Power Magnetics Component Roundup

This article highlights more than a dozen new inductors, transformers, and cores targeting a range of power supply applications. These products, which were introduced over the past 12 months or are about to be introduced, boast performance improvements such as greater current handling ability, lower losses, higher-temperature or higher-frequency operation, higher dc bias, and smaller size (especially lower package height.) The following components are described in this feature:

- Coupled Inductor Comes In Composite Constructed Case
- Transformers Are Optimized For Popular Offline Switcher ICs
- Moulded Inductors Provide High Performance, Wide Temperature Range
- Low-Profile Inductors Support Noise Reduction in High-Frequency Switching Applications
- High-Current, Shielded Power Inductors Feature Small Size, Low DCR
- LLC Transformer Provides High Efficiency, Board Space Savings
- SMT Power Inductors Expand To Higher Inductance And Current Ratings
- Low-Profile Inductor Is Rated To 180 A And 155°C
- Semi-Shielded Inductors Are Smaller Than Conventional Shielded Ferrites
- Amorphous Powder Core Delivers Low Core Loss And High DC Bias.
- Large E Core Brings Material Advantages To High-Current Inductors
- 1.2-mm Tall Power Inductor Boasts High DC Bias Characteristic
- PFC Inductors Feature High-Flux Materials
- Wireless Charging Rx Coil Offers High Permeability Shielding, High Efficiency
- Miniature Power Inductors Handle Currents Up To 32 A

Coupled Inductor Comes In Composite Constructed Case

From Vishay Dale comes the soon-to-be released IHCL-4040DZ-5A low-profile, high-current coupled inductor. According to Doug Lillie, product marketing manager for the Inductors Division, this inductor is world's first high-current coupled inductor in a composite constructed case, which results in ultra low buzz noise. This self-shielded device operates at temperatures up to 155°C applications and at high frequencies, up to 5.0 MHz. The IHCL-4040DZ-5A is also said to provide the lowest DCR/µH in its package size, which is 10.16 mm x 10.67 mm x 4.0 mm (see the table.)

This inductor is also available in other sizes. "We have provided similar parts in case sizes 2525, 3232, 4040, 5050, and 6767, says Lillie, who adds "we can provide customized solutions for customers to meet their needs."

Other features include the ability to handle high transient current spikes without saturation and coupling (>90%) that is optimized

STANDARD ELECTRICAL SPECIFICATIONS					
	L_0 INDUCTANCE ± 20 % AT 100 kHz, 0.25 V, 0 A (µH)	DCR NOM. 25 °C (mΩ)	DCR MAX. 25 °C (mΩ)	HEAT RATING CURRENT DC TYP. (A) [3]	SATURATION CURRENT DC TYP. (A) [4]
L_{1-2}	2.7	15.75	16.8	8.5	11.0
L_{3-4}	2.7	14.0	15.0	8.5	11.0
L_{1-4} (L_{2-3} shorted)	10.8	30	32.1	6.0	5.25
L_{1-3} (L_{2-4} shorted)	0.1	30	32	6.0	See note [6]
$L_{Common\ Mode}$ (1-3 and 2-4 shorted)	2.7	7.6	8.1	13.25	11.0
$L_{Differential\ Mode}$ (1-4 and 2-3 shorted)	0.1	7.6	8.1	13.25	See note [6]

Table. Key electrical specifications for the IHCL-4040DZ-5A.

for SEPIC converters. Target applications include point of load converters, isolated dc-dc converters, and low profile high current power supplies and targeted end products include PDA/notebook/desktop/server applications and battery-powered devices.

Transformers Are Optimized for Popular Offline Switcher ICs

Today, Premier Magnetics is announcing its POL-HX Series of switch-mode transformers designed to complement the TopSwitch-HX Series of Enhanced EcoSmart, Integrated Off-Line Switcher ICs from Power Integrations. The Premier Magnetics POL-HX Series is currently available in 21 models—most accommodating a universal ac input range of 85 to 265 V ac. This product line covers a wide range of input voltage, output voltage and power levels.

