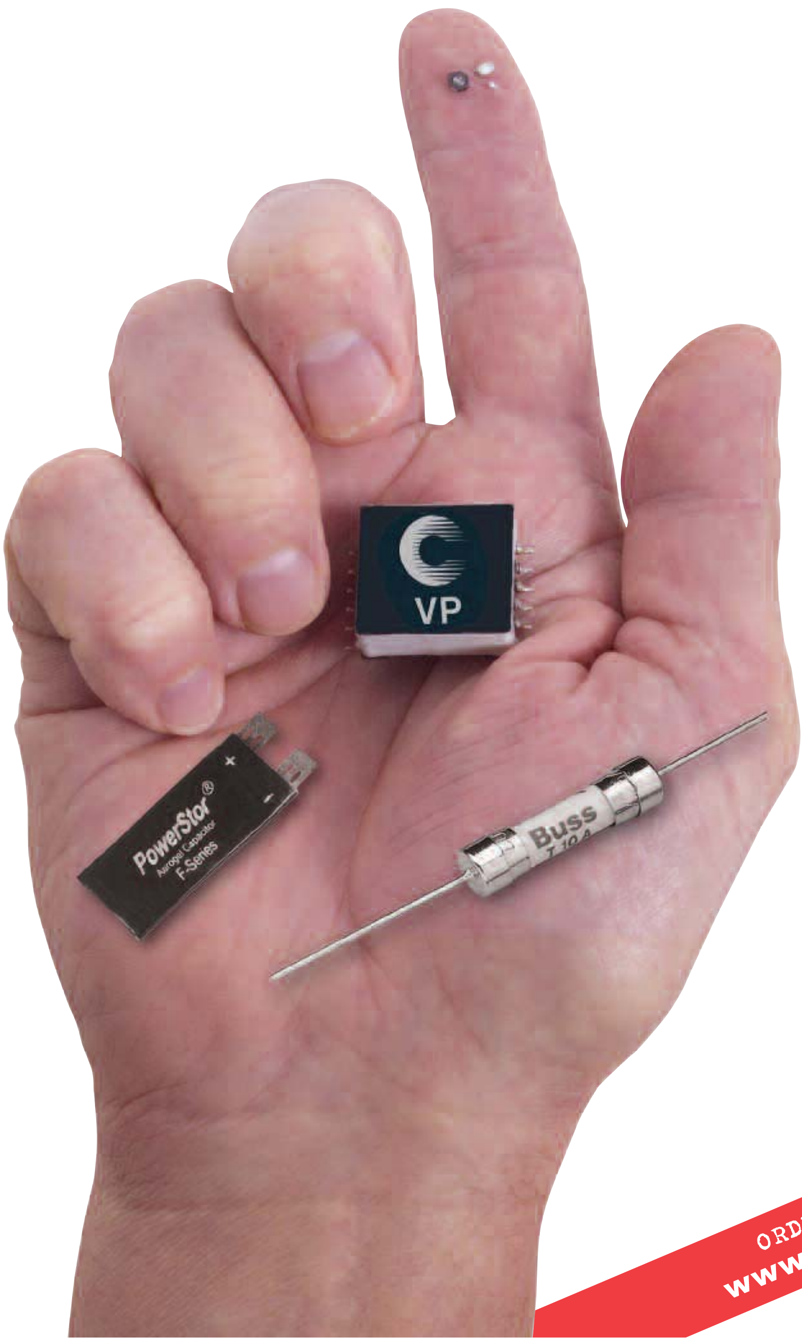
COOPER Bussmann

Circuit Protection and Power Management Solutions

Full Line Electronics Catalog



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COOPER Bussmann

INTRODUCTION

From overcurrent and overvoltage protection to supercapacitors and magnetics, Cooper Bussmann provides integrated solutions that meet the evolving needs of technology-driven markets. Cooper Bussmann is a leader and an innovator in providing cost-effective, comprehensive solutions that utilize the high quality brand names that customers know and trust.

Circuit Protection

The Cooper Bussmann® Electronic Fuse family offers fail-safe circuit protection devices in SMD, Thru-Hole, and traditional Ferrule Fuse packages.

The Cooper Bussmann® PolySurg™ sub-branded family offers protection for sensitive electronic circuits from the damaging effects of electrostatic discharge (ESD).

Power Management

The Cooper Coiltronics® family of transformers and inductors offers a broad range of solutions to meet precise specifications in a variety of applications.

The Cooper PowerStor® family of aerogel capacitors offers ultra-low resistance supercapacitors, unique high-energy storage devices.

Cooper Bussmann continues its 90-year history of blazing new trails of innovative technologies. Cooper Bussmann manufactures the industry's first truly global product line. Each item is backed by an efficient worldwide network of distribution, customer service and technical support. Cooper Bussmann products include the most extensive circuit protection solutions approved for use in compliance with a variety of major standards: UL, CSA, IEC within wide range of applications: industrial motor protection, power conversion, medium voltage, power distribution, telecommunications network equipment, electronics, and automotive. Manufacturing operations in North America, Europe, and Asia have earned ISO 9000 certification. Cooper Bussmann customers are assured of only the utmost quality across every product line. Our team is knowledgeable, responsive and customer focused. Bussmann continues to set the standard for circuit protection solutions around the world.

To receive further information on Cooper Bussmann products, visit www.cooperbussmann.com or contact customer service at 888-414-2645.

Circuit Protection Group

The Cooper Bussmann® Electronic Fuse family offers fail-safe circuit protection devices in SMD, Thru-Hole, and traditional Ferrule Fuse packages.

RoHS 2002/95/EC

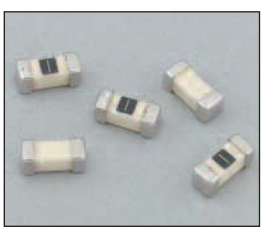
CHIP™ Fuses (0603FA & 3216FF Series)

Cooper Bussmann's patented Solid Matrix CHIP™ fuses provide reliable overcurrent protection to secondary circuits found in mobile phone handsets, battery packs, digital still cameras, PDA's, HDD's, printers, notebook computers, televisions, automotive instrument panels, battery packs, and more. Its excellent cycling characteristics, small footprint, and SMD package provide the most effective, reliable overcurrent protection solution for today's - and tomorrow's - technologies.

Telecom Circuit Protector (TCP Series)

Cooper Bussmann is proud to be the first to offer a surface mount telecom circuit protector designed to protect against power cross faults and comply with surge requirements for the telecom industry. Today, you will find the TCP Series fuse in central office subscriber line interface cards, basestations, set-top box modems, and xDSL modems among other applications.

BRICK™ Fuses (6125FA/TD & 1025FA/TD Series)



Cooper Bussmann's patented BRICK™ fuses provide the excellent inrush withstand capabilities in a space saving SMD package needed in many of today's more demanding applications such as power supplies, base stations, televisions, computers, white goods, and motor control circuits among others.

SR-5 & SS-5 Series Radial Leaded Fuses

Cooper Bussmann is bringing the space-saving SR-5 and SS-5 family of radial leaded fuses to the global market to provide cost-effective primary circuit protection in space-constrained applications such as power adapters, televisions, handheld consumer products, white goods, and more.

IEC & UL Electronic Fuses

In addition to SMD and Thru-Hole Device Fuses, Cooper Bussmann offers a full range of traditional electronic fuses designed to IEC standards (5mm product line) and UL standards (1/4" product line). Both product lines offer a cost-efficient overcurrent protection solution for a wide range of applications including power supplies, white goods, motor control equipment, and set-top boxes. Coupled with one of Cooper Bussmann’s extensive fuse accessories product offerings, these fuses can be conveniently inserted into a circuit while allowing for end-user replacement if desired. And with Cooper Bussmann's expansive global distribution, your customers will have easy access to ensure safe, reliable, correct replacement parts available when needed.

Electrical Fuses

Cooper Bussmann® brand power fuses are the industry leader for your more demanding power applications.

From the innovative CUBEFuse™ product line – offering touch-safe, current-limiting fusible protection – to the time-honored Fusetron® product line with class-leading time-delay performance, Cooper Bussmann® fuses set the standard for motor and branch circuit protection. And now, with easyID™ technology available with the CUBEFuse™ and Low-Peak® product lines, reliable permanent open fuse indication for reduced downtime and maintenance costs.

For more delicate semiconductor drive applications, Cooper Bussmann High Speed fuses provide rapid response to damaging short circuits keeping your investment safe from damages. And look no further than the Cooper Bussmann Telpower® brand fuses for protection of critical telecommunication infrastructure.

COOPER Bussmann® PolySurg™ ESD Suppressors

PolySurg™ ESD Suppression Devices

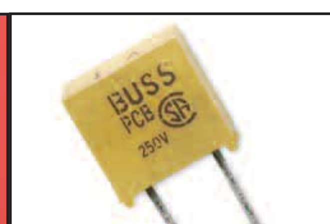
Cooper Bussmann PolySurg™ ESD Suppressors are bi-directional ESD overvoltage protection devices that respond in less than 1ns and can protect against a threat voltage up to 15kV per IEC standard 61000-4-2. With leakage current of less than 1nA and an ultra low capacitance less than 0.15pF, these devices are an especially viable solution for high data rate applications. With an insertion loss of less than -0.2dB at frequencies up to 6 GHz, the PolySurg™ ESD Suppressors are invisible to the protected circuit, introducing no additional loading or signal distortion.

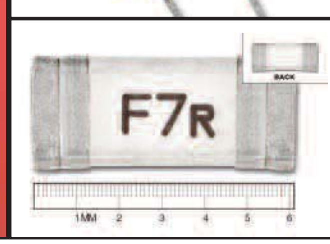
ESD Protection for High Frequency, Low Voltage Designs

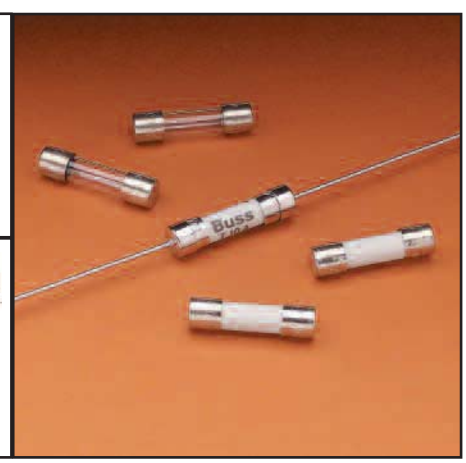
PolySurg™ surface mount devices are ideally suited for ESD protection of data I/O ports, computers and peripherals, media interfaces (DVI and HDMI), mobile communication products, hand-held test equipment and other similar uses.

MLP Series Now Available

The MLP Series, comprised of the 0402ESDA-MLP and 0603ESDA-MLP ESD suppression devices, is now available as discrete devices in an 0402 and 0603 footprint, respectively. This series utilizes Cooper Bussmann's patented PolyFAMILY design to deliver enhanced ESD protection using state of the art process and material technologies.







Power Management Group

COILTRONICS®

A leading global brand name in the power magnetics marketplace since 1977.

RoHS 2002/95/EC

Leading-Edge Technology

Cooper Coiltronics® brand magnetics specializes in standard and custom solutions offering the latest in state-of-the-art low profile high power density magnetic components. In working closely with the industry leaders in chipset and core development, we remain at the forefront of innovation and new technology to deliver the optimal mix of packaging, high efficiency and unbeatable reliability. Our designs utilize high frequency, low core loss materials, new and custom core shapes in combination with innovative construction and packaging to provide designers with the highest performance parts available on the market.

Market-Driven Products

Cooper Coiltronics brand magnetics is the first choice in power inductor and transformer solutions to the ever-changing Digital Home, Office and Mobile electronics world. In support of this market, we specialize in inductors and transformers for DC-DC power conversion and switch-mode applications requiring high frequency. Our component solutions can be found in many products requiring power conversion including cellular telephones, digital cameras, MP3 players, notebook and desktop computers & peripherals & LCD displays across the Consumer, Communication, Computer, Industrial and Automotive markets.

Standard Products

Cooper Coiltronics brand product line of power magnetics continually expands to satisfy shifts in technology and related market needs. Categories of Standard Products include:

- Shielded Drum Inductors
- Low Profile Shielded Drum Inductors
- Unshielded Drum Inductors
- High Current Inductors
- Common-Mode Inductors
- Toroidal Inductors
- Transformers
- Custom Magnetics

Custom-Engineered Capabilities

- Inductors and Transformers for DC/DC Converters and Off-Line Switch Mode Power Supplies (To 200 Watts at voltages up to 450Vac [640 Vdc] and Frequencies from 20Khz to 10Mhz)
- Custom SMT Inductors and Transformers

Cooper Coiltronics brand products can provide you with custom designs from print through manufacture. Our design Engineers can take your designated specifications or help you determine what the specifications should be. Either way, we'll get you the right power magnetic solution to your design challenge.

COOPER Bussmann

Shielded Drum Inductors and Low Profile Shielded Drum Inductors

Cooper Coiltronics® brand magnetics put forward one of the largest variety of shielded drum core inductors that utilize a magnetic shield reducing EMI effects and have the best power density versus size ratio on the market.

Features:
- Large variety of shapes and sizes
- Maximum Power Density
- Ultra Low Profile (as low as 1.0mm in height)
- Dual Winding: Coupled Inductor, SEPIC, Flyback Transformer, 1:1 Isolation Transformer
- High current
- Magnetic Shielding, Reduced EMI
- Compact Footprint

Standard Product Families:
Shielded Drum:
DR, DRQ, DR124, DR1030, DR1040, DR1050, LDS0705.

Low Profile Shielded Drum:
SD, SDQ, SD3110, SD3112, SD3114, SD3118, SD52, SD53, SD38, SDH3812, SD6020, SD6030, SD7030, SD8328, SD8350.

High Current Inductors

The Cooper Coiltronics® brand high current inductor product lines provide an optimal mix of innovative packaging, high efficiency and unbeatable reliability.

Features:
- Large variety of shapes and sizes
- Low profile (as low as 3mm)
- Low DCR, High Efficiency
- Designed for High Current, Low Voltage Applications
- Foil construction adds higher reliability factor than traditional magnet wire used for higher frequency circuits
- Gapped Ferrite: Maximum Efficiency, Low core loss
- High Temperature Powder Iron: 155°C Maximum Temperature Operation, Organic Binder Eliminates Thermal Aging

Standard Product Families:
HC1, HC2LP, HC3, HC7, HC8, HC8LP, HC9, HCP0703, HCP1104, HCP1305, HCPT1309, HCF1305, FLAT-PAC™(FP2), FLAT-PAC™ (FP3), FLAT-PAC™ 4, (FP4), CPL.

Unshielded Drum Core Inductors

Cooper Coiltronics® brand magnetics offer a wide variety of unshielded drum core inductors in different shapes and sizes to fit all board space constraints.

Features:
- Multiple sizes available
- Miniature Surface Mount Design
- Low Profile
- Small Footprint
- Ferrite Core Material

Standard Product Families:
UNI-PAC™ (UP1B, 2B, 3B, 4B), UNI-PAC™ 0.4C (UP0.4C), UNI-PAC™ 2.8B (UP2.8B), UNI-PAC™ 2C (UP2C), LD.

Toroid Inductors

The Cooper Coiltronics® brand magnetics also offer a mixture of toroid constructed inductors available in surface mount, through hole, and dual winding platforms.

Features:
- Surface Mount and Through-Hole Mounting
- Maximum Power Density
- Dual Winding: Coupled Inductor, SEPIC, Flyback Transformer, 1:1 Isolation Transformer
- Low EMI
- Variety Of Core Materials: Powder Iron, MPP, Gapped Ferrite, Amorphous

Standard Product Families:
ECONO-PAC™, OCTA-PAC®, ™, OCTA-PAC® Plus, MICRO-PAC™, , MICRO-PAC™ Plus, Low Cost Power Inductors (LCPI), Current Sense (CS).

Common-Mode Inductors

Cooper Coiltronics® brand magnetics also offer a variety of surface mount and through hole inductors specifically for common-mode circuits.

Features:
- Variety Of Sizes
- Surface mount and through hole packages
- Wide inductance offering
- Ferrite core material

Standard Product Families:
Common Mode Inductor SMT (CMS), Common Mode Inductor THT (CMT)

Transformers

Cooper Coiltronics® brand magnetics also offer a variety of standard transformers that increase versatility in design needs.

Features:
- Multi-configurable transformer/Inductors
- Variety Of Sizes
- Multi-configurable Power Over Ethernet/PD Flyback and Forward Transformers
- Cold Cathode Fluorescent Lamp (CCFL) Transformers

Standard Product Families:
VERSA-PAC® (VP), VERSA-PAC® High Inductance (VPH), Power Over Ethernet/ PD Configurable Transformer (PoE) Flyback and Forward, Cold Cathode Fluorescent Lamp (CCFL)

Custom Magnetics

Cooper Coiltronics® brand magnetics can be customized to meet your application needs. We specialize in designing product to specific requirements and new technology, as well as modifying our standard product platforms to meet your requirements.

Modifications to standard products are available.

All surface mount components are available in tape-and-reel packaging for pick-and-place utilization.

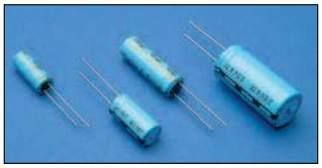
Power Management Group

PowerStor®

The Cooper PowerStor® family of aerogel capacitors offers ultra-low resistance supercapacitors, unique high-energy storage devices.

RoHS 2002/95/EC

Supercapacitors Extend Battery Life

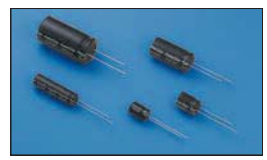


The Cooper PowerStor® A series supercapacitors are available in values from 0.47F to 4.7F, 2.5V and offer equivalent series resistance as low as 25mΩ. In remote battery powered applications that have pulse current loads this low ESR can be utilized to prolong battery life.

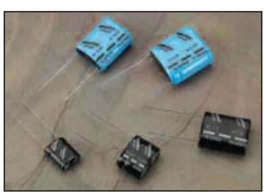
Low cost battery solutions tend to have high ESR and as a result large amounts of stored energy can't be used when supplying pulse currents. By combining a supercapacitor in parallel with the battery the overall ESR is lowered and battery life, typically, increased by 300%. For remote applications such as utility meters, weather & river level monitoring and hotel door locks this can dramatically reduce replacement costs.

Offering Environmentally Friendly Alternative to Ni-CD Batteries

The Cooper PowerStor® B series is available in values from 0.22F to 50F, 2.5V and is fully compliant with the EC RoHS directive. For equipment that is only required for short term use, up to several minutes, and has a local charger the B series offers a realistic alternative to Ni-CD batteries.



Low equivalent series resistance allows the B series parts to be rapidly charged and discharged without damage and low leakage current means they can hold their charge for weeks. Unlike batteries PowerStor® supercapacitors have a very long cycle life, over 500,000 cycles, so they won't need replacing and at end of life there are no recycling or disposal issues.



Supercapacitors Provide Last Gasp Power

The Cooper PowerStor® P series is available in values from 0.1F to 1.0F, 5V and is ideal for hold-up and bridging power applications. For telecom products such ADSL routers a P series supercapacitor can be used to provide power for a 'leaving network' signal after a mains supply failure.

Unlike batteries the P series supercapacitors have a long cycle life, over 500,000 cycles, so they won't need replacing. In addition to this they have ESR as low as 0.2 Ohms and small package sizes from 0.75 cm^3 to 4.7 cm^3. All this makes the P series an ideal choice for supporting continued operation during battery swap-out or for controlled shut down after a mains failure.

Providing Power Management Solutions

In addition to a broad range of standard products Cooper PowerStor® also offer custom solutions for applications such as automated meter reading, PCMCIA cards, handheld electronics, data storage systems and toys.

These products include high integrity capacitor packs that incorporate active voltage balancing, ultra thin 'Flat Pack' devices with low ESR and optimized cylindrical components that meet specific customer requirements.

Circuit Protection

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FUSE TECHNOLOGY

This fuse technology guide will discuss basic fuse operating, application, and selection criteria concepts. The intended purpose of this section is to aid designers with the operation and characteristics of an overcurrent protection device and to assist in device selection.

Overcurrent fuses serve two main purposes:

a. To protect components, equipment and people from risk of fire and shock caused by overcurrents.

b. To isolate sub systems from the main system once a fault has occurred.

Overcurrents

Overcurrents exist when the normal load for a circuit is exceeded. It can either be an overload or short circuit condition.

An overload condition is any current flowing within the circuit path that is higher than the circuit's normal full load current. An overload is typically 2 to 5 times the magnitude of a circuit's normal operating current.

A short circuit is an overcurrent condition that leaves the normal current path and which greatly exceeds the normal full load current of the circuit by a factor of tens, hundreds, or thousands. Components and equipment can be damaged by both types of overcurrents.

Selecting Overcurrent Protection

During normal load conditions, the fuse must carry the normal operating current of the circuit without nuisance openings. However, when an overcurrent occurs the fuse must interrupt the overcurrent and withstand the voltage across the fuse after internal arcing. To properly select a fuse the following items must be considered:

- Voltage rating (ac or dc voltage)
- Current rating
- Normal operating current
- Ambient temperature
- Overload conditions and opening times
- Available short circuit current
- Melting Integral (I^2t)
- Pulse and In-rush characteristics
- Characteristics of equipment or components to be protected
- Physical size and available board space
- Standards requirements

Voltage Ratings

The voltage rating of the fuse must be greater than or equal to the maximum open circuit voltage. Because the fuse has such low resistance, the voltage rating becomes critical only when the fuse is trying to open. The fuse must be able to open quickly, extinguish the arc after the fuse element has melted and prevent the system's open-circuit voltage from re-striking across the open fuse element.

Current Ratings

The current rating of a fuse identifies its current-carrying capacity based on a controlled set of test conditions. Each fuse is marked with its current rating. This rating can be identified with a numeric, alpha, or color code mark. Marking codes can be found in each product's data sheet.

Normal Operating Current

The normal operating current of a circuit is the level of current drawn (in RMS or dc amperes) after it has been energized and is operating under normal conditions. An operating current of 80% or less of rated current is recommended for operation at 25°C to avoid nuisance openings. For example, a fuse with a current rating of 1A is usually not recommended in circuits with normal operating currents of more than 800mA. Further derating is required at elevated ambient temperatures.

Ambient Temperature

Ambient temperature is the temperature of the air immediately surrounding the fuse and is not necessarily room temperature. All electrical characteristics of a fuse are rated and validated at an ambient temperature of 25°C. Both higher and lower ambient temperatures will affect the fuse's opening and current carrying characteristics. This effect is demonstrated in temperature re-rating curves. Please refer to the re-rating curves for individual product series found in the Engineering Product Specifications located on the Cooper Electronic Technologies web site, or contact CET directly for technical assistance.

Overload Conditions and Opening Times

Specific attention must be given to first overload operating points. For fuses, the first overload point is usually between 200% to 300% of rated current. 400% is typically the first overload point for circuit protectors.

Breaking Capacity / Interrupting Rating

A fuse must be able to open the circuit under a short circuit condition without endangering its surroundings. The breaking capacity or interrupting rating of a protective device is the maximum available current, at rated voltage, that the device can safely open without rupturing. The breaking capacity or interrupting rating of a fuse must be equal to or greater than the available short circuit current of the circuit.

Melting Integral

The melting integral of a fuse, termed melting I^2t, is the thermal energy required to melt a specific fuse element. The construction, materials, and cross sectional area of the fuse element will determine this value. Each fuse series and ampere rating utilize different materials and element configurations, and therefore it is necessary to determine the I^2t value for each fuse. Tests to determine the I^2t of a fuse are usually performed with a fault current of at least 10x the rated current with a time constant of less than 50 microseconds in a DC test circuit. High-speed oscilloscopes and integral programs are used to measure very accurate I^2t values.

The melting I^2t of a fuse is one of the values used to assist circuit designers when selecting and properly sizing a fuse in a specific application. It can be compared to the thermal energy created by transient surge currents in a circuit.

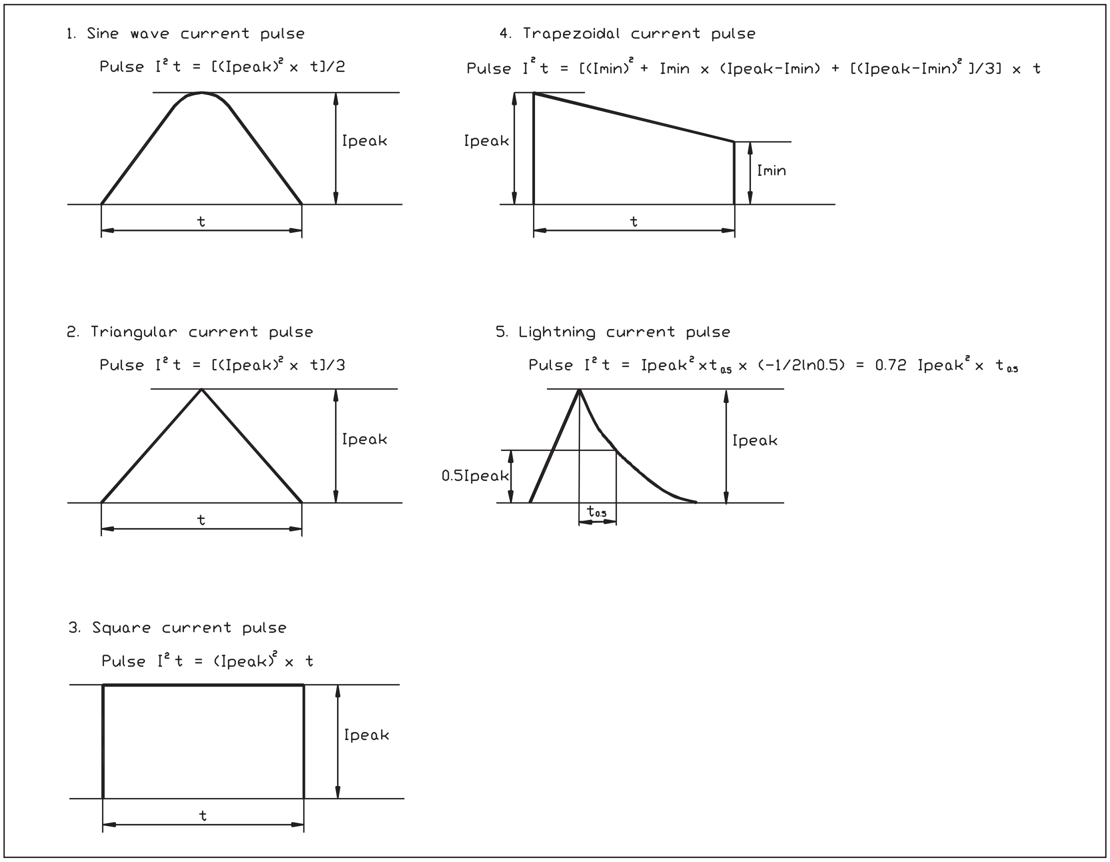
Surge and Pulse Current Characteristics

Transient surge or pulse currents are used to describe wave shapes that result from any startup, inrush, surge, or transient currents in a circuit. The pulse currents are normal for some applications. It is therefore important to size the fuse properly to allow these pulses to pass without nuisance openings or degradation of the fuse element. The fuse must then open within the limits specified by UL and CSA if the overload condition continues. The ability to resist surges is a function of the fuse design and/or classification relative to the surge pulse, duration frequency etc.

Pulse currents can produce thermal energy that may not be large enough to open the fuse but could possibly cause element fatigue and decrease the life of the fuse. To properly size a fuse and determine its surge withstand capability, the circuit's pulse energy should be determined and compared to the time current curve and I^2t rating of the fuse. The fuse's melting I^2t value must be greater than or equal to the pulse I^2t multiplied by a pulse factor.

The peak current and decay time define the pulse current characteristic or waveform. Pulses can generate different waveform shapes, which determines the formula used to calculate the pulse energy or I^2t. Refer to Table 1 to select the appropriate waveform and its corresponding pulse I^2t calculation.

Table 1. Pulse Waveshapes and I^2t Calculations



Fuse Surge Withstand Capability

The fuse's capability to withstand a surge pulse without causing thermal stress to the fuse element, which may result in nuisance openings, can be determined once the circuit's pulse I^2t is calculated. The circuit designer needs to properly size the fuse so that the fuse's melting I^2t value is greater than or equal to the pulse I^2t multiplied by a pulse factor F_p ($I^2t_{fuse} \geq I^2t_{pulse} \times F_p$).

The pulse factor is dependent on the construction of the fuse element. A wire-in-air constructed fuse element (ferrule fuses, 6125 and 1025 series for example) will be affected by the number and frequency of surge pulses the fuse is subjected to over the lifetime of the device. This construction design utilizes low-melting-point metals plated or deposited on the main element material to cause an "M" effect. If the fuse is sized improperly, low level pulse currents may cause the low-melting-point metals to alloy to the element without completely opening the element.

A series of pulse currents will eventually create enough heat to shift resistance or even permanently open the fuse. Thus it is important to take into account the number of pulse currents to which the fuse will be subjected.

Solid matrix fuses (for example 0603FA or 3216FF sized surface mount fuses) do not currently use an "M" effect for the element construction. The element will only then be affected by the thermal energy of each pulse, and will not normally degrade as a result of the number or frequency of pulses. Please refer to Table 2 to determine the pulse factor, F_p.

For example, a pulse current with an I^2t of 0.0823 and a pulse factor, F_p=1.25 would require the selection of a fuse to have a melting I^2t greater than or equal to 0.1029.

$$\text{Melting } I^2t_{fuse} \geq I^2t_{pulse} \times F_p$$
$$\text{Melting } I^2t_{fuse} \geq 0.0823 \times 1.25$$
$$\text{Melting } I^2t_{fuse} \geq 0.1029$$

It is important to note that the melting I^2t values of the fuse and pulse current that are compared must be calculated or tested at the same test conditions, most importantly the magnitude of the peak current must be the same. For example, if the pulse's peak current is 15A, then the fuse's melting I^2t must be calculated at 15A as well to fully understand its electrical characteristics at that magnitude of current. Please contact CET directly for technical assistance.

Table 2. Pulse Factor, F_p

Solid Matrix Construction

Number of Surge Pulses	Pulse Factor, F_p
1 to 100,000	1.25

Wire-in-Air Construction

Number of Surge Pulses	Pulse Factor, F_p
100	2.1
1,000	2.6
10,000	3.4
100,000	4.5

Time vs. Current Curves

A time current curve represents the relationship between a fuse's melting or clearing time and the magnitude of RMS or dc current. The characteristics represented on most published graphs usually indicate a fuse's average melting time when subjected to a certain level of current. The curves will typically demonstrate the ability to carry 100% of rated current, and then also represent the fuse's ability to open within the maximum opening time at designated overload points (typically 135% to 300% of the fuse rating). Time vs. current curves are a useful design aid for an engineer when specifying a fuse type or rating for an application. It is however recommended that fuse samples be tested in the actual application to verify performance.

Fuse Resistance

In most applications, the voltage drop across the fuse due to its internal and contact resistance is negligible. There are, however, certain critical applications where the fuse resistance must be considered and it is important that the circuit designer understands the fuse characteristics in order to select the proper fuse. Applications that are powered by low voltage batteries, typically 3V or less, and utilize fractional rated fuses with high resistance may require special attention be given to the voltage drop across the fuse.

Physical Sizes

There are numerous physical sizes of electronic fuses, including subminiature fuses. The most common ferrule designs are 5x15mm, 5x20mm and 6.3x32mm (1/4" x 1 1/4").

Subminiature fuses are often used when board space is limited. For applications of this type, there are through-hole and surface mount devices available. Standard package sizes for surface mount fuses are 0402 (1005), 0603 (1608), 1206 (3216), 6125, and 1025. These sizes are standard throughout the electronic industry. Through-hole axial and radial leaded products allow fuses to be PCB mounted. Standard ferrule fuses fitted with leads can also be mounted in this way.

Physical Sizes of Traditional Ferrule Fuses

5mmx20mm	0.2" x .79"
1AG	1/4" x 5/8"
2AG (5mmx15mm)	0.2" x .59"
3AG	1/4" x 1 1/4"
4AG	9/32" x 1 1/4"
5AG	13/32" x 1 1/2"
7AG	1/4" x 7/8"
8AG	1/4" x 1"

Standards

North American UL/CSA and IEC standards require significantly different time vs. current characteristics for overcurrent devices.

Typically the physical dimensions and materials used are similar; however, fuses built to different standards are not interchangeable because their element melting and opening times will differ when subjected to the same magnitude of current. It is therefore important for the circuit designer to consider that world standards may require different fuses.

Glossary of Terms

Ampere squared seconds I^2t
The melting, arcing, or clearing integral of a fuse, termed I^2t, is the thermal energy required to melt, arc, or clear a specific current. It can be expressed as melting I^2t, arcing I^2t or the sum of them, clearing I^2t.

Arcing time
The amount of time from the instant the fuse link has melted until the overcurrent is interrupted, or cleared.

Clearing time
The total time between the beginning of the overcurrent and the final opening of the circuit at rated voltage by an overcurrent protective device. Clearing time is the total of the melting time and the arcing time.

Fast acting fuse
A fuse which opens on overload and short circuits very quickly. This type of fuse is not designed to withstand temporary overload currents associated with some electrical loads. UL listed or recognized fast acting fuses would typically open within 5 seconds maximum when subjected to 200% to 250% of its rated current. IEC has two categories of fast acting fuses:
- F = quick acting, opens 10x rated current within 0.001 seconds to 0.01 seconds
- FF = very quick acting, opens 10x rated current in less than 0.001 seconds

Fuse
An overcurrent protective device with a fusible link that operates and permanently opens the circuit on an overcurrent condition.

Overcurrent
A condition which exists in an electrical circuit when the normal load current is exceeded. Overcurrents take on two separate characteristics-overloads and short circuits.

Overload
Can be classified as an overcurrent which exceeds the normal full load current of a circuit by 2 to 5 times its magnitude and stays within the normal current path.

Resistive load
An electrical load which is characterized by not drawing any significant inrush current. When a resistive load is energized, the current rises instantly to its steady state value, without first rising to a higher value.

RMS Current
The R.M.S. (root mean square) value of any periodic current is equal to the value of the direct current which, flowing through a resistance, produces the same heating effect in the resistance as the periodic current does.

Short circuit
An overcurrent that leaves the normal current path and greatly exceeds the normal full load current of the circuit by a factor of tens, hundreds, or thousands times.

Time delay fuse
A fuse with a built-in time delay that allows temporary and harmless inrush currents to pass without operating, but is so designed to open on sustained overloads and short circuits. UL listed or recognized time delay fuses typically open in 2 minutes maximum when subjected to 200% to 250% of rated current. IEC has two categories of time delay fuses:
- T = time lag, opens 10x rated current within 0.01 seconds to 0.1 seconds
- TT = long time lag, opens 10x rated current within 0.1 seconds to 1 second

Voltage rating
A maximum open circuit voltage in which a fuse can be used, yet safely interrupt an overcurrent. Exceeding the voltage rating of a fuse impairs its ability to clear an overload or short circuit safely.

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Overcurrent
Protection Group

Selection Guide

The following is a quick selection guide to assist in selecting the appropriate product series for your application. Please refer to the corresponding catalog pages for a complete listing of product specifications.

Chip Fuses						
Product Series	**Voltage Rating**	**Amp Rating**	**Electrical Characteristic**	**Size**	**Mounting Method**	**3rd Party Testing**
0603FA	32 VDC 24 VDC	250mA - 2A 2.5A-5A	Fast Acting	1.6mmx0.8mm (.060"x.030")	Surface Mount	UL/CSA
3216FF	32 VAC, 63 VDC 32 VAC, 32 VDC	250mA-3A 4A-7A	Fast Acting	3.2mmx1.6mm (.120"x.060")	Surface Mount	UL/CSA
3216TD	63 VAC, 63 VDC 32 VAC, 32 VDC	1A 1.5A-12A	Time Delay	3.2mmx1.6mm (.120"x.060")	Surface Mount	cRUus
3216LV	125 VAC/DC	250mA-1.5A	Fast Acting	3.2mmx1.6mm (.120"x.060")	Surface Mount	UL/CSA

Brick Fuses						
Product Series	**Voltage Rating**	**Amp Rating**	**Electrical Characteristic**	**Size**	**Mounting Method**	**3rd Party Testing**
6125TD	125VAC, 60VDC	250mA-7A	Time Delay	6.1mmx2.5mm (0.24"x0.1")	Surface Mount	UL/CSA
6125FF	125VAC, 72VDC	375mA-15A	Fast Acting	6.1mmx2.5mm (0.24"x0.1")	Surface Mount	cRUus
6125FA	125VAC, 125VDC 125VAC, 86VDC 86VDC	250mA-7A 10A-12A 15A	Fast Acting	6.1mmx2.5mm (0.24"x0.1")	Surface Mount	UL/CSA
1025TD	250AC, 125VDC	250mA-5A	Time Delay	10.1mmx2.5mm (0.4"x0.1")	Surface Mount	UL/CSA
1025FA	250VAC, 125VDC	250mA-15A	Fast Acting	10.1mmx2.5mm (0.4"x0.1")	Surface Mount	UL/CSA

Telecom Fuses						
Product Series	**Voltage Rating**	**Amp Rating**	**Electrical Characteristic**	**Size**	**Mounting Method**	**3rd Party Testing**
TCP	250VAC	500mA-2A	Time Delay for Telecom Applications	10.1mmx2.5mm (0.4"x0.1")	Surface Mount	UL/CSA

Traditional Subminiature Fuses						
Product Series	**Voltage Rating**	**Amp Rating**	**Electrical Characteristic**	**Size**	**Mounting Method**	**3rd Party Testing**
MCRW	125VAC, 125VDC	1/10A-15A	Fast Acting, Wire in Air	7.1mmx3.18mm (.280"x.125")	Axial Through Hole	UL/CSA
MCRS	125VAC, 125VDC	250MA-7A	Slow Blow, Wire in Air	7.1mmx3.18mm (.280"x.125")	Axial Through Hole	UL/CSA
PC-Tron	250VAC, 450VDC 250VAC, 350VDC 125VAC, 250VDC	500mA-2.5A 3A 5A	Fast Acting, Solid Matrix	8.89mmx8.89mm (.35"x.35")	Radial Through Hole	UL/CSA
SR-5	250VAC	500mA-6.3A	Time Delay	8.35mmx7.7mm (.33"x.3")	Radial Through Hole	UL/CSA SEMKO/VDE
SS-5	250VAC	500mA-6.3A	Time Delay	8.6mmx8.4mm (.34"x.33")	Radial Through Hole	UL/CSA SEMKO/VDE
SR-5F	250VAC 125VAC	800mA-5A 6.3A-10A	Fast Acting	8.35mmx7.7mm (.33"x.3")	Radial Through Hole	UL/CSA
SS-5F	250VAC 125VAC	800mA-5A 6.3A-10A	Fast Acting	8.6mmx8.4mm (.34"x.33")	Radial Through Hole	UL/CSA
SR-5H	300VAC 250VAC	1A-6.3A	Time Delay	8.35mmx8.6mm (.33"x.34")	Radial Through Hole	cURus SEMKO/VDE

1/4" Diameter Ferrule Fuses						
Product Series	**Voltage Rating**	**Amp Rating**	**Electrical Characteristic**	**Size**	**Mounting Method**	**3rd Party Testing**
AGA	125VAC, 32VAC	63mA-30A	Fast Acting	6.3mmx15.9mm (1/4"x5/8")	Clips, Blocks, and Holders	UL/UR
AGA-V	125VAC, 32VAC	63mA-30A	Fast Acting	6.3mmx15.9mm (1/4"x5/8")	Axial Through Hole	UL/UR
AGX	250VAC, 125VAC, 32VAC	1/500mA-30A	Fast Acting	6.3mmx25.4mm (1/4"x1")	Clips, Blocks, and Holders	UL/UR/CSA
AGX-V	250VAC, 125VAC, 32VAC	1/500mA-30A	Fast Acting	6.3mmx25.4mm (1/4"x1")	Axial Through Hole	UL/UR/CSA
ABC	250VAC, 125VAC	1/4A-30A	Fast Acting	6.3mmx32mm (1/4"x1-1/4")	Clips, Blocks, and Holders	UL/UR/CSA
ABC-V	250VAC, 125VAC	1/4A-30A	Fast Acting	6.3mmx32mm (1/4"x1-1/4")	Axial Through Hole	UL/UR/CSA
AGC	250VAC, 32VAC	1/20A-30A	Fast Acting	6.3mmx32mm (1/4"x1-1/4")	Clips, Blocks, and Holders	UL/UR/CSA
AGC-V	250VAC, 32VAC	1/20A-30A	Fast Acting	6.3mmx32mm (1/4"x1-1/4")	Axial Through Hole	UL/UR/CSA
GBB	250VAC	1A-30A	Very Fast Acting	6.3mmx32mm (1/4"x1-1/4")	Clips, Blocks, and Holders	UR/CSA
GBB-V	250VAC	1A-30A	Very Fast Acting	6.3mmx32mm (1/4"x1-1/4")	Axial Through Hole	UR/CSA
MDA	250VAC	2/10A-30A	Time Delay	6.3mmx32mm (1/4"x1-1/4")	Clips, Blocks, and Holders	UL/CSA
MDA-V	250VAC	2/10A-30A	Time Delay	6.3mmx32mm (1/4"x1-1/4")	Axial Through Hole	UL/CSA
MDL	250VAC, 32VAC	1/16A-30A	Time Delay	6.3mmx32mm (1/4"x1-1/4")	Clips, Blocks, and Holders	UL/UR/CSA
MDL-V	250VAC, 32VAC	1/16A-30A	Time Delay	6.3mmx32mm (1/4"x1-1/4")	Axial Through Hole	UL/UR/CSA
MDQ	250VAC	1/100A-15A	Dual Element Time Delay	6.3mmx32mm (1/4"x1-1/4")	Clips, Blocks, and Holders	UL/UR/CSA
MDQ-V	250VAC	1/100A-15A	Dual Element Time Delay	6.3mmx32mm (1/4"x1-1/4")	Axial Through Hole	UL/UR/CSA

5x15mm Ferrule Fuses						
Product Series	Voltage Rating	Amp Rating	Electrical Characteristic	Size	Mounting Method	3rd Party Testing
C515	250VAC	125mA-7A	Time Delay	5.5mmx15.2mm (0.22"x0.60")	Axial Through Hole	UL/UR/CSA
C517	350VAC	3A	Fast Acting	5.5mmx15.2mm (0.22"x0.60")	Axial Through Hole	UL/UR/CSA
C518	250VAC	100mA-5A	Fast Acting	5.5mmx15.2mm (0.22"x0.60")	Axial Through Hole	UL/CSA
C519	250VAC	125mA-5A	Time Delay	5.2mmx15mm (0.20"x0.59")	Clips, Blocks, and Holders	UL/UR/CSA
C520	250VAC	100mA-5A	Fast Acting	5.2mmx15mm (0.20"x0.59")	Clips, Blocks, and Holders	UL/CSA

5x20mm Ferrule Fuses						
Product Series	Voltage Rating	Amp Rating	Electrical Characteristic	Size	Mounting Method	3rd Party Testing
GMA	250VAC, 125VAC	63mA-15A	Fast Acting	5.2mmx20mm (0.20"x0.79")	Clips, Blocks, and Holders	UL/UR/CSA/MITI
GMA-V	250VAC, 125VAC	63mA-15A	Fast Acting	5.5mmx21.1mm (0.22"x0.83")	Axial Through Hole	UL/UR/CSA/MITI
GMC	250VAC, 125VAC	50mA-10A	Medium Time Delay	5.2mmx20mm (0.20"x0.79")	Clips, Blocks, and Holders	UL/UR/CSA/MITI
GMC-V	250VAC, 125VAC	50mA-10A	Medium Time Delay	5.5mmx21.1mm (0.22"x0.83")	Axial Through Hole	UL/UR/CSA/MITI
GMD	250VAC	125mA-4A	Time Delay	5.2mmx20mm (0.20"x0.79")	Clips, Blocks, and Holders	UL/UR/CSA/MITI
GMD-V	250VAC	125mA-4A	Time Delay	5.5mmx21.1mm (0.22"x0.83")	Axial Through Hole	UL/UR/CSA/MITI
S500	250VAC	32mA-10A	Fast Acting, Low Breaking Capacity	5.2mmx20mm (0.20"x0.79")	Clips, Blocks, and Holders	UR/CSA/Semko/ VDE/IMQ/BSI
S500-V	250VAC	32mA-10A	Fast Acting, Low Breaking Capacity	5.5mmx21.1mm (0.22"x0.83")	Axial Through Hole	UR/CSA/Semko/ VDE/IMQ/BSI
S501	250VAC	50mA-10A	Fast Acting, High Breaking Capacity	5.2mmx20mm (0.20"x0.79")	Clips, Blocks, and Holders	UR/Semko/ VDE/IMQ
S501-V	250VAC	50mA-10A	Fast Acting, High Breaking Capacity	5.5mmx21.1mm (0.22"x0.83")	Axial Through Hole	UR/Semko/ VDE/IMQ
S505	250VAC	500mA-12A	Time Delay, High Breaking Capacity	5.5mmx21.1mm (0.22"x0.83")	Clips, Blocks, and Holders	UR/BSI/MITI/ Semko/VDE/IMQ
S505-V	250VAC	500mA-12A	Time Delay, High Breaking Capacity	5.5mmx21.1mm (0.22"x0.83")	Axial Through Hole	UR/BSI/MITI/ Semko/VDE/IMQ
S506	250VAC	32mA-15A	Time Delay, Low Breaking Capacity	5.2mmx20mm (0.20"x0.79")	Clips, Blocks, and Holders	UR/BSI/MITI/ Semko/VDE/IMQ
S506-V	250VAC	32mA-15A	Time Delay, Low Breaking Capacity	5.5mmx21.1mm (0.22"x0.83")	Axial Through Hole	UR/BSI/MITI/ Semko/VDE/IMQ

Fuse Accessory Selection Guide

Fuse	Size	PC Board Fuse Clip (Qty. 2)	PC Board Mount Holder	Panel Mount Holder	In-Line Fuse Holder	Fuseblock
ABC	1/4" x 1-1/4"	1A1907	HBH-I / HBV-I	HTB / HKP	HRK / HHB / HFA	S-8000
AGA	1/4" x 5/8"	1A1907	-	-	-	-
AGC	1/4" x 1-1/4"	1A1907	HBH-I / HBV-I	HTB / HKP	HRK / HHB / HFA	S-8000
AGU	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
AGW	1/4" x 7/8"	1A1907	-	-	HRK / HHB / HFA	-
AGX	1/4" x 1"	1A1907	-	HJL	HRK / HHB / HFA	3828-1
ATC	-	1A5600	-	-	HHD	-
ATM	-	1A5778	-	-	HHM	-
BAF	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
BAN	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
BBS	13/32" x 1-3/8"	1A3400	-	HPS-L	HEH	BM6031PQ
C519	5mm x 15mm	1A3399	-	-	HHT	-
C520	5mm x 15mm	1A3399	-	-	HHT	-
DCM	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
FNA	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
FNM	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
FNQ	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
FNQ-R	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BC6031PQ
FWH	1/4" x 1-1/4"	1A1907	-	-	-	-
GBA	1/4" x 1-1/4"	1A1907	-	HLD	HRK / HHB / HFA	S-8000
GBB	1/4" x 1-1/4"	1A1907	HBH-I / HBV-I	HTB / HKP	HRK / HHB / HFA	S-8000
GLD	1/4" x 1-1/4"	1A1907	-	HLD	HRK / HHB / HFA	S-8000
GMA	5mm x 20mm	1A3399	HTC-45M / -50M	HTB / HTC	HHT	HTC-15M
GMC	5mm x 20mm	1A3399	HTC-45M / -50M	HTB / HTC	HHT	HTC-15M
GMD	5mm x 20mm	1A3399	HTC-45M / -50M	HTB / HTC	HHT	HTC-15M
KLM	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
KTK	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
KTK-R	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BC6031PQ
KTQ	13/32" x 1-3/8"	1A3400	-	HPS-L	HEH	BM6031PQ
LP-CC	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BC6031PQ
MDA	1/4" x 1-1/4"	1A1907	HBH-I / HBV-I	HTB / HKP	HRK / HHB / HFA	S-8000
MDL	1/4" x 1-1/4"	1A1907	HBH-I / HBV-I	HTB / HKP	HRK / HHB / HFA	S-8000
MDQ	1/4" x 1-1/4"	1A1907	HBH-I / HBV-I	HTB / HKP	HRK / HHB / HFA	S-8000
MIC	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
MIN	13/32" x 1-1/2"	1A3400	-	HPG	HEB	BM6031PQ
PCB	-	-	PCS	-	-	-
PCD	-	-	PCS	-	-	-
S500 / GDB	5mm x 20mm	1A3399	HTC-45M / -50M	HTB / HTC	HHT	HTC-15M
S501 / GDA	5mm x 20mm	1A3399	HTC-45M / -50M	HTB / HTC	HHT	HTC-15M
S505	5mm x 20mm	1A3399	HTC-45M / -50M	HTB / HTC	HHT	HTC-15M
S506 / GDC	5mm x 20mm	1A3399	HTC-45M / -50M	HTB / HTC	HHT	HTC-15M
SC-1 to 15	13/32" x 1.31"	1A3400	-	HPS-EE	HEG	BG3011PQ
SC-20	13/32" x 1.41"	1A3400	-	HPS-JJ	HEH	BG3021PQ
SC-25 to 30	13/32" x 1.63"	1A3400	-	HPS-FF	HEC	BG3031PQ
SC-35 to 60	13/32" x 2-1/4"	1A3400	-	-	HEJ	G30060-1CR
SR-5	-	-	PCS	-	-	-
SR-5F	-	-	PCS	-	-	-
SS-5	-	-	PCS	-	-	-
SS-5F	-	-	PCS	-	-	-
TDC10	1/4" x 1-1/4"	1A1907	HTC-45M / -50M	HTB / HKP	HRK / HHB / HFA	S-8000
TDC11	1/4" x 1-1/4"	1A1907	HTC-45M / -50M	HTB / HKP	HRK / HHB / HFA	S-8000
TDC180	1/4" x 1"	1A1907	-	HJL	HRK / HHB / HFA	3828-1

COOPER Bussmann

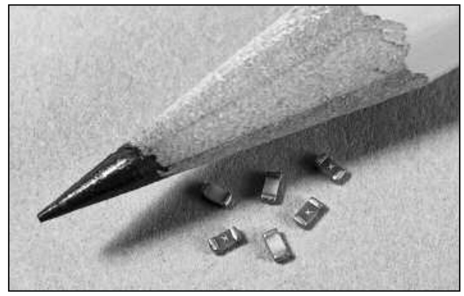
Chip™ Fuses

0603FA Series, Fast Acting

Description

- Rapid interruption of excessive current
- Compatible with reflow and wave solder
- Rugged ceramic and glass construction
- Excellent environmental integrity
- One time positive disconnect
- Compatible with lead free solders and higher temperature profiles

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS	
% of Amp Rating	Opening Time
100%	4 Hours Minimum
200%	60 Seconds Maximum

Agency Information

- UL Recognition Guide & File numbers: JDYX2 &E19180
- CSA Component Acceptance: 053787 C 000 & Class Number: 1422 30

Environmental Data

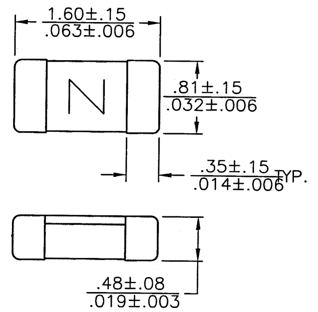
- Life Test: MIL-STD-202, Method 108A
- Load Humidity Test: MIL-STD-202, Method 103B
- Moisture Resistance Test: MIL-STD-202, Method 106E
- Terminal Strength Test: Downward force is applied to cause a 1mm deflection for 1 minute
- Thermal Shock Test: MIL-STD-202, Method 107D
- Solderability: ANSI/J-STD-002
- Mechanical Shock Test: MIL-STD-202, Method 213B
- High Frequency Vibration Test: MIL-STD-202, Method 204D
- Resistance to Solvents Test: MIL-STD-202, Method 215A

Ordering

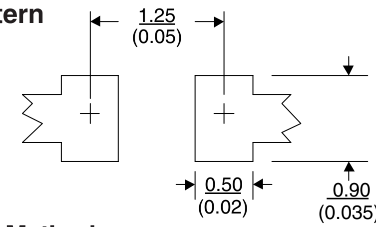
- Specify packaging and product code (i.e., TR/0603FA250-R)

Dimensions mm/(inches)

Drawing Not to Scale



Land Pattern



Soldering Method

- Wave Solder: 260°C, 10 sec max.
- Infrared Reflow: 260°C, 30 sec max.

SPECIFICATIONS							
Product Code	Current Rating	Voltage Rating DC	Interrupting Rating at Rated Voltage*	DC Cold Resistance** (ohms) Typical	Typical Melting I^2t***	Typical Voltage Drop†	Alpha Code Marking‡
0603FA250-R	250mA	32V	50A	3.100	0.0004	0.921	D
0603FA375-R	375mA	32V	50A	1.250	0.0009	0.605	E
0603FA500-R	500mA	32V	50A	1.025	0.00193	0.600	F
0603FA750-R	750mA	32V	50A	0.450	0.0090	0.440	G
0603FA1-R	1A	32V	50A	0.150	0.0025	0.211	H
0603FA1.25-R	1.25A	32V	35A	0.108	0.0130	0.151	J
0603FA1.5-R	1.5A	32V	35A	0.086	0.0319	0.138	K
0603FA2-R	2A	32V	35A	0.051	0.0491	0.116	N
0603FA2.5-R	2.5A	24V	35A	0.037	0.0625	0.113	O
0603FA3-R	3A	24V	35A	0.028	0.0699	0.110	P
0603FA3.5-R	3.5A	24V	35A	0.022	0.1200	0.103	R
0603FA4-R	4A	24V	35A	0.017	0.2430	0.097	S
0603FA5-R	5A	24V	35A	0.011	0.6950	0.090	T

* DC Interrupting Rating (Measured at designated voltage, time constant of less than 50 microseconds, battery source)

** DC Cold Resistance (Measured at ≤10% of rated current)

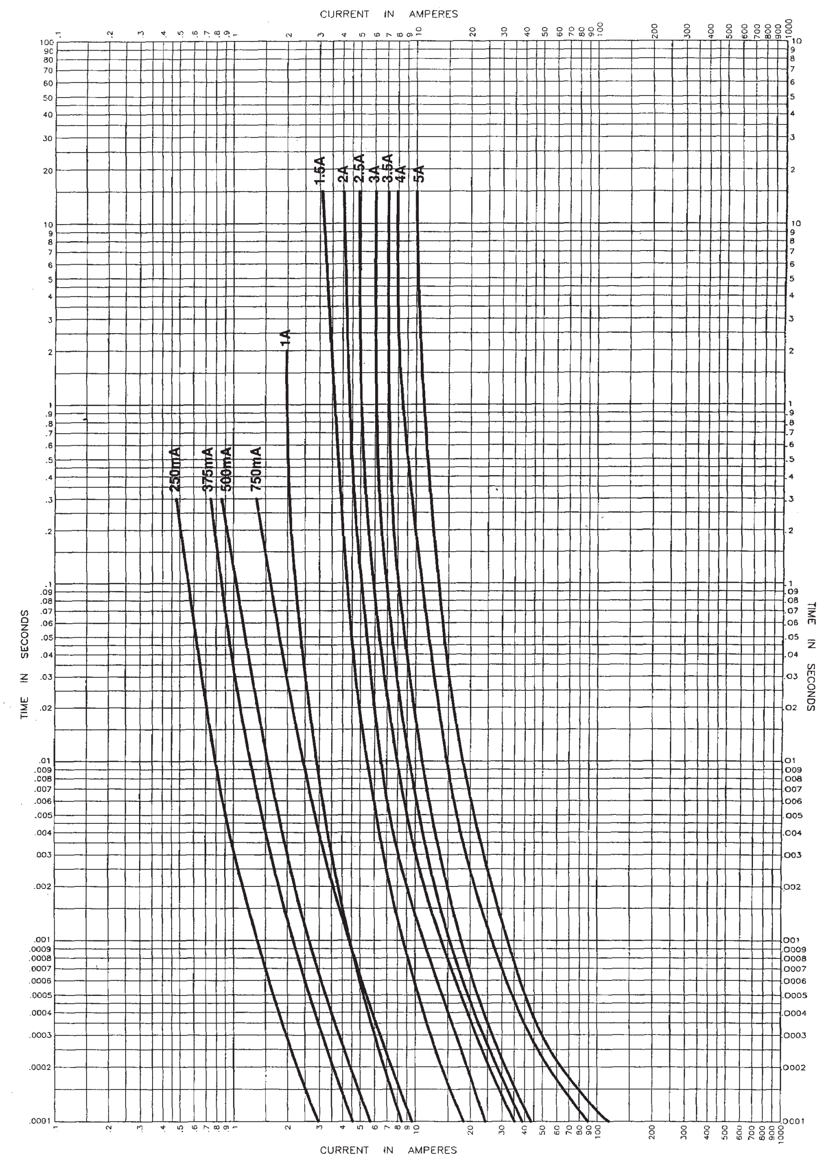
*** Typical Melting I^2t (Measured with a battery bank at rated DC voltage, 10x-rated current, not to exceed IR, time constant of calibrated circuit less than 50 microseconds) (0603FA4A and 5A measured at interrupting rating)

† Typical Voltage Drop (Measured at rated current after temperature stabilizes)

‡ Alpha code to be marked on the top of fuse body for all ratings

- Device designed to carry rated current for four hours minimum. An operating current of 80% or less of rated current is recommended, with further derating required at elevated ambient temperatures.

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
TR	5,000 pieces of fuses in paper tape and reeled on a 178mm (7 inch) reel per EIA Standard 481-1

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Visit us on the web at:
www.cooperbussmann.com

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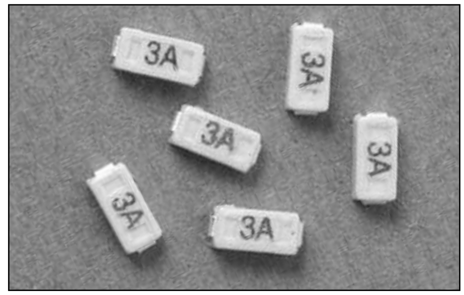
Chip™ Fuses
3216TD Series, Time Delay

COOPER Bussmann

Description

- Protects against harmful overcurrents in secondary applications
- High inrush withstand capability
- Wire-in-Air performance
- Compatible with leaded and lead-free reflow and wave solder

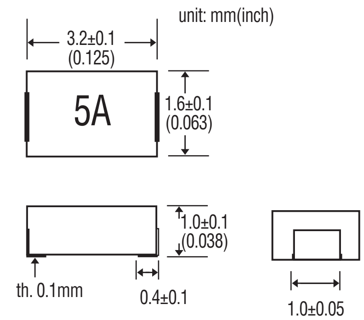
RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS	
% of Amp Rating	**Opening Time**
100%	4 Hours Minimum
200%	1 sec. minimum, 120 sec. maximum
300%	0.05 sec. minimum, 3 sec. maximum
800%	0.002 sec. minimum, 0.05 sec. maximum

Dimensions mm/(inches)

Drawing Not to Scale



Agency Information

- c UR us Recognition File number: E19180, Volume 13

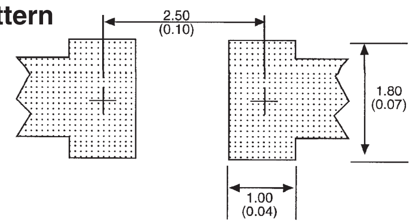
Environmental Data

- Thermal Shock: Withstands 5 cycles of -55°C & 125°C
- Vibration: MIL-STD-202F, Method 201A, Method 204D Condition D
- Solderability: ANSI/J-STD-002, Test B

Ordering

- Specify packaging and product code (i.e. TR/3216TD1-R)

Land Pattern



Soldering Method

- Wave Immersion: 260°C, 10 sec max.
- Infrared Reflow: 260°C, 30 sec max.
- Hand Solder: 350°C, 3 sec max.

SPECIFICATIONS							
Product Code	**Current Rating**	**Voltage Rating AC**	**Voltage Rating DC**	**Interrupting Rating* AC/DC**	**Resistance (ohms)** Typ.**	**Typical Melt I²t† DC**	**Typical Voltage Drop (V)‡**
3216TD1-R	1A	63 V	63 V	50 A	0.075	0.32	75
3216TD1.5-R	1.5A	32 V	32 V	35 A	0.050	0.62	75
3216TD2-R	2A	32 V	32 V	35 A	0.030	1.30	60
3216TD2.5-R	2.5A	32 V	32 V	35 A	0.022	2.25	55
3216TD3-R	3A	32 V	32 V	35 A	0.018	3.30	55
3216TD4-R	4A	32 V	32 V	35 A	0.0165	5.20	56
3216TD5-R	5A	32 V	32 V	35 A	0.015	8.40	66
3216TD6.3-R	6.3A	32 V	32 V	35 A	0.0120	13.8	75
3216TD7-R	7A	32 V	32 V	35 A	0.0095	16.9	67
3216TD10-R	10A	32 V	32 V	35 A	0.006	54.4	65
3216TD12-R	12A	32 V	32 V	35 A	0.005	64.0	65

* AC Interrupting Rating (Measured at rated voltage with a unity power factor); DC Interrupting Rating (Measured at rated voltage, time constant of less than 50 microseconds, battery source)

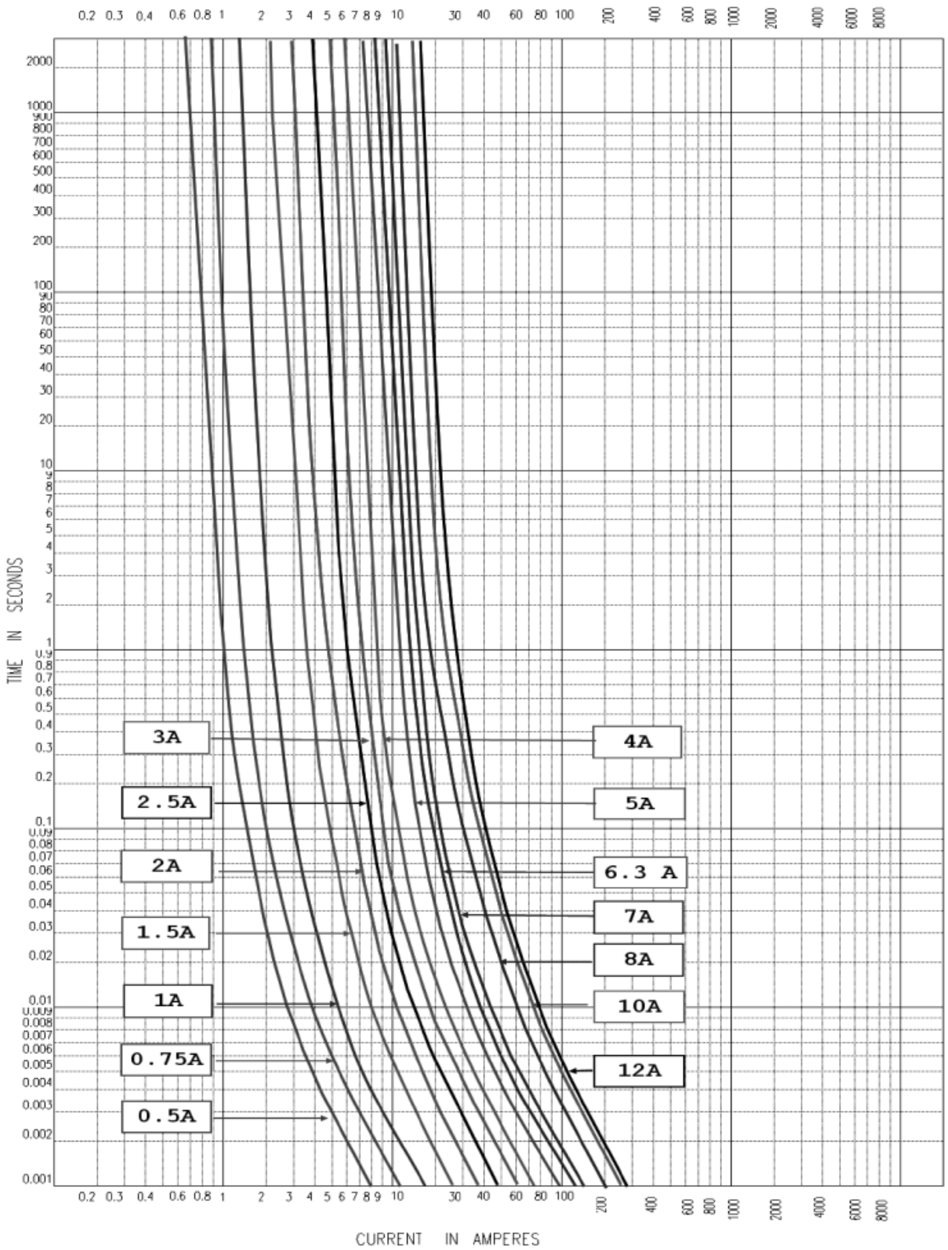
** DC Cold Resistance (Measured at 10% of rated current)

† Typical Melting I²t (Measured with a battery bank at rated DC voltage, 10x-rated current at 1 microsecond, not to exceed IR. Above 7a uses 70 micron thickness copper layer test board of IEC 60127-3. Others uses 35 micron thickness copper layer.

‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)

Device designed to carry rated current for four hours minimum. An operating current of 80% or less of rated current is recommended, with further derating required at elevated ambient temperatures.

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
TR	2,500 pieces of fuses on 12mm tape-and-reel on a 180mm reel per EIA-481-A & IEC286-3

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Chip™ Fuses
3216FF Series, Fast Acting

Description
- Fast acting surface mount fuse
- Ratings up to 20A
- Excellent temperature and cycling characteristics
- Compatible with reflow and wave solder

Agency Information

ELECTRICAL CHARACTERISTICS		
Ampere Rating	**% of Amp Rating**	**Opening Time**
250mA - 7A	100%	4 Hours Minimum
1.25A - 3A	200%	60 Seconds Maximum
250mA - 3A	250%	5 Second Maximum
4A - 7A	350%	1 Second Maximum
15A - 20A	350%	5 Second Maximum

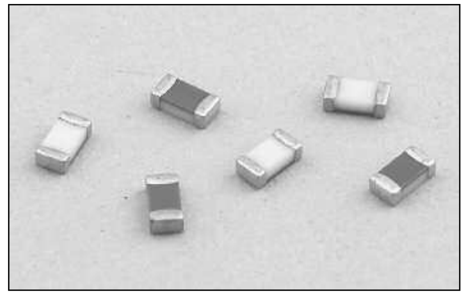
- UL Recognition Guide & File numbers: JDYX2 & E19180.
- CSA Component Acceptance: 053787 C 000 & Class No: 1422 30.
- c UL us Recognition File number: E19180 (15A - 20A)

Environmental Data
- Thermal Shock: MIL-STD-202, Method 107, Test Condition B
- Vibration: MIL-STD-202, Method 204, Test Condition C
- Moisture Resistance: MIL-STD-202, Method 106, 10 day cycle
- Solderability: ANSI/J-STD-002, Test B

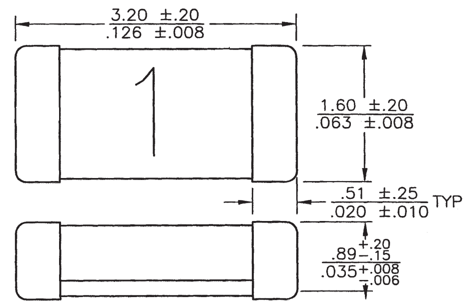
Ordering
- Specify packaging and product code (i.e. TR/3216FF250-R)

Soldering Method
- Wave Immersion: 260°C, 10 sec max.
- Infrared Reflow: 260°C, 30 sec max.

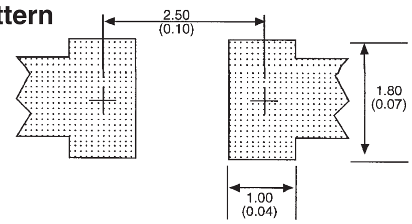
RoHS 2002/95/EC



Dimensions mm/(inches)
Drawing Not to Scale



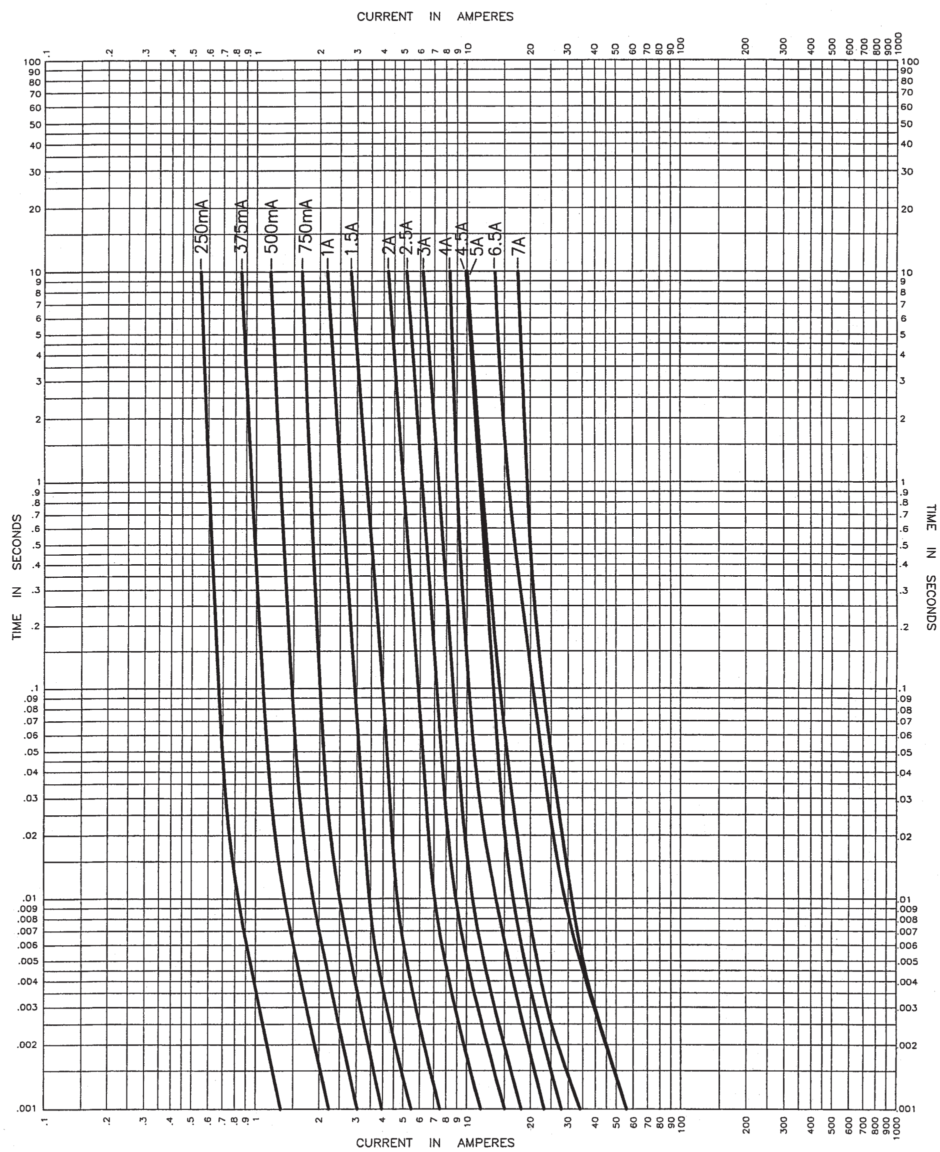
Land Pattern



SPECIFICATIONS							
Product Code	**Current Rating**	**Voltage Rating**		**Interrupting Rating***	**Resistance (ohms)****	**Typical Melt I²t†**	**Typical Voltage**
		AC	**DC**	**AC/DC**	**Typ.**	**DC**	**Drop (V)‡**
3216FF250-R	250mA	32 V	63 V	50 A	3.0	0.00038	1.4
3216FF375-R	375mA	32 V	63 V	50 A	1.75	0.00077	0.73
3216FF500-R	500mA	32 V	63 V	50 A	0.98	0.0019	0.66
3216FF750-R	750mA	32 V	63 V	50 A	0.50	0.0053	0.63
3216FF1-R	1A	32 V	63 V	50 A	0.24	0.030	0.20
3216FF1.25-R	1.25A	32 V	63 V	50 A	0.135	0.060	0.19
3216FF1.5-R	1.5A	32 V	63 V	50 A	0.119	0.093	0.18
3216FF2-R	2A	32 V	63 V	50 A	0.066	0.126	0.16
3216FF2.5-R	2.5A	32 V	63 V	50 A	0.046	0.260	0.14
3216FF3-R	3A	32 V	63 V	50 A	0.040	0.275	0.13
3216FF4-R	4A	32 V	32 V	50 A	0.018	0.337	0.11
3216FF4.5-R	4.5A	32 V	32 V	50 A	0.016	0.405	0.10
3216FF5-R	5A	32 V	32 V	50 A	0.014	0.534	0.09
3216FF6.5-R	6.5A	32 V	32 V	50 A	0.0082	2.294	0.076
3216FF7-R	7A	32 V	32 V	50 A	0.0078	3.623	0.078
3216FF15-R	15A	24 V	24 V	150 A	0.0031	25.5	0.065
3216FF20-R	20A	24 V	24 V	150 A	0.0018	48.6	0.058

* AC Interrupting Rating (Measured at rated voltage with a unity power factor); DC Interrupting Rating (Measured at rated voltage, time constant of less than 50 microseconds, battery source)
** DC Cold Resistance (Measured at 10% of rated current)
† Typical Melting I²t (Measured with a battery bank at rated DC voltage, 10x-rated current, not to exceed IR, time constant of calibrated circuit less than 50 microseconds) (6.5A & 7A measured at interrupting rating)
‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)
It is recommended that fuses be mounted with ceramic (white) side facing up.
Device designed to carry rated current for four hours minimum. An operating current of 80% or less of rated current is recommended, with further derating required at elevated ambient temperatures.

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
TR	3,000 pieces of fuses on 8mm tape-and-reel on a 7 inch (178mm) reel per EIA Standard 481

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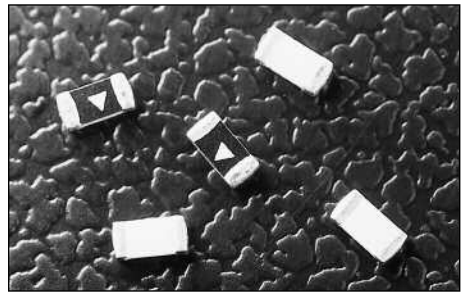
Description

- Surface mount fuse, fast acting, 125 VAC
- Utilize thick and thin metal film technologies for superior fusing action and enhanced reliability.

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS	
% of Amp Rating	Opening Time
100%	4 hours minimum
250%	5 seconds maximum

Agency Information

- UL Recognition Guide & File numbers: JDYX2 & E19180.
- CSA Component Acceptance: 053787 C 000 & Class No: 1422 30.

