Power Magnetics Component Roundup

by David G. Morrison, Editor, How2Power.com

This article highlights the latest introductions of power magnetic components, presenting news about power inductors, transformers, wireless power coils, chokes and filters, and cores introduced over the past six months. Most of the familiar trends continue with a high percentage of new products, especially inductors, targeting automotive applications. The list of specific automotive uses is long: advanced driver-assistance systems (ADASs), LIDAR microprocessors, vacuumless braking systems, on-board chargers, brushless dc electric motors, headlights, airbags, electric power steering, engine control units, Class D audio amps, automotive power over coax (PoC), and others.

There are also quite a few new inductors aimed at computing applications, including those for use in VRMs and other multi-phase buck converters. Some of the latest inductors target dc-dc converter applications with higher switching frequencies of a few megahertz or more. There's also another new inductor series for the trans-inductor voltage regulator topology. One more component stands out for targeting quasi-resonant converters.

While inductor announcements continued to dominate the magnetics news in the second half of this year, there were also more transformer introductions than usual. Among these, isolation transformers for battery management systems in EVs appeared novel.

Other notable components included an integrated resonant transformer-inductor for LLC converters, a transformer series for various dc-dc converter topologies, and a 350-kW planar transformer with high efficiency. A flyback transformer offering multiple outputs, enabling three groups of IGBTs or MOSFETs to be controlled by one transformer, and a Qi-compliant wireless charging coil that's just 0.76-mm thick, were also interesting.

This article represents a follow-up to the Power Magnetics Component Roundup published in the June 2022 issue and earlier magnetics articles published in How2Power Today.

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Power Inductors

Two-In-One Inductor For Class D Audio Amps

Sumida's C2DEPI60D70 is a 2-in-1, magnetically shielded LPF inductor for use in class d amplifiers in automotive applications. It is wound using flat wire, which provides low dc resistance, on a Mn-Zn ferrite core. Meanwhile its mountability is improved by reforming the gap structure from top-surface to side-surface gap.

The C2DEPI60D70 is being offered with an inductance of 3.30 µH ±20%, a DCR of 17.50 mΩ, a max saturation current of 5.10 A, and a 40°C temperature rise current of 3.60 A. The part measures 6.6 × 6.5 × 7.3 mm max. For more information see the C2DEPI60D70 page .

High-Frequency Litz Wire Inductor Is Designed For QR Converters

Pulse's PH9499.xxxCNL is the company's first high-frequency inductor series designed specifically for quasi-resonant converters. The series, which offers values ranging 0.95 µH to 1.25 µH at 3.5 Arms is optimized for the 800-kHz to 1.2-MHz frequency range typical of this topology. Litz wire is used to limit the ratio of ac to dc resistance to 1.25 at 1 MHz, so that the converter maximizes the benefit of its low (22 mΩ max) dc resistance.

The PH9499.xxxCNL series was primarily designed for power modules converting directly from 48 V to silicon core voltages. Through its compact size (11.2 × 9.75 × 7.6 mm max) and its 1.1-mm standoff design feature that allows components to be mounted beneath the inductor, a power density of over 240 W/in^3 can be achieved in the resultant power module design. Additionally, an industry leading 6% inductance tolerance is achieved to maximize the benefits of the resonant topology, according to the vendor. This tight tolerance, which arises from the selected number of winding turns, results in a high saturation current (>18 A) so a high overcurrent can be supported for a short duration without compromising performance.

"Many families of inductors claim to be market leaders, due to their ultra-low DCR specification, without publishing any data on their high frequency core and copper losses. While solutions such as molded inductors are very compact in their construction as magnetic material is pressed directly around the winding coil, their high-frequency resistance can be multiples of their dc resistance and their iron powder material becomes lossy at megahertz frequency of operation. The PH9499 series addresses these limitations by using a high-frequency grade, low-core-loss, ferrite material and a fine-gauge litz wire, especially selected to optimize the performance of your module, allowing you to achieve over 90% efficiency," said Gerard Healy, Product Marketing, Specialized Power PBU, Pulse Electronics.

As the typical application for this inductor may require that the part is subjected to several passes though the reflow oven (both during the mounting of the components on the module and the mounting of the module in the end application), the PH9499 series has been qualified to withstand four passes of the IPC/JEDEC J-STD-20E lead-free reflow profile.

For further information about Pulse inductive solutions, please refer to the Power Inductor Product Guide or see the datasheet. To inquire about lead times, competitive pricing, samples and more, contact the company.

Metal Inductors Come In Range Of Footprints

Sumida's CY*****T125/DS series of automotive-grade SMD metal inductors includes a variety of devices with footprints ranging from 4 x 4 mm to 17 x 17 mm. The inductors can be used in dc-dc converters for LED headlights, ECUs, and other high-reliability applications.

Absolute max voltage across the inductors is 50 V. Operating temperature range is -40°C to 125°C including self-heating. For more information, see the CY0420AT125/DS, CY0530AT125/DS, CY0630AT125/DS, CY01040AT125/DS, CY01260AT125/DS, CY01770AT125/DS product pages.

Edge-Wound Inductors Deliver Stable Inductance To 180°C

Vishay Intertechnology's Vishay Custom Magnetics IHDM-1107BBEV-20 and IHDM-1107BBEV-30 are edge-wound, through-hole inductors in the 1107 case for commercial applications with soft saturation current to 422 A. Featuring a powdered iron alloy core technology, the inductors provide stable inductance and saturation over a demanding operating temperature range from -55°C to +180°C with low power losses and excellent heat dissipation.

The edge-wound coil provides low DCR down to 0.25 mΩ, which minimizes losses and improves rated current performance for increased efficiency. According to the vendor, when compared to competing ferrite-based solutions, the IHDM-1107BBEV-20 and IHDM-1107BBEV-30 offer 30% higher rated current and 30% higher soft saturation current levels that are stable at continuous operating temperatures to +180°C. The inductors' soft saturation provides a predictable inductance decrease with increasing current, independent of temperature.

With an operating voltage up to 350 V, the devices are well suited for dc-dc converters, inverters, differential-mode chokes, and filters for motor and switching noise suppression in high-current, high-temperature applications, including industrial, medical, and military systems. The inductors are available with a selection of two core materials for optimized performance depending on the application.

Standard terminals for the IHDM-1107BBEV-20 and IHDM-1107BBEV-30 are stripped and tinned for through-hole mounting. Vishay can customize the devices' performance—including inductance, DCR, rated current, and voltage rating on request. Customizable mounting options include bare copper, surface-mount, and press fit. To reduce the risk of whisker growth, the inductors feature a hot-dipped tin plating.

Samples and production quantities of the inductors are available now, with lead times of 12 weeks. Pricing for U.S. delivery only is $4.00 per piece in 1,000-piece quantities. For more information see the IHDM-1107BB-X0 product information page.

Table. Key specs for the IHDM-1107BBEV-20 and IHDM-1107BBEV-30 inductors.