Premier Magnetics' selection guide identifies a specific Power Integrations part number along with the matching Premier Magnetics transformer. The selection guide also includes recommended input filter and output power inductors with links to the specific part details.

"The POL-HX Series is the latest of several generations and versions of switch mode transformers designed specifically for the Power Integrations TopSwitch line," says Jim Earley, president of Premier Magnetics. "We've also designed complete families of transformers, filters and inductors for the LinkSwitch and Tinyswitch ICs. Our goal is to simplify switching power supply optimization by providing our customers with reference designs and recommended filters and power inductors to complete the task."

As an example of pricing for devices in the POL-HX series, the POL-HX014 is priced at $0.55 each in OEM quantites. Samples are in stock for immediate delivery.

Moulded Inductors Provide High Performance, Wide Temperature Range

Earlier this week, TT electronics unveiled the details of its next-generation moulded inductor devices from BI Technologies. The HM72E and HA72E are engineered for high performance and cost effectiveness and will use Si-Fe alloy core materials that are optimized for high-temperature stability, minimal oxidation, high dc bias capability and low losses. Circuit applications include dc-dc converters and signal conditioning where high power density is a requirement.

With the overmoulded construction and the wide temperature rating this series works in powertrain applications where the environmental requirements are demanding. High-end industrial applications include dc-dc power modules with the inductor integrated into the module.

The HM72E and HA72E series will feature a rated operating temperature of -40°C to 155°C, dc bias current of up to 45 A and inductance levels ranging from 0.10 µH to 33 µH at a maximum dimension of 6.8 (L) x 7.23 (W) x 3mm (H). The HA72E series is also qualified to AEC-Q200 certification for automotive applications. The HM72E and HA72E are available in volume with unit pricing from $0.19.

For further information, e-mail sales director Donna Schaefer at donna.schaefer@ttelectronics.com or contact a TT electronics' regional sales office.

Low-Profile Inductors Support Noise Reduction In High-Frequency Switching Applications

In April, Murata introduced the Murata Power Solutions 3000A and 3000B series of low-profile power inductors for use in noise reduction circuits of high-frequency and high-current switching power supplies, dc-dc converters and voltage regulator modules.

The 3000A series is available with 80, 100, 150 or 200 nH inductance values. Maximum rated peak current is 57 A for the 80-nH device. Typical Rdc is only 0.20 mΩ across the series. The 3000B series has inductance values of 85, 100, 120, 150 or 200 nH and a maximum rated current of 78 A for the 85-nH inductor. Rdc is also extremely low

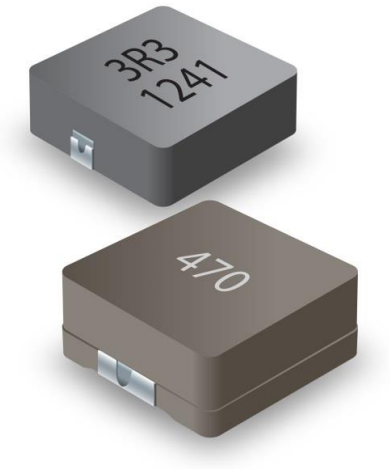
Murata Power Solutions' 3000A and 3000B series of low-profile power inductors.

and is typically 0.29 mΩ.

Using a low-loss core material, combined with low series resistance (Rdc), gives the inductors a high overall efficiency. The low inductance values suit high-frequency applications while their compact low-profile dimensions, 7.1 x 7.0 x 4.96 mm for the 3000A series, are ideal for designs where available board space is at a premium. Both series are available in surface-mount packages suiting high-volume manufacturing. For datasheets and additional information see the announcement.

High-Current, Shielded Power Inductors Feature Small Size, Low DCR

In March, Bourns Inductive Components Product Line introduced two additional series of high-current, shielded power inductors—models SRP5030T and SRP6540. Bourns now offers a total of sixteen SRP models. The SRP5030T and SRP6540 shielded power inductor series are designed with molded construction of an iron powder core that offers a compact size, low dc resistance (DCR), high current-carrying capability and magnetically shielded features. These inductors are ideal for use in dc-dc converters for mobile electronic devices, computers, data storages and voltage regulator modules. The low dc resistance feature makes them especially attractive for mobile electronic device applications with prolonged battery life where low power dissipation is essential. The magnetically shielded construction of the SRP Series has low radiation that is ideal for high-density board assembly.



