Power Capacitor Chip in industrial and automotive electronics

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Concentrated power

PROFILE	POWER CAPACITOR CHIPS

The geometry of Power Capacitor Chips can be adapted to almost any application to give equipment designers even more degrees of freedom.

Rated voltages:	up to 1000 V DC
Capacitances:	up to 4000 µF
Operating temperature:	-40 to +165 °C

The challenge in industrial and automotive electronics is to pack more and more power into equipment of diminishing dimensions. For this purpose, EPCOS offers the Power Capacitor Chip (PCC), an innovative approach to miniaturization and integration.

Higher and higher power density is characteristic of the frequency converters in IGBT technology used in modern industrial drives. Until a few years ago, volume and design were secondary. Today, however, customers expect manufacturers to deliver converters so compact that they can even be mounted right on the motor. Link circuit capacitors are crucial components of these new designs. Here the PCC opens up completely new opportunities for equipment designers.

For low- to medium-power converters, the PCC concept is based on the new metalized polymer multilayer (MPM) winding technology, i.e. on a layered winding in power capacitor format with flat limiting surfaces. It offers all the advantages of the tried and tested metalized film capacitor technology, such as compact and dry design. Both structured and unstructured metalized polymer films with edge reinforcement are used. A combination of wavy cut and smooth profiles maximizes the effective contact area thanks to a precise MPM winding with a small offset. The necking effect at the film edges of the all-plastic windings is avoided and a high current handling capacity attained. The PCC's rated voltage extends up to 1000 V DC for industrial applications, while rated capacitance ranges from 50 to 4000 µF, depending on system requirements.

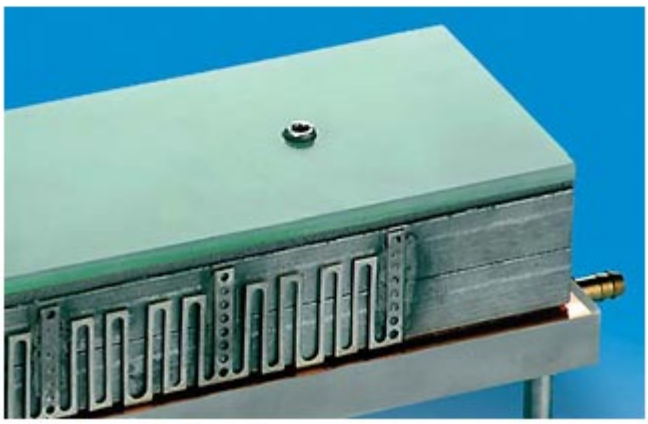
Applications & Cases

PCCs are available in a wide variety of sizes and configurations to give converter designers more degrees of freedom. Both cased and caseless components are manufactured. The caseless types can be integrated straight into the converter package, while the cased types are provided with resin-filled plastic or metal packages for standard applications or to match customer specifications. PCCs with integrated ribbon leads, for example with special attachment holes, are also available so that all design requirements can be met. The PCC and the IGBT are connected by a busbar. Various connectors can be integrated into the capacitor design to obtain an optimum solution for every application. Typical designs in PCC technology are shown in → 1.

1 | Typical designs in PCC technology

PCC with radial screw holes

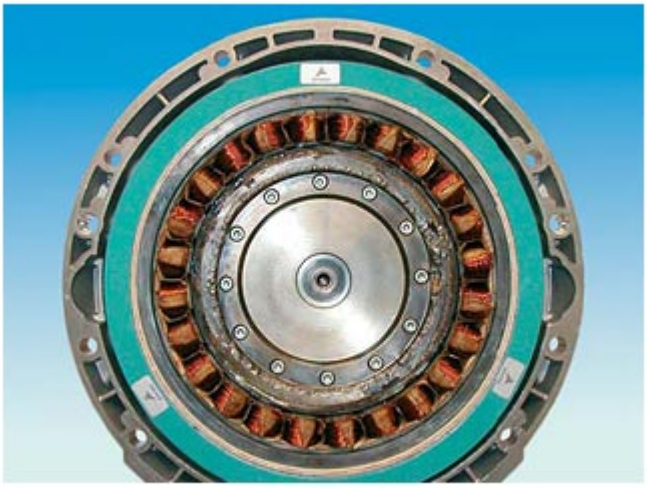
PCC in plastic package



PCC in a compact IGBT converter

Applications & Cases

2 | PCCs for hybrid drives



2 A ring-shaped capacitor is arranged around the transmission bell housing of a hybrid drive.

PCCs for automotive applications

EPCOS is applying the experience gained with PCCs in industrial applications to hybrid drives in motor vehicles and has been active in this market sector for more than five years. The EPCOS portfolio contains capacitor solutions for various converters.