Part number	IHDM-1107BBEV-20	IHDM-1107BBEV-30
Inductance (µH)	0.47 to 7.5	0.68 to 12.0
DCR typ. (mΩ)	0.25 to 2.17	
DCR max. (mΩ)	0.30 to 2.60	
Heat rating current typ. (A)(1)	31 to 128	35 to 125
Saturation current typ. (A)	96 to 343(2) / 118 to 422(3)	49 to 202(2)/ 61 to 248(3)

SRF typ. (MHz)	29 to 217	21 to 181

(1) Dc current (A) that will can an approximate ΔT of 40°C
(2) Dc current (A) that will cause L0 to drop approximately 20%
(3) Dc current (A) that will cause L0 to drop approximately 30%

Compact Inductors For ADAS/AD Power Management

TDK's CLT32 series power inductors feature extremely compact dimensions and excellent electrical values thanks to their new design. The nine types cover an inductance range of 17 nH to 440 nH and are designed for 13.5 A to 60 A saturation currents. With a compact footprint of 3.2 x 2.5 mm and an insertion height of 2.5 mm, these are the most compact SMT power inductors in their performance class, according to TDK.

Constructed for a temperature range of -40°C to 165°C including self-heating, these AEC-Q200 certified components are designed with a solid copper coil overmolded with a ferromagnetic plastic compound. The coil ends already function as terminals which significantly increases reliability. Due to the solid copper coil, these products can achieve an exceptionally low DCR value, keeping losses to a minimum. The ohmic resistance is only 0.39 mΩ at an inductance value of 17 nH.

The compact and highly robust CLT32 inductors are well suited for use in safety-relevant automotive applications in ADAS/AD where they can support PMIC-based dc-dc converters which deliver double-digit currents to high-performance processors. The CLT32 series is designed for switching frequencies of up to 10 MHz and already meets future requirements placed on dc-dc converters with high clock rates.

For further information, see the CLT32 power inductors page.

Inductor Delivers Current Ratings Up To 155 A In 6767 Case Size

Vishay Intertechnology's Vishay Dale IHSR-6767GZ-5A is described as the first AEC-Q200 qualified IHSR high-temperature inductor with current ratings to 155 A in the 19.0-mm by 17.1-mm by 7.0-mm 6767 case size. Designed for multi-phase, high-current power supplies and input/output filters in automotive underhood and ADAS applications, the inductor offers a 50% reduction in DCR over typical power inductors and a smaller size than similar ferrite-based solutions, according to the vendor.

The automotive-grade inductor is optimized for energy storage in dc-dc converters up to 5 MHz and high current filtering applications. With its high operating temperature up to +155°C, the device is also suitable for filtering and dc-dc conversion in ADAS and LIDAR microprocessors, 12-V/48-V vacuumless braking systems, on-board chargers, and brushless dc electric motors up to 140 A.

For these applications, the IHSR-6767GZ-5A's low typical DCR of 0.24 mΩ and inductance of 0.22 µH allow for higher current density than competing technologies, says the vendor, with no hard saturation and more stable inductance and saturation over the entire operating temperature range.

Packaged in a shielded, composite construction that reduces buzz noise to ultra low levels, the inductor offers high resistance to thermal shock, moisture, and mechanical shock and handles high transient current spikes without saturation.

Samples and production quantities of the IHSR-6767GZ-5A are available now, with lead times of 16 weeks. Pricing for U.S. delivery only is $2.75 per piece in 200-piece quantities. For more information, see the IHSR-6767GZ-5A product page.

Table. Key specifications for the IHSR-6767GZ-5A inductor.

Case size	6767
Inductance (µH)	0.22
DCR typ. (mΩ)	0.24
Heat rating current typ. (A)	100(1) / 141(2)
Saturation current typ. (A)	107(3) / 155(4)

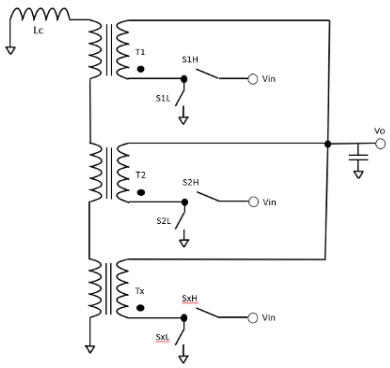
1 Dc current (A) that will cause an approximate ΔT of 40°C
2 Dc current (A) that will cause an approximate ΔT of 80°C
3 Dc current (A) that will cause L0 to drop approximately 20%
4 Dc current (A) that will cause L0 to drop approximately 30%

Trans-Inductors For Multi-Phase Voltage Regulators

Pulse's PAL6374.XXXHL series inductors are designed for use with the trans-inductor voltage regulator (TLVR) topology but leverage the company's existing high volume automated manufacturing to ensure quality, reliability, and cost-effectiveness. The company is also introducing a footprint-compatible traditional VRM inductor series, the PAL6374.XXXAHLT. The PAL6374.XXXHLT and PAL6374.XXXAHLT come in a 10- x 5- x 12-mm package, with inductances of 70 nH to 180 nH and saturation currents of 47 A to 134 A.

To mitigate bandwidth limitations of existing VRM solutions and further drive performance improvements, a "trans-inductor" based voltage regulator was developed in the common domain. The trans-inductor is very similar to a traditional one-turn VR inductor but has the addition of a second tightly coupled winding. The main low DCR "primary" is used in the same fashion as in a traditional VR inductor, having a PWM input with several phases feeding the output. Each single-turn "secondary" is tied in a series loop referenced to the local ground.

When a load step occurs on a given phase, the resultant increase or decrease in duty cycle is reflected to its secondary winding and because the secondaries of each phase are in a series loop they all see this change immediately. Through the magnetic coupling this sensed change is reflected to each inductor's primary winding. In effect, this allows all phases to respond simultaneously to a load transient greatly reducing the time needed for the converter to adjust.



"The PAL6374.XXXHL series provides TLVR performance in a form factor that many design engineers are comfortable with. Additionally, our footprint compatible PAL6374.XXXAHL series is a traditional VRM inductor available on the market. These two series allow for platform flexibility to switch between TLVR and traditional VR power stages with minimal risk," said Andrew Mun, Product Marketing, Pulse Electronics.

In addition to the PAL6374.XXXHLT trans-inductor and PAL6374.XXXAHLT traditional VRM inductor, the company has three families of trans-inductors and footprint compatible traditional inductors that are in development. For more information, see the PAL6374.XXXHLT and PAL6374.XXXAHLT datasheets. To inquire about lead times, competitive pricing, samples and more, just contact the company or use the quote form.