Environmental Data

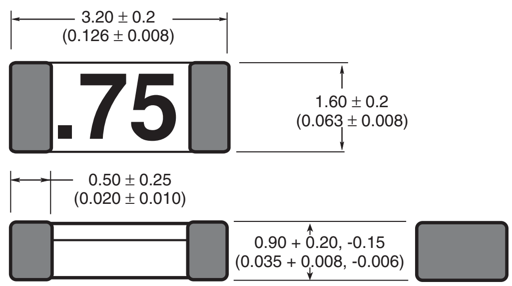
- Operating Temperature Range: -65 to +125°C, with proper derating
- Thermal Shock: MIL-STD-202, Method 107, Test Condition B (-65 to 125°C), 1000 cycles, fuses soldered to FR-4 glass-epoxy circuit board
- Vibration: MIL-STD-202, Method 204, Test Condition C (55 to 2000 HZ, 10G)
- Solderability: Withstands 60 seconds above 200°C, 260°C maximum
- Moisture Resistance: MIL-STD-202, Method 106, 10 day cycle
- Solder Leach Resistance & Terminal Adhesion: EIA-576 (30 seconds submersion in 260°C tin-lead solder)

Ordering

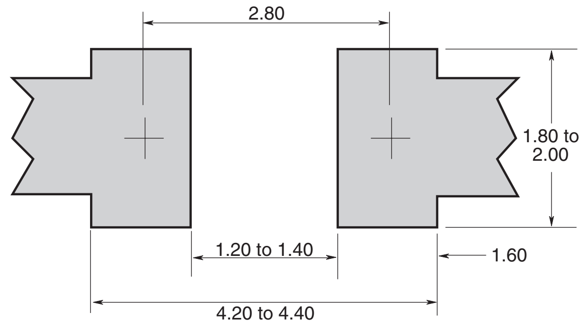
- Specify packaging and product code (i.e. TR/3216LV1-R)

Dimensions mm/(inches)

Drawing Not to Scale



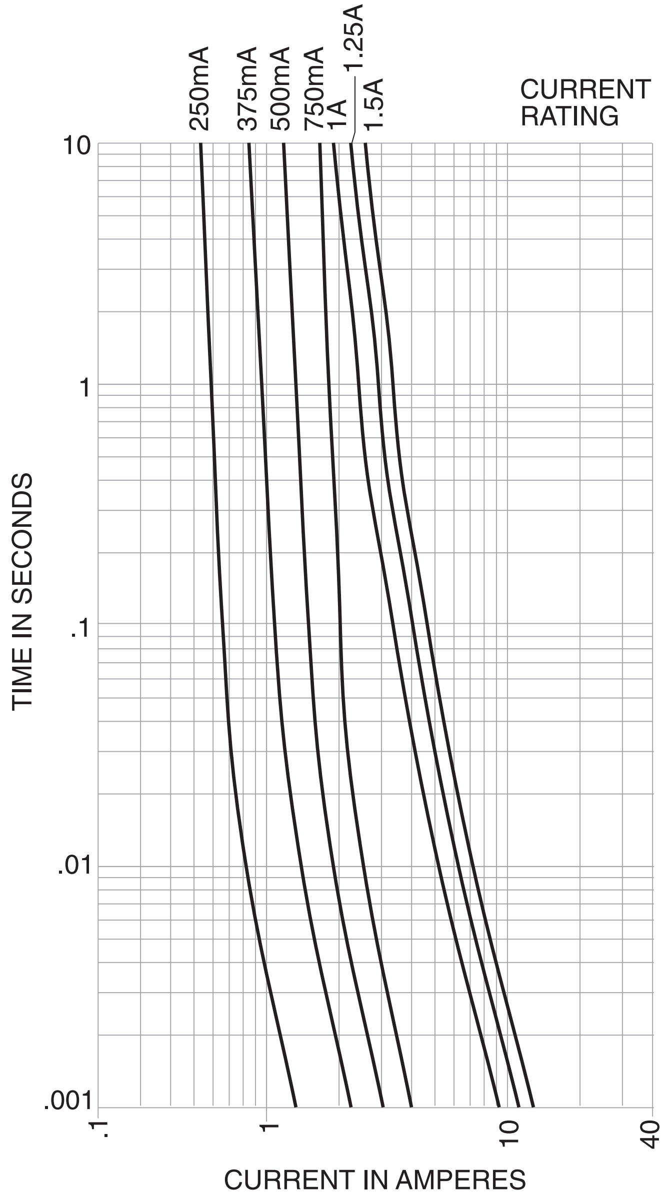
Land Pattern



SPECIFICATIONS							
Product Code	Current Rating	Voltage Rating AC/DC	Interrupting Rating 125V AC/DC	Typical Melting Integral @ 10X Rated Current (A² * sec)		Typ. Resistance @ ≤ 10% Rated Current (Ohms)	Typ. Voltage Drop @ Rated Current (Volts)
				AC	DC		
3216LV250-R	250mA	125V	50A	.00016	.000084	4.5	1.4
3216LV375-R	375mA	125V	50A	.001	.0002	1.80	.73
3216LV500-R	500mA	125V	50A	.0014	.0019	1.15	.66
3216LV750-R	750mA	125V	50A	.0033	.00379	.75	.63
3216LV1-R	1A	125V	50A	.020	.0084	.52	.63
3216LV1.25-R	1.25A	125V	50A	.035	.021	.40	.62
3216LV1.5-R	1.5A	125V	50A	.038	.024	.26	.49

Notes:
1. AC interrupting rating, melting integral and total clearing integral measured at 125V, unity power factor
2. DC interrupting rating, melting integral and total clearing integral measured at 125V with a battery source
3. Voltage drop measured at 23 ± 3°C ambient temperature with the device mounted on a suitable circuit board trace
4. It is recommended that fuses be mounted with ceramic (white) side facing up
5. Device designed to carry rated current for four hours minimum. An operating current of 80% or less of rated current is recommended, with further derating required at elevated ambient temperatures

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
TR	3,000 pieces of fuses on 8mm tape-and-reel on a 7 inch (178mm) reel per EIA Standard 481

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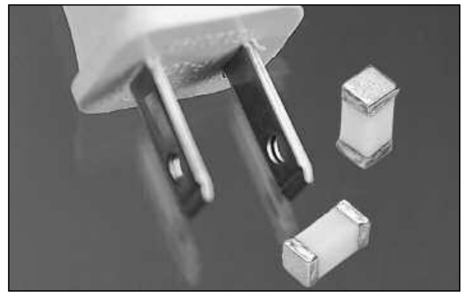
COOPER Bussmann

Brick™ Fuses
6125TD Series, Time Delay

Description
- Time Delay surface mount fuse
- Complies with EIA-IS-722 Standard
- Solder Immersion Compatible

RoHS 2002/95/EC



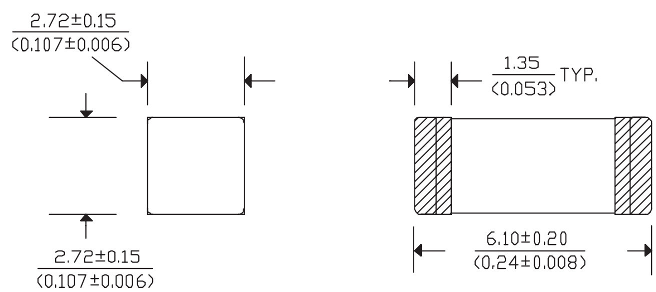
ELECTRICAL CHARACTERISTICS	
% of Amp Rating	Opening Time
100%	4 Hours Minimum
200%	1 Second Minimum
200%	2-4 Seconds Typical
200%	60 Seconds Maximum

Agency Information
- UL Recognition Guide & File numbers: JDYX2 & E19180.
- CSA Component Acceptance: 053787 C 000 & Class No: 1422 30.

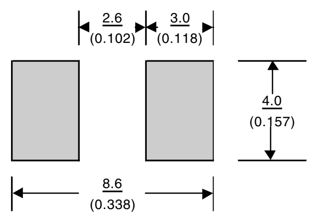
Environmental Data
- Life Test: MIL-STD-202, Method 108A, Test Condition D
- Load Humidity: MIL-STD-202, Method 103B
- Moisture Resistance: MIL-STD-202, Method 106E
- Thermal Shock: MIL-STD-202, Method 107D, air-to-air
- Case Resistance: EIA/IS-722
- Resistance to Dissolution of Metallization: ANSI J-STD-002, Test D
- Mechanical Shock: MIL-STD-202, Method 213B, Test Condition A
- High Frequency Vibration: MIL-STD-202, Method 204D, Test Condition D
- Resistance to Solvents: MIL-STD-202, Method 215A

Ordering
- Specify packaging and product code (i.e., TR1/6125TD500-R)

Dimensions mm/(inches)



Land Pattern

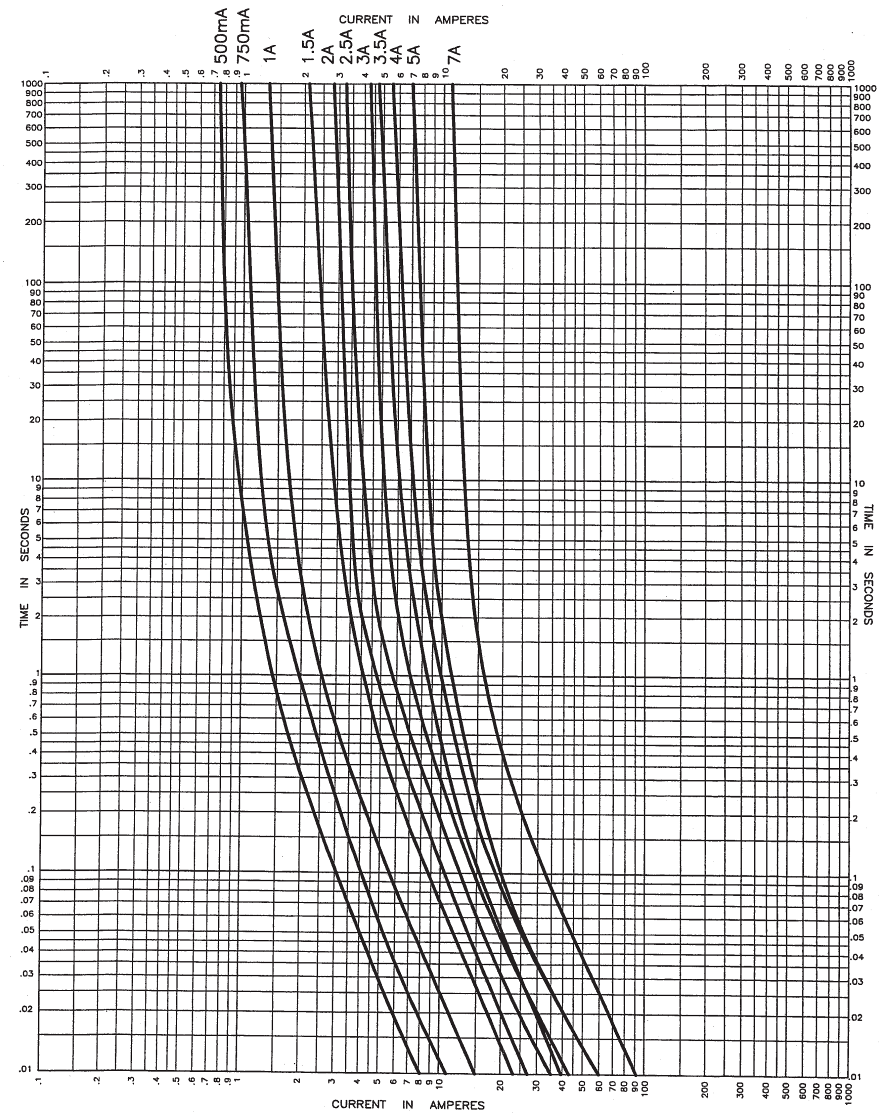


Soldering Method
- Wave Immersion: 260°C, 10 sec max.
- Infrared: 260°C, 30 sec max.

SPECIFICATIONS								
Product Code	Current Rating	Voltage Rating AC	Voltage Rating DC	Interrupting Rating* 125VAC	Interrupting Rating* 60VDC	Resistance (ohms)** Typ.	Typical Melting I²t†	Typical Voltage Drop‡
6125TD500-R	500mA	125V	60V	50A	50A	0.4025	0.716	245 mV
6125TD750-R	750mA	125V	60V	50A	50A	0.2350	1.07	250 mV
6125TD1-R	1A	125V	60V	50A	50A	0.1680	2.88	256 mV
6125TD1.5-R	1.5A	125V	60V	50A	50A	0.0630	2.35	125 mV
6125TD2-R	2A	125V	60V	50A	50A	0.0480	9.45	133 mV
6125TD2.5-R	2.5A	125V	60V	50A	50A	0.0350	16.2	130 mV
6125TD3-R	3A	125V	60V	50A	50A	0.0263	15.3	97 mV
6125TD3.5-R	3.5A	125V	60V	50A	50A	0.0195	14.5	95 mV
6125TD4-R	4A	125V	60V	50A	50A	0.0185	38.8	106 mV
6125TD5-R	5A	125V	60V	50A	50A	0.0133	34.4	100 mV
6125TD7-R	7A	125V	60V	50A	50A	0.0087	90.2	99 mV

* AC Interrupting Rating (Measured at designated voltage, 100% power factor); DC Interrupting Rating (Measured at designated voltage, time constant of less than 50 microseconds, battery source)
** DC Cold Resistance (Measured at 10% of rated current)
† Typical Melting I²t (Measured with a battery bank at rated DC voltage, 10x-rated current (not to exceed IR), time constant of calibrated circuit less than 50 microseconds)
‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)
Device designed to carry rated current for four hours minimum. An operating current of 80% or less of rated current is recommended, with further derating required at elevated ambient temperatures.

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
TR1	1,000 pieces of fuses on 12mm tape-and-reel on a 7 inch (177mm) reel per EIA Standard 481

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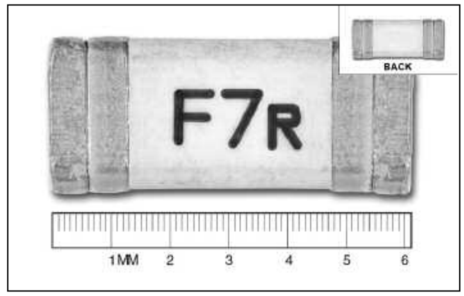
COOPER Bussmann

Brick™ Fuses
6125FF Series, Fast Acting

Description
- Fast Acting Surface Mount Fuse
- Overcurrent protection of systems up to 125VAC/72VDC
- High inrush withstand capability
- Solder immersion compatible

ELECTRICAL CHARACTERISTICS	
% of Amp Rating	Opening Time
100%	4 Hours Minimum
200%	5 Second Maximum

RoHS 2002/95/EC



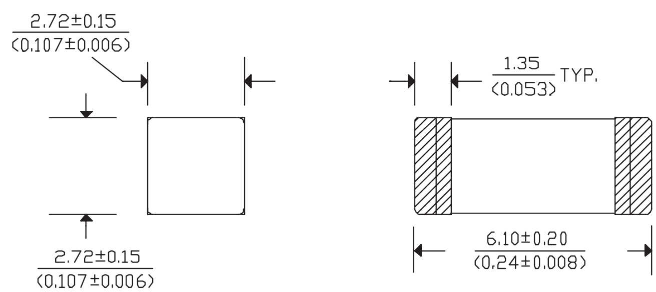
Agency Information
- cULus Recognition File number: E19180

Environmental Data
- Operating Temperature: -55°C to 125°C
- Mechanical Shock: MIL-STD-202, Method 213
- High Frequency Vibration: MIL-STD-202, Method 204
- Load Humidity: MIL-STD-202, Method 103
- Moisture Resistance: MIL-STD-202, Method 106
- Resistance to Solvents: MIL-STD-202, Method 215
- Thermal Shock: MIL-STD-202, Method 107

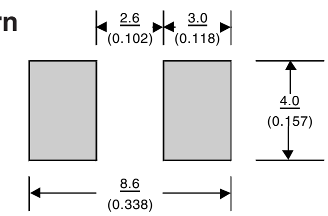
Ordering
- Specify packaging and product code (i.e., TR2/6125FF500-R)

Soldering Method
- Wave Immersion: 260°C, 10 sec max.
- Infrared: 260°C, 30 sec max.

Dimensions mm/(inches)



Land Pattern

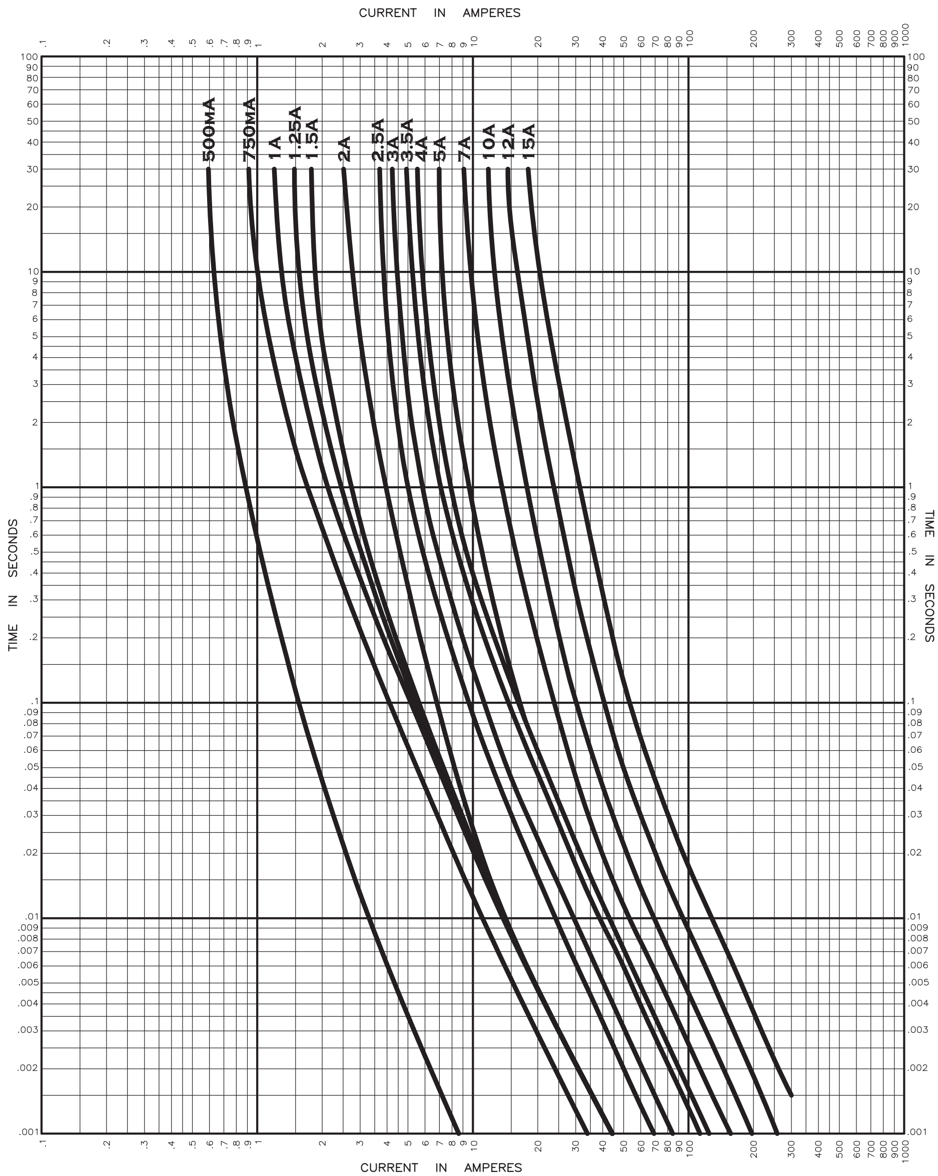


SPECIFICATIONS									
Part Number	Voltage Rating		Interrupting Rating			DC Cold Resistance	Melting I²t	Typical Voltage Drop (mV)	
	AC	DC	125V AC	72V DC	32V DC	(milliohms) Typ.	(A² sec)		
6125FF500-R	125V	72V	50A	50A	300A	1130	0.090	935	
6125FF750-R	125V	72V	50A	50A	300A	350	0.152	433	
6125FF1-R	125V	72V	50A	50A	300A	260	0.180	415	
6125FF1.25-R	125V	72V	50A	50A	300A	171	0.355	410	
6125FF1.5-R	125V	72V	50A	50A	300A	112	0.456	365	
6125FF2-R	125V	72V	50A	50A	300A	49	1.67	160	
6125FF2.5-R	125V	72V	50A	50A	300A	45	5.20	155	
6125FF3-R	125V	72V	50A	50A	300A	35	8.00	153	
6125FF3.5-R	125V	72V	50A	50A	300A	27	15.00	150	
6125FF4-R	125V	72V	50A	50A	300A	26	15.80	145	
6125FF5-R	125V	72V	50A	50A	300A	17	17.20	141	
6125FF6.3-R	125V	72V	50A	50A	300A	14	22.50	135	
6125FF7-R	125V	72V	50A	50A	300A	11	37.25	112	
6125FF10-R	125V	72V	50A	50A	300A	7.3	67.75	110	
6125FF12-R	125V	72V	50A	50A	300A	5.3	210.59	106	
6125FF15-R	125V	72V	50A	50A	300A	4.2	296.10	104	

* AC Interrupting Rating (Measured at designated voltage, 100% power factor); DC Interrupting Rating (Measured at designated voltage, time constant of less than 50 microseconds, battery source)

** Typical Melting I²t (Measured at 72Vdc, 10X rated current (not exceed 50A - IR @ 72Vdc)

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
TR2	5,000 pieces of fuses on tape-and-reel on a 13 inch (330mm) reel

North America

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Toll Free: 1-888-414-2645

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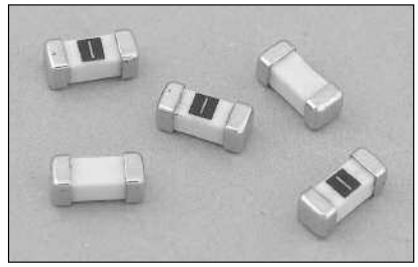
COOPER Bussmann

Brick™ Fuses
6125FA Series, Fast Acting

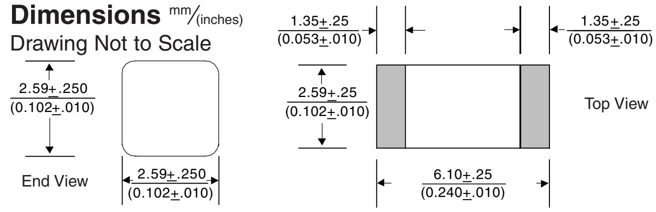
Description
- Fast Acting Surface Mount Fuse
- Complies with the EIA-IS-722 Standard
- Solder Immersion Compatible
- Overcurrent protection of systems up to 125VAC/DC
- Wire-in-air design

RoHS 2002/95/EC



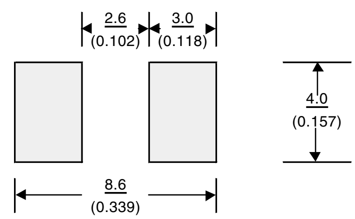
ELECTRICAL CHARACTERISTICS	
% of Amp Rating	**Opening Time**
100%	4 Hours Minimum
200%	5 Seconds Maximum

Dimensions mm/(inches)
Drawing Not to Scale



Agency Information
- UL Listed Guide and File Numbers (250mA-12A): JDYX & E19180
- UL Recognized Guide and File Numbers (15A): JDYX2 & E195337
- CSA Component Acceptance: 053787 C 000 & Class No: 1422 30

Land Pattern



Environmental Data
- Shock: MIL-STD-202, Method 213, Test Condition 1 (100 G's peak for 6 milliseconds)
- Vibration: MIL-STD-202, Method 201 (10-55 Hz, 0.06 inch, total excursion)
- Salt Spray: MIL-STD-202, Method 101, Test Condition B (48 hrs)
- Insulation Resistance: MIL-STD-202, Method 302, Test Condition A (After Opening) 10,000 ohms minimum
- Resistance to Solder Heat: MIL-STD-202, Method 210, Test Condition F (20 sec, at 260° C)
- Thermal Shock: MIL-STD-202, Method 107, Test Condition B (-65° C to +125° C)

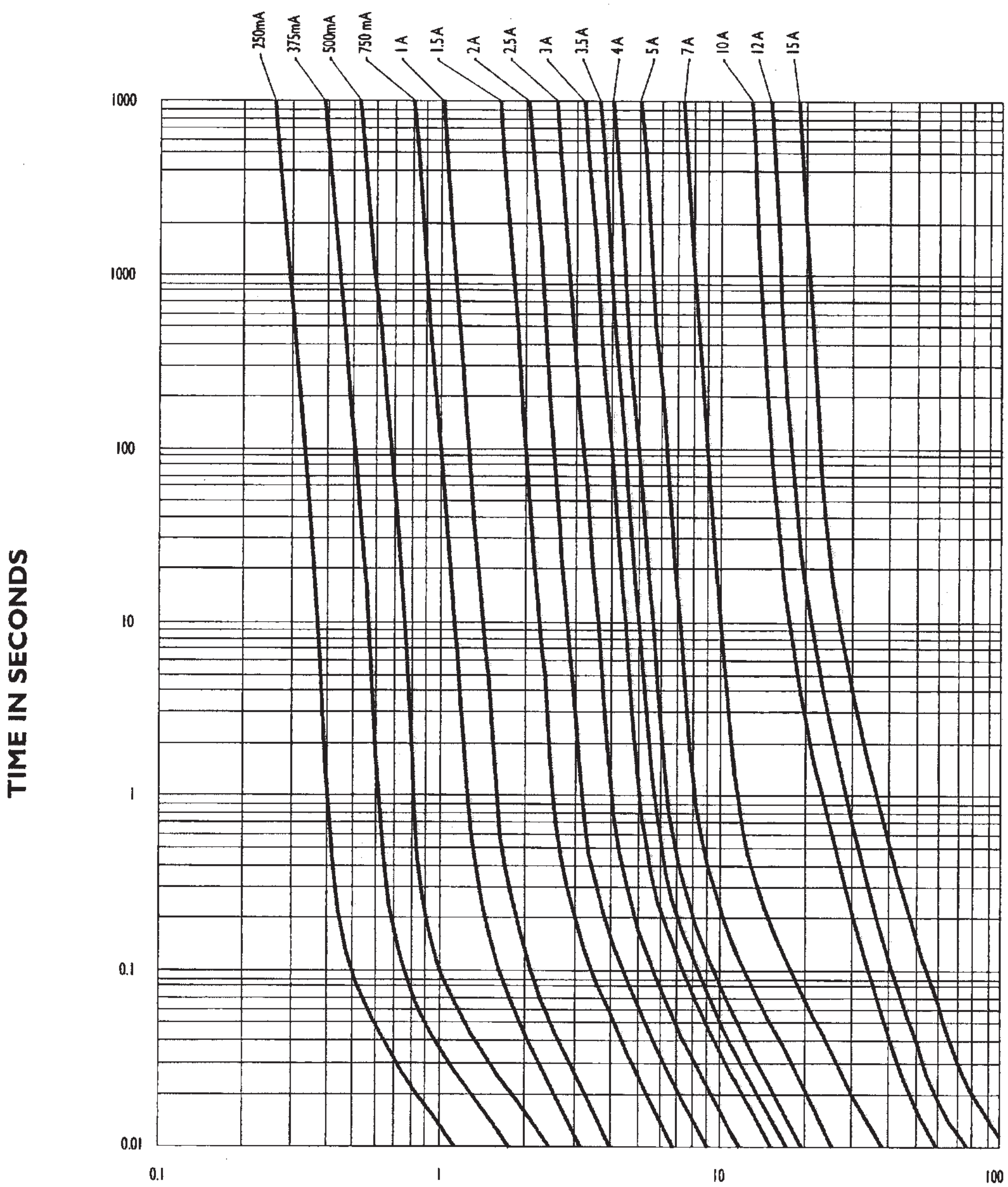
Soldering Method
- Wave Solder: 260°C, 10 sec max. (MIL-STD-202, Method 210)
- Infrared Reflow: 260°C, 30 sec max.

Ordering
- Specify product and packaging code

SPECIFICATIONS									
Product Code	**Voltage Rating AC**	**DC**	**DC**	**Interrupting Rating* 125V AC**	**125V DC**	**86V DC**	**Resistance (ohms)** Typ.**	**Typical Melt I²t†**	**Typical Voltage Drop (V)‡**
6125FA250mA	125V	125V	86V	50A	300A	10,000A	0.65	0.01	0.30
6125FA375mA	125V	125V	86V	50A	300A	10,000A	0.36	0.03	0.25
6125FA500mA	125V	125V	86V	50A	300A	10,000A	0.24	0.06	0.22
6125FA750mA	125V	125V	86V	50A	300A	10,000A	0.15	0.07	0.17
6125FA1A	125V	125V	86V	50A	300A	10,000A	0.11	0.14	0.17
6125FA1.25A	125V	125V	86V	50A	300A	10,000A	0.09	0.24	0.16
6125FA1.5A	125V	125V	86V	50A	300A	10,000A	0.07	0.41	0.15
6125FA2A	125V	125V	86V	50A	300A	10,000A	0.05	0.80	0.15
6125FA2.5A	125V	125V	86V	50A	300A	10,000A	0.038	1.4	0.14
6125FA3A	125V	125V	86V	50A	300A	10,000A	0.028	2.4	0.13
6125FA3.5A	125V	125V	86V	50A	300A	10,000A	0.025	3.3	0.13
6125FA4A	125V	125V	86V	50A	300A	10,000A	0.022	4.4	0.13
6125FA5A	125V	125V	86V	50A	300A	10,000A	0.016	7.8	0.12
6125FA6.3A	125V	125V	86V	50A	300A	10,000A	0.012	14.0	0.12
6125FA7A	125V	125V	86V	50A	300A	10,000A	0.011	19.0	0.114
6125FA10A	125V	N/A	86V	50A	N/A	10,000A	0.007	44	0.107
6125FA12A	125V	N/A	86V	50A	N/A	10,000A	0.006	69	0.103
6125FA15A	N/A	N/A	86V	N/A	N/A	10,000A	0.004	124	0.098

* AC Interrupting Rating (Measured at designated voltage, 100% power factor); DC Interrupting Rating (Measured at designated voltage, time constant of less than 50 microseconds, battery source)
** DC Cold Resistance (Measured at 10% of rated current)
† Typical Melting I²t (Measured with a battery bank at rated DC voltage, 10x-rated current, time constant of calibrated circuit less than 50 microseconds)
‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)
Device designed to carry rated current for four hours minimum. An operating current of 80% or less of rated current is recommended, with further derating required at elevated ambient temperatures.

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
TR2	5,000 pieces of fuses on 12mm tape-and-reel on a 13 inch (330mm) reel per EIA Standard 481

COOPER Bussmann

Visit us on the web at:
www.cooperbussmann.com

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Brick™ Fuses
1025TD Series, Time Delay

RoHS 2002/95/EC

Description

- Time Delay Surface Mount Fuse
- Satisfies the EIA/IS-722 Standard
- Solder Immersion Compatible

ELECTRICAL CHARACTERISTICS	
% of Amp Rating	**Opening Time**
100%	4 Hours Minimum
200%	1 Second Minimum
200%	60 Seconds Maximum
250% *	10 Seconds Maximum

* If fuse does not open @ 200% in 60 seconds, raise current to 250% and the fuse must open in 10 seconds maximum.

Agency Information

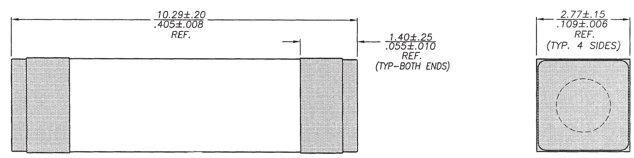
- UL Recognition Guide & File numbers: JDYX2 & E19180 (250mA - 5A)
- CSA Component Acceptance: File # 053787 C000, Class # 1422 30

Environmental Data

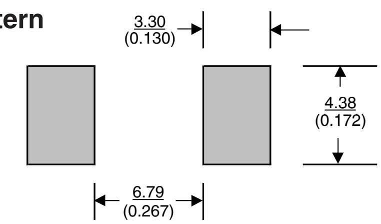
- Life Test: MIL-STD-202, Method 108A, Test Condition D
- Load Humidity: MIL-STD-202, Method 103B
- Moisture Resistance: MIL-STD-202, Method 106E
- Terminal Strength: MIL-STD-202, Method 211A
- Thermal Shock: MIL-STD-202, Method 107D, air-to-air
- Case Resistance: EIA/IS-722
- Resistance to Dissolution of Metallization: ANSI J-STD-002, Test D
- Mechanical Shock: MIL-STD-202, Method 213B with exceptions per EIA/IS-722 Standard
- High Frequency Vibration: MIL-STD-202, Method 204D, Test Condition D
- Resistance to Solvents: MIL-STD-202, Method 215A

Dimensions mm/(inches)

Drawing Not to Scale



Land Pattern



Ordering

- Specify packaging and product code (i.e., TR2/1025TD250-R)

Soldering Method

- Wave Immersion: 260°C, 10 sec max.
- Infrared: 260°C, 30 sec max.

SPECIFICATIONS								
Product Code	**Current Rating**	**Voltage Rating**		**Interrupting Rating***		**DC Cold Resistance** (ohms) Typical**	**Typical Melting I²t†**	**Typical Voltage Drop‡**
		AC	**DC**	**250VAC**	**125VDC**			
1025TD250-R	250mA	250V	125V	50A	50A	4.200	0.128	1900 mV
1025TD500-R	500mA	250V	125V	50A	50A	0.5500	1.47	455 mV
1025TD750-R	750mA	250V	125V	50A	50A	0.317	0.93	400 mV
1025TD1-R	1A	250V	125V	50A	50A	0.2030	9.91	387 mV
1025TD1.5-R	1.5A	250V	125V	50A	50A	0.1025	11.79	310 mV
1025TD2-R	2A	250V	125V	50A	50A	0.0680	17.27	250 mV
1025TD2.5-R	2.5A	250V	125V	50A	50A	0.0420	16.51	201 mV
1025TD3-R	3A	250V	125V	50A	50A	0.0330	42.74	184 mV
1025TD3.5-R	3.5A	250V	125V	50A	50A	0.0270	43.33	180 mV
1025TD4-R	4A	250V	125V	50A	50A	0.0220	66.96	152 mV
1025TD5-R	5A	250V	125V	50A	50A	0.0160	88.38	145 mV

* AC Interrupting Rating (Measured at designated voltage, 100% power factor random closing); DC Interrupting Rating (Measured at designated voltage, time constant of the calibrated circuit is less than 50 microseconds, battery source)

** DC Cold Resistance (Measured at ≤10% of rated current)

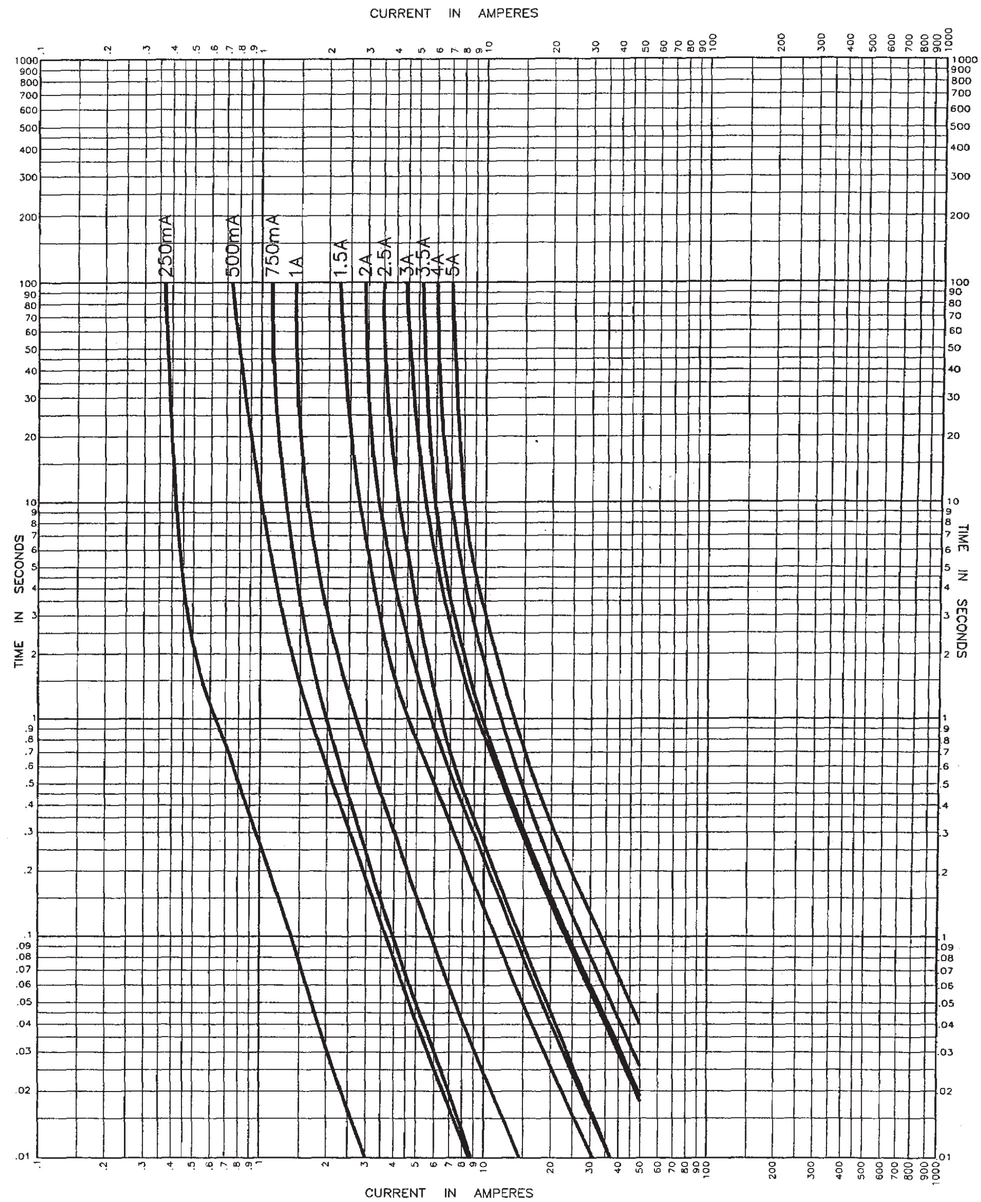
† Typical Melting I^2t (Measured with a battery bank at rated DC voltage, 10x-rated current, time constant of calibrated circuit less than 50 microseconds)

‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)

‡‡ Marking Code - 3rd (U = USA, T = Taiwan and S = China)

• Device designed to carry rated current for four hours minimum. An operating current of 80% or less of rated current is recommended, with further derating required at elevated ambient temperatures.

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
TR2	2,500 pieces of fuses on 24mm tape-and-reel on 13 inch (330mm) reel per EIA Standard 481

North America

Cooper Electronic Technologies
1225 Broken Sound Parkway NW
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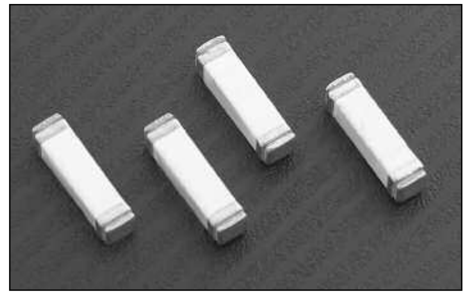
Brick™ Fuses
1025FA Series, Fast Acting

Description

- Fast Acting Surface Mount Fuse
- Satisfies the EIA/IS-722 Standard
- Solder Immersion Compatible

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS	
% of Amp Rating	**Opening Time**
100%	4 Hours Minimum
200% (250mA-5A)	5 Seconds Maximum
250% (250mA-5A fuse)	1 Second Maximum
200% (7A-15A fuse)	20 Seconds Maximum
250% (7A-15A fuse)	4 Seconds Maximum

Note: 30vde constant current source required for 200% overload tests on 250ma-1a.

Agency Information

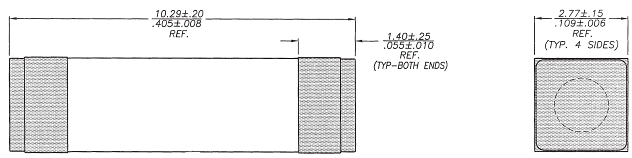
- UL Recognition Guide & File numbers: JDYX2 & E19180 (250mA - 15A)
- CSA Component Acceptance: File # 053787 C000, Class # 1422 30

Environmental Data

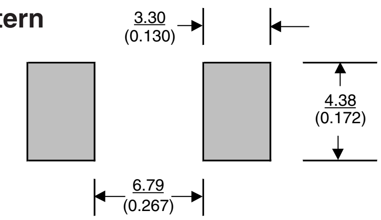
- Life Test: MIL-STD-202, Method 108A, Test Condition D
- Load Humidity: MIL-STD-202, Method 103B
- Moisture Resistance: MIL-STD-202, Method 106E
- Terminal Strength: MIL-STD-202, Method 211A
- Thermal Shock: MIL-STD-202, Method 107D, air-to-air
- Case Resistance: EIA/IS-722
- Resistance to Dissolution of Metallization: ANSI J-STD-002, Test D
- Mechanical Shock: MIL-STD-202, Method 213B with exceptions per EIA/IS-722 Standard
- High Frequency Vibration: MIL-STD-202, Method 204D, Test Condition D
- Resistance to Solvents: MIL-STD-202, Method 215A

Dimensions mm/(inches)

Drawing Not to Scale



Land Pattern



Ordering

- Specify packaging and product code (i.e., TR2/1025FA250-R)

Soldering Method

- Wave Solder: 260°C, 10 sec max.
- Infrared Reflow: 260°C, 30 sec max.

SPECIFICATIONS

Product Code	Current Rating	Voltage Rating AC	Voltage Rating DC	Interrupting Rating* 250VAC	Interrupting Rating* 125VDC	Interrupting Rating* 60VDC	DC Cold Resistance** (ohms) Typical	Typical Melting I^2t†	Typical Voltage Drop‡
1025FA250-R	250mA	250V	125V	50A	50A	-	5.0000	0.1212	2019 mV
1025FA500-R	500mA	250V	125V	50A	50A	-	1.2000	0.0415	1500 mV
1025FA750-R	750mA	250V	125V	50A	50A	-	0.6000	0.143	880 mV
1025FA1-R	1A	250V	125V	50A	50A	-	0.3000	1.750	560 mV
1025FA1.5-R	1.5A	250V	125V	50A	50A	-	0.1040	1.460	260 mV
1025FA2-R	2A	250V	125V	50A	50A	-	0.0800	6.086	258 mV
1025FA2.5-R	2.5A	250V	125V	50A	50A	-	0.0510	8.48	232 mV
1025FA3-R	3A	250V	125V	50A	50A	-	0.0390	18.15	205 mV
1025FA3.5-R	3.5A	250V	125V	50A	50A	-	0.0300	17.83	185 mV
1025FA4-R	4A	250V	125V	50A	50A	-	0.0270	23.32	190 mV
1025FA5-R	5A	250V	125V	50A	50A	-	0.0200	38.74	180 mV
1025FA7-R	7A	250V	60V	50A	50A	-	0.0116	138	150 mV
1025FA10-R	10A	250V	60V	50A	50A	-	0.0076	457	146 mV
1025FA12-R	12A	250V	60V	50A	-	50A	0.0550	498	120 mV
1025FA15-R	15A	250V	60V	50A	-	50A	0.0041	1451	110 mV

* AC Interrupting Rating (Measured at designated voltage, 100% power factor random closing); DC Interrupting Rating (Measured at designated voltage, time constant of less than 50 microseconds, battery source)

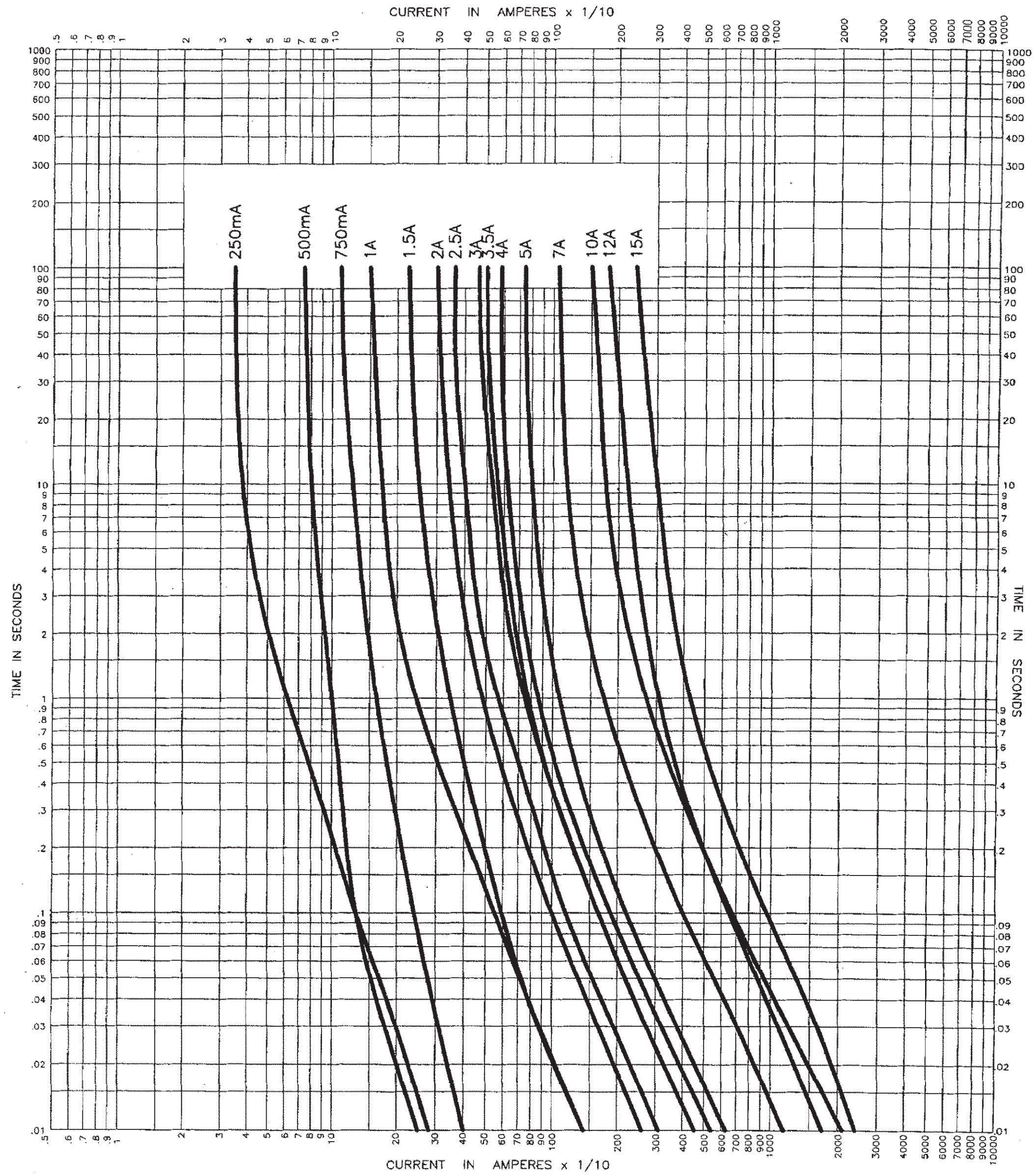
** DC Cold Resistance (Measured at ≤10% of rated current)

† Typical Melting I^2t (Measured with a battery bank at rated DC voltage, 10x-rated current, but not exceeding the interrupting rating. Time constant of calibrated circuit less than 50 microseconds). Test current not to exceed interrupting rating of 50A.

‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)

- Device designed to carry rated current for four hours minimum. An operating current of 80% or less of rated current is recommended, with further derating required at elevated ambient temperatures.

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
TR2	2,500 pieces of fuses on 24mm tape-and-reel on 13 inch (330mm) reel per EIA Standard 481

COOPER Bussmann

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COOPER Bussmann

TCP1.25A, Telecom Circuit Protector

RoHS 2002/95/EC

Description

- The first and most reliable surface mount telecom circuit protector designed to protect against power cross faults and comply with all surge requirements.
- Allows compliance with telecom regulatory standards including Bellcore GR 1089, UL 1950/60950, and FCC part 68. Application circuit testing is recommended.
- Eliminates the need for a current limiting resistor.
- Protects against overcurrent conditions found in telecom Subscriber Line Interface Cards (SLICs), xDSL Modem Applications, Set-Top Boxes, and Consumer Premises Equipment (CPE).
- TCP1.25A tested and confirmed compatible with STMicroelectronics Trisil™ Transient Surge Arrestor (list of part numbers below)

STMicroelectronics Trisil™ P/N's	
SMP100LC-XXX	SMP100MC-XXX

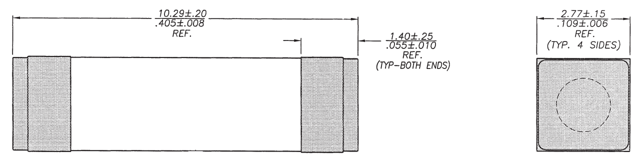
ELECTRICAL CHARACTERISTICS	
% of Amp Rating	**Opening Time**
100%	4 Hours Minimum
250%	1 Second Minimum
250%	4-10 Seconds Typical
250%*	120 Seconds Maximum
300%	10 Seconds Maximum

* If the device does not open at 250% within 120 seconds, increase current to 300% of amp rating. Device must open in 10 seconds max.

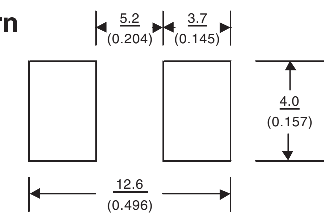
Environmental Data

- Life Test: MIL-STD-202, Method 108A, Test Condition D
- Load Humidity: MIL-STD-202, Method 103B
- Moisture Resistance: MIL-STD-202, Method 106E
- Thermal Shock: MIL-STD-202, Method 107D, air-to-air
- Case Resistance: EIA/IS-722
- Resistance to Dissolution of Metallization: ANSI J-STD-002, Test D
- Mechanical Shock: MIL-STD-202, Method 213B, Test Condition A
- High Frequency Vibration: MIL-STD-202, Method 204D, Test Condition D
- Resistance to Solvents: MIL-STD-202, Method 215A

Dimensions mm/(inches)



Land Pattern



Agency Information

- UL Recognition Card: JDYX2/E19180
- CSA Component Certification Record and Class No.: 053787C000, 1422 30

Ordering

- Specify packaging, product and option code (refer to OC-35) (i.e., TR2/TCP1.25-R)

Soldering Method

- Wave Immersion: 260°C, 10 sec max.
- Infrared: 260°C, 30 sec max.

LIGHTNING SURGE SPECIFICATIONS						
Surge Specification	**Surge**	**Repetitions**	**Waveform (μSec.)**	**Current (A)**	**Voltage (V)**	**Performance Requirement**
FCC 47 Part 68	Longitudinal Type A	2	10x160	100 per fuse	1500	Fuse cannot open
FCC 47 Part 68	Metallic Type B	2	10x560	100	800	Fuse cannot open
Bellcore GR-1089-CORE	First Level Lightning	50	10x1000	100	1000	Fuse cannot open
Bellcore GR-1089-CORE	First Level Lightning	50	2x10	500	2500	Fuse cannot open
Surge out		1	10x160	160	N/A	Fuse cannot open
Surge out		1	10x560	115	N/A	Fuse cannot open

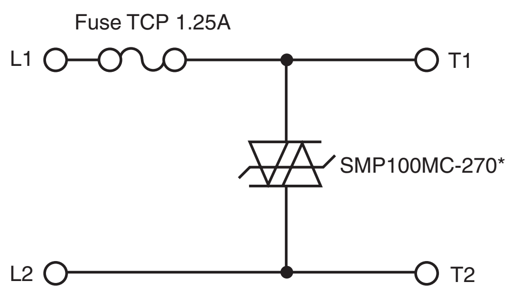
ELECTRICAL AND POWER CROSS SPECIFICATIONS											
Product Code	**Voltage Rating AC**	**Interrupting Rating***		**DC Cold Resistance** (ohms)**			**Typical Melting I²t†**	**Maximum Total Clearing**	**Typical Voltage Drop‡**	**Alpha Code Marking**	
		250VAC	**600VAC**	**min.**	**typ.**	**max.**				**1st Code**	**2nd Code**
TCP1.25A	250 V	50 A	60 A	0.070	0.090	0.110	22.2 A^2s	100 A^2s	150mV	J	R***

* AC Interrupting Rating (Measured at designated voltage, 100% power factor)
** DC Cold Resistance (Measured at 10% of rated current)
*** On RoHS Compliant Version (-R option)
† Typical Melting I^2t (Measured with a battery bank at 60V DC, 10x-rated current, time constant of calibrated circuit less than 50 microseconds)
‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)

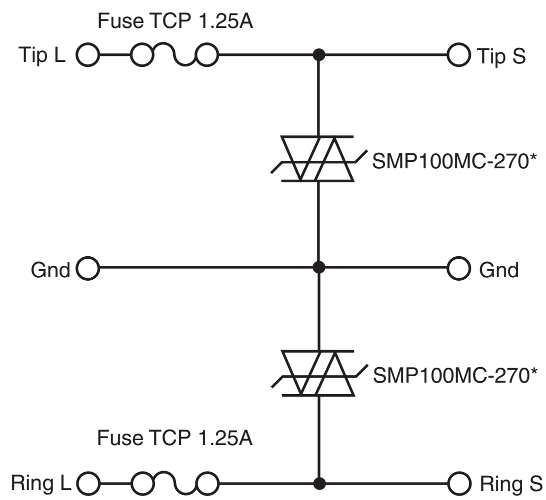
Special Investigation

The TCP1.25A is designed to provide overcurrent protection for telecom SLIC, xDSL modem, and set-top box applications regardless of the overvoltage device selected. To provide an easier specification experience, Cooper Bussmann and STMicroelectronics have joined together to provide a special test report confirming the coordination between the TCP1.25A and SMP100MC-270 devices.

TEST CIRCUITS



Test Circuit 1



Test Circuit 2

*** Note:** or other STMicroelectronics Trisil™ part number listed in table on page 1

TEST PROGRAM

Test	Standard	Results
Lightning Surge Tests		
10/1000µs + and –1kV 100A (25 pulses of each polarity)	Bellcore GR-1089	Passed
2/10µs + and –2.5 and 5kV 500A (10 pulses of each polarity)	Bellcore GR-1089	Passed
10/560µs + and –800V 100A (1 pulse of each polarity)	FCC Part 68	Passed
10/160µs + and –1.5kV 200A (1 pulse of each polarity)	FCC Part 68	Passed
10/700µs + and –1.5kV 37.5A (5 pulses of each polarity)	K20	Passed
Electrical and Power Cross Tests		
600V 3A 1.1s (first level)	Bellcore GR-1089	Passed
277V 25A (second level)	Bellcore GR-1089	Passed
600V 60A 5s(second level)	Bellcore GR-1089	Passed
600V 40A 1.5s	UL 60950	Passed
600V 2.2A 30min	UL 60950	Passed
600V 1A 0.2s (A criteria)	K20	Passed
230V 1.44A/0.77A/0.38A 15min (A criteria)	K20	Passed
230V 23A 15min (A criteria)	K20	Passed

For additional information on STMicroelectronic's Trisil™ Product line, please see www.st.com/protection

TCP™ Series

TCP500MA & TCP2A, Telecom Circuit Protector

COOPER Bussmann

Description

- Designed to protect Consumer Premises Equipment from harmful overcurrents.
- Allows compliance with telecom regulatory standards including UL 1950/60950, and FCC part 68. Application circuit testing is recommended.
- Eliminates the need for a current limiting resistor.

RoHS 2002/95/EC

ELECTRICAL CHARACTERISTICS	
% of Amp Rating	Opening Time
100%	4 Hours Minimum
250%	1 Second Minimum
250%	4-10 Seconds Typical
250%*	120 Seconds Maximum
300%	10 Seconds Maximum

* If the device does not open at 250% within 120 seconds, increase current to 300% of amp rating. Device must open in 10 seconds max.

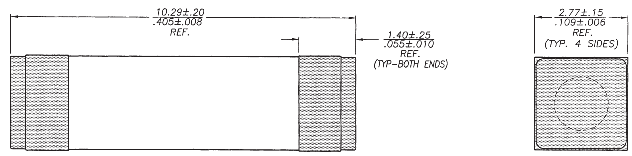
Agency Information

- UL Recognition Card: JDYX2/E19180
- CSA Component Certification Record and Class No.: 053787C000, 1422 30

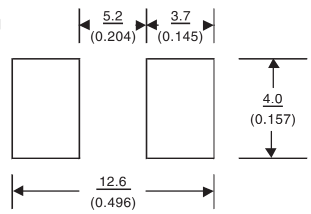
Environmental Data

- Life Test: MIL-STD-202, Method 108A, Test Condition D
- Load Humidity: MIL-STD-202, Method 103B
- Moisture Resistance: MIL-STD-202, Method 106E
- Thermal Shock: MIL-STD-202, Method 107D, air-to-air
- Case Resistance: EIA/IS-722
- Resistance to Dissolution of Metallization: ANSI J-STD-002, Test D
- Mechanical Shock: MIL-STD-202, Method 213B, Test Condition A
- High Frequency Vibration: MIL-STD-202, Method 204D, Test Condition D
- Resistance to Solvents: MIL-STD-202, Method 215A

Dimensions mm/(inches)



Land Pattern



Ordering

- Specify packaging, product and option code (i.e., TR2/TCP500-R)

Soldering Method

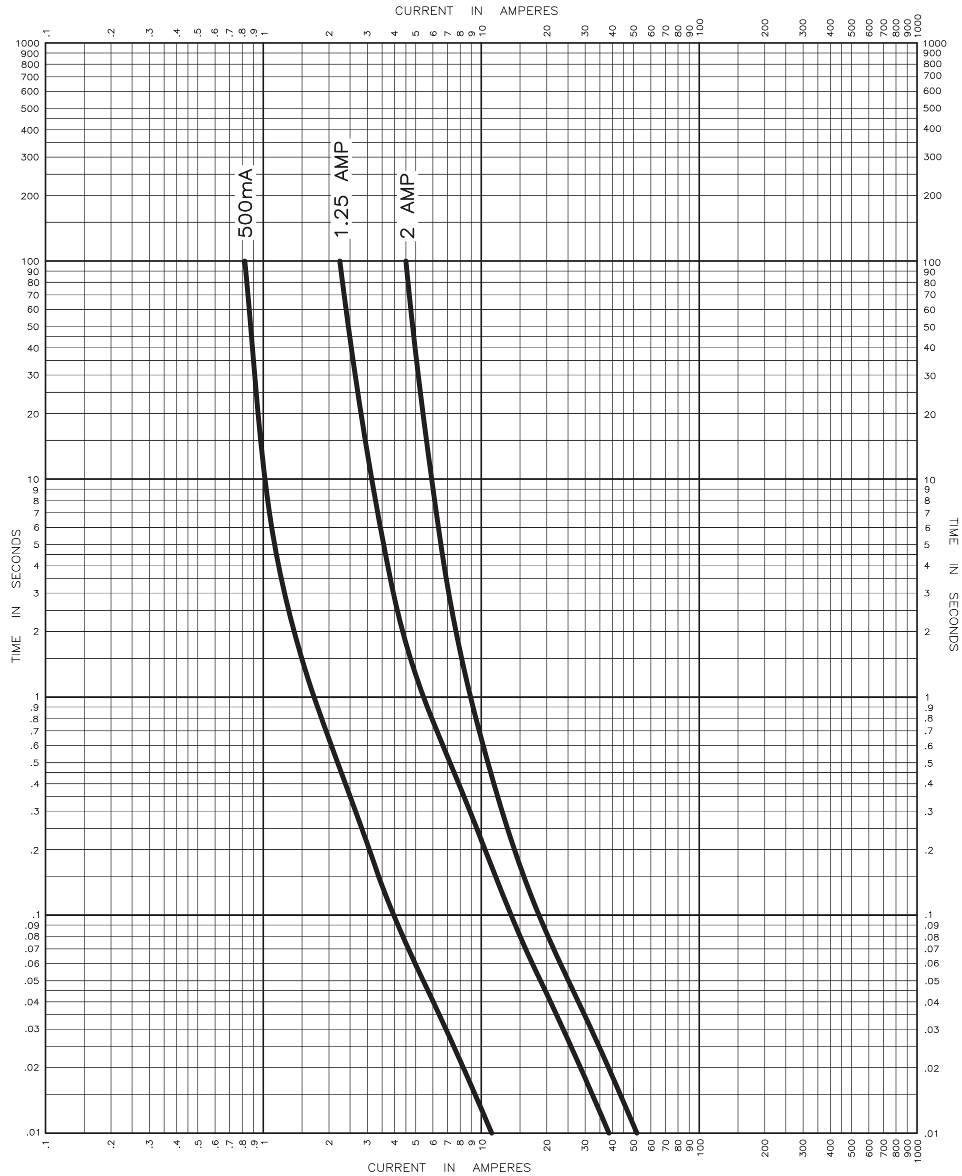
- Wave Immersion: 260°C, 10 sec max.
- Infrared: 260°C, 30 sec max.

LIGHTNING SURGE SPECIFICATIONS						
Surge Specification	Surge	Repetitions	Waveform (μSec.)	Current (A)	Voltage (V)	Performance Requirement
TCP 500mA tested						
FCC 47 Part 68	Longitudinal Type B	2	5x320	37.5	N/A	Fuse cannot open
FCC 47 Part 68	Metallic Type A	2	10x560	100	800	Fuse must open safely
Surge out		25	10x160	65	N/A	Fuse cannot open
TCP2A tested						
FCC 47 Part 68	Longitudinal Type A	2	10x160	100 per fuse	1500	Fuse cannot open
FCC 47 Part 68	Metallic Type B	2	10x560	100	800	Fuse cannot open
Bellcore GR-1089-CORE	First Level Lightning	50	10x1000	100	1000	Fuse cannot open
Bellcore GR-1089-CORE	First Level Lightning	50	2x10	500	2500	Fuse cannot open
Surge out		1	10x160	160	N/A	Fuse cannot open
Surge out		1	10x560	115	N/A	Fuse cannot open

ELECTRICAL AND POWER CROSS SPECIFICATIONS											
Product Code	Voltage Rating AC	Interrupting Rating*		DC Cold Resistance** (ohms)			Typical Melting I²t†	Maximum Total Clearing	Typical Voltage Drop‡	Alpha Code Marking	
		250VAC	600VAC	min.	typ.	max.				1st Code	2nd Code
TCP500mA	250 V	50 A	40 A	0.420	0.530	0.640	1.3 A²s	100 A²s	471mV	F	R***
TCP2A	250 V	50 A	60 A	0.050	0.075	0.100	30 A²s	100 A²s	205mV	N	

* AC Interrupting Rating (Measured at designated voltage, 100% power factor)
** DC Cold Resistance (Measured at 10% of rated current)
*** On RoHS Compliant Version (-R option)
† Typical Melting I²t (Measured with a battery bank at 60V DC, 10x-rated current, time constant of calibrated circuit less than 50 microseconds)
‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)

TIME CURRENT CURVE



Printed Circuit Board Fuses - Surface Mount

PACKAGING CODE	
Packaging Code	**Description**
TR2	2,500 pieces of fuses on 24mm tape-and-reel on 13 inch (330mm) reel per EIA Standard 481, 8mm pitch

OPTION CODE	
Option Code	**Description**
-R	RoHS Compliant Version (Sn plating w/ Ni barrier)

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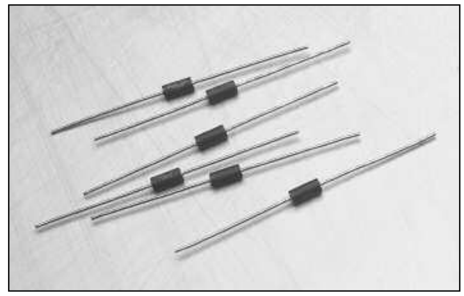
Subminiature Microtron® Fuses

MCRW Series, Fast Acting, Wire-in-Air

Description

- Axial Leaded Fast Acting Thru-Hole Fuse
- Tin-lead Plated Copper Lead Wires
- High Temperature Epoxy Plastic Body, UL 94 VO
- Low resistance values

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS	
% of Amp Rating	Opening Time
100%	4 hours minimum
200%	5 seconds maximum

Agency Information

- UL Recognition Guide & File numbers: JDYX2 & E195337.
- CSA Certification Record No: LR 701159 & Class No: 1422 30 and 1422 01.

Environmental Data

- Shock Resistance: MIL-STD-202, Method 213, Test Condition 1 (Sawtooth)
- Vibration Resistance: MIL-STD-202, Method 201 (10-55 Hz x 3 axis/ no load)
- Moisture Resistance: MIL-STD-202F, Method 106
- Soldering Heat Resistance: 260°C, 10 seconds per IEC 68-2-20
- Salt Spray: MIL-STD-202, Method 101, Test Condition B (48 Hours)

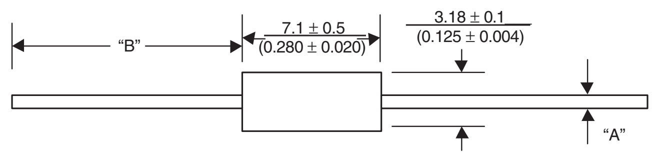
Ordering

- Specify packaging and product code (i.e., TR1/MCRW100mA)

Soldering Method

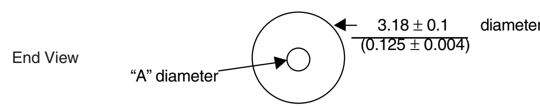
- Heat Resistance: 260°C, 10 sec per IEC 68-2-20

Dimensions mm/(inches)

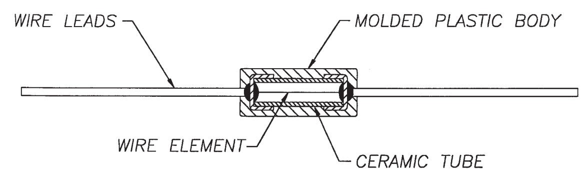


Amperage	"A" Diameter
100mA - 7A	0.025"
10A - 15A	0.032"

Packaging Code	"B" Length
BK1	1.5"
TR1	1.13"



Construction



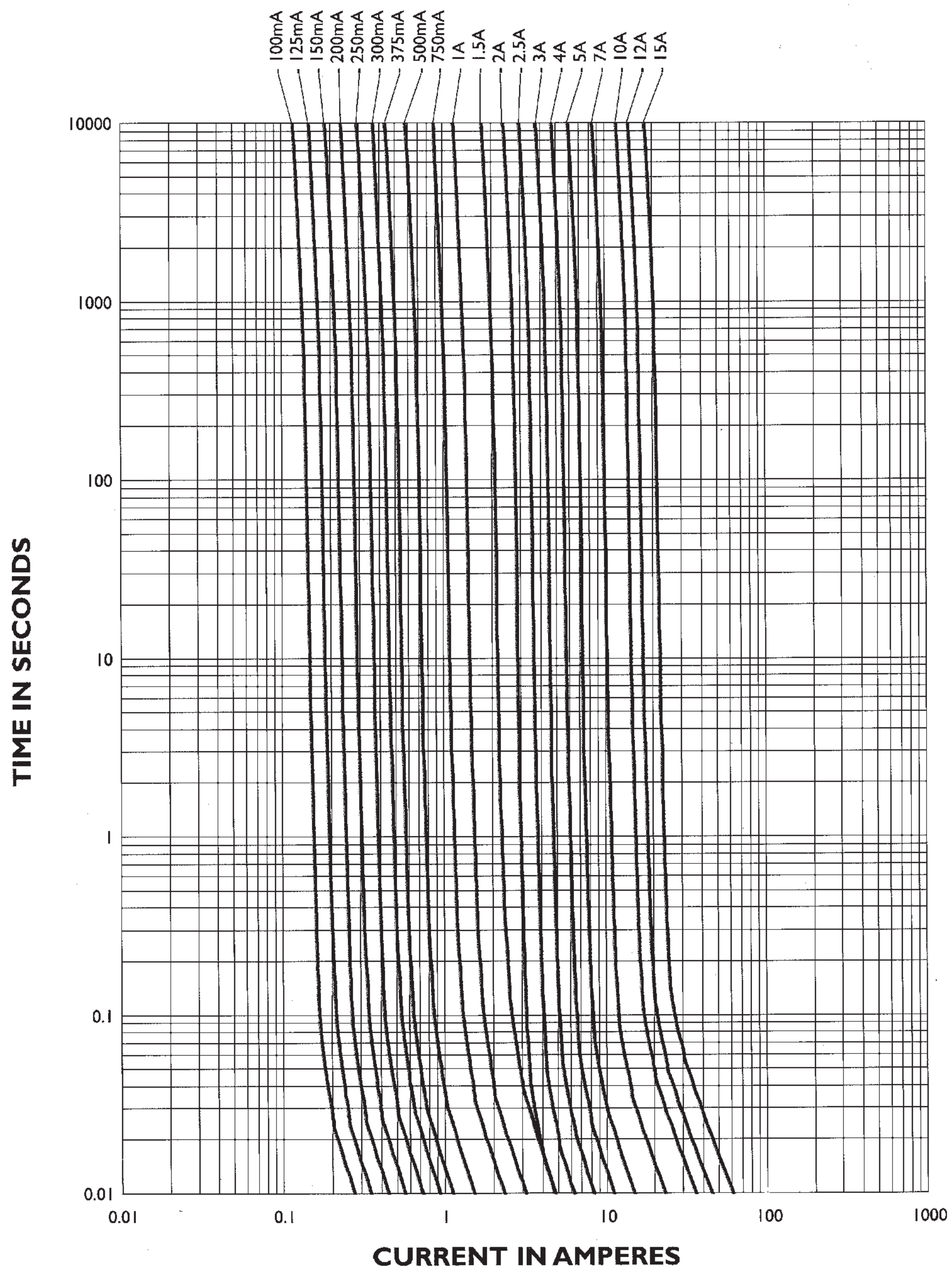
SPECIFICATIONS						
Product Code	Voltage Rating AC/DC	Interrupting Rating*		Resistance (ohms)** Typ.	Typical Melt I^2t†	Typical Voltage Drop (V)‡
		AC	DC			
MCRW100mA	125 V	50 A	300 A	15.5	0.0006	0.68
MCRW125mA	125 V	50 A	300 A	2.2	0.0009	0.61
MCRW150mA	125 V	50 A	300 A	1.6	0.0015	0.54
MCRW200mA	125 V	50 A	300 A	1.2	0.002	0.48
MCRW250mA	125 V	50 A	300 A	0.85	0.004	0.43
MCRW300mA	125 V	50 A	300 A	0.62	0.008	0.39
MCRW375mA	125 V	50 A	300 A	0.49	0.012	0.35
MCRW500mA	125 V	50 A	300 A	0.33	0.023	0.31
MCRW750mA	125 V	50 A	300 A	0.19	0.056	0.25
MCRW1A	125 V	50 A	300 A	0.13	0.10	0.22
MCRW1.5A	125 V	50 A	300 A	0.07	0.25	0.18
MCRW2A	125 V	50 A	300 A	0.054	0.27	0.24
MCRW2.5A	125 V	50 A	300 A	0.041	0.50	0.22
MCRW3A	125 V	50 A	300 A	0.031	0.9	0.20
MCRW4A	125 V	50 A	300 A	0.023	1.6	0.19
MCRW5A	125 V	50 A	300 A	0.018	3	0.17
MCRW7A	125 V	50 A	300 A	0.012	7	0.15
MCRW10A	125 V	50 A	300 A	0.007	21	0.098
MCRW12A	125 V	50 A	300 A	0.006	35	0.093
MCRW15A	125 V	50 A	300 A	0.004	63	0.088

* AC Interrupting Rating (Measured at designated voltage, 100%) DC Interrupting Rating (Measured at designated voltage, rise time of less than 50 microseconds, battery source)
** DC Cold Resistance (Measured at 10% of rated current)
† Typical Melting I^2t (Measured with a battery bank at rated DC voltage, 10x-rated current, rise time of calibrated circuit less than 50 microseconds)
‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)

Subminiature Microtron® Fuses

MCRW Series, Fast Acting, Wire-in-Air

TIME CURRENT CURVE



	PACKAGING CODE
Packaging Code	**Description**
BK1	1,000 pieces in bulk
TR1	2,500 pieces on tape-and-reel per EIA-296-E @ 5 mm pitch and 52.4mm inside tape spacing

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COOPER Bussmann

Subminiature Microtron® Fuses

MCRS Series, Slow Blow, Wire-in-Air

Description

- Axial Leaded Slow Blow Thru-Hole Fuse
- Tin-lead Plated Copper Lead Wires
- High Temperature Epoxy Plastic Body, UL 94 VO

ELECTRICAL CHARACTERISTICS	
% of Amp Rating	Opening Time
100%	4 hours minimum
200%	30 seconds maximum

Agency Information

- UL Recognition Guide & File numbers: JDYX2 & E195337.
- CSA Certification Record No: LR 701159 & Class No: 1422 30 and 1422 01.

Environmental Data

- Shock Resistance: MIL-STD-202, Method 213, Test Condition 1 (Sawtooth)
- Vibration Resistance: MIL-STD-202, Method 201 (10-55 Hz x 3 axis/ no load)
- Moisture Resistance: MIL-STD-202F, Method 106
- Soldering Heat Resistance: 260°C, 10 seconds per IEC 68-2-20
- Salt Spray: MIL-STD-202, Method 101, Test Condition B (48 Hours)

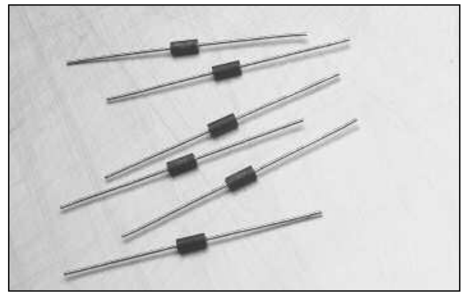
Ordering

- Specify packaging and product code (i.e., TR1/MCRS250mA)

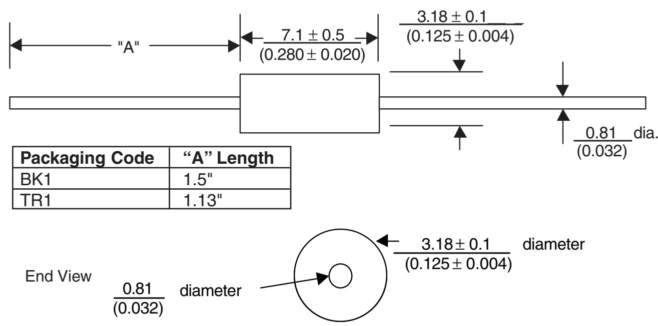
Soldering Method

- Heat Resistance: 260°C, 10 sec per IEC 68-2-20

RoHS 2002/95/EC

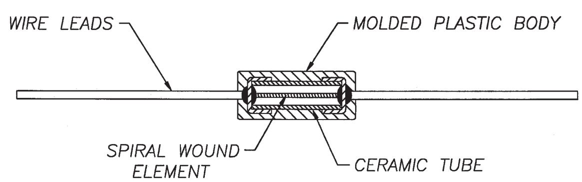


Dimensions mm/(inches)



Packaging Code	"A" Length
BK1	1.5"
TR1	1.13"

Construction

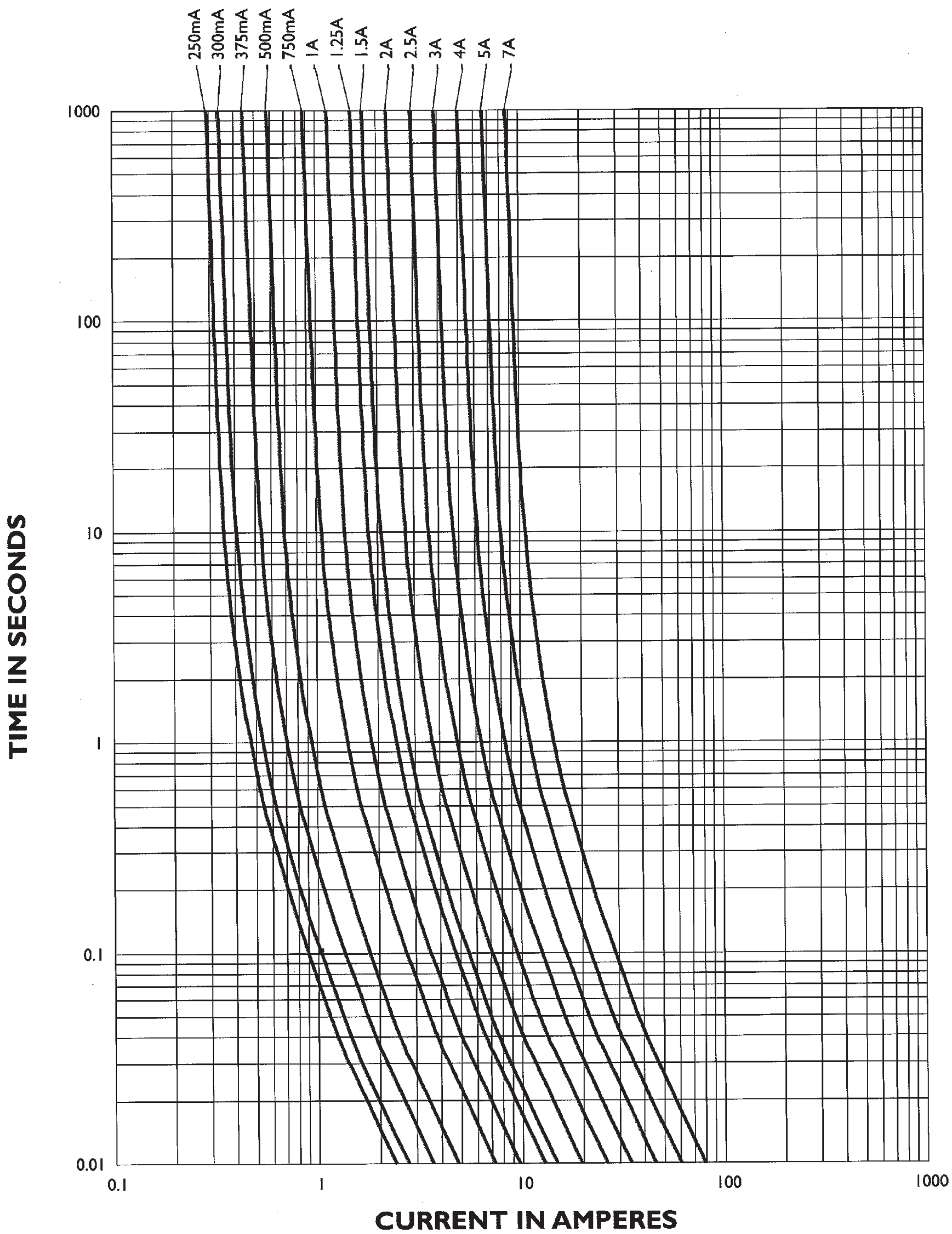


SPECIFICATIONS						
Product Code	Voltage Rating AC/DC	Interrupting Rating*		Resistance (ohms)** Typ.	Typical Melt I^2t†	Typical Voltage Drop (V)‡
		AC	DC			
MCRS250mA	125 V	50 A	300 A	3.20	0.042	2.20
MCRS300mA	125 V	50 A	300 A	2.57	0.056	2.02
MCRS375mA	125 V	50 A	300 A	1.66	0.101	1.69
MCRS500mA	125 V	50 A	300 A	1.07	0.18	1.42
MCRS750mA	125 V	50 A	300 A	0.55	0.44	1.09
MCRS1A	125 V	50 A	300 A	0.36	0.78	0.91
MCRS1.25A	125 V	50 A	300 A	0.23	1.41	0.77
MCRS1.5A	125 V	50 A	300 A	0.18	1.9	0.7
MCRS2A	125 V	50 A	300 A	0.12	3.4	0.59
MCRS2.5A	125 V	50 A	300 A	0.08	6.1	0.5
MCRS3A	125 V	50 A	300 A	0.06	8.1	0.45
MCRS4A	125 V	50 A	300 A	0.04	15	0.38
MCRS5A	125 V	50 A	300 A	0.02	35	0.29
MCRS7A	125 V	50 A	300 A	0.01	63	0.25

* AC Interrupting Rating (Measured at designated voltage, 100%) DC Interrupting Rating (Measured at designated voltage, rise time of less than 50 microseconds, battery source)
** DC Cold Resistance (Measured at 10% of rated current)
† Typical Melting I^2t (Measured with a battery bank at rated DC voltage, 10x-rated current, rise time of calibrated circuit less than 50 microseconds)
‡ Typical Voltage Drop (Measured at rated current after temperature stabilizes)

Subminiature Microtron® Fuses
MCRS Series, Slow Blow, Wire-in-Air

TIME CURRENT CURVE



	PACKAGING CODE
Packaging Code	**Description**
BK1	1,000 pieces in bulk
TR1	2,500 pieces on tape-and-reel per EIA-296-E @ 5 mm pitch and 52.4mm inside tape spacing

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Fax: +65 270 4160

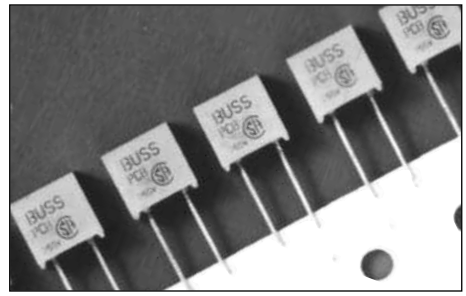
Printed Circuit Board Fuses

PC-Tron® Series

Description

- Radial Leaded Fast Acting Thru-Hole Fuse
- Ideal for high voltage DC applications
- Board washable
- Optional mounting socket available (PCS)
- Available in different lead configurations

RoHS 2002/95/EC



AC TIME-CURRENT CHARACTERISTICS	
% of Amp Rating	Opening Time
100%	4 hours minimum
200%	10 second maximum

Agency Information

- UL Recognized: E19180
- CSA: 42731

Ordering

- Specify packaging, product, and option code (i.e., BK/PCB-1/2-R)

DC Application

The PC-Tron subminiature fuse is UL Recognized for DC supplementary overcurrent protection to provide individual protection for components or internal circuits in equipment. Suitability for a specific application is dependent on time constants and capacitance values. It is the responsibility of the customer to evaluate the information provided for applicability to their particular application.

