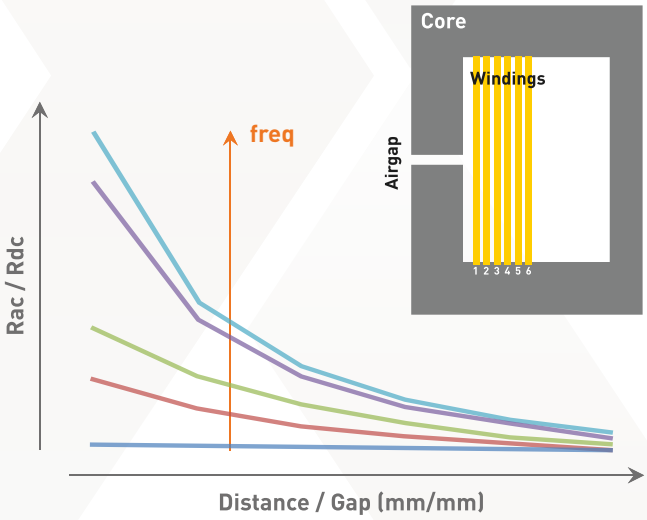
Proximity effect appears when the distribution of current in one layer of a winding influences the distribution in another layer, always in the same winding.

Such proximity effect, therefore, increases winding resistance (Rac)



3. Fringing effect

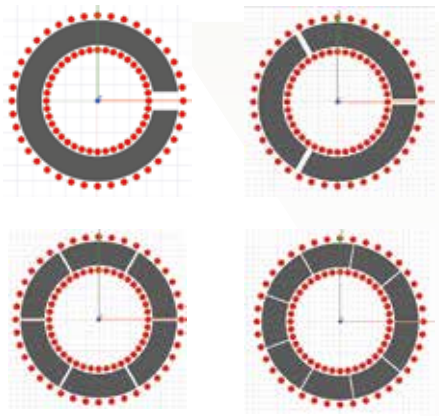
Fringing effect happens when a magnetic flux near a core airgap bends out.
The distance over which these flux fringes out is basically proportional to the length of the airgap.
One single gap can be splited into several smaller gaps, preserving total volume and length. By doing so, effective permeability and energy storage capabilities are still the same, but the flux fringing is significantly reduced.

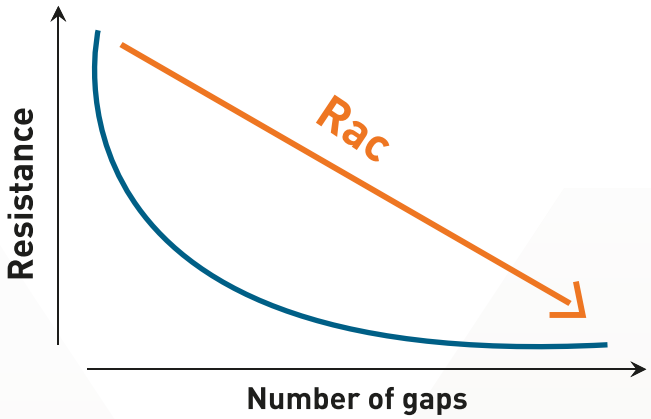


What is xgap Technology?

xgap technology is a multi-gap approach for inductors and transformers highly recommended for resonant topologies and widely used in DC charging applications.

This multi-gap technology has been developed by PRAX to reduce winding AC losses. It allows a large air gap to be evenly distributed on a toroid to minimize fringing effect by splitting the gap into smaller gaps. With these evenly distributed gaps (up to 12 or 15 on a single toroid), losses are reduced exponentially because of the Rac reduction.