Ferrite-Core Inductors Suit PSiP Power Supplies

Pulse's PGL6477 and PGL6478 series high-current, low-DCR inductors can be used in single-phase PoL and multi-phase buck converters to power processors, memory modules, FPGAs and ASICS in servers, datacenters, networking systems and graphics cards. These product series provide lower core loss at high frequency by using

ferrite material. Using Pulse's power bead technology, the series are built with a single turn of copper frame, which helps provide the very low ac loss. The PGL6477 has a footprint of 6.45 × 6.45 mm and a max height of 5.4 mm, while the PGL6478 is a low-profile platform with 10.05 x 10.05 mm footprint and a max height of 3.55 mm.

"These product series, PGL6477 & PGL6478 are designed as a straddle construction and are suitable for PSiP power supply. The straddle terminals occupy a small PAD layout area, allowing more components to be put under the PSiP inductor, which helps to reduce the footprint size of the power supply. These series are built with automated production, and are suitable for high-performance, high-reliability applications in data communications, computing, and industrial markets which also require a price competitive solution," said Kevin Li, Product Marketing, Power PBU, Pulse Electronics.

For more information, contact the company.

Table. Key specs for the PGL6477 and PGL6478 series inductors.

Part Number	Inductance Range	Current (max Isat A)	DCR (mΩ)	Length (mm)	Width (mm)	Height (mm)
PGL6477.XXXHLT	100 nH to 215 nH	50	0.4	6.45	6.45	5.4
PGL6478.XXXHLT	120 nH to 280 nH	62	0.45	10.05	10.05	3.55

Inductors For Server VCORE Power

Pulse's PG2290.XXXHLT, PGL6395.XXXHLT and PA5615.XXXHLT series of high current, low DCR inductors are intended for use in single-phase PoL and multi-phase buck converters to power processors, memory modules, FPGAs and ASICS in servers, datacenters, networking systems and graphics cards. The three families provide lower core loss using the latest high frequency materials, reduced DCR, and higher current ratings in different footprints. The thinnest one is only 4.6 mm max with 140-A Isat max. These three new series are available in multiple sizes, inductances, and current ratings.

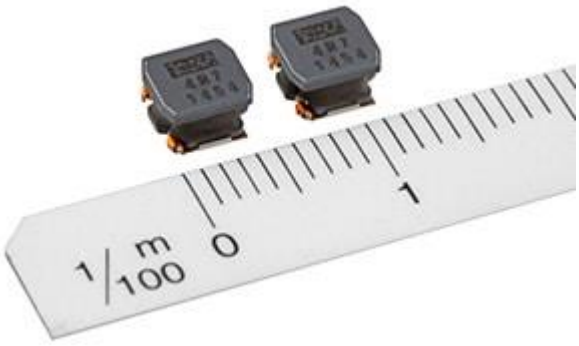
Table. Key specs for the three series of high-current, low-DCR inductors.

Part Number	DCR	Dimensions (length x width x height)			Inductance (nH)	Current (Apk)
PG2290.XXXHLT	0.15	10.7	7.5	12	120-320	140
PGL6395.XXXHLT	0.23	10.2	4.6	10	70-220	140
PA5615.XXXHLT	0.125	10	6	8.5	80-100	105

"With voltage regulator transient response and load line requirements constantly becoming stricter and more demanding, there is significant pressure to reduce losses and increase current ratings while continuing to reduce inductor footprint. Pulse is able to leverage our relationships with our magnetic material suppliers and Power IC partners along with advanced design capabilities to provide optimal magnetic solutions," said Damon Huang, Product Marketing, Power PBU, Pulse Electronics.

For more information, contact the company.

Inductors Feature High Magnetic Shielding



TDK's has introduced the VLS5030EX-D type power inductor, which measures 5.3 x 5.0 x 3.0 mm (L x W x H)), as part of the VLS-EX-D series of wound power inductors for automotive power circuits. These compact components provide excellent dc superposition characteristics with an assured performance at temperatures of up to 150°C. These inductors are suitable for headlights, airbags, electric power steering (EPS), advanced driver-assistance systems (ADASs), engine control units (ECUs), and various other power circuit applications.

Additionally, the inductors support automotive power over-coax (PoC) implementations with an excellent dc superposition characteristic for transmitting data as well as supplying power, fulfilling the needs of, for example, ADASs that employ low-voltage differential signaling (LVDS) transmission. In addition, as the ICs' processing capability increases, a higher current is required, and the VLS-EX-D series supports these specifications. Compliant with AEC-Q200, the inductors support an operating temperature range of -40 to +150°C (including self-heating).

The VLS-EX-D series of inductors achieves a higher-rated current compared to TDK's standard VLS-EX-H series. These improvements are achieved by using TDK's innovative metallic magnetic material for the magnetic shielding function. Specifically, for the VLS5030EX-D inductor, the rated Isat is 3.3 A at 4.7 µH, which is an increase of approximately 6% from standard parts of the same size—5.3 x 5.0 x 3.0 mm. Moreover, thanks to the welding method used for connecting the wire winding to the external electrodes, high reliability is implemented for reflow and use in high-temperature environments. For more information see the VLS5030EX-D type datasheet.

Table. Key specifications for a member of the VLS5030EX-4R7M-D inductor series.

Type	Inductance (µH)	DC resistance (Ω) typ.	Rated current* Isat (A) max.	Rated current Isat (A) typ.	Rated current Itemp (A) typ.
VLS5030EX-4R7M-D	4.7±20%	0.040±20%	3.3	3.7	3.4

The rated current shall be Isat or Itemp, whichever is less.

Isat: Current value based on inductance variation (30% lower than the initial inductance value).

Itemp: Current value based on temperature increase (Temperature increase of 40 ℃ by self-heating).

*Itemp varies depending on the usage environment (board specifications, mounting density, etc.).

Shielded Power Bead Inductors Target Multiphase Applications

Bourns' Model SPB0705, SPB1005, SPB1007, SPB1012 and SPB1308 shielded power bead inductor series feature high rated current, ferrite-based shielded construction and extremely low dc resistance with inductance values from from 72 to 440 nH. Bourns designed these series to match the enhanced efficiency, low magnetic field radiation and reduced power loss requirements in a broad variety of multi-phase integration applications.

The advanced features and the multiple SMD footprints (6.7 x 6.5 to 13.5 x 13 mm) offered in the five new power inductor series make them excellent power conversion solutions for applications in voltage regulator modules (VRMs), power processors, memory modules, high-current ASICs, servers, storage, data centers, networking systems and graphic cards.

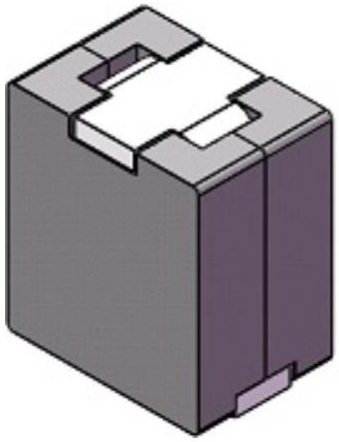
All five inductor series are available now. For more information, see the website.

