

## **Power Magnetics Component Roundup**

*by David G. Morrison, Editor, How2Power.com*

With magnetic components continuing to dwarf the ICs and power semiconductors in many power converter designs, magnetics manufacturers continue their efforts to shrink their products by lowering their DCR and increasing their current ratings in a given package size. This trend is ongoing for off-the-shelf power inductors as reflected in recently introduced products.

In addition to this broad trend in size reduction, magnetics manufacturers also continue to optimize their inductors for use in dc-dc converters, other SMPS designs and EMI filtering, by tailoring these products to specific applications. While automotive has perhaps been the most often targeted application area in recent years, the latest batch of power inductors also addresses requirements in industrial, telecom, computing and audio applications. Along with improvements in size and electrical performance, many of these new inductors boast wide operating temperature ranges and ruggedness in line with the harsh environments for which they are made. Some new inductors address requirements for higher-frequency operation.

Read this article to learn about recent developments in power inductors introduced over the past six months. In addition to power inductor news, this feature includes information on new inductor cores and magnetics-related literature. This article represents a follow-up to the Power Magnetics Component Roundup published in the May 2019 issue and other [magnetics articles](#) published in How2Power Today

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## Power Inductors

### Inductors Are Optimized For 48-V Automotive Systems

[Coilcraft's](#) AGM2222 series power inductors offer current ratings up to 110 A and very low DCR in a package measuring just 22 x 22 x 23 mm, a 73% volume reduction from previous-generation products. This significant improvement in power density makes the AGM2222 well suited for high-current applications including automotive bidirectional 12-V to 48-V dc-dc converters.

The AGM2222 series is available in 13 inductance values from 1.9  $\mu$ H to 10  $\mu$ H. It is qualified to AEC-Q200 Grade 1 (-40°C to 125°C ambient), making it suitable for automotive and other high-temperature applications. Soft saturation is stable over temperature and enables high peak current handling. Magnetic shielding reduces EMI at high switching frequencies. Technical specifications and free evaluation samples of the AGM2222 series are available from the company [website](#).



### Shielded Inductors Deliver High Inductance

[Coilcraft's](#) XAL7050 series of high-temperature power inductors is available with inductance values from 22 to 47  $\mu$ H and current ratings as high as 5.5 A, with low DCR for greater efficiency. For lower inductance values, Coilcraft offers a lower-profile companion, the XAL7030, with an identical footprint and inductance range of 0.16 to 10  $\mu$ H.



The XAL7050 measures just 7.2 x 7.5 x 5.0 mm and features a rugged, composite construction that provides magnetic shielding and minimizes audible buzzing. It is qualified to AEC-Q200 Grade 1 (-40°C to +125°C) standards and exhibits no thermal aging issues, making it well suited for automotive and other harsh-environment applications. Soft saturation characteristics allow the XAL7050 to withstand high current spikes.

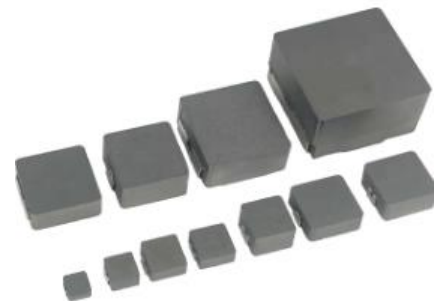
The XAL7050 features RoHS-compliant tin-silver (96.5/3.5) over copper terminations and offers a maximum reflow temperature of 260°C. COTS Plus tin-silver-copper and tin-lead terminations are also available. Free evaluation samples and complete technical specifications for the XAL7050 are available at [www.coilcraft.com](http://www.coilcraft.com).

### Robust, Automotive-Grade Inductors Provide Added Reliability

[Eaton's](#) automotive-grade HCM1AV2 product line of high-current power inductors is designed for the transportation market to address increased power conversion and filtering requirements. The HCM1AV2 is tested beyond AEC-Q200 Grade 1 requirements for added reliability and confidence desired by automotive engineers.

The robust molded construction makes the HCM1AV2 capable of withstanding high vibration and shock conditions. Among many other benefits, the HCM1AV2 offers 10 standard inductor sizes and PCB footprints from 4 mm to 22 mm, high-current capability up to 100 A, lower DCR, low EMI, high-voltage isolation, lower core loss, soft saturation (roll-off) and great performance stability across operating temperature range.