Prax's expertise allows many possibilities by applying this technology:

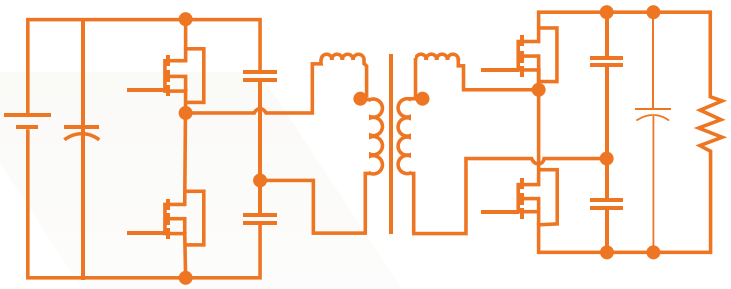
- xgap technology-based set of transformers and chokes
- Multi-gap core solution with triple-insulated litz wire

Advantages of xgap technology:

- Winding area increases by means of using toroid formats
- High current and high frequency capabilities by low loss ferrite material
- Distributed gap component, minimizing fringing losses
- Tighter inductance tolerance (from ± 8% to ± 15%)
- Best heat dissipation of windings in any type of cooling systems
- Finite Elements Analysis (FEA) simulations available for extra accurate loss calculation
- Reduction of core volume around 30%, allowing an overall size reduction up to 20%
- Cost-effective solution compared with PQ or PM core formats

xgap technology used as

- A transformer in converters and SMPS up to 30kW
- A resonant inductor in resonant topologies including LLC, CLLC, DAB and Phase Shift where inductance needs to remain flat as current increases
- A PFC, input or output choke where ripple current is high (>35%) and frequencies are higher than 50kHz, such as interleaved PFCs



prax Differentials

- Finite Elements Analysis (FEA) simulations available for accurate loss calculations
- Narrow tolerance for the inductance value (from ± 8% to ± 15%)
- Wide inductance value range by adjusting gap thicknesses
- Off-the-shelf solutions and quick, easy and cost-effective custom adaptations available
- 10+ experience years in custom multi-gap magnetic component solutions

Product Overview

Custom as Standard – Within Prax magnetic components subcategories, our default way of co-operation with our customers' R&D teams is to offer customized designs that are optimized to the specific requirements of every application.

Common Mode Chokes

Common noise filtering chokes. For a discrete component EMC filtering approach, Prax offers a wide range of CMCs in any format and with world-class materials (soft ferrite, nanocrystaline).

Current Transformers

AC current measuring magnetic components for low and high frequency applications. Different material grades allow either high accuracy for critical low frequency metering applications or consumption control in high frequency (SMPS).

EMC Filters

EMC filtering solutions in single-phase and three-phase for various industrial and renewable energy applications.

Input and Output Chokes

Mid-power range chokes, for various high frequency switching applications. Copper foil, flat and round wire, combined with several magnetic materials (soft ferrite, Sendust, iron powder, amorphous) and multiple formats (E-cores, C-cores, toroidal) allow Prax to meet virtually any customer requirement.

PFC Chokes

PFC chokes specifically designed to maximize power of a circuit by driving voltage and current with the same phase.

Planar Transformers

If low profile, high efficiency and mechanical reliability are a must for customer final application, planar transformers are the optimal solution for high frequency converters.
Combinations of specially shaped soft ferrite cores with multilayer PCBs and copper tracks make a very compact component in a high power density solution.

Power Inductors

Standard power inductors are proven to have limitations for new high current demanding applications. Prax advanced high current power inductors combine special materials and shapes with flat wire helical winding for a very compact and efficient design.

Pulse Transformers

Design and manufacturing of Pulse and Gate Drive transformers for transmitting a control signal assuring isolations between low and high voltage circuits.