Flat-Wire Inductors For Multiphase Power Supplies

Sumida's CDEPH7212 magnetically shielded power inductor has flat-wire windings that provide exceptionally low DCR, according to the vendor. The device targets the server market for hypercale data centers and use in multiphase digital PWM power supplies.

For more information see the CDEPH7212 page.

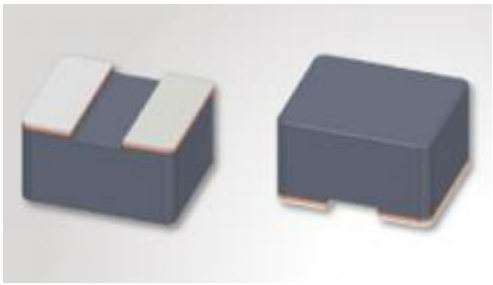
Part Name	Inductance [Within] (μH) ※1	D.C.R. at 20℃ (A) Max. (Typ.) (mΩ)	Saturation Current (A) Max.(Typ.) ※2		Temperature Rise Currrent (A) (Typ.) ※3
			20℃	125℃	
CDEPH7212NP-R13LC	0.13 ± 15%	(0.15)	115 (125+)	86.00 (102)	(75.00)
CDEPH7212NP-R15LC	0.15 ± 15%	(0.15)	102 (120)	72.00 (85.00)	(75.00)
CDEPH7212NP-R18LC	0.18 ± 15%	(0.15)	80.00 (95.00)	63.00 (75.00)	(75.00)
CDEPH7212NP-R20LC	0.20 ± 15%	(0.15)	76.00 (90.00)	57.00 (67.00)	(75.00)
CDEPH7212NP-R22LC	0.22 ± 15%	(0.15)	69.00 (82.00)	51.00 (60.00)	(75.00)
CDEPH7212NP-R28LC	0.28 ± 15%	(0.15)	53.00 (63.00)	38.00 (45.00)	(75.00)
CDEPH7212NP-R47LC	0.47 ± 15%	(0.15)	28.00 (34.00)	22.00 (26.00)	(75.00)



1. Measuring frequency inductance at 1 MHz.
2. Saturation current: This indicates the value of the dc current when the inductance becomes 20% lower than its initial value (Ta = 20°C).
3. Temperature rise current: the actual value if dc current when the temperature of coil becomes ΔT = 40°C (Ta = 20°C).

Bottom-Termination Powder Inductors Lower DCR For POLs

Pulse's BDQQ series of miniature molded inductors is designed to reduce the overall losses in point-of-load designs (PoLs), especially buck converter applications for smart phones and wearable devices. The BDQQ series is a bottom-terminated product, where the terminal is directly formed by the flat enameled wire on the base. Without the contact resistance of the lead frame as seen from more traditional molded inductors, the BDQQ series will typically have lower DCR.



Space savings is further driven with smaller package sizes including: 1.4 x 1.2mm, 2.0 x 1.2mm, and 2.0 x 1.6mm, while the termination of the series allows for the inductors to be placed close to each other on the PCB. A broad range of inductances values can be expected ranging from 110 nH to 2.2 µH to account for various PoL designs.

With both the special patented coil design and new magnetic powder development, the BDQQ series will achieve better performance with a lower dc resistance, higher saturation current, and a lower core loss. To summarize, the BDQQ series will help customers improve their system's efficiency and through the inductor's bottom-termination design, will help reduce the overall solution's footprint.

"This is a new milestone for Pulse to step into a new era of power inductors with the trend of miniaturization and low profile. With the new design of integrated manufacturing systems of wire winding and magnetic powder forming processes, the cost-effectiveness of new bottom-termination products will help our customers' products to be more competitive with their competition. Smaller and thinner power inductors will be released next year," said Alex Lin, Product Marketing, Standard Power PBU, Pulse Electronics. For more information, see the datasheet.

Transformers

350-kW Planar Transformer Is 99.62% Efficient

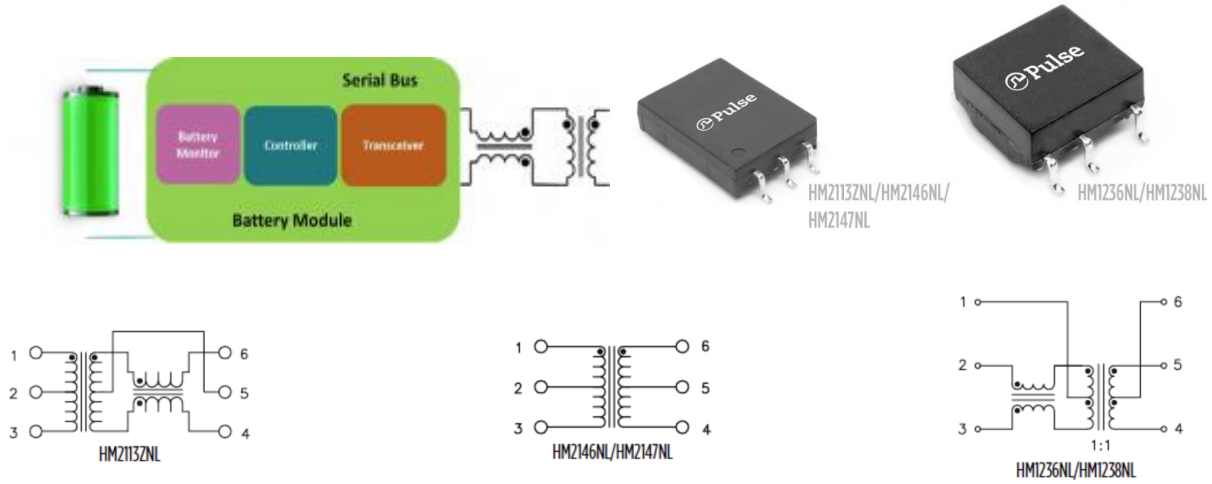
Payton Planar has developed a 350-kW planar transformer that measures just 390 mm x 370 mm x 75 mm (15.4 x 14.6 x 3.0 in.). Its single primary and dual secondaries feature a 6:4:4 turns ratio with each secondary rated to handle 175 kW at 50 kHz operating frequency with 800-V nominal input. Secondaries are designed to support output voltages of 200 to 1400 V.

The primary is rated for 630 Arms continual (or 1300 A for 500 us), while the secondaries are rated for 560 Arms (or 975 A for 500 µs). Core losses are specified as 582 W while winding losses are 758 W. With total losses of 1340 W at 350-kW output power, the transformer is 99.62% efficient, leading to a max estimated temperature rise of 95°C, which is about 0.071°C/W of thermal impedance. The transformer is configured for liquid cooling. For more information, see the website or contact the company.

Low-Profile Isolation Transformers For BMS Chipsets

Pulse's 3.45-mm-high BMS transformers are said to be the market's lowest-profile packages and complement the current BMS range of products that Pulse already offers. And being matched and qualified to the latest BMS silicon makes the new transformers easy to design with.