Bourns' SRP5030T and SRP6540 high-current, shielded power inductors.

The SRP5030T series offers a 5.7-mm x 5.2-mm footprint in a 2.8-mm height with an inductance range of 0.33 to 10 µH, heat rating current up to 14 A, and saturation current up to 18 A. The operating temperature range is from -40 to +125 °C.

The SRP6540 Series offers a 7.2-mm x 6.5-mm footprint in a 4-mm height, an inductance range of 0.56 µH to 47 µH with both heat rating and saturation current up to 18 A. The operating temperature range is from -55 to +125 °C.

These inductors are available in minimum order quantities of 2000 pieces/reel for the SRP5030T and 1200 pieces/reel for the SRP6540. Samples are available upon request.

LLC Transformer Provides High Efficiency, Board Space Savings

In March, Precision, launched an LLC transformer that provides up to 99% efficiency and extremely low power loss. The technology combines two discrete components—a resonant inductor and transformer—into a single package, reducing costs by as much as 75% and real estate up to 50%.

The Precision LLC transformer is ideally suited for use in converters for a wide range of efficiency-sensitive applications including LED and LCD televisions, industrial LED lighting and any ac-dc power converter with a PFC front end.

Precision's LLC transformer.

According to Precision, the company supports its new high-performance LLC transformer with market-leading technical support. Experienced engineers study the LLC transformer design to obtain the correct leakage inductance through bobbin and litz wire optimizations. Their expertise in this area can be applied to each unique application to reduce transformer losses and costs by as much as 30%.

In addition, Precision's technical support is enhanced by the company's extensive stock of litz wire and bobbins. This combination ensures that Precision customers can get the most optimized product, in the shortest amount of time.

Samples of the Precision LLC transformer can be provided in as little as three days depending on design complexity, speeding time to market. Time to market is also minimized as the design is optimized from the beginning, eliminating the need for design reiterations.

Precision offers both standard and custom LLC transformers. The power ranges of standard packages are between 100 W and 800 W. High-power custom designs are also available. Lead times are as short as three days for samples and as little as 6-8 weeks for production quantities (dependent on technology complexity).

SMT Power Inductors Expand To Higher Inductance And Current Ratings

In March, Pulse Electronics expanded its range of round-wire coil (RWC) surface mount power inductors to deliver higher inductance and current capability. Mechanical sizes from 7.6 x 7.4 x 6.4 mm up to 21.7 x 21.5 x 12.5 mm are now available with an inductance range from 0.3 µH to 50 µH and with a current rating up to 70 A. These inductors use a ferrite core material that yields a 90% core loss reduction and 30% increase in maximum operating temperature when compared to standard iron powder material used in flat-coil inductors.

"Because ferrite material is immune to thermal aging, these inductors are more reliable and better performing at higher temperatures and frequencies than non-ferrite core inductors," says Gerard Healy, field applications engineer, Pulse Electronics Power Division. "The properties of ferrite material are more appropriate to the typical requirement of a dc-dc converter inductor, and using round wire instead of a flat coil results in a 25% cost reduction."

These inductors are used as energy storage devices and filters in point-of-load (POL) regulators and as dc-dc converter output inductors for telecom, datacom, server, and industrial applications. They are a lower-cost alternative to flat coil inductors for applications where very low profile is not a requirement.

The series consists of the PG0871NL, PG0702NL, PG0926NL, PH0936NL, and PG1083NL. These inductors have a three-pin design for improved mechanical stability. An unconnected third pin at the back of the inductor distributes the part's weight and balances the three terminals during mechanical vibration. Flattened leads serve as the pad, making the coil self-leaded. No additional base is required, further minimizing the cost.