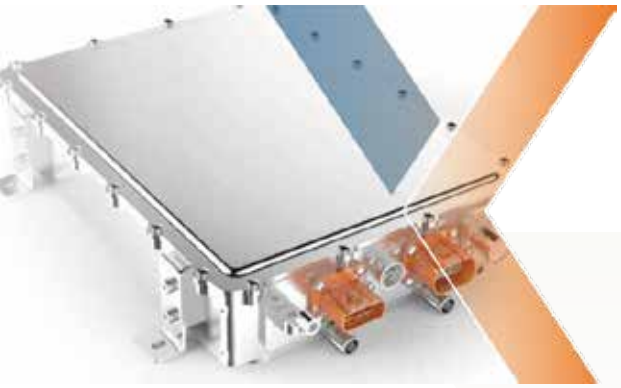
SMPS Transformers

Switch-mode power supply main transformers requirements depend on power range, topology, isolation and frequency. Therefore, a wide range of materials, formats and winding technologies are available. Our aim is to optimize size, efficiency and cost.
Designs available for topologies such as flyback, forward, push-pull, half-bridge, full-bridge and advanced resonant topologies.

Application case 1

11kW Onboard Charger for BEV

Transformer and Resonant Choke for LLC.

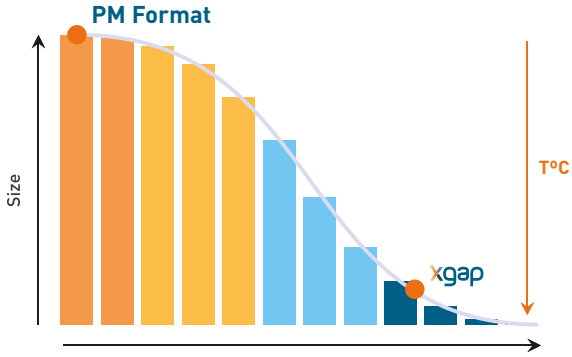


Requirement

- Compact, yet fully functional transformer and choke for LLC topology for an 11KW onboard charger

Solution

- xgap technology-based transformer and choke
- Multi-gap core solution with triple-insulated litz wire
- Toroid format for both components
- Interconnected components



Benefits

- Reduction in number of components used
- Volume savings of around 30% compared to other traditional formats such as PQ or PM
- Optimal cooling capabilities

Application case 2

30kW DC Fast Charger

30kW Transformer for Bi-Directional Phase Shifted Dual Active Bridge

Requirement

- Optimized power density
- Safety and reliability
- Suitable for use in high demand cutting-edge resonant topologies
- Easy mounting

Solution

- Litz wire for high frequency
- MultiGap technology xgap for minimizing fringe effect losses
- High insulation
- Toroidal shape for high magnetic path optimization
- Integrated custom mechanical solution

Benefits

- 20% size reduction vs traditional multi-E core structure
- ~16% reduction in losses
- Optimized transformer shape for maximum heat dissipation

Application case 3

Scalable Three Phase EV Fast Charger

3-in-1 Assembly PFC Choke for Active PFC Rectifier.

Requirement

- Compact and sturdy solution
- Design for minimum weight
- Enhanced thermal behavior

Solution

- High operating temperature design up to 155ºC
- Toroidal shape for high magnetic path optimization
- Integrated custom mechanical solution
- Potted 3-in-1 Assembly
- Polymer based mechanical assembly solution

Benefits

- Up to 70% weight reduction on the overall solution
- Additional +25ºC working temperature design