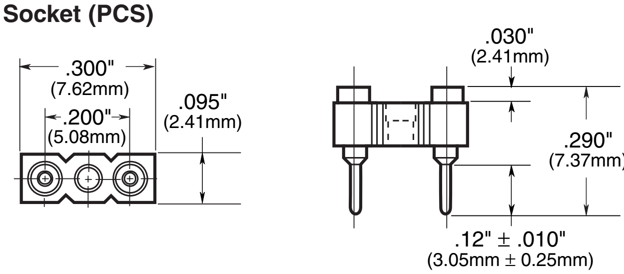
Dimensions mm/(inches)

Dimensional Data: All tolerances $\frac{\pm .005"}{\pm .13 \text{ mm}}$

Mounting Socket (RoHS compliant)

- Available as option. Specify catalog number BK/PCS (100-in) and short fuse lead length — PCC or PCE

Socket (PCS)



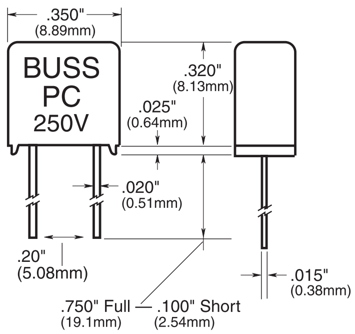
SPECIFICATIONS						
Product Code / Amp Rating	Lead Length	Voltage Rating AC	AC Interrupting	Voltage Rating DC	DC Interrupting Min.	Max.
PCB - 1/2, 3/4, 1, 1-1/2, 2, 2-1/2	Full - 0.750" (straight)	250V	50A @ 250V 10kA @ 125V	450V	300	5900A
PCB - 3	Full - 0.750" (straight)	250V	50A @ 250V	350V	300	4400A
PCC - 1/2, 3/4, 1, 1-1/2, 2, 2-1/2	Short 0.100" (straight)	250V	50A @ 250V 10kA @ 125V	450V	300	5900A
PCC - 3	Short 0.100" (straight)	250V	50A @ 250V 10kA @ 125V	350V	300	4400A
PCD - 5	Full - 0.750" (straight)	125V	10kA @ 125V	250V	300	4200A
PCE - 5	Short 0.100" (straight)	125V	10kA @ 125V	250V	300	4200A
PCF - 1/2, 3/4, 1, 1-1/2, 2, 2-1/2	0.475"	250V	50A @ 250V 10kA @ 125V	450V	300	5900A
PCF - 3	0.475"	250V	50A @ 250V 10kA @ 125V	350V	300	4400A
PCG - 5	0.475"	125V	10kA @ 125V	250V	300	4200A
PCH - 1/2, 3/4, 1, 1-1/2, 2, 2-1/2	0.125"	250V	50A @ 250V 10kA @ 125V	450V	300	5900A
PCH - 3	0.125"	250V	50A @ 250V 10kA @ 125V	350V	300	4400A
PCI - 5	0.125"	125V	10kA @ 125V	250V	300	4200A

Device designed to carry rated current for four hours minimum. An operating current of 80% or less of rated current is recommended, with further derating required at elevated ambient temperatures.

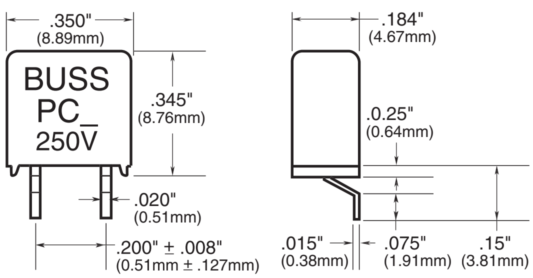
Printed Circuit Board Fuses
PC-Tron® Series

Dimensional Data: All tolerances ± .005" / ± .13 mm

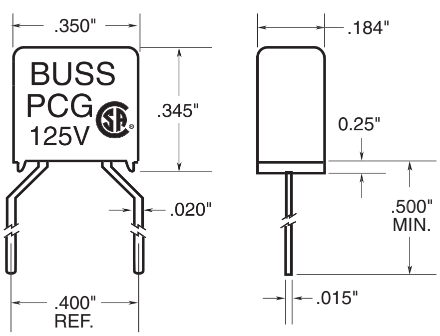
Standard Fuse (PCB, PCD)



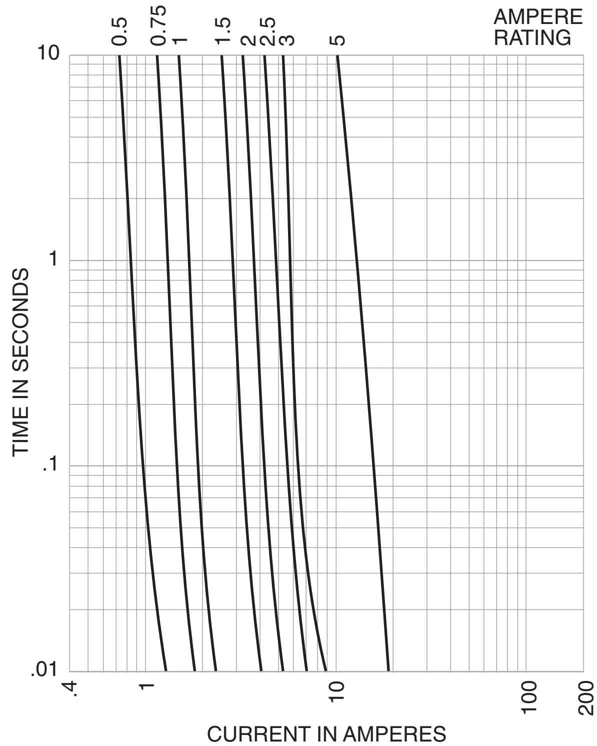
Dimensional Data (PCH, PCI)



Dimensional Data (PCF, PCG)



Time-Current Characteristic Curves–Average Melt



Max. Total Clearing I²t (Amps² Sec.)

Amp Rating	Volts AC 125 Volts 50A	125 Volts 1,000A	250 Volts 10,000A	250 Volts 35A & 50A
1/2A	0.006	0.006	0.006	0.006
3/4A	0.016	0.016	0.016	0.016
1A	0.020	0.020	0.020	0.020
1-1/2A	0.090	0.090	0.090	0.090
2A	0.200	0.200	0.200	0.200
2-1/2A	0.300	0.300	0.300	0.300
3A	0.750	0.750	0.750	0.750
5A	5.0	5.0	5.0	—

Note—Power Factor > .90.

PACKAGING CODE	
Packaging Code	**Description**
Blank	5 pieces of fuses
BK	100 pieces of fuses in a carton
TR*	500 pieces of fuses on tape and Reel

* Only for PCB and PCD

OPTION CODE	
Option Code	**Description**
-R	RoHS Compliant Version

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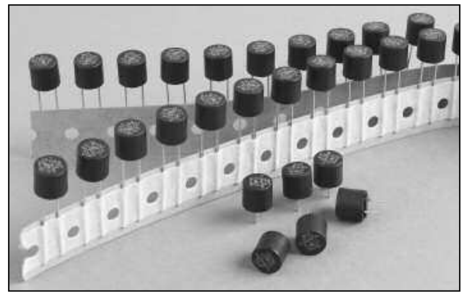
Subminiature Fuses
SR-5 Series, Time Lag

COOPER Bussmann

Description

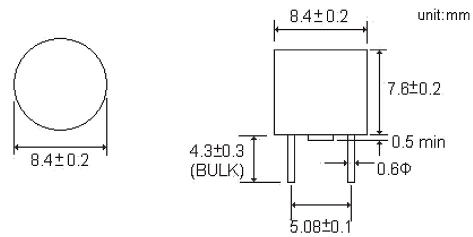
- Radial Leaded Time Lag Thru-Hole Fuse
- Designed to IEC 60127-3, Sheet 4
- Internationally accepted for primary and secondary overcurrent protection
- Place directly into PCB or plug into BK/PCS holder
- High inrush withstand capability
- Compatible with leaded and lead-free reflow and wave solder
- Base/Cap is Nylon #66, UL 94V0
- Pins are Tin Plated Copper

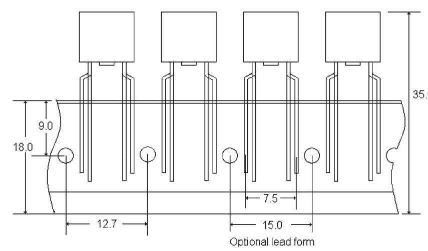
RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS									
Rated Current	1.5 In min	2.1 In max	2.75 In min	2.75 In max	4 In min	4 In max	10 In min	10 In max
400mA-6.3A	1hr	2 min	400 ms	10 sec	150 ms	3 sec	20 ms	150 ms

Dimensions mm/(inches)





Agency Information

- UL Recognition: E146895 (400mA thru 6.3A)
- CSA: LR98127 (400mA thru 5A)
- VDE: 122052 (500mA thru 4A, 6.3A)
- SEMKO: 0035176 (500mA thru 4A)
- CCC 2003010207072514 (500mA thru 4A)
- METI: 32-1966 (500mA thru 5A)
- EK: KTL SA05004 (500mA thru 4A)
- Remaining 5-6.3A Approvals Pending

Specifications

- Solderability: EIA-186-9E Method 9
- High Frequency Vibration: MIL-STD-202F, Method 201A
- Operating Temperature: -40°C to +125°C
- Soldering Heat Resistance: 260°C, 10S (IEC 60068-2-20)

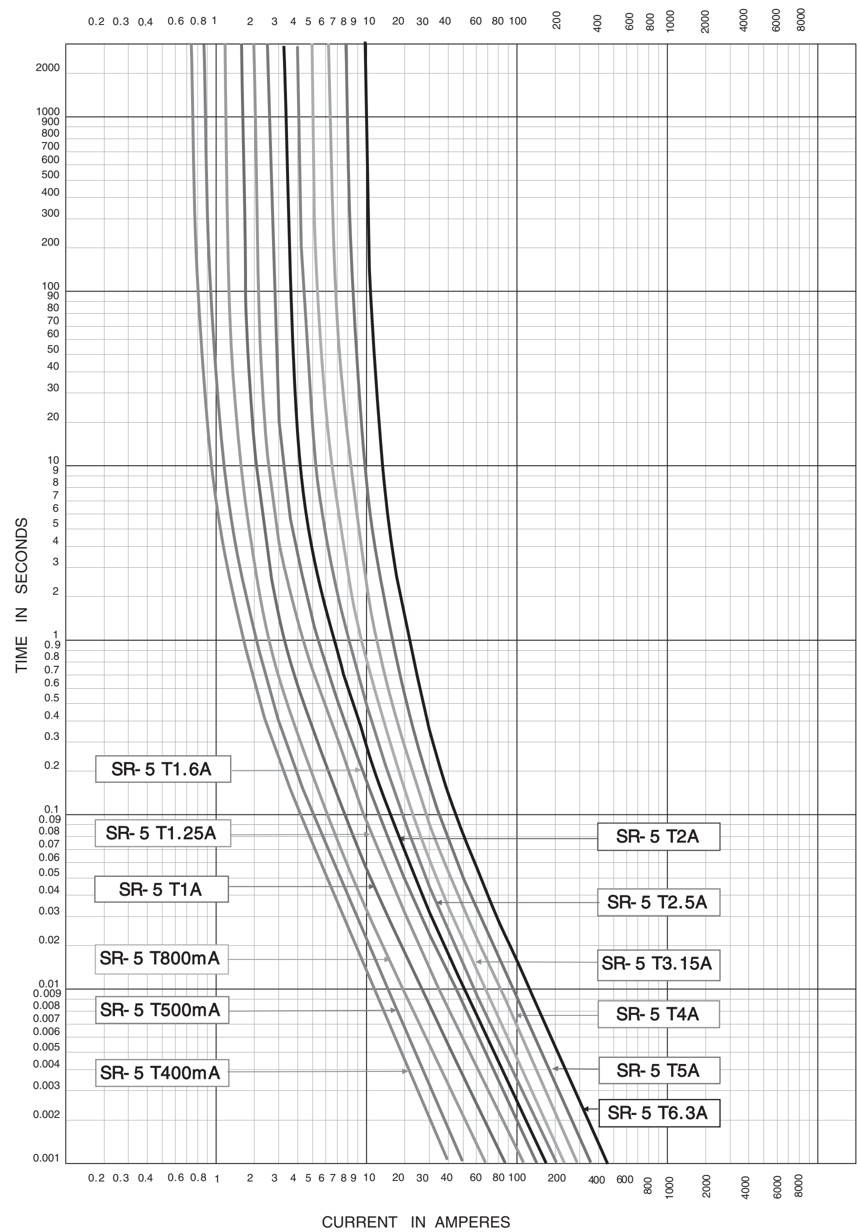
Ordering

- Specify product and packaging code (i.e., SR-5-1A-AP)

SPECIFICATIONS					
Product Code	**Voltage Rating AC**	**Interrupting Rating @ Rated Voltage**	**Typical DC Cold Resistance (ohms)**	**Typical Melting I^2t (A^2s) at 1ms**	**Maximum Power Dissipation (mW)**
SR-5-500mA	250V	35A	0.270	2	310
SR-5-630mA	250V	35A	0.175	3.5	360
SR-5-800mA	250V	35A	0.125	6.5	430
SR-5-1A	250V	35A	0.083	9	500
SR-5-1.25A	250V	35A	0.061	13	600
SR-5-1.6A	250V	35A	0.047	24	730
SR-5-2A	250V	35A	0.031	30	870
SR-5-2.5A	250V	35A	0.028	45	1000
SR-5-3.15A	250V	35A	0.023	57	1200
SR-5-4A	250V	40A	0.015	80	1400
***SR-5-5A**	250V	50A	0.011	120	1800
***SR-5-6.3A**	250V	63A	0.009	140	2000

* Conducting Path min. $0.2mm^2$

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
-AP	Ammo-pack taped 1,000 per box
-BK	In bulk 200 per bag

Printed Circuit Board Fuses - Axial and Radial Leaded

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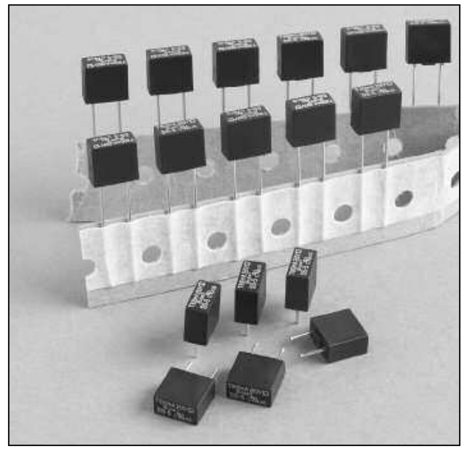
Subminiature Fuses
SS-5 Series, Time Lag

COOPER Bussmann

Description

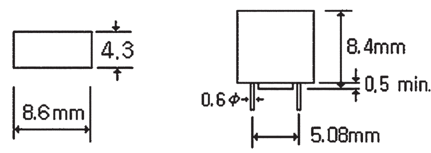
- Radial Leaded Time Lag Thru-Hole Fuse
- Rectangular shape with reduced foot print
- Designed to IEC 60127-3, Sheet 4
- Internationally accepted for primary and secondary overcurrent protection
- Place directly into PCB or plug into BK/PCS holder
- High inrush withstand capability
- Compatible with leaded and lead-free reflow and wave solder
- Base/Cap is Nylon #66, UL 94V0
- Pins are Tin Plated Copper

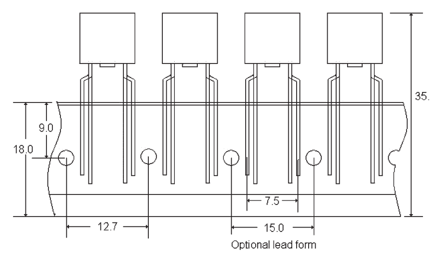
RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS								
Rated Current	1.5 In min	2.1 In max	2.75 In min	2.75 In max	4 In min	4 In max	10 In min	10 In max
400mA-6.3A	1hr	2 min	400 ms	10 sec	150 ms	3 sec	20 ms	150 ms

Dimensions mm/(inches)





Agency Information

- UL Recognition: E146895 (400mA thru 6.3A)
- CSA: LR98127 (400mA thru 5A)
- VDE: 122052 (500mA thru 4A, 6.3A)
- SEMKO: 603891 (630mA thru 4A)
- CQC 05012014933 (630mA thru 4A)
- METI: 32-1966 (500mA thru 5A)
- Remaining 5-6.3A Approvals Pending

Specifications

- Solderability: EIA-186-9E Method 9
- High Frequency Vibration: MIL-STD-202F, Method 201A
- Operating Temperature: -40°C to +125°C
- Soldering Heat Resistance: 260°C, 10S (IEC 60068-2-20)

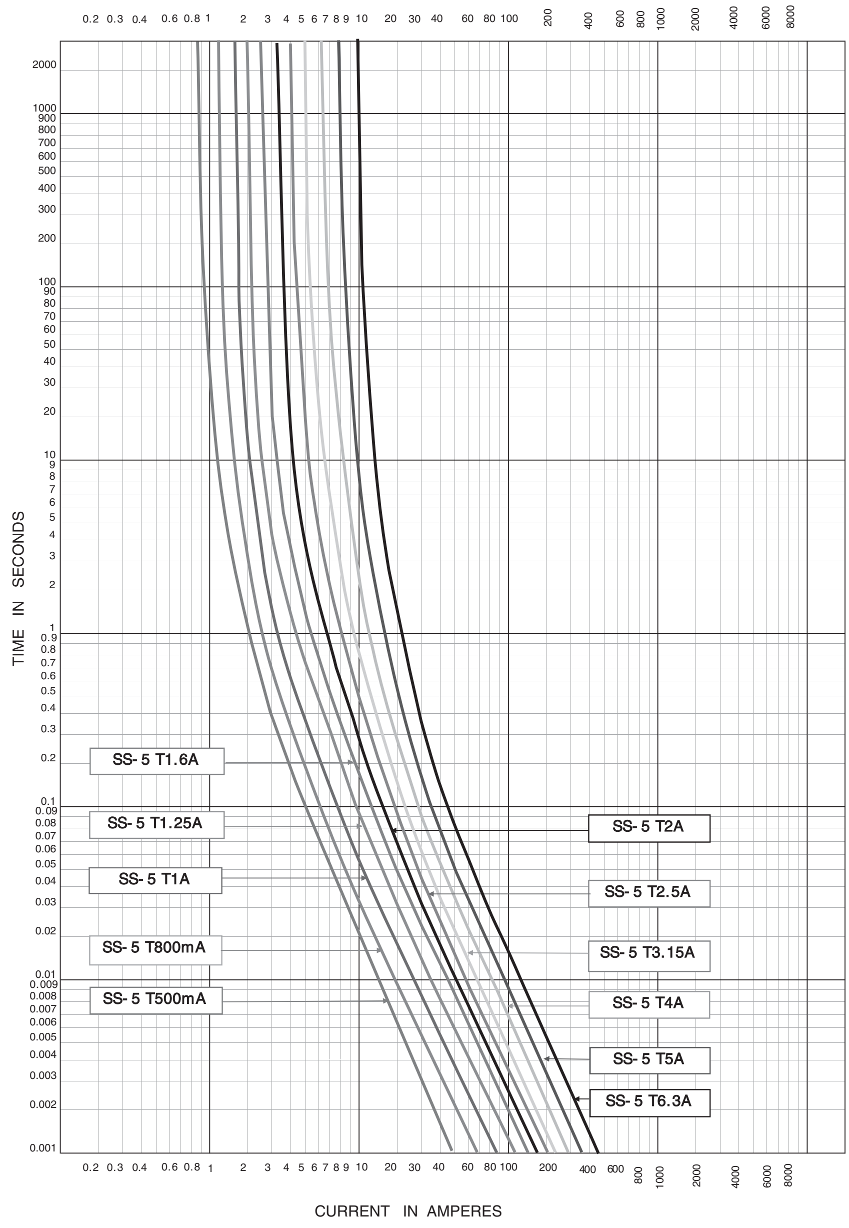
Ordering

- Specify product and packaging code (i.e., SS-5-1A-AP)

SPECIFICATIONS					
Product Code	**Voltage Rating AC**	**Interrupting Rating @ Rated Voltage**	**Typical DC Cold Resistance (ohms)**	**Typical Melting I^2t (A^2s) at 1ms**	**Maximum Power Dissipation (mW)**
SS-5-500mA	250V	35A	0.270	2	310
SS-5-630mA	250V	35A	0.175	3.5	360
SS-5-800mA	250V	35A	0.125	6.5	430
SS-5-1A	250V	35A	0.083	9	500
SS-5-1.25A	250V	35A	0.061	13	600
SS-5-1.6A	250V	35A	0.047	24	730
SS-5-2A	250V	35A	0.031	30	870
SS-5-2.5A	250V	35A	0.028	45	1000
SS-5-3.15A	250V	35A	0.023	57	1200
SS-5-4A	250V	40A	0.015	80	1400
***SS-5-5A**	250V	50A	0.011	120	1800
***SS-5-6.3A**	250V	63A	0.009	140	2000

* Conducting Path min. $0.2mm^2$

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
-AP	Ammo-pack taped 1,000 per box
-BK	In bulk 200 per bag

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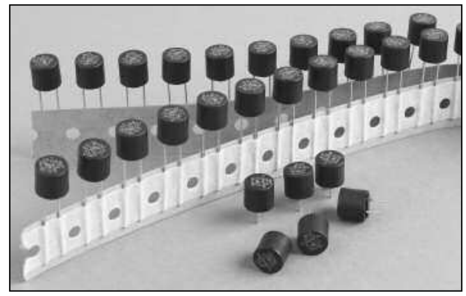
COOPER Bussmann

Subminiature Fuses
SR-5F Series, Fast Acting

Description
- Radial Leaded Fast Acting Thru-Hole Fuse
- Designed to UL 248-14
- Accepted for primary and secondary overcurrent protection
- Place directly into PCB or plug into BK/PCS holder
- Compatible with leaded and lead-free reflow and wave solder
- Base/Cap is Nylon #66, UL 94V0
- Pins are Tin Plated Copper

RoHS 2002/95/EC



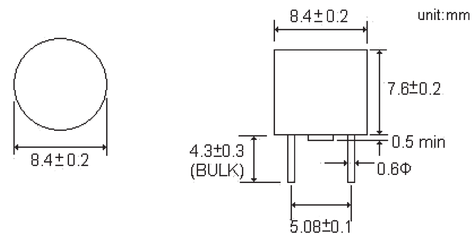
ELECTRICAL CHARACTERISTICS			
Rated Current	1 In min	1.5 In max	2 In max
400mA-10A	1hr	10 min	2 min

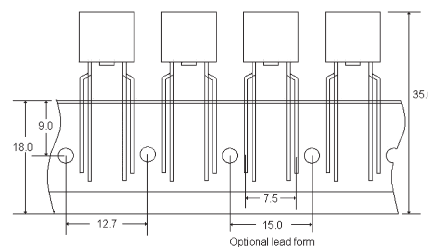
Agency Information
- UL Listed: E146895 (400mA thru 10A)
- CSA: LR98127 (400mA thru 10A)

Specifications
- Solderability: EIA-186-9E Method 9
- High Frequency Vibration: MIL-STD-202F, Method 201A
- Operating Temperature: -40°C to +125°C
- Soldering Heat Resistance: 260°C, 10S (IEC 60068-2-20)

Ordering
- Specify product and packaging code (i.e., SR-5F-1A-AP)

Dimensions mm/(inches)

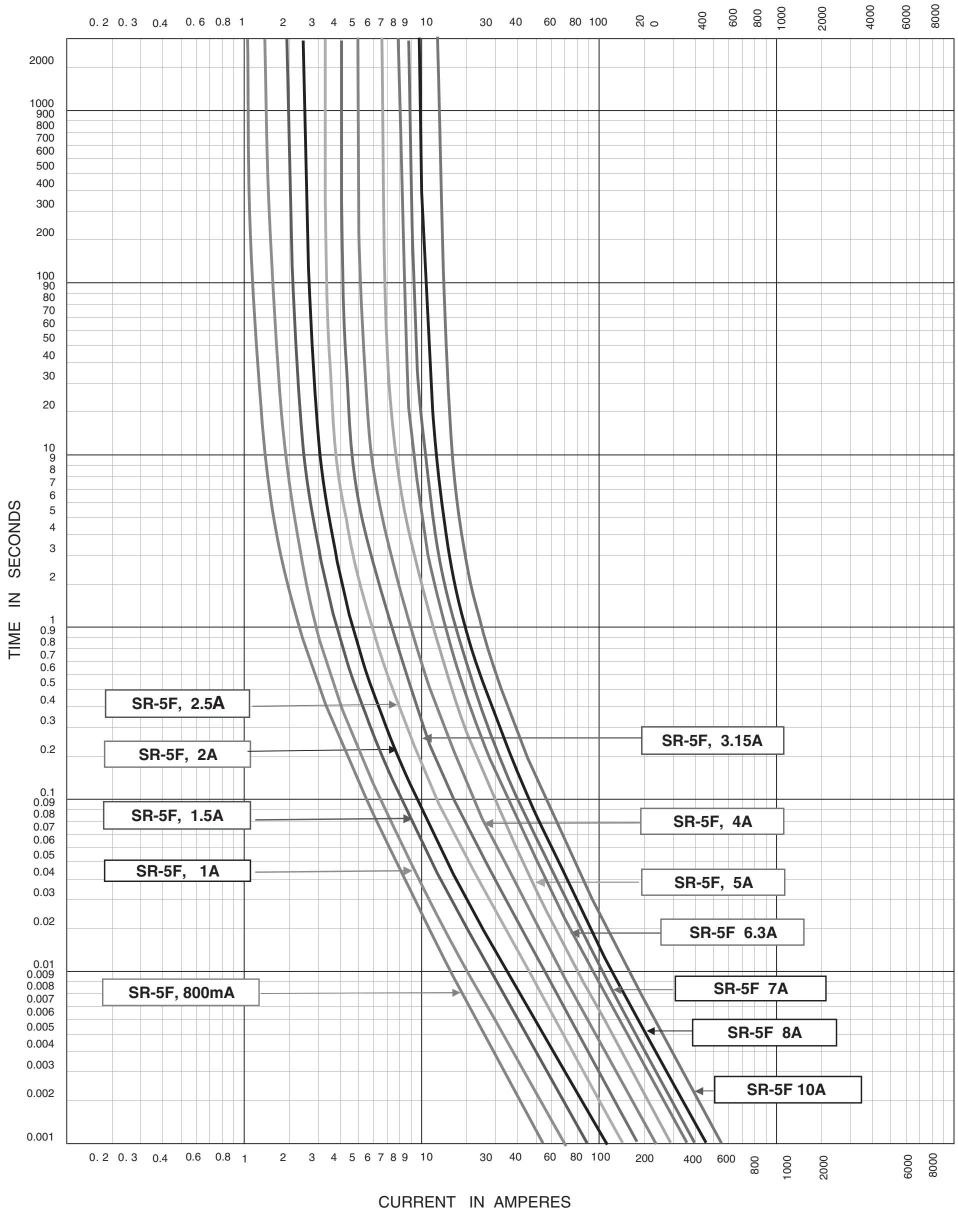




SPECIFICATIONS				
Product Code	Voltage Rating AC	Interrupting Rating @ Rated Voltage	Typical DC Cold Resistance (ohms)	Typical Melting I^2t (A^2s) at 1ms
SR-5F-800mA	250V	50A	210	2.7
SR-5F-1A	250V	50A	120	4.9
SR-5F-1.6A	250V	50A	73	8.0
SR-5F-2A	250V	50A	50	12.1
SR-5F-2.5A	250V	50A	40	16.8
SR-5F-3.15A	250V	50A	32	32.4
SR-5F-4A	250V	50A	25	48.4
***SR-5F-5A**	250V	50A	17	75.0
***SR-5F-6.3A**	125V	50A	14	108
***SR-5F-7A**	125V	50A	11	160
***SR-5F-8A**	125V	50A	9	190
***SR-5F-10A**	125V	50A	7	270

* Conducting Path min. $0.2mm^2$

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
-AP	Ammo-pack taped 1,000 per box
-BK	In bulk 200 per bag

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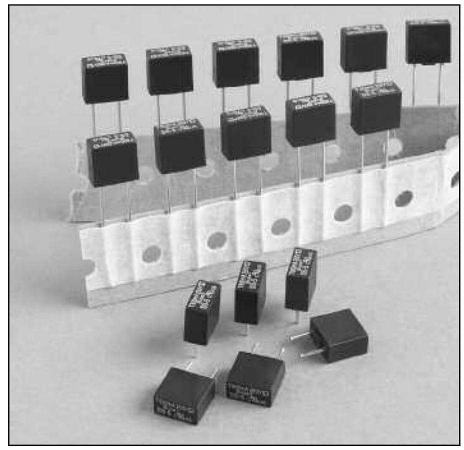
Subminiature Fuses
SS-5F Series, Fast Acting

Description
- Radial Leaded Fast Acting Thru-Hole Fuse
- Rectangular shape with reduced foot print
- Designed to UL 248-14
- Accepted for primary and secondary overcurrent protection
- Place directly into PCB or plug into BK/PCS holder
- Compatible with leaded and lead-free reflow and wave solder
- Base/Cap is Nylon #66, UL 94V0
- Pins are Tin Plated Copper

RoHS 2002/95/EC



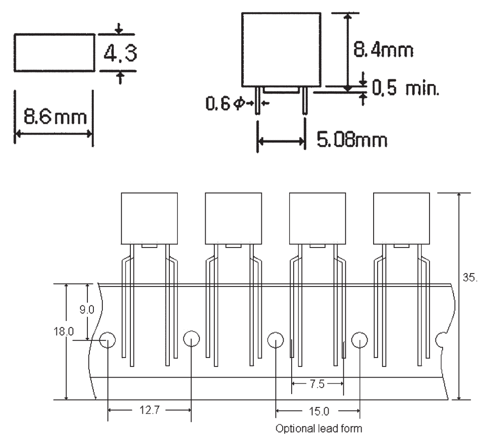
ELECTRICAL CHARACTERISTICS			
Rated Current	1 In min	1.5 In max	2 In max
400mA-10A	1hr	10 min	2 min

Agency Information
- UL Listed: E146895 (400mA thru 10A)
- CSA: LR98127 (400mA thru 10A)

Specifications
- Solderability: EIA-186-9E Method 9
- High Frequency Vibration: MIL-STD-202F, Method 201A
- Operating Temperature: -40°C to +125°C
- Soldering Heat Resistance: 260°C, 10S (IEC 60068-2-20)

Ordering
- Specify product and packaging code (i.e., SS-5F-1A-AP)

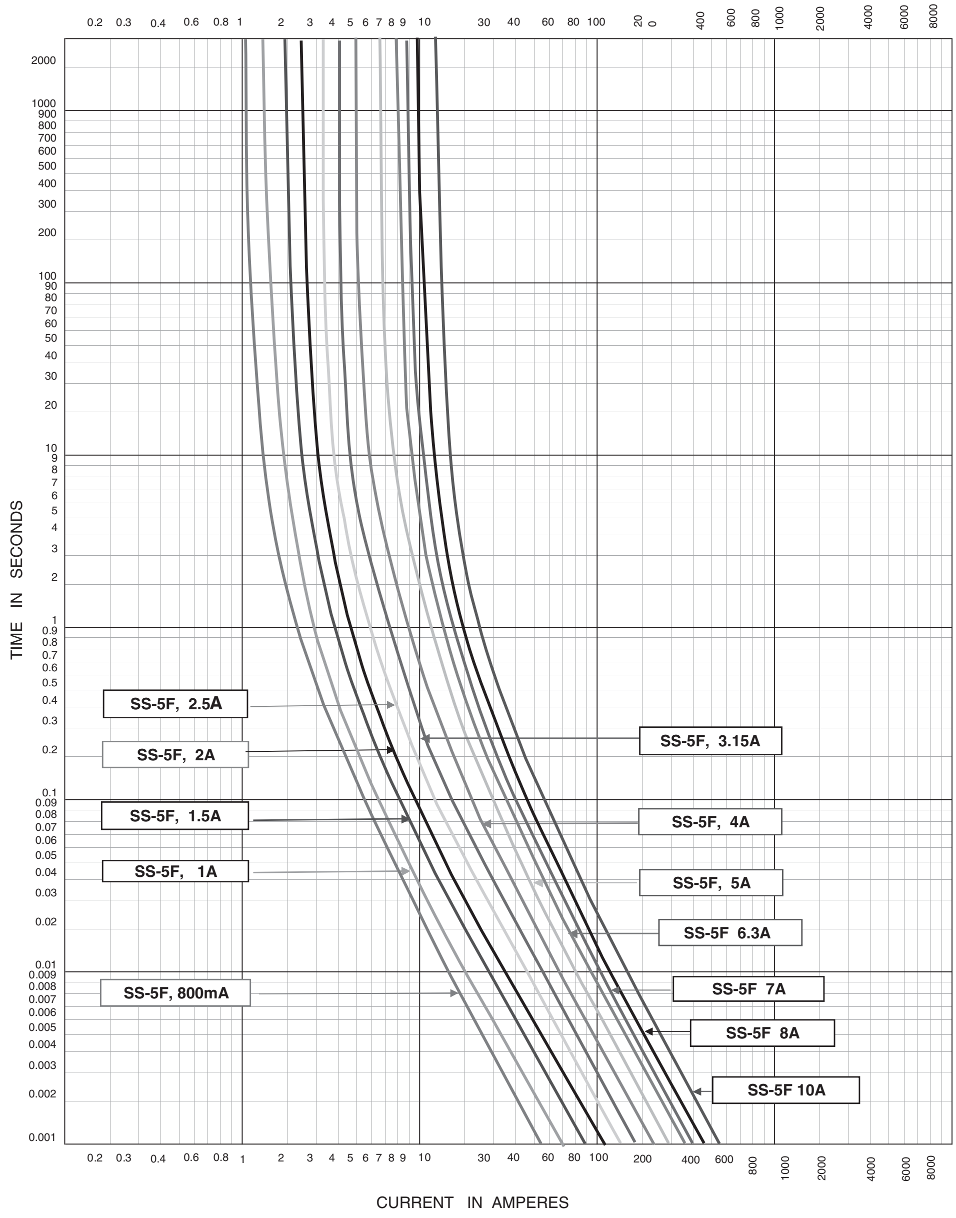
Dimensions mm/(inches)



SPECIFICATIONS				
Product Code	Voltage Rating AC	Interrupting Rating @ Rated Voltage	Typical DC Cold Resistance (ohms)	Typical Melting I^2t (A^2s) at 1ms
SS-5F-800mA	250V	50A	210	2.7
SS-5F-1A	250V	50A	120	4.9
SS-5F-1.6A	250V	50A	73	8.0
SS-5F-2A	250V	50A	50	12.1
SS-5F-2.5A	250V	50A	40	16.8
SS-5F-3.15A	250V	50A	32	32.4
SS-5F-4A	250V	50A	25	48.4
*SS-5F-5A	250V	50A	17	75.0
*SS-5F-6.3A	125V	50A	14	108
*SS-5F-7A	125V	50A	11	160
*SS-5F-8A	125V	50A	9	190
*SS-5F-10A	125V	50A	7	270

* Conducting Path min. $0.2mm^2$

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
-AP	Ammo-pack taped 1,000 per box
-BK	In bulk 200 per bag

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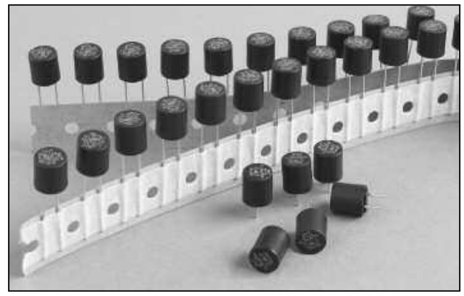
Subminiature Fuses
SR-5H Series, Time Lag

RoHS 2002/95/EC

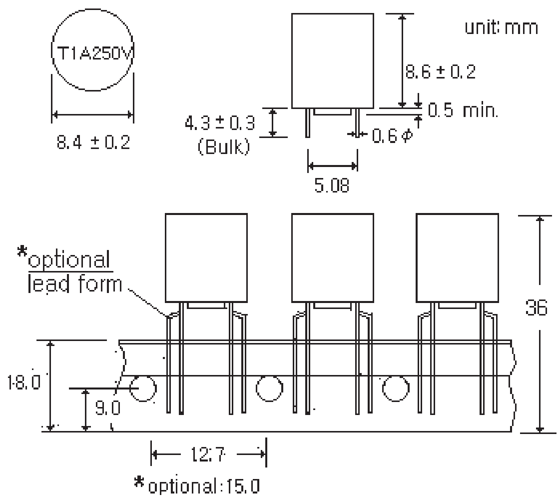


Description

- Radial Leaded Time Lag Thru-Hole Fuse
- Designed to IEC 60127-3, Sheet 4
- Ideal for electronic lighting ballasts
- cURus Recognized at 300V/100A
- Internationally accepted for primary and secondary overcurrent protection
- Place directly into PCB or plug into BK/PCS holder
- High inrush withstand capability
- Compatible with leaded and lead-free reflow and wave solder
- Base/Cap is Nylon #66, UL 94V0
- Pins are Tin Plated Copper

ELECTRICAL CHARACTERISTICS								
Rated Current	1.5 In min	2.1 In max	2.75 In min	2.75 In max	4 In min	4 In max	10 In min	10 In max
1A-6.3A	1hr	2 min	400 ms	10 sec	150 ms	3 sec	20 ms	150 ms

Dimensions mm/(inches)



Agency Information

- cURus: E146895 (1A thru 5A @ 300V/100A)
- PSE: (1A thru 6.3A @ 300V/100A)
- VDE: (1A thru 5A)
- SEMKO: (1A thru 5A) Pending
- CCC (1A thru 6.3A) Pending
- EK: KTL (1A thru 6.3A) Pending

Specifications

- Solderability: EIA-186-9E Method 9
- High Frequency Vibration: MIL-STD-202F, Method 201A
- Operating Temperature: -40°C to +125°C
- Soldering Heat Resistance: 260°C, 10S (IEC 60068-2-20)

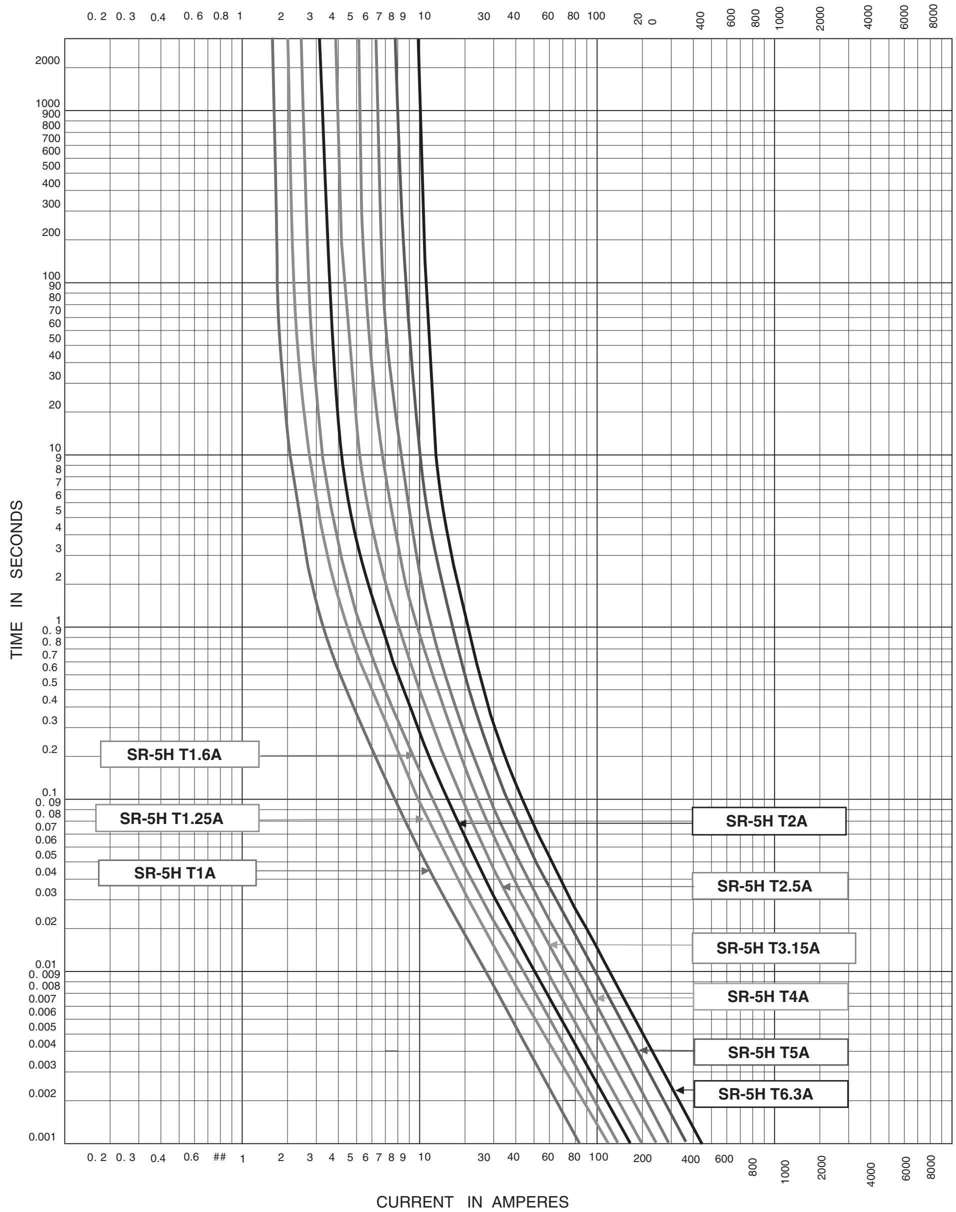
Ordering

- Specify product and packaging code (i.e., SR-5H-1A-AP)

SPECIFICATIONS					
Product Code	**Voltage Rating AC**	**Interrupting Rating @ Rated Voltage**	**Typical DC Cold Resistance (ohms)**	**Typical Melting I^2t (A^2s) at 1ms**	**Maximum Power Dissipation (mW)**
SR-5H-1A	250V	100A	0.083	9	500
SR-5H-1.25A	250V	100A	0.061	13	600
SR-5H-1.6A	250V	100A	0.047	24	730
SR-5H-2A	250V	100A	0.031	30	870
SR-5H-2.5A	250V	100A	0.028	45	1000
SR-5H-3.15A	250V	100A	0.023	57	1200
SR-5H-4A	250V	100A	0.015	80	1400
***SR-5H-5A**	250V	100A	0.011	120	1800
***SR-5H-6.3A**	250V	100A	0.009	140	2000

* Conducting Path min. $0.2mm^2$

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
-AP	Ammo-pack taped 1,000 per box
-BK	In bulk 200 per bag

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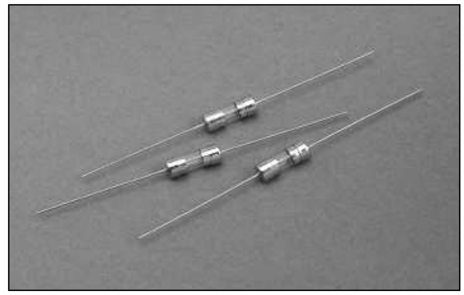
COOPER Bussmann

5mm x 15mm Fuses
C515 Series, Time Delay, Glass Tube

Description

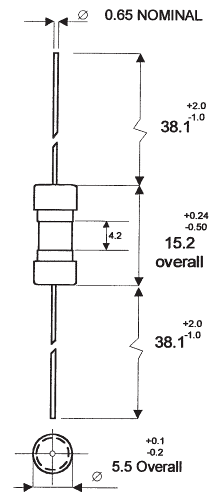
- Axial leaded, time delay
- 5mm x 15mm physical size
- Glass tube, nickel-plated brass endcap construction
- Leads are tin coated
- Optional sleeve is flexible flouropolymer (U.L. flammability rating VW-1).
- UL Listed product meets standard UL 248-14

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS		
Rated Current	**Amp Rating**	**Opening Time**
125mA - 250mA	135%	60 minutes max.
	200%	3 seconds min.
		120 seconds max.
350mA	100%	4 hours min.
	470mA	30 minutes max.
	600mA	90 seconds max.
	2A	2 seconds max.
	6A	500 milliseconds max.
375mA - 7A	135%	60 minutes max.
	200%	3 seconds min.
		120 seconds max.

Dimensions (mm)
Drawing Not to Scale



Agency Information

- UL Listed Card: C515 125mA-250mA and 375mA-3A (Guide JDYX, File E19180)
- UL Recognized Card: C515 350mA, and 3.5A-7A (Guide JDYX2, File E19180)
- CSA Certification Card: C515 125mA-250mA and 375mA-3A (Class 1422-01, LR65063)

Ordering

- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. C515-1-R)
- With TR2 packaging code, lead wire length is 20.3mm

SPECIFICATIONS							
Product Code	**Voltage Rating AC**	**AC Interrupting Rating 600V**	**250V**	**125V**	**Typical DC Cold Resistance* (ohms)**	**Typical Melting I²t† AC**	**Typical Voltage Drop (mV)‡**
C515-125mA	250V	-	35A	10000A	4.72	0.101	770
C515-250mA	250V	-	35A	10000A	1.32	0.467	430
C515-350mA	250V	25A	35A	10000A	1.04	1.169	530
C515-375mA	250V	-	35A	10000A	0.81	1.531	470
C515-500mA	250V	-	35A	10000A	0.54	2.280	440
C515-600mA	250V	-	35A	10000A	0.38	6.982	350
C515-750mA	250V	-	35A	10000A	0.26	9.162	310
C515-800mA	250V	-	35A	10000A	0.23	10.544	260
C515-1A	250V	-	35A	10000A	0.14	14.289	230
C515-1.25A	250V	-	100A	10000A	0.13	22.961	220
C515-1.5A	250V	-	100A	10000A	0.100	31.989	240
C515-1.6A	250V	-	100A	10000A	0.090	35.156	200
C515-2A	250V	-	100A	10000A	0.059	60.256	170
C515-2.25A	250V	-	100A	10000A	0.057	97.724	180
C515-2.5A	250V	-	100A	10000A	0.046	78.163	190
C515-3A	250V	-	100A	10000A	0.035	80.426	150
C515-3.5A	125V	-	-	400A	0.028	149.279	130
C515-4A	125V	-	-	400A	0.023	233.346	130
C515-5A	125V	-	-	400A	0.019	354.813	150
C515-6A	125V	-	-	400A	0.014	471.360	125
C515-7A	125V	-	-	400A	0.013	710.500	100

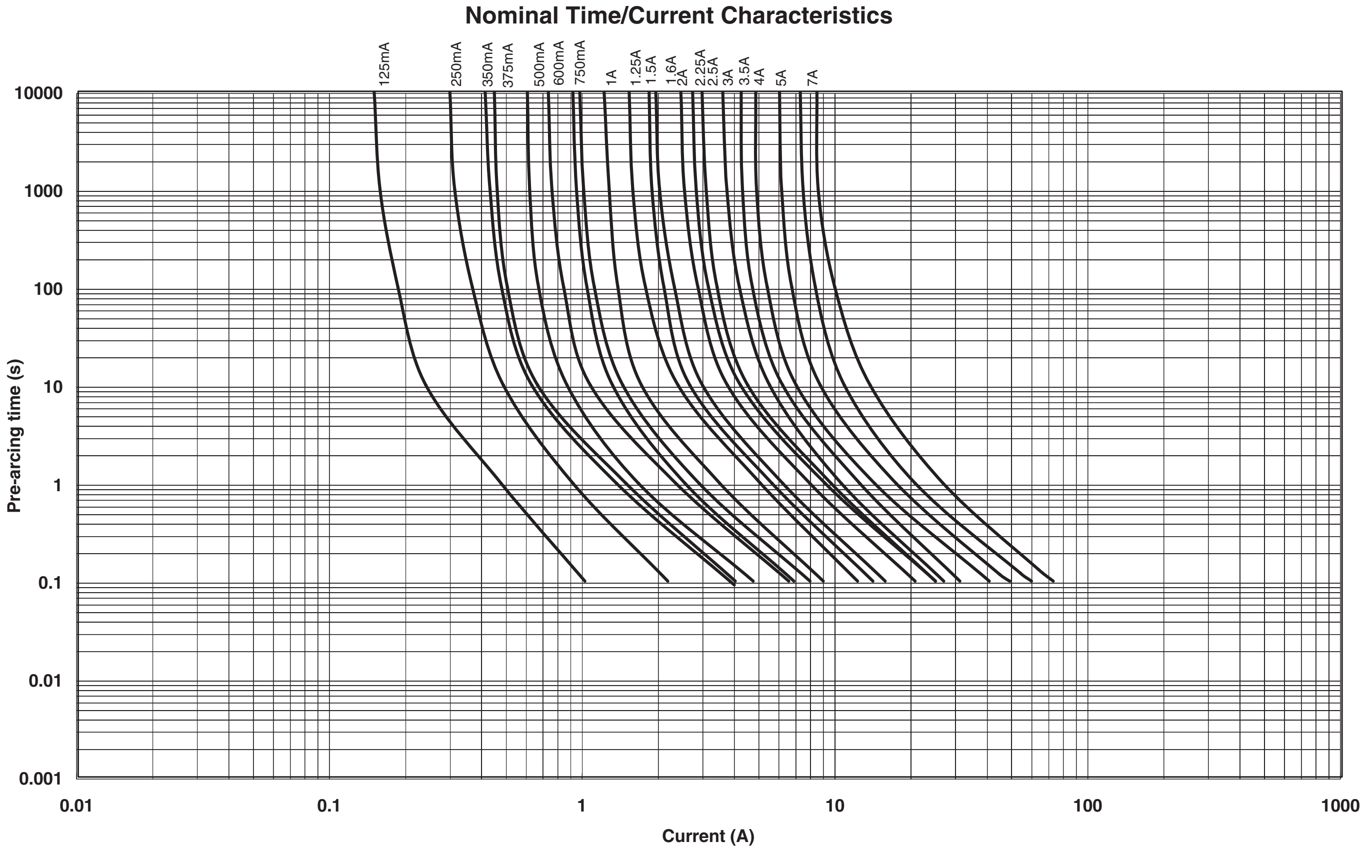
* DC Cold Resistance (Measured at <10% of rated current)
† Typical Melting I^2t (A^2Sec) (Minimum I^2t at 10 times rated current)
‡ Typical Voltage Drop (Voltage drop was measured at 25°C ambient temperature at rated current)

COOPER Bussmann

5mm x 15mm Fuses

C515 Series, Time Delay, Glass Tube

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
TR2	1,500 pieces of fuses packed into tape on a reel (20.3mm lead wire length)

OPTION CODE	
Option Code	**Description**
S	Insulation Sleeve
-R	RoHS compliant version

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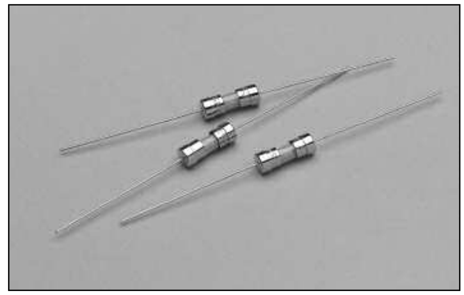
COOPER Bussmann

5mm x 15mm Fuses
C517 Series, Fast Acting, Glass Tube

Description

- Axial leaded fast acting
- 5mm x 15mm physical size
- Glass tube, nickel-plated brass endcap construction
- Leads are plated with 95% tin, 5% lead
- Optional sleeve is flexible flouropolymer (U.L. flammability rating VW-1).
- UL Listed product meets standard UL 248-14
- High breaking capacity for lighting ballast applications

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS		
Rated Current	Amp Rating	Opening Time
3A	100%	None
	135%	60 minutes max.
	200%	2 seconds max.

Agency Information

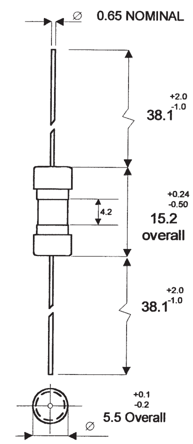
- UL Listed Card: C517 3A (Guide JDYX, File E75865)
- UL Recognition Card: C517 3A (Guide JDYX2, File E75865)
- CSA Certification Card: 3A (Class 1422-01, LR65063)

Ordering

- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. C517-3-R)

Dimensions (mm)

Drawing Not to Scale



- With TR2 packaging code, lead wire length is 20.3mm

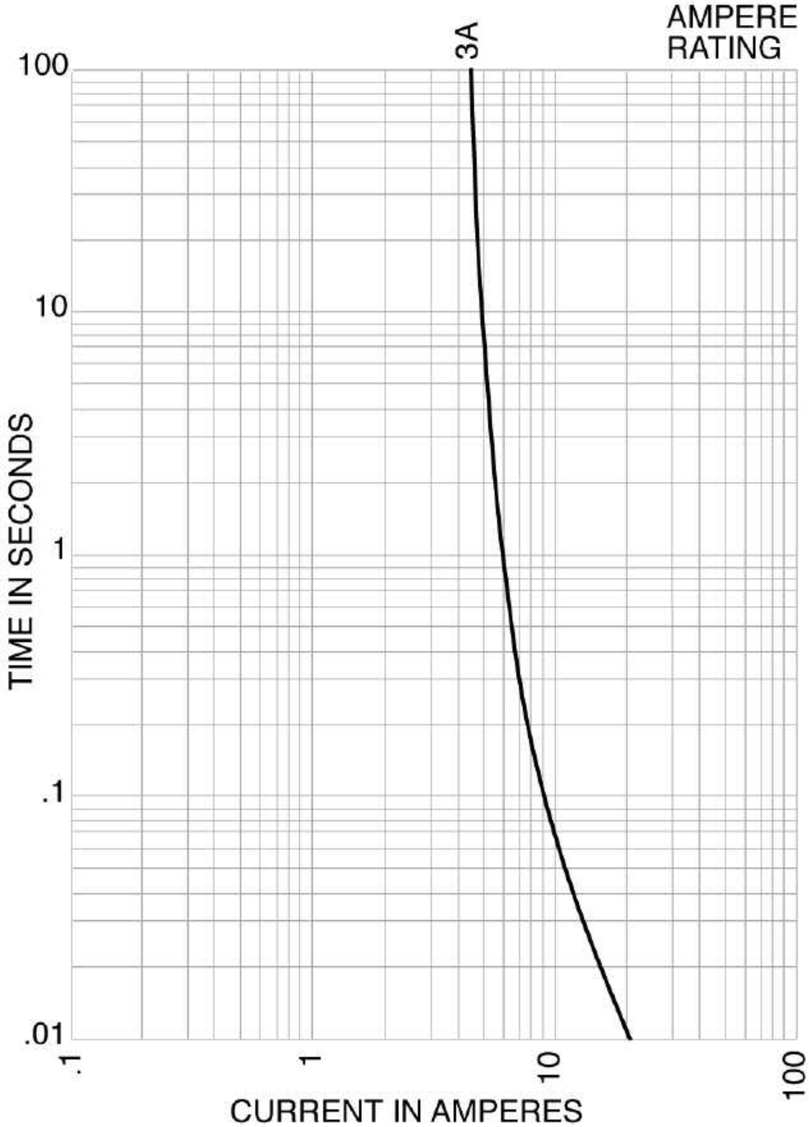
SPECIFICATIONS					
Product Code	Voltage Rating AC	Interrupting Rating at Rated Voltage AC	Typical DC Cold Resistance* (ohms)	Typical Melting I^2t† AC	Typical Voltage Drop (mV)‡
C517-3A	350V**	100A	0.34	5.87	141.7
	250V	100A			
	125V	10,000A			

* DC Cold Resistance (Measured at <10% of rated current)
† Typical Melting I^2t (A^2Sec) (Minimum I^2t at 10 times rated current)
‡ Typical Voltage Drop (Voltage drop was measured at 25°C ambient temperature at rated current)
** 350VAC is UL Recognized

5mm x 15mm Fuses

C517 Series, Fast Acting, Glass Tube

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
TR2	1,500 pieces of fuses packed into tape on a reel (20.3mm lead wire length)

OPTION CODE	
Option Code	**Description**
S	Insulation Sleeve
-R	RoHS compliant version

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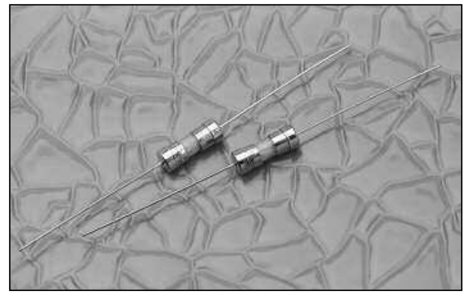
COOPER Bussmann

5mm x 15mm Fuses
C518 Series, Fast Acting, Glass Tube

Description

- Axial leaded fast acting
- 5mm x 15mm physical size
- Glass tube, nickel-plated brass endcap construction
- Leads are plated with 95% tin, 5% lead
- Optional sleeve is flexible flouropolymer (U.L. flammability rating VW-1).
- UL Listed product meets standard UL 248-14

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS		
Rated Current	Amp Rating	Opening Time
100mA-5A	100%	None
	135%	60 minutes max.
	200%	2 seconds max.

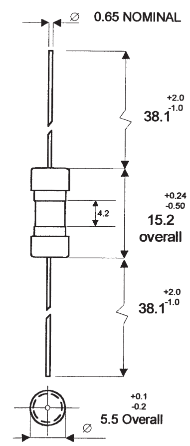
Agency Information

- UL Listed Card: Guide JDYX, File E19180
- CSA Certification Card: Class 1422-01, LR65063

Ordering

- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. C518-3-R)

Dimensions (mm)
Drawing Not to Scale

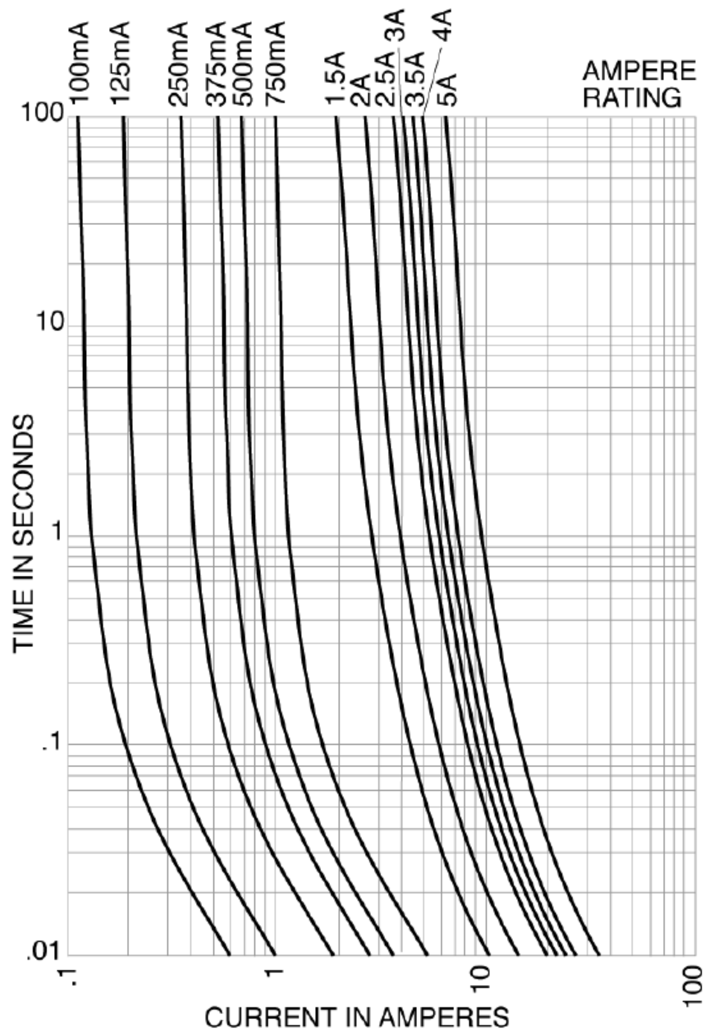


- With TR2 packaging code, lead wire length is 20.3mm

SPECIFICATIONS						
Product Code	Voltage Rating AC	Interrupting Rating at Rated Voltage 250VAC	125VAC	Typical DC Cold Resistance* (ohms)	Typical Melting I^2t† AC	Typical Voltage Drop (mV)‡
C518-100mA	250V	35A	10,000A	22.30	0.0010	2230
C518-125mA	250V	35A	10,000A	15.20	0.0019	1930
C518-250mA	250V	35A	10,000A	5.66	0.012	1450
C518-375mA	250V	35A	10,000A	2.53	0.039	968
C518-500mA	250V	35A	10,000A	1.66	0.059	845
C518-750mA	250V	35A	10,000A	0.91	0.264	686
C518-1.5A	250V	100A	10,000A	0.900	0.800	135
C518-2A	250V	100A	10,000A	0.064	1.9	136
C518-2.5A	250V	100A	10,000A	0.046	2.9	121
C518-3A	250V	100A	10,000A	0.038	6.1	116
C518-3.5A	250V	100A	10,000A	0.032	9.7	115
C518-4A	250V	200A	10,000A	0.022	16.6	88
C518-5A	250V	200A	10,000A	0.018	22.4	91

* DC Cold Resistance (Measured at <10% of rated current)
† Typical Melting I^2t (A^2Sec) (Minimum at 10 times rated current)
‡ Typical Voltage Drop (Voltage drop was measured at 20°C ambient temperature at rated current)

TIME CURRENT CURVE
Time-Current Characteristic Curves–Average Melt



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
TR2	1,500 pieces of fuses packed into tape on a reel (20.3mm lead wire length)

OPTION CODE	
Option Code	**Description**
S	Insulation Sleeve
-R	RoHS compliant version

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5mm x 15mm Fuses
C519 Series, Time Delay, Glass Tube

RoHS 2002/95/EC

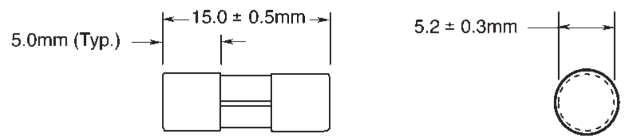
Description

- Time delay
- 5mm x 15mm physical size
- Glass tube, nickel-plated brass endcap construction
- Optional sleeve is flexible flouropolymer (U.L. flammability rating VW-1).
- UL Listed product meets standard UL 248-14

ELECTRICAL CHARACTERISTICS		
Rated Current	Amp Rating	Opening Time
125mA - 250mA	135%	60 minutes max.
	200%	3 seconds min.
		120 seconds max.
350mA	100%	4 hours min.
	470mA	30 minutes max.
	600mA	90 seconds max.
	2A	2 seconds max.
	6A	500 milliseconds max.
375mA - 5A	135%	60 minutes max.
	200%	3 seconds min.
		120 seconds max.

Dimensions

Drawing Not to Scale



Agency Information

- UL Listed Card: C519 125mA-250mA and 375mA-3A (Guide JDYX, File E19180)
- UL Recognized Card: C519 350mA, and 3.5A-7A (Guide JDYX2, File E19180)
- CSA Certification Card: C519 125mA-250mA and 375mA-3A (Class 1422-01, LR65063)

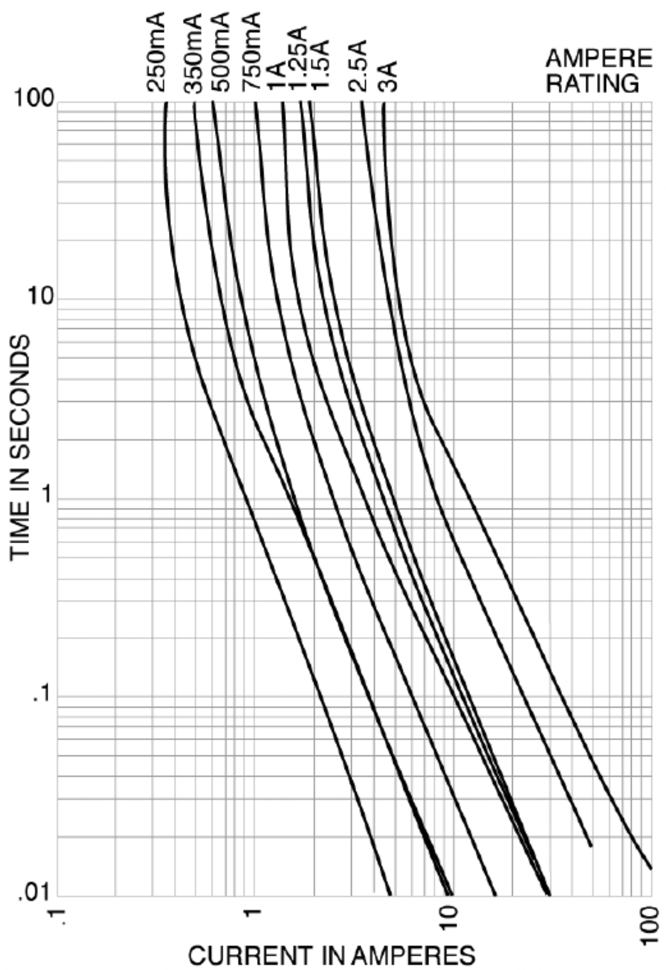
Ordering

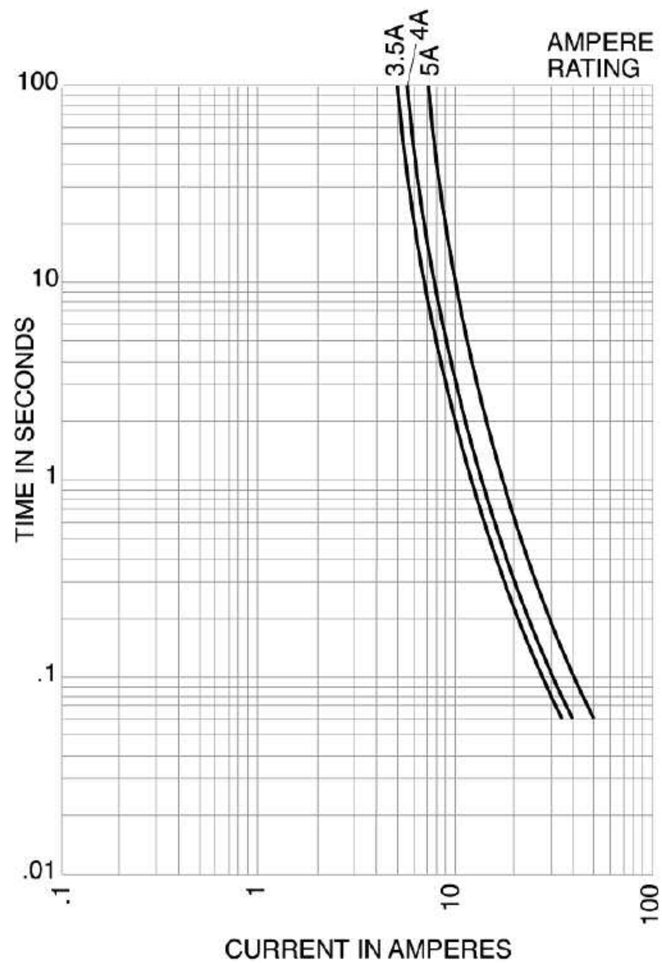
- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. C519-3-R)

SPECIFICATIONS							
Product Code	Voltage Rating AC	Interrupting Rating at Rated Voltage			Typical DC Cold Resistance* (ohms)	Typical Melting I^2t† AC	Typical Voltage Drop (mV)‡
		600V	250V	125V			
C519-125mA	250V	-	35A	10,000A	4.72	0.101	770
C519-250mA	250V	-	35A	10,000A	1.32	0.467	430
C519-350mA	250V	25A	35A	10,000A	1.04	1.169	530
C519-375mA	250V	-	35A	10,000A	0.81	1.531	470
C519-500mA	250V	-	35A	10,000A	0.54	2.280	440
C519-600mA	250V	-	35A	10,000A	0.38	6.982	350
C519-750mA	250V	-	35A	10,000A	0.26	9.162	310
C519-1A	250V	-	35A	10,000A	0.14	14.289	230
C519-1.25A	250V	-	100A	10,000A	0.13	22.961	220
C519-1.5A	250V	-	100A	10,000A	0.10	31.989	240
C519-1.6A	250V	-	100A	10,000A	0.09	31.156	200
C519-2A	250V	-	100A	10,000A	0.059	60.256	170
C519-2.25A	250V	-	100A	10,000A	0.057	97.724	180
C519-2.5A	250V	-	100A	10,000A	0.046	78.163	190
C519-3A	250V	-	100A	10,000A	0.035	80.426	150
C519-3.5A	125V	-	-	400A	0.028	149.279	130
C519-4A	125V	-	-	400A	0.023	233.346	130
C519-5A	125V	-	-	400A	0.019	354.813	150

* DC Cold Resistance (Measured at <10% of rated current)
† Typical Melting I^2t (A^2Sec) (Typical I^2t at 10 times rated current)
‡ Typical Voltage Drop (Voltage drop was measured at 25°C±3°C ambient temperature at rated current)

TIME CURRENT CURVE





PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a cardboard carton

OPTION CODE	
Option Code	**Description**
S	Insulation Sleeve
-R	RoHS compliant version

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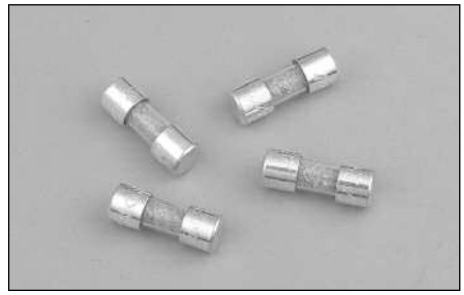
5mm x 15mm Fuses
C520 Series, Fast Acting, Glass Tube

RoHS 2002/95/EC



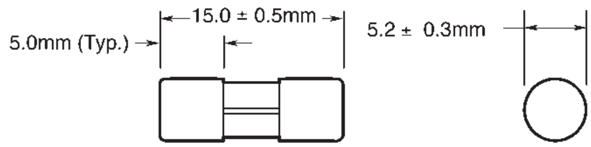
Description

- Fast acting
- 5mm x 15mm physical size
- Glass tube, nickel-plated brass endcap construction
- Optional sleeve is flexible flouropolymer (U.L. flammability rating VW-1).
- UL Listed product meets standard UL 248-14

ELECTRICAL CHARACTERISTICS		
Rated Current	Amp Rating	Opening Time
100mA - 5A	100%	None
	135%	1 hours max.
	200%	2 seconds max.