The smaller packages are size compatible with industry-standard flat-coil inductors on the market (including the Pulse PG0426NL, PG0255NL, and PG0277NL series) commonly referred to as the 2525 series (quarter inch by quarter inch), the 4040 series (0.4 x 0.4 inch) and the 5050 series (0.5 x 0.5 inch) flat-coil inductors. The larger sizes satisfy the needs for emerging higher power (current) PSUs where industry-standard platforms are currently lacking.

Pricing for Pulse's RWCs ranges from $0.49 to $0.99 in quantities of 50,000 pieces. Pricing varies according to order configuration and destination. For more information see the product overview as well as the white paper "Ferrite Core Round Wire Inductor Takes the Lead."

Low-Profile Inductor Is Rated To 180 A And 155°C

In December of last year, Vishay Dale announced a new IHLP low-profile, high-current inductor in the 8787 case size with a rated current from 9.7 A to 180 A (an industry high according to Vishay) and a high operating temperature to +155°C. The IHLP-8787MZ-5A offers high efficiency with max. DCR from 0.17 mΩ to 28.30 mΩ and a wide range of inductance values from 0.22 µH to 100 µH.

With a frequency range up to 1 MHz, the new device serves as a high-performing, space- and power-saving solution for VRMs and dc-dc converters. The IHLP-8787MZ-5A is designed for high-temperature automotive applications, including engine and transmission control units, diesel injection drivers, entertainment and navigation systems, noise suppression for motors, and power seats and mirrors.

Vishay Dale's IHLP-8787MZ-5A low-profile, high-current inductor.

The new inductor handles high transient current spikes without hard saturation. Packaged in a shielded, composite construction that reduces buzz noise to ultra-low levels, the device is specified for an operating temperature range of −55°C to +155°C, with high resistance to thermal shock, moisture, mechanical shock, and vibration.

Samples of the IHLP-8787MZ-5A are available now. Production quantities were expected in Q1 2013. For more information, see the datasheet.

Semi-Shielded Inductors Are Smaller Than Conventional Shielded Ferrites

In December, Bourns Inductive Components Product Line introduced four additional models designed using semi-magnetic shielding technology. Bourns now has a total of seven SRN models with selections of 3-mm x 3-mm to 10-mm x 10-mm footprints, 1-mm to 6-mm heights and 0.5 µH to 470 µH inductance values (see the table.)

Instead of a conventional ferrite shield, the magnetic shield of the SRN series utilizes an epoxy-ferrite powder mixture resin. This compound is applied to the perimeter of the inductor which completely envelops the winding. As a result, the SRN model series inductors provide effective magnetic shielding while emitting lower radiation than non-shielded inductors.

In addition, the models offer a reduced footprint and cost savings versus comparably-sized conventional ferrite shield inductors. The semi-shielded SRN model series inductors combine the features of non-shielded and shielded inductors, making them ideal for use in dc-dc converters that provide power management to mobile electronic devices, computers, data storages and consumer electronics. The SRN series is also well-suited for industrial applications such as LED lighting, control circuits and GPS.

Table. Key specifications for new members of the SRN series.

Model	Footprint	Height	Inductance Range	Heating Current Range	Saturation Current Range
SRN3010	3 x 3 mm	1 mm	1 – 47 µH	0.35 - 2.3 A	0.28 - 2.3 A
SRN4018	4 x 4 mm	1.8 mm	0.82 – 220 µH	0.28 - 4 A	0.3 - 4.2 A
SRN5020	5 x 5 mm	2 mm	1 – 33 µH	0.9 - 3.6 A	0.8 - 4 A
SRN1060	10 x 10 mm	6 mm	10 – 470 µH	0.8 - 5.4 A	0.8 - 5.2 A

Minimum order quantities are 2000 pieces/reel for the SRN3015 and SRN5020, 3000 pieces /reel for the SRN4018 and 650 pieces/reel for the SRN1060. Samples are available upon request.

Amorphous Powder Core Delivers Low Core Loss And High DC Bias

In November, Magnetics introduced a new generation of powder alloy materials with the introduction of its AmoFlux amorphous powder cores. This alloy starts with low core loss amorphous ribbon that is pulverized into powder and then pressed into a toroid. By converting the amorphous ribbon into a powder form, the resulting AmoFlux cores have the same excellent properties, including soft saturation, as Magnetics' other powder core materials: Kool Mu, MPP, High Flux, and XFlux.