The low-profile BMS transformers are offered in several single-channel versions with center taps and chokes. The different configurations and their part numbers are shown in the figure. These transformers are matched to various BMS cell monitor and controller chipsets as indicated in the table. Other features include design to the latest IEC-62368 standard, functional insulation with creepage distance >5 mm, working voltages of -600, 1000 and 1500 Vdc for 15 years and a high operating temp range that spans -40°C to 125°C.



BMS CHIPSET PART SPECIFICATIONS

Part Number	Turns Ratio	OCL (uH)	Isolation Voltage	Working Voltage	Isolation & Creepage	Temperature Rating	Package size (L x W x H) mm	Matched Silicon
HM2113ZNL	1:1	150uH Min, 450uH Max	3000VDC	1000Vdc	Functional >3mm	-40°C to +125°C	9.2x15.4x3.45	NXP, ADI, Infineon
HM1236NL HM1238NL	1:1	500uH Min,	3200VDC 4300VDC	600Vdc 1000Vdc	Functional >3mm	-40°C to +125°C -40°C to +150°C	8.6x10.9x4.06	Maxim: MAX17841B
HM2146NL	1:1	150uH Min, 650uH Max	3000VDC	1000Vdc	Functional >5mm	-40°C to +125°C	9.2x15.4x3.45	TEXAS/NXP/ADI
HM2147NL	1:1	500uH Min, 1400uH Max	4300VDC	1500Vdc	Functional >5mm	-40°C to +125°C	9.2x15.4x3.45	TEXAS: BQ7961x-Q1

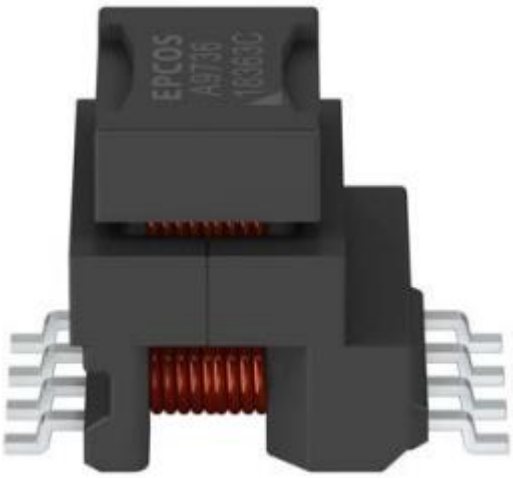
The new options are well suited for use in electric vehicle (EV), marine, aviation and energy storage (ESS) applications where multiple large battery packs are connected in series and space is at a premium. BMS transformers protect the digital controller boards from large potential voltage differences which may occur between battery packs. For the BMS to monitor and control each cell/pack, serial communication links between boards are used and these need to be isolated by transformer coupling circuits instead of capacitor coupling due to the high voltages, and in EV applications, a longevity of 15 years.

The two newest single-channel transformers are qualified with the serial bus communications transceivers from Texas Instruments. Parts are AEC-Q200 certified and can be manufactured in an ISO/IATF16949 facility. BMS chipset part specifications are shown in the table. Contact the company for other package sizes and configurations.

Compact SMT Transformers With High Dielectric Strength For DC-DC Converters

TDK's EPCOS E13EMHV series of compact SMT transformers, also referred to as the B78308*A003 series, offers high dielectric strength for a wide range of dc-dc converter topologies. The isolation distances comply with the IEC 60664-1 and 61558-2-16 standards, achieving a high working voltage of 1000 Vdc. Transient overvoltages of up to 2500 Vpeak are permitted. The high dielectric strength between the primary and secondary sides is 3000 Vac (50 Hz, 60 sec).

With dimensions of only 12.9 x 15.8 x 11.4 mm, the B78308*A003 series transformers are space-saving. The requirements for clearance and creepage distances according to the IEC 60664-1 standard (Np/Ns: min. 8.14 mm clearance, min. 11.2 mm creepage) are met in this compact design thanks to the internal construction of the transformers.



Two types are available for dc-dc converters in flyback topology with turns ratios of 1:0.22:0.78 and 1:0.33:0.7. Three types are available for push-pull and half-bridge converters with turns ratios of 1:1.07 and 1:1:0.57:2.14.

All new transformers are designed for a frequency range of 100 kHz to 500 kHz and have a very low coupling capacitance of only 2 pF. The permissible operating temperature range is between -40°C and +150°C. The components of this transformer series are qualified to AEC-Q200 Rev. D and are suitable for various dc-dc converter topologies and gate driver circuits in e-mobility and industrial electronics.

For more information, see the Transformers for IGBT/FET page and the E13EMHV series datasheet.

Integrated Resonant Transformer-Inductor Saves Space In LLC Converters

Vishay Intertechnology's 5.5-kW Vishay Custom Magnetics MRTI5R5EZ is a resonant transformer for LLC converter applications that features both the transformer and an integrated inductor in a single package. Designed to save PCB space while simplifying layouts and reducing component-mounting requirements, the MRTI5R5EZ offers fully tunable magnetizing and leakage inductance with minimal parasitic variation.

According to the company, this device is the first transformer of its kind to use a second middle transformer leg to complete the resonant inductor portion of the circuit. Other implementations require an additional magnetic core to deliver the same performance. Not only does this unique construction save space, but it also simplifies designs by eliminating the need for interconnects or jumpers from the resonant inductor to the transformer's winding.

The MRTI5R5EZ is intended for use in on-board chargers and half- and full-bridge resonant power supply transformers in industrial controls, solar inverters, and military, avionics, and construction equipment. In addition to providing a customizable turns ratio for these applications, the transformer's losses can be moved from the core to the coil as needed to deliver the best performance and heat dissipation, while its minimal parasitic variation optimizes capacitor selection.

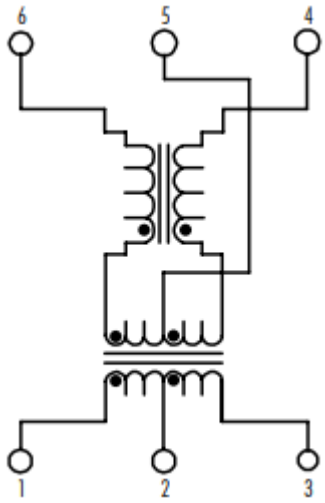
The device features operating frequencies from 100 kHz to 350 kHz, rated power from 4 kW to 6 kW with 400-V to 800-V input voltage, and rated current to 28 A. The isolation voltage rating for the MRTI5R5EZ is 2500 V.

The transformer includes a bracket for cold-plate mounting with raised bosses, with flush-mount options available. M4 ring terminals are standard for the transformer, with customizable lead lengths and terminal types available, and the device can be provided with a thermal gap pad on the mounting surface.