Dimensions

Drawing Not to Scale



Agency Information

- UL Listed Card: Guide JDYX, File E19180
- CSA Certification Card: Class 1422-01, LR65063

Ordering

- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. C520-3-R)

SPECIFICATIONS						
Product Code	Voltage Rating AC	Interrupting Rating at Rated Voltage 250VAC	125VAC	Typical DC Cold Resistance* (ohms)	Typical Melting I^2t† AC	Typical Voltage Drop (mV)‡
C520-100mA	250V	35A	10,000A	22.30	0.0010	2230
C520-125mA	250V	35A	10,000A	15.20	0.0019	1930
C520-250mA	250V	35A	10,000A	5.60	0.012	1450
C520-375mA	250V	35A	10,000A	2.53	0.039	968
C520-500mA	250V	35A	10,000A	1.66	0.059	845
C520-750mA	250V	35A	10,000A	0.91	0.264	686
C520-1.5A	250V	100A	10,000A	0.900	0.800	135
C520-2A	250V	100A	10,000A	0.064	1.9	136
C520-2.5A	250V	100A	10,000A	0.046	2.9	121
C520-3A	250V	100A	10,000A	0.038	6.1	116
C520-3.5A	250V	100A	10,000A	0.032	9.7	115
C520-4A	250V	200A	10,000A	0.022	16.6	88
C520-5A	250V	200A	10,000A	0.018	22.4	91

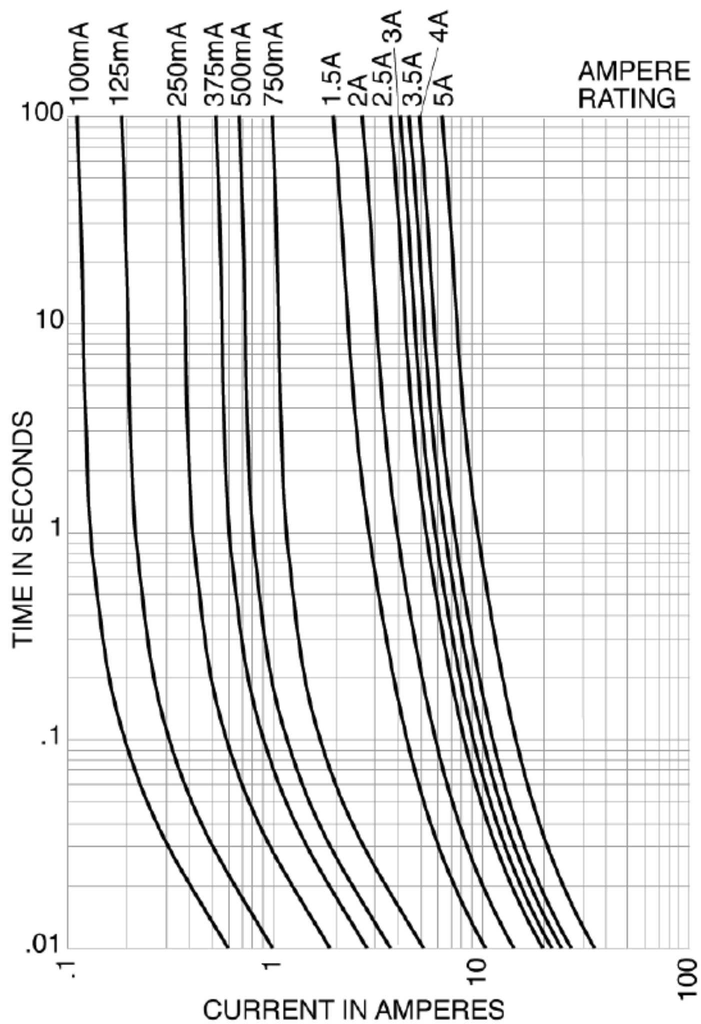
* DC Cold Resistance (Measured at <10% of rated current)
† Typical Melting I^2t (A^2Sec) (maximum I^2t at 10 times rated current)
‡ Typical Voltage Drop (Voltage drop was measured at 25°C±3°C ambient temperature at rated current)

5mm x 15mm Fuses

C520 Series, Fast Acting, Glass Tube

TIME CURRENT CURVE

Time-Current Characteristic Curves–Average Melt



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a cardboard carton

OPTION CODE	
Option Code	**Description**
S	Insulation Sleeve
-R	RoHS compliant version

Traditional Ferrule Fuses - Ferrule Type

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COOPER Bussmann

5mm x 20mm Fuses

S500 Series, Fast Acting, Glass Tube

Description

RoHS 2002/95/EC

- Fast acting, low breaking capacity
- Optional Axial leads available
- 5mm x 20mm physical size
- Glass tube, nickel-plated brass endcap construction
- Designed to IEC 60127-2 (32mA-6.3A)

ELECTRICAL CHARACTERISTICS							
	1.5 In	2.1 In	2.75 In		4 In		10 In
In	min	max	min	max	min	max	max
32mA-100mA	60 min	30 min	10 ms	500 ms	3 ms	100 ms	20 ms
125mA-6.3A	60 min	30 min	50 ms	2 sec	10 ms	300 ms	20 ms

Agency Information

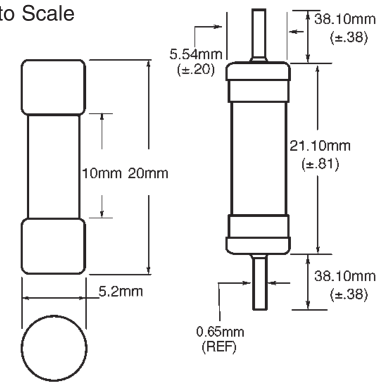
- UL Recognized Card: (32mA-10A) Guide JDYX2, File E19180
- CSA Component Acceptance: File 53787
- cURus Recognition: Guide JDYX8, File E19180
- SEMKO Approval 160mA-10A
- VDE Approval 160mA-10A
- BSI Approval 160mA-10A
- IMQ Approval 160mA-10A
- CCC Approval 160mA-6.3A

Ordering

- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. S500-2-R)

Dimensions

Drawing Not to Scale



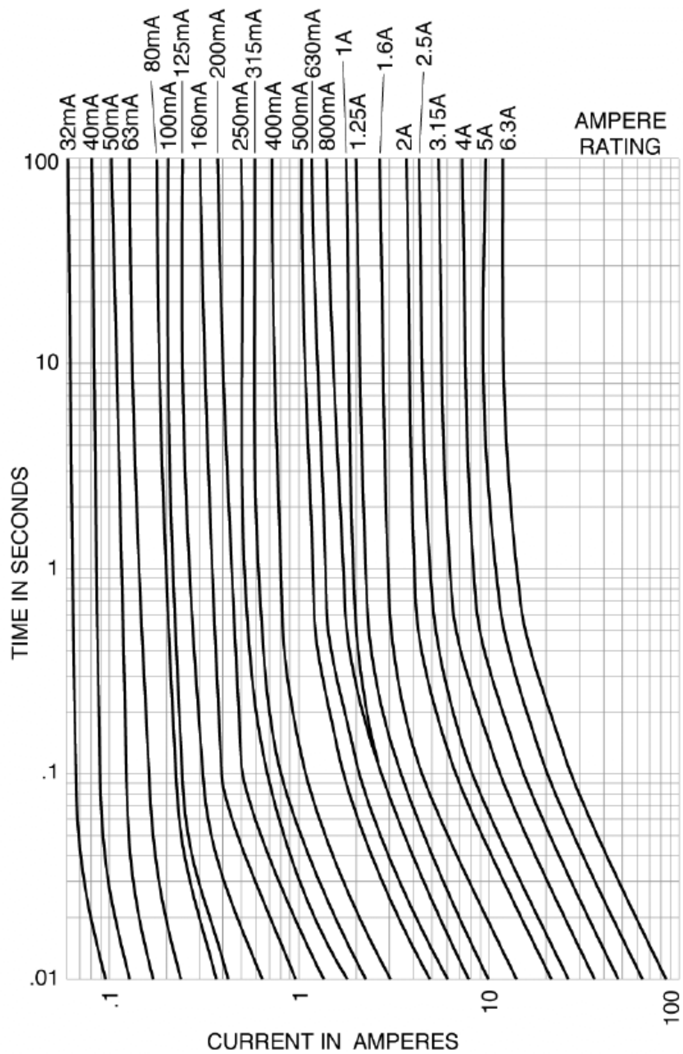
- Ratings above 6.3A have a 0.8mm diameter lead
- With TR2 packaging code, lead wire length is 19.05mm

SPECIFICATIONS					
Product Code	**Voltage Rating AC**	**Interrupting Rating at Rated Voltage (50Hz) AC**	**Typical DC Cold Resistance (ohms)***	**Typical Melting I^2t (A^2Sec) AC†**	**Maximum Voltage Drop (mV)‡**
S500-32mA	250V	35A	41.5	0.000047	3200
S500-40mA	250V	35A	25.5	0.00011	2500
S500-50mA	250V	35A	17.5	0.00020	2400
S500-63mA	250V	35A	12.9	0.00057	2000
S500-80mA	250V	35A	5.2	0.0012	1200
S500-100mA	250V	35A	3.9	0.003	1100
S500-125mA	250V	35A	2.9	0.005	1000
S500-160mA	250V	35A	9.2	0.008	2000
S500-200mA	250V	35A	7.0	0.016	1700
S500-250mA	250V	35A	4.5	0.28	1400
S500-315mA	250V	35A	3.2	0.58	1300
S500-400mA	250V	35A	1.9	0.18	1100
S500-500mA	250V	35A	0.27	0.18	220
S500-630mA	250V	35A	0.21	0.35	220
S500-800mA	250V	35A	0.15	0.67	190
S500-1A	250V	35A	0.13	0.60	200
S500-1.25A	250V	35A	0.098	0.84	200
S500-1.6A	250V	35A	0.068	1.6	190
S500-2A	250V	35A	0.044	4.2	150
S500-2.5A	250V	35A	0.035	6.1	150
S500-3.15A	250V	35A	0.026	13	130
S500-4A	250V	40A	0.022	22	130
S500-5A	250V	50A	0.015	42	120
S500-6.3A	250V	63A	0.010	69	120
S500-8A	250V	80A	N/A	N/A	N/A
S500-10A	250V	100A	N/A	N/A	N/A

* DC Cold Resistance (Measured at <10% of rated current)
† Typical Melting I^2t (I^2t was measured at listed interrupting rating and rated voltage)
‡ Maximum Voltage Drop (Voltage drop was measured at 20°C ambient temperature at rated current)

TIME CURRENT CURVE

Time-Current Characteristic Curves–Average Melt



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a poly bag
TR2	1,500 pieces of fuses packed into tape on a reel (19.05mm lead wire length)

OPTION CODE	
Option Code	**Description**
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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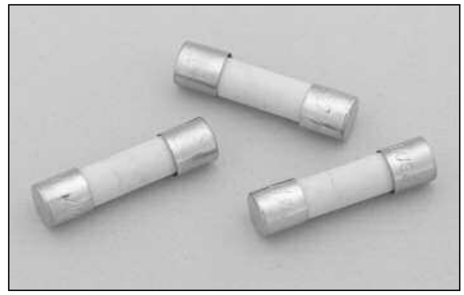
5mm x 20mm Fuses

S501 Series, Fast Acting, Ceramic Tube

RoHS 2002/95/EC



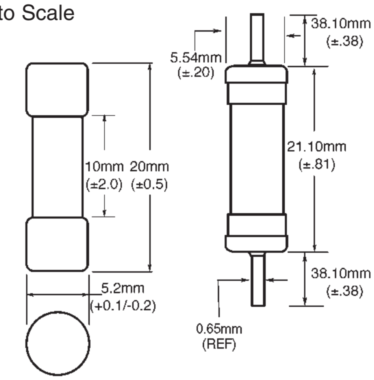
Description

- Fast acting
- Optional axial leads available
- 5mm x 20mm physical size
- Ceramic tube, nickel brass endcap construction
- Designed to IEC 60127-2

ELECTRICAL CHARACTERISTICS							
	1.5 In	2.1 In	2.75 In		4 In		10 In
In	min	max	min	max	min	max	max
50mA-3.15A	60 min	30 min	10 ms	2 sec	3 ms	300 ms	20 ms
4A-10A	60 min	30 min	10 ms	3 sec	3 ms	300 ms	20 ms

Dimensions

Drawing Not to Scale



- Ratings above 6.3A have a 0.8mm diameter lead
- With TR2 packaging code, lead wire length is 19.05mm

Agency Information

- UL Recognized Card: (50mA-10A) Guide JDYX2, File E19180
- CSA Component Acceptance: File 53787
- cURus Recognition: Guide JDYX8, File E19180
- SEMKO Approval 50mA, 160mA-10A
- VDE Approval 160mA-10A
- IMQ Approval 50mA-10A
- CCC Approval 160mA-10A

Ordering

- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. S501-2-R)

SPECIFICATIONS				
Product Code	**Voltage Rating AC**	**Interrupting Rating at Rated Voltage AC**	**Typical Melting I²t (A²Sec) AC**	**Typical Voltage Drop (mV)‡**
S501-50mA	250V	1500A	0.0017	9000
S501-63mA	250V	1500A	0.0005	3300
S501-80mA	250V	1500A	0.0011	2600
S501-100mA	250V	1500A	0.0018	2300
S501-125mA	250V	1500A	0.0037	1900
S501-160mA	250V	1500A	0.008	1600
S501-200mA	250V	1500A	0.020	1350
S501-250mA	250V	1500A	0.027	1300
S501-315mA	250V	1500A	0.010	1400
S501-400mA	250V	1500A	0.018	1200
S501-500mA	250V	1500A	0.038	1050
S501-630mA	250V	1500A	0.064	1200
S501-800mA	250V	1500A	0.097	490
S501-1A	250V	1500A	0.480	230
S501-1.25A	250V	1500A	0.9	200
S501-1.6A	250V	1500A	1.9	180
S501-2A	250V	1500A	2.0	205
S501-2.5A	250V	1500A	3.9	190
S501-3.15A	250V	1500A	8.1	160
S501-4A	250V	1500A	14	160
S501-5A	250V	1500A	25	155
S501-6.3A	250V	1500A	48	150
S501-8A	250V	1500A	N/A	N/A
S501-10A	250V	1500A	N/A	N/A

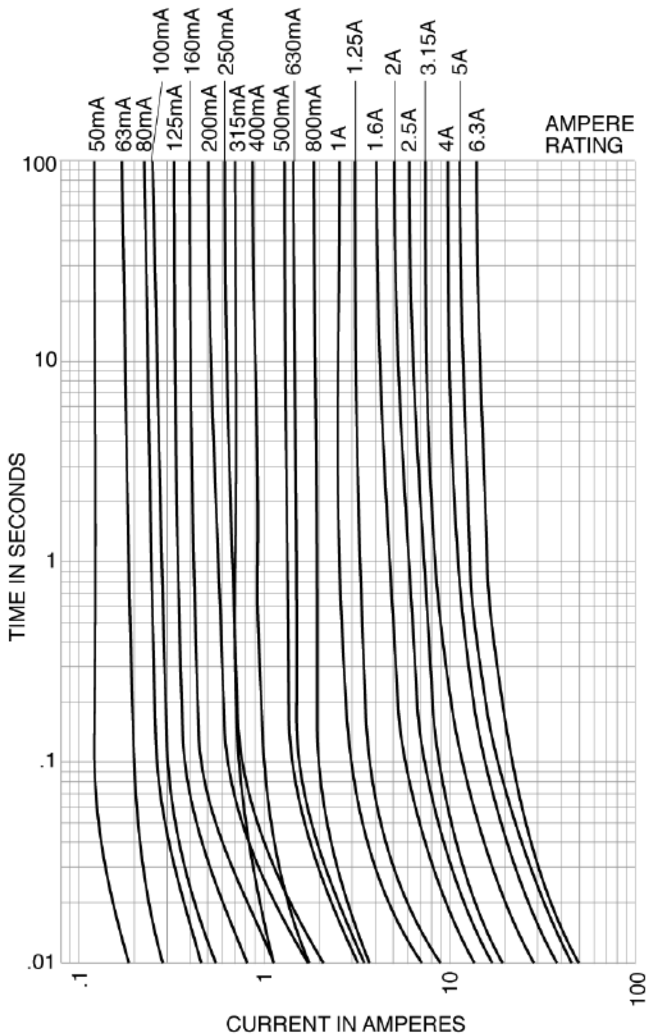
‡ Typical Voltage Drop (Voltage drop was measured at 20°C ambient temperature at rated current)

5mm x 20mm Fuses

S501 Series, Fast Acting, Ceramic Tube

TIME CURRENT CURVE

Time-Current Characteristic Curves–Average Melt



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a poly bag
TR2	1,500 pieces of fuses packed into tape on a reel (19.05mm lead wire length)

OPTION CODE	
Option Code	**Description**
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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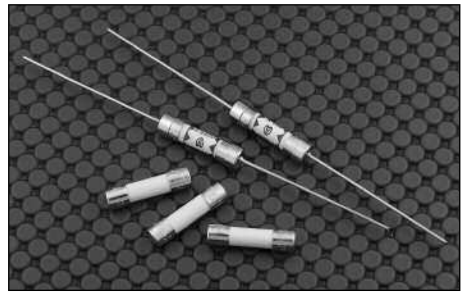
5mm x 20mm Fuses
S505 Series, Time Delay, Ceramic Tube

Description

- Time delay, high breaking capacity
- Optional axial leads available
- 5mm x 20mm physical size
- Ceramic tube, nickel plated brass endcap construction
- Designed to IEC 60127-2 (1A-12A)

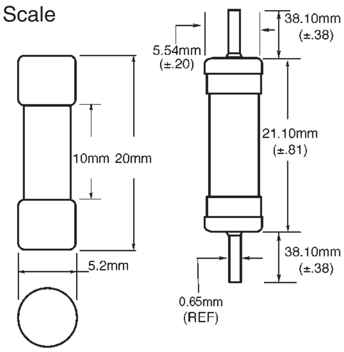
RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS								
	1.5 In	2.1 In	2.75 In		4 In		10 In	
In	min	max	min	max	min	max	min	max
<1A	60 min	30 min	250 ms	80 sec	50 ms	5 sec	5 ms	55 ms
1A-3.15A	60 min	30 min	1 sec	80 sec	95 ms	5 sec	10 ms	100 ms
4A-10A	60 min	30 min	1 sec	80 sec	150 ms	5 sec	20 ms	100 ms
12.5A	--	30 min	1 sec	80 sec	150 ms	5 sec	20 ms	100 ms

Dimensions

Drawing Not to Scale



Agency Information

- UL Recognized Card: (500mA-12A) Guide JDYX2, File E19180
- CSA Component Acceptance: File 53787, 500mA-10A
- SEMKO Approval, 500mA-10A
- VDE Approval, 500mA-10A
- BSI Approval, 500mA-10A
- IMQ Approval, 500mA-10A
- CCC Approval, 500mA-6.3A

Ordering

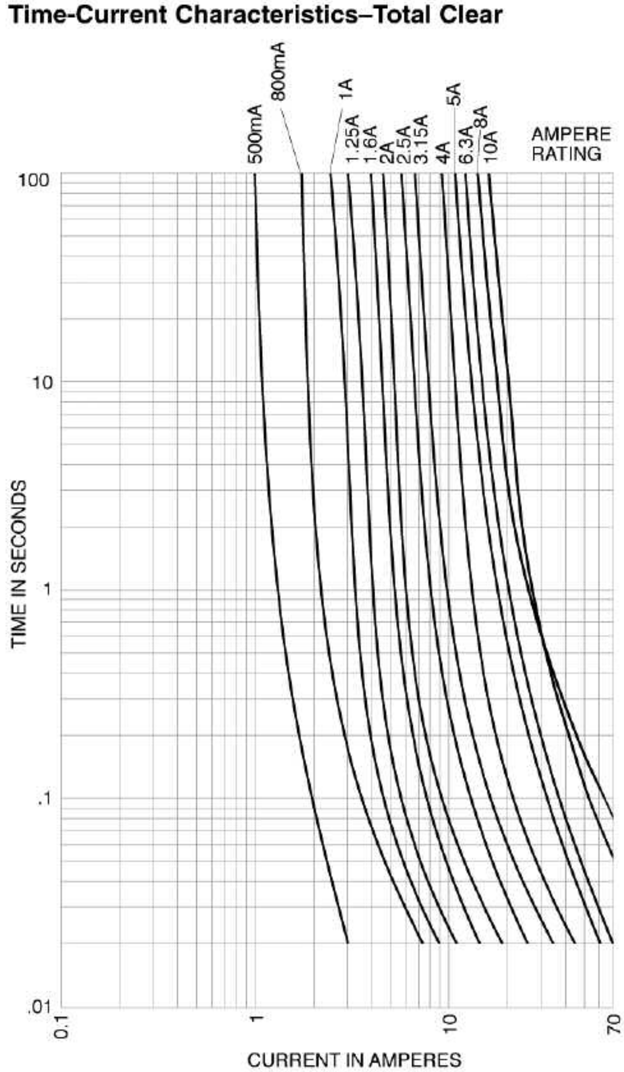
- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. S505-3-R)

- Ratings above 6.3A have a 0.8mm diameter lead
- With TR2 packaging code, lead wire length is 19.05mm

SPECIFICATIONS					
Product Code	Voltage Rating AC	Interrupting Rating at Rated Voltage (50Hz) AC	Typical DC Cold Resistance (ohms)*	Typical Melting I^2t (A^2Sec) AC†	Typical Voltage Drop (mV)‡
S505-500mA	250V	1500A	0.507	-	295
S505-800mA	250V	1500A	0.237	-	189
S505-1A	250V	1500A	0.138	0.74	170
S505-1.25A	250V	1500A	0.089	1.6	150
S505-1.6A	250V	1500A	0.060	3.5	130
S505-2A	250V	1500A	0.041	7.6	110
S505-2.5A	250V	1500A	0.030	14	100
S505-3.15A	250V	1500A	0.021	27	90
S505-4A	250V	1500A	0.015	52	85
S505-5A	250V	1500A	0.011	98	80
S505-6.3A	250V	1500A	0.008	197	75
S505-8A	250V	1500A	0.007	311	75
S505-10A	250V	1500A	0.006	397	72
S505-12A	250V	1000A	0.005	714^x	77

* DC Cold Resistance (Measured at <10% of rated current)
† Typical Melting I^2t (I^2t was measured at listed interrupting rating and rated voltage)
‡ Typical Voltage Drop (Voltage drop was measured at 20°C ambient temperature at rated current)
x Typical Melting I2t was measured at 10 times the rated current under DC

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a poly bag
TR2	1,500 pieces of fuses packed into tape on a reel (19.05mm lead wire length)

OPTION CODE	
Option Code	**Description**
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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5mm x 20mm Fuses

S506 Series, Time Delay, Glass Tube

Description
- Time delay, low breaking capacity
- Optional axial leads available
- 5mm x 20mm physical size
- Glass tube, nickel-plated brass endcap construction
- Designed to IEC 60127-2 (32mA-10A)

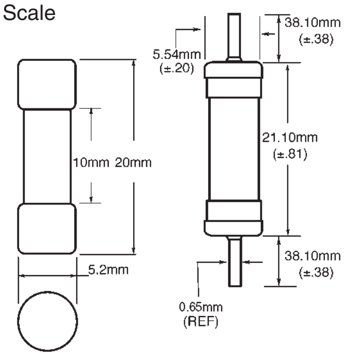
RoHS 2002/95/EC

S506 ELECTRICAL CHARACTERISTICS								
	2.1 In	2.75 In		4 In		10 In		
In	max	min	max	min	max	min	max	
32mA-100mA	2 min	200 ms	10 sec	40 ms	3 sec	10 ms	300 ms	
125mA-6.3A	2 min	600 ms	10 sec	150 ms	3 sec	20 ms	300 ms	
8A-15A	2 min	600 ms	10 sec	150 ms	3 sec	20 ms	300 ms	

Agency Information
- UL Recognized Card: (32mA-15A) Guide JDYX2, File E19180
- CSA Component Acceptance: File 53787
- cURus Recognition: Guide JDYX8, File E19180
- SEMKO Approval, 32mA-10A
- VDE Approval, 32mA-10A
- BSI Approval, 32mA-10A
- IMQ Approval, 32mA-10A
- MITI Approval, 32mA-6.3A
- CCC Approval, 32mA-6.3A

Ordering
- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. S506-2-R)

Dimensions
Drawing Not to Scale

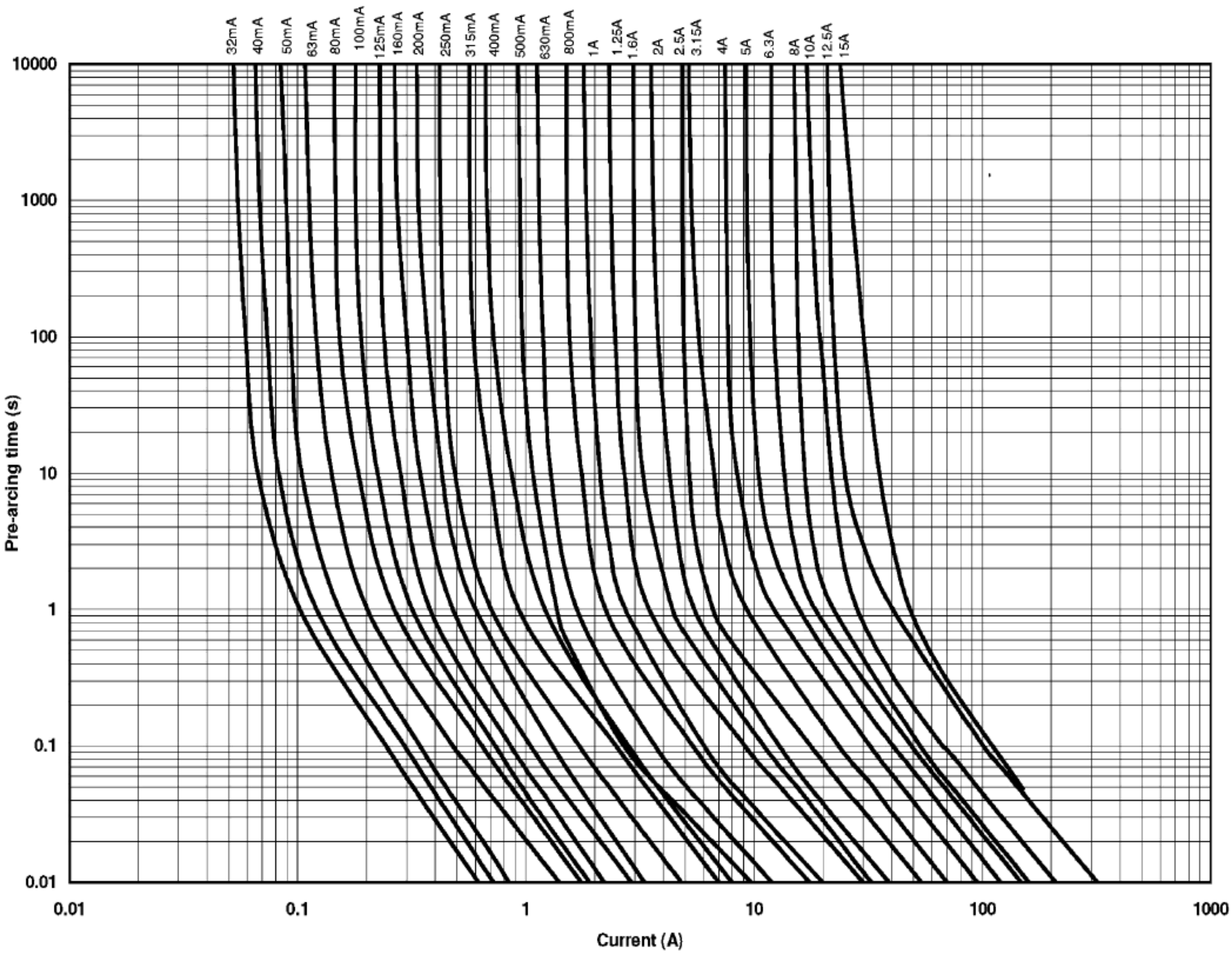


- Ratings above 6.3A have a 0.8mm diameter lead
- With TR2 packaging code, lead wire length is 19.05mm

SPECIFICATIONS					
Product Code	Voltage Rating AC	Interrupting Rating at Rated Voltage (50Hz) AC	Typical DC Cold Resistance (ohms)*	Minimum Pre-Arching I^2t (A^2Sec) AC†	Typical Voltage Drop (mV)‡
S506-32mA	250V	35A	21.0	0.0014	1050
S506-40mA	250V	35A	13.90	0.0034	920
S506-50mA	250V	35A	9.24	0.006	800
S506-63mA	250V	35A	6.96	0.012	760
S506-80mA	250V	35A	4.42	0.015	580
S506-100mA	250V	35A	2.74	0.022	490
S506-125mA	250V	35A	1.97	0.034	390
S506-160mA	250V	35A	1.27	0.052	320
S506-200mA	250V	35A	1.00	0.078	340
S506-250mA	250V	35A	0.640	0.17	270
S506-315mA	250V	35A	0.450	0.41	250
S506-400mA	250V	35A	0.308	0.61	210
S506-500mA	250V	35A	0.183	0.67	140
S506-630mA	250V	35A	0.186	1.0	150
S506-800mA	250V	35A	0.128	2.2	75
S506-1A	250V	35A	0.062	2.7	80
S506-1.25A	250V	35A	0.045	6.7	70
S506-1.6A	250V	35A	0.038	9.7	70
S506-2A	250V	35A	0.028	15	68
S506-2.5A	250V	35A	0.023	25	68
S506-3.15A	250V	35A	0.017	51	66
S506-4A	250V	40A	0.012	88	66
S506-5A	250V	50A	0.008	150	66
S506-6.3A	250V	63A	0.008	214	60
S506-8A	250V	80A	0.006	192	55
S506-10A	250V	100A	0.004	420	54
S506-12.5A	250V	125A	0.004	812	45
S506-15A	250V	125A	0.004	1029	73

* DC Cold Resistance (Measured at <10% of rated current)
† Minimum Pre-Arching I^2t (Measured at 10 In and rated voltage)
‡ Typical Voltage Drop (Voltage drop was measured at 20°C ambient temperature at rated current)

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a poly bag
TR2	1,500 pieces of fuses packed into tape on a reel (19.05mm lead wire length)

OPTION CODE	
Option Code	**Description**
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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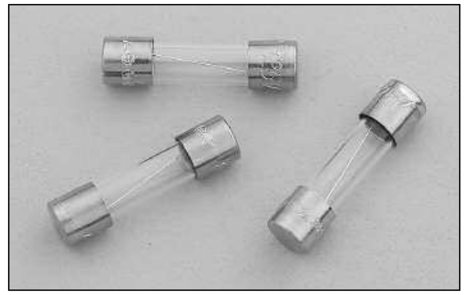
5mm x 20mm Fuses
GMA Series, Fast Acting, Glass Tube

Description

- Fast acting, low breaking capacity
- Optional axial leads available
- 5mm x 20mm physical size
- Glass tube, nickel-plated brass endcap construction
- Designed to UL/CSA 248-14

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS		
Rated Current	% of Amp Rating	Opening Time
63mA - 10A	100%	None
	135%	60 minutes maximum
	200%	2 minutes maximum

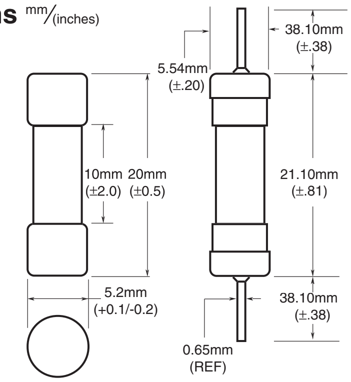
Agency Information

- UL Listed, Guide JDYX, File E19180, 63mA-6A
- UL Recognized Card: (7A-15A) Guide JDYX2, File E19180
- CSA Certified, Class 1422-01, File E65063, 63mA-6A
- MITI Approval, 1A-15A
- CCC Approval, 63mA-6A

Ordering

- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. GMA-2-R)

Dimensions mm/(inches)



- Ratings above 6.3A have a 0.8mm diameter lead
- With TR2 packaging code, lead wire length is 19.05mm

SPECIFICATIONS						
Product Code	Voltage Rating AC	AC Interrupting Rating* 250V	AC Interrupting Rating* 125V	Typical DC Cold Resistance (ohms)**	Typical Pre-Arc I^2t AC†	Maximum Voltage Drop (mV)‡
GMA-63mA	250V	35A	10,000A	-	0.00024	4700
GMA-100mA	250V	35A	10,000A	-	0.0001	4300
GMA-125mA	250V	35A	10,000A	-	0.0024	2600
GMA-200mA	250V	35A	10,000A	-	0.001	3400
GMA-250mA	250V	35A	10,000A	-	0.018	2200
GMA-300mA	250V	35A	10,000A	-	0.019	470
GMA-315mA	250V	35A	10,000A	-	0.019	450
GMA-500mA	250V	35A	10,000A	0.454	0.15	230
GMA-600mA	250V	35A	10,000A	0.256	0.32	200
GMA-750mA	250V	35A	10,000A	0.186	0.47	200
GMA-800mA	250V	35A	10,000A	0.170	0.70	180
GMA-1A	250V	35A	10,000A	0.163	0.48	300
GMA-1.25A	250V	100A	10,000A	0.122	0.84	290
GMA-1.5A	250V	100A	10,000A	0.090	1.6	270
GMA-1.6A	250V	100A	10,000A	0.080	2.0	260
GMA-2A	250V	100A	10,000A	0.066	3.1	250
GMA-2.5A	250V	100A	10,000A	0.046	4.9	240
GMA-3A	250V	100A	10,000A	0.039	8.8	215
GMA-3.15A	125V	-	10,000A	0.036	9.7	210
GMA-3.5A	125V	-	10,000A	0.030	13	210
GMA-4A	125V	-	10,000A	0.026	19	205
GMA-5A	125V	-	10,000A	0.021	29	200
GMA-6A	125V	-	10,000A	0.017	45	180
GMA-7A	125V	-	200A	0.012	150	110
GMA-8A	125V	-	200A	0.009	280	110
GMA-10A	125V	-	200A	0.006	280	110
GMA-15A	125V	-	150A	0.004	950	100

* Interrupting ratings: Interrupting ratings for 63mA - 6A were measured at 70% - 80% power factor on AC. The interrupting ratings for 7A - 15A were measured at 100% power factor on AC.
** DC Cold Resistance (Measured at <10% of rated current)
† Typical Pre-Arching I^2t (I^2t was measured at listed interrupting rating and rated voltage)
‡ Maximum Voltage drop (Voltage drop was measured at 20°C ambient temperature at rated current)

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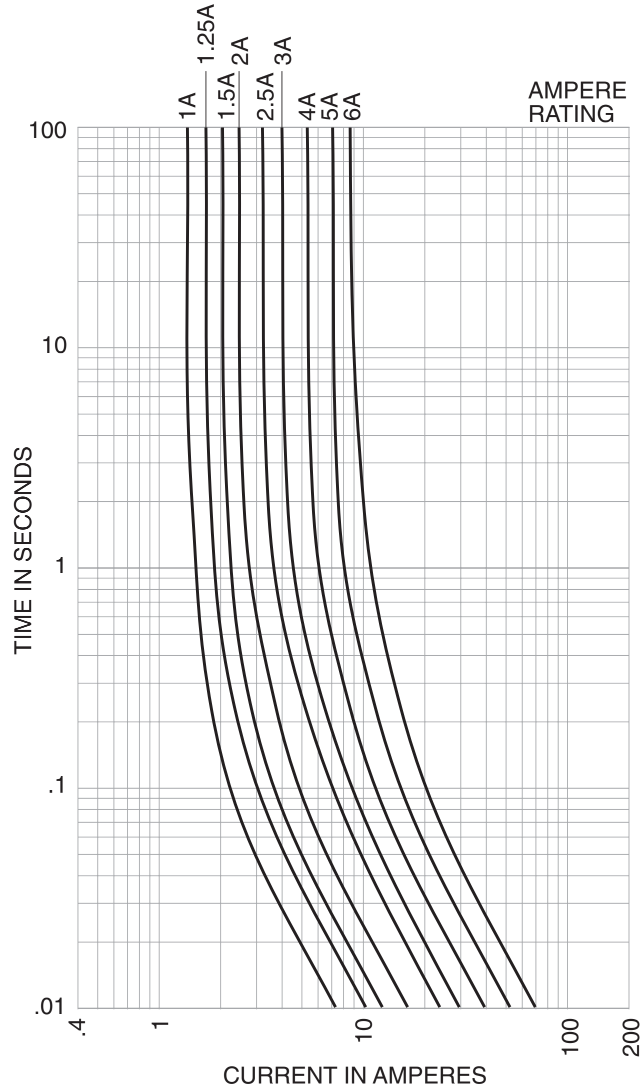
5mm x 20mm Fuses

GMA Series, Fast Acting, Glass Tube

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a poly bag
TR2	1,500 pieces of fuses packed into tape on a reel (19.05mm lead wire length)

OPTION CODE	
Option Code	**Description**
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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COOPER Bussmann

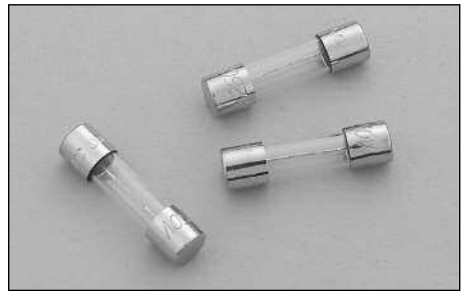
5mm x 20mm Fuses

GMC Series Medium Time Delay, Glass Tube

Description

- Medium time delay, low breaking capacity
- Optional axial leads available
- 5mm x 20mm physical size
- Glass tube, nickel-plated brass endcap construction
- Designed to UL/CSA 248-14

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS		
Rated Current	% of Amp Rating	Opening Time
63mA - 10A	100%	None
	135%	60 minutes maximum
	200%	2 minutes maximum

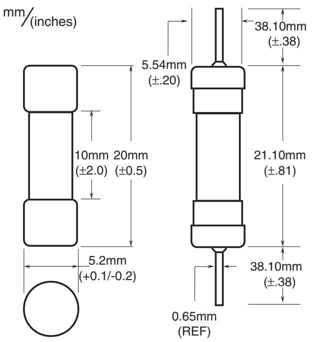
Agency Information

- UL Listed, Guide JDYX, File E19180, 63mA-6.3A
- UL Recognized Card: (7A-10A) Guide JDYX2, File E19180
- CSA Certified, Class 1422-01, File E65063, 63mA-6.3A
- MITI Approval, 1A-10A
- CCC Approval, 500mA-6.3A

Ordering

- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. GMC-2-R)

Dimensions mm/(inches)



- Ratings above 6.3A have a 0.8mm diameter lead
- With TR2 packaging code, lead wire length is 19.05mm

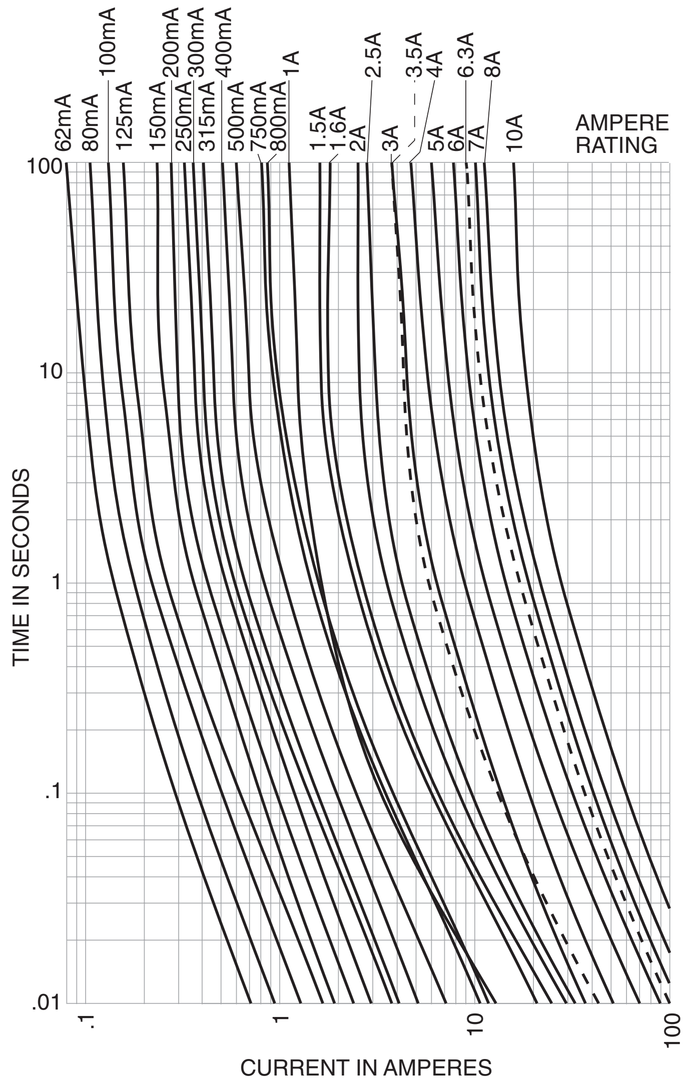
SPECIFICATIONS						
Product Code	Voltage Rating AC	AC Interrupting Rating* 250V	AC Interrupting Rating* 125V	Typical DC Cold Resistance (ohms)**	Typical Pre-Arc I^2t AC†	Maximum Voltage Drop (mV)‡
GMC-63mA	250V	35A	10,000A	10.350	0.0027	1400
GMC-80mA	250V	35A	10,000A	-	0.0050	1400
GMC-100mA	250V	35A	10,000A	4.775	0.0094	1200
GMC-125mA	250V	35A	10,000A	3.400	0.014	1000
GMC-150mA	250V	35A	10,000A	2.555	0.022	800
GMC-160mA	250V	35A	10,000A	2.295	0.022	730
GMC-200mA	250V	35A	10,000A	1.395	0.032	650
GMC-250mA	250V	35A	10,000A	0.965	0.046	490
GMC-300mA	250V	35A	10,000A	0.838	0.081	580
GMC-315mA	250V	35A	10,000A	0.685	0.081	480
GMC-400mA	250V	35A	10,000A	0.615	0.18	510
GMC-500mA	250V	35A	10,000A	0.335	0.41	370
GMC-600mA	250V	35A	10,000A	0.282	0.60	360
GMC-630mA	250V	35A	10,000A	0.246	0.66	360
GMC-700mA	250V	35A	10,000A	0.213	0.85	340
GMC-750mA	250V	35A	10,000A	0.213	0.85	320
GMC-800mA	250V	35A	10,000A	0.180	0.85	290
GMC-1A	250V	35A	10,000A	0.156	1.8	250
GMC-1.25A	250V	100A	10,000A	0.098	3.4	200
GMC-1.5A	250V	100A	10,000A	0.076	5.4	190
GMC-1.6A	250V	100A	10,000A	0.067	5.8	160
GMC-2A	250V	100A	10,000A	0.043	8.9	130
GMC-2.5A	250V	100A	10,000A	0.035	13	130
GMC-3A	250V	100A	10,000A	0.026	19	130
GMC-3.15A	250V	100A	10,000A	0.025	23	130
GMC-3.5A	125V	-	10,000A	0.022	25	130
GMC-4A	125V	-	10,000A	0.019	36	120
GMC-5A	125V	-	10,000A	0.014	58	120
GMC-6A	125V	-	10,000A	0.013	88	120
GMC-6.3A	125V	-	10,000A	0.012	110	120
GMC-7A	125V	-	200A	0.012	150	120
GMC-8A	125V	-	200A	0.009	200	110
GMC-10A	125V	-	200A	0.007	300	110

* Interrupting ratings: Interrupting ratings for 63mA - 6.3A were measured at 70% - 80% power factor on AC. The interrupting ratings for 7A - 10A were measured at 100% power factor on AC.
** DC Cold Resistance (Measured at <10% of rated current)
† Typical Pre-Arching I^2t (I^2t was measured at listed interrupting rating and rated voltage)
‡ Maximum Voltage drop (Voltage drop was measured at 20°C ambient temperature at rated current)

5mm x 20mm Fuses

GMC Series Medium Time Delay, Glass Tube

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a poly bag
TR2	1,500 pieces of fuses packed into tape on a reel (19.05mm lead wire length)

OPTION CODE	
Option Code	**Description**
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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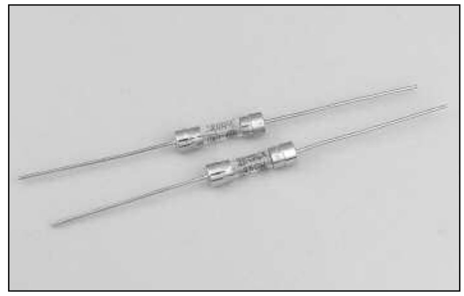
5mm x 20mm Fuses
GMD Series, Time Delay, Glass Tube

Description

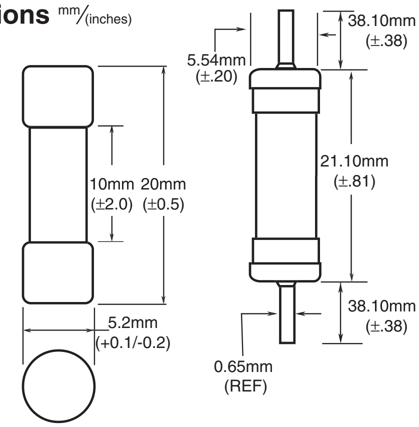
RoHS 2002/95/EC

- Time delay, low breaking capacity
- Optional axial leads available
- 5mm x 20mm physical size
- Glass tube, nickel-plated brass endcap construction
- Designed to UL/CSA 248-14



ELECTRICAL CHARACTERISTICS		
Rated Current	% of Amp Rating	Opening Time
100mA - 4A	100%	None
	135%	60 minutes maximum
	200%	5 seconds minimum
		2 minutes maximum

Dimensions mm/(inches)



- With TR2 packaging code, lead wire length is 19.05mm

Agency Information

- UL Listed, Guide JDYX, File E19180, 125mA-3A
- UL Recognition Card: (4A) Guide JDYX2, File E19180
- CSA Certified, Class 1422-01, File E65063

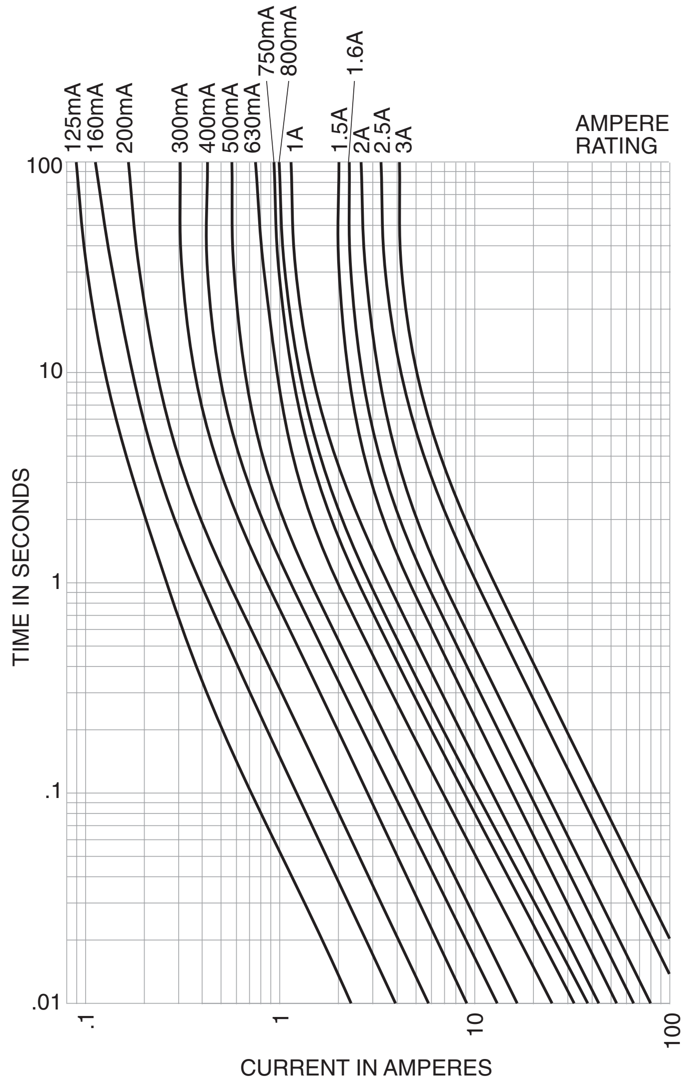
Ordering

- Specify packaging, product, and option code
- For -R option, drop mA or A from product code (i.e. GMD-3-R)

SPECIFICATIONS						
Product Code	Voltage Rating AC	AC Interrupting Rating* 250V	AC Interrupting Rating* 125V	Typical DC Cold Resistance (ohms)**	Typical Pre-Arc I^2t AC†	Maximum Voltage Drop (mV)‡
GMD-125mA	250V	35A	10,000A	-	0.043	1600
GMD-150mA	250V	35A	10,000A	-	0.046	1200
GMD-200mA	250V	35A	10,000A	-	0.20	1100
GMD-250mA	250V	35A	10,000A	-	0.40	950
GMD-300mA	250V	35A	10,000A	-	0.65	800
GMD-315mA	250V	35A	10,000A	-	0.89	750
GMD-375mA	250V	35A	10,000A	-	0.89	650
GMD-400mA	250V	35A	10,000A	-	1.2	600
GMD-500mA	250V	35A	10,000A	-	1.4	550
GMD-600mA	250V	35A	10,000A	-	3.1	450
GMD-630mA	250V	35A	10,000A	-	3.1	450
GMD-750mA	250V	35A	10,000A	-	4.7	410
GMD-800mA	250V	35A	10,000A	-	6.6	380
GMD-1A	250V	35A	10,000A	-	12	310
GMD-1.2A	250V	100A	10,000A	-	16	280
GMD-1.25A	250V	100A	10,000A	-	16	245
GMD-1.5A	250V	100A	10,000A	-	25	240
GMD-1.6A	250V	100A	10,000A	-	27	220
GMD-2A	250V	100A	10,000A	-	42	200
GMD-2.5A	250V	100A	10,000A	-	94	195
GMD-3A	250V	100A	10,000A	-	145	190
GMD-4A	250V	200A	10,000A	-	300	190

* Interrupting ratings: Interrupting ratings for 125mA - 3A were measured at 70% - 80% power factor on AC. The interrupting ratings for 4A were measured at 100% power factor on AC.
** DC Cold Resistance (Measured at <10% of rated current)
† Typical Pre-Arching I^2t (I^2t was measured at listed interrupting rating and rated voltage)
‡ Maximum Voltage drop (Voltage drop was measured at 20°C ambient temperature at rated current)

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a poly bag
TR2	1,500 pieces of fuses packed into tape on a reel (19.05mm lead wire length)

OPTION CODE	
Option Code	**Description**
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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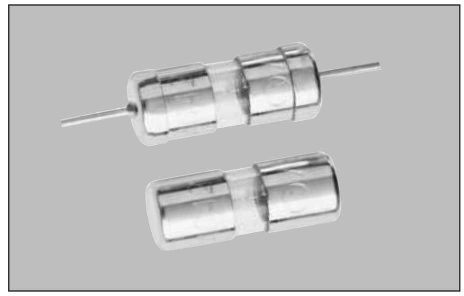
COOPER Bussmann

1/4" x 5/8" Fuses
AGA Series, Fast Acting, Glass Tube

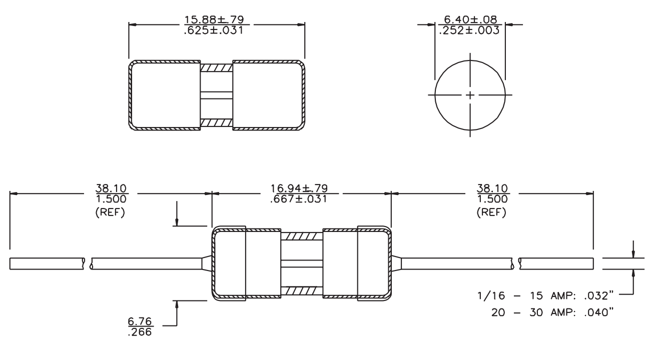
Description

- Fast acting
- 1/4" x 5/8" (6.3mm x 15.9mm) physical size
- Glass tube, nickel-plated brass endcap construction
- Optional leaded version available
- UL Listed product meets standard 248-14

ELECTRICAL CHARACTERISTICS		
Rated Current	% of Amp Rating	Opening Time
1/16 - 10A	100%	4 hours minimum
	135%	60 minutes maximum
	200%	120 seconds maximum



Dimensions mm/(inches)



Agency Information

- UL Listed, Guide JDYX, File E19180 (AGA 0-1 1/2A)
- UL Listed, Guide JDYX, File E19180 (AGA-V 0-5A)
- UL Recognized, Guide JDYX2, File E19180 (AGA 2A-12A)
- UL Recognized, Guide JDYX2, File E19180 (AGA-V 6A-12A)

Ordering

- Specify packaging, product, and option code

SPECIFICATIONS							
Product Code	Voltage Rating AC	AC Interrupting Rating* 125V	AC Interrupting Rating* 32V	Typical DC Cold Resistance (ohms)**	Typical Melt AC	Typical Melt DC	Typical Voltage Drop (V)‡
AGA-1/16	125 V	10,000A	-	13.250	TBD	-	TBD
AGA-1/10	125 V	10,000A	-	6.250	TBD	-	TBD
AGA-1/8	125 V	10,000A	-	4.000	TBD	-	TBD
AGA-1/4	125 V	10,000A	-	1.740	TBD	-	TBD
AGA-3/8	125 V	10,000A	-	0.925	TBD	-	TBD
AGA-1/2	125 V	10,000A	-	0.300	TBD	-	TBD
AGA-6/10	125 V	10,000A	-	0.250	TBD	-	TBD
AGA-3/4	125 V	10,000A	-	0.179	TBD	-	TBD
AGA-1	125 V	10,000A	-	0.118	TBD	-	TBD
AGA-1-1/2	125 V	10,000A	-	0.077	TBD	-	TBD
AGA-2	125 V	200A	-	0.054	TBD	-	TBD
AGA-2-1/2	125 V	200A	-	0.040	TBD	-	TBD
AGA-3	125 V	200A	-	0.031	TBD	-	TBD
AGA-5	125 V	200A	-	0.017	TBD	-	TBD
AGA-6	32 V	-	1,000A	0.014	TBD	-	TBD
AGA-7	32 V	-	1,000A	0.012	TBD	-	TBD
AGA-7-1/2	32 V	-	1,000A	0.010	TBD	-	TBD
AGA-10	32 V	-	1,000A	0.007	TBD	-	TBD
AGA-15	32 V	-	1,000A	0.005	TBD	-	TBD
AGA-20	32 V	-	1,000A	0.003	TBD	-	TBD
AGA-25	32 V	-	1,000A	0.003	TBD	-	TBD
AGA-30	32 V	-	1,000A	0.002	TBD	-	TBD

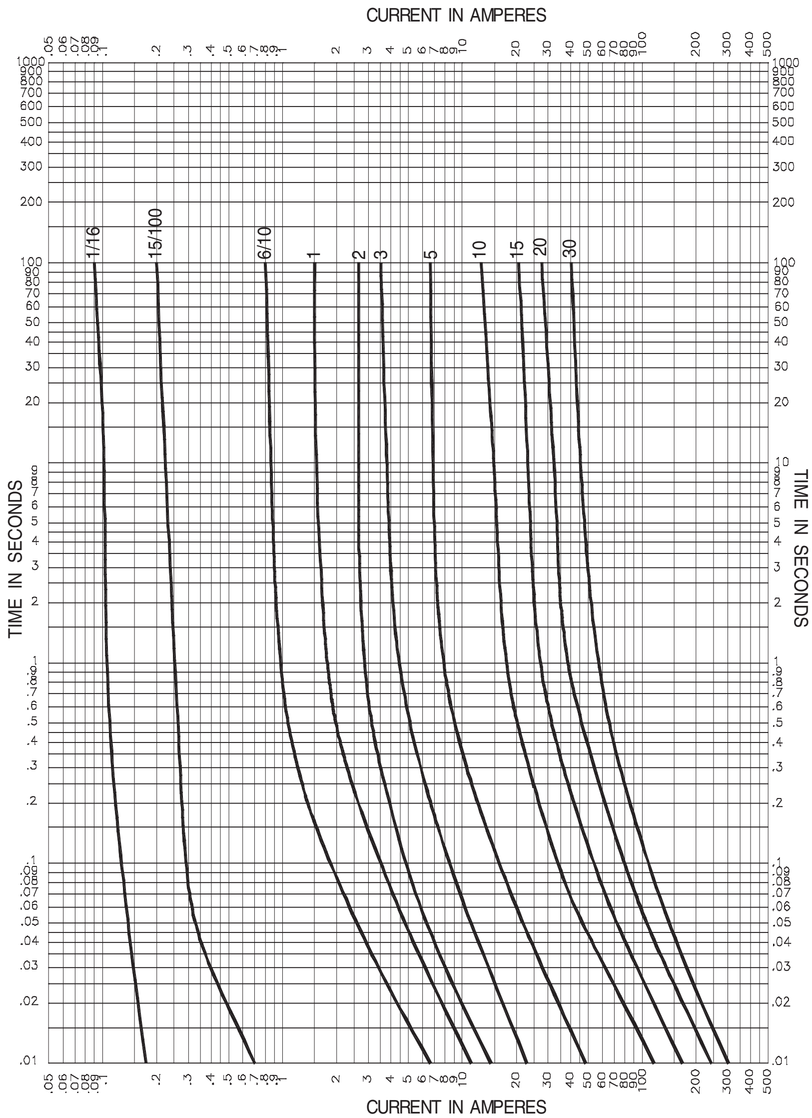
* Interrupting Rating: Interrupting ratings for 2A-5A has been measured at 70%-80% power factor. ratings for 5.1A-12A were measured at 80% power factor.
** DC Cold Resistance (Measured at <10% of rated current)
‡ Typical Voltage Drop (Measured at 25°C±3°C ambient temperature at rated current)

COOPER Bussmann

1/4" x 5/8" Fuses

AGA Series, Fast Acting, Glass Tube

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK8	8,000 pieces of fuses packed into a cardboard carton

OPTION CODE	
Option Code	**Description**
B	Board Washable - Hermetically sealed to withstand aqueous cleaning
V	Axial leads - copper tinned wire with nickel plated brass overcaps

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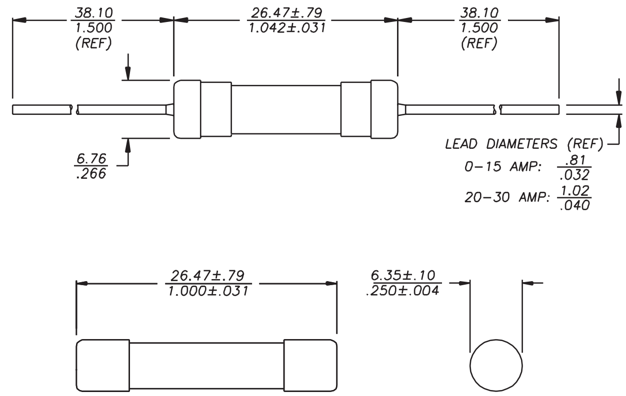
1/4" x 1" Fuses
AGX Series, Fast Acting, Glass Tube

Description

- Fast acting
- 1/4" x 1 (6.3mm x 25.4mm) physical size
- Glass tube, nickel-plated brass endcap construction
- For instruments, electronic and small appliance circuits
- UL Listed product meets standard 248-14

ELECTRICAL CHARACTERISTICS		
Rated Current	**% of Amp Rating**	**Opening Time**
1/500 - 30A	110%	4 hours minimum
	135%	60 minutes maximum
1/500 - 2A	200%	5 seconds maximum
2.5A - 30A	200%	2 minutes maximum

Dimensions mm/(inches)



Agency Information

- UL Listed Card: AGX 0-5A (Guide JDYX, File E19180)
- UL Recognized Card: AGX 6-20A (Guide JDYX2, File E19180)
- CSA Component Acceptance Card (Class No. 1422-01, File 53787)

Ordering

- Specify packaging, product, and option code

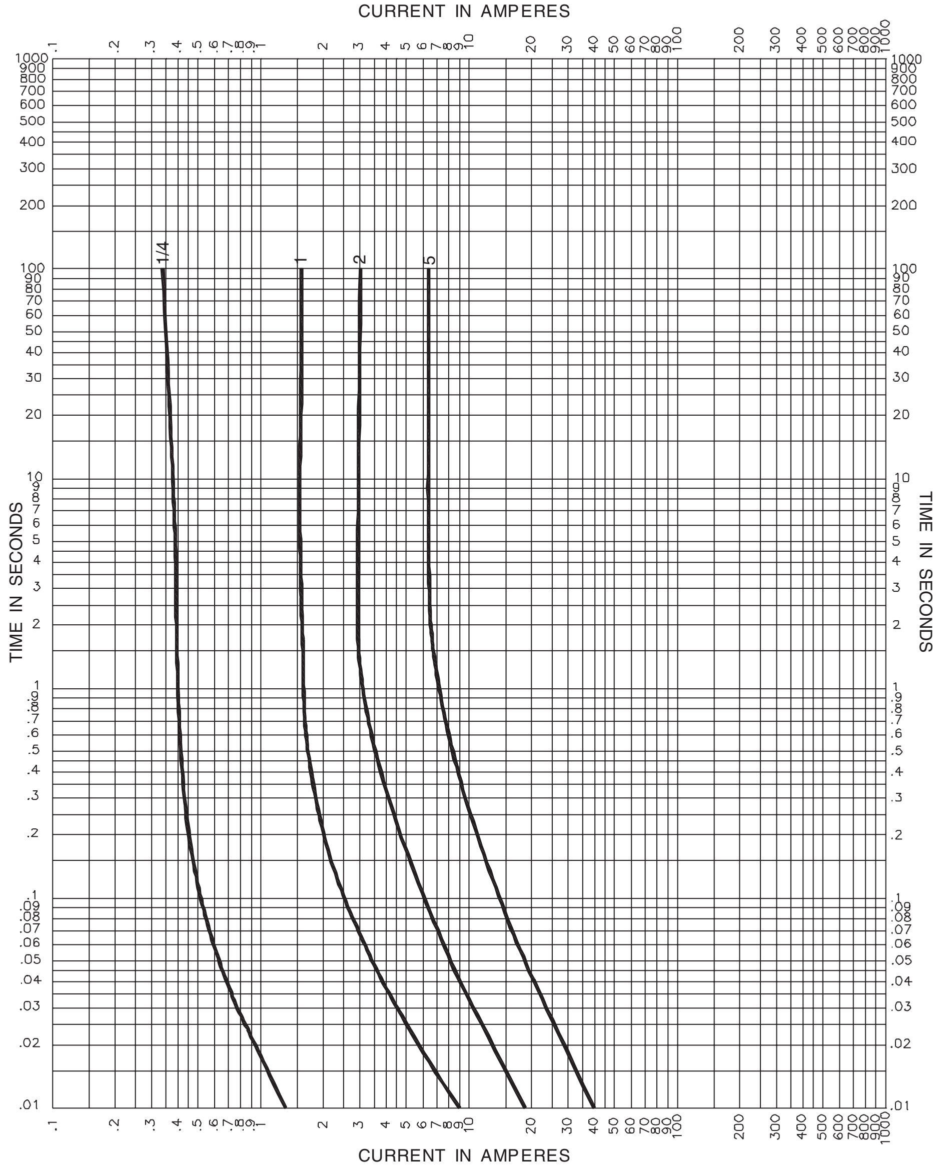
SPECIFICATIONS					
Product Code	**Voltage Rating AC**	**Interrupting Rating 250VAC**	**125VAC**	**32VAC**	**Typical DC Cold Resistance (ohms)****
AGX-1/500	250V	35A	10,000A	-	1750.00000
AGX-1/200	250V	35A	10,000A	-	285.00000
AGX-1/100	250V	35A	10,000A	-	155.00000
AGX-1/32	250V	35A	10,000A	-	35.00000
AGX-1/16	250V	35A	10,000A	-	22.50000
AGX-1/10	250V	35A	10,000A	-	10.25000
AGX-1/8	250V	35A	10,000A	-	5.41000
AGX-3/16	250V	35A	10,000A	-	3.11500
AGX-2/10	250V	35A	10,000A	-	2.66000
AGX-1/4	250V	35A	10,000A	-	2.79000
AGX-3/10	250V	35A	10,000A	-	1.42500
AGX-3/8	250V	35A	10,000A	-	0.93050
AGX-4/10	250V	35A	10,000A	-	0.89900
AGX-1/2	250V	35A	10,000A	-	0.47850
AGX-3/4	250V	100A	10,000A	-	0.26000
AGX-1	250V	100A	10,000A	-	0.16250
AGX-1-1/4	250V	100A	10,000A	-	0.12750
AGX-1-1/2	250V	100A	10,000A	-	0.09400
AGX-2	250V	100A	10,000A	-	0.06825
AGX-2-1/2	125V	-	10,000A	-	0.04930
AGX-3	125V	-	10,000A	-	0.03825
AGX-4	125V	-	10,000A	-	0.02700
AGX-5	125V	-	10,000A	-	0.02050
AGX-6	125V	-	1,000A	-	0.01475
AGX-7	125V	-	1,000A	-	0.01275
AGX-8	32V	-	-	1,000A	0.01100
AGX-10	32V	-	-	1,000A	0.00867
AGX-15	32V	-	-	1,000A	0.00510
AGX-20	32V	-	-	1,000A	0.00358
AGX-25	32V	-	-	1,000A	0.00275
AGX-30	32V	-	-	1,000A	0.00215

** DC Cold Resistance (Measured at <10% of rated current)

1/4" x 1" Fuses

AGX Series, Fast Acting, Glass Tube

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton

OPTION CODE	
Option Code	**Description**
B	Board Washable - Hermetically sealed to withstand aqueous cleaning
V	Axial leads - copper tinned wire with nickel plated brass overcaps

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1/4" x 1-1/4" Fuses
TDC Series, Glass Tube

COOPER Bussmann

Description

TDC10

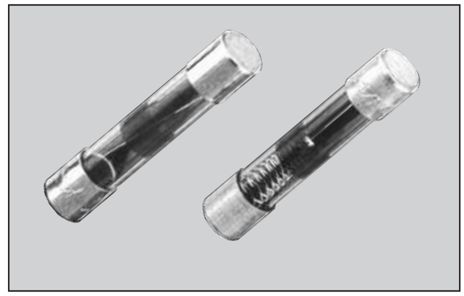
- Fast Acting
- 1/4" x 1-1/4" physical size
- Glass tube, electroplated brass endcap construction
- Interrupting rating equals 10 times rated current
- Designed to British Standard BS2950A

TDC11

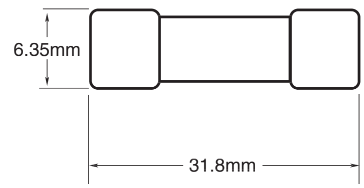
- Time Delay
- 1/4" x 1-1/4" physical size
- Glass tube, electroplated brass endcap construction
- Interrupting rating equals 10 times rated current

Ordering

- Specify packaging and product code



Dimensions mm/(inches)



SPECIFICATIONS - TDC10									
Product Code	Voltage Rating AC	Interrupting Rating*							
		1000V	750V	500V	350V	250V	150V	100V	32V
TDC10-50MA	1000V	500MA	-	-	-	-	-	-	-
TDC10-60MA	1000V	600MA	-	-	-	-	-	-	-
TDC10-100MA	1000V	1A	-	-	-	-	-	-	-
TDC10-150MA	1000V	1.5A	-	-	-	-	-	-	-
TDC10-250MA	1000V	2.5A	-	-	-	-	-	-	-
TDC10-500MA	750V	-	5A	-	-	-	-	-	-
TDC10-750MA	500V	-	-	7.5A	-	-	-	-	-
TDC10-1A	350V	-	-	-	10A	-	-	-	-
TDC10-1.5A	250V	-	-	-	-	15A	-	-	-
TDC10-2A	250V	-	-	-	-	20A	-	-	-
TDC10-3A	250V	-	-	-	-	30A	-	-	-
TDC10-5A	250V	-	-	-	-	50A	-	-	-
TDC10-7A	150V	-	-	-	-	-	70A	-	-
TDC10-10A	100V	-	-	-	-	-	-	100A	-
TDC10-12A	32V	-	-	-	-	-	-	-	120A
TDC10-15A	32V	-	-	-	-	-	-	-	150A
TDC10-20A	32V	-	-	-	-	-	-	-	200A
TDC10-25A	32V	-	-	-	-	-	-	-	250A

SPECIFICATIONS - TDC11								
Product Code	Voltage Rating AC	Interrupting Rating*						
		1000V	750V	500V	350V	250V	150V	100V
TDC11-50MA	1000V	500MA	-	-	-	-	-	-
TDC11-60MA	1000V	600MA	-	-	-	-	-	-
TDC11-100MA	1000V	1A	-	-	-	-	-	-
TDC11-150MA	1000V	1.5A	-	-	-	-	-	-
TDC11-250MA	1000V	2.5A	-	-	-	-	-	-
TDC11-500MA	750V	-	5A	-	-	-	-	-
TDC11-750MA	500V	-	-	7.5A	-	-	-	-
TDC11-1A	350V	-	-	-	10A	-	-	-
TDC11-1.5A	250V	-	-	-	-	15A	-	-
TDC11-2A	250V	-	-	-	-	20A	-	-
TDC11-3A	250V	-	-	-	-	30A	-	-
TDC11-5A	250V	-	-	-	-	50A	-	-
TDC11-7A	150V	-	-	-	-	-	70A	-
TDC11-10A	100V	-	-	-	-	-	-	100A

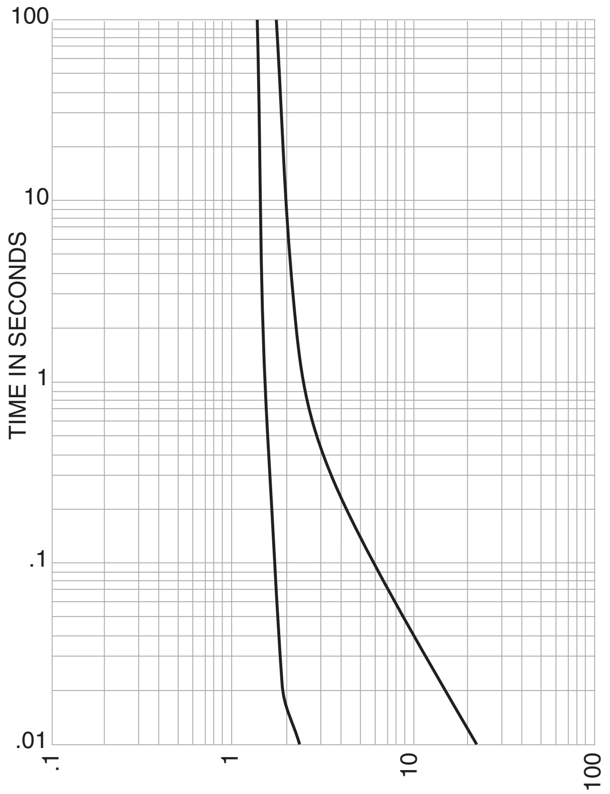
* Interrupting Rating: Interrupting rating is 10 times the rated current.
** DC Cold Resistance (Measured at <10% of rated current)

1/4" x 1-1/4" Fuses

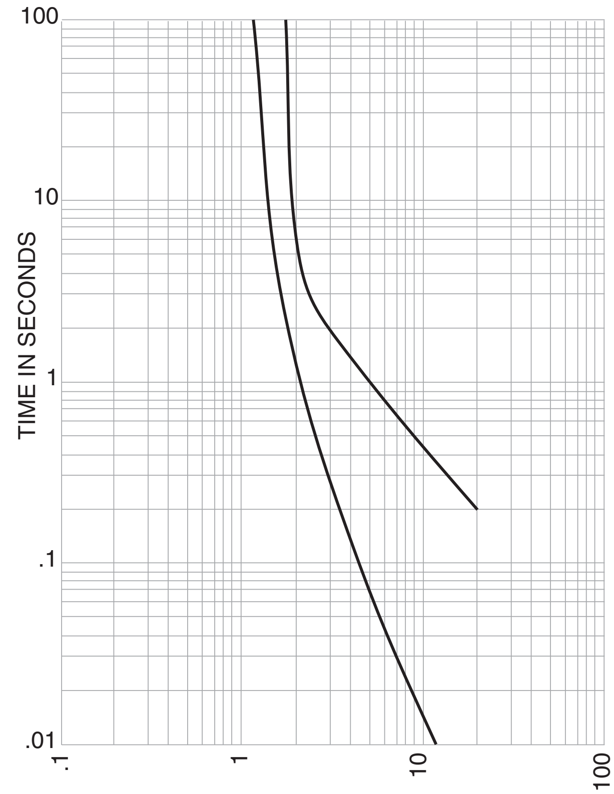
TDC Series, Glass Tube

TIME CURRENT CURVE

TDC10



TDC11



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a cardboard carton

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1/4" x 1-1/4" Fuses

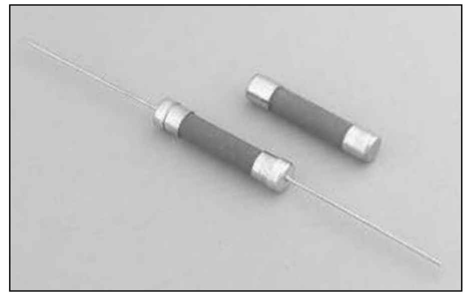
ABC Series, Fast Acting, Ceramic Tube

COOPER Bussmann

Description

• Fast-acting, ceramic tube
• Optional axial leads available
• 1/4 x 1-1/4 (6.3mm x 32mm) physical size
• Ceramic tube, nickel-plated brass endcap construction
• UL Listed product meets standard 248-14

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS	
% of Amp Rating	**Opening Time**
100%	4 Hours Minimum
135%	60 Minutes maximum
200%	120 Seconds Maximum

Agency Information

• UL Listed Guide & File numbers (ABC 1/4 - 15A): JDYX & E19180.
• UL Recognition Guide & File numbers (ABC 18 - 30A): JDYX2 & E19180.
• CSA Certification Record No: 053787 C 000 & Class No: 1422 01 & 1422 30.