Magnetics's AmoFlux amorphous powder cores.

What makes this amorphous powder core material unique is the combination of low core loss and high

dc bias. AmoFlux is a new distributed gap material ideal for power factor correction (PFC) and various types of output chokes. These attributes make AmoFlux an excellent choice for inductors in computer, server, and industrial power supplies that require maximum efficiency at high dc currents.

The core loss density of AmoFlux is significantly lower than High Flux, which allows for a more-efficient design with less temperature rise. According to the company, Magnetics' Molypermalloy Powder (MPP) material has the best core loss density of the available powder core materials and AmoFlux is only 20% higher. The dc bias of AmoFlux is similar to High Flux and superior to both MPP and Kool Mu. Better dc bias will allow higher current handling in the same size core or a smaller size core to be used to achieve the same target inductance.

According to the vendor, this combination of high dc bias and low core loss density makes AmoFlux the optimal solution for high-efficiency, high-power inductors. Since AmoFlux is a powder core, it has the same soft saturation characteristic as Magnetics' other powder cores. Samples are available in toroids ranging from 20 to 33 mm outer diameter. Additional sizes will be added in 2013. For more information see the AmoFlux Technical bulletin.

Large E Core Brings Material Advantages To High-Current Inductors

In October 2012, Magnetics Kool Mu E Core product line was expanded to include the E450, 114 mm E core, part number 00K114LEXXX. The E450 has 3.7 times greater overall volume than the 80. Production quantities in 14u, 26u and 60u will be available Q3 2012.

Magnetics' Kool Mu 00K114LEXXX E450, 114-mm E core.

Ideal for high-current inductors, large Kool Mu geometries offer all the advantages of Kool Mu material, low core loss, excellent performance over temperature, near zero magnetostriction and soft saturation. Typical applications for the types of high current inductors built using Kool Mu E cores include UPSs (including transformerless UPS), large PFC chokes, traction and inverters for renewable energy (solar/wind/fuel cell conversion.)

The vendor notes that the most critical parameter of a switching regulator material is its ability to provide inductance, or permeability, under dc bias. The distributed air gap of Kool Mu results in a soft inductance versus dc bias curve. In most applications, this swinging inductance is desirable since it improves efficiency, decreases the volume needed and accommodates a wide operating range. With a fixed current requirement, the soft inductance versus dc bias curve provides added protection against overload conditions. For more information see the K114 E Core announcement.

1.2-mm Tall Power Inductor Boasts High DC Bias Characteristic

In October, Taiyo Yuden announced the commercial release of the MDMK4040 following the commercialization of a 4-mm square metal-core SMD power inductor MCOIL series that uses metallic magnetic materials. Measuring 4.0 x 4.0 x 1.2 mm, this product is a power inductor for choke coil applications aimed at the power circuits of low-profile digital devices, such as notebook PCs, as typified by the tablet PC and Ultrabook device, with their continuing trend for small size, low profile and high performance.

Taiyo Yuden's MDMK4040 MCOIL 4-mm² SMD power inductors.

Through the integration of Taiyo Yuden's metallic magnetic material technology and advanced process technology, this product combines what's described as an industry-leading dc bias characteristic with a smaller, lower-profile size. For example, one device in this series, the MDMK4040T2R2 offers an inductance value of 2.2 µH and a dc bias characteristic of 4500 mA. This may be compared to the company's conventional product, the NRS4012T 2R2, which has the same

inductance value, but a significantly lower dc bias characteristic of 1650 mA. So, the new part represents an approximately 2.7 times improvement in the dc bias characteristic, contributing to the better performance of the new device. Specifications for MDMK4040T2R2 and other inductors in the series are shown in the table.

Production commenced in July 2012, at the company's Nakanojo plant at an output pace of 10 million units per month. The sample price is $1.00 each.

Table. Key specifications for the Metal Core SMD Power Inductor MCOILTM MDMK4040 series.