Samples and production quantities of the MRTI5R5EZ are available now, with lead times of four weeks for samples and 16 to 20 weeks for production quantities. Pricing for U.S. delivery only is $100.00 per piece in 1000-piece quantities. For more information, see the MRTI5R5EZ product information page.

Single-Channel BMS Transformers For EVs Are Robust

iNRCORE's RA1055NL is the first in a new line of single-channel battery management system (BMS) transformers for electric vehicle (EV), data center, solar energy storage, and smart grid industries. The RA1055NL, has received AEC-Q200 qualification for EV automotive applications and is available to the EV market. With a data rate of 1 Mbps and isolation of 4300 Vdc, the BMS features double connections and full automation of key processes that significantly boost reliability.



"iNRCORE's BMS transformer solution is far more robust than other options on the market," says Leo Pan, regional sales manager at iNRCORE. "Open failure is a common issue for this type of construction. We have solved the issue, offering increased reliability for the booming EV market."

iNRCORE's single-channel BMS transformers resolves the key customer pain point of open failure at wire termination by using spot welding and adding post soldering processes. Once coil wound, wires are spot welded to terminals, which melts enamel wires to leads. Post soldering then prevents oxidation. Together these processes deliver a robust connection to increase reliability by avoiding open failure.

The BMS transformers provide safety isolation and EMI noise suppression. They support serial daisy chain, isoSPI, SPI, and other applications. The transformers have an operating temperature of -40°C to more than +125°C and can be manufactured as dual channel or with higher isolation upon request.

To ensure quality, iNRCORE operates full automation for coil winding, spot welding, soldering, testing, and packing processes initially in its AS9100D-certified facility until IATF 16949 is achieved next year. For more information, see the datasheet or contact the company.

High-Isolation Current-Sense Transformer For Automotive Applications

Pulse's PMS9505 is an automotive-grade IATF certified version of the company's PH9505 series high-isolation current-sense transformer, and maintains the same platform and footprint size as PH9505.

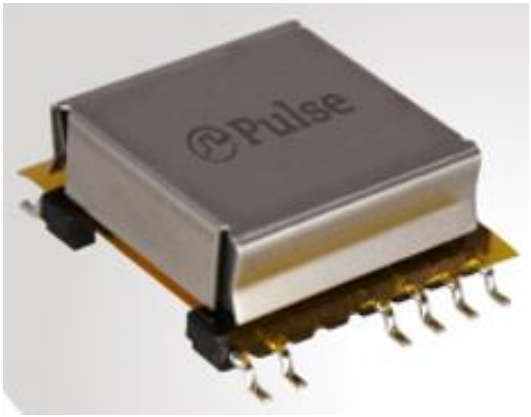
The PMS9505 uses a unique construction where the primary winding is molded into the plastic base forming a solid insulation barrier. This allows the part to be a compact 13.6 x 12.8 x 14.4 mm, and achieve reinforced insulation per IEC60664/IEC60950-1 for a working voltage up to 300 Vrms. The low DCR primary allows for a rated current of 30 Arms with a range of turns ratios from 1:50 to 1:180.

"Our existing product line for surface mount current sense transformers, including the ever popular PA1005 EE5 series, remain the component of choice for applications that require just functional insulation. However, many automotive applications require reinforced insulation, where current needs to be measured across different ground planes. This is a typical requirement for OBC and dc-dc converter in EV, PMS9505 is designed to satisfy with these requirements," said Kevin Li, Product Marketing, Power PBU, Pulse Electronics.

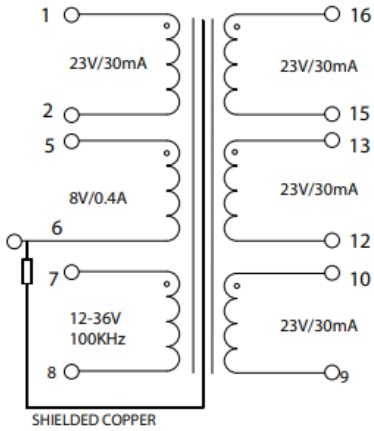
The high current rating of these compact solutions are well suited to high performance applications such as battery management, power conversion, inverter drive and motor control. See the PMS9505 datasheet for further details.

Gate-Drive Transformer With High Isolation Voltage

Pulse's PG1895NL EFD20 flyback transformer is specifically designed for SiC or IGBT devices switching. The PG1895NL is a 6-W flyback which provides five groups of output with footprint size 29.4 mm x 25.5 mm x 12 mm max, and a 2400-Vrms isolation voltage max.



One typical application for the PG1895NL is in a three-phase inverter drive system. Three groups of 23 V can be used to drive the high-side IGBT/MOSFET and one 23 V is used to drive the low-side IGBT/MOSFET. Three groups of IGBT/MOSFET are controlled by one transformer, saving the space and cost.



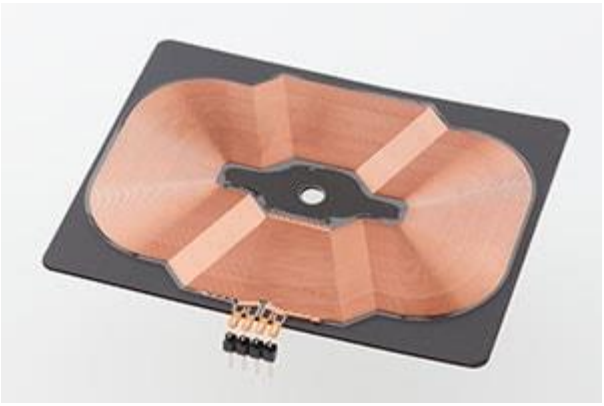
"We have been delighted with the market interested in the PG1895NL and the range of applications into which they have been designed. This smaller product offering five outputs to control multi-group MOSFET or IGBT, 23-V output can be divided into +18 V and -5 V to turn on or turn off IGBT. Compared to existing products on the market, it would occupy a smaller footprint size," said Kevin Li, Product Marketing, Power PBU, Pulse Electronics.

The winding of the round wire coil is fully automated, making this product well suited for high-performance, high-reliability applications in the data communications, industrial and automotive markets which also require a price-competitive solution. For more information, see the datasheet.

Wireless Power Coils

Wireless Charging Coil Is Just 0.76-mm Thick, Supports Large Charging Area

TDK's WCT38466-N0E0SST101 Qi-compliant wireless charging coil offers a thin pattern coil to support the wireless charging of next-generation mobile devices. Its 0.76-mm thickness, which is described by the company as industry leading, was developed without employing conventional lithographic exposure/etching techniques. Instead, TDK's process technology was leveraged, in combination with plating technology using the nano dispersion of the organic compound polypyrrole, developed by Achilles Corporation. The coil's overall measurements are 85 x 67 x 0.76 mm, inductance is 10.6 µH and resistance at 100 kHz is 0.139 Ω.