The advanced construction and high-grade materials used in the HCM1AV2 inductors are designed to withstand the effects of high temperature, high humidity environments in many automotive electronic systems. Eaton's solution offers high current-carrying capacity, high power density, low core losses and magnetic shielding to reduce EMI effects to other devices in the automotive engine compartment.



The HCM1AV2 inductors are AEC-Q200 Automotive Grade 1 compliant, with a maximum operating temperature range of -55°C to +155°C (ambient plus self-temperature rise) in which a component can be safely operated. Samples can be requested at the company [website](#) or can be purchased through authorized distributors.

### **SMT Inductors Enable More Efficient, Compact DC-DC Converters**

[KEMET](#)'s METCOM series SMD metal composite power inductors enable development of more efficient dc-dc converters as well as other power-related applications including EMI filtering. The metal composite core offers high current saturation characteristics that allow the inductors to maintain function with the large ripple currents typically found in modern power applications. High permeability enables low values of dc resistance (DCR) that result in significantly reduced self-heating during high-current operation, thereby increasing system efficiency and reducing the need for thermal design considerations.

The METCOM inductors feature a shielded construction that contains the magnetic flux within the inductor body, increasing the efficiency of operation. This also improves EMI performance and eliminates interference with surrounding circuitry, significantly simplifying the task of gaining power supply approvals.

The inductors are designed for use in dc-dc converters utilized in a variety of commercial and consumer applications including notebook computers, tablets, servers and HDTVs. Qualification of the devices to AEC-Q200 guidelines for automotive applications is in process.



Comprising a total of 102 devices covering an inductance range from 0.10  $\mu\text{H}$  to 47.00  $\mu\text{H}$ , the METCOM series offers DCR values as low as 1.5 m $\Omega$ . The inductors can support currents up to 35.4 A and operating temperatures between -55°C and +155°C. With footprints as small as 5.3 mm x 5.00 mm and profiles as low as 2.0 mm, the METCOM series is well suited for densely-packed modern power applications.

Commenting on the launch of the new devices, Philip Lessner, KEMET senior vice president and chief technology officer, said, "Increasing power supply density and efficiency is a key challenge for many designers. When it comes to size, reliability and performance the METCOM inductors offer very low losses in a small form factor, helping designers to develop modern, high-performance power solutions that meet increasingly stringent application requirements." For more information, visit [www.kemet.com/metcom](http://www.kemet.com/metcom).

### **Surface-Mount Inductors Target Industrial And Telecom Applications**

[TT Electronics](#) has introduced two series of ferrite-based, magnetically shielded surface-mount power inductors that are said to feature wider operating temperature range and smaller footprint than their competition. These characteristics make them well suited for industrial and telecom markets. The HM66M series is designed for use in high-frequency power conversion systems and EMI filter applications, while the HM78M series is meant for use in high-density and high-frequency dc-dc converter applications.

The HM66M series power inductors are designed for the complex industrial and telecommunications markets. The HM66M is a shielded, miniature low-profile inductor that integrates a ferrite material core for significant permeability and temperature advantages. Characterized by low losses at high frequencies, these inductors are suited for power supplies and frequency converters that operate with fast switching power semiconductors such as GaN transistors.

Power inductance is optimized within a frequency range from 700 kHz to 4 MHz, and designed for systems that require switching frequencies up to 4 MHz and operating temperatures at 125°C. The HM66M series is offered in three standard case sizes: 60, 70 and 84.



The HM78M series power inductors are shielded, ferrite-based inductors designed for use in high frequency dc-dc converter configurations popular in industrial markets. With their high inductance and current values, these power inductors offer a switching frequency configuration range of 100 kHz to 3 MHz making them suitable for use in a buck converter or an EMI filter. TT Electronics' HM78M series comes in two standard package sizes: 10 and 20.

Semi-custom designs of both the HM66M and HM78M are also available to meet special requests.

"TT's new SMD inductors offer greater operating temperature ranges in a smaller package than competitive options," said Raj Singaraju, Global Product Line director, TT Electronics. "Designers now have a clear advantage in addressing the complex needs of high power density applications common in today's industrial and telecom equipment markets."

Additional TT inductor portfolio information can be found in the company's [Electromagnetics catalog](#). For SMD power inductor needs specific to your application, contact [magsales@ttelelectronics.com](mailto:magsales@ttelelectronics.com).

## Surface-Mount Power Inductor Suits Class D Amplifiers

[Sumida's](#) C2DEPIH99 magnetically shielded power inductor contains a flat wire winding and a Mn-Zn ferrite core. The flat wire provides exceptionally low dc resistance. This surface mount component reduces packing space by adapting two-in-one construction. Key specifications for the C2DEPIH99 series are listed in the table.