Part number	Inductance (µH)	Inductance Tolerance (%)	DC resistance (mΩ) max.	Maximum rated current (mA)	
				Saturation current	Temperature rise current
MDMK4040TR47MF	0.47	±20	29	7,500	4,600
MDMK4040T1R0MF	1.00	±20	47	5,200	3,500
MDMK4040T1R2MF	1.20	±20	47	4,200	3,500
MDMK4040T1R5MF	1.50	±20	65	3,700	3,300
MDMK4040T2R2MF	2.20	±20	92	3,200	2,500

For more information, see the Metal Power Inductors MCOIL product page.

PFC Inductors Feature High-Flux Materials

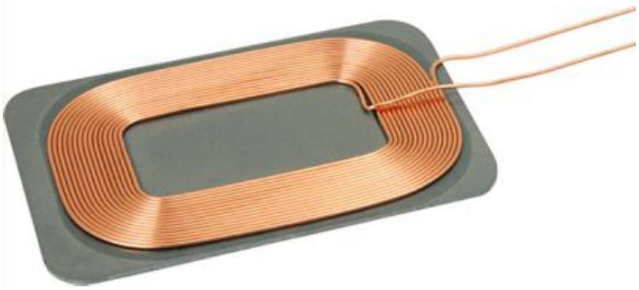
In August, MPS Industries announced two series of PFC inductors. The P1900-series and P191-series toroidal PFC inductors are constructed with high-flux materials for high-current applications that require low loss at high frequencies to address the emerging global mandate on increased PFC performance. These low-core-loss inductors are designed for consistent performance, low EMI emissions, high efficiency and high saturation flux density with a significant reduction in size and weight. For more information, see the company's PFC Inductors page.

MPS Industries' PF1900 passive PFC Inductor.

Wireless Charging Rx Coil Offers High Permeability Shielding, High Efficiency

In July 2012, Vishay Dale announced a powdered-iron-based, Wireless Power Consortium (WPC) compliant receiving coil for the wireless charging of 5-V portable electronics. Offering a durable construction and high permeability shielding, the IWAS-3827EC-50 provides high efficiency greater than 70% for receive (Rx) applications to 10 W and is 33% smaller than the standard 48 mm by 32 mm IWAS-4832FF-50 Rx coil, with dimensions of 38 mm by 27 mm.

For wireless power base stations and receivers, the IWAS-3827EC-50's high-saturation powdered iron is not affected by permanent locating magnets, and the device blocks charging flux from sensitive components or batteries. As an alternative to ferrite-based



Vishay Dale's IWAS-3827EC-50 WPC-compliant receiving coil for wireless charging.

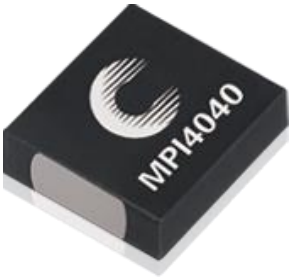
solutions, which can saturate in the presence of a strong magnetic field, the IWAS-3827EC-50 offers a magnetic saturation of 50% at 4000 gauss.

The device features an inductance of 10.7 µH at 200 kHz with a ±5% inductance tolerance, a DCR of 183 mΩ at + 25°C, and a Q of 30 typical at 200 kHz. The receiving coil features a lead length of 50 mm and tinned length of 10 mm.

Samples and production quantities of the IWAS-3827EC-50 Rx coil are available now. For more information, see the datasheet.

Miniature Power Inductors Handle Currents Up To 32 A

From Cooper Bussman, the Coiltronics MPI4040 series of high-frequency, high-current miniature power inductors offer operation from 20 kHz to 10 MHz and current ratings ranging from 1.1 A to 32.0 A. Beyond these ratings, the inductors can handles high transient inrush current spikes. Available in inductance values from 0.09 µH to 22 µH, these magnetically shielded, ruggedly constructed, surface-mount devices specify a maximum total temperature operation of 125°C. Package dimensions are 4.7 x 4.31 x 1.2, 1.5, 1.85 and 2.0 mm max. For more information, see the datasheet.



Cooper Bussman's Coiltronics MPI4040 series miniature power inductors.