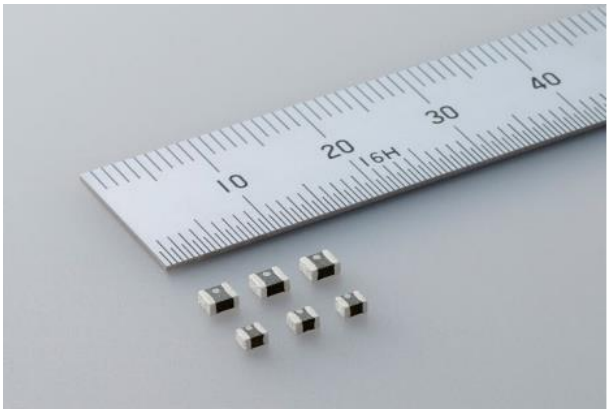
Although wireless charging coils have generally been produced by winding wires, this new approach has made it possible to manufacture them using a thick copper pattern on a thin film. This, along with the application of TDK's proprietary magnetic materials has enabled coil thickness reduction down to 0.76 mm, which is approximately one-fifth of the thickness of traditional 3.8-mm diameter wound wire coils, according to the vendor. Furthermore, the use of TDK's original optimal coil shape pattern means that the new coils cover a larger charging area, resulting in greater user convenience.

With their dramatically thinner diameters, the TDK coils will open up new opportunities for wireless charging deployment. In addition, while it was previously necessary for three coils to be incorporated into wireless charging systems, now only one coil will be required, thereby enabling system miniaturization. For more information, see the website.

Chokes And Filters

Metal Power Inductors Feature High Saturation Current And Low DCR

Taiyo Yuden's MCOIL LCEN series of AEC-Q200-qualified, wire-wound metal power inductors consists of 13 devices in two sizes, including the LCENA2016MKTR24M0NK (2.0 x 1.6 x 1.2 mm where height is its maximum value). This power inductor product is designed for use as a choke coil in power supply circuits for automotive body and information systems.



The design of the MCOIL LCEN series is based on the metal power inductor MCOIL ME series, and maintains its advantages of a large current and a low dc resistance. The LCENA2016MKTR24M0NK (inductance = 0.24 µH) simultaneously features industry-leading dc superposition characteristics (saturation current at 6.8 A) and a low dc resistance (18 mΩ) (both are the maximum values), according to the vendor, contributing to the downsizing and power consumption reduction of power supply circuits for ADAS units and instrument clusters, which are increasingly being upgraded with greater functionality and performance.

Production of the product commenced at our subsidiary company, Fukushima Taiyo Yuden Co., Ltd. (Date-shi, Fukushima prefecture, Japan) from May 2022 with a sample price of 50 yen per unit. For the detailed product lineup, see the website. For product inquiries, see the Contact Us page.

Table. Key specifications of the MCOIL LCEN series.

Part number	Size (LxW) [mm]	H [mm] max.	Nominal inductance [µH]	Inductance tolerance [%]	Rated current*3 [A] max.		DC resistance [Ω] max.	Operating Temp. Range [℃]
					Saturation current Idc1*1	Temperature rise current Idc2*2		
LCENA2016MKTR24M0NK	2.0x1.6	1.2	0.24	±20	6.8	5.5	0.018	-40～+125
LCENA2016MKTR33M0NK			0.33	±20	5.4	4.9	0.022	
LCENA2016MKTR47M0NK			0.47	±20	4.8	4.7	0.025	
LCENA2016MKT1R0M0NK			1.0	±20	3.1	3.2	0.045	
LCENA2016MKT2R2M0NK			2.2	±20	2.2	1.8	0.120	
LCENA2520MKTR15M0NK	2.5x2.0	1.2	0.15	±20	10.2	6.7	0.009	
LCENA2520MKTR33M0NK			0.33	±20	7.0	5.6	0.015	
LCENA2520MKTR47M0NK			0.47	±20	5.9	5.0	0.020	
LCENA2520MKT1R0M0NK			1.0	±20	4.4	3.2	0.042	
LCENA2520MKT1R5M0NK			1.5	±20	3.3	2.8	0.057	
LCENA2520MKT2R2M0NK			2.2	±20	3.0	2.4	0.077	
LCENA2520MKT3R3M0NK			3.3	±20	2.3	1.8	0.131	
LCENA2520MKT4R7M0NK			4.7	±20	2.1	1.5	0.185	

*1. The saturation current value (Idc1) is the dc current value having inductance decrease down to 30% (at 20℃).

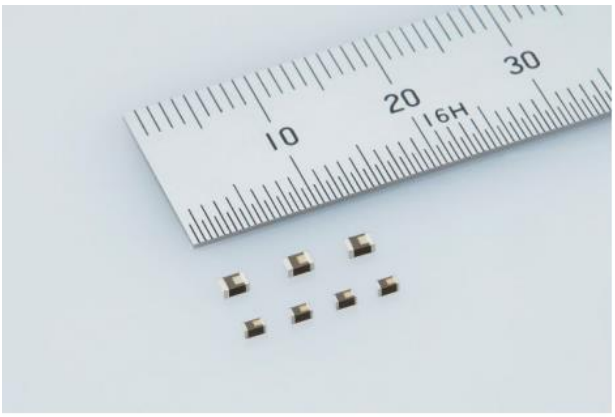
*2. The temperature rise current value（Idc2) is the dc current value having temperature increase up to 40℃ (at 20℃).

*3. The rated current is the dc current value that satisfies both of current value saturation current value and temperature rise current value.

Derating of rated current is necessary depending on the ambient temperature.

Multilayer Metal Power Inductor Combines Small Size With High Current, Low DCR

Taiyo Yuden has added seven models in two sizes to the AEC-Q200-qualified multilayer metal power inductor MCOIL LCCN series, including the LCCNF1608KKTR24MAD (which measures 1.6 x 0.8 x 1.0 mm, where height is its maximum value). This power inductor product is designed for use as a choke coil in power supply circuits for automotive body and information systems.



The product has a wider operating temperature range of -55 to +150°C than the existing product, the LCCNF1608KKTR24MA (-40 to +125°C). According to the company, the LCCNF1608KKTR24MAD simultaneously features industry-leading dc superposition characteristics (saturation current at 3.2 A) and low dc resistance (35 mΩ) (both are the maximum values), while maintaining the compact size of the metal power inductor MCOIL LSCN series.

The product contributes to the high-density mounting of power supply circuits for ADAS units and instrument clusters, which are increasingly being upgraded with greater functionality and performance. Production of the product commenced at the subsidiary company, Wakayama Taiyo Yuden Co., Ltd. (Inami-cho, Hidaka-gun, Wakayama prefecture, Japan) from June 2022, with a sample price of 50 yen per unit.

Table. Key specs for the MCOIL LCCN series of multilayer metal power inductors.