Environmental Data

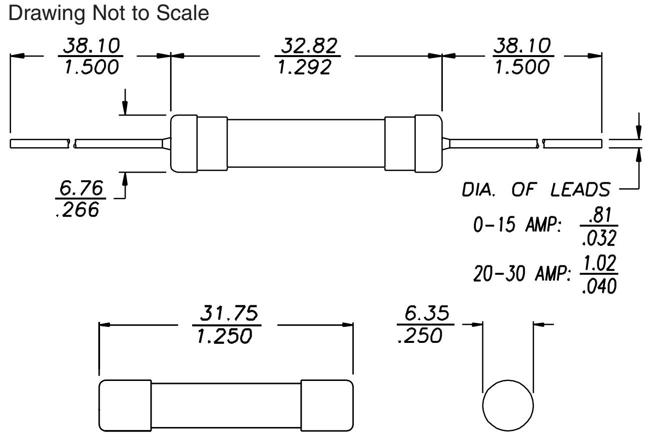
• Shock: 1/4A and 1/2A – MIL-STD-202, Method 213, Test Condition I; 1A thru 30A – MIL-STD-202, Method 207, (HI Shock)
• Vibration: 1/4A thru 30A – MIL-STD-202, Method 204, Test Condition C (Except 5g, 500HZ)

Ordering

• Specify packaging, product, and option code

Dimensions (mm/in)

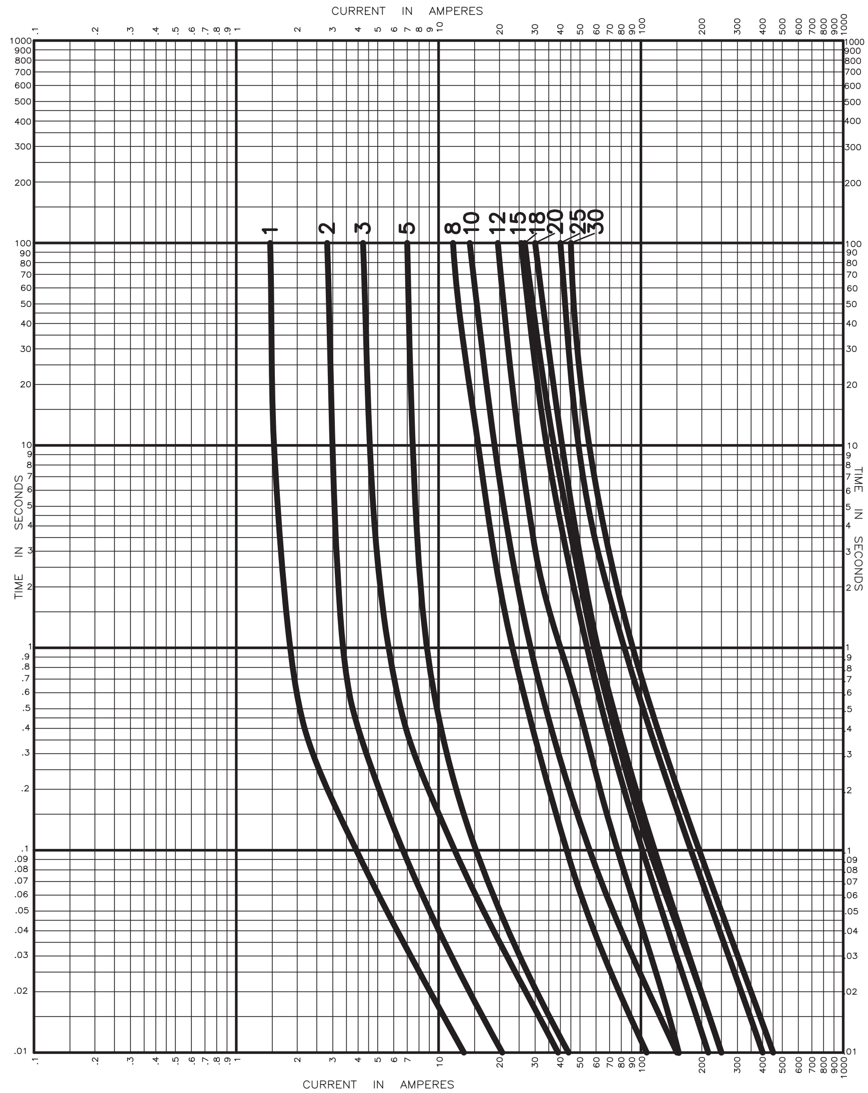
Drawing Not to Scale



SPECIFICATIONS									
Product Code	**Voltage Rating**		**AC Interrupting Rating**		**DC Interrupting Rating**		**Typical DC Cold Resistance****	**Typical Melting I²t†**	**Typical Voltage Drop‡**
	AC	**DC**	**250V**	**125V**	**125V**	**75V**	**(ohms)**	**AC**	
ABC-1/4	250V	125V	35A	10000A	10000A	-	3.000	0.02	3.25
ABC-1/2	250V	125V	35A	10000A	10000A	-	0.788	0.19	0.51
ABC-3/4	250V	125V	35A	10000A	10000A	-	0.303	0.8	0.42
ABC-1	250V	125V	35A	10000A	10000A	-	0.197	1.4	0.35
ABC-1-1/2	250V	125V	100A	10000A	10000A	-	0.1175	2.9	0.35
ABC-2	250V	125V	100A	10000A	10000A	-	0.0755	4.2	0.25
ABC-2-1/2	250V	125V	100A	10000A	10000A	-	0.05875	8.53	0.26
ABC-3	250V	125V	100A	10000A	10000A	-	0.0435	19.5	0.25
ABC-4	250V	125V	200A	10000A	10000A	-	0.02975	29.1	0.25
ABC-5	250V	125V	200A	10000A	10000A	-	0.0286	16.4	0.23
ABC-6	250V	125V	200A	10000A	10000A	-	0.02315	31.6	0.24
ABC-7	250V	125V	200A	10000A	10000A	-	0.0183	73.2	0.20
ABC-8	250V	125V	200A	10000A	10000A	-	0.0146	111.9	0.17
ABC-10	250V	125V	200A	10000A	10000A	-	0.01205	215.6	0.15
ABC-12	250V	125V	750A	10000A	10000A	-	0.0068	129.6	0.11
ABC-15	250V	125V	750A	10000A	10000A	-	0.005425	200.2	0.12
ABC-20	250V	125V	400A	1000A	10000A	-	0.00366	550.8	0.13
ABC-25	125V	125V	-	1000A	400A	1000A	0.00263	839.3	0.12
ABC-30	125V	125V	-	1000A	400A	1000A	0.002225	1,429	0.14

** DC Cold Resistance (Measured at ≤10% of rated current)
† Typical Melting I²t (A²Sec) (I²t was measured at listed interrupting rating and rated voltage. Measured at 70% to 80% power factor on AC)
‡ Typical Voltage Drop (Voltage drop was measured at 25°C±3°C ambient temperature at rated current)

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a cardboard carton
BK8	8,000 pieces of fuses packed into a cardboard carton

OPTION CODE	
Option Code	**Description**
B	Board Washable - Hermetically sealed to withstand aqueous cleaning
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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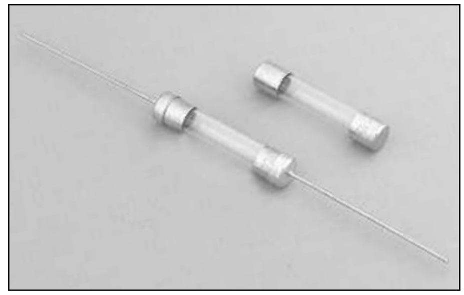
1/4" x 1-1/4" Fuses
AGC Series, Fast Acting, Glass Tube

Description

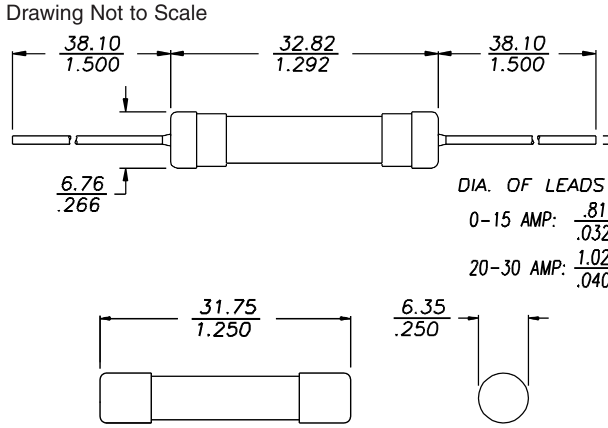
RoHS 2002/95/EC

- Fast-acting, glass tube
- Optional axial leads available
- 1/4 x 1-1/4 (6.3mm x 32mm) physical size
- Glass tube, nickel-plated brass endcap construction
- UL Listed product meets standard 248-14



ELECTRICAL CHARACTERISTICS	
% of Amp Rating	**Opening Time**
100%	None
135%	60 Minutes Maximum
200%	120 Seconds Maximum

Dimensions (mm/in)
Drawing Not to Scale



Agency Information
- UL Listed Card: AGC 1/500-10
- UL Recognition Card: AGC 11-45
- CSA Component Acceptance Card (Class No. 1422 30)
- CSA Certification Card (Class No. 1422 01)

Environmental Data
- Shock: 1/100A thru 3/4A – MIL-STD-202, Method 213, Test Condition I; 1A thru 30A – MIL-STD-202, Method 207, (HI Shock)
- Vibration: 1/100A thru 30A – MIL-STD-202, Method 204, Test Condition A (Except 5g, 500HZ)

Ordering
- Specify packaging, product, and option code

SPECIFICATIONS

Product Code	Voltage Rating AC	AC Interrupting Rating 250V	AC Interrupting Rating 125V	AC Interrupting Rating 32V	Typical DC Cold Resistance** (ohms)	Typical Melting I^2t† AC	Typical Voltage Drop‡
AGC-1/20	250V	35A	10000A	-	4.500	0.00773	0.67
AGC-1/16	250V	35A	10000A	-	29.000	0.000181	10.41
AGC-1/10	250V	35A	10000A	-	12.565	0.000787	6.00
AGC-1/8	250V	35A	10000A	-	6.800	0.00131	4.67
AGC-3/16	250V	35A	10000A	-	4.900	0.00637	4.12
AGC-2/10	250V	35A	10000A	-	3.360	0.00435	4.51
AGC-1/4	250V	35A	10000A	-	2.300	0.0148	0.89
AGC-3/10	250V	35A	10000A	-	1.670	0.0208	2.88
AGC-3/8	250V	35A	10000A	-	1.203	0.0321	4.59
AGC-1/2	250V	35A	10000A	-	0.615	0.269	0.59
AGC-3/4	250V	35A	10000A	-	0.312	0.815	0.37
AGC-1	250V	35A	10000A	-	0.190	1.615	0.31
AGC-1-1/4	250V	100A	10000A	-	0.145	0.018	0.35
AGC-1-1/2	250V	100A	10000A	-	0.115	0.0149	0.27
AGC-2	250V	100A	10000A	-	0.078	0.00509	0.28
AGC-2-1/4	250V	100A	10000A	-	0.067	0.00588	0.26
AGC-2-1/2	250V	100A	10000A	-	0.057	0.00879	0.31
AGC-3	250V	100A	10000A	-	0.045	0.0167	0.25
AGC-4	250V	200A	10000A	-	0.030	0.0305	0.22
AGC-5	250V	200A	10000A	-	0.024	0.045	0.23
AGC-6	250V	200A	10000A	-	0.020	0.071	0.23
AGC-7	250V	200A	10000A	-	0.017	0.105	0.23
AGC-7-1/2	250V	200A	10000A	-	0.0146	-	-
AGC-8	250V	200A	10000A	-	0.014	0.152	0.19
AGC-9	250V	200A	10000A	-	0.012	0.21	0.18
AGC-10	250V	200A	10000A	-	0.008	0.492	0.20
AGC-12	32V	-	-	1000A	0.0070	-	-
AGC-14	32V	-	-	1000A	0.0062	-	-
AGC-15	32V	-	-	1000A	0.006	0.566	0.14
AGC-20	32V	-	-	1000A	0.004	1.438	0.12
AGC-25	32V	-	-	1000A	0.003	2.109	0.11
AGC-30	32V	-	-	1000A	0.002	3.807	0.12
AGC-35	32V	-	-	70A	0.0014	-	-
AGC-40	32V	-	-	80A	0.0019	-	-

** DC Cold Resistance (Measured at ≤10% of rated current)
† Typical Melting I^2t (A^2Sec) (I^2t was measured at listed interrupting rating and rated voltage.)
‡ Typical Voltage Drop (Voltage drop was measured at 25°C ambient temperature at rated current)

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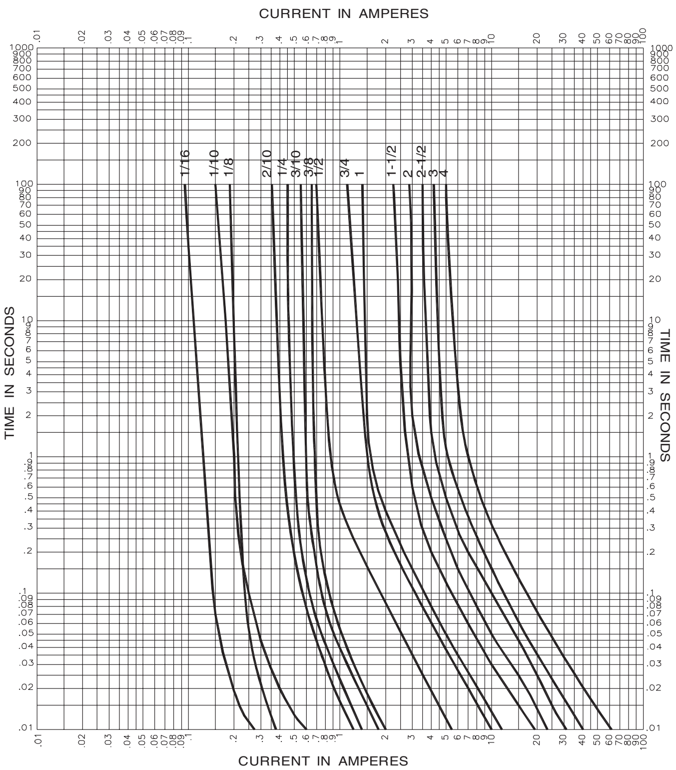
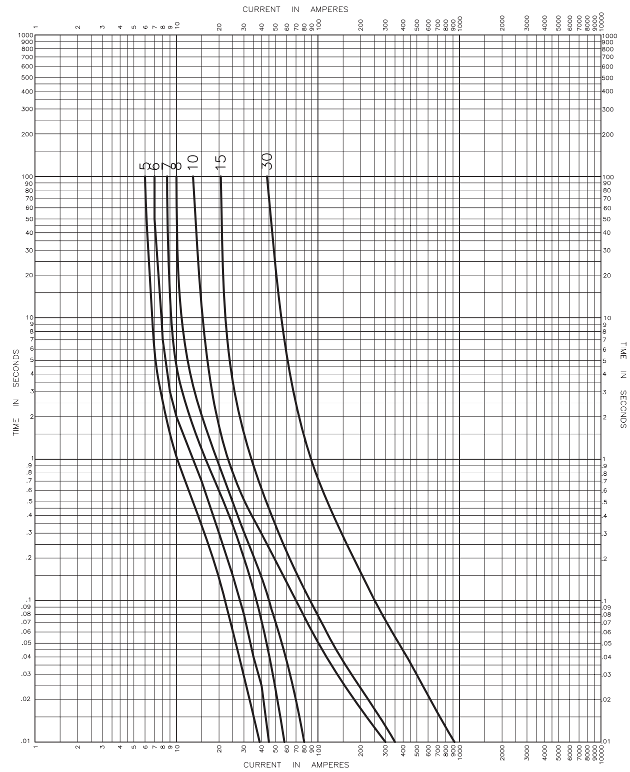
1/4" x 1-1/4" Fuses

AGC Series, Fast Acting, Glass Tube

TIME CURRENT CURVE





	PACKAGING CODE
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton with flaps folded
BK1	1,000 pieces of fuses packed into a cardboard carton with flaps folded
BK8	8,000 pieces of fuses packed into a cardboard carton with flaps folded

	OPTION CODE
Option Code	**Description**
B	Board Washable - Hermetically sealed to withstand aqueous cleaning
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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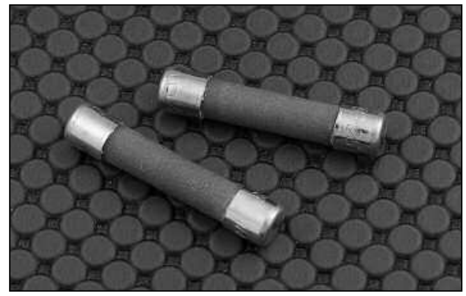
1/4" x 1-1/4" Fuses

GBB Series Very Fast Acting, Ceramic Tube

Description

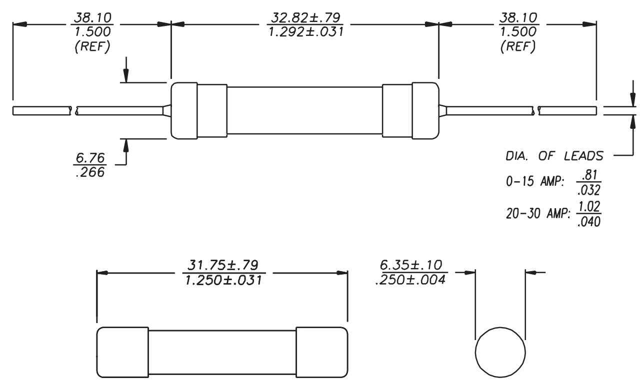
- Very fast-acting
- Optional axial leads available
- 1/4" x 1-1/4" (6.3mm x 32mm) physical size
- Ceramic tube, nickel-plated brass endcap construction
- 100pc-carton quantity weighs 1.0 lb (0.45 kg)
- UL recognized product meets standard 248-14

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS		
Rated Current	% of Amp Rating	Opening Time
1 - 20A	100%	None
	150%	2 minutes maximum
	250%	1 seconds maximum
	400%	-
25, 30A	100%	None
	150%	2 minutes maximum
	250%	6 seconds maximum
	400%	-

Dimensions mm/(inches)



Agency Information

- UL Recognized Card: GBB 1-30A (JFHR2, E56412)
- CSA Component Certified Card (Class 1422-01 File 53787)

Ordering

- Specify packaging, product, and option code

SPECIFICATIONS									
Product Code	Voltage Rating		AC Interrupting Rating*		DC Interrupting Rating*	Typical DC Cold Resistance	Typical Melt I^2t †		Typical Voltage
	AC	DC	250V	125V	125V	(ohms)**	AC	DC	Drop (V)‡
GBB-1	250V	125V	200A	10,000A	10,000A	0.17750	-	-	0.17750
GBB-1-1/4	250V	125V	200A	10,000A	10,000A	0.17900	-	-	0.17900
GBB-2	250V	125V	200A	10,000A	10,000A	0.06620	-	-	0.07000
GBB-3	250V	125V	200A	10,000A	10,000A	0.04475	-	-	0.04475
GBB-4	250V	125V	200A	10,000A	10,000A	0.03175	-	-	0.03175
GBB-5	250V	125V	200A	10,000A	10,000A	0.02125	-	-	0.02125
GBB-6	250V	125V	200A	10,000A	10,000A	0.01800	-	-	0.01800
GBB-7	250V	125V	200A	10,000A	10,000A	0.01550	-	-	0.01550
GBB-8	250V	125V	200A	10,000A	10,000A	0.01360	-	-	0.01360
GBB-9	250V	125V	200A	10,000A	10,000A	0.01070	-	-	0.01070
GBB-10	250V	125V	200A	10,000A	10,000A	0.00934	-	-	0.00934
GBB-12	250V	125V	200A	10,000A	10,000A	0.00620	-	-	0.08620
GBB-15	250V	125V	200A	10,000A	10,000A	0.00472	-	-	0.00472
GBB-20	250V	125V	200A	200A	200A	0.00330	-	-	0.00365
GBB-25	250V	125V	200A	200A	200A	0.00252	-	-	0.00252
GBB-30	250V	125V	200A	200A	200A	0.00206	-	-	0.00206

* Interrupting ratings: Interrupting ratings for 1-15A at 125Vdc was measured at 10,000A, 3.5 ms maximum, with time constant. Ratings 20-30A at 125Vdc were measured at 200A, 0.5 ms maximum, with time constant. Ratings 1-15A at 125Vac were measured at 10,000A, and 70% - 80% power factor. The interrupting ratings for 1-30A at 250Vac were measured at 90% - 100% power factor.

** DC Cold Resistance (Measured at <10% of rated current)

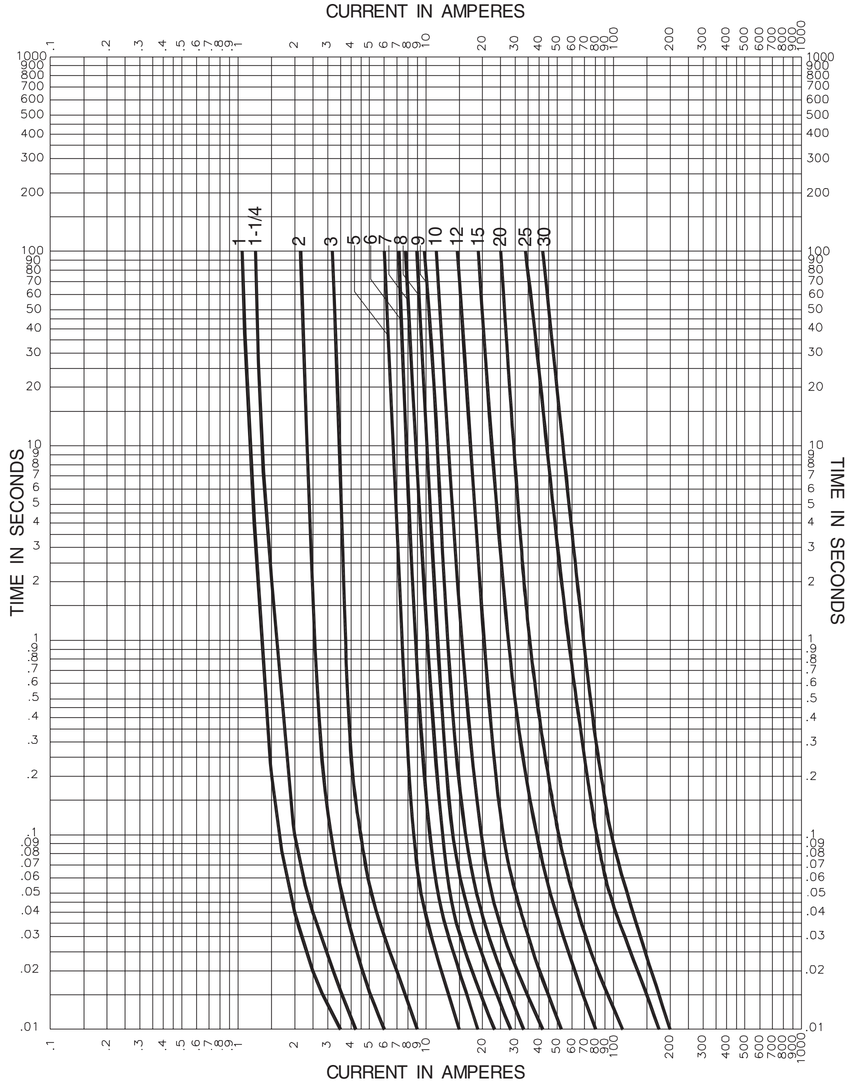
† Typical Melting I^2t (I^2t was measured at listed interrupting rating and rated voltage) Interrupting ratings were measured at 70% to 80% power factor on AC.

‡ Typical Voltage drop (Voltage drop was measured at 25°C±3°C ambient temperature at rated current)

1/4" x 1-1/4" Fuses

GBB Series Very Fast Acting, Ceramic Tube

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a cardboard carton

OPTION CODE	
Option Code	**Description**
B	Board Washable - Hermetically sealed to withstand aqueous cleaning
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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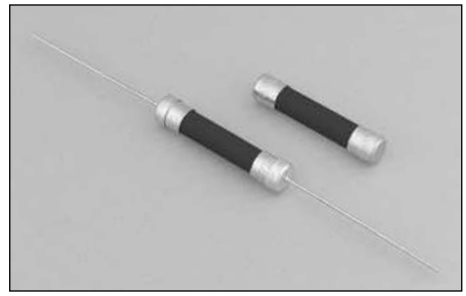
1/4" x 1-1/4" Fuses

MDA Series, Time Delay, Ceramic Tube

RoHS 2002/95/EC



Description

- Time Delay, ceramic tube
- Optional axial leads available
- 1/4 x 1-1/4 (6.3mm x 32mm) physical size
- Ceramic tube, nickel-plated brass endcap construction
- UL Listed product meets standard 248-14

ELECTRICAL CHARACTERISTICS		
Rated Current	**Amp Rating**	**Opening Time**
1/4 - 30A	100%	None
	135%	60 Minutes Max.
	200%	120 Seconds Max.

Agency Information

- UL Listed Card: MDA 2/10 - 20A (Guide JDYX, File E19180)
- UL Recognized Card: MDA 25 - 30A (Guide JDYX2, File E19180)
- CSA Certification Card: MDA 2/10 - 20 (Class No. 1422-01)
- CSA Component Acceptance: MDA 25-30A (Class No. 1422-30)

Environmental Data

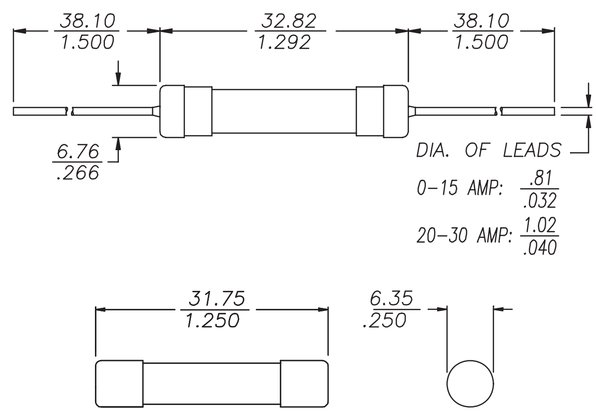
- Shock: 1/100A and 8/10A – MIL-STD-202, Method 213, Test Condition I; 1A thru 30A – MIL-STD-202, Method 207, (HI Shock)
- Vibration: 1/100A and 8/10A – MIL-STD-202, Method 201; 1/4A thru 30A – MIL-STD-202, Method 204, Test Condition C (Except 5g, 500HZ)

Ordering

- Specify packaging, product, and option code

Dimensions (mm/in)

Drawing Not to Scale



SPECIFICATIONS								
Product Code	**Voltage Rating AC**	**DC**	**AC Interrupting Rating* 250V**	**125V**	**DC Interrupting Rating 125V**	**Typical DC Cold Resistance** (ohms)**	**Typical Melting I²t† AC**	**Typical Voltage Drop‡**
MDA-1/4	250V	-	35A	10000A	-	9.325	0.68	4.00
MDA-1/2	250V	-	35A	10000A	-	1.925	2.3	1.42
MDA-3/4	250V	-	35A	10000A	-	0.8555	7.8	1.31
MDA-1	250V	-	35A	10000A	-	0.560	11.1	1.03
MDA-1-1/2	250V	-	100A	10000A	-	0.2585	25.0	0.691
MDA-2	250V	-	100A	10000A	-	0.1645	64.0	0.623
MDA-2-1/2	250V	-	200A	10000A	-	0.06685	28.9	0.213
MDA-3	250V	-	200A	10000A	-	0.0507	40.9	0.182
MDA-4	250V	-	200A	10000A	-	0.0346	134.0	0.162
MDA-5	250V	-	200A	10000A	-	0.02355	345.9	0.145
MDA-6	250V	-	200A	10000A	-	0.01850	534.3	0.141
MDA-7	250V	-	200A	10000A	-	0.01475	580.3	0.137
MDA-8	250V	-	200A	10000A	-	0.01230	944.0	0.134
MDA-10	250V	-	200A	10000A	-	0.00858	1491.3	N/A
MDA-12	250V	-	750A	10000A	-	0.00725	113.8	0.114
MDA-15	250V	-	750A	10000A	-	0.00543	206.2	0.107
MDA-20	250V	125V	1500A	10000A	10000A	0.00358	439.5	0.095
MDA-25A	250V	125V	1500A	10000A	10000A	0.00309	667.9	0.105
MDA-30A	250V	125V	1500A	10000A	10000A	0.00243	997.0	0.110

* Interrupting Ratings (Measured at 70% - 80% power factor on AC. The interrupting ratings for 25Amp, 30Amp were measured at 90% - 100% power factor on AC)

** DC Cold Resistance (Measured at ≤10% of rated current)

† Typical Melting I²t (A²Sec) (I²t was measured at listed interrupting rating and rated voltage)

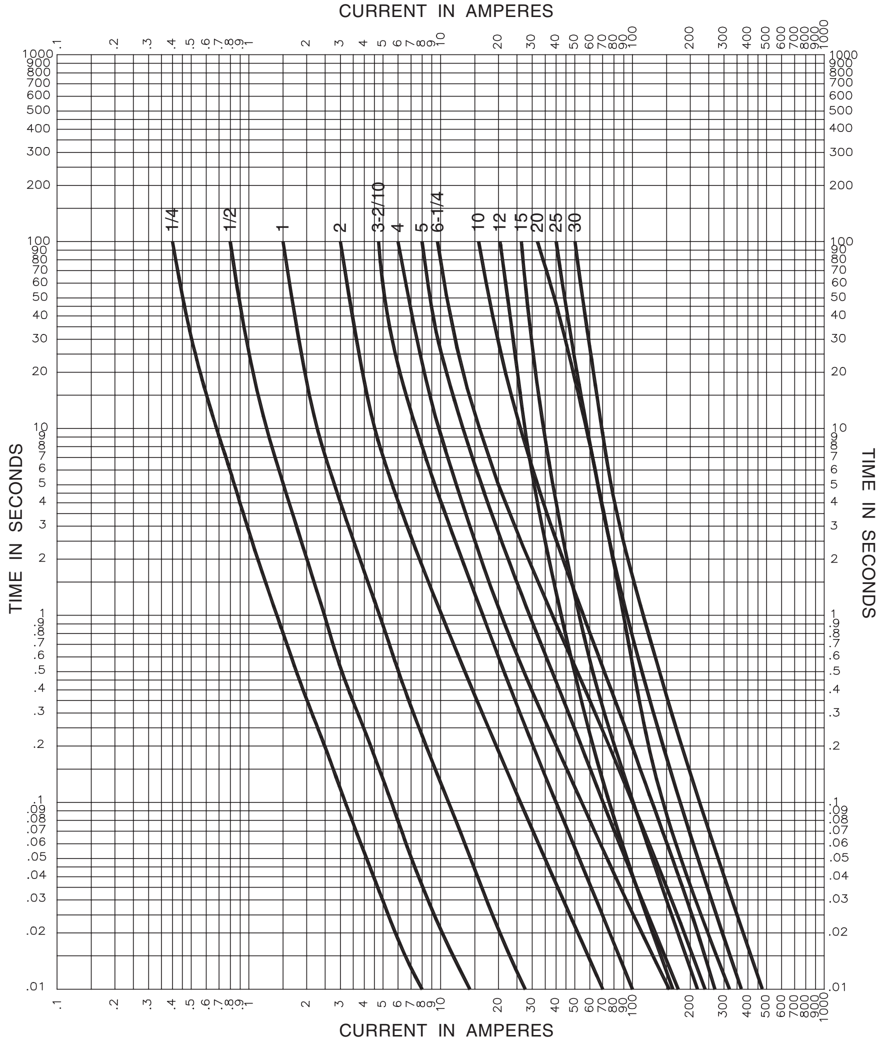
‡ Typical Voltage Drop (Voltage drop was measured at 25°C ambient temperature at rated current)

COOPER Bussmann

1/4" x 1-1/4" Fuses

MDA Series, Time Delay, Ceramic Tube

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a cardboard carton
BK8	8,000 pieces of fuses packed into a cardboard carton

OPTION CODE	
Option Code	**Description**
B	Board Washable - Hermetically sealed to withstand aqueous cleaning
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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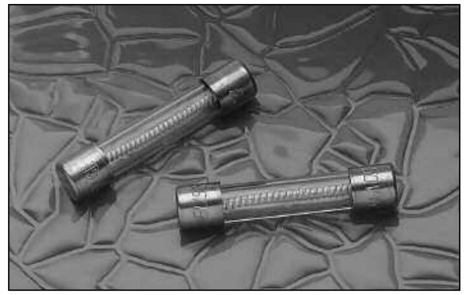
1/4" x 1-1/4" Fuses
MDL Series, Time Delay, Glass Tube

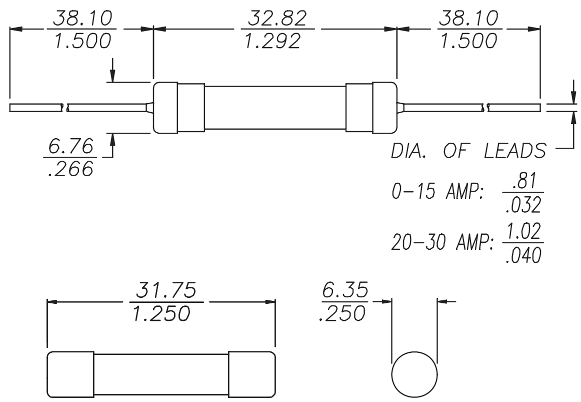
Description
- Time delay, glass tube
- Optional axial leads available
- 1/4 x 1-1/4 (6.3mm x 32mm) physical size
- Glass tube, nickel-plated brass endcap construction
- UL Listed product meets standard 248-14

RoHS 2002/95/EC



ELECTRICAL CHARACTERISTICS		
Rated Current	**Amp Rating**	**Opening Time**
1/16 - 30A	100%	None
	135%	60 minutes max.
	200%	120 seconds max.
1/16 - 3A	200%	5 seconds min.
3-2/10 - 8A	200%	12 seconds min.

Dimensions (mm/in)
Drawing Not to Scale



Agency Information
- UL Listed Card: MDL 1/16 - 8A (Guide JDYX, File E19180)
- UL Recognized Card: MDL 9 - 30A (Guide JDYX2, File E19180)
- CSA Certification Card: MDL 1/16 - 8A (Class No. 1422-01)
- CSA Component Acceptance: MDL 9-30A (Class No. 1422-30)

Environmental Data
- Shock: 1/100A and 8/10A – MIL-STD-202, Method 213, Test Condition I; 1A thru 30A – MIL-STD-202, Method 207, (HI Shock)
- Vibration: 1/100A and 8/10A – MIL-STD-202, Method 201; 1/4A thru 30A – MIL-STD-202, Method 204, Test Condition C (Except 5g, 500HZ)

Ordering
- Specify packaging, product, and option code

SPECIFICATIONS

Product Code	Voltage Rating AC	AC Interrupting Rating* 250V	125V	32V	Typical DC Cold Resistance** (ohms)	Typical Melting I²t† AC	Typical Voltage Drop‡
MDL-1/16	250V	35A	10000A	-	38.000	0.0046	2.79
MDL-1/10	250V	35A	10000A	-	15.900	0.0420	1.95
MDL-1/8	250V	35A	10000A	-	9.850	0.0422	1.52
MDL-3/16	250V	35A	10000A	-	4.680	0.116	1.05
MDL-2/10	250V	35A	10000A	-	4.115	0.314	0.972
MDL-1/4	250V	35A	10000A	-	3.200	0.447	0.965
MDL-3/10	250V	35A	10000A	-	2.300	0.412	0.808
MDL-3/8	250V	35A	10000A	-	2.800	0.982	1.46
MDL-1/2	250V	35A	10000A	-	1.725	1.656	1.27
MDL-3/4	250V	35A	10000A	-	0.822	4.343	1.01
MDL-1	250V	35A	10000A	-	0.525	11.498	0.995
MDL-1-1/4	250V	100A	10000A	-	0.320	86.2	0.722
MDL-1-1/2	250V	100A	10000A	-	0.250	22.7	0.721
MDL-2	250V	100A	10000A	-	0.173	62.3	0.644
MDL-2-1/4	250V	100A	10000A	-	0.068	49.6	0.535
MDL-2-1/2	250V	100A	10000A	-	0.096	63.1	0.410
MDL-3	250V	100A	10000A	-	0.067	67.5	0.345
MDL-4	250V	200A	10000A	-	0.035	19.3	0.187
MDL-5	250V	200A	10000A	-	0.023	32.0	0.160
MDL-6	250V	200A	10000A	-	0.018	37.4	0.155
MDL-6-1/4	250V	200A	10000A	-	0.018	38.7	0.152
MDL-7	250V	200A	10000A	-	0.018	42.7	0.140
MDL-8	250V	200A	10000A	-	0.011	47.8	0.119
MDL-9	32V	-	-	1000A	0.009	51.5	0.124
MDL-10	32V	-	-	1000A	0.008	64.4	0.114
MDL-15	32V	-	-	1000A	0.006	354.0	0.130
MDL-20	32V	-	-	1000A	0.002	2914.0	0.530
MDL-25	32V	-	-	1000A	0.001	15221.0	0.30
MDL-30	32V	-	-	1000A	0.001	15581.0	0.40

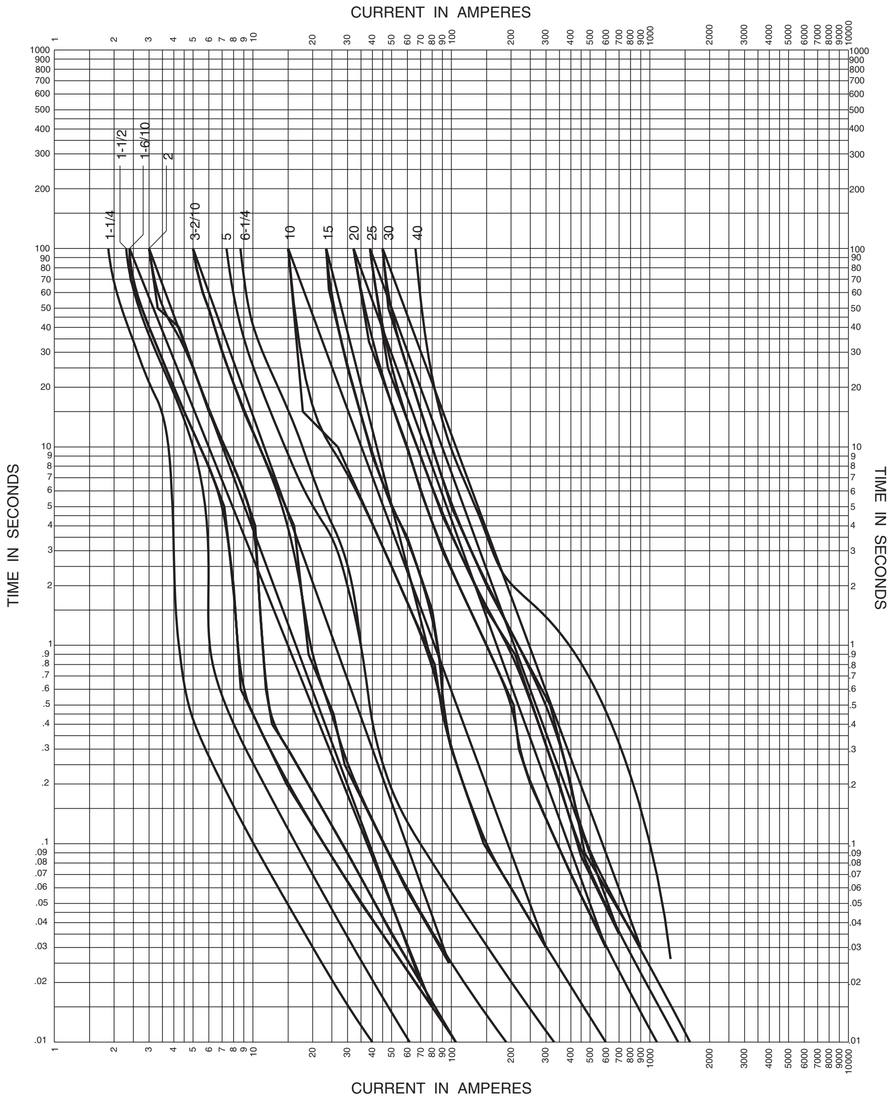
* Interrupting Ratings (Interrupting ratings were measured at 70% - 80% power factor on AC)
** DC Cold Resistance (Measured at ≤10% of rated current)
† Typical Melting I²t (A²Sec) (I²t was measured at listed interrupting rating and rated voltage.)
‡ Typical Voltage Drop (Voltage drop was measured at 25°C±3°C ambient temperature at rated current)

COOPER Bussmann

1/4" x 1-1/4" Fuses

MDL Series, Time Delay, Glass Tube

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a cardboard carton
BK8	8,000 pieces of fuses packed into a cardboard carton

OPTION CODE	
Option Code	**Description**
B	Board Washable - Hermetically sealed to withstand aqueous cleaning
V	Axial leads - copper tinned wire with nickel plated brass overcaps
-R	RoHS compliant version

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COOPER Bussmann

1/4" x 1-1/4" Fuses

MDQ Series Dual Element, Time Delay, Glass Fuse

Description

- Dual element, time delay
- 1/4" x 1-1/4" (6.3mm x 32mm) physical size
- Glass tube, nickel-plated brass endcap construction
- UL Listed product meets standard 248-14

ELECTRICAL CHARACTERISTICS		
Rated Current	% of Amp Rating	Opening Time
1/16A - 30A	100%	None
	135%	60 minutes maximum
	200%	120 seconds maximum

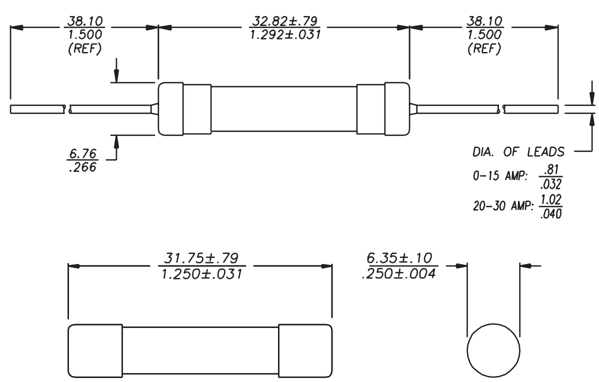
Agency Information

- UL Listed Card: MDQ-1/16 - 7A (Guide JDYX, File E19180)
- UL Recognition Card: MDQ-7.5 - 30A (Guide JDYX2, File E19180)
- CSA Component Acceptance Card: MDQ-1/100 - 30 (Class 1422-01)

Ordering

- Specify packaging, product, and option code

Dimensions mm/(inches)



SPECIFICATIONS			
Product Code	Voltage Rating AC	Interrupting Rating AC	Typical DC Cold Resistance (ohms)**
MDQ-1/16	250V	35A	83.30000
MDQ-1/10	250V	35A	35.00000
MDQ-1/8	250V	35A	21.50000
MDQ-3/16	250V	35A	10.00000
MDQ-2/10	250V	35A	8.65000
MDQ-1/4	250V	35A	5.77500
MDQ-3/10	250V	35A	4.20000
MDQ-3/8	250V	35A	2.35000
MDQ-1/2	250V	35A	1.40000
MDQ-3/4	250V	35A	0.39685
MDQ-1	250V	35A	0.37400
MDQ-1-1/4	250V	100A	0.36000
MDQ-1-1/2	250V	100A	0.27000
MDQ-2	250V	100A	0.13250
MDQ-2-1/4	250V	100A	0.11450
MDQ-2-1/2	250V	100A	0.10050
MDQ-3	250V	100A	0.05715
MDQ-4	250V	200A	0.03510
MDQ-5	250V	200A	0.02650
MDQ-6	250V	200A	0.01715
MDQ-6-1/4	250V	200A	0.01690
MDQ-7	250V	200A	0.01375
MDQ-8	32V	1,000A	0.01200
MDQ-9	32V	1,000A	0.00888
MDQ-10	32V	1,000A	0.00720
MDQ-15	32V	1,000A	0.00410
MDQ-20	32V	1,000A	0.00150
MDQ-25	32V	1,000A	0.00123
MDQ-30	32V	1,000A	0.00105

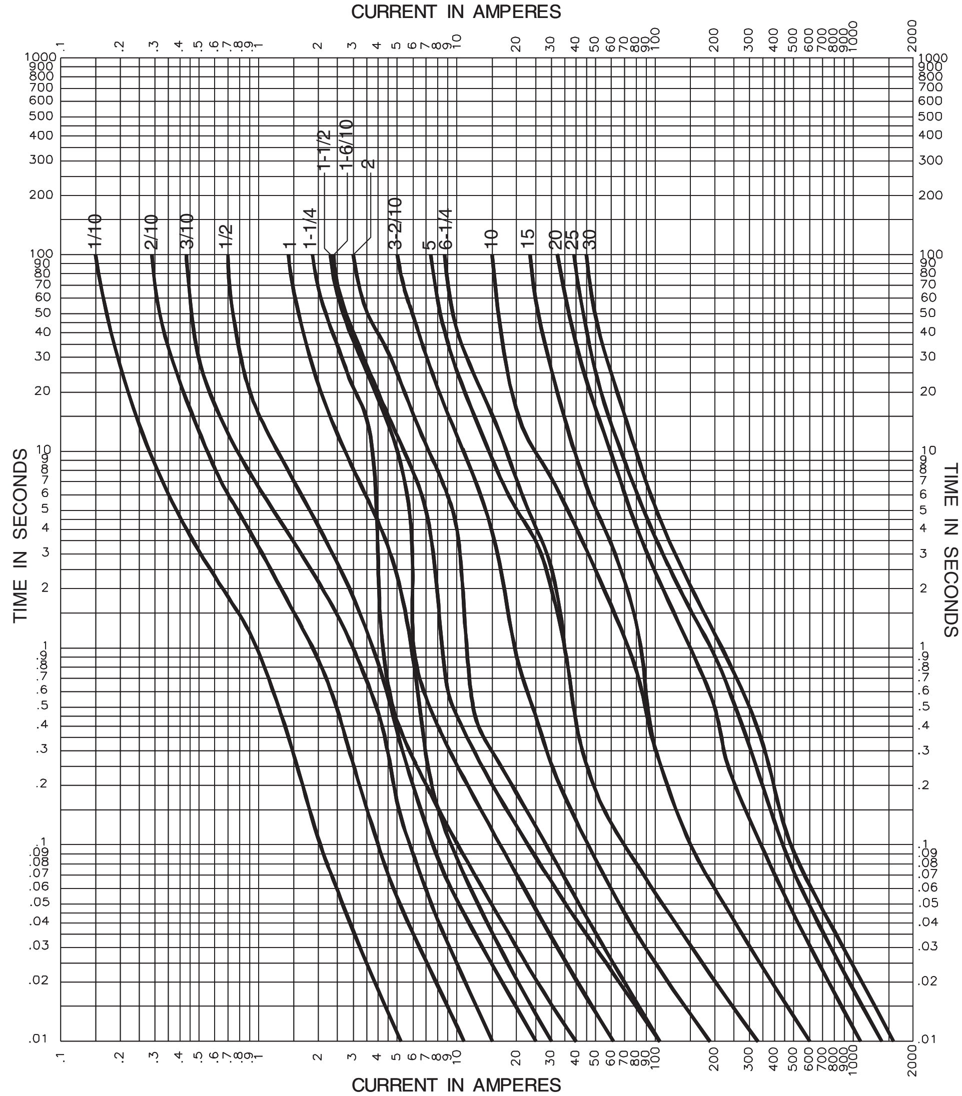
** DC Cold Resistance (Measured at <10% of rated current)

COOPER Bussmann

1/4" x 1-1/4" Fuses

MDQ Series Dual Element, Time Delay, Glass Fuse

TIME CURRENT CURVE



PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces of fuses packed into a cardboard carton
BK1	1,000 pieces of fuses packed into a cardboard carton

OPTION CODE	
Option Code	**Description**
B	Board Washable - Hermetically sealed to withstand aqueous cleaning
V	Axial leads - copper tinned wire with nickel plated brass overcaps

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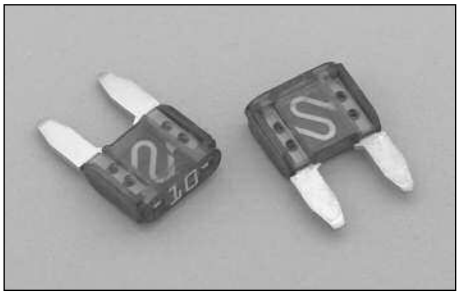
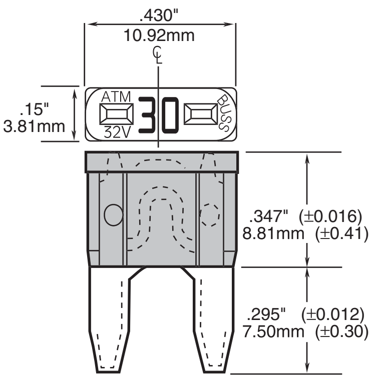
COOPER Bussmann

Blade-Type Fuses
ATM Series, Fast Acting

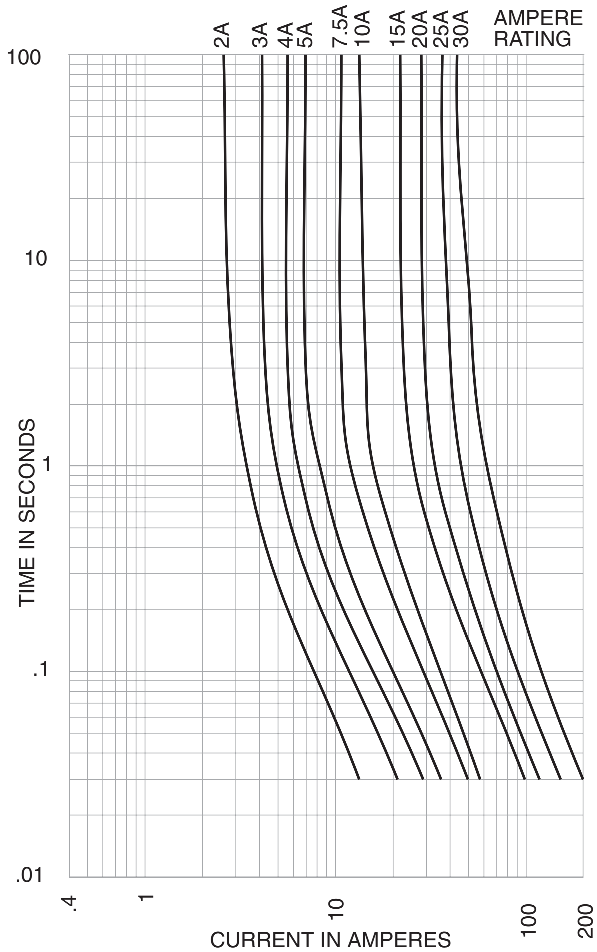


RoHS 2002/95/EC

Dimensional Data



Time-Current Characteristic Curves–Average Melt



Catalog Symbol: ATM
Fast-Acting
Ampere Ratings: 2 to 30 Amperes
Interrupting Rating: 1,000 Amperes
Ordering: Specify packaging and product code

SPECIFICATIONS

Product Code	Body Color	Voltage Rating DC
ATM-2	Gray	32V
ATM-3	Violet	32V
ATM-4	Pink	32V
ATM-5	Tan	32V
ATM-7 1/2	Brown	32V
ATM-10	Red	32V
ATM-15	Lt. Blue	32V
ATM-20	Yellow	32V
ATM-25	Natural White	32V
ATM-30	Green	32V

Recommended Bussmann Fuseholders

Blade-Type	Part	Description	Fuse Size	Wire Size
ATM	HHM	Fuseholder w/Cover	3-30 Amps	#12 Lead Wire; 4" Length
	HHM-B	Body Only		
	HHM-C	Cover Only	—	—
	HHL	Fuseholder w/Cover	2-20 Amps	#16 Lead Wire; 4" Length
	HHL-B	Body Only		

PACKAGING CODE

Packaging Code	Description
Blank	5 pieces of fuses packed in a tin
BK	500 pieces of fuses packed in a carton

COOPER Bussmann

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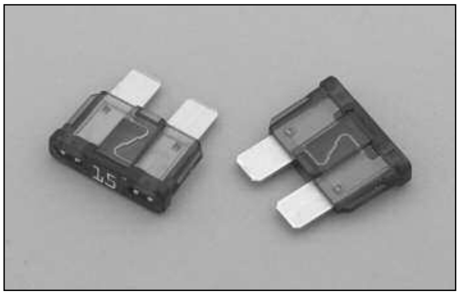
COOPER Bussmann

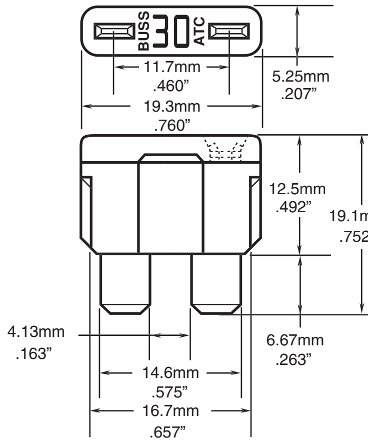
Blade-Type Automotive Fuses

ATC Series, Fast Acting

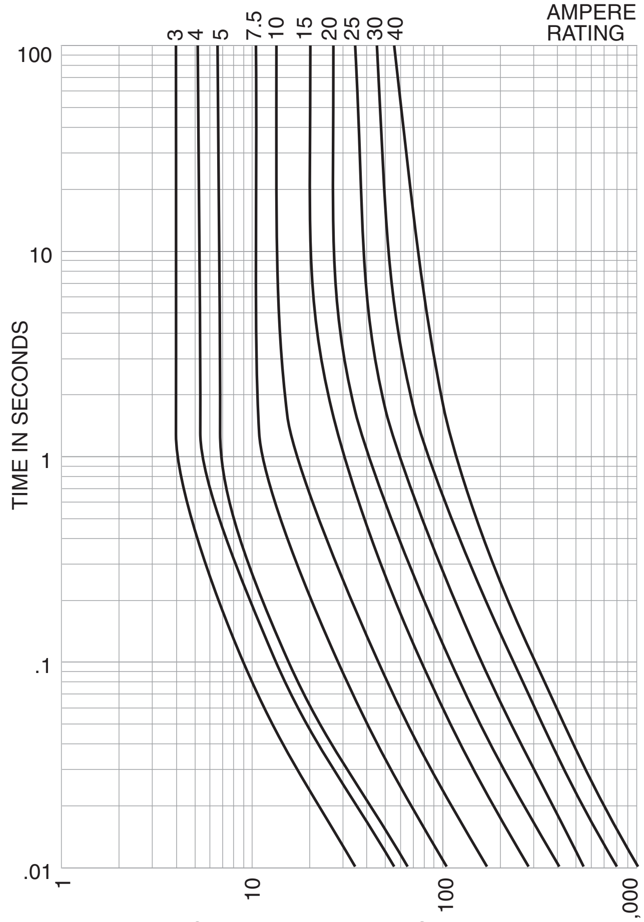


RoHS 2002/95/EC

Dimensional Data



Time-Current Characteristic Curves–Average Melt



Catalog Symbol: ATC
Fast-Acting
Ampere Rating: 1 to 40 Amperes
Interrupting Rating: 1,000 Amperes
Agency Approvals: U.L. Recognized, (3-40A) Guide JFHR2, File E56412
Ordering: Specify packaging and product code

SPECIFICATIONS

Product Code	Body Color	Voltage Rating DC
ATC-1	Black	32V
ATC-2	Gray	32V
ATC-3	Violet	32V
ATC-4	Pink	32V
ATC-5	Tan	32V
ATC-7 1/2	Brown	32V
ATC-10	Red	32V
ATC-15	Blue	32V
ATC-20	Yellow	32V
ATC-25	Clear	32V
ATC-30	Green	32V
ATC-40	Amber	32V

Recommended Bussmann Fuseholders*

Blade-Type	Part	Description	Fuse Size	Wire Size
ATC	HHC	Yellow Fuseholder	3-20 Amps	#16 Lead Wire
	HHF	Black Fuseholder w/cover	3-20 Amps	#14 Lead Wire
	HHD	Black Fuseholder	3-30 Amps	#12 Lead Wire
	HHG	Black Fuseholder w/cover	3-30 Amps	#12 Lead Wire
	HHD-C	Cover Only	—	—

*Also used in Bussmann 1A5600 Fuse Clips (0-20A)

PACKAGING CODE

Packaging Code	Description
Blank	5 pieces of fuses packed in a tin
BK	2,000 pieces of fuses packed in a carton

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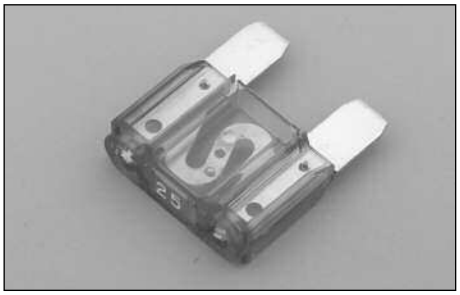
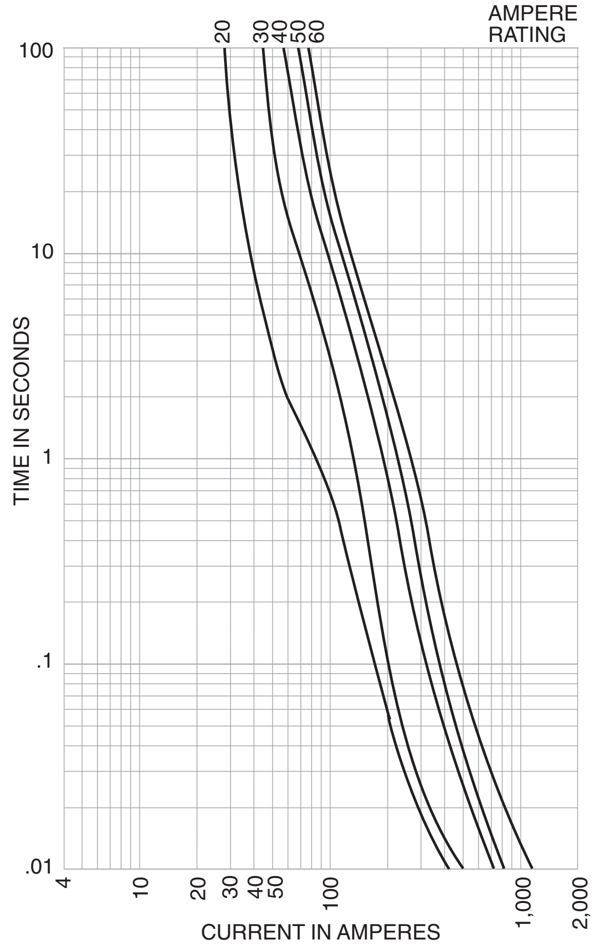
Blade-Type Fuses
MAX Series



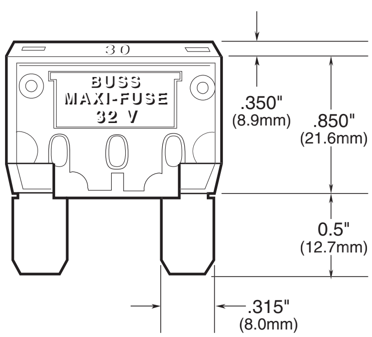
RoHS 2002/95/EC

Time-Current Characteristic Curves–Average Melt



Dimensional Data

All tolerances: ±0.008"/-.005" ±0.20mm/-0.13mm



Catalog Symbol: MAX
Fast-Acting
Ampere Rating: 20 to 80 Amperes
Interrupting Rating: 1,000 Amperes
Ordering: Specify packaging and product code

SPECIFICATIONS

Product Code	Body Color	Voltage Rating DC
MAX-20	Yellow	32V
MAX-30	Green	32V
MAX-40	Orange	32V
MAX-50	Red	32V
MAX-60	Blue	32V
MAX-70	Tan	32V
MAX-80	Natural	32V

Recommended Bussmann Fuseholders

Blade-Type	Part	Description	Fuse Size	Wire Size
MAX	HHX	Fuseholder w/Cover	20-60 Amps	#6 Lead Wire; 5" Length
	HHX-B	Body Only		
	HHX-C	Cover Only	—	—

PACKAGING CODE

Packaging Code	Description
Blank	1 pieces of fuses packed in a tin
BK	250 pieces of fuses packed in a carton

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PC Board Fuseclips for 5mm Diameter Fuses

HTC-15M, HTC-140M

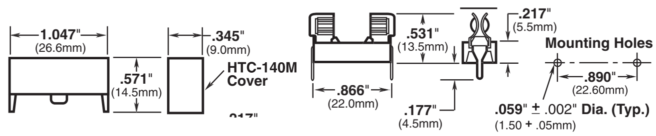
RoHS 2002/95/EC

PCB Mounted Fuse Holder & Snap-On Cover

Voltage Rating: 250V, 6.3A, 1.6W

HTC-15M (fuse holder), HTC-140M (natural cover), HTC-150M* (transparent cover)

*Available in bulk only. Use this format: BK/HTC-150M



HTC-200M

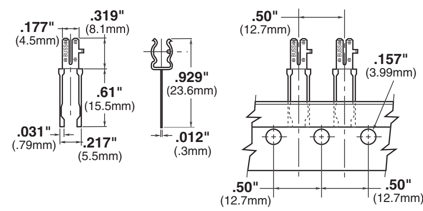
RoHS 2002/95/EC

PCB Mounted Fuseclip

Construction: Tin-plated bronze

Tape and Fan Fold packed

Ammo Pack (AP/HTC-200M) 1000 pieces per box



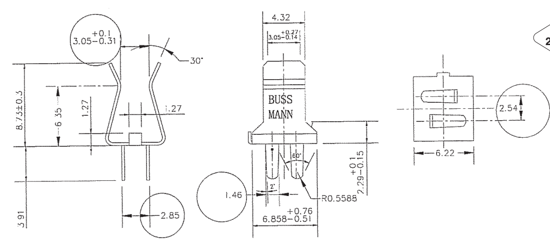
HTC-211M

RoHS 2002/95/EC

PCB Mounted Fuseclip with End Stops

Construction: Tin-plated brass

*Equivalent replacement to HTC-210M



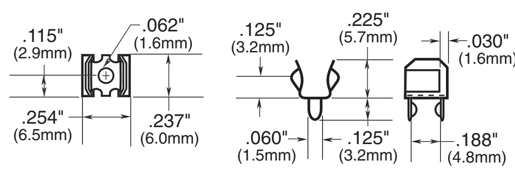
1A3399 Series**

RoHS 2002/95/EC

PCB Fuseclips with End Stops & Straight Leads

Catalog Numbers	Clip Material*	Finish
1A3399-01	Beryllium copper*	Silver
1A3399-04	Beryllium copper*	Bright tin
1A3399-10	Spring bronze	Bright tin

*Beryllium copper recommended for amps higher than 15 amps (¼" clips).



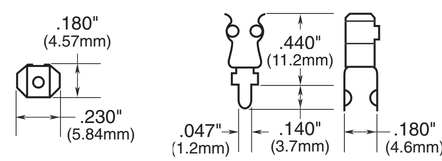
1A5018 Series**

RoHS 2002/95/EC

PCB High Profile Fuseclips with End Stops & Straight Leads

Catalog Numbers	Clip Material*	Finish
1A5018-07	Spring bronze	Silver
1A5018-10	Spring bronze	Bright tin

*Beryllium copper recommended for amps higher than 15 amps (¼" clips).

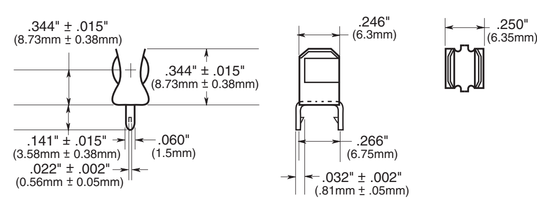


1A5601 Series

RoHS 2002/95/EC

PCB Fuseclips (0-7A)

Catalog Number	Clip Material	Finish
1A5601	Cartridge brass	Bright tin

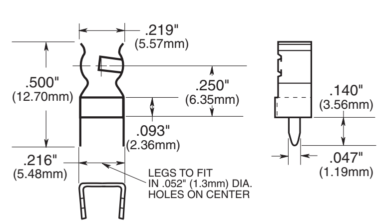


1A5602 Series

RoHS 2002/95/EC

PCB Fuseclips (0-7A)

Catalog Number	Clip Material	Finish
1A5602	Cartridge brass	Bright tin



**For RoHS compliant version, add "-R" option code suffix to part number.

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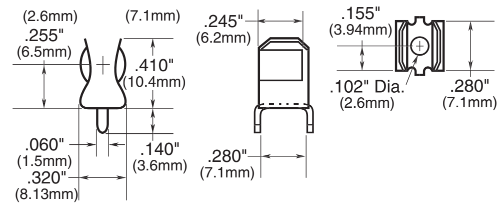
PC Board Fuseclips for 1/4" Diameter Fuses

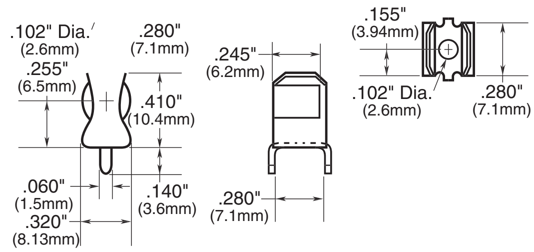
1A3398 Series**



PCB Fuseclips without End Stops or Straight Leads

Catalog Numbers	Clip Material	Finish
1A3398-07	Cartridge brass	Bright tin

1A1907 Series**

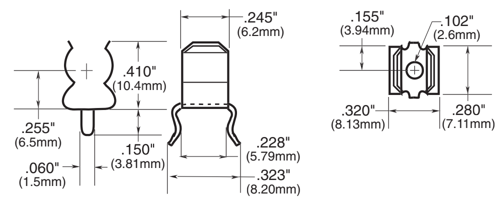


PCB Fuseclips with End Stops & Straight Leads

Catalog Numbers	Clip Material*	Finish
1A1907-02	Cartridge brass	None/bright dipped
1A1907-03	Beryllium copper*	Bright tin
1A1907-05	Beryllium copper*	Silver
1A1907-06	Cartridge brass	Bright tin

*Beryllium copper recommended for amps higher than 15A ¼" clips).

1A4533 Series**

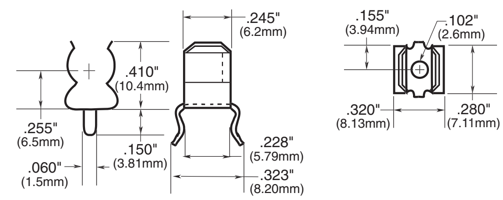


PCB Fuseclips without End Stops or Angled Out Leads

Catalog Numbers	Clip Material*	Finish
1A4533-01	Beryllium copper*	Bright tin
1A4533-06	Cartridge brass	Bright tin

*Beryllium copper recommended for amps higher than 15A (¼" clips).

1A4534 Series**

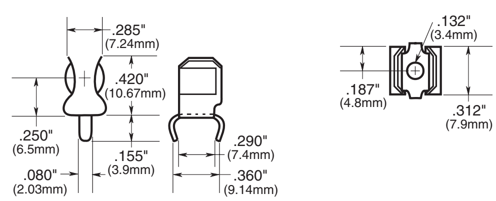


PCB Fuseclips with End Stops & Angled Out Leads

Catalog Numbers	Clip Material*	Finish
1A4534-01	Beryllium copper*	Bright tin
1A4534-06	Cartridge brass	Bright tin

*Beryllium copper recommended for amps higher than 15A (¼" clips).

1A1119 Series**

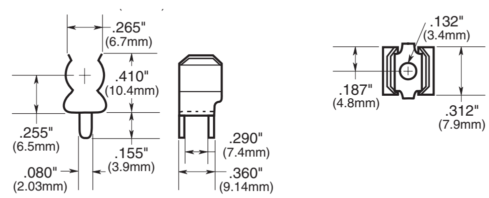


Fuseclips with End Stops & Angled In Leads

Catalog Numbers	Clip Material*	Finish
1A1119-04	Beryllium copper*	Bright tin
1A1119-05	Beryllium copper*	Silver
1A1119-10	Cartridge brass	Bright tin

*Beryllium copper recommended for amps higher than 15A (¼" clips).

1A1120 Series**



PCB Fuseclips without End Stops or Angled In Leads

Catalog Numbers	Clip Material*	Finish
1A1120-02	Cartridge brass	None/bright dipped
1A1120-05	Beryllium copper*	Silver
1A1120-06	Beryllium copper*	Bright tin
1A1120-09	Cartridge brass	Bright tin

*Beryllium copper recommended for amps higher than 15A (¼" clips).

For RoHS compliant version, add "-R" option code suffix to part number.

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5mm x 20mm Fuseholders
HTC Printed Circuit Board Series

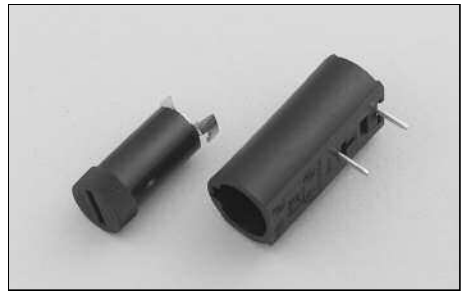
Description
- For 5mm x 20mm fuses
- Fuse carriers are interchangeable
- Both vertical and horizontal mounting features
- Fuse carrier and knob are spring loaded bayonet type with screwdriver slot
- Solderability in accordance with IEC 68-2-20
- Shock safety of PC2
- High temperature thermoplastic meets:
  - UL 94-VO
  - Glow wire test: 960°C per IEC 695-2-1

HTC series printed circuit board fuseholders accept 5 x 20mm fuses.

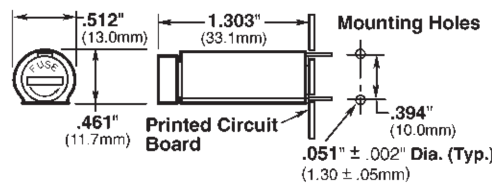
Agency Information
- UL Recognized: IZLT2, E14853A
- CSA Component Certified: Class 6225-01, File 47235

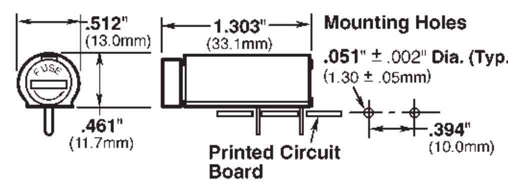
Ordering
- Specify packaging and product code

RoHS 2002/95/EC



Dimensions
Drawing Not to Scale





Component	Material
Clip	Tin Plating
Terminals	Copper, Tin Plated
Body	Thermoplastic

SPECIFICATIONS

Product Code	Voltage Rating AC	Current Rating Agency Approval UL	CSA	SEMKO	Ambient Temperature	Temperature Rise	Mounting
HTC-45M	250V	6.3A	6.3A	6.3A	24C	41C	Vertical
HTC-50M	250V	6.3A	6.3A	6.3A	24C	41C	Horizontal

PACKAGING CODE

Packaging Code	Description
Blank	10 pieces of fuseholder packed into a carton
BK	100 pieces of fuseholders packed into a cardboard shelf package

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COOPER Bussmann

5mm x 20mm Fuseholders
HTC Panel Mount Series

Description

- For 5mm x 20mm fuses
- Tin-plated brass terminals
- Shock safety of PC2
- High temperature Thermoplastic meets:
  - UL 94 VO
  - Glow wire test: 960°C IEC 695-2-1
- Designed to IEC 68-2-20

Agency Information

- UL Recognized: IZLT2, E14853A
- CSA Component Certified: Class 6225-01, File 47235

RoHS 2002/95/EC

Ordering

- Specify packaging and product code

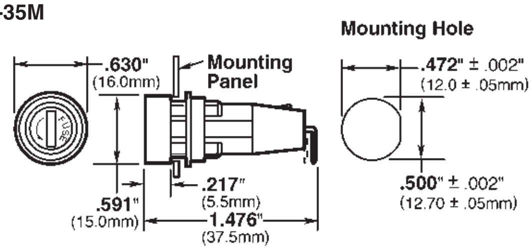
SPECIFICATIONS

Product Code	Cap Type	Voltage Rating AC	Current Rating AC	Ambient Temperature	Temperature Rise	Maximum Temperature (C)
HTC-35M	Threaded Cap/Carrier	250V	6.3A	24C	43C	75
HTC-40M	Screwdriver Slot	250V	6.3A	24C	43C	75
HTC-55M	Bayonet Cap/Carrier	250V	6.3A	24C	43C	65
HTC-70M	Bayonet Cap/Carrier	250V	10A	24C	43C	65

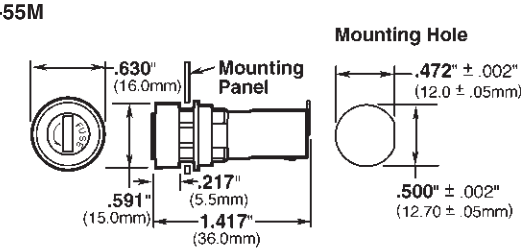
Dimensions

Drawing Not to Scale

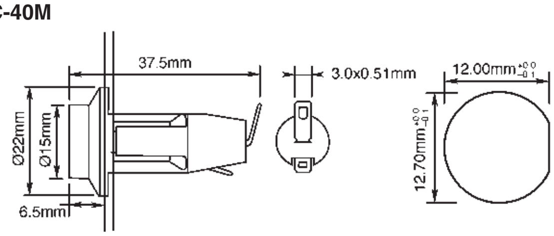
HTC-35M



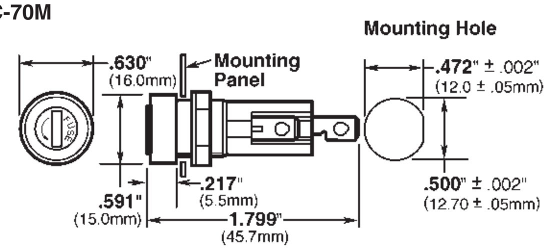
HTC-55M



HTC-40M



HTC-70M



Component	Material
Terminal	Tin-Plated Brass
Body	Thermoplastic
Cap	Thermoplastic
Nut	Polycarbonate

PACKAGING CODE

Packaging Code	Description
Blank	10 pieces of fuseholders packed into a carton
BK	100 pieces of fuseholders packed into a cardboard shelf package

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Fuseholders
HB PCB Series (HBH, HBV, HBW)

COOPER Bussmann

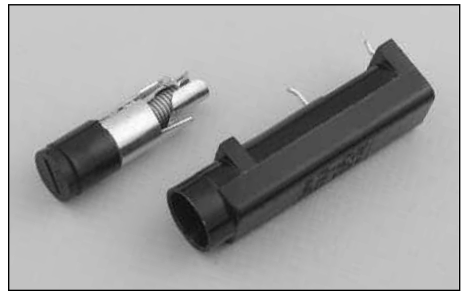
Description
- For 1/4" x 1-1/4" and 5mm x 20mm fuses
- Fuse carriers are interchangeable
- Carriers are color coded for easy identification:
  - Gray for 1/4" fuses
  - Black for 5mm fuses
- Both vertical and horizontal mounting features
- Fuse carrier and knob are spring loaded bayonet type with screwdriver slot
- "Kicked" terminals (all models) for optimum wave-soldering
- Stabilizer pins on HBV model
- High dielectric molded thermoplastic meets UL 94 VO

Resistance Ratings
- Insulation Resistance: 10,000 megaohm at 500Vdc
- Contact Resistance: Less than 0.005 ohms at 200mV

Dielectric Strength
- Dielectric Strength: Over 200mV

Agency Information
- UL Recognized: IZLT2, E14853
- CSA Component Acceptance: Class 6225-01, File 47235

RoHS 2002/95/EC



Environmental Data
- Temperature Rating (RTI): The mounting body for all devices has a temperature rating of 150°C. The knob for all devices has a temperature rating of 130°C.

Ordering
- Specify packaging, product, and option code

SPECIFICATIONS

Product Code	Fuseholder Body Mount	Fuseholder Carrier Size	Voltage Rating	Current Rating Agency Approval UL	CSA	VDE	SEMKO
HBH-I	Horizontal	1/4" x 1-1/4"	250V	16A	12A	6.3A	10A
HBH-M	Horizontal	5mm x 20mm	250V	16A	12A	6.3A	10A
HBV-I	Vertical w/ Stability Pins	1/4" x 1-1/4"	250V	16A	12A	6.3A	10A
HBV-M	Vertical w/ Stability Pins	5mm x 20mm	250V	16A	12A	6.3A	10A
HBW-I	Vertical w/o Stability Pins	1/4" x 1-1/4"	250V	16A	12A	6.3A	10A
HBW-M	Vertical w/o Stability Pins	5mm x 20mm	250V	16A	12A	6.3A	10A
HBH	Horizontal	na	250V	16A	12A	6.3A	10A
HBV	Vertical w/ Stability Pins	na	250V	16A	12A	6.3A	10A
HBW	Vertical w/o Stability Pins	na	250V	16A	12A	6.3A	10A
FBI	na	1/4" x 1-1/4"	250V	16A	12A	6.3A	10A
FBM	na	5mm x 20mm	250V	16A	12A	6.3A	10A

Accessories - Fuseholders

PACKAGING CODE

Packaging Code	Description
Blank	10 pieces of fuseholders packed into a carton
BK	100 pieces of fuseholders packed into a cardboard shelf package

OPTION CODE

Option Code	Description
-R	RoHS compliant version

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COOPER Bussmann

1/4" x 1-1/4" Fuseholders

HKP Panel Mount Series

Description

- For 1/4" x 1-1/4" (6.3mm x 32mm) fuses
- Maximum panel thickness 5/16" (7.9mm) thick
- Bayonet-type Knob
- Vibration Resistant
- Military version is designated FHN26G1
- Plastic nut – BK/1A4287
- Metal nut – BK/1A4806-2
- Cap – 9435-1/2
- Neoprene washer – 9732

Agency Information

- UL Recognized: IZLT2, E14853
- CSA Component Acceptance:
  Class 6225-01, File 47235

Ordering

- Specify packaging, product, and option code

RoHS 2002/95/EC

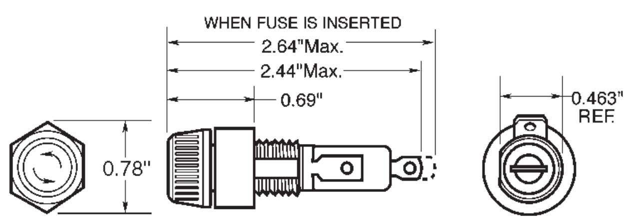
Environmental Data

- Temperature rating (RTI): The mounting body for all devices has a temperature rating of 150°C. The knob for these devices are molded plastic with a temperature rating of 150°C.
- Thermoplastic meets UL 94 HB
- Terminal Strength: 5 pounds
- Torque: Mounting – 20 inch-pound
- Salt Spray (corrosion): Test condition B

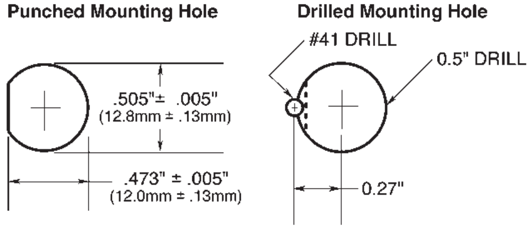
Dimensions

Drawing Not to Scale

HKP-BBHH, HKP-HH, HKP-LW-HH

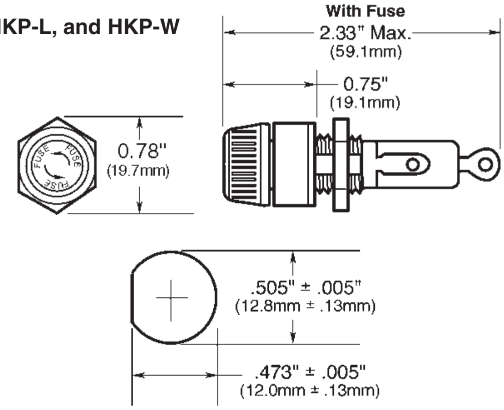


Punched Mounting Hole **Drilled Mounting Hole**

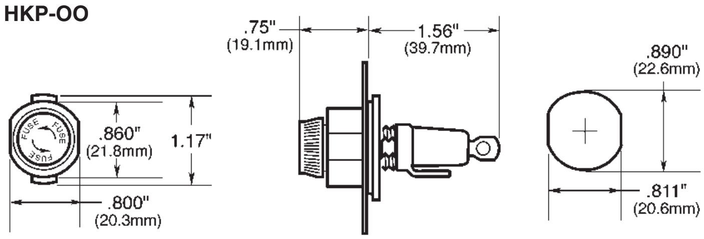


Component	Material
Terminal	Tin-Plated Brass
Body	Thermoset
Cap	Thermoset
Nut	Thermoplastic

HKP, HKP-L, and HKP-W



HKP-OO



1/4" x 1-1/4" Fuseholders
HKP Panel Mount Series

SPECIFICATIONS			
Product Code	**Feature**	**Voltage Rating**	**Current Rating**
HKP	Standard	250V	30A
HKP-BBHH	1/4" Quick Connects, nut and washer assembled	250V	20A
HKP-HH	1/4" Quick Connects	250V	20A
HKP-L	2250 stand-off barrier	250V	30A
HKP-LW-HH	Drip-proof knob, 2250V stand-off barrier and 1/4" quick connects	250V	20A
HKP-OO	Snap-lock	250V	30A
HKP-W	Drip-proof knob	250V	30A

PACKAGING CODE	
Packaging Code	**Description**
Blank	10 pieces of fuseholders packed into a carton
BK	100 pieces of fuseholder components packed separately into a carton

OPTION CODE	
Option Code	**Description**
-R	RoHS compliant version

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COOPER Bussmann

Fuseholders
HTB Panel Mount Series

Description

- For 1/4" x 1-1/4" and 5mm x 20mm fuses
- All holder bodies have the option of using 1/4" x 1-1/4" or 5mm x 20mm carriers
- Withstands 15 to 20 lbs-in torque to mounting nut when mounting fuseholder to panel
- High temperature, flame retardant, Thermoplastic meets UL 94 VO

RoHS 2002/95/EC

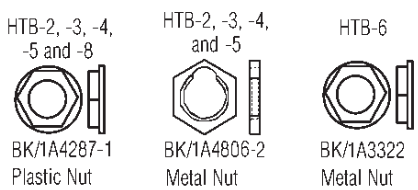
SPECIFICATIONS				
Product Code	**Current Rating**	**Voltage Rating**	**Fuse Size**	**Quick Connect**
HTB-X2I	15A	250V	1/4" x 1-1/4"	3/16"
HTB-X4I	15A	250V	1/4" x 1-1/4"	3/16"
HTB-X6I	20A	250V	1/4" x 1-1/4"	1/4"
HTB-X8I	20A	250V	1/4" x 1-1/4"	1/4"
HTB-X2M	15A	250V	5mm x 20mm	3/16"
HTB-X4M	15A	250V	5mm x 20mm	3/16"
HTB-X6M	16A	250V	5mm x 20mm	1/4"
HTB-X8M	16A	250V	5mm x 20mm	1/4"

Agency Information

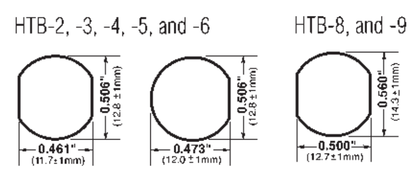
- UL Recognized: IZLT2, E14853
- CSA Component Acceptance: Class 6225-01, File 47235
- VDE Certified: 136128, HTB-XXM
- SEMKO Certification: Ref. #0146149/01, HTB-XXM

Maximum Panel Thickness		
Body Type	**Inch**	**Millimeters**
HTB-2	0.30	7.62
HTB-3	0.30	7.62
HTB-4	0.125	3.18
HTB-5	0.125	3.18
HTB-6	0.30	7.62
HTB-8	0.125	3.18
HTB-9	0.125	3.18

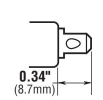
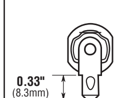
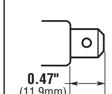
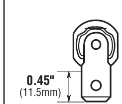
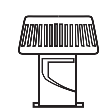
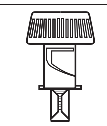
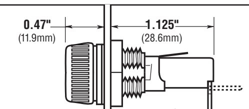
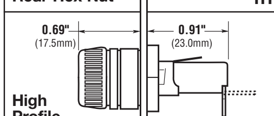
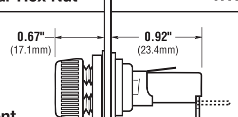
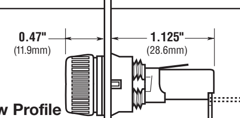
Replacement Parts



Mounting Dimensions

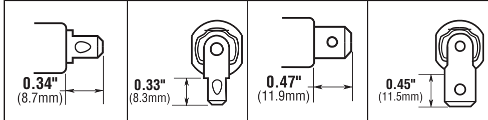
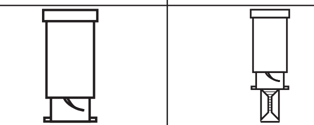
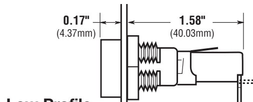
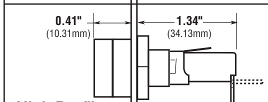
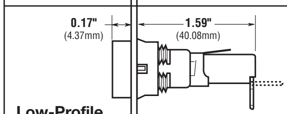


Dimensional Data

Knob Type Carrier	Maximum Panel Thickness	Terminal Options: Solder/ 3⁄16″ Quick-Connect, In-Line	Terminal Options: Solder/ 3⁄16″ Quick-Connect, Rt. Angle	Terminal Options: 1⁄4″ Quick-Connect, In-Line	Terminal Options: 1⁄4″ Quick-Connect, Rt. Angle	Carrier Options: 1⁄4″ x 1 1⁄4″ (“I” Equals Inches), Knob	Carrier Options: 5mm x 20mm (“M” Equals Metric), Knob
Common Dimensional Data: Length (Knob Type) - 1.69″ (42.9mm) Plus In-Line Terminal (Screwdriver Slotted) 1.75″ (44.5mm) NOTE: Plus In-Line Terminal							
 **Low Profile Rear Hex Nut** **HTB-2**	0.30″ 7.62mm	HTB-22I	HTB-24I	HTB-26I	HTB-28I	✓	—
		HTB-22M	HTB-24M	HTB-26M	HTB-28M	—	✓
 **High Profile Rear Hex Nut** **HTB-4**	0.125″ 3.18mm	HTB-42I	HTB-44I	HTB-46I	HTB-48I	✓	—
		HTB-42M	HTB-44M	HTB-46M	HTB-48M	—	✓
 **Front Hex Nut** **HTB-6**	0.30″ 7.62mm	HTB-62I	HTB-64I	HTB-66I	HTB-68I	✓	—
		HTB-62M	HTB-64M	HTB-66M	HTB-68M	—	✓
 **Low Profile Snap-In** **HTB-8**	0.125″ 3.18mm	HTB-82I	HTB-84I	HTB-86I	HTB-88I	✓	—
		HTB-82M	HTB-84M	HTB-86M	HTB-88M	—	✓

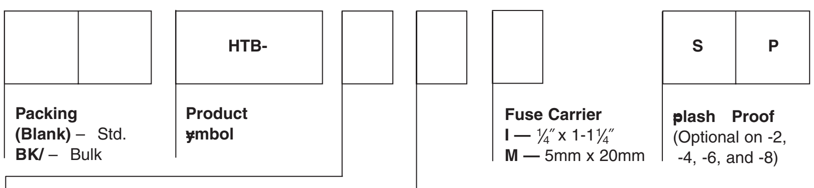
Fuseholders and fuse carriers may be ordered separately.