Targeted applications for the C2DEPIH99 include compact digital amplifiers (class-D audio amplifiers), radio audio amplifiers and the like. Operating temperature range is -40°C to +125°C (including the coil's self-temperature rise). For more information, see the product [page](#).

Table. Key specifications for the C2DEPIH99 shielded power inductors.

Part name	Inductance (μH)[1] and tolerance	DCR at 20°C (A) max. (typ.) (mΩ)	Saturation current (A) max. (typ.) [2]		Temperature rise current (A) [3]
			20°C Max. (Typ.)	125°C Max. (Typ.)	
C2DEPIH99NP-3R3MC	3.30 ± 20%	9.40 (7.50)	10.00 (11.80)	7.60 (9.00)	8.50
C2DEPIH99NP-100MC	10.00 ± 20%	28.00 (22.50)	6.10 (7.20)	4.20 (5.00)	4.70
C2DEPIH99NP-150MC	15.00 ± 20%	29.00 (23.50)	4.30 (5.10)	3.40 (4.00)	4.60
C2DEPIH99NP-220MC	22.00 ± 20%	29.00 (23.50)	2.90 (3.40)	2.10 (2.50)	4.60



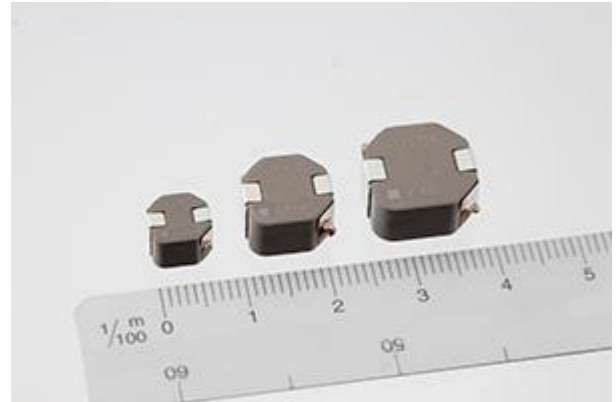
1. Measuring frequency inductance at 100 kHz and 1.0 V.
2. Saturation current: This indicates the value of dc current when the inductance becomes 25% lower than its initial value.
3. Temperature rise current: The actual value of dc current when temperature of coil increased  $\Delta T = 40^\circ\text{C}$  ( $T_a = 20^\circ\text{C}$ ).

## Metal Core Inductors Are Designed For Automotive LED Headlights

[TDK](#) has expanded its lineup of metal-core power inductors with the SPM-VT series, which is designed especially for the high thermal and current demands of automotive LED headlights. These wire-wound power inductors feature both a broad operating temperature range from  $-55^\circ\text{C}$  up to  $+155^\circ\text{C}$  and high current ratings from 4.7 A to 36.6 A (Isat), depending on type.

The new components are qualified to AEC-Q200 and are initially available in three sizes: 7.5 x 7.0 x 5.4 mm, 10.5 x 10.0 x 6.5 mm and 13.0 x 12.5 x 6.5 mm. Their rated inductances range from 1  $\mu\text{H}$  to 47  $\mu\text{H}$ , depending on type.

The SPM-VT series is based on TDK's innovative metallic magnetic material technology that enables a high magnetic saturation density and robust structural design. According to the company, these metal-core power inductors boast superior dc superposition characteristics in a compact size and feature a rated current that is approximately two to three times higher than that of comparable high-temperature products based on ferrite core materials.

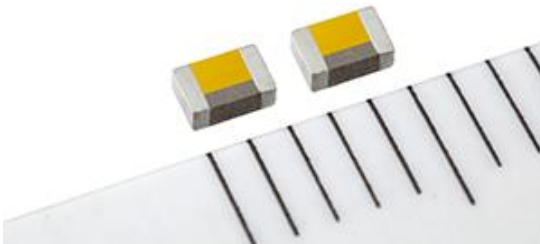


Modern adaptive LED headlights typically use one and the same control circuit to drive all LED headlight functions such as low and high beams, daytime running lights and curve lighting. Thanks to their low power consumption and multifunctionality, LED headlights are now rapidly replacing conventional halogen and HID headlights. The dc-dc converters in the power circuits of LED headlights use power inductors, and as the functionality of the headlights increases, the number of inductors needed is also growing.