prax

The Company

Company focus

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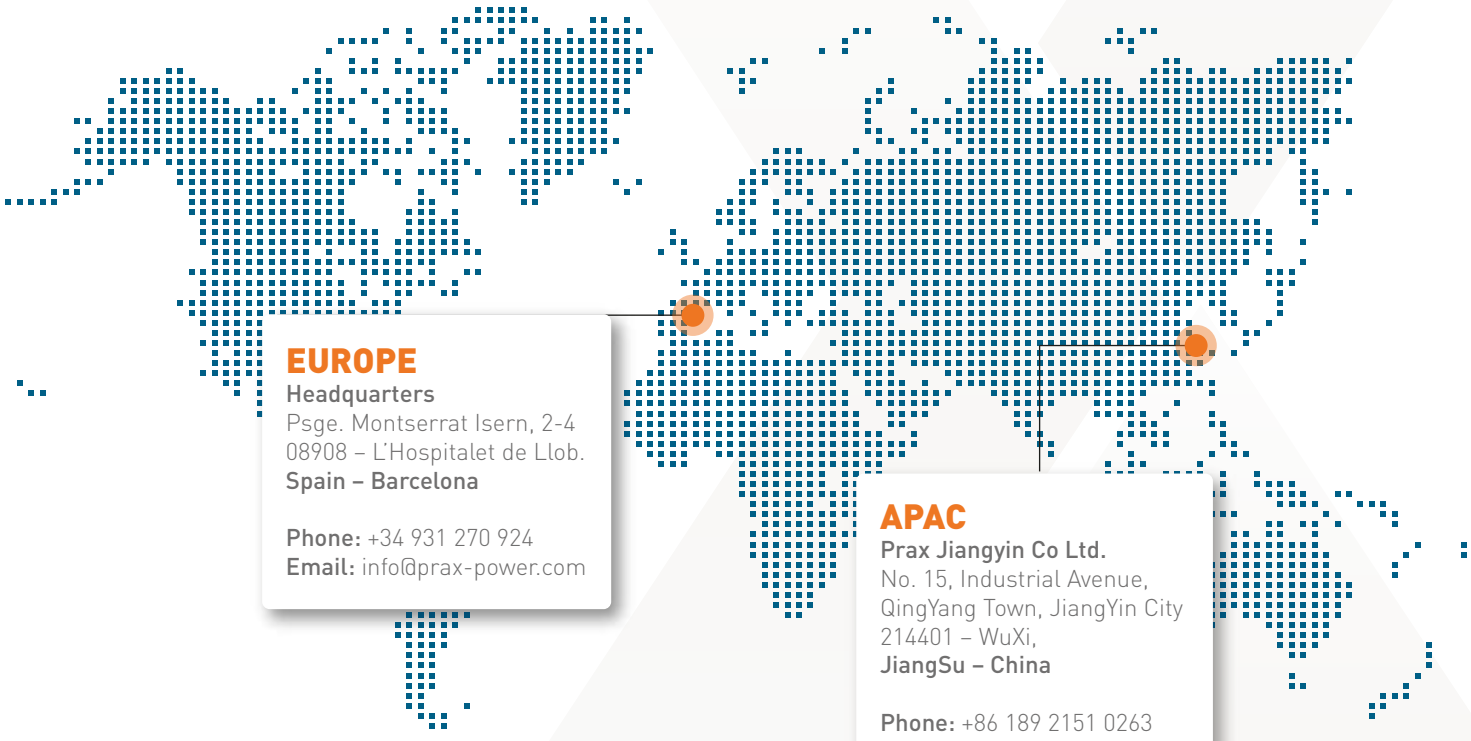
Where to find us



EUROPE
Headquarters
Psge. Montserrat Isern, 2-4
08908 – L'Hospitalet de Llob.
Spain – Barcelona

Phone: +34 931 270 924
Email: info@prax-power.com

APAC
Prax Jiangyin Co Ltd.
No. 15, Industrial Avenue,
QingYang Town, JiangYin City
214401 – WuXi,
JiangSu – China

Phone: +86 189 2151 0263
Email: info@prax-power.com

Your expert in custom specific inductive components

SINCE 2011

300
Qualified employees

+25
Years of experience

- Design & Development
- Samples & Prototypes
- Industralization
- Automation
- Mechanical Solution
- Testing

95%
Customized products

We are your CUSTOM factory

Optimized tailored solutions for magnetic components in power conversion applications

45M
Components delivered worldwide

+1200
Part numbers in the market

100%
Designed in Spain

Our obsession: High Quality Standards Mindset

REACH · ROHS · ISO 9001 · ISO 14001

Environmental policy

eMobility

Prax & EV Chargers

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for Efficient and Reliable
Electric Vehicle Chargers

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Please contact Heynen for distribution in BENELUX.

heynen@heynen.com
NL tel: +31 (0)485-550909
BE tel: +32 (0)11-600909
LUX tel: +352(0)26-910781