Dimensional Data

Knob Type Carrier	Maximum Panel Thickness	Terminal Options				Carrier Options	
		Solder/ 3/16″ Quick-Connect		1/4″ Quick-Connect			
		In-Line	Rt. Angle	In-Line	Rt. Angle	1/4″ × 1 1/4″ (“I” Equals Inches) Screwdriver	5mm × 20mm (“M” Equals Metric) Screwdriver
Common Dimensional Data: Length (Knob Type) - 1.69″ (42.9mm) Plus In-Line Terminal (Screwdriver Slotted) 1.75″ (44.5mm) NOTE: Plus In-Line Terminal							
 Low Profile Rear Hex Nut **HTB-3**	0.30″ 7.62mm	HTB-32I	HTB-34I	HTB-36I	HTB-38I	✓	—
		HTB-32M	HTB-34M	HTB-36M	HTB-38M	—	✓
 High Profile Rear Hex Nut **HTB-5**	0.125″ 3.18mm	HTB-52I	HTB-54I	HTB-56I	HTB-58I	✓	—
		HTB-52M	HTB-54M	HTB-56M	HTB-58M	—	✓
 Low-Profile Snap-In **HTB-9**	0.125″ 3.18mm	HTB-92I	HTB-94I	HTB-96I	HTB-98I	✓	—
		HTB-92M	HTB-94M	HTB-96M	HTB-98M	—	✓

Fuseholders and fuse carriers may be ordered separately.

Ordering Information



Packing
(Blank) – Std.
BK/ – Bulk

Product ymbol

Body Configuration and Mounting
Finger Grip Holders
2 — Low Profile (Rear Panel Hex-Nut)
4 — High Profile
***6** — (Front Panel Hex-Nut)
8 — Low Profile (Snap-In)
crewdriver lotted Holders
3 — Low Profile
5 — High Profile
9 — Low Profile (Snap-In)

Rear Terminal Configuration
2 — Solder / 3/16″ Quick-Connect (In-Line)
4 — Solder / 3/16″ Quick-Connect (Right Angle)
6 — 1/4″ Quick-Connect (In-Line)
8 — 1/4″ Quick-Connect (Right Angle)

Fuse Carrier
I — 1/4″ x 1-1/4″
M — 5mm x 20mm

plash Proof
(Optional on -2, -4, -6, and -8)

RoH= Compliant Version

FUE CARRIER ONLY

Packaging
(Blank) – Std.
BK/ – Bulk

Product ymbol
FT — Knob Type (For 20, 40, 60, and 80 Series Only)
T — Screwdriver Slotted (For 30, 50, and 90 Series Only)

Fuse Carrier
I — 1/4″ x 1 1/4″
M — 5mm x 20mm

***Profile varies with panel thickness. Holder installs thru rear of panel.**

PACKAGING CODE	
Packaging Code	**Description**
Blank	10 pieces of fuseholders packed into a carton
BK	100 pieces of fuseholders packed into a cardboard shelf package

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1/4" x 7/8" to 1-1/4" Fuseholders

HHB In-Line Series

COOPER Bussmann

Description

- For 1/4" x 7/8" to 1/4" x 1-1/4" fuses
- Accepts #16 to #12 AWG copper wire
- Simple crimp assembly
- “Snap-Lock” feature provides strong positive union
- High visibility yellow color
- Recommended crimp tools:
  - Thomas & Betts – ERG-2002
  - Channelock No. 909
  - General Electric – U.S. & Metric Electrical Terminal Tool
- UL flammability rating 94 V2

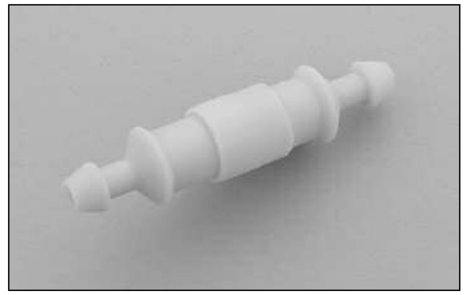
Environmental Data

- Pull Force: 5 pounds minimum to separate fuseholder housing with fuse inside

Ordering

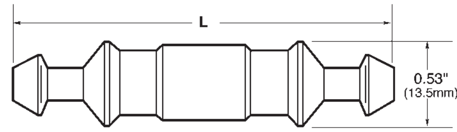
- Specify packaging, product, and option code

RoHS 2002/95/EC



Dimensions

Drawing Not to Scale



Fuse Length	“L” with fuse installed
7/8”	2.100 Max.
1”	2.250 Max.
1-1/4”	2.420 Max.

SPECIFICATIONS

Product Code	Voltage Rating AC	Current Rating AC
HHB	32V	30A

Component	Material
Body	Nylon
Crimp	Copper Tin-Plated

PACKAGING CODE

Packaging Code	Description
Blank	10 pieces of fuseholders packed into a carton
BK	1,000 pieces of fuseholders packed into a cardboard shelf package

OPTION CODE

Option Code	Description
Y408	#14 AWG insulated wire with 8 inch yellow leads
R408	#14 AWG insulated wire with 8 inch red leads
B408	#14 AWG insulated wire with 8 inch black leads
Y419	#14 AWG insulated wire with 19 inch yellow leads
R419	#14 AWG insulated wire with 19 inch red leads
B419	#14 AWG insulated wire with 19 inch black leads
-R	RoHS Compliant version

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COOPER Bussmann

1/4" x 1-1/4" Fuseholders
HFB In-Line Waterproof Series

Description
- For 1/4" x 1-1/4" (6.35mm x 31.8mm) fuses
- Ideal for harsh environments
  - Water
  - Salt Spray
  - Ultraviolet Light
  - Ozone
  - -40° to 150°C temperature range
  - Withstands many organic solvents and rigorous shock and vibration
- Accepts #18 to #12 AWG copper wire
- High visibility yellow color
- Recommended crimp tools:
  - Thomas & Betts – WT-112M
  - California Terminal Products No. 1250
  - Channelock No. 909
- Replacement contact clip: BK/1A2294
- UL flammability rating 94 HB

Ordering
- Specify packaging, product, and option code

RoHS 2002/95/EC

Environmental Data
- Temperature Rating (RTI): 100°C
- Waterproof typically to a depth of 1 foot for 2 hours
- Vibration Resistance: Per MIL STD 810C
- Humidity: 85°C/85% relative humidity for 96 hours
- Brittle Point: Less than -60°C
- Abrasion: 54% NBS index
- Fluid resistance: Type and Class AA, BA, BC, BE, CA, CE per ASTM D-2000 Standard Classification System for rubbers
- Flame Resistance: Pass FMVSS302 and related slow burning when tested in accordance with UL 94HB
- Ozone Resistance: Passed 70 Hours in 50 ppm ozone per ASTM D-5
- Salt Spray: 15% for 166 hours = 0% volume swell
- Xenon Arc Weatherometer

Time (Hrs)	Tensile Strength (psi)	Elong. (%)	100% Mod. (psi)
0	1100	375	470
500	1130	350	520
1000	1190	350	520

- Heat Aging (% Retention of Mechanical Properties at 125°C)

Parameters	Days 1	7	15	30	41.7
Tensile Strength	100	105	115	120	120
% Elongation	90	90	90	90	90
100% Mod.	105	110	120	120	120

Component	Material
Body	Thermoplastic Rubber
Crimp	Copper Tin-Plated

SPECIFICATIONS

Product Code	Voltage Rating AC	Current Rating AC
HFB	32V	30A

PACKAGING CODE

Packaging Code	Description
Blank	10 pieces of fuseholders packed into a carton
BK	100 pieces of fuseholders packed into a poly bag

OPTION CODE

Option Code	Description
-R	RoHS compliant version

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COOPER Bussmann

1/4" x 1-1/4" Fuseholders
HFA In-Line Waterproof Series

Description

- For 1/4" x 1-1/4" (6.35mm x 31.8mm) fuses
- Waterproof for exposed locations
- Accepts #16 to #12 copper wire
- Copper crimp lead material
- Recommended crimp tools:
  - Thomas & Betts – WT-112M
  - Thomas & Betts – ERG-2002
  - Channelock No. 909
- High temperature, flame retardant, phenolic meets UL 94 HB
- Crimp or 1/4" quick connect terminals
- In-line connection

Agency Information

- UL Recognized: (IZLT2, E14853) HFA recognized with use of No. 12 AWG copper conductors secured with Thomas & Betts crimping tool WT-180 or WT-112M
- HFA-HH not UL Recognized

Environmental Data

- Temperature Rating (RTI): 150°C

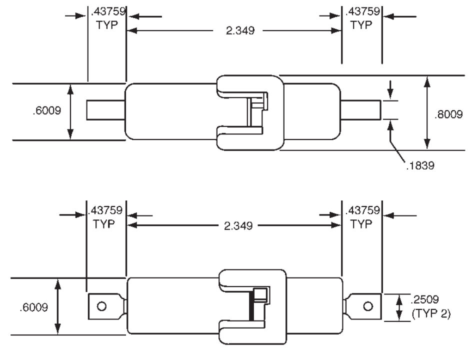
Ordering

- Specify packaging, product, and option code

RoHS 2002/95/EC

Dimensions

Drawing Not to Scale



Component	Material
Body	Phenolic
Crimp	Copper, Tin-Plated

SPECIFICATIONS			
Product Code	Voltage Rating	Current Rating	Terminal
HFA	250V	20A	Crimp
HFA-HH	250V	20A	1/4 Quick Connect

PACKAGING CODE	
Packaging Code	Description
Blank	10 pieces of fuseholders packed into a carton
BK	20 pieces of fuseholders packed into a carton

OPTION CODE	
Option Code	Description
-R	RoHS compliant version

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COOPER Bussmann

1/4" x 7/8" to 1-1/4" Fuseholders

HRK Universal In-Line Series

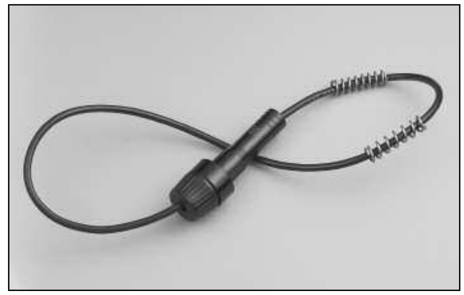
Description

- For 1/4" x 7/8" to 1/4" x 1-1/4" fuses
- #14 AWG copper wire leads
- 8" (203mm) leads
- Three springs furnished to accept different fuse lengths
- Wire leads are staked and soldered to the contacts of the fuseholder

Ordering

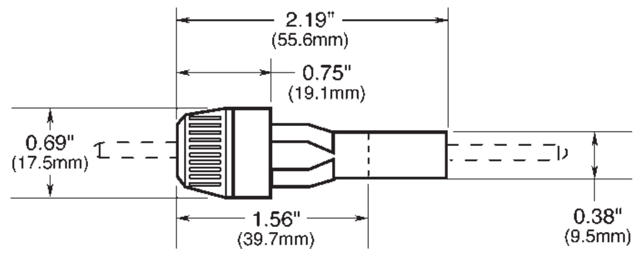
- Specify packaging, product, and option code

RoHS 2002/95/EC



Dimensions

Drawing Not to Scale



SPECIFICATIONS		
Product Code	**Voltage Rating**	**Current Rating**
HRK	32V	15A

PACKAGING CODE	
Packaging Code	**Description**
Blank	10 pieces of fuseholder packed into a carton
BK	100 pieces of fuseholder packed into a carton

OPTION CODE	
Option Code	**Description**
-R	RoHS compliant version

Accessories - Fuseholders

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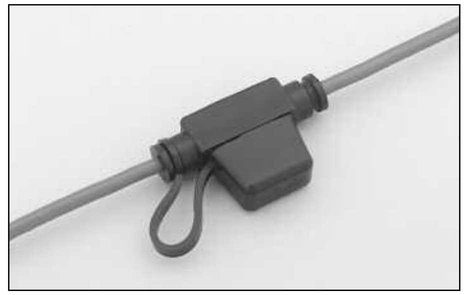
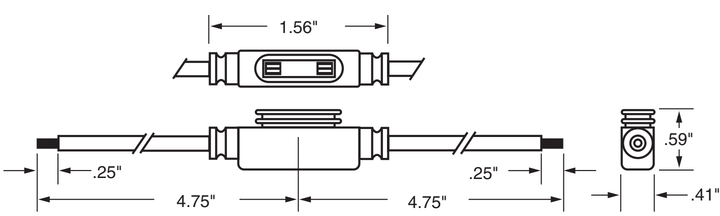
MINI® Fuseholders
HHL & HHM

Description
- In-Line Fuseholders for MINI® Fuses.
- Voltage Rating: 32Vdc maximum
- Current Rating: See Table
- Body material withstands high temps. Protective cover has removable straps.

Ordering
- Specify packaging and product code

RoHS 2002/95/EC





MINI® Fuse Blade Type Holder				
Catalog No.	Description	Fuse Size	Electrical Connection	Maximum Continuous Current Rating
HHL	Black fuseholder w/cover	2-20A	#16 black lead wire; 4" length stripped to 1/4"	16A*
HHL-B	Black fuseholder - Body only			
HHM	Black fuseholder w/cover	2-30A	#12 red lead wire; 4" length stripped to 1/4"	24A*
HHM-B	Black fuseholder - Body only			
HHM-C	Black cover only			

Bulk Products (Bulk Quantity - 1000 Pieces)				
Catalog No.	Description	Fuse Size	Electrical Connection	Maximum Continuous Current Rating
BK/HHL-R	Black fuseholder - Body only	2-20A	#16 red lead wire; 4" length stripped to 1/4"	16A*

* or 80% of fuse rating, whichever is less

A fuse must be properly and fully inserted into the holder to provide a solid connection. Poor or improper insertion of the fuse can result in failure of the fuse and holder, thus not protecting the device for which it was intended.

PACKAGING CODE	
Packaging Code	Description
BK	1,000 pieces in a box

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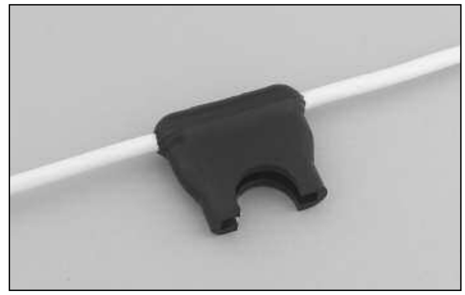
ATC® Fuseholders
HHC, HHD, HHF, HHG

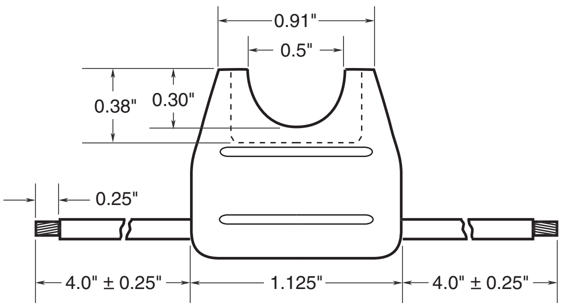
RoHS 2002/95/EC

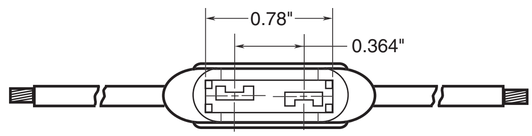
Description
- In-Line Fuseholders
- Voltage Rating: 32Vdc maximum
- Current Rating: See Table

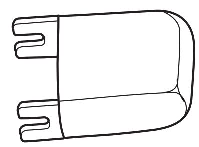
Ordering
- Specify packaging and product code



Dimensional Data







Cover for HHD Fuseholder
Catalog Symbol: HHD-C

Electrical Ratings

Catalog Code	Description	Fuse Size	Electrical Connection	Maximum Continuous Current Rating
HHC	Yellow fuseholder	3-20A	#16 black leadwire	16A*
HHD	Black fuseholder	3-30A	#12 yellow leadwire	24A*
HHD-C	Cover only	Fits HHD only	Clear polycarbonate	
HHF	Black fuseholder	3-20A	#16 yellow leadwire	16A*
HHG	Black fuseholder w/ cover	3-30A	#12 yellow leadwire	24A*

* or 80% of fuse rating, whichever is less.
- For ATC® blade-type fuses.
- “Write-in” space for circuit identification on HHC holders (bright yellow)

Bulk Products (Bulk Quantity - 1000 Pieces)

Catalog Code	Description	Fuse Size	Electrical Connection	Maximum Continuous Current Rating
BK/HHC-R	Yellow fuseholder	3-20A	#16 red leadwire	16A*
BK/HHF-B	Black fuseholder w/ cover	3-20A	#16 black leadwire	16A*

* or 80% of fuse rating, whichever is less.

A fuse must be properly and fully inserted into the holder to provide a solid connection. Poor or improper insertion of the fuse can result in failure of the fuse and holder, thus not protecting the device for which it was intended.

PACKAGING CODE

Packaging Code	Description
BK	1,000 pieces in a box

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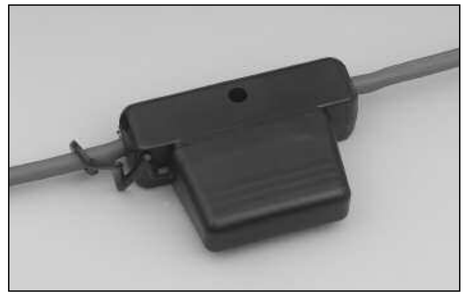
MAXI® Fuseholders

HHX

Description

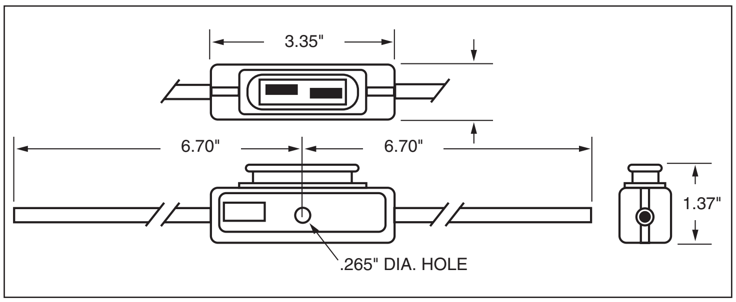
- In-Line Fuseholders for MAXI® Fuses.
- Voltage Rating: 32Vdc maximum
- Current Rating: See Table
- Firewall mounting hole permits two or more holders to be mounted together. Cover comes with a removable strap.

RoHS 2002/95/EC



Ordering

- Specify packaging and product code



MAXI® Fuse Blade Type Holder				
Catalog Code	**Description**	**Fuse Size**	**Electrical Connection**	**Maximum Continuous Current Rating**
HHX	Black fuseholder w/cover	20-60A	#6 red lead wire; 5" length with blunt ends	48A*
HHX-B	Black fuseholder - Body only			
HHX-C	Black cover only			

* or 80% of fuse rating, whichever is less

A fuse must be properly and fully inserted into the holder to provide a solid connection. Poor or improper insertion of the fuse can result in failure of the fuse and holder, thus not protecting the device for which it was intended.

PACKAGING CODE	
Packaging Code	**Description**
BK	100 pieces in a box

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5 x 20mm Fuse Blocks

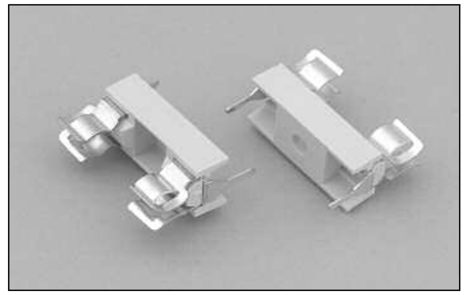
HTC Series

COOPER Bussmann

Description

- For 5 x 20mm fuses
- With snap-on cover
  - BK/HTC-150M (Transparent Cover)
- Tight cluster mounting
- Clips made of nickel-tin plated spring-bronze
- Available only in bulk of 100 and 1,000 pieces
- High temperature thermoplastic meets:
  - UL 94-VO
  - Glow wire test: 960°C per IEC 695-2-1

RoHS 2002/95/EC



Environmental Data

- Maximum suitable temperature: 110°C
- MSL Level 1 (conditions ≤ 30°C / 85% RH)

Ordering

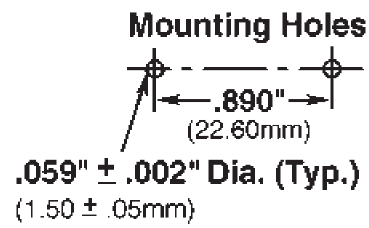
- Specify packaging and product code

SPECIFICATIONS			
Catalog Number	Voltage Rating AC	Current Rating AC	Watts
HTC-15M	250V	6.3A	1.6W

Agency Information

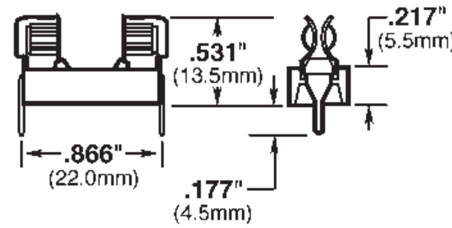
- UL Recognized: IZLT2, E14853
- SEMKO Certificate: 204805
- VDE Certificate: 40004439

Mounting Holes



Dimensions - in (mm)
HTC-15M Fuse Block Only

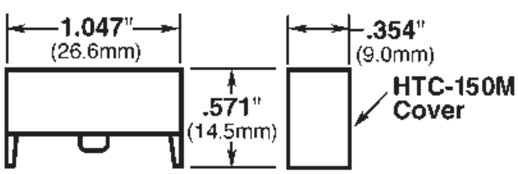
Drawing Not to Scale



Component	Material
Clip	Spring-Bronze, Bright Tin Plate
Body	Thermoplastic

Dimensions - in (mm)
HTC-150M Fuse Block with Cover

Drawing Not to Scale



PACKAGING CODE	
Packaging Code	Description
BK	100 pieces of fuse blocks packed into a cardboard shelf package
BK1	1,000 pieces of fuse blocks packed into a carton

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COOPER Bussmann

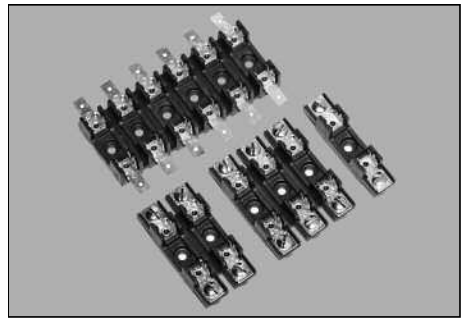
1/4" x 1-1/4" Fuseblocks
S-8000 Series

Description
- For 1/4" x 1-1/4" (6.3mm x 32mm) fuses
- Bolt-in and snap-in mounting available
- Tight cluster mounting
- All types of terminal configurations
- Clips made of spring-bronze
- Anti-rotational pin provided
- Flame retardant thermoplastic meets UL 94 VO

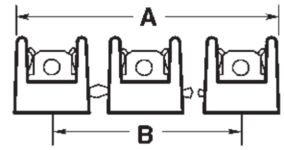
Environmental Data
- Temperature Rating (RTI): The mounting body for all devices (except those with Suffix –1-SNP or –W-SNP), has a temperature rating of 130°C. The mounting body for all devices with Suffix –1-SNP has a temperature rating of 110°C.

Agency Information
- UL Recognized: E14853
- CSA Certified: 47235

RoHS 2002/95/EC



Multiple Pole

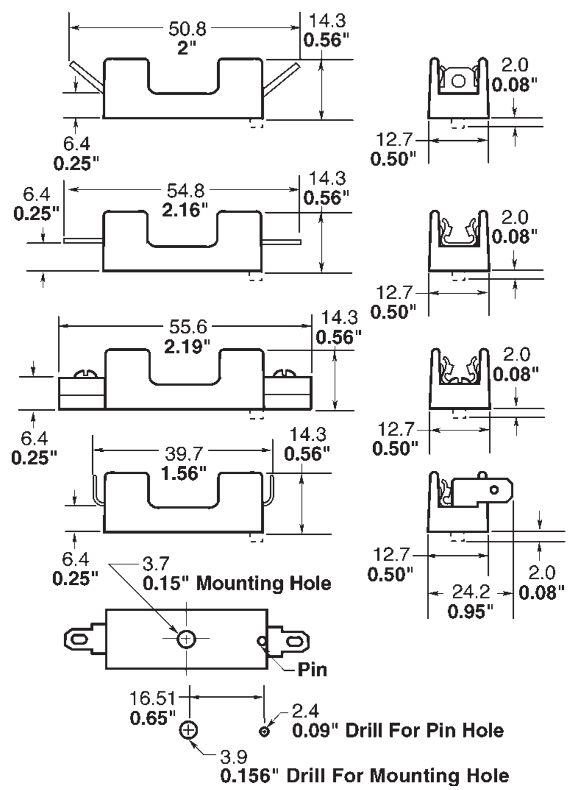


SPECIFICATIONS	Voltage Rating AC	Voltage Rating DC
S-8000	300V	300V
S-8100	300V	300V
S-8200	300V	300V
S-8300	300V	300V

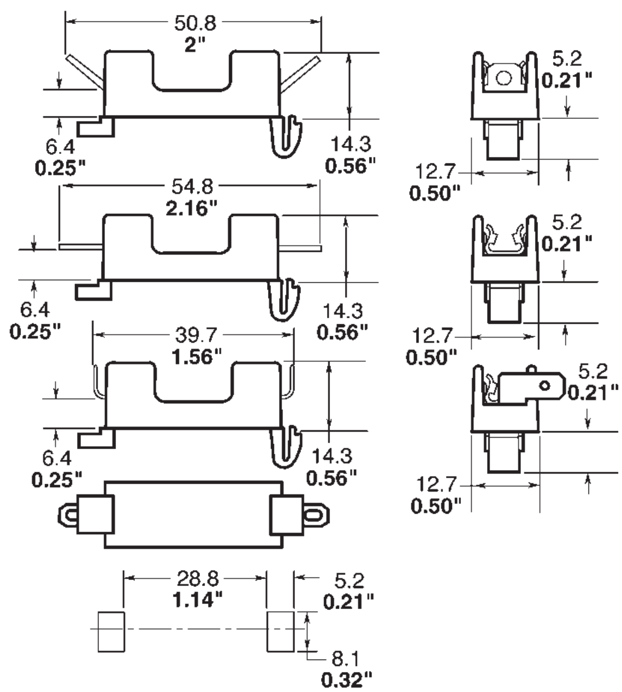
Dimensions

No. of Poles	Inches A	Inches B	Millimeters A	Millimeters B
1	*	*	*	*
2	1 1/8"	5/8"	28.6	15.9
3	1 3/4"	1 1/4"	44.4	31.8
4	2 3/8"	1 7/8"	60.3	47.6
5	3"	2 1/2"	76.2	63.5
6	3 5/8"	3 1/8"	92.1	79.4
7	4 1/4"	3 3/4"	108	95.2
8	4 7/8"	4 3/8"	123.8	111.1
9	5 1/2"	5"	139.7	127.0
10	6 1/8"	5 5/8"	155.6	142.9
11	6 3/4"	6 1/4"	171.4	158.8
12	7 3/8"	6 7/8"	187.3	174.6

Dimensions
S-8000 Single Pole Bolt-In Mounting Series



S-8000 Single Pole Snap-In Mounting Series



Component	Material
Clip	Spring-Bronze, Bright Tin-Lead Plate
Body	Thermoplastic

PACKAGING CODE	
Packaging Code	**Description**
Blank	Varies with number of poles. Contact customer service.
BK/	Varies with number of poles. Contact customer service.

Ordering

• Specify packaging, product, and option code

Example: BK/S-8001-01-SNP

BK/	S-8	0	01	–	01	–	SNP	-R
↓	↓	↓	↓		↓		↓	↓
1	2	3	4		5		6	7

1. Packaging Code:	BK/
2. Series Number:	S-8
3. Type Terminal:	0 = Solder
	1 = 3/16" Quick Connect
	2 = 1/4" Quick Connect
	3 = Screw
4. Terminal Angle:	01 = Straight (0°)
	02 = 40° Angle
	03 = Side*
5. Number of Poles:	(01 – 12)
	1X = One pole, No Mounting Stud
6. Mounting Style:	SNP = Snap-in Mounting
7. RoHS Compliant Version	-R

*Available only in single pole

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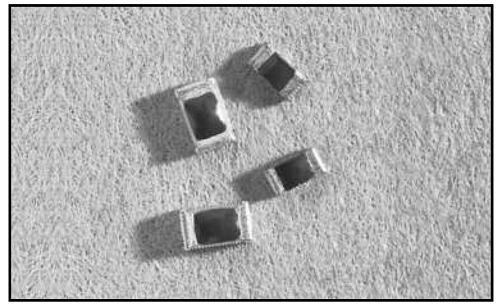
ESD Suppression Selection Guide
Polymer ESD Suppressors

Features:

- Outstanding ESD protection for high frequency, low voltage applications.
- Exceeds testing requirements outlined in IEC 61000-4-2
- Extremely low capacitance
- Very low leakage current
- Fast response time
- Bi-directional
- Surface mount
- Solder Termination

RoHS 2002/95/EC



What is it:

Our Voltage Variable Material (VVM) has unique properties that are highly preferred in ESD suppression applications. The polymer matrix responds to an over-voltage condition by rapidly changing from a high impedance state to a low impedance state.

Cooper Bussmann utilizes this polymeric matrix in PolySurg ESD Suppressors for fast response, ultra low capacitance, and very low current leakage. The device is activated by over-voltage threat and clamps to a low value to protect sensitive circuit components.

How it Works:

The PolySurg TR and MLP Series are board level circuit protection devices designed exclusively for the fast, transient over-voltages associated with ESD. When a sufficient over-voltage occurs it exhibits a dramatic increase in the ability to conduct electrons. The nature of the material creates a bi-directional part, which means that only one device is required to provide complete ESD protection regardless of the surge polarity. In a typical application, the device is placed across a signal line leading to an integrated circuit and ground. The device exhibits minimal capacitance and is "invisible" to the circuit during the normal operation. Under normal operating voltages (typically 3 to 15V) the high impedance of the device insulates each signal line from ground. When an ESD event occurs, the voltage variable material switches to a conductive state within nanoseconds. The voltage across signal line collapses to the clamping level, and current is shunted through the device to the ground. When the overvoltage event ends, the circuit returns to its normal operating state as the device switches back to its >10^{12}Ohm, high resistance state and "invisibility."

PolySurg™ ESD Suppressor Selection Guide:

Part Number	Package Size	Lines	Operating Voltage (VDC)	Capacitance (pF @ 1KHz ~ 1.8GHz)	Current Leakage (nA @ 12VDC)	Clamp Voltage V	Specification
0402ESDA-MLP7	0402	1	0 ~ 30	< 0.15	< 0.1	35	IEC61000-4-2, Level 4
0603ESDA-MLP7	0603	1	0 ~ 30	< 0.15	< 0.1	35	IEC61000-4-2, Level 4
0603ESDA-TR1	0603	1	0 ~ 24	< 0.15	< 0.1	35	IEC61000-4-2, Level 4

Device Marking

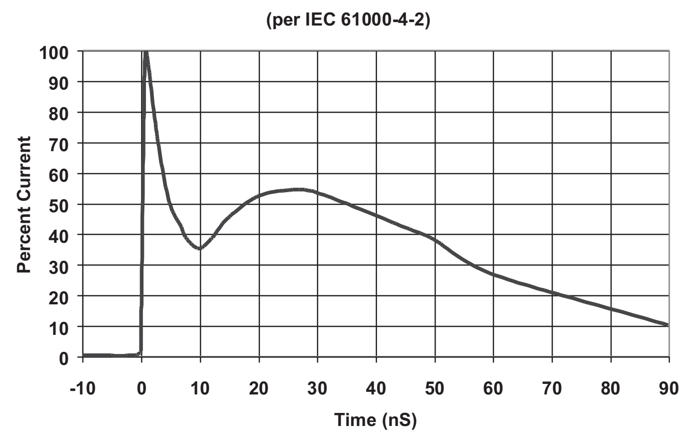
PolySurg™ ESD Suppressors are marked on the tape and reel packages, not individually. Since the product is bi-directional and symmetrical, no orientation marking is required.

Test Methodology

Full product characterization requires use of multiple test methods. Each test method reveals unique information about the device response. The results of all of the tests must be analyzed to fully understand the PolySurg™ ESD Suppressor response to an over-voltage event.

Electrostatic Discharge (ESD) Pulse

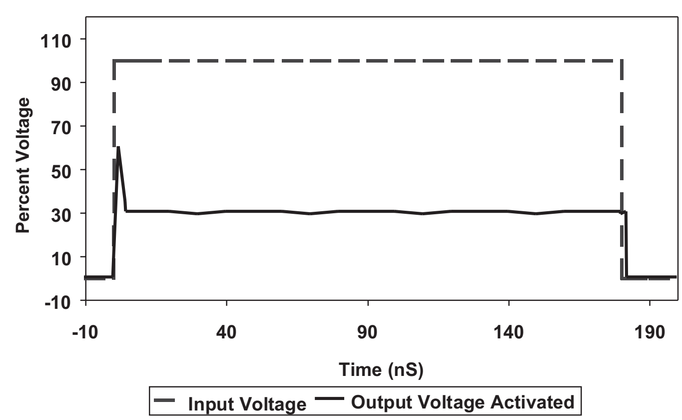
The ESD pulse is the defining test for an ESD protective device. The ESD pulse is an extremely fast rising transient event. The pulse, as characterized in IEC 61000-4-2, has a rise time of less than 1ns, peak currents up to 45A, and voltage levels to 15 kV. Characteristics determined by this test are those such as voltage overshoot, peak voltage, clamping voltage, peak current, and device resistance.



Due to the extremely fast rate of rise of the ESD pulse, the test setup can have a definite impact on the above factors. Variables such as wiring inductance and probe capacitance can produce inaccurate readings on an otherwise capable oscilloscope.

Transmission Line Pulse (TLP)

The Transmission Line Pulse tester implements a controlled impedance cable to deliver a square wave current pulse. The advantage of this technique is that the constant current of the square wave allows the behavior of the protection structure to be more accurately studied.



The actual implementation of this technique produces a waveform that has a slightly slower rise time that the ESD pulse but can be correlated to the deliver approximately the same surge current and energy. This controlled impedance pulse provides a more accurate depiction of the trigger voltage of the device because of the reduced voltage overshoot caused by a fast rising transient and the reactive components of the test fixture.

Definition of Terms

Clamp Voltage – The voltage at which the PolySurg™ device stabilizes during the transition from high to low impedance. This is the voltage experienced by the circuit, after stabilizing, for the duration of the ESD transient.

Trigger Voltage – The voltage at which the PolySurg™ device begins to function. When the ESD threat voltage reaches this level, the PolySurg™ device begins the transition from high impedance to low impedance, shunting the ESD energy to ground.

Threat Voltage – The voltage that the test equipment is set to operate (i.e. the voltage across the discharge capacitor).

Peak Current – The maximum instantaneous current level that a device will receive. IEC-61000-4-2 states that the peak current should be 30A at 8kV ESD and 45A at 15kV ESD.

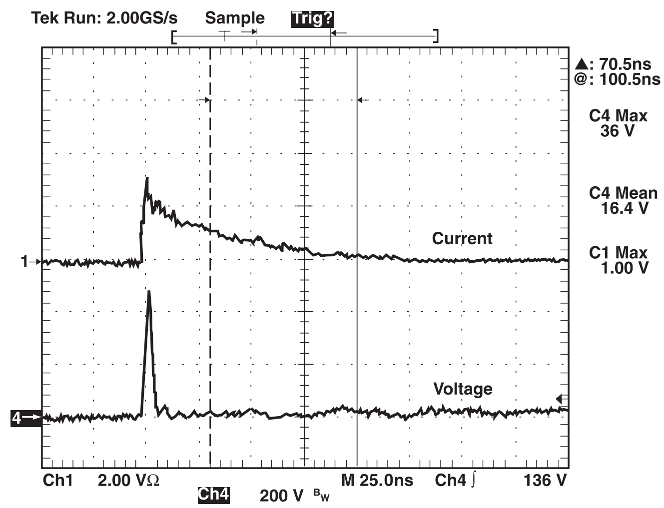
Selected Characterization Data

ESD Transient Pulse Energy Controlled by PolySurg™

Figure 1 shows typical PolySurg™ ESD Suppressor response to an 8 kV contact ESD pulse. Triggered polymer in the device conducts excess energy to ground and prevents system damage by ESD transient threat. As the polymer resistance drops current flows to ground.

The top scope trace indicates current, and the bottom scope trace indicates voltage.

Figure 1. Typical Device Response to 8kV ESD



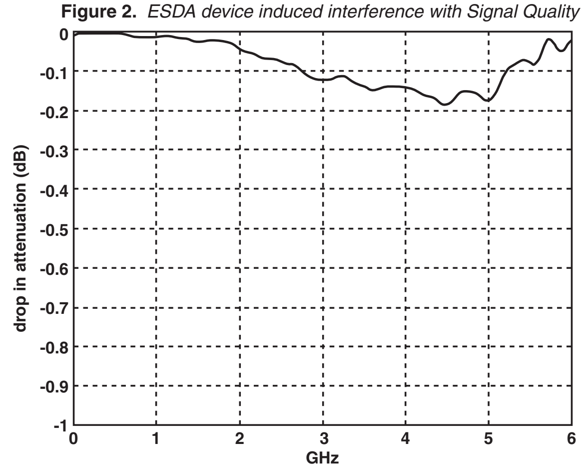
Protects against ESD Voltage Transient without Affecting Signal Quality

PolySurg™ ESD Suppressors have an ultra low capacitance of <0.15pF and when typically installed from the signal line to ground have a negligible effect on the signal.

As *Figure 2* shows, the test conducted with a precision network analyzer on a 50 Ω circuit at up to 6GHz. Only a 0.2dB deviation from the original signal was recorded.

The setup was similar to the addition of the PolySurg™ ESD Suppressor to a circuit with very fast digital signal or a cellular phone antenna.

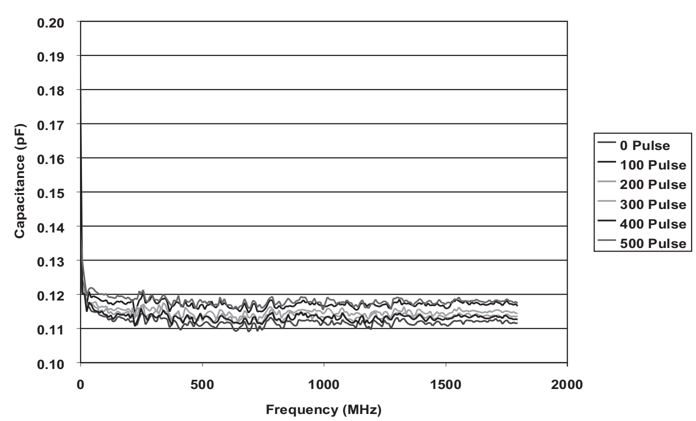
Figure 2. *ESDA device induced interference with Signal Quality*



Signal Frequency does not affect the Capacitance of the Device

The device capacitance is very low and constant over wide frequency range. The typical capacitance is less than 0.15pF over the tested range of 0.1MHz to 1.8GHz. In addition, as shown in *Figure 3*, the capacitance will remain same over the life cycle of the device (i.e. the number of the ESD pulse does not change the device capacitance.)

Figure 3. Capacitance vs. Frequency

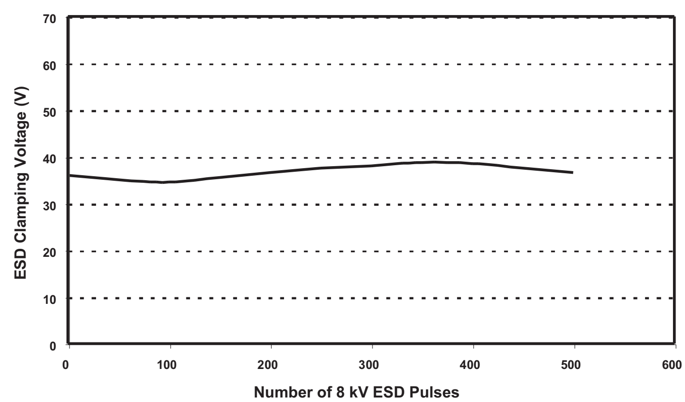


Clamp Voltage Remains Consistent Despite Repeated ESD Pulses

As *Figure 4* shows, PolySurg™ ESD Suppressors are highly reliable and stable over hundreds of pulses.

PolySurg™ ESD Suppressors have been tested with fast rate ESD pulses at 8kV contact discharge. Clamping voltage measured at every pulse shows minimal changes throughout the test.

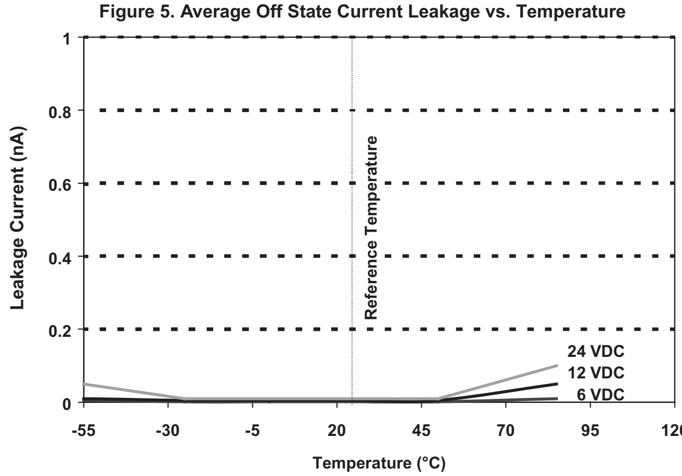
Figure 4. ESD Clamping Voltage vs. Number of 8 kV ESD Pulse



Typical non-triggered (Off State) Current Leakage is Very Low at Normal Operating Voltages and Temperatures

As shown by *Figure 5* the current leakage of the PolySurg™ ESD Suppressor is typically very low, well under 1nA, even over 12VDC operating voltage. Some increase in the current leakage may be expected at much higher operating voltage and elevated temperature.

Figure 5. Average Off State Current Leakage vs. Temperature



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0402ESDA-MLP
MLP Series ESD Suppressor

Features & Benefits

RoHS 2002/95/EC

- Ultra-low capacitance (0.05pF typ.) ideal for high speed data applications
- Provides ESD protection with fast response time (<1ns) allowing equipment to pass IEC 61000-4-2 level 4 test
- Single-line, bi-directional device for placement flexibility
- Low profile 0402/1005 design for board space savings
- Low leakage current (<0.1nA typ.) reduces power consumption

Applications

- Computers & Peripherals
- HDTV Equipment
- DVD Players
- A/V Equipment
- Satellite Radio
- Cell Phones
- PDA's
- Digital Still Cameras
- Digital Camcorders
- MP3 / Multimedia Players
- Set Top Boxes
- External Storage
- DSL Modems
- High Speed Data Ports
  - USB 2.0
  - IEEE 1394
  - HDMI
  - DVI
  - High Speed Ethernet
  - Infiniband®

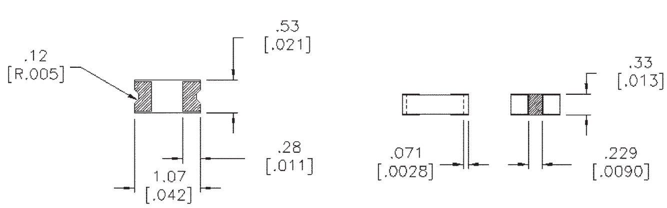
Description

The PolySurg™ 0402ESDA-MLP ESD Suppressors protect valuable high-speed data circuits from ESD damage without distorting data signals as a result of its ultra-low (0.05pF typical) capacitance.

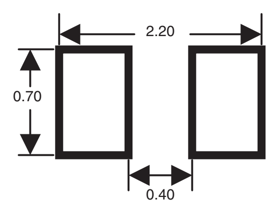
Ordering Information

Catalog Number	Packaging
0402ESDA-MLP7	10,000 pieces in paper tape on 7" (178mm) reel
0402ESDA-MLP8	2,500 pieces in paper tape on 7" (178mm) reel

Product Dimensions: mm [inches]



Solder Pad Recommendation: mm [inches]



Design Considerations

The location in the circuit for the MLP series has to be carefully determined. For better performance, the device should be placed as close to the signal input as possible and ahead of any other component. Due to the high current associated with an ESD event, it is recommended to use a "0-stub" pad design (pad directly on the signal/data line and second pad directly on common ground).

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0402ESDA-MLP
MLP Series ESD Suppressor

Electrical Characteristics

Characteristic	Value
Rated Voltage	30VDC maximum
Clamping Voltage[1]	35V typical
Trigger Voltage[2]	300V typical
Capacitance (@1MHz)	0.05pF typ., 0.15pF max.
Attenuation Change (0-6GHz)	-0.2dB typical
Leakage Current (@12VDC)	<0.1nA typical
ESD Capability	
IEC61000-4-2 Direct Discharge	8kV typical
IEC61000-4-2 Air Discharge	15kV typical
ESD Pulse Withstand[1]	>1000 typical

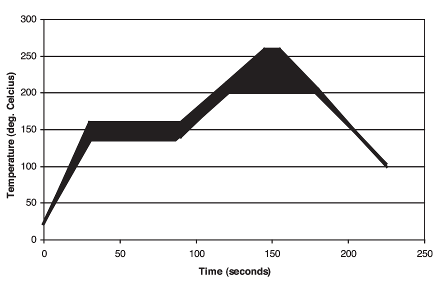
Notes:
1. Per IEC61000-4-2, Level 4 waveform (8kV direct, 30A) measured 30ns after initiation of pulse.
2. Trigger measurement made using Transmission Line Pulse (TLP) method.
3. Minor shifting in characteristics may be observed over multiple ESD pulses at very rapid rate.

Environmental Specifications:

- Load Humidity: 12VDC per EIA/IS-772 Para. 4.4.2, +85°C, 85% RH for 1000 hours
- Thermal Shock: EIA/IS-722 Para 4.6, Air to Air -55°C to +125°C, 5 cycles
- Moisture Resistance Test: MIL-STD-202G Method 106G, 10 cycles
- Mechanical Shock: EIA/IS-722 Para. 4.9
- Vibration: EIA/IS-722 Para. 4.10
- Resistance to Solvent: EIA/IS-722 Para. 4.11
- Operating & Storage Temperature Range: -55°C to +125°C

Soldering Recommendations

- Compatible with lead and lead-free solder reflow processes
- Peak reflow temperatures and durations:
  - IR Reflow = 260°C max for 10 sec. max.
  - Wave Solder = 260°C max. for 10 sec. max.
- Recommended IR Reflow Profile:



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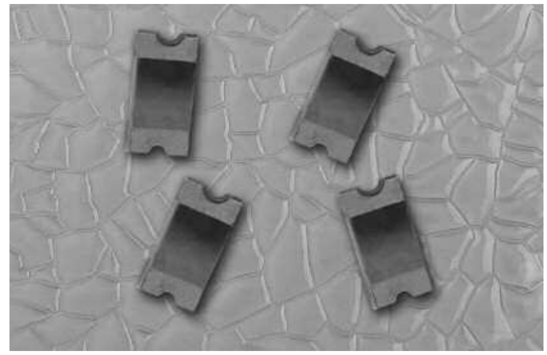
0603ESDA-MLP
MLP Series ESD Suppressor

Features & Benefits

- Ultra-low capacitance (0.05pF typ.) ideal for high speed data applications
- Provides ESD protection with fast response time (<1ns) allowing equipment to pass IEC 61000-4-2 level 4 test
- Single-line, bi-directional device for placement flexibility
- Low profile 0603/1608 design for board space savings
- Low leakage current (<0.1nA typ.) reduces power consumption

RoHS 2002/95/EC



Applications

- Computers & Peripherals
- HDTV Equipment
- DVD Players
- A/V Equipment
- Satellite Radio
- Cell Phones
- PDA's
- Digital Still Cameras
- Digital Camcorders
- MP3 / Multimedia Players
- Set Top Boxes
- External Storage
- DSL Modems
- High Speed Data Ports
    - USB 2.0
    - IEEE 1394
    - HDMI
    - DVI
    - High Speed Ethernet
    - Infiniband®

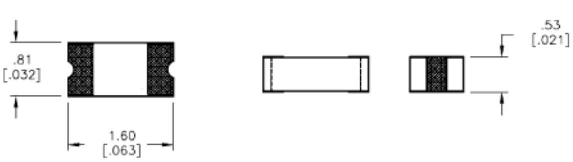
Description

The PolySurg™ 0603ESDA-MLP ESD Suppressors protect valuable high-speed data circuits from ESD damage without distorting data signals as a result of its ultra-low (0.05pF typical) capacitance.

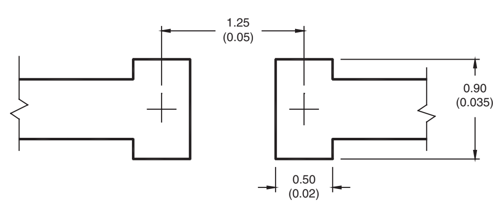
Ordering Information

Catalog Number	Packaging
0603ESDA-MLP7	5,000 pieces in paper tape on 7" (178mm) reel

Product Dimensions: mm [inches]



Solder Pad Recommendation: mm [inches]



Design Considerations

The location in the circuit for the MLP series has to be carefully determined. For better performance, the device should be placed as close to the signal input as possible and ahead of any other component. Due to the high current associated with an ESD event, it is recommended to use a "0-stub" pad design (pad directly on the signal/data line and second pad directly on common ground).

0603ESDA-MLP
MLP Series ESD Suppressor

Electrical Characteristics

Characteristic	Value
Rated Voltage	30VDC maximum
Clamping Voltage[1]	35V typical
Trigger Voltage[2]	300V typical
Capacitance (@1MHz)	0.05pF typ., 0.15pF max.
Attenuation Change (0-6GHz)	-0.2dB typical
Leakage Current (@12VDC)	<0.1nA typical
ESD Capability	
IEC61000-4-2 Direct Discharge	8kV typical
IEC61000-4-2 Air Discharge	15kV typical
ESD Pulse Withstand[1]	>1000 typical

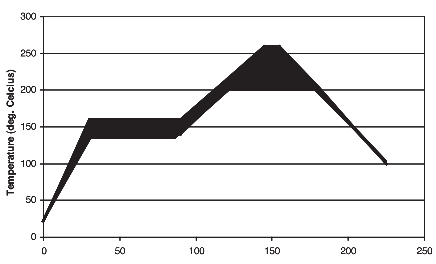
Notes:
1. Per IEC61000-4-2, Level 4 waveform (8kV direct, 30A) measured 30ns after initiation of pulse.
2. Trigger measurement made using Transmission Line Pulse (TLP) method.
3. Minor shifting in characteristics may be observed over multiple ESD pulses at very rapid rate.

Environmental Specifications:

- Load Humidity: 12VDC per EIA/IS-772 Para. 4.4.2, +85°C, 85% RH for 1000 hours
- Thermal Shock: EIA/IS-722 Para 4.6, Air to Air -55°C to +125°C, 5 cycles
- Moisture Resistance Test: MIL-STD-202G Method 106G, 10 cycles
- Mechanical Shock: EIA/IS-722 Para. 4.9
- Vibration: EIA/IS-722 Para. 4.10
- Resistance to Solvent: EIA/IS-722 Para. 4.11
- Operating & Storage Temperature Range: -55°C to +125°C

Soldering Recommendations

- Compatible with lead and lead-free solder reflow processes
- Peak reflow temperatures and durations:
  - IR Reflow = 260°C max for 10 sec. max.
  - Wave Solder = 260°C max. for 10 sec. max.
- Recommended IR Reflow Profile:



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0603ESDA-TR
TR Series ESD Suppressor

Features:

RoHS 2002/95/EC

- 0603/1608 foot print
- Ideal ESD protection for high frequency, low voltage applications.
- Exceeds testing requirements outlined in IEC 61000-4-2
- Ultra low capacitance (0.15pF maximum)
- Very low leakage current
- Fast response time
- Bi-directional
- Surface mount

Applications

- Computers & Peripherals
- HDTV Equipment
- DVD Players
- A/V Equipment
- Satellite Radio
- Cell Phones
- PDA's
- Digital Still Cameras
- Digital Camcorders
- MP3 / Multimedia Players
- Set Top Boxes
- External Storage
- DSL Modems
- High Speed Data Ports
  - USB 2.0
  - IEEE 1394
  - HDMI
  - DVI
  - High Speed Ethernet
  - Infiniband®

Description

The PolySurg™ 0603ESDA-TR ESD Suppressors protect valuable high-speed data circuits from ESD damage without distorting data signals as a result of its ultra-low (0.15pF maximum) capacitance.

Ordering Information

Catalog Number	Packaging
0603ESDA-TR1	5,000 pieces in paper tape on 7" (178mm) reel

Part Ratings and Characteristics:

Performance Characteristics	Units	Min	Typ	Max
Continuous operating voltage	VDC	-	-	24
Clamping voltage[2]	V	-	35	60
Trigger voltage[3]	V	-	125	-
ESD Threat voltage capability[4]	kV	-	8	15
Capacitance (@ 1 KHz ~ 1.8GHz)	pF	-	-	0.15
Leakage current (@ 12 VDC)	nA	0.01	<0.1	-
Peak current[2]	A	-	30	45
Operating temperature	°C	-56	+25	+105
ESD pulse withstand [2]	# pulses	20	>500[1]	-

Notes:

1. Some shifting in characteristics may occur when tested over several hundred ESD pulses at very rapid rate of 1 pulse per second or faster.
2. Per IEC 61000-4-2, 30A @ 8kV, level 4, clamp measurement made 30ns after initiation of pulse, all tests in contact discharge mode.
3. Trigger measurement made using Transmission Line Pulse (TLP) method
4. PolySURG™ devices are capable of withstanding up to a 15 kV, 45A ESD pulse. Device ratings are given at 8kV per Note 1, unless otherwise specified.

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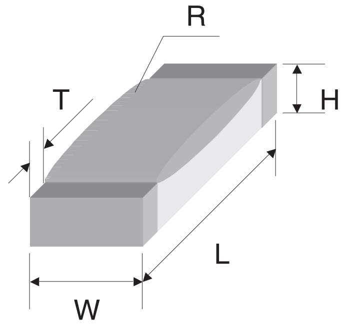
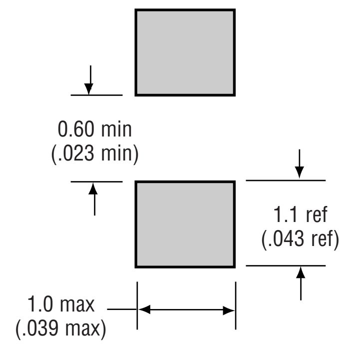
0603ESDA-TR
TR Series ESD Suppressor

Product Dimension



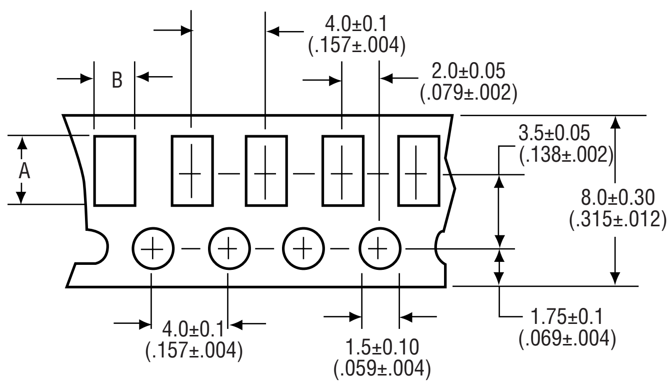
Recommended Solder Pad Outline
(per IPC-SM-782)

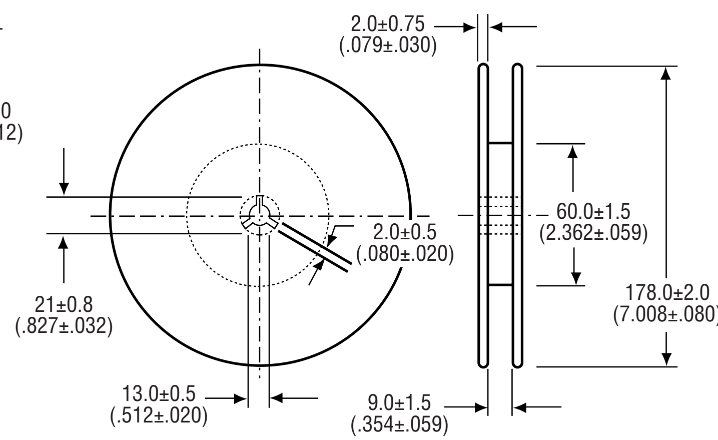


EIA Size mm (in)	L	W	H	T	R
0603ESDA	1.60 ± 0.10 (.063 ± .004)	0.80 ± 0.10 (.031 ± .004)	0.50 ± 0.10 (.020 ± .004)	0.30 ± 0.20 (.012 ± .008)	0.70 ± 0.10 (.028 ± .004)

Tape-and-Reel Specification

mm (inches)





Dimension	0603
A	1.90±0.20 (.075±0.008)
B	1.10±0.20 (.043±0.008)

Environmental Specifications:

- Moisture Resistance per EIA/IS-722 Paragraph 4.4.2. This standard is based upon MIL-STD-202G Method 103B but with temperature and relative humidity at +85°C and 85% RH respectively. Test condition 'A' (240Hr) per MIL-STD-202G
- Thermal shock: MIL-STD-202, Method 107G, -55°C to 125°C, 30 min. cycle, 10 cycles
- Vibration: MIL-STD-202F, Method 201A,(10 to 55 to 10 Hz, 1 min. cycle, 2 hrs each in X-Y-Z)
- Chemical resistance: ASTM D-543, 4 hrs @ 40°C, 3 solutions (H2O, detergent solution, defluxer)
- Operating temperature characteristics, measurement at +25°C, +105°C and -56°C
- Full load voltage: 14.4VDC, 18VDC & 24VDC for 1000 hrs, 25°C
- Solder leach resistance and terminal adhesion: Per EIA-576
- Solderability: MIL-STD-202, Method 208 (95% coverage)

Device Marking

PolySurg™ ESD Suppressors are marked on the tape and reel packages, not individually. Since the product is bi-directional and symmetrical, no orientation marking is required.

Design Consideration

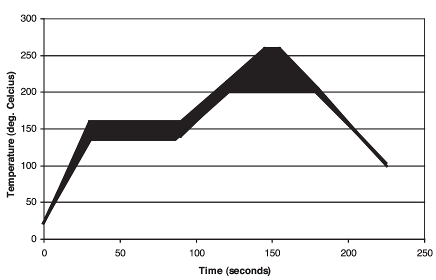
The location in the circuit for the TR series has to be carefully determined. For better performance, the device should be placed as close to the signal input as possible and ahead of any other component. Due to the high current associated with an ESD event, it is recommended to use a “0-stub” pad design (pad directly on the signal/data line and second pad directly on common ground).

Processing Recommendations

The TR series currently has a convex profile on the top surface of the part. This profile is a result of the construction of the deice. They can be processed using standard pick-and-place equipment. The placement and processing techniques for these devices are similar to those used for chip resistors and chip capacitors.

Soldering Recommendations

- Compatible with lead and lead-free solder reflow processes
- Peak reflow temperatures and durations:
    - IR Reflow = 260°C max for 10 sec. max.
    - Wave Solder = 260°C max. for 10 sec. max.
- Recommended IR Reflow Profile:



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ESD Protection of Set Top Appliances with PolySurg™ ESD Suppressors

What Are Set Top Boxes?
The continuing trend is to link broadband signal delivery to the home entertainment display, and other devices via set top boxes. Set top boxes used to be just an analog cable tuner/decoder but now it includes the likes of digital cable, satellite controller, internet service controllers, digital video recording systems and home networking.

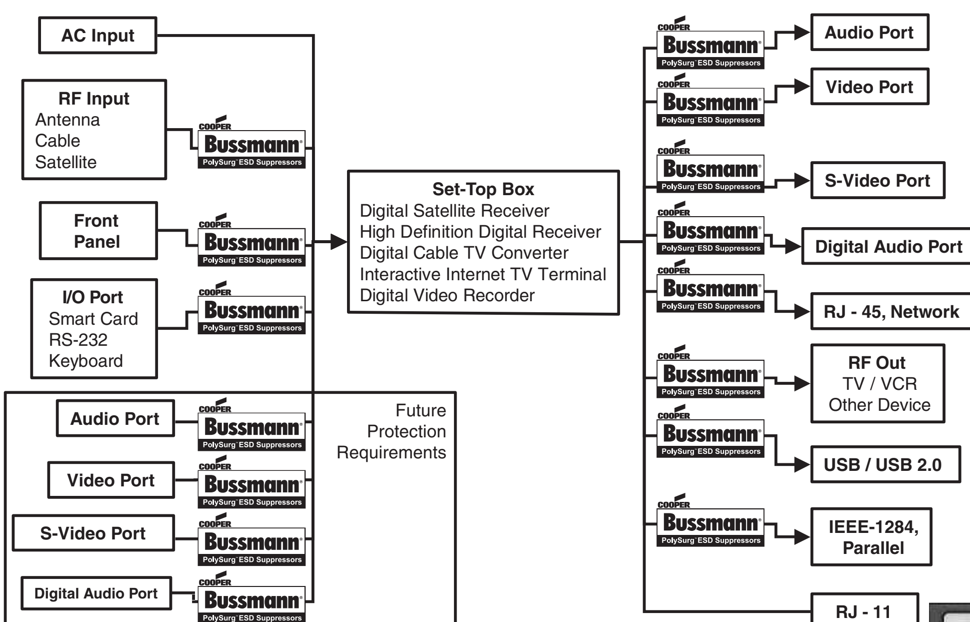
These devices allow the various cable and satellite signal operators to deliver a wide variety of services from television to internet and the hardware manufacturers can provide many features and benefits including home networking capabilities. There is digital video recording onto hard disk drives, replacing the cassette format, allowing pause and replay of and live television, or interactive TV. There are new standards being created to facilitate the design of the boxes such as a recent reference blueprint development by communications chipmaker Broadcom using the Microsoft interactive TV software system. The set top box is going to be a high volume commodity with many forms and functions.

Why are Set Top boxes vulnerable to ESD
The more sophisticated boxes include a variety of I/O jacks such as front panel USB, Audio/Video, S-Video, rear panel Satellite, cable, TV antenna, Wireless transmitter connection, home networking HPNA option, Toslink digital input, connections for CD, DVD,VCR, Outputs for Video, Audio, and more. Most of these jacks are susceptible to ESD threat.

The PolySurg™ solution to the ESD protection problem
Utilize the 0402ESDA-MLP, 0603ESDA-MLP, or 0603ESDA-TR1 PolySurg™ devices to protect the set top box electronics from catastrophic ESD damage at each potential outside metal contact or connector on each line. Audio, Video, RF, USB and RS-232 lines may be protected from ESD TVS occurrences on set top systems.

Design Wins with Set Top boxes
Cooper Bussmann has recorded some notable design wins already with it's PolySurg™ ESD Suppressors in applications involving the protection of set top systems.

Protection Against ESD Threat for Set Top System Input/Output Ports with PolySurg™



A Typical Set Top Box Rear View

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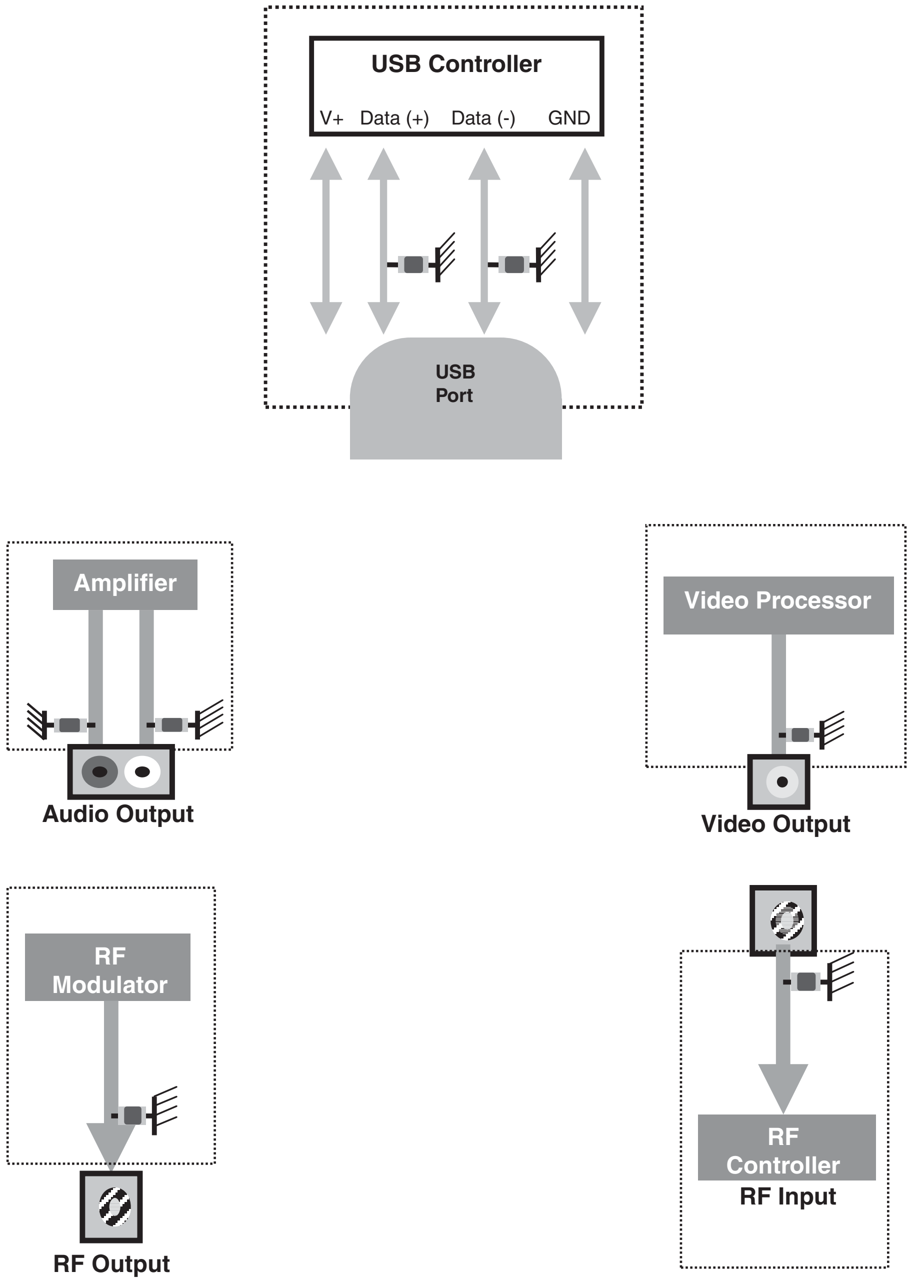
COOPER Bussmann PolySurg™ ESD Suppressors

Typical ESD Protection Applications with PolySurg™ 0402ESDA-MLP, 0603ESDA-MLP, or 0603ESDA-TR



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ESD Protection of High-Speed Data Lines

DVI/HDMI High Speed Date Rates
Communication data lines continue to be increasingly vulnerable to ESD transients. The ever-increasing bandwidth of the faster data lines such as the 10/100 or Gigabit Ethernet, USB 2.0, IEEE-1394b, make the traditional ESD protection schemes such as silicon based devices, or multi layer varistors less desirable, due to signal distortion from the relatively high capacitance of these components.

PolySurg™ ESD Suppressors
The typical capacitance of the device (0402ESDA-MLP, 0603ESDA-MLP, or 0603ESDA-TR) is measured to be below 0.15pF, in a range of 0.1 kHz to nearly 2 GHz. The low capacitance throughout this wide frequency range makes these devices suitable for ESD protection of low analog signals to fast digital data lines.

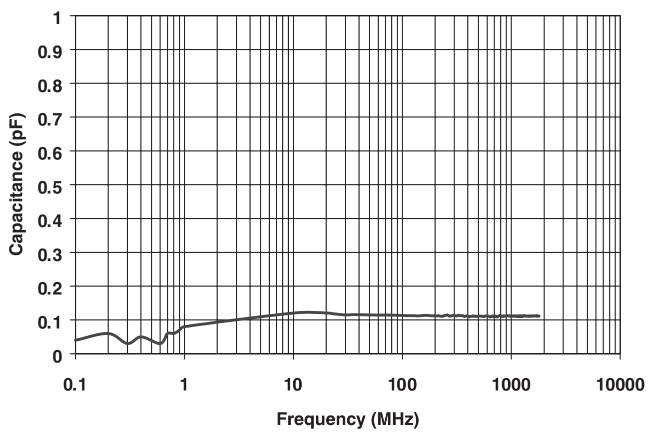

Chart 1. The Capacitance of a PolySurg™ ESD Suppressor from 0.1MHz to 1.8GHz

Another special characteristic of the PolySurg™ ESD Suppressor is that it is virtually invisible to the circuit at normal operation. The off-state resistance of the device is over 10^{13} Ohms, and the typical current leakage of the device is a negligible, 0.01nA at 12VDC. As Chart 2 shows, the additional attenuation in a 50ohm circuit measured at frequencies up to 6GHz is less than -0.2dbB.

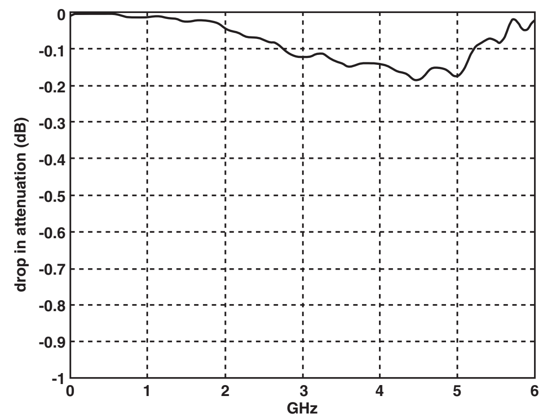

Chart 2. Additional Attenuation in a 50Ohm System due to the PolySurg™ ESD Suppressor

Example of devices that PolySurg™ ESD Suppressors can protect from ESD:

- Network interface cards for desktops
- PC cards for laptops
- DSL / Cable modems.
- Routers and switches /hubs

Selected Protection Applications

Ethernet ports: The RJ-45 is the most common Ethernet connection. The typical 10Base-T/100Base-TX uses 4 out of 8 lines. Each line in use can be protected with one PolySurg™ ESD Suppressor installed between the data line and the ground. For the best performance, place the devices at the closest location to the RJ-45 port (See Figure 1)

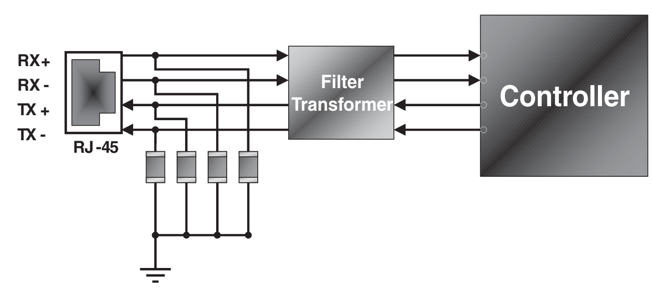

Figure 1. The ESD Protection of 10 / 100 Ethernet (RJ-45) device with a PolySurg™ ESD Suppressor

Firewire: The IEEE-1394 (Firewire) series are the newest serial ports for computer and other instruments with data transfer rates up to 1,600Mbp (1394a is 400Mbps, and 1394b will be 800~1,6000Mbps.) This higher transfer speed data is more easily subject to distortion (Chart 3). The PolySurg™ ESD Suppressor can protect data lines from ESD without distorting the high speed signal possible from IEEE-1394 connection. All data lines should be protected individually. (See Figure 2)

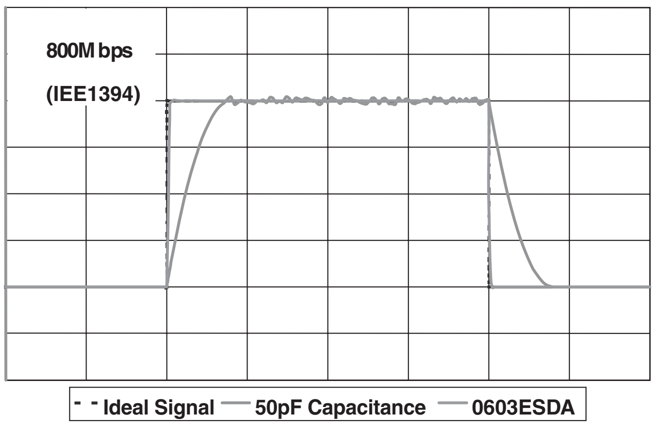

Chart 3. Signal distortion comparisons at 800Mbps

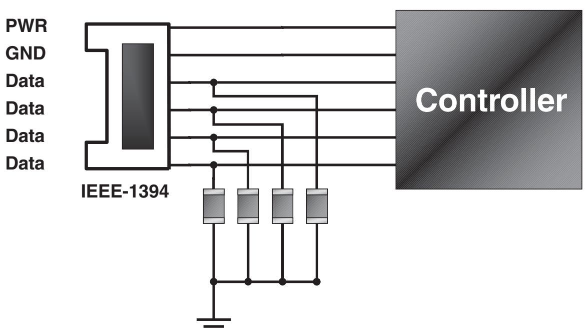

Figure 2. The ESD Protection of Typical IEEE-1394a device with a PolySurg™ ESD Suppressor

Example of devices that PolySurg™ ESD Suppressor can protect from ESD:

- Firewire interface cards
- Digital camcorders
- Printers / scanners
- Other peripherals with Firewire capability

USB 2.0: The USB 2.0 has a fast data transfer rate of 400Mbps. A device equipped with USB 2.0 will give the best performance when protected with the ultra low capacitance PolySurg ESD Suppressor.This will result in much less data distortion than if zener diodes or multi layer varistors are used for ESD protection (See Figure 3)

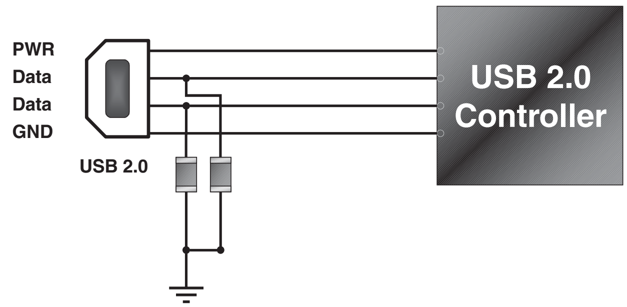

Figure 3. ESD protection of USB 2.0 devices with a PolySurg™ ESD Suppressor

Special Applications

When the unused data port is connected to a higher operating voltage such as 24V or higher for special applications, the PolySurg™ ESD Suppressor can be installed in series for ESD protection on the higher voltage line. The operating voltage capability will be increased without changing total capacitance or the current leakage of the devices.