The SPM-VT series meets the automotive industry's demand for compact, high-performance power inductors that can support high currents and withstand high temperatures. TDK will continue to expand the SPM power inductor lineup to include more miniaturized inductors with dimensions of 7.0 x 6.5 x 4.5 mm and 5.3 x 5.1 x 3.0 mm, for example. For more information, see the [spm7054vt-d](#), [spm10065vt-d](#) and [spm12565vt-d](#) data sheets.

## Thin-Film Inductors Lower DCR For Mobile Devices

[TDK's](#) TFM201208ALD is a miniaturized thin-film power inductor in an IEC 2012 case size that can handle higher currents than conventional products, according to the company. The low-profile inductor measures 2.0 x 1.25 x 0.8 mm and is available with a rated inductance of 1.0  $\mu\text{H}$ .



Thanks to its reduced dc resistance of 79 m $\Omega$ , which is said to be 12% lower than that of conventional products, the power inductor achieves low losses. Combined with improved dc superposition characteristics, the power inductor features a rated current of 2.5 A, which is described as 4% percent higher than conventional products.

As a result, the new power inductor helps to improve the power conversion efficiency of power circuits at high loads, especially in the power circuits of compact mobile devices such as smartphones and tablets. This, in turn, helps to maximize battery life, while maintaining the high functionality of the devices.

TDK will continue to expand its lineup of thin-film power inductors with miniaturized IEC 1608 types and automotive-grade types. For more information on the TFM201208ALD, see the [data sheet](#).

## Inductors Offer High-Temperature Operation For Computer And Telecom Applications

[Vishay Intertechnology](#)'s Vishay Dale IHLP-1212AZ-51, IHLP-1212AB-51, and IHLP-1212BZ-51 are commercial IHLP low-profile, high-current inductors with high operating temperatures up to +155°C in the 3.3-mm by 3.3-mm 1212 case size — the company's smallest to date. Designed to save space in computer and telecom applications, these inductors offer low profiles down to 1.0 mm.

These devices are optimized for energy storage in dc-dc converters up to 5 MHz and provide excellent attenuation of noise in high-current filtering applications up to the SRF of the inductor (see the table). Applications for the inductors include notebooks, desktops, and servers; low-profile, high-current power supplies; and distributed power systems and FPGAs.

Packaged in a 100% lead (Pb)-free shielded, composite construction that reduces buzz to ultra-low levels, these inductors offer high resistance to thermal shock, moisture, and mechanical shock, and they handle high transient current spikes without saturation.

Pricing for U.S. delivery only in 10,000-piece quantities begins at \$0.17 per piece. For more information, see the [IHLP-1212AZ-51](#), [IHLP-1212AB-51](#), and [IHLP-1212BZ-51](#) product pages.

Table: Device specifications for recently introduced IHLP series inductors.

Part number	IHLP-1212AZ-51	IHLP-1212AB-51	IHLP-1212BZ-51
Case size	1212	1212	1212
Profile (mm)	1.0	1.2	2.0
Inductance range (μH)	0.10 to 1.0	0.10 to 1.2	0.10 to 3.3
DCR typ. (mΩ)	7.31 to 26.66	7.01 to 53.49	6.58 to 88.38
DCR max. (mΩ)	8.81 to 29.92	7.50 to 57.65	6.95 to 96.79
Heat rating current (A)	5.35 to 11.13	3.98 to 11.50	3.26 to 12.26
Saturation current (A)	4.43 to 7.38	3.84 to 11.79	2.52 to 13.46
SRF typ. (MHz)	152 to 440	82 to 455	40 to 380
Operating temp. range (°C)	-55 to +155	-55 to +155	-55 to +155

## Small Automotive-Grade Inductors For Under-Hood Applications

[Vishay Intertechnology](#) has introduced its smallest automotive-grade IHLP low-profile, high-current inductors to date. Offered in the 3.3-mm by 3.3-mm 1212 case size to save space in next-generation ADAS and sensor applications, the Vishay Dale IHLP-1212AZ-A1 and IHLP-1212AB-A1 combine operating temperatures of +125 °C with extremely low profiles down to 1.0 mm, while the IHLP-1212AB-5A features high operating temperatures to +155°C and a profile of 1.2 mm.

The AEC-Q200-qualified devices are optimized for energy storage in dc-dc converters up to 5 MHz. They also provide excellent attenuation of noise in high-current filtering applications up to the SRF of the inductor (see the table). With their high operating temperatures, the inductors are designed for filtering and dc-dc conversion in ADAS, sensor, and entertainment/navigation systems, in addition to noise suppression for medium-current filter applications.