This is illustrated by a solution for DaimlerChrysler in which the capacitors are arranged as small discrete components in a ring around the transmission bell housing → 2. To minimize development time and ease pressure on the budget, the engineers at DaimlerChrysler initially selected this approximate solution based on discrete capacitors. Rated at 310 µF, each link circuit capacitor is designed for an operating voltage of 450 V DC and thermal current of 200 A. Here too, the capacitor case acts as the converter housing, which simplifies heat dissipation. A busbar is already integrated for PEM contacting, and the connection tabs have an inductance of only 10 nH. Voltage overshoots occurring when high currents are switched are therefore very low.

When such hybrid vehicles go into volume production, EPCOS will use a special winding machine matching these core diameters to manufacture a capacitor for the vehicle manufacturers that perfectly fits around the transmission bell housing. The capacitance required is thus obtained in an even smaller space, and the ribbon lead is integrated. The capacitor system must also operate reliably at temperatures up to +130°C prevailing in this part of the vehicle.

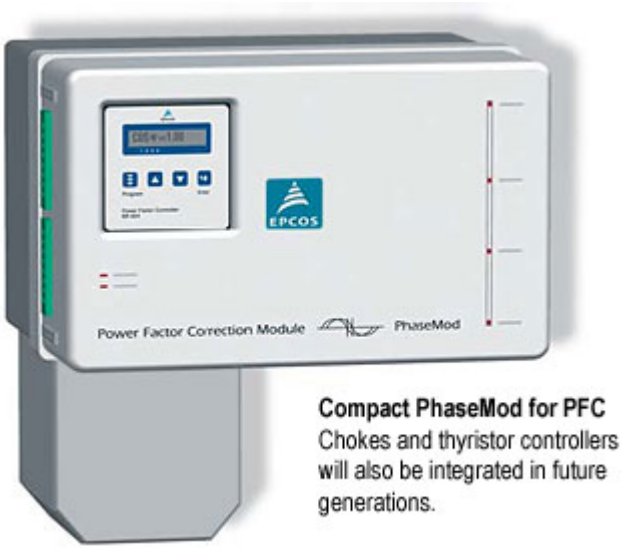
Space savings of 80% with PFC

After EPCOS had successfully applied its integration and platform know-how to the high-power PCC, the next logical step was to offer industrial customers a complete PFC solution in the form of the compact PhaseMod™ regulator (see photo bottom right). Capacitors, controllers, contactors, fuses and busbars are all integrated into this module, resulting in space savings of up to 80% against conventional solutions. Costs are also 50% lower.

At the core of the PhaseMod is a PhaseCap® capacitor plus a multifunctional carrier platform comprising suitably dimensioned conductive plates surrounded by sheet molding compound (SMC) to produce an insulated assembly base. The choice of SMC with reinforced fiberglass as the platform material was crucial to implementation of the project. Wiring is three-dimensional: copper rails carry the currents beyond the base points of the fuses, and the busbars can withstand reactive power up to 500 kvar. A complete PhaseMod family comprising over 70 standard types is now available. It covers voltages from 230 to 480 V and powers from 50 to 100 kvar at rated frequencies of 50 or 60 Hz.

Applications & Cases

Apart from stepping up active PFC, EPCOS will integrate an inductor in the form of a coil to suppress harmonics as well as improving the power factor. In a further development stage, dynamic power factor correction will also be implemented with fast thyristor switches combined with PhaseMod modules. Power semiconductors will replace conventional contactors, and the thyristors will be integrated into the SMC platform. Special emphasis will be placed on power dissipation.



Compact PhaseMod for PFC
Chokes and thyristor controllers will also be integrated in future generations.