Part number	Size (LxW) [mm]	H [mm] max.	Nominal inductance [µH]	Inductance tolerance [%]	Rated current*3 [A] max.		DC resistance [mΩ] max.	Operating temp. range [°C]
					Saturation current Idc1*1	Temperature rise current Idc2*2		
LCCNF1608KKTR24MAD	1.6x0.8	1.0	0.24	±20%	3.2	3.8	35	-55～+150
LCCNF1608KKTR33MAD			0.33	±20%	2.8	3.3	46	
LCCNF1608KKTR47MAD			0.47	±20%	2.6	3.0	65	
LCCNF2012KKTR24MAD	2.0x 1.25	1.0	0.24	±20%	4.8	5.4	20	
LCCNF2012KKTR33MAD			0.33	±20%	4.4	4.5	30	
LCCNF2012KKTR47MAD			0.47	±20%	3.8	3.8	41	
LCCNF2012KKT1R0MAD			1.00	±20%	2.7	2.7	85	

*1. The saturation current value (Idc1) is the dc current value having inductance decrease down to 30%. (at 20℃).

*2. The temperature rise current value（Idc2) is the dc current value having temperature increase up to 40℃. (at 20℃).

*3. The rated current is the dc current value that satisfies both saturation current value and temperature rise current value.

For the detailed product lineup, see the website.

Multilayer Inductors Meet Evolving Automotive PoC Demands

TDK's MLJ1608WG series multilayer inductors are targeted for use in automotive power over coax (PoC) implementations. The inductors achieve a maximum impedance of 2500 Ω. They also retain impedance levels of 1000 Ω over a 300-MHz to 2-GHz frequency range. While the impedance characteristics of conventional multilayer inductors will vary considerably, depending on the current applied, and cannot secure sufficient impedance, the MLJ1608WG series offers far less current variation.

A high-rated current of 500 mA is supported despite these components having 1.6 x 0.8 x 0.8 mm (L x W x H) dimensions. This significantly reduces variation in impedance during current application. The components can be operated at temperatures of up to 125°C with a current of 400 mA.

With the widespread uptake of advanced driver-assistance systems (ADASs), the performance of automotive cameras has advanced dramatically. Consequently, there are growing demands for higher-speed and larger-capacity interfaces. Automotive camera systems using LVDS transmission are adopting a PoC approach, which superimposes data and power supply onto a single coaxial cable.

Effective filtering is needed to separate data from the power supply in a PoC circuit. This will generally consist of two to four inductors. Inductors used in such filters must have high impedance for ac components from low right through to high frequencies. By achieving impedance values of 1000 Ω or higher over a broad range of frequencies, the MLJ1608WG series is highly optimized for meeting such requirements.

For more information see the datasheet.

Table. Key specs for a member of the MLJ1608WG series of multilayer inductors

Type	Inductance (µH)	Dc resistance (Ω) typ.	Dc resistance (Ω) max.	Rated current (mA) max. at 105°C	Rated current (mA) max. at 125°C
MLJ1608WGCR56NTD25	0.56 ± 30%	0.45	0.70	500	400

EMI-RFI Three-Phase Filter Is Volumetrically Efficient

From KEMET, a part of the YAGEO Group, the GTX series of metal box three-phase filters fulfills the growing need for EMI-RFI filters to suppress electromagnetic conductive noise in general-purpose inverters and medical power supplies. With a nanocrystalline metal core, the GTX series achieves a 50% improvement in volumetric efficiency and is compact and lightweight due to its high-density mechanical structure, according to the vendor. In contrast, many solutions comparable to the GTX series use ferrite materials, which have a larger footprint and are heavier in weight.

The GTX metal-case filters cover three-phase EMC requirements with a wide variety of characteristics. With a nanocrystalline core, these filters achieve excellent damping and attenuation characteristics in a compact size, coupled with a broader frequency range. In addition, six different combinations of Y capacitors can be selected to support various equipment topologies. Applications for these filters include machine tools, industrial robots, wind-power generation, power storage systems, medical equipment and diagnostic instruments.

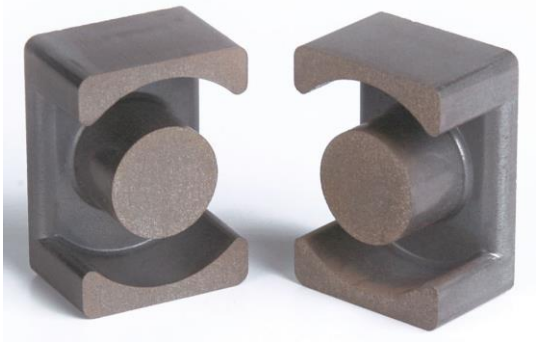
The GTX series is rated to 500 Vac (50/60 Hz), 500 Vdc (250 Vac, 353.3 Vdc for c-UL). The filters can operate over a temperature range of -25°C to +55°C. Additionally, the nanocrystalline metal core results in rated currents of 30 A to 60 A. GTX is safety-certified by UL, c-UL, and TüV.

The GTX series is available immediately via KEMET distributors. For more information, see the GTX Metal Case Three Phase Filter page.

Cores

Powder Cores Are Available In Multiple Geometries

Magnetics' Kool Mμ MAX and Kool Mμ H*ƒ* powder core materials are now available in multiple geometries, including E, EQ, LP, and blocks. Kool Mμ MAX includes a variety of sizes of E cores, Blocks, EQ cores, and LP cores. Kool Mμ H*ƒ* is available in five sizes of Blocks from 47.5 mm to 95.0 mm.



Kool Mμ MAX is the next generation of sendust cores from Magnetics. These offer 50% better dc bias performance than the low core loss Kool Mμ material for better power handling. Use of copper wire is minimized by maintaining inductance using less turns, resulting in savings in overall component cost. With its super low losses, Kool Mμ MAX does not mimic the temperature rise problems found in iron powder cores. Improve inductor efficiency at a fraction of the cost of High Flux with Kool Mμ MAX, says the vendor.

Kool Mμ H*ƒ* powder cores are made from distributed gap alloy powder optimized for frequencies of 200 to 500 kHz. Exhibiting approximately 35% lower losses when compared to Kool Mμ, Kool Mμ H*ƒ* is a cost-effective solution for minimizing power losses in high-frequency power supplies using GaN or SiC power switches, high efficiency power supplies, and UPSs.

See the Kool Mμ MAX and Kool Mμ H*ƒ* material pages for datasheets and instructions on how to order, or contact the company for more information.

Alloy Powder Cores With Better Bias Come In E Shape And Blocks

Magnetics' Edge powder core materials are now available in E shape and blocks. U, EQ, and LP shapes available upon request. Edge cores are said to offer the best dc bias of all alloy powder cores. When compared with High Flux, Edge displays approximately 40% lower losses and 30% improvement in dc bias.

Applications include rack-mount power supplies, telecom servers, switching regulator inductors, inline noise filters, flyback transformers, power factor correction stages, and pulse transformers. See the Edge material page for datasheets and instructions on how to order, or contact the company.