Packaged in a 100% lead (Pb)-free shielded, composite construction that reduces buzz to ultra-low levels, these inductors offer high resistance to thermal shock, moisture, and mechanical shock, and handle high transient current spikes without saturation. Pricing for U.S. delivery only in 10,000-piece quantities begins at \$0.18 per piece. For more information see the [IHLP-1212AZ-A1](#), [IHLP-1212AB-A1](#) and [IHLP-1212AB-5A](#) product pages.

Table. Device specifications for the IHLP-1212AZ-A1, IHLP-1212AB-A1 and IHLP-1212AB-5A.

Part number	IHLP-1212AZ-A1	IHLP-1212AB-A1	IHLP-1212AB-5A
Case size	1212	1212	1212
Profile (mm)	1.0	1.2	1.2
Inductance range (mH)	0.10 to 1.0	0.10 to 1.2	0.10 to 1.2
DCR typ. (mΩ)	8.60 to 63.61	8.98 to 60.16	7.01 to 53.49
DCR max. (mΩ)	9.20 to 66.38	9.61 to 62.79	7.50 to 57.65
Heat rating current (A)	3.47 to 10.50	3.81 to 10.48	3.98 to 11.50
Saturation current (A)	5.23 to 19.21	5.61 to 18.92	3.84 to 11.79
SRF typ. (MHz)	95 to 475	79 to 419	82 to 455
Operating temp. range (°C)	-55 to +125	-55 to +125	-55 to +155

## Rugged Surface-Mount Inductors Are Designed To Mil Specs



[API Delevan](#)'s HRSPD125 series shielded, surface-mount power inductors are built to meet mechanical shock, high-frequency vibration, solderability, and moisture resistance per MIL-STD-202, thermal shock per MIL-PRF-27, and SnPb reflow profile per MIL-PRF-83446. These low DCR, high-current inductors have an operating temperature range of -55°C to +130°C, and are available in inductance values from 2.2 µH to 1000 µH.

Contact API Delevan for custom values. Full engineering support is available to assist with your design, assembly and circuit testing needs. Samples are available upon request. For more information, see the company [website](#).

## Inductor Cores

### Powder Cores Are Designed For Cutting Edge Performance

For designers of high-current inductors targeting minimum size and maximum efficiency, [Magnetics](#) has developed the Edge powder alloy core material. Edge provides a dramatic improvement in dc bias performance versus the company's High Flux series while also cutting ac core losses to less than half of High Flux losses.

The inherent advantage of powder alloy cores is their dc bias performance, meaning how well the material maintains inductance under current loading. For high-current inductor applications, High Flux has often been the design solution that gives the smallest package size since it offers the best dc bias performance with the highest saturation level. Magnetics' Edge boosts that saturation level even higher.

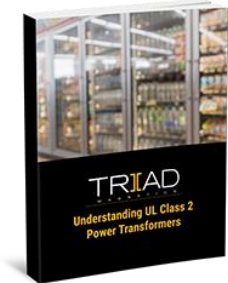
For comparison, 60 permeability Edge reaches 50% rolloff at 205 Oersteds, vs. 185 to 195 Oersteds for best-in-class High Flux materials, and 165 Oersteds for 6.5% silicon iron powder cores, according to the company. In addition, the performance tradeoff that designers have had to make in the past when using High Flux—inferior ac losses—is removed, because Edge core losses are reduced to a level similar to those of MPP (molypermalloy powder).



Edge is available in permeabilities of 26 and 60 and in standard toroid sizes up to 40 mm diameter, as well as custom heights. Larger cores and additional permeabilities, including 125  $\mu$ , are in development for release later this year.  $A_L$  values, dimensions, coatings, and dielectric guarantees for Edge are the same as High Flux. For more information, see the Edge cores product [page](#).

### **Related Magnetics News**

#### **Free E-Book Explains UL Class 2 Power Transformers**



Triad Magnetics has published a free e-book titled "Understanding UL Class 2 Power Transformers." This book breaks down everything you need to know about Class 2 transformers, including their characteristics, the UL standards, applications and more.

Transformer classifications describe the performance levels and capabilities of a transformer. When selecting a transformer, it's necessary to understand the requirements of your application to ensure you choose a class that can meet the demands of the intended use. Class 2 transformers have distinct characteristics that make them ideal for a broad range of industrial applications. To download a copy of this book, see the Triad [website](#).