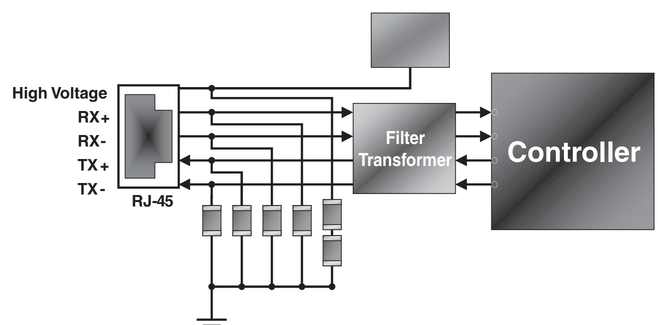

Figure 4. The Parallel connection for high voltage line protection using a PolySurg™ ESD Suppressor on RJ-45

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ESD Protection for High Speed Digital Video Solutions (DVI & HDMI)

High speed, uncompressed, digital video solutions such as Digital Visual Interface (DVI) and High Definition Multimedia Interface (HDMI) utilize small geometry CMOS processes in order to provide maximum performance in a small package. However these geometries are more susceptible to electrostatic discharge (ESD) and the high-speed digital signals present a real challenge when selecting an appropriate protection device.

DVI/HDMI High Speed Date Rates

DVI equipment can, currently, transmit at up to 1.6 Gbps for a 1600 x 1200 resolution signal. The receiver end can support up to 1.08 Gbps for 1280 x 1024 resolution but will soon increase to 1.65 Gbps. HDMI is an advancement of DVI that handles both audio and video signals with enough bandwidth for data rates of up to 5 Gbps. These high-speed data rates require any ESD protection device to have low capacitance in order to minimize signal distortion. At high frequency any capacitance will be seen as a low impedance path to ground, thus loading the data signal. Figure 1 shows the minimal effect of of a PolySurg™ ESD Suppressor on an 800 Mbps data signal compared to a 50pF capacitor.

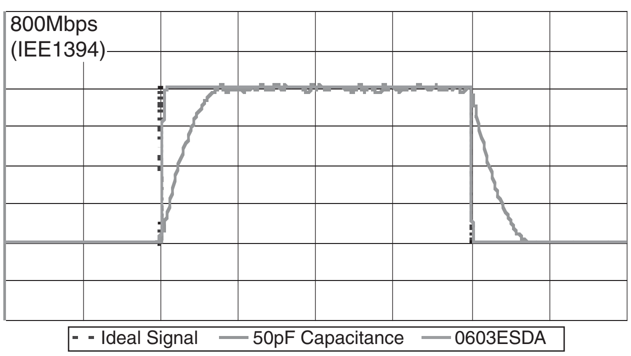

Figure 1 – IEE1394 Signal Distortion due to 50pF and 0603ESDA PolySurg™ ESD Suppressor

Traditional low capacitance steering diode solutions have a number of problems when used in high-speed data applications such as HDMI & DVI. Diodes are typically connected rail to rail as shown in Figure 2. During a negative voltage transient the bottom diode conducts clamping the voltage to a diode drop below ground. During a positive voltage transient the top diode will conduct the surge current (I1) into the power rail. Dumping the surge current into an unprotected supply rail can cause latch up of the protection circuit, so an additional transient voltage suppression (TVS) device between the supply rail and ground is required**.**

Typically discrete steering diodes are not rated for the high transient currents associated with ESD. This misuse results in a short cycle life and eventual diode failure, which is commonly in short circuit mode. This short circuit failure mode usually results in the equipment no longer functioning, even though the ESD event has passed. The preferred failure mode is open, since the equipment will certainly not operate with a shorted device, but has a potential to operate longer if the device were to fail open.

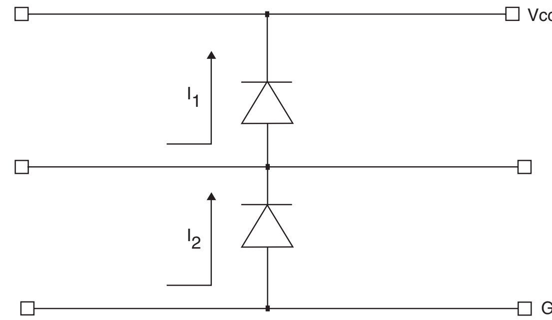

Figure 2 – Rail to Rail Diode Connection

In order to make a low capacitance diode a small junction area is used which presents a high resistance during ESD transients. Also, diode response time is slow compared to the ESD voltage rise time and the complete solution has significant parasitic inductance associated with the device leads and tracking. All this results in a large amount of voltage overshoot and a much higher clamping voltage. With the HDMI/DVI chip still exposed to several hundred or even one thousand volts following an ESD event, using this protection technique, there is potentially enough stress to damage the device.

Other solutions such as zener diodes, multi-layer varistors (MLV's) and TVS all exhibit levels of capacitance that are too large for them to be practical solutions in DVI and HDMI applications. With capacitance values from 25pF to 500pF coupled with leakage currents of 0.5-50µA the level of loading on the signal lines becomes unacceptable.

PolySurg™ ESD Suppressor Product Family

The Cooper Bussmann PolySurg™ ESD Suppressor provides the solution to the problem of providing ESD protection for these new high-speed circuits. This product is a bi-directional device that has leakage current of less than 1nA and capacitance less than 0.15pF. This ultra-low capacitance makes the PolySurg™ ESD Suppressor a viable solution for high data rate protocols like HDMI and DVI. With an insertion loss of less than -0.2dB at frequencies up to 6GHz the PolySurg™ ESD Suppressor is invisible to the circuit, introducing no additional loading or signal distortion.

The PolySurg™ ESD Suppressor product family is comprised of the 0402ESDA-MLP, 0603ESDA-MLP, and 0603ESDA-TR series ESD suppression devices. All are discrete devices exhibiting ultra-low capacitance to maintain signal integrity while protecting all but the most sensitive IC's from the harmful effects of ESD strikes up to 15kV (air discharge).

Summary

Commercial products require ESD surge protection of all the interface hardware schemes. New higher end consumer electronics are increasingly using high data rate protocols such as DVI and HDMI. The traditional protection devices have all been used with varying success, however the increase in data rates now indicates a need for ultra low capacitance devices, such as Cooper Bussmann's PolySurg™ ESD Suppressors.

NOTES

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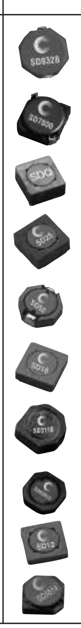
Inductor Selection Guide

	Product Family	Maximum Current Rating		Maximum Inductance Rating		Winding Configuration	Product Size (mm)			Core	EMI	
		Inductance	Current[1]	Inductance	Current[1]	(if applicable)	L	W	H	Structure	Rating[2]	SMT/THT
High Current 	HC3	0.50	78.00	6.0	30.00	-	30.00	25.30	17.50	UI	2	SMT
	HC2 LP	0.47	52.90	6.0	16.50	-	19.20	19.20	11.18	UI	2	SMT
	HCP1305	0.470	38.00	2.200	20.00	-	13.80	12.90	5.00	EI	1	SMT
	HC9	0.200	46.70	47.000	3.65	-	13.80	13.10	7.50	EI	2	SMT
	HCF1305	0.470	32.00	4.700	10.40	-	12.50	12.50	5.00	EI	1	SMT
	FLAT-PAC (FP1308)	0.110	68.00	0.440	32.00	-	13.70	12.95	8.00	UI	2	SMT
	HCP1104	0.200	32.00	0.900	22.00	-	11.50	10.25	4.00	EI	1	SMT
	HCPT1309	0.200	43.10	3.310	11.40	-	13.20	14.00	9.00	EI	1	THT
	HC7	0.47	23.40	4.7	9.20	-	13.00	13.80	5.50	EI	1	SMT
	HC1	0.22	40.50	10.0	5.30	-	13.00	13.00	10.00	UI	2	SMT
	HC7 (HC7-R20)	0.20	35.80	0.20	35.80	-	13.00	14.25	6.00	EI	1	SMT
	HC8	0.15	39.00	47.0	2.40	-	10.40	10.40	4.00	EI	1	SMT
	HC8LP	0.15	29.00	47.0	1.70	-	10.40	10.40	3.50	EI	1	SMT
	FLAT-PAC Single (FP4-S_)	0.100	40.00	0.200	30.00	-	6.80	10.20	5.00	UI	2	SMT
	HCP0703	0.150	26.00	10.000	3.00	-	7.30	7.00	3.00	EI	1	SMT
	FLAT-PAC 5mm (FP2-V_)	0.050	70.00	0.200	19.00	-	7.20	6.70	5.00	UI	2	SMT
	FLAT-PAC Single (FP3-S)	0.100	19.00	15.0	2.00	-	7.25	6.50	3.00	EI	1	SMT
	FLAT-PAC Single (FP2-S_)	0.047	39.00	0.120	18.00	-	7.20	6.70	3.00	UI	2	SMT
	FLAT-PAC Dual (FP2-D_)	0.188	16.00	0.480	9.00	Series	7.20	6.70	3.00	UI	2	SMT
	FLAT-PAC Dual (FP2-D_)	0.047	37.00	0.120	18.00	Parallel	7.20	6.70	3.00	UI	2	SMT
	CPL (Multi-Phase)	See Data Sheet										
Shielded Drum (DR Style) 	DRQ127	1.68	8.94	4020.0	0.307	Series	12.50	12.50	8.00	Shld Drum	2	SMT
	DRQ127	0.47	17.90	1000.0	0.610	Parallel	12.50	12.50	8.00	Shld Drum	2	SMT
	DR127	0.47	17.90	1000.0	0.610	-	12.50	12.50	8.00	Shld Drum	2	SMT
	DRQ125	0.47	17.60	1000.0	0.570	Parallel	12.50	12.50	6.00	Shld Drum	2	SMT
	DR125	0.47	17.60	1000.0	0.570	-	12.50	12.50	6.00	Shld Drum	2	SMT
	DRQ125	1.82	8.80	4032.0	0.283	Series	12.50	12.50	6.00	Shld Drum	2	SMT
	DR124	0.47	16.00	1000.0	0.440	-	12.30	12.30	4.50	Shld Drum	2	SMT
	DR1050	0.80	9.70	1000.0	0.430	-	10.50	10.30	5.00	Shld Drum	2	SMT
	DR1040	1.50	6.50	330.0	0.520	-	10.50	10.30	4.00	Shld Drum	2	SMT
	DRQ74	1.18	3.10	4036.0	0.135	Series	7.60	7.60	4.35	Shld Drum	2	SMT
	DRQ74	0.33	6.20	1000.0	0.270	Parallel	7.60	7.60	4.35	Shld Drum	2	SMT
	DR74	0.33	6.26	1000.0	0.270	-	7.60	7.60	4.35	Shld Drum	2	SMT
	DR1030	1.10	7.00	150.0	0.680	-	10.50	10.30	3.00	Shld Drum	2	SMT
	DRQ73	1.22	3.10	3980.0	0.128	Series	7.60	7.60	3.55	Shld Drum	2	SMT
	LDS0705	0.82	7.68	470.0	0.368	-	8.00	7.20	5.00	Shld Drum	2	SMT
	DRQ73	0.33	6.19	1000.0	0.250	Parallel	7.60	7.60	3.55	Shld Drum	2	SMT
	DR73	0.33	6.21	1000.0	0.250	-	7.60	7.60	3.55	Shld Drum	2	SMT
Low Profile Shielded Drum (SD Style) 	SD8350	1.80	5.50	100.0	0.800	-	9.50	8.30	4.50	Shld Drum	2	SMT
	SD8328	2.50	4.50	100.0	0.800	-	9.50	8.30	3.00	Shld Drum	2	SMT
	SD7030	3.30	3.00	680.0	0.210	-	7.00	7.00	3.00	Shld Drum	2	SMT
	SD53	1.10	3.25	100.0	0.440	-	5.20	5.20	3.00	Shld Drum	2	SMT
	SD6030	2.70	2.60	680.0	0.160	-	6.00	6.00	3.00	Shld Drum	2	SMT
	SDQ25	0.47	3.71	1000.0	0.127	Parallel	5.20	5.20	2.50	Shld Drum	2	SMT
	SDQ25	1.57	1.86	4032.0	0.063	Series	5.20	5.20	2.50	Shld Drum	2	SMT
	SD25	0.47	3.88	1000.0	0.126	-	5.20	5.20	2.50	Shld Drum	2	SMT
	SD14	0.58	3.52	1000.0	0.117	-	5.20	5.20	1.40	Shld Drum	2	SMT
	SD6020	3.90	1.95	100.0	0.360	-	6.00	6.00	2.00	Shld Drum	2	SMT
	SD52	1.20	2.33	150.0	0.280	-	5.60	5.20	2.00	Shld Drum	2	SMT
	SD18	0.47	3.58	1000.0	0.102	-	5.20	5.20	1.80	Shld Drum	2	SMT
	SDQ12	1.96	1.39	331.0	0.154	Series	5.20	5.20	1.20	Shld Drum	2	SMT
	SDQ12	0.47	2.78	82.0	0.309	Parallel	5.20	5.20	1.20	Shld Drum	2	SMT
	SD20	0.47	3.59	1000.0	0.088	-	5.20	5.20	2.00	Shld Drum	2	SMT
	SD12	0.47	3.19	1000.0	0.086	-	5.20	5.20	1.20	Shld Drum	2	SMT
	SD3118	1.00	2.01	1000.0	0.083	-	3.10	3.10	1.80	Shld Drum	2	SMT
	SD3814	0.47	2.81	680.0	0.100	-	4.00	4.00	1.40	Shld Drum	2	SMT
	SD10	0.47	2.59	470.0	0.110	-	5.20	5.20	1.00	Shld Drum	2	SMT
	SDH3812	0.47	2.69	220.0	0.160	-	4.00	4.00	1.20	Shld Drum	2	SMT
	SD3812	0.47	2.53	220.0	0.160	-	4.00	4.00	1.20	Shld Drum	2	SMT
	SD3114	1.00	1.60	330.0	0.113	-	3.10	3.10	1.40	Shld Drum	2	SMT
	SD3112	1.00	1.39	220.0	0.117	-	3.10	3.10	1.20	Shld Drum	2	SMT
	SD3110	0.50	1.54	220.0	0.106	-	3.10	3.10	1.00	Shld Drum	2	SMT

Note 1 = Current ratings listed are the lower value of the Isat and Irms ratings
Note 2 = EMI Rating: 1) Closed magnetic path - best EMI shield; 2) Small gap, or external shield - some EMI fringing; 3) No shield - Highest EMI
Note 3 = Alternate sizes, terminal styles available

General information needed to select proper inductor:
___I. Inductance and Current requirements
___II. Mounting style (surface mount or thru hole) and size constraints
___III. Frequency of operation (switching frequency)
___IV. Circuit susceptibility to EMI
___V. Consider using two parts in series for lower profiles, higher current ratings or higher inductance values

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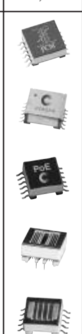
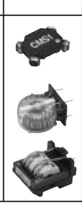
Inductor Selection Guide

	Product Family	Maximum Current Rating		Maximum Inductance Rating		Winding Configuration	Product Size (mm)			Core	EMI	
		Inductance	Current[1]	Inductance	Current[1]	(if applicable)	L	W	H	Structure	Rating[2]	SMT/THT
Unshielded Drum Core 	UNI-PAC 4B	0.47	19.20	470.0	0.914	-	22.10	15.00	7.87	Drum	3	SMT
	UNI-PAC 3B (UP3B)	0.47	16.00	330.0	0.750	-	19.30	13.21	6.80	Drum	3	SMT
	UNI-PAC 2C (UP2C)	0.47	12.20	1000.0	0.380	-	12.90	9.40	5.20	Drum	3	SMT
	LD2	10.00	3.45	470.0	0.550		7.80	7.00	5.00	Drum	3	SMT
	UNI-PAC 2B (UP2B)	0.47	10.60	1000.0	0.300	-	13.79	10.41	6.00	Drum	3	SMT
	UNI-PAC 2.8B (UP2.8B)	1.00	3.60	150.0	0.620	-	12.90	9.40	2.80	Drum	3	SMT
	UNI-PAC 1B (UP1B)	0.47	6.00	330.0	0.280	-	8.89	6.10	5.00	Drum	3	SMT
	LD1	1.00	2.60	68.0	0.460		4.50	4.00	3.20	Drum	3	SMT
	UNI-PAC 0.4C (UP0.4C)	1.00	2.88	100.0	0.350	-	6.60	4.45	2.92	Drum	3	SMT
Toroid 	OCTA-PAC Plus 4 (CTX_-4A)	0.33	12.20	300.0	0.75	Parallel	13.97	11.43	6.35	Toroid	1	SMT
	OCTA-PAC Plus 4 (CTX_-4A)	1.25	6.09	1211.0	0.37	Series	13.97	11.43	6.35	Toroid	1	SMT
	OCTA-PAC 4 (CTX_-4)	0.47	7.00	300.0	0.62	Parallel	13.97	11.43	6.35	Toroid	1	SMT
	OCTA-PAC 4 (CTX_-4)	1.76	3.50	1192.0	0.31	Series	13.97	11.43	6.35	Toroid	1	SMT
	OCTA-PAC Plus 2 (CTX_-2A)	1.14	5.47	1215.0	0.29	Series	11.43	8.89	5.97	Toroid	1	SMT
	OCTA-PAC Plus 2 (CTX_-2A)	0.33	10.90	300.0	0.58	Parallel	11.43	8.89	5.97	Toroid	1	SMT
	ECONO-PAC 4P (CTX_-4P)	0.47	7.90	300.0	0.54	Parallel	13.97	11.43	6.35	Toroid	1	SMT
	OCTA-PAC Plus 3 (CTX_-3A)	0.33	11.40	300.0	0.54	Parallel	13.97	11.43	4.83	Toroid	1	SMT
	ECONO-PAC 4P (CTX_-4P)	1.95	3.95	1195.0	0.27	Series	13.97	11.43	6.35	Toroid	1	SMT
	OCTA-PAC Plus 3 (CTX_-3A)	1.47	5.72	1185.0	0.27	Series	13.97	11.43	4.83	Toroid	1	SMT
	ECONO-PAC 3P (CTX_-3P)	0.47	6.20	300.0	0.50	Parallel	13.97	11.43	4.83	Toroid	1	SMT
	ECONO-PAC 3P (CTX_-3P)	1.85	3.10	1193.0	0.25	Series	13.97	11.43	4.83	Toroid	1	SMT
	OCTA-PAC Plus 1 (CTX_-1A)	0.33	10.00	300.0	0.47	Parallel	11.43	8.89	4.19	Toroid	1	SMT
	OCTA-PAC Plus 1 (CTX_-1A)	1.61	4.98	1203.0	0.23	Series	11.43	8.89	4.19	Toroid	1	SMT
	ECONO-PAC 2P (CTX_-2P)	2.18	2.95	1201.0	0.21	Series	11.43	8.89	5.97	Toroid	1	SMT
	ECONO-PAC 2P (CTX_-2P)	0.47	5.90	300.0	0.42	Parallel	11.43	8.89	5.97	Toroid	1	SMT
	OCTA-PAC 3 (CTX_-3)	1.54	3.00	1204.0	0.20	Series	13.97	11.43	4.83	Toroid	1	SMT
	OCTA-PAC 3 (CTX_-3)	0.47	6.00	300.0	0.40	Parallel	13.97	11.43	4.83	Toroid	1	SMT
	OCTA-PAC 2 (CTX_-2)	1.69	3.25	1203.0	0.19	Series	11.43	8.89	5.97	Toroid	1	SMT
	OCTA-PAC 2 (CTX_-2)	0.47	6.50	300.0	0.38	Parallel	11.43	8.89	5.97	Toroid	1	SMT
	ECONO-PAC 1P (CTX_-1P)	0.47	5.50	300.0	0.32	Parallel	11.43	8.89	4.19	Toroid	1	SMT
	ECONO-PAC 1P (CTX_-1P)	1.67	2.75	1199.0	0.16	Series	11.43	8.89	4.19	Toroid	1	SMT
	Micro-Pac Plus (MP2A)	0.47	3.52	100.0	0.39	-	7.50	5.20	1.80	Toroid	1	SMT
	OCTA-PAC 1 (CTX_-1)	1.60	2.75	1210.0	0.11	Series	11.43	8.89	4.19	Toroid	1	SMT
	OCTA-PAC 1 (CTX_-1)	0.47	5.50	300.0	0.22	Parallel	11.43	8.89	4.19	Toroid	1	SMT
	Micro-Pac (MP2)	0.47	2.02	47.0	0.31	-	7.50	5.20	1.80	Toroid	1	SMT
	Large Toroid (LCPI) Vertical	various	various	various	various	-	various	various	various	Toroid	1	THT
	Large Toroid (LCPI) Horizontal	various	various	various	various	-	various	various	various	Toroid	1	THT
	Large Toroid (LCPI) w/ Header Vert.	various	various	various	various	-	various	various	various	Toroid	1	THT
	Large Toroid (LCPI) w/ Header Horiz.	various	various	various	various	-	various	various	various	Toroid	1	THT
	Current Sense	various	various	various	various	-	17.15	9.53	20.32	Toroid	1	THT
Transformers 	Versa-Pac (VP5/VPH5)	multiple	multiple	multiple	multiple	6 windings	28.50	21.00	10.80	E	2	SMT
	Versa-Pac (VP4/VPH4)	multiple	multiple	multiple	multiple	6 windings	24.60	18.00	10.00	E	2	SMT
	Versa-Pac (VP3/VPH3)	multiple	multiple	multiple	multiple	6 windings	22.30	17.10	8.40	E	2	SMT
	Versa-Pac (VP2/VPH2)	multiple	multiple	multiple	multiple	6 windings	16.80	16.30	7.80	E	2	SMT
	Versa-Pac (VP1/VPH1)	multiple	multiple	multiple	multiple	6 windings	13.00	12.90	6.20	E	2	SMT
	Power Over Ethernet/PD 26W (Forward)	n/a	n/a	n/a	n/a	-	28.50	21.50	10.80	E	2	SMT
	PowerOver Ethernet/PD 13W (Flyback)	n/a	n/a	n/a	n/a	-	24.60	18.00	10.00	E	2	SMT
	Power Over Ethernet/PD 7W (Flyback)	n/a	n/a	n/a	n/a	-	22.30	17.10	8.40	E	2	SMT
	Power Over Ethernet/PD 4W (Flyback)	n/a	n/a	n/a	n/a	-	22.30	17.10	8.40	E	2	SMT
	CCFL 14W	n/a	n/a	n/a	n/a	-	28.50[3]	25.40[3]	15.00[3]	E	2	THT
	CCFL 6W	n/a	n/a	n/a	n/a	-	26.00[3]	16.50[3]	7.10[3]	E	2	SMT
	CCFL 4W	n/a	n/a	n/a	n/a	-	26.00[3]	16.50[3]	5.50[3]	E	2	SMT
	CCFL 2.5W	n/a	n/a	n/a	n/a	-	20.60[3]	14.35[3]	8.00[3]	E	2	SMT
Common-Mode 	Common-Mode SMT (CMS3)	78.0	4.75	1600	0.75	-	13.97	11.43	6.00	Toroid	1	SMT
	Common-Mode SMT (CMS2)	30.0	5.35	1600	0.50	-	11.43	8.89	6.00	Toroid	1	SMT
	Common-Mode SMT (CMS1)	5.50	7.00	250	0.85	-	9.40	7.20	2.60	Toroid	1	SMT
	Common-Mode Thru-hole (CMT4) Vert	530	6.50	5400	2.00	-	25.00	15.40	25.50	Toroid	1	THT
	Common-Mode Thru-hole (CMT3) Horz	530	6.50	5400	2.00	-	25.00	25.00	14.00	Toroid	1	THT
	Common-Mode Thru-hole (CMT2)	1600	5.75	30,000	1.50	-	36.50	22.00	44.50	E	2	THT
	Common-Mode Thru-hole (CMT1)	940	6.05	66,000	0.74	-	29.50	22.00	36.50	E	2	THT

Note 1 = Current ratings listed are the lower value of the Isat and Irms ratings
Note 2 = EMI Rating: 1) Closed magnetic path - best EMI shield; 2) Small gap, or external shield - some EMI fringing; 3) No shield - Highest EMI
Note 3 = Alternate sizes, terminal styles available

General information needed to select proper inductor:

___I. Inductance and Current requirements
___II. Mounting style (surface mount or thru hole) and size constraints
___III. Frequency of operation (switching frequency)
___IV. Circuit susceptibility to EMI
___V. Consider using two parts in series for lower profiles, higher current ratings or higher inductance values

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FLAT-PAC™ Low Profile Inductors (Surface Mount)

Description

RoHS 2002/95/EC

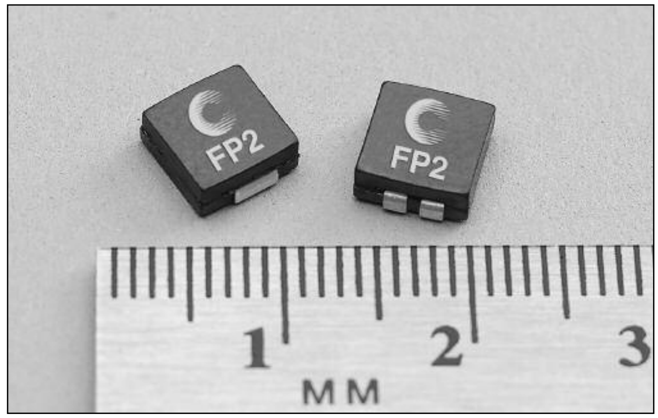
- 125°C maximum total temperature operation
- Surface mount inductors designed for higher speed switch mode applications requiring lower inductance and high current
- Dual conductors allow for low inductance and high current or high inductance and lower current
- Inductance range from .047uH to 0.480uH
- Current range up to 42 Amps
- Meets UL 94V-0 flammability standard
- Ferrite core material

Applications

- Next generation microprocessors

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +125°C (range is application specific).
- Solder reflow temperature: +260°C max. for 10 seconds max.



Packaging

- Supplied in tape and reel packaging, 1700 (FP2-S and FP2-D) and 950 (FP2-S200 and FP2-VXXX) per reel

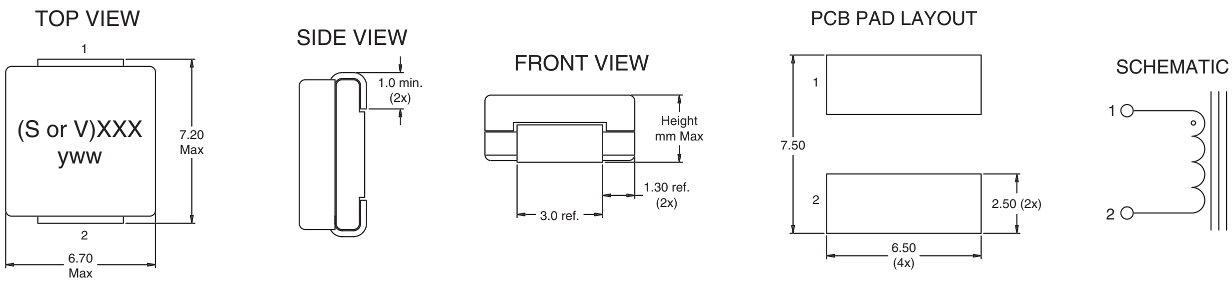
Parallel Mode							
Part Number	Inductance µH (rated)	OCL(1) µH± 15%	I RMS(2) Amps	I SAT(3) Amps	DCR(4) Ω nom.	Height	Volt-µ Sec (VµS) ref.(5)
Single Conductor							
FP2-S047-R	0.047	0.047	39.0	42.0	0.00024	3.00	0.75
FP2-S068-R	0.068	0.068	39.0	32.0	0.00024	3.00	0.75
FP2-S082-R	0.082	0.082	39.0	26.0	0.00024	3.00	0.75
FP2-S100-R	0.100	0.100	39.0	22.0	0.00024	3.00	0.75
FP2-S120-R	0.120	0.120	39.0	18.0	0.00024	3.00	0.75
FP2-S200-R	0.200	0.200	37.0	19.0	0.00028	5.00	0.99
FP2-V050-R	0.050	0.050	37.0	70.0	0.00028	5.00	0.99
FP2-V100-R	0.100	0.100	37.0	40.0	0.00028	5.00	0.99
FP2-V120-R	0.120	0.120	37.0	33.0	0.00028	5.00	0.99
FP2-V150-R	0.150	0.150	37.0	25.5	0.00028	5.00	0.99
Double Conductor							
FP2-D047-R	0.047	0.047	37.0	42.0	0.00026	3.00	0.75
FP2-D068-R	0.068	0.068	37.0	32.0	0.00026	3.00	0.75
FP2-D082-R	0.082	0.082	37.0	26.0	0.00026	3.00	0.75
FP2-D100-R	0.100	0.100	37.0	22.0	0.00026	3.00	0.75
FP2-D120-R	0.120	0.120	37.0	18.0	0.00026	3.00	0.75
Series Mode							
Part Number	Inductance µH ref. (rated)	OCL(1) µH ref.	I RMS(2) Amps	I SAT(3) Amps	DCR(4) Ω ref.	Height	Volt-µ(5) Sec (VµS) ref.
Double Conductor							
FP2-D047-R	0.188	0.188	16.0	21.0	0.0013	3.00	1.50
FP2-D068-R	0.272	0.272	16.0	16.0	0.0013	3.00	1.50
FP2-D082-R	0.328	0.328	16.0	13.0	0.0013	3.00	1.50
FP2-D100-R	0.400	0.400	16.0	11.0	0.0013	3.00	1.50
FP2-D120-R	0.480	0.480	16.0	9.0	0.0013	3.00	1.50

Notes: (1) Open Circuit Inductance Test Parameters: 1MHz, .100Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
(3) Peak current for approximately 30% rolloff at 20°C.
(4) DCR limits 20°C.
(5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 500KHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.

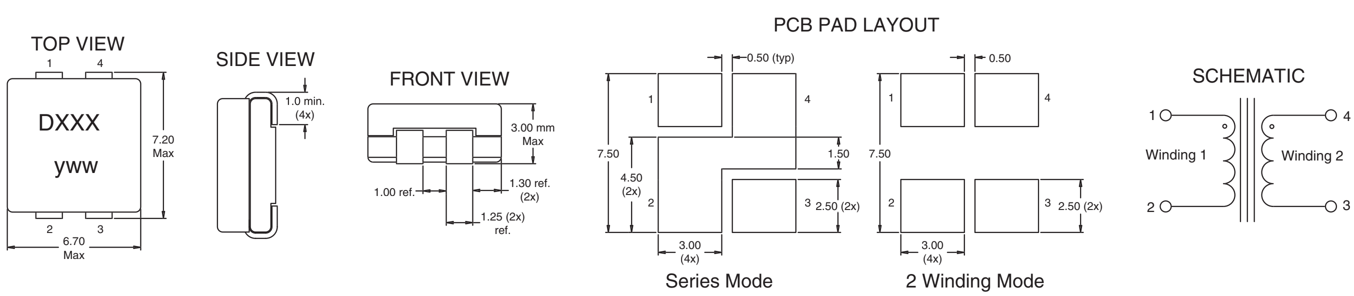
FLAT-PAC™ Low Profile Inductors (Surface Mount)

Mechanical Diagrams

Single Conductor

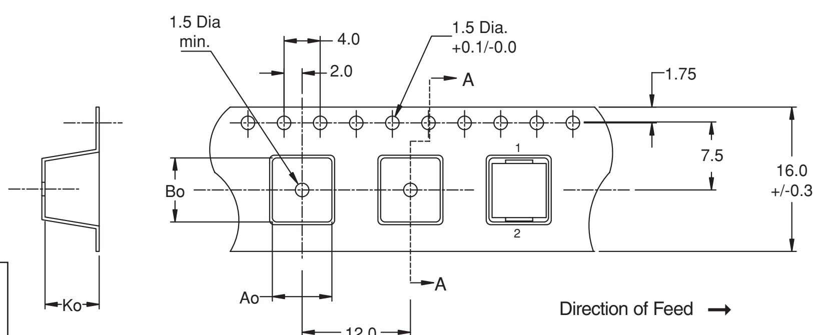


Dual Conductor



Notes: (1) Marking SXXX = S: Single Conductor Style, DXXX = D: Dual Conductor Style, XXX - last three digits of part number. Date Code: yww = y: Last Digit of year, ww: week of year.
(2) All Dimensions are in millimeters unless otherwise specified.
(3) For parallel mode operation, connect terminals 1 to 4 and 2 to 3 on PCB (use Single Conductor PCB Layout) For series mode operation, connect terminals 2 to 4 on PCB (Dual Conductor Model).

Packaging Information



Ao=6.6mm
Bo=7.1mm
Ko=3.2mm
Ko=5.2mm
(FP2-S200
& FP2V)

ACTUAL SIZE
FLAT-PAC'S

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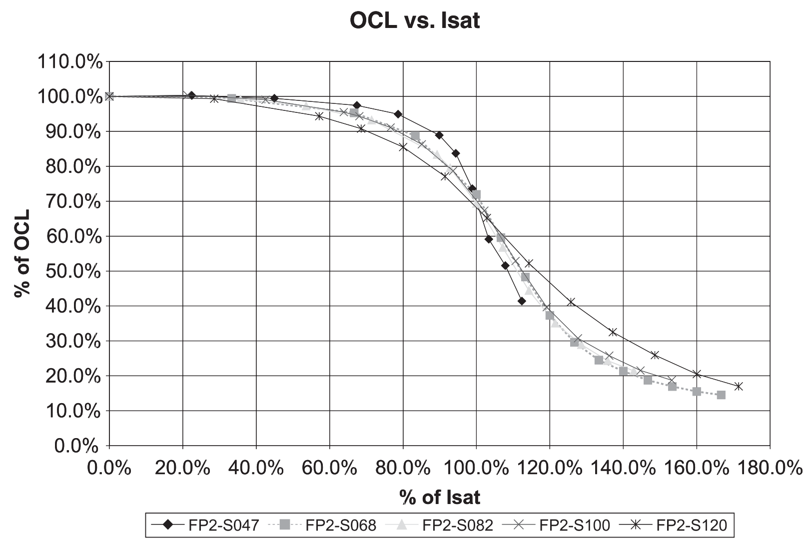
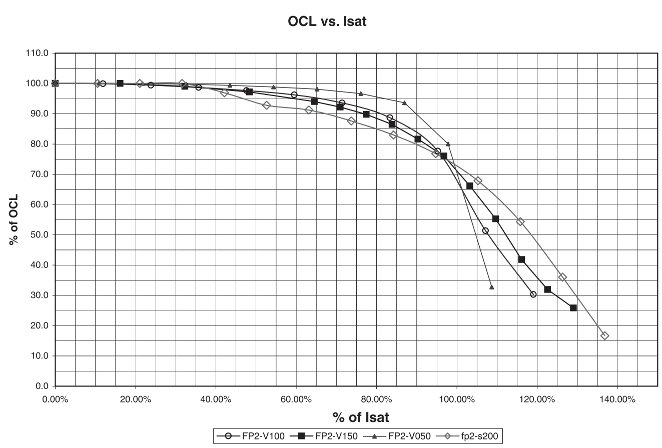
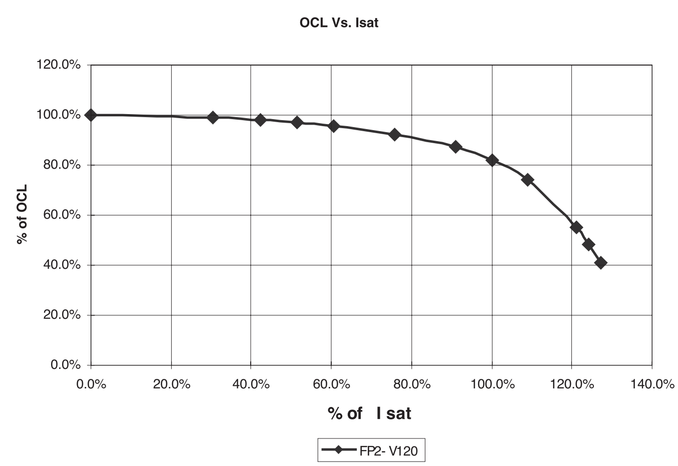
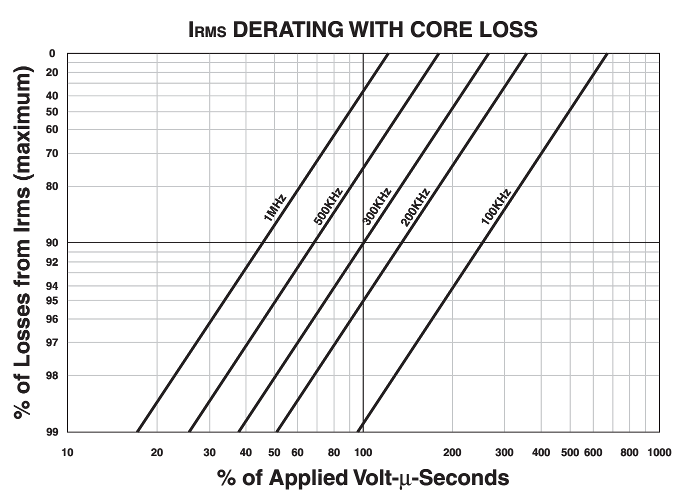
Inductance Characteristics







Core Loss



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FLAT-PAC™ 3
Low Profile Inductors

Description

RoHS 2002/95/EC

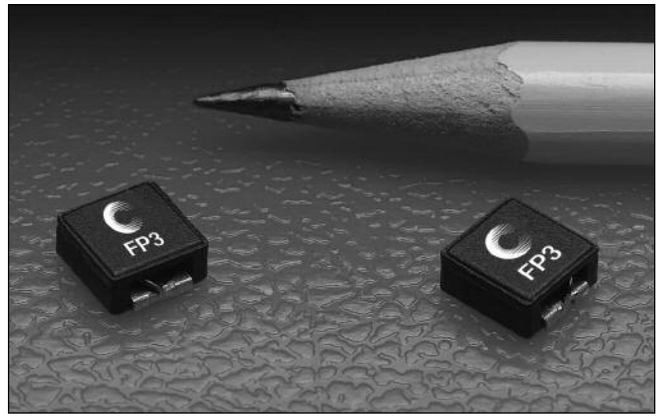
- 155°C maximum total temperature operation
- Low profile high current inductors
- Inductance range 0.1uh to 15uh
- Design utilizes high temperature powder iron material with a non-organic binder to eliminate thermal aging
- Current rating up to 34.7Adc (Higher peak currents may be attained with a greater rolloff, see rolloff curve)
- Frequency range up to 2MHz

Applications

- Computers and portable power devices
- Energy storage applications
- DC-DC converters
- Input - Output filer application

Environmental Data

- Storage temperature range: -40°C to +155°C
- Operating ambient temperature range: -40°C to +155°C (range is application specific).
- Solder reflow temperature: +260°C max. for 10 seconds max.



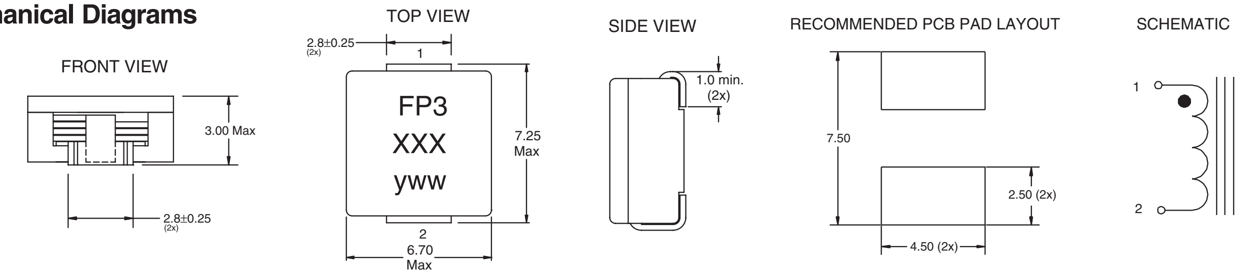
Packaging

- Units supplied in tape and reel packaging. Reel quantity = 1,700 parts per reel.

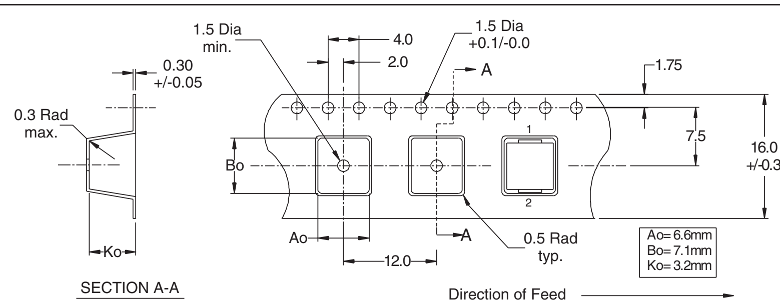
Part Number	Rated Inductance µH	OCL (1) µH ± 15%	Irms (2) Amperes	Isat (3) Amperes Approx. 10%	Isat (4) Amperes Approx. 15%	DCR mOhms @ 20°C (Max.)	K-factor (5)
FP3-R10-R	0.10	0.10	19.0	27	34.7	1.21	803
FP3-R20-R	0.20	0.22	15.3	16	20.8	1.88	482
FP3-R47-R	0.47	0.44	10.9	11.6	14.9	3.67	344
FP3-R68-R	0.68	0.72	9.72	9.0	11.6	4.63	268
FP3-1R0-R	1.00	1.10	6.26	7.4	9.5	11.2	219
FP3-1R5-R	1.50	1.50	5.78	6.2	8.0	13.1	185
FP3-2R0-R	2.00	2.00	5.40	5.4	6.9	15.0	161
FP3-3R3-R	3.30	3.20	3.63	4.3	5.5	30.0	127
FP3-4R7-R	4.70	4.70	3.23	3.5	4.2	40.0	105
FP3-8R2-R	8.20	8.5	2.91	2.6	3.4	74.0	78
FP3-100-R	10.0	10.9	2.30	2.3	3.0	101	69
FP3-150-R	15.0	14.9	2.22	2.0	2.5	127	59

1) OCL (Open Circuit Inductance) Test parameters: 100kHz, 0.1Vrms, 0.0Adc
2) DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 155°C under worst case operating conditions verified in the end application.
3) Isat Amperes Peak for approximately 10% rolloff @ 20°C
4) Isat Amperes Peak for approximately 15% rolloff @ 20°C
5) K-factor: Used to determine B p-p for core loss (see graph). B p-p =K*L*ΔI B p-p:(Gauss), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).

Mechanical Diagrams



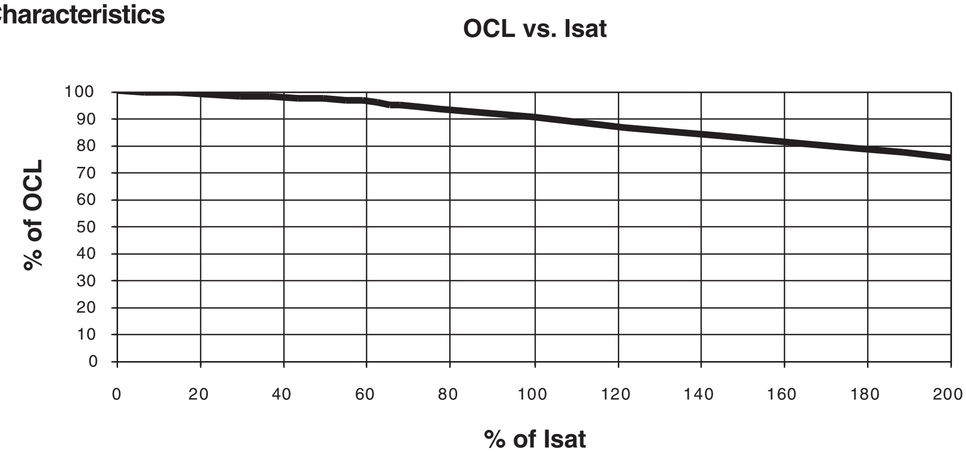
Packaging Information



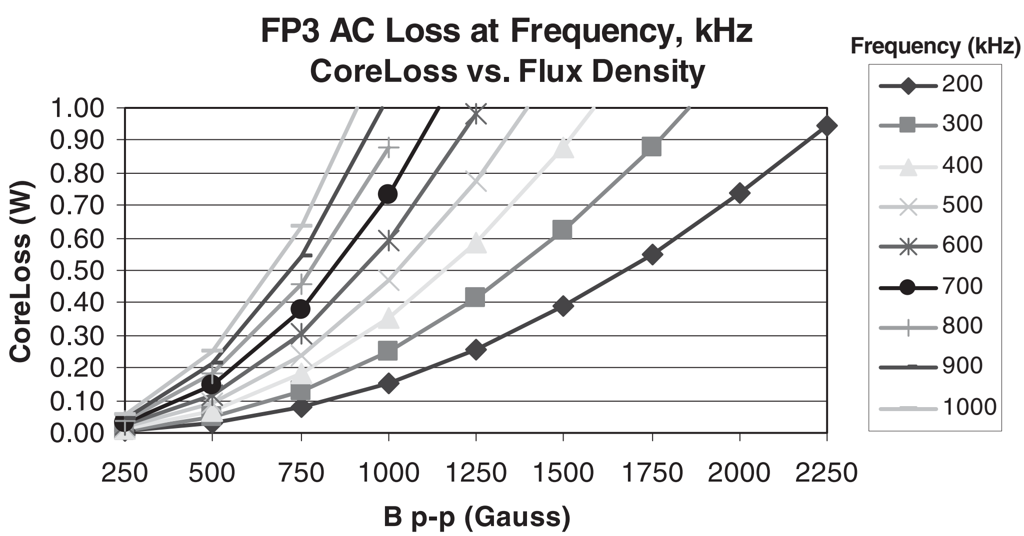
Dimensions in Millimeters

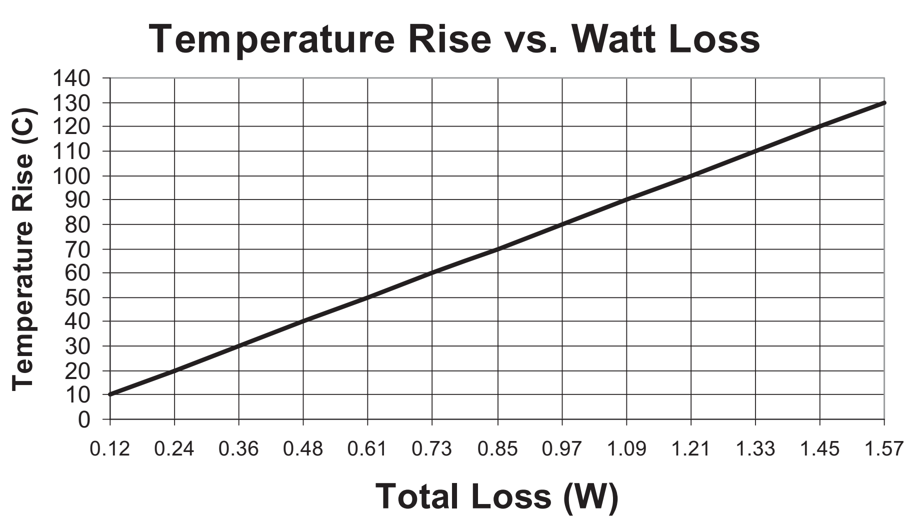
xxx = Inductance value
yww = Date code

Inductance Characteristics



Core Loss





FLAT-PAC™ 4
5mm Height Inductors
(Surface Mount)

COOPER Bussmann

Description

RoHS 2002/95/EC

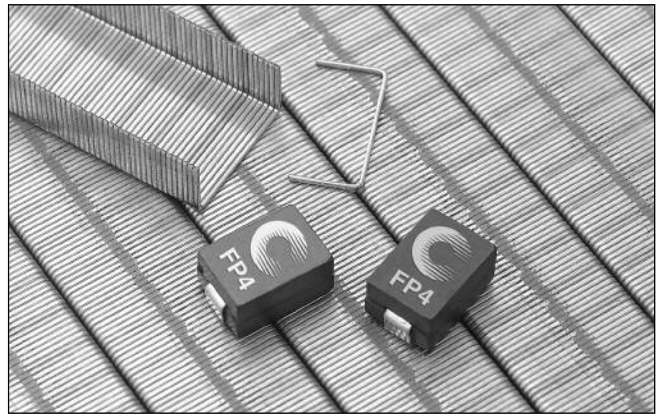
- 155°C maximum total temperature operation
- Surface mount inductors designed for high speed, high current switch mode applications requiring lower inductance
- Gapped ferrite cores for maximum efficiency
- Inductance values from 0.100 uH to 0.200 uH
- Current range up to 64 Amps
- Meets UL 94V-0 flammability standard
- Ferrite core material

Applications

- Voltage regulator modules (VRMs) for servers, microprocessors
- High frequency, high current switching power supplies

Environmental Data

- Storage temperature range: -40°C to +155°C
- Operating ambient temperature range: -40°C to +155°C (range is application specific).
- Solder reflow temperature: +260°C max. for 10 seconds max.



Packaging

- Supplied in tape and reel packaging, 900 parts per reel

Part Number	Rated Inductance µH	OCL (2) ± 15% µH	Isat (5) Amperes Peak	Irms (4) Amperes	DCR Ω @ 20°C (Nom.)	DCR Ω @ 20°C (Max.)	Volts-µSec (3) (VuSec) (ref.)
FP4-100-R	0.100	0.100	64	40	0.00048	0.00065	1.33
FP4-120-R	0.120	0.120	54	40	0.00048	0.00065	1.33
FP4-150-R	0.150	0.150	42	40	0.00048	0.00065	1.33
FP4-200-R	0.200	0.200	30	40	0.00048	0.00065	1.33

1) Units supplied in Tape & Reel packaging; 900 parts on 13" diameter reel.
2) OCL (Open Circuit Inductance) Test parameters: 1MHz, .100Vrms, 0.0Adc & ISAT @20°C
3) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 500kHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.
4) DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, airflow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 155°C under worst case operating conditions verified in the end application.
5) Peak Current for approximately 30% rolloff @ 20°C

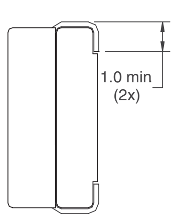
Part Number	Rated Inductance µH	OCL (2) ± 15% µH	Isat (5) Amperes Peak	Irms (4) Amperes	DCR @ 25°C	Volts-µSec (3) (Vus) (ref.)
FP4-090SK-R	0.090	0.090	72	33	0.423-0.517	1.33

1) Units supplied in Tape & Reel packaging; 900 parts on 13" diameter reel.
2) OCL (Open Circuit Inductance) Test parameters: 100kHz, 1.0Vrms, 0.0Adc & ISAT @25°C
3) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 500kHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.
4) DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, airflow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 155°C under worst case operating conditions verified in the end application.
5) Peak Current for approximately 20% rolloff @ 25°C

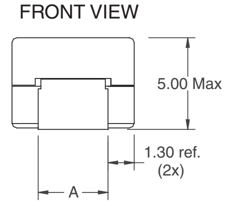
Mechanical Diagrams

TOP VIEW

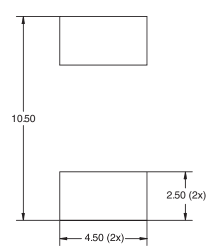
SIDE VIEW



FRONT VIEW

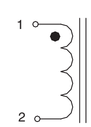


PCB PAD LAYOUT

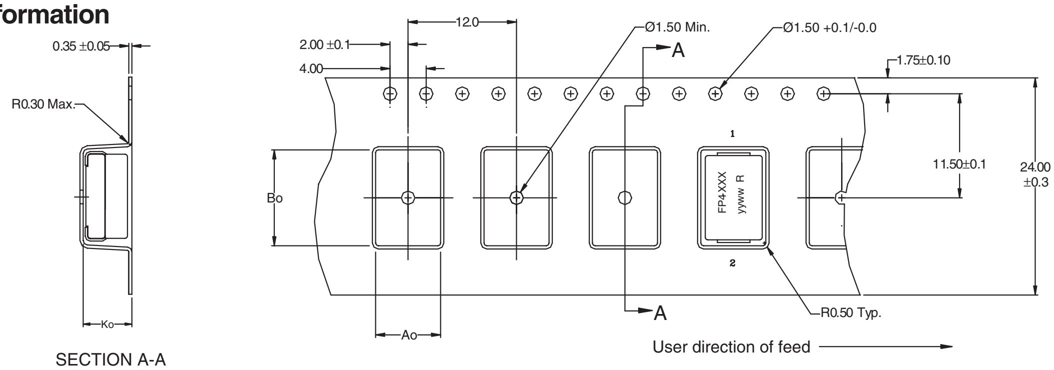


Part Number	Dimension “A” (mm) ref.
FP4-100-R	3.0
FP4-120-R	3.0
FP4-150-R	3.0
FP4-200-R	3.0
FP4-090SK-R	2.8

SCHEMATIC



Packaging Information

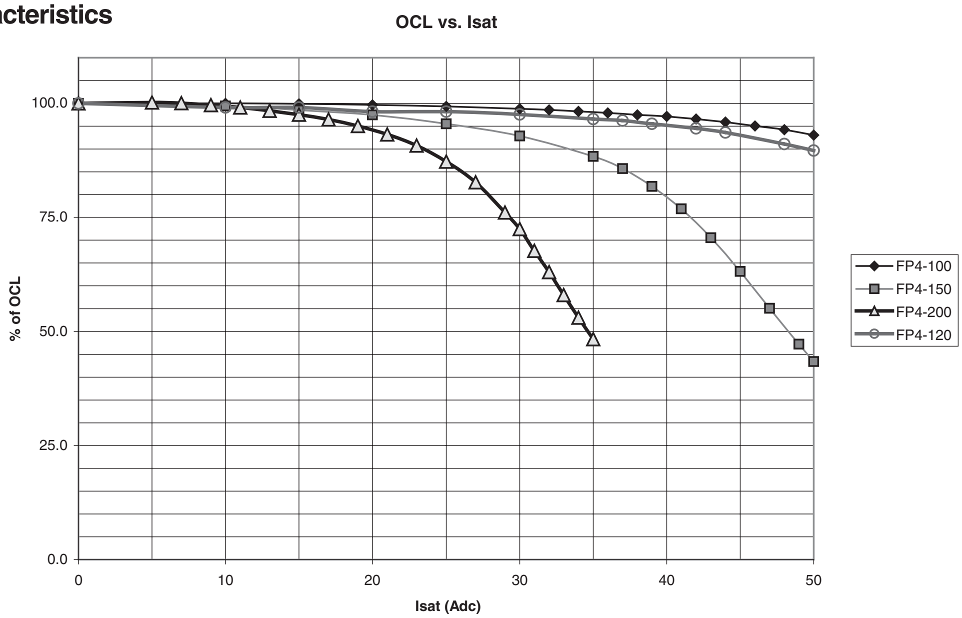


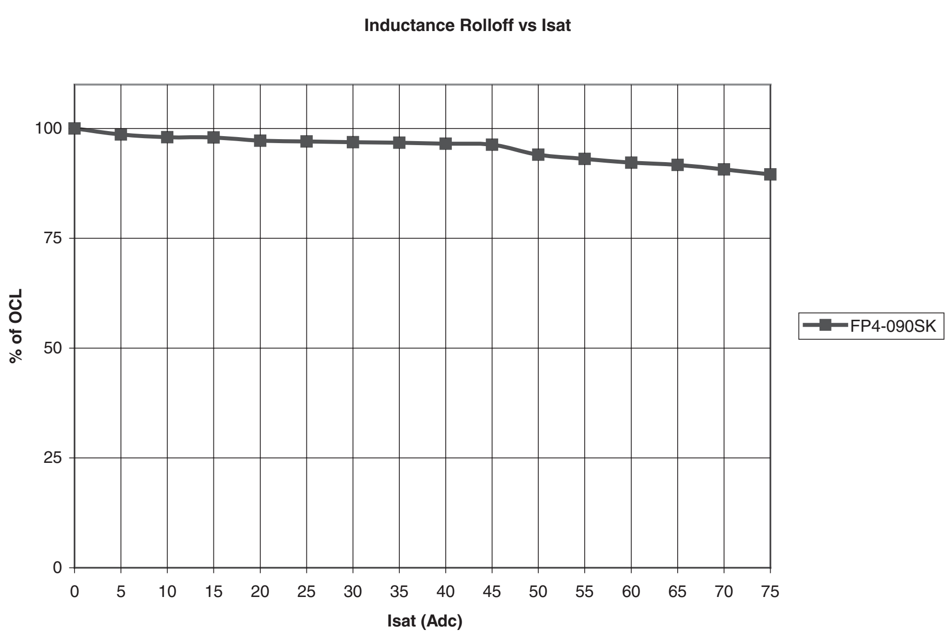
Ao=7.20mm
Bo=10.60mm
Ko=5.40mm

Dimensions in Millimeters

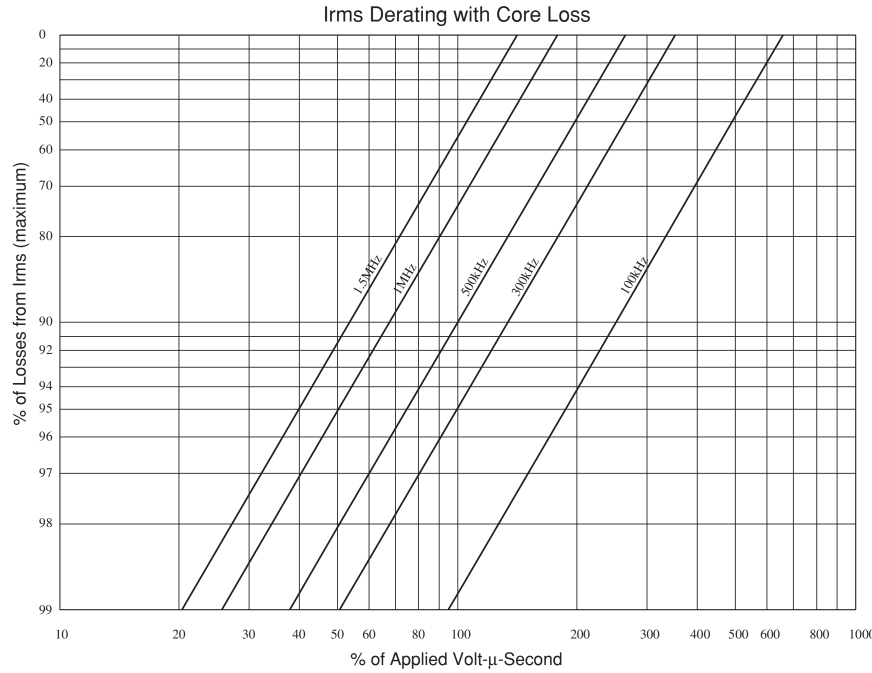
xxx = Inductance value
yww = Date code R = Revision level

Inductance Characteristics





Core Loss


Irms Derating with Core Loss
% of Losses from Irms (maximum)
0
20
40
50
60
70
80
90
92
94
95
96
97
98
99
10
20
30
40
50
60
80
100
200
300
400
500
600
800
1000
% of Applied Volt-µ-Second
1.5MHz
1MHz
500kHz
300kHz
100kHz

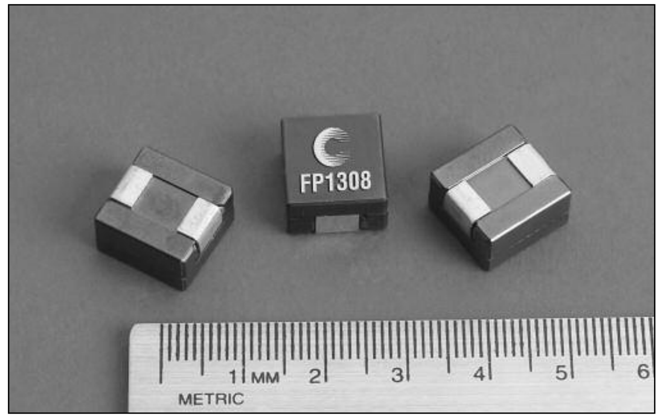
COOPER Bussmann

FP1308 Series
FLAT-PAC™
High Current Power Inductors

Description

RoHS 2002/95/EC

- 125°C maximum total temperature operation
- 12.9mm x 13.7mm x 8.0mm surface mount package
- High current handling capability, compact footprint
- Ferrite core material
- Inductance range from 110nH to 440nH
- Current range from 120 Amps to 32 Amps
- Frequency range up to 2MHz



Applications

- Voltage Regulator Modules (VRM) for servers and microprocessors
- Multi-Phase Buck inductors
- High frequency, high current switching power supplies

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

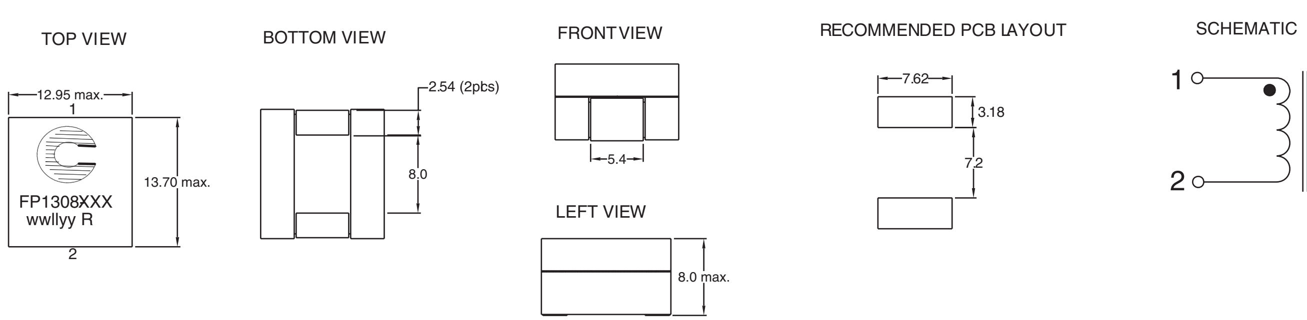
Packaging

- Supplied in tape and reel packaging, 450 per reel

Part Number	Rated Inductance (nH)	OCL (1) nH±10%	Irms(2) Amperes	Isat (3) Amperes	DCR mΩ @25°C (Typical)	DCR mΩ @25°C (Maximum)	K-factor (4)
FP1308-R11-R	110	110	68	120	0.20	0.24	21.330
FP1308-R21-R	210	210	68	72	0.20	0.24	21.333
FP1308-R26-R	260	260	68	60	0.20	0.24	21.335
FP1308-R32-R	320	320	68	45	0.20	0.24	21.340
FP1308-R44-R	440	440	68	32	0.20	0.24	21.366

(1) Open Circuit Inductance Test Parameters: 100kHz, 1.0V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for 20% maximum rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in μH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: FP1308-xxx-R
FP1308 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

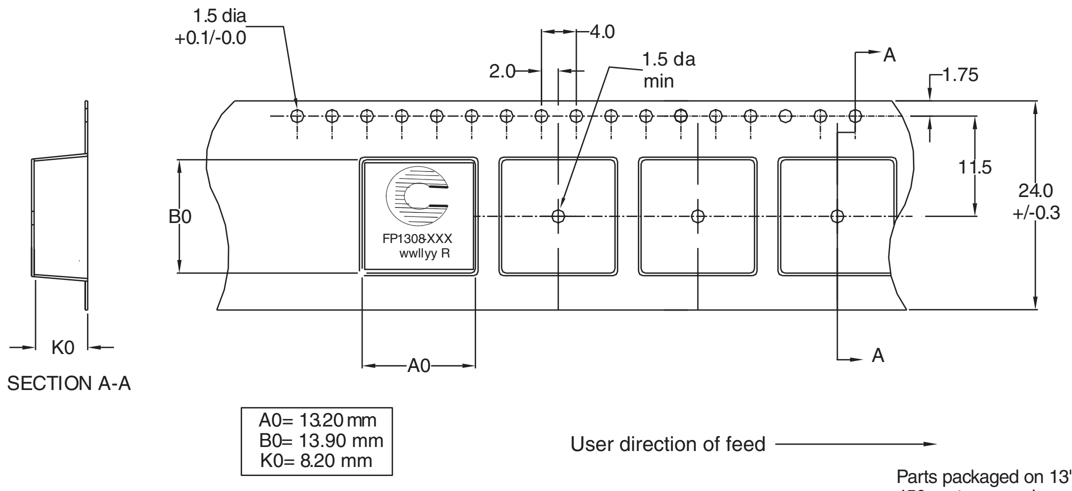
Mechanical Diagrams



Dimensions are in millimeters.

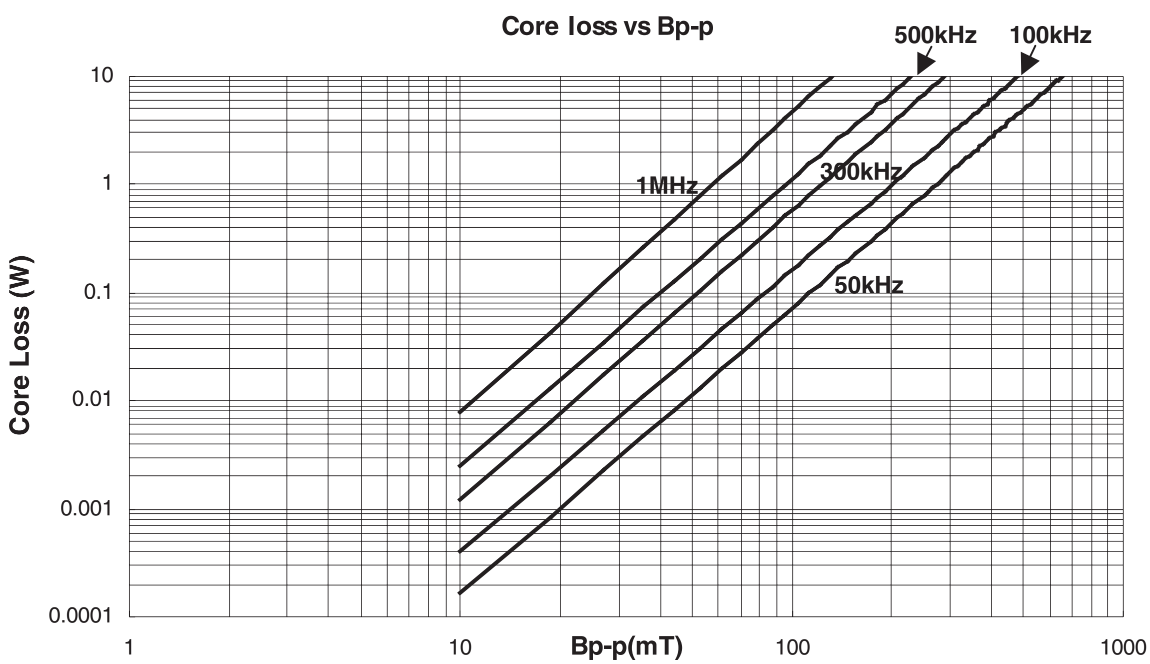
wwlly = Date Code. R = Revision level.

Packaging Information



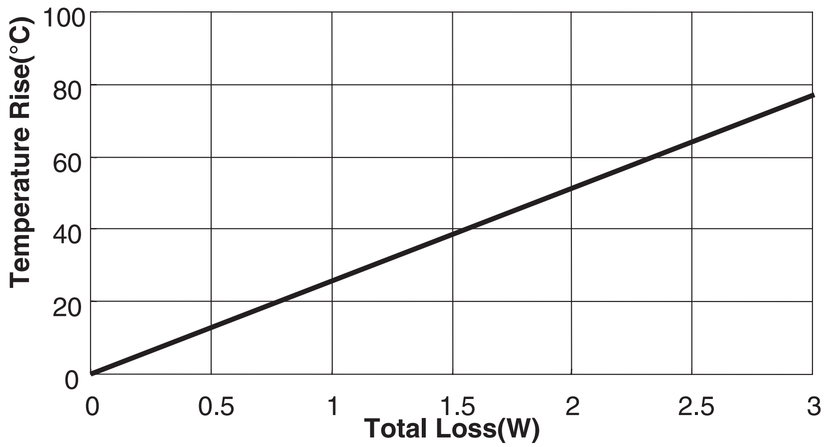
Parts packaged on 13" Diameter reel, 450 parts per reel.

Core Loss

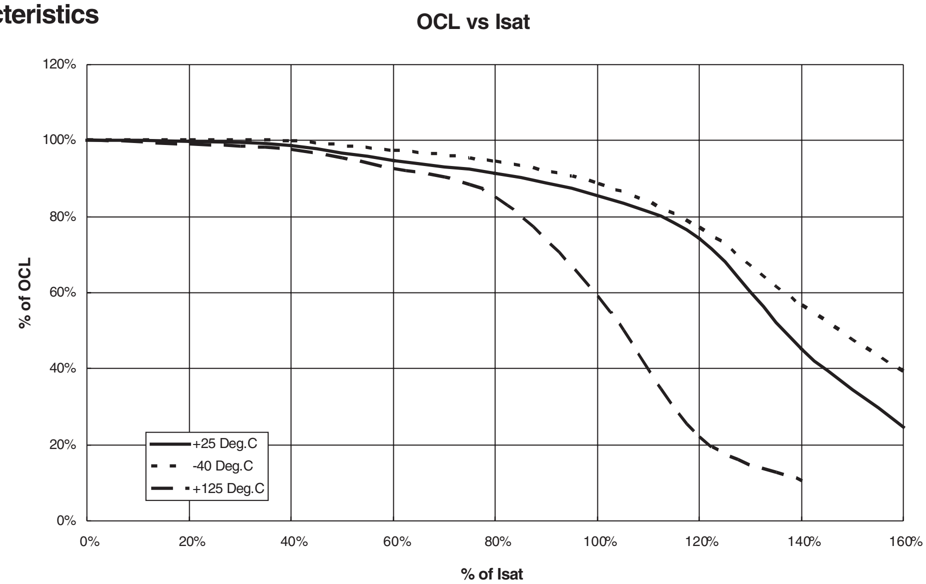


COOPER Bussmann

Temperature Rise vs. Loss



Inductance Characteristics



HCP0703 Series
High Current Pressed Power Inductors

Description

RoHS 2002/95/EC

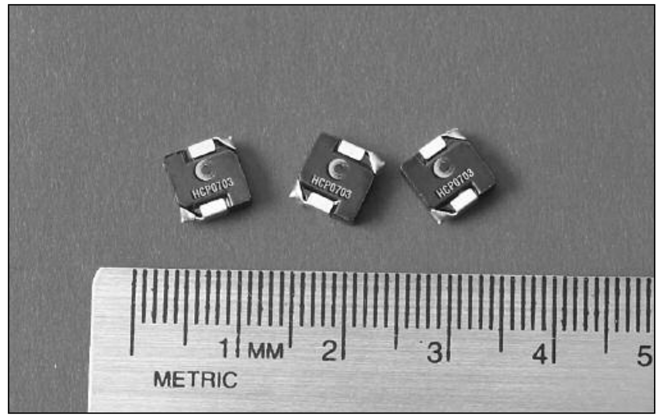
- 125°C maximum total temperature operation
- 7.0mm x 7.3mm x 3.0mm surface mount package
- Pressed powder iron core material
- Enhanced core coating eliminates rusting and provides high insulation impedance
- Inductance range from 0.15µH to 10.0µH
- Current range from 52.0 Amps to 3.0 Amps
- Frequency range up to 1MHz

Applications

- Notebook power
- VRM, multi-phase buck regulator
- DC-DC converters
- PC workstations/Servers/Desktop
- Routers

Environmental Data

- Storage temperature range: -55°C to +125°C
- Operating temperature range: -55°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



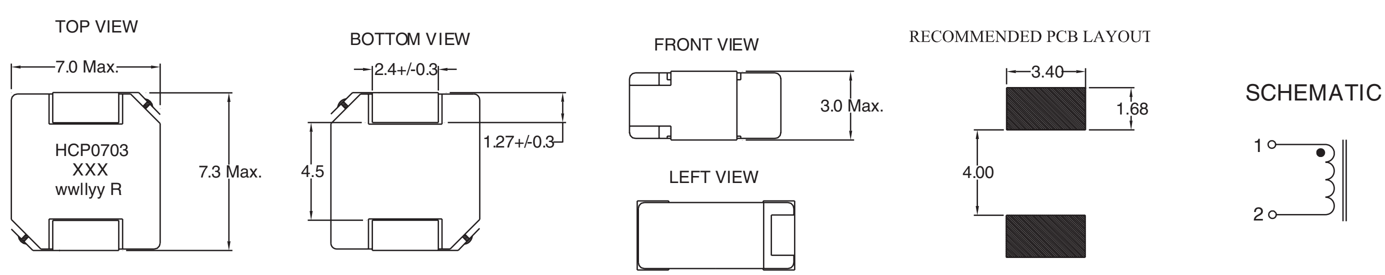
Packaging

- Supplied in tape and reel packaging, 1500 parts per reel

Part Number	Rated Inductance (µH)	OCL (1) µH ± 20%	Irms (2) Amperes	Isat (3) Amperes	DCR mΩ@20°C (Typical)	DCR mΩ@20°C (Maximum)	K-factor (4)
HCP0703-R15-R	0.15	0.15	26	52	1.9	2.5	1100
HCP0703-R22-R	0.22	0.22	23	40	2.5	2.8	922
HCP0703-R47-R	0.47	0.47	17	26	4.0	4.2	559
HCP0703-R68-R	0.68	0.68	15	25	5.0	5.5	435
HCP0703-R82-R	0.82	0.82	13	24	6.8	8.0	360
HCP0703-1R0-R	1.0	1.0	11	22	9.0	10	356
HCP0703-1R5-R	1.5	1.5	9	18	14	15	307
HCP0703-2R2-R	2.2	2.2	8	14	18	20	206
HCP0703-3R3-R	3.3	3.3	6	13.5	28	30	186
HCP0703-4R7-R	4.7	4.7	5.5	10	37	40	171
HCP0703-6R8-R	6.8	6.8	4.5	8	54	60	140
HCP0703-8R2-R	8.2	8.2	4	7.5	64	68	132
HCP0703-100-R	10.0	10.0	3	7.0	102	105	112

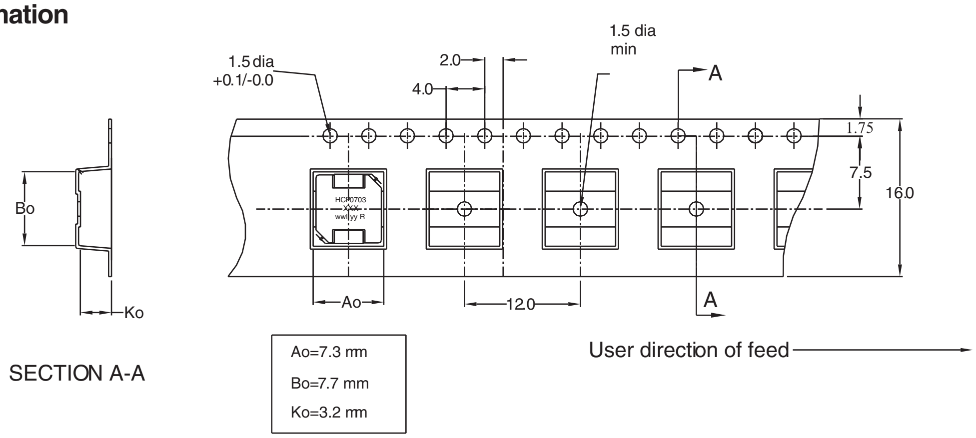
(1) Open Circuit Inductance Test Parameters: 100kHz, 0.25V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 20% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p: (Gauss), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).

Mechanical Diagrams

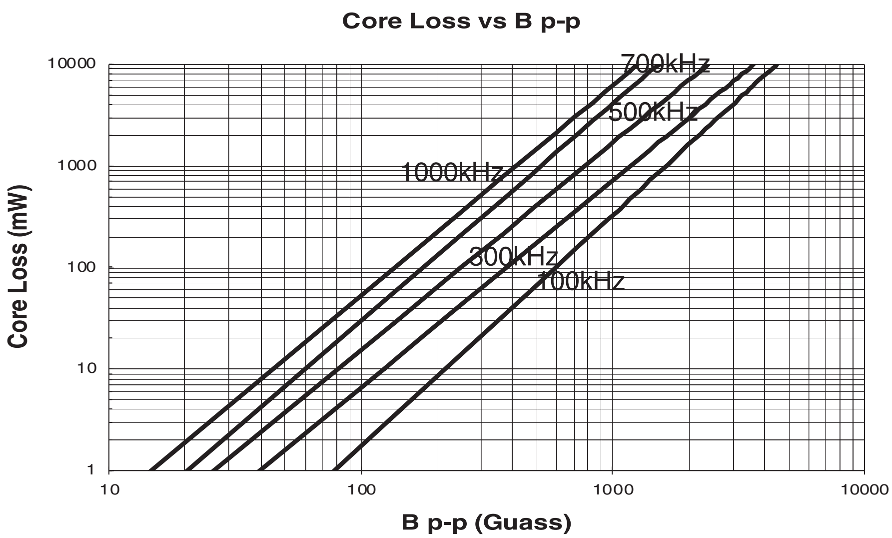


Dimensions are in millimeters.
wwllyy = Date Code. R = Revision Level.

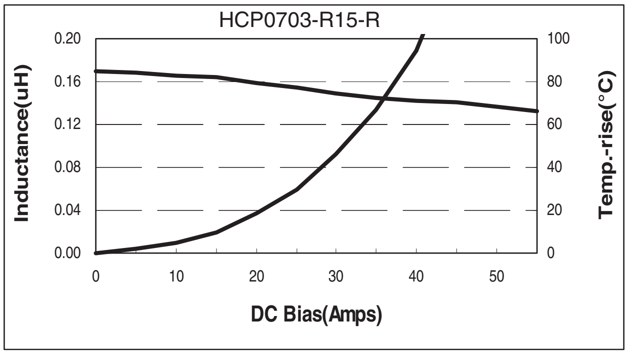
Packaging Information

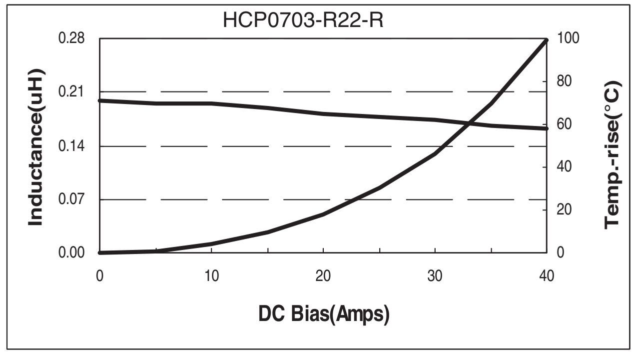


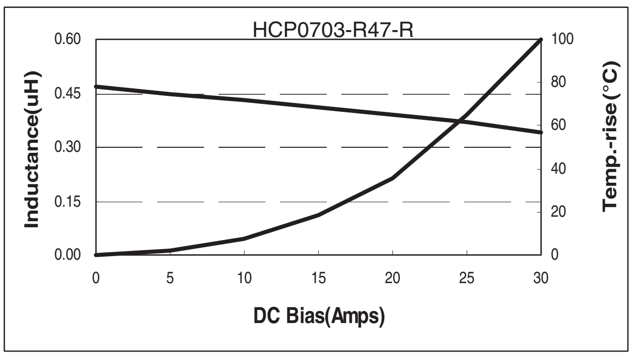
Core Loss

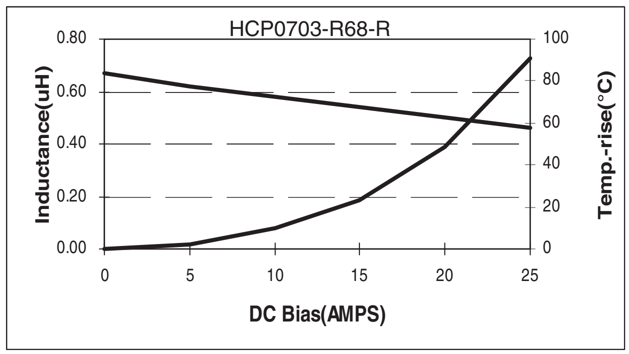


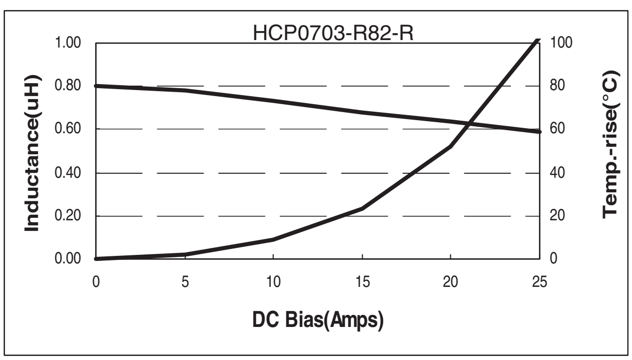
Performance Graphs

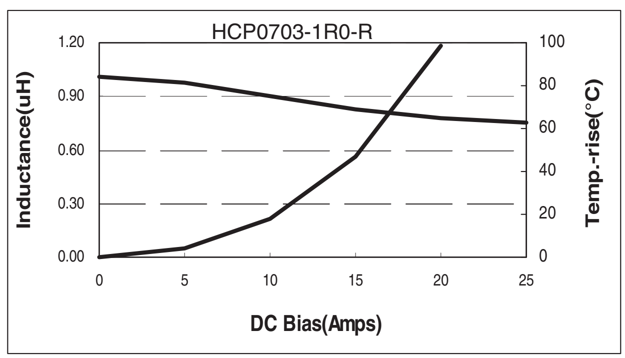


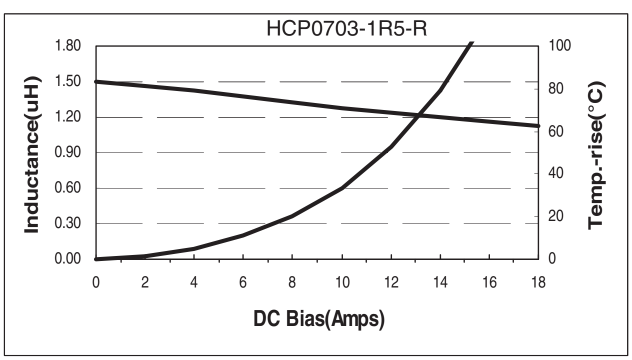




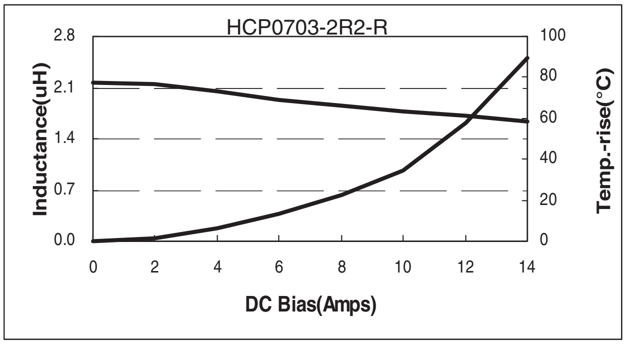


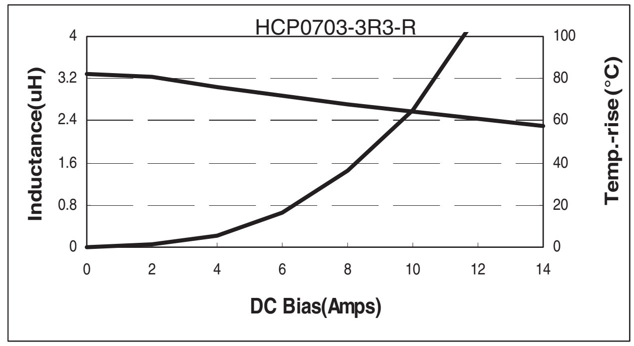


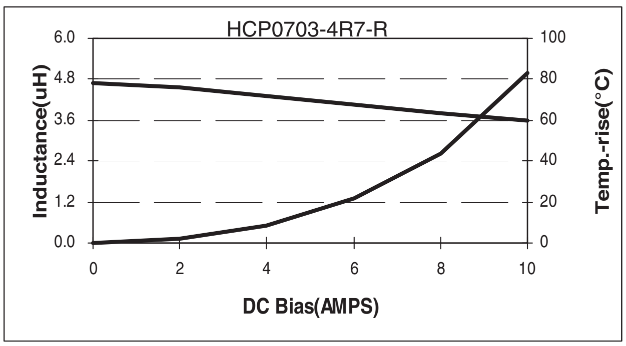


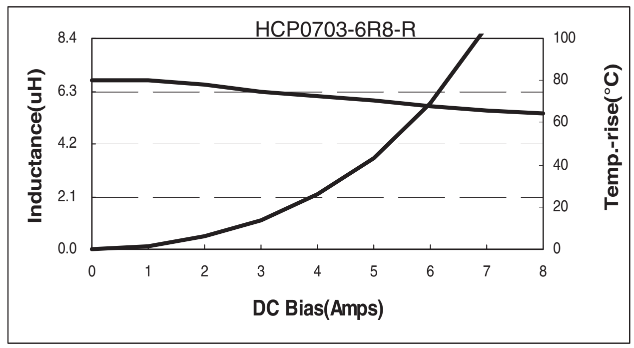


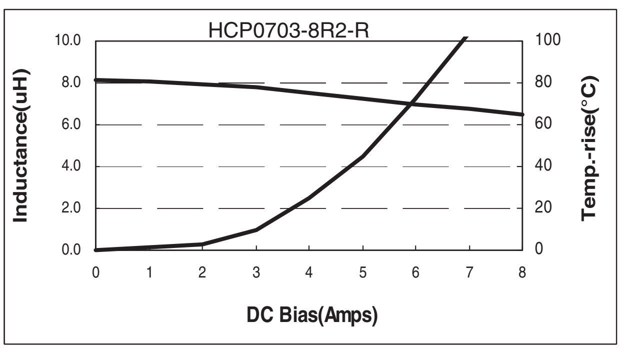
Performance Graphs

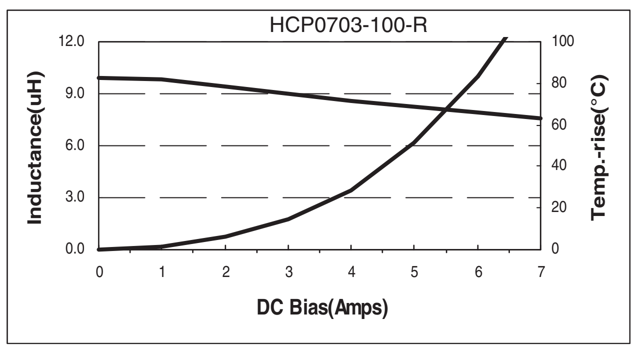












HIGH CURRENT (HCP0703)

COOPER Bussmann

HCP1104 Series
High Current Pressed Power Inductors

RoHS 2002/95/EC

Description

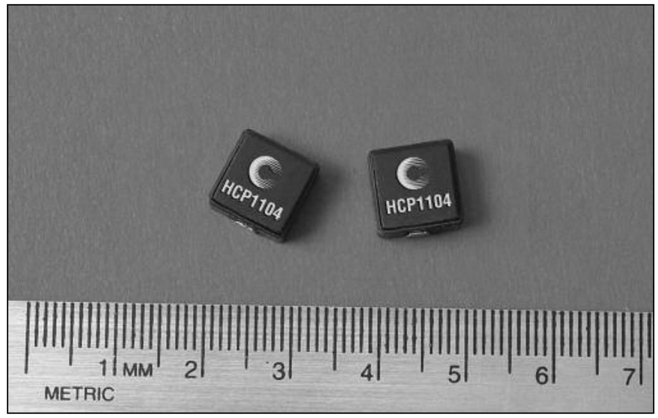
- 125°C maximum total temperature operation
- Low profile surface mount inductors
- 10mm x 11.5mm x 4.0mm package
- Pressed powder iron core material
- Enhanced core coating eliminates rusting and provides high insulation impedance
- Inductance range from 0.2µH to 0.9µH
- Current range from 42.0 Amps to 22 Amps
- Frequency range up to 1MHz

Applications

- Notebook power
- VRM, multi-phase buck regulator
- DC-DC converters
- PC workstations/Servers
- Routers

Environmental Data

- Storage temperature range: -55°C to +125°C
- Operating temperature range: -55°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



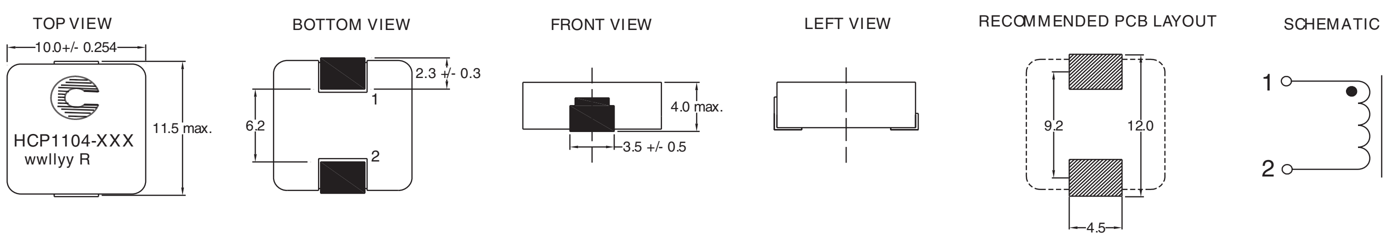
Packaging

- Supplied in tape and reel packaging, 950 parts per reel

Part Number	Rated Inductance (µH)	OCL (1) µH ± 20%	Irms (2) Amperes	Isat (3) Amperes	DCR mΩ@20°C (Typical)	DCR mΩ@20°C (Maximum)	K-factor (4)
HCP1104-R20-R	0.20	0.20	32	42	0.7	0.9	505
HCP1104-R36-R	0.36	0.36	30	40	1.0	1.2	289
HCP1104-R45-R	0.45	0.45	30	35	1.25	1.4	334
HCP1104-R56-R	0.56	0.56	25	32	1.60	1.8	287
HCP1104-R90-R	0.90	0.90	22	25	2.30	2.5	168

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.25V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 20% rolloff (@20°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B-p-p: (Gauss), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).

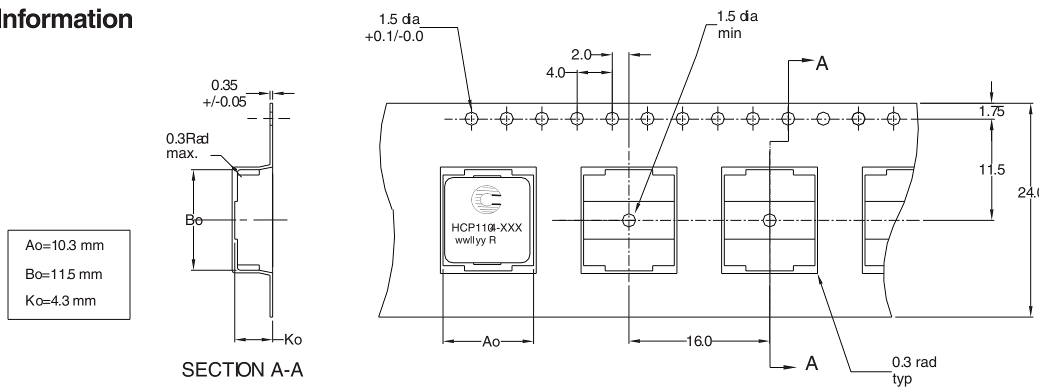
Mechanical Diagrams



Dimensions are in millimeters.

wwlly = Date Code. R = Revision Level.

Packaging Information

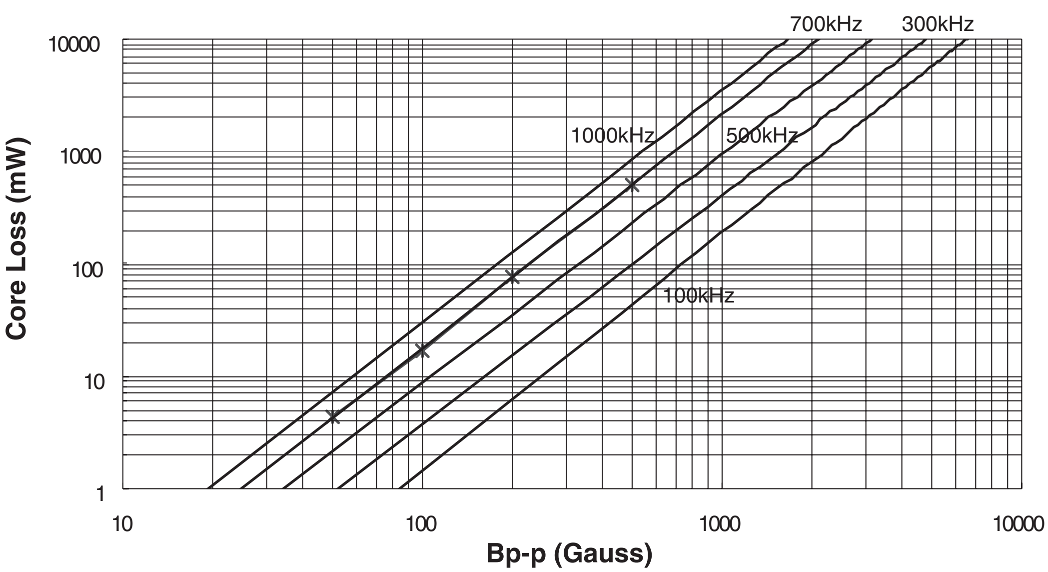


Parts packaged on a 13" Diameter reel.
950 parts per reel.

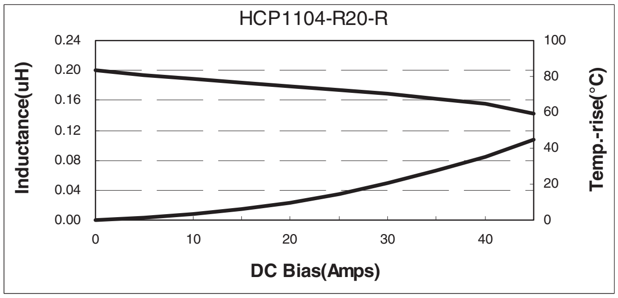
User direction of feed

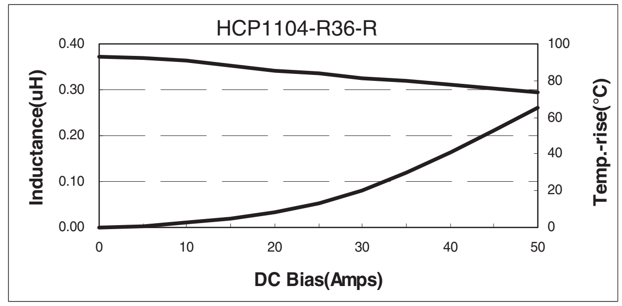
Core Loss

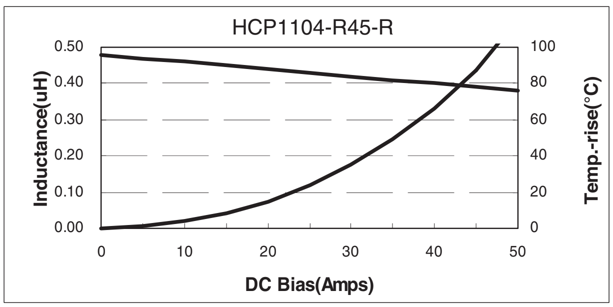
Core Loss vs Bp-p

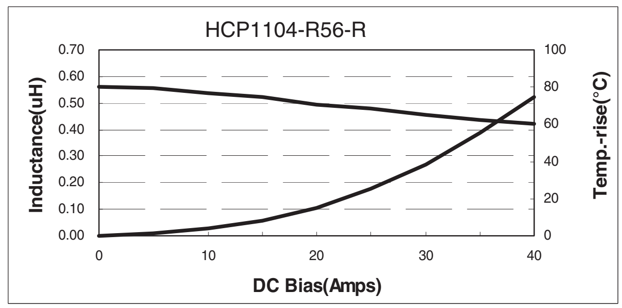


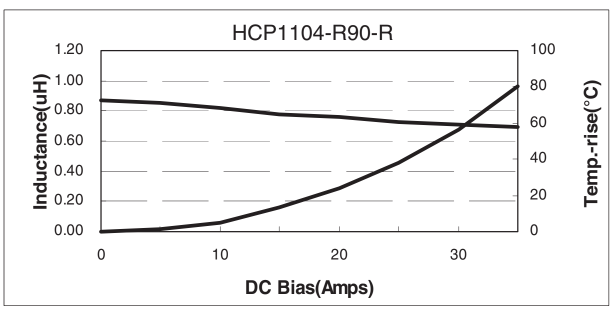
Performance Graphs











COOPER Bussmann

HCP1305 Series
High Current Pressed Power Inductors

Description

RoHS 2002/95/EC

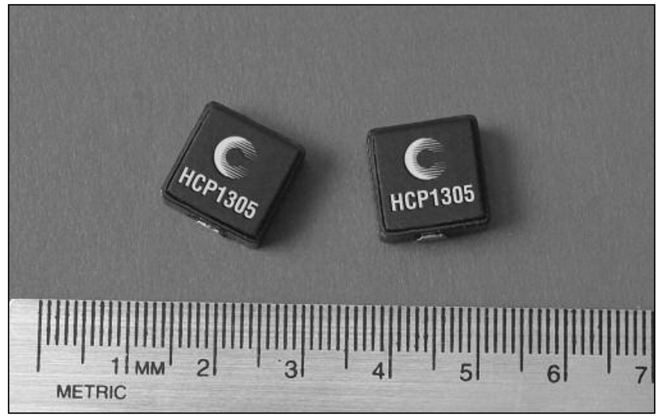
- 125°C maximum temperature operation
- 12.9mm x 13.8mm x 5.0mm surface mount package
- Pressed powder iron core material
- Enhanced core coating eliminates rusting and provides high insulation impedance
- Inductance range from 0.47µH to 2.2µH
- Current range from 65.0 Amps to 20 Amps
- Frequency range up to 1MHz

Applications

- Notebook power
- VRM, multi-phase buck regulator
- DC-DC converters
- PC workstations/Servers/Desktop
- Routers

Environmental Data

- Storage temperature range: -55°C to +125°C
- Operating temperature range: -55°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



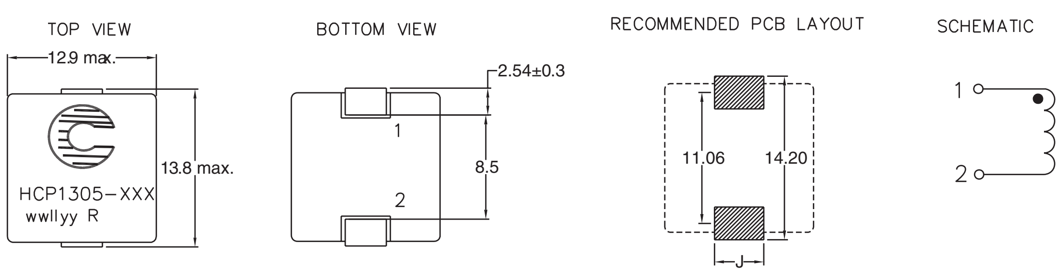
Packaging

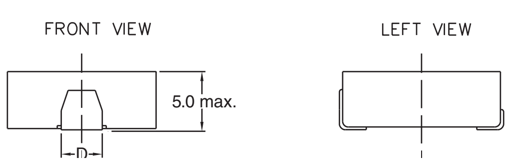
- Supplied in tape and reel packaging, 400 parts per reel

Part Number	Rated Inductance (µH)	OCL (1) µH ± 20%	Irms (2) Amperes	Isat (3) Amperes	DCR mΩ@20°C (Typical)	DCR mΩ@20°C (Maximum)	K-factor (4)
HCP1305-R47-R	0.47	0.47	38	65	1.1	1.3	181
HCP1305-R56-R	0.56	0.56	36	55	1.3	1.5	130
HCP1305-R68-R	0.68	0.68	34	53	1.5	1.7	172
HCP1305-R82-R	0.82	0.82	31	52	2.0	2.3	167
HCP1305-1R0-R	1.0	1.0	29	50	2.1	2.5	134
HCP1305-1R5-R	1.5	1.5	23	48	3.4	4.1	105
HCP1305-2R2-R	2.2	2.2	20	32	4.6	5.5	77

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.25V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 20% rolloff (@20°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p: (Gauss), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).

Mechanical Diagrams

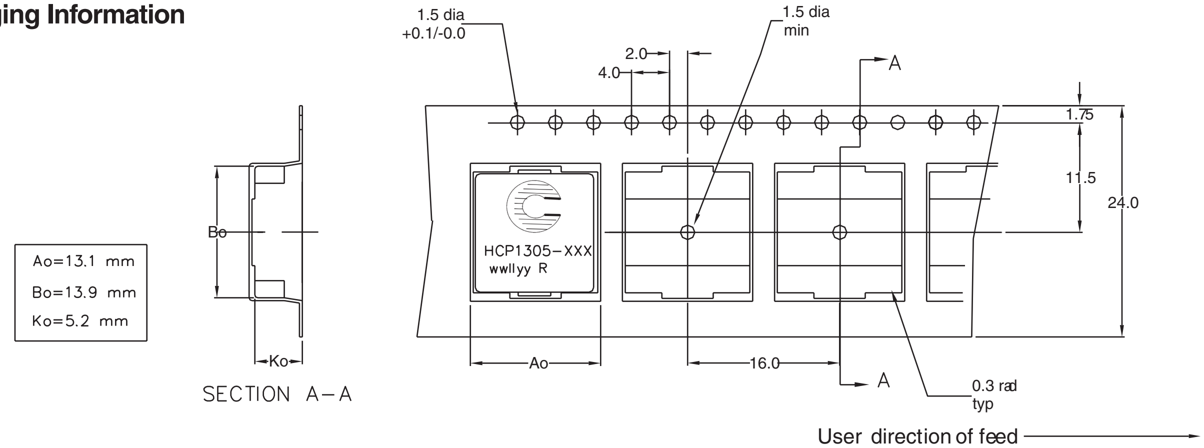




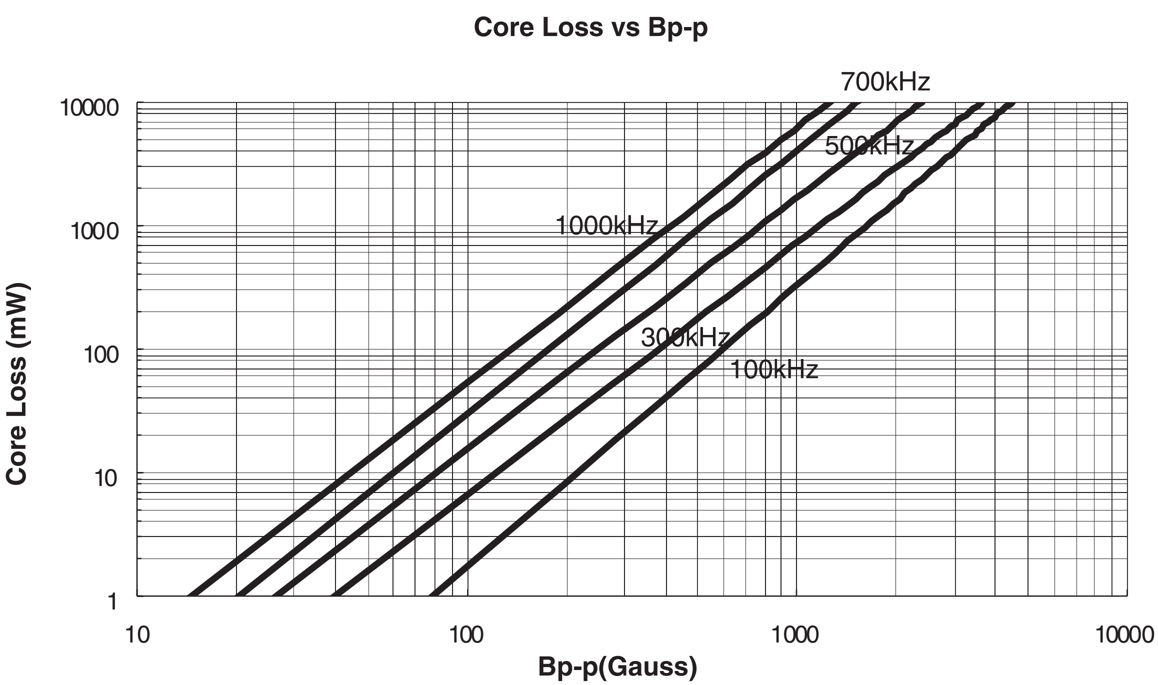
P/N	D Dimension	J Dimension
R47/R56	4.7+/−0.5	5.4 ref.
R68/R82/1R0	3.5+/−0.5	4.2 ref.
1R5/2R2	3.0+/−0.5	3.8 ref.

Dimensions are in millimeters.
wwlly = Date Code. R = Revision Level.

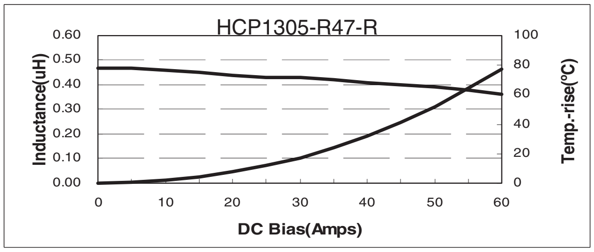
Packaging Information

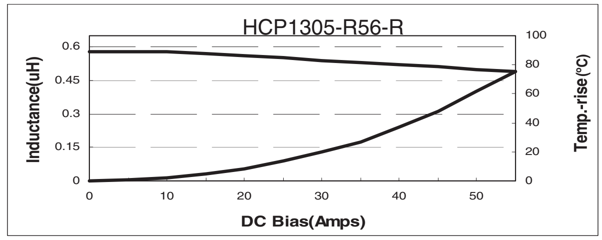


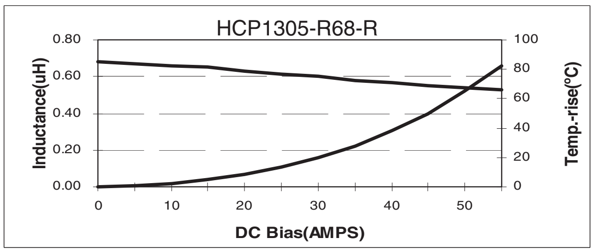
Core Loss

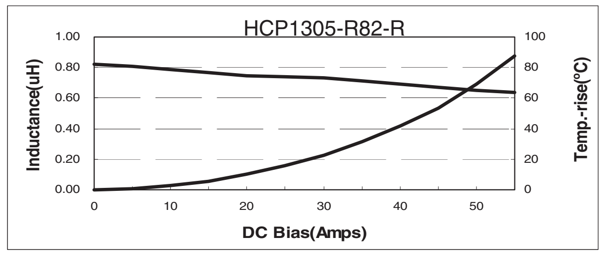


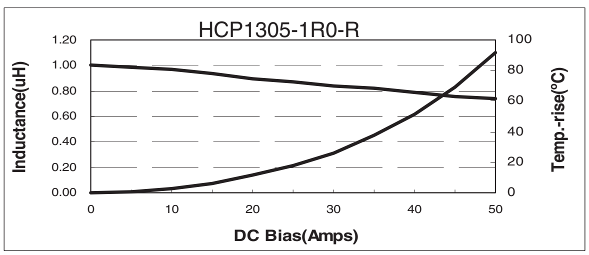
Performance Graphs

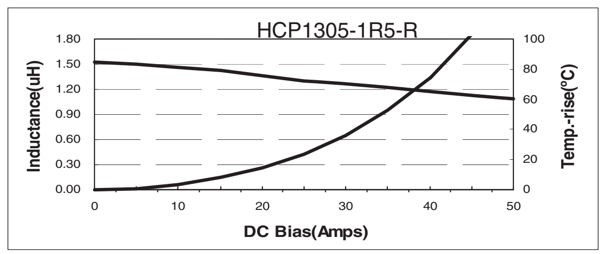


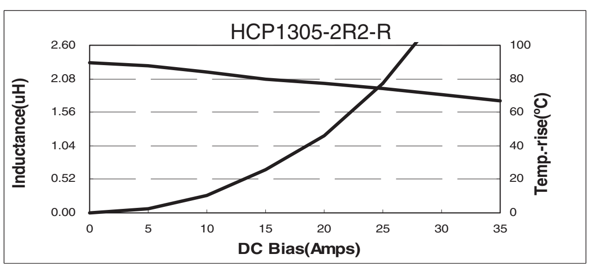












COILTRONICS®

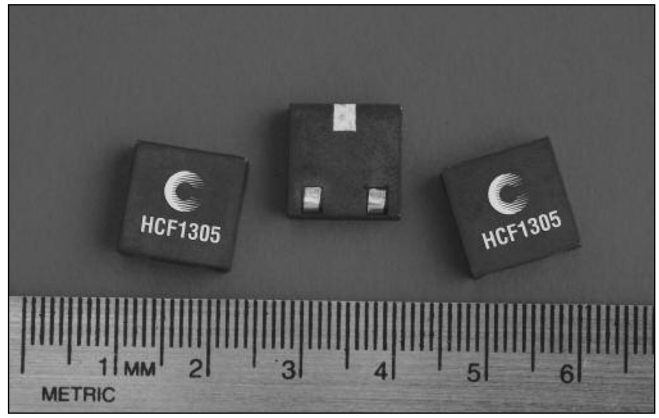
COOPER Bussmann

HCF1305 Series Power Inductors

Description

RoHS 2002/95/EC

- 125°C maximum total temperature operation
- 12.5mm x 12.5mm x 5.0mm ferrite core material package
- Low profile surface mount inductors designed for higher speed switch mode applications requiring low voltage and high current
- Design utilizes ferrite core with high DC bias resistance and low core loss
- Inductance range from 0.47µH to 4.7µH
- Current range from 36.0 Amps to 10.4 Amps
- Frequency range 100kHz to 1MHz



Applications

- Next generation processors
- High current DC-DC converters
- VRM, multi-phase buck regulators
- PC Workstations, Routers, Servers
- Telecom soft switches, Base stations

Packaging

- Supplied in tape and reel packaging, 600 parts per reel

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

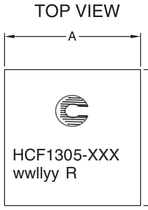
Part Number	Rated Inductance (µH)	OCL (1) µH ± 20%	Irms (2) Amperes	Isat (3) Amperes	Isat2 (4) Amperes	DCR mΩ@20°C (Typical)	DCR mΩ@20°C (Maximum)	K-factor (5)
HCF1305-R47-R	0.47	0.47	32.0	36.0	30.0	0.83	1.00	21
HCF1305-R56-R	0.56	0.56	32.0	30.0	22.5	0.83	1.00	21
HCF1305-1R0-R	1.00	1.00	22.0	24.0	20.0	1.58	1.90	14
HCF1305-1R2-R	1.20	1.20	22.0	20.0	15.0	1.58	1.90	14
HCF1305-1R8-R	1.80	1.80	16.3	18.0	15.0	2.58	3.10	10
HCF1305-2R2-R	2.20	2.20	16.3	15.0	11.2	2.58	3.10	10
HCF1305-3R0-R	3.00	3.00	13.2	14.4	12.0	4.08	4.90	8.3
HCF1305-3R3-R	3.30	3.30	13.2	12.5	9.0	4.08	4.90	8.3
HCF1305-4R0-R	4.00	4.00	10.9	12.0	10.0	6.0	7.2	6.9
HCF1305-4R7-R	4.70	4.70	10.9	10.4	7.5	6.0	7.2	6.9

1) OCL: Open Circuit Inductance test parameters: 100kHz, 0.1Vrms, 0.0Adc. OCL@-40°C can be lower than OCL@20°C by 15% max.
2) Irms: DC current for an approximate DT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
3) Isat1: Amperes Peak for approximately 30% rolloff (@25°C)
4) Isat2: Amperes Peak for approximately 30% rolloff (@125°C)
5) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI B p-p:(mT), K: (K factor from table), L: (Inductance in µH), ΔI (Peak to peak ripple current in Amps).

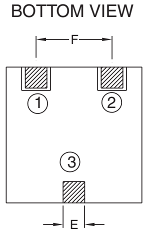
Part number definition:
HCF1305-XXX-R
HCF1305 = Product code and size
XXX = Inductance value in uH.
R = Decimal point. If no R is present, third character = #of zeros
-R suffix indicates RoHS compliant

Mechanical Diagrams

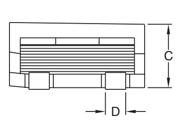
TOP VIEW



BOTTOM VIEW



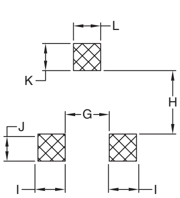
FRONT VIEW



DIMENSION TABLE

A: 12.5max	G: 4.00 Ref
B: 12.5max	H: 5.40 Ref.
C: 5.0max	I: 3.00 Ref.
D: 2.00 ref	J: 4.00 Ref.
E: 2.40 +/- 0.10	K: 4.00 Ref.
F: 6.90 +/- 0.30	L: 3.4 Ref.

RECOMMENDED PCBLAYOUT

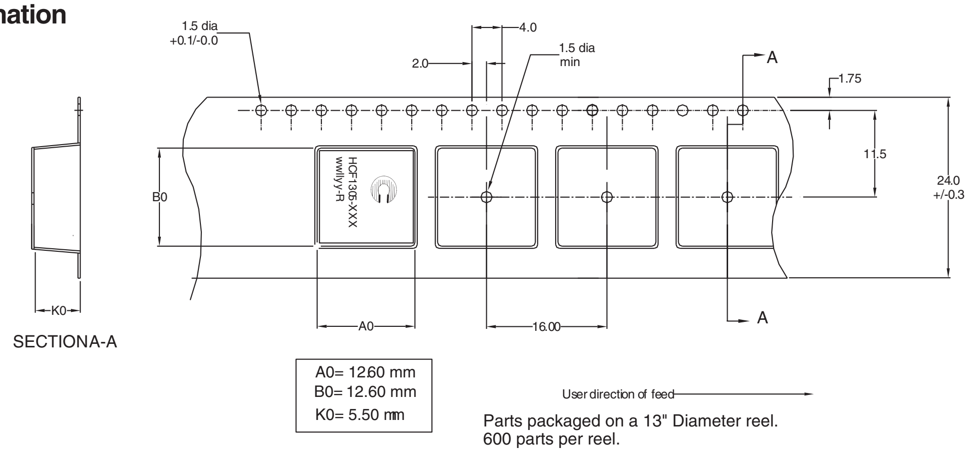


SCHEMATIC

Dimensions in Millimeters

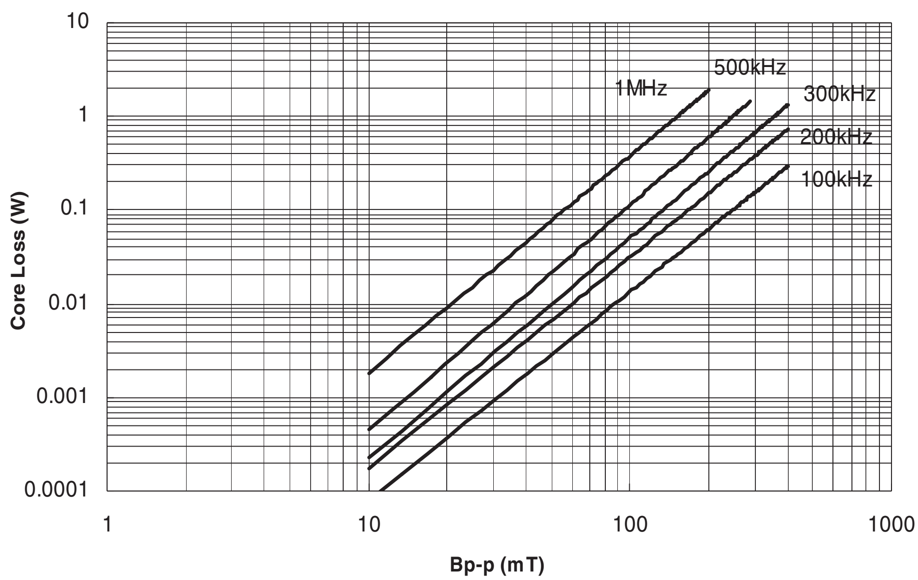
wwllyy=Date code, R=Revision Level

Packaging Information

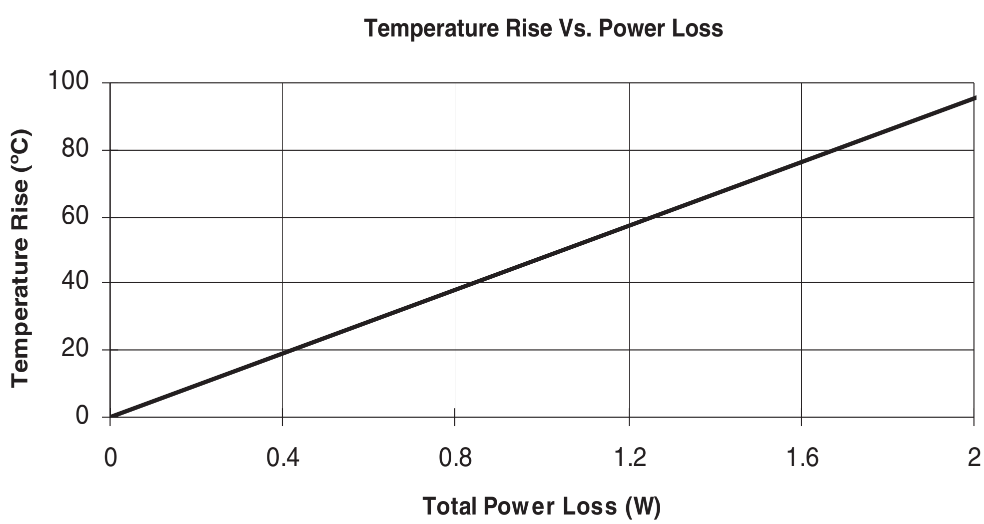


Parts packaged on a 13" Diameter reel.
600 parts per reel.

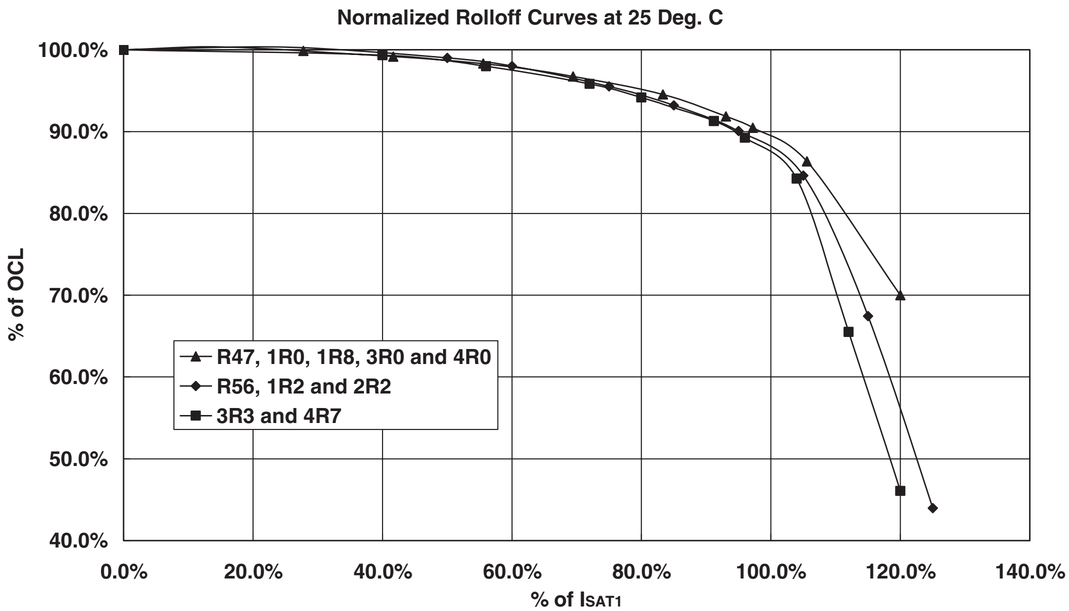
Core Loss

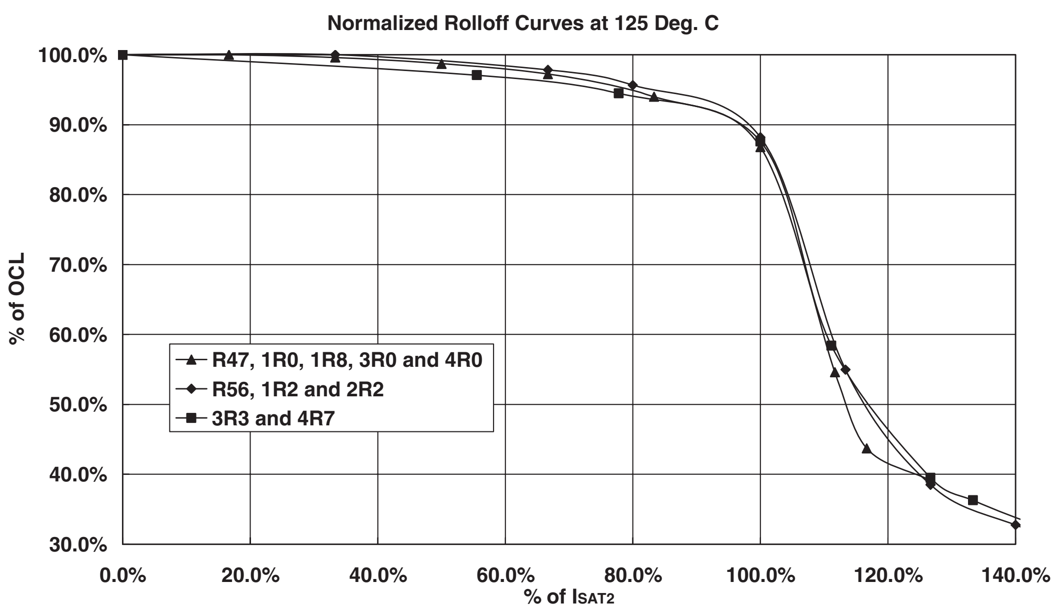


Temperature Rise vs. Total Loss



Inductance Characteristics





HIGH CURRENT 1
Power Inductors

Description

RoHS 2002/95/EC

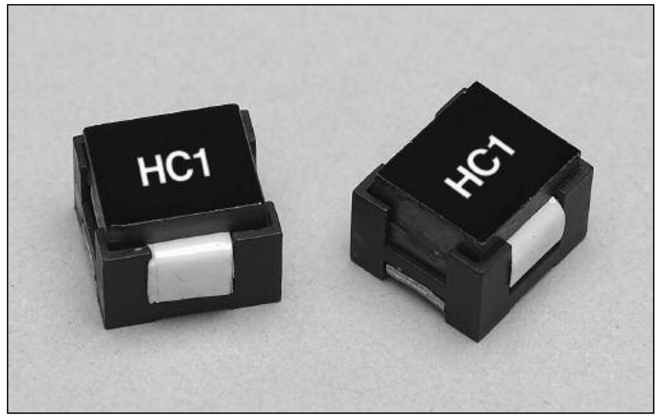
- Designed for high current, low voltage applications
- Low DCR, high efficiency
- Foil construction for higher frequency circuit designs
- Suited for IR and vapor reflow solder
- Frequency range 1kHz to 1MHz
- Ferrite core material

Applications

- Next generation microprocessors
- High current DC-DC converters
- Computers

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific).
- Solder reflow temperature: +260°C max. for 10 seconds max.



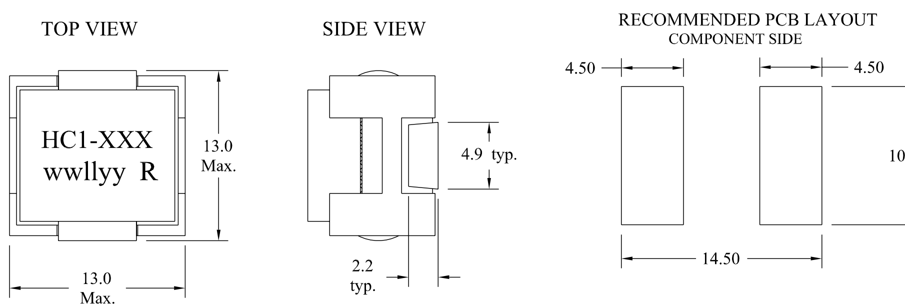
Packaging

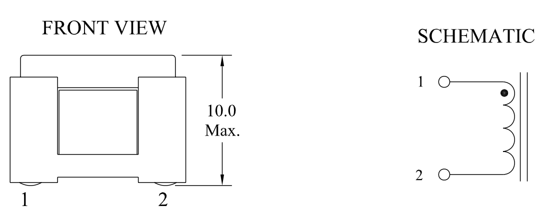
- Supplied in tape and reel packaging, 250 per reel

Part Number	Rated Inductance µH	OCL (1) ± 15% µH	Irms (2) Amperes (Approx.)	Isat (3) Amperes (Approx.)	DCR (Ω) Max. @ 20°C	Volt-µSec (4) (VµS) (ref.)
HC1-R22-R	0.22	0.218	51.42	40.5	0.00036	1.83
HC1-R30-R	0.30	0.291	51.42	31.8	0.00036	1.83
HC1-R57-R	0.57	0.572	37.83	33.4	0.00068	3.66
HC1-R87-R	0.87	0.866	28.01	31.0	0.00123	5.49
HC1-1R0-R	1.0	1.12	28.01	25.4	0.00123	5.49
HC1-1R7-R	1.7	1.66	22.30	22.2	0.0020	7.33
HC1-2R3-R	2.3	2.29	22.30	16.7	0.0020	7.33
HC1-3R6-R	3.6	3.59	16.76	13.4	0.0035	9.16
HC1-5R1-R	5.1	5.15	12.79	11.2	0.0057	10.99
HC1-7R8-R	7.8	7.85	12.79	6.7	0.0057	10.99
HC1-100-R	10	10.5	12.79	5.3	0.0057	10.99

1) OCL (Open Circuit Inductance) Test parameters: 300KHz, .25Vrms, 0.0Adc & Isat.
2) Irms Amperes for approximately ΔT of 40°C. DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
3) Isat Amperes Peak for approximately 30% rolloff @ 20°C
4) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 200kHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise. See Core Loss Graph.
Units supplied in tape & reel packaging; 250 parts on 13" diameter reel.

Mechanical Diagrams

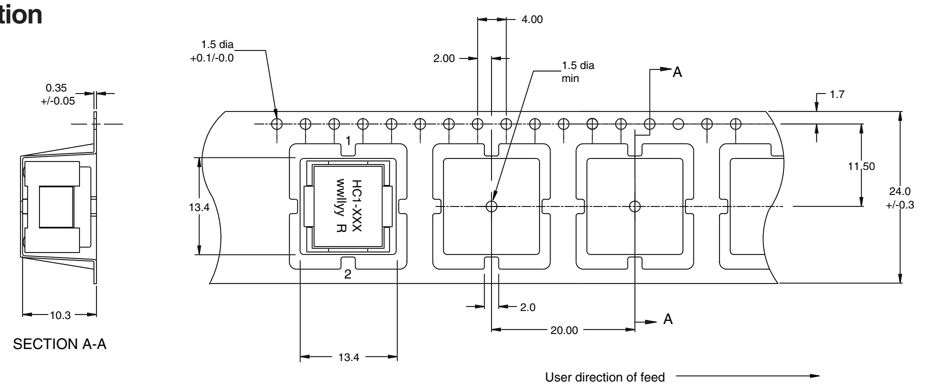




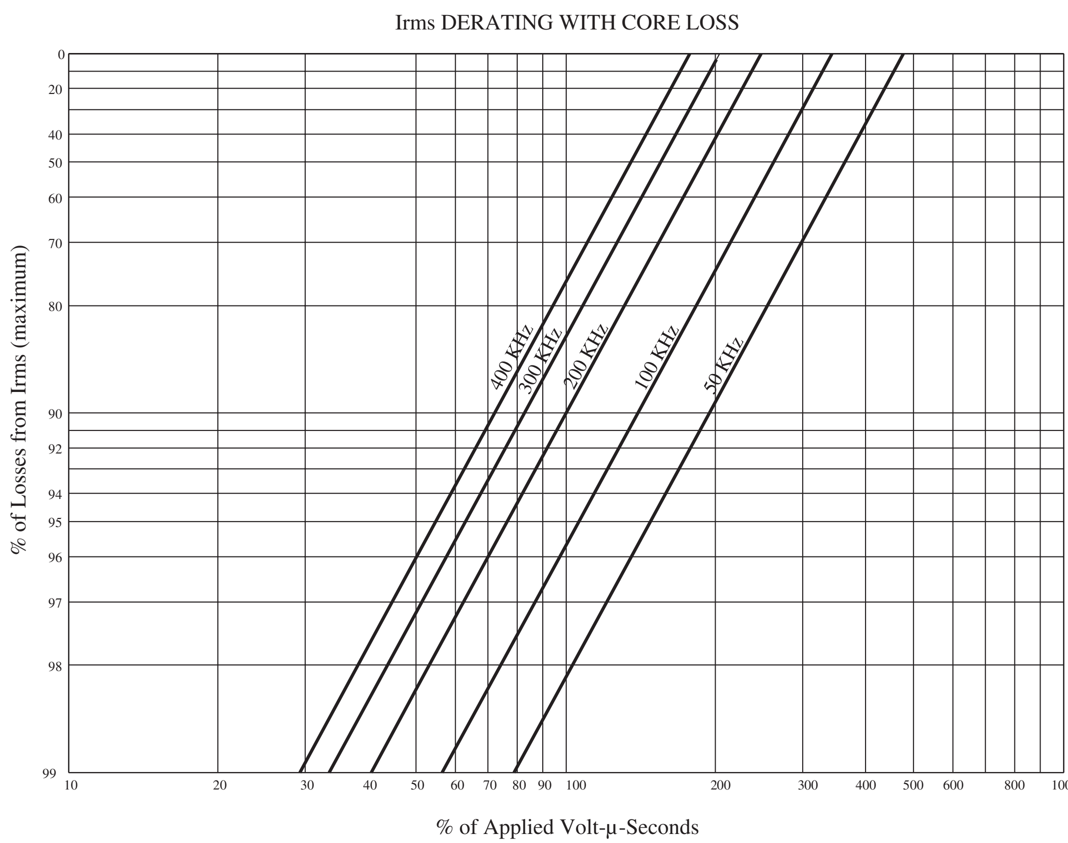
Dimensions in Millimeters

xxx = Inductance value
wwllyy = Date code R = Revision level

Packaging Information

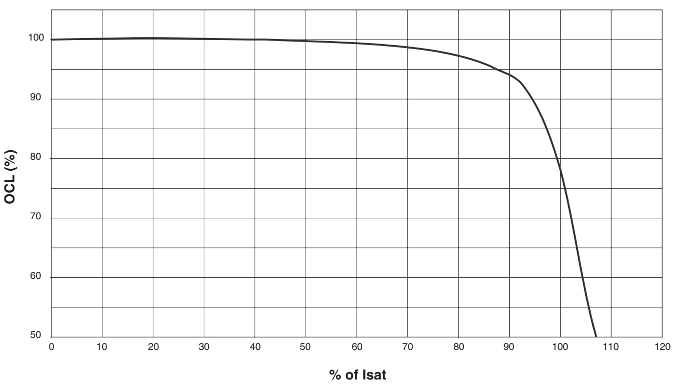


Core Loss

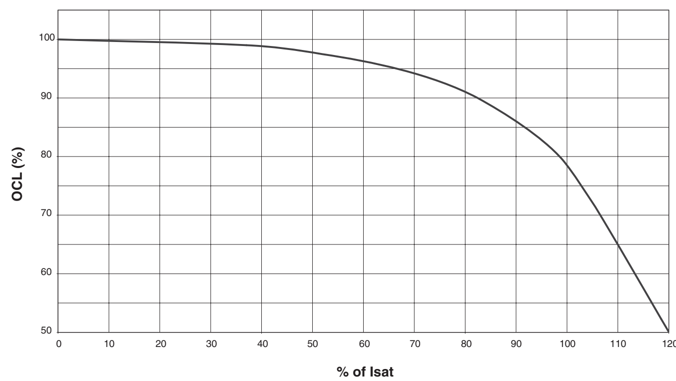


Inductance Characteristics

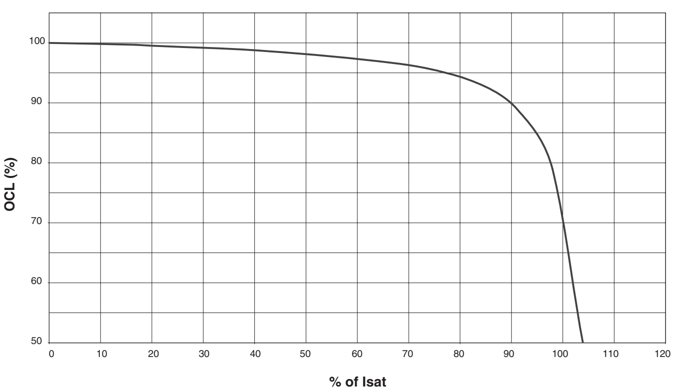
HC1 Inductor (R87)



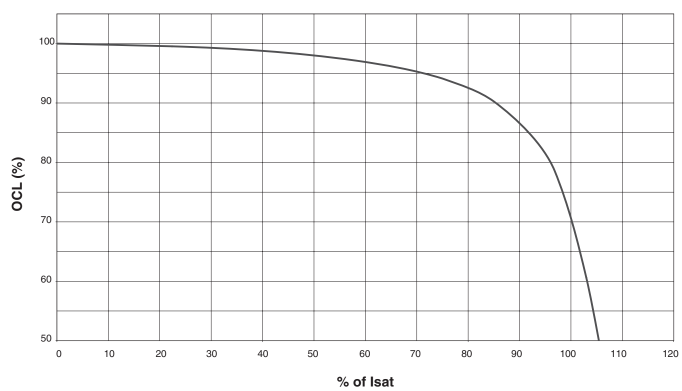
HC1 Inductor (R22, 7R8)



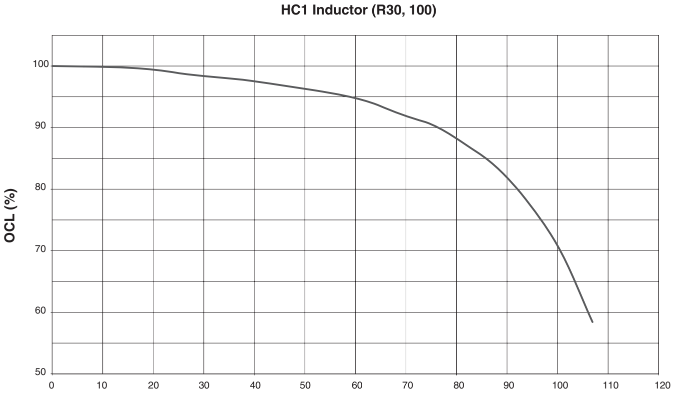
HC1 Inductor (1R7)



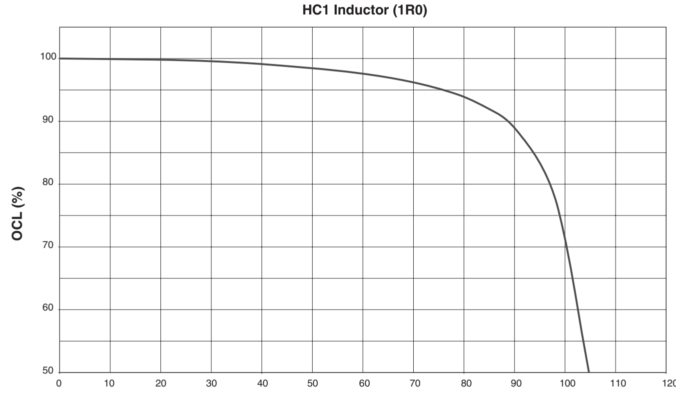
HC1 Inductor (R57, 2R3, 3R6, 5R1)



HC1 Inductor (R30, 100)



HC1 Inductor (1R0)



COOPER Bussmann

HIGH CURRENT 2LP
Low Profile Power Inductors

Description

RoHS 2002/95/EC

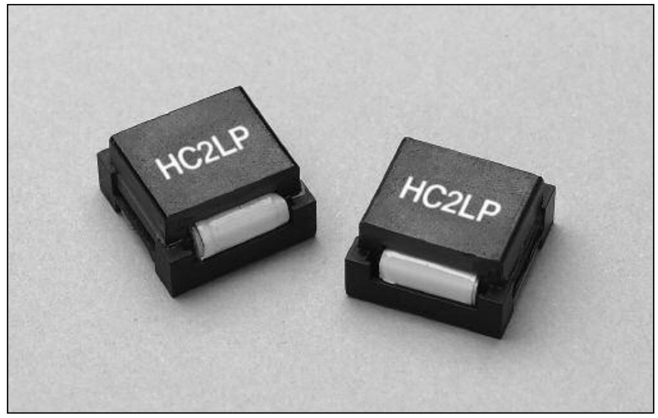
- Compact footprint for high density, high current/low voltage applications
- Foil technology that adds higher reliability factor over the traditional magnet wire used for higher frequency circuit designs
- Frequency Range up to 1MHz
- Ferrite core material

Applications

- Next generation microprocessors
- Energy storage applications
- DC-DC converters
- Computers

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific).
- Solder reflow temperature: +260°C max. for 10 seconds max.



Packaging

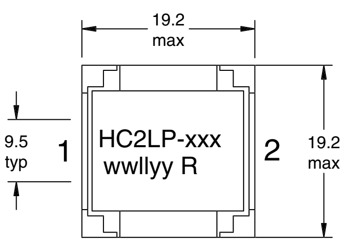
- Supplied in tape and reel packaging, 44mm width, 130 parts per 13" reel

Part Number	Rated Inductance µH	OCL (1) µH ± 20%	Irms (2) Amperes (Typ.)	Isat (3) Amperes (Typ.)	DCR (4) Ohms (Max.)	Volts (5) µSec
HC2LP-R47-R	.47	.52	52.9	63.75	.0006	6.87
HC2LP-R68-R	.68	.63	52.9	50.00	.0006	6.87
HC2LP-1R0-R	1.0	1.15	33.0	42.50	.0013	10.31
HC2LP-2R2-R	2.2	2.00	24.3	31.90	.0023	13.75
HC2LP-4R7-R	4.7	4.55	17.0	21.25	.0046	20.62
HC2LP-6R0-R	6.0	6.00	17.0	16.50	.0046	20.62

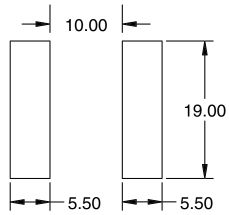
1) Open Circuit Inductance Test Parameters: 300kHz, 0.250 Vrms, 0.0 Adc
2) DC current for an approximate temperature change of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
3) Peak current for approximately 30% roll-off
4) Values @ 20°C
5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 300KHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.

Mechanical Diagrams

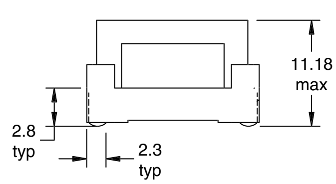
TOP VIEW



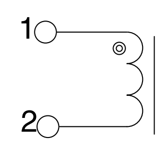
RECOMMENDED PCB PAD LAYOUT



FRONT VIEW

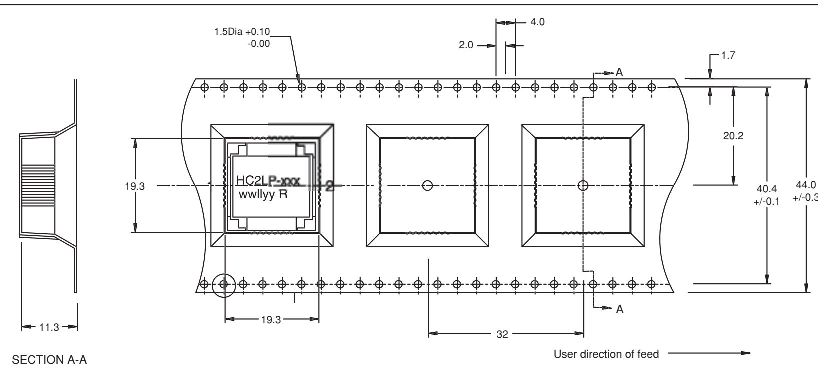


SCHEMATIC



xxx = Inductance value
wwllyy = Date code R = Revision level

Packaging Information

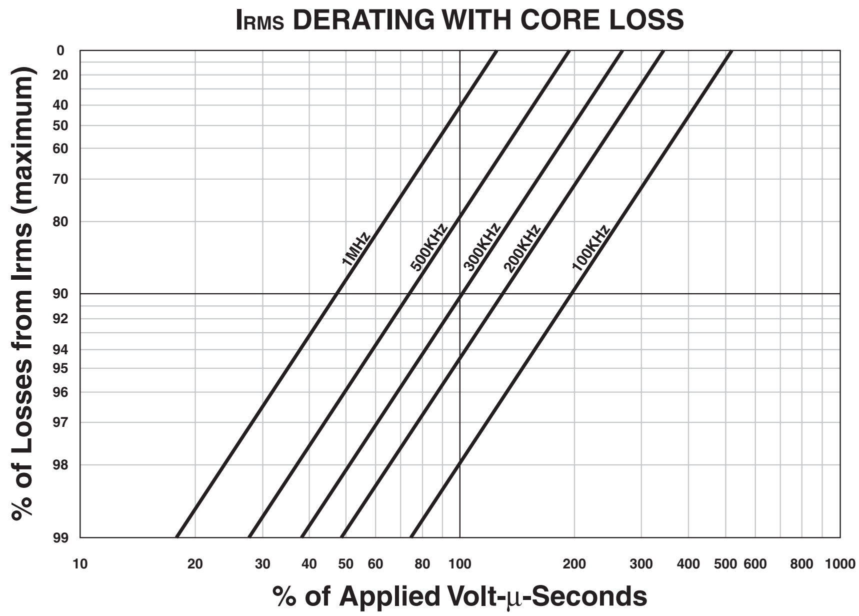


Dimensions in Millimeters

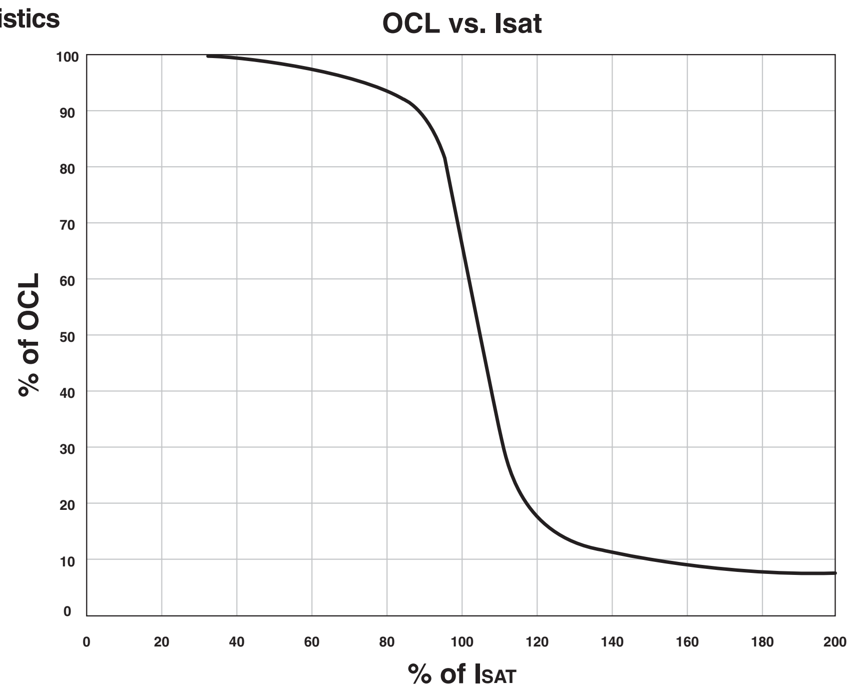
Parts packaged on 13" Diameter reel, 130 parts per reel.

HIGH CURRENT (HC2LP)

Core Loss



Inductance Characteristics



COILTRONICS®

COOPER Bussmann

HC3 Series
HIGH CURRENT 3
Power Inductors

RoHS 2002/95/EC

Description

- High Density, high current/low voltage applications
- Foil technology that adds higher reliability factor over the traditional magnet wire used for higher frequency circuit designs
- Current range from 78.0 to 33.8 Amps
- Inductance range from 0.50uH to 6.52uH
- Ferrite core material

Applications

- Next generation microprocessors
- Energy storage applications
- DC-DC converters
- Computers

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging

- Supplied in bulk packaging, 24 parts per tray

HIGH CURRENT (HC3)

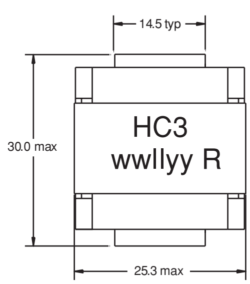
Part Number	Rated Inductance µH	OCL (1) nominal +/-20% µH	Irms (2) Amperes (Typ.)	Isat (3) Amperes (Typ.)	DCR (mΩ) max. @ 20°C	Volts (4) µSec (VµS) (ref.)
HC3-R50-R	0.50	0.50	78.00	120	0.42	17.33
HC3-1R0-R	1.0	1.05	78.00	78	0.42	17.33
HC3-2R2-R	2.2	2.05	55.50	60	0.70	26.01
HC3-3R3-R	3.3	3.63	42.45	46	1.20	34.65
HC3-4R7-R	4.7	4.98	33.80	38	2.17	43.30
HC3-5R6-R	5.6	5.68	33.80	34.5	2.17	43.30
HC3-6R0-R	6.0	6.52	33.80	30.0	2.17	43.30

1) Test Parameters: 300kHz, 0.25 Vrms
2) DC current for approximately ΔT of 40°C without core loss
   De-rating is necessary for AC currents. PCB layout, trace thickness and width, air flow and proximity of other heat generating components will affect temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case conditions verified in the end application.
3) Peak current for approximately 30% rolloff (@20°C)
4) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 300kHz necessary to generate a core loss equal to 10% of the total losses for a 40°C temperature rise.

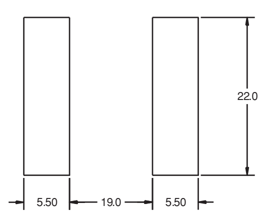
Part number definition:
HC3-XXX-R
HC3 = Product code and size
XXX = Inductance value in uH.
R = Decimal point. If no R is present, third character = #of zeros
-R suffix indicates RoHS compliant

Mechanical Diagrams

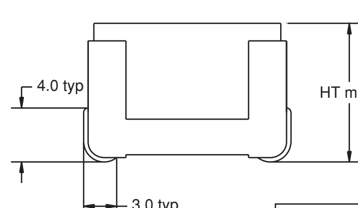
TOP VIEW



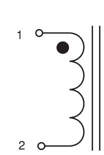
RECOMMENDED PCB PAD LAYOUT



FRONT VIEW



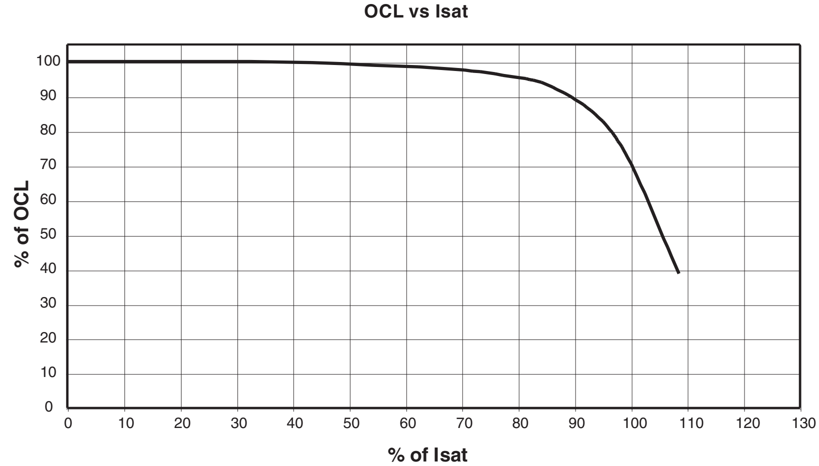
SCHEMATIC



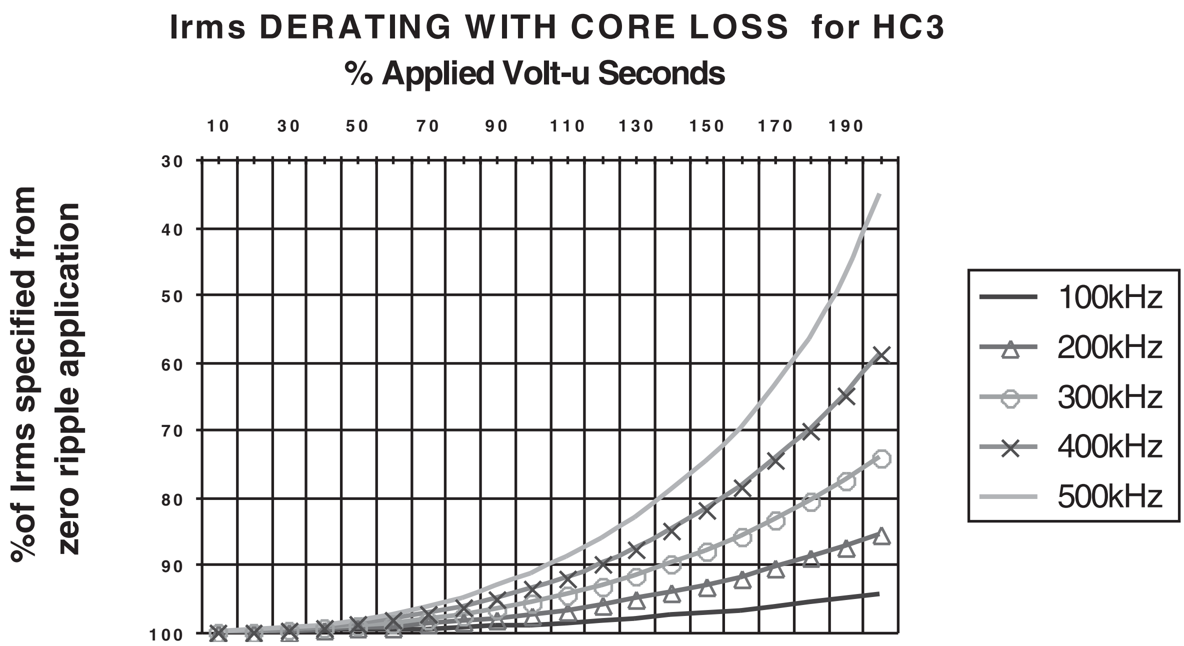
Part Number	Height max
HC3-R50-R	18.0
HC3-1R0-R	17.5
HC3-2R2-R	17.5
HC3-3R3-R	17.5
HC3-4R7-R	17.5
HC3-5R6-R	17.5
HC3-6R0-R	17.5

wwllyy = Date code R = Revision level

Inductance Characteristics



Core Loss



COILTRONICS®

COOPER Bussmann

HC7 Series
HIGH CURRENT 7
Power Inductors

Description

RoHS 2002/95/EC

- 155°C maximum total temperature operation
- Surface mount inductors designed for higher speed switch mode applications requiring lower inductance, low voltage and high current
- Design utilizes high temperature powder iron material with a non-organic binder to eliminate thermal aging
- Inductance range from 0.22 uH to 4.81 uH
- Current range from 35.8 to 9.8 Amps
- Frequency range 1kHz to 500kHz

Applications

- Next generation microprocessors
- High current DC-DC converters
- VRM, multi-phase buck regulator
- PC, Workstations, Routers
- Telecom soft switches, Base Stations

Environmental Data

- Storage temperature range: -40°C to +155°C
- Operating ambient temperature range: -40°C to +155°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging

- Supplied in tape and reel packaging, 610 parts per reel

Part Number	Rated Inductance µH	OCL (1) nominal +/-20% µH	Irms (2) Amperes (Typ.)	Isat (3) Amperes 15% rolloff	Isat (4) Amperes 30% rolloff	DCR (mΩ) max. @ 20°C	Volts (5) µSec (VµS)
HC7-R20-R	.20	0.220	35.80	45.8	86.5	0.67	2.27
HC7-R47-R	.47	0.534	23.40	27.5	51.9	1.60	3.83
HC7-1R0-R	1.0	1.05	20.30	19.6	37.1	2.10	5.36
HC7-1R5-R	1.5	1.73	14.20	15.3	28.8	4.30	6.90
HC7-2R2-R	2.2	2.58	13.00	12.5	23.6	5.20	8.40
HC7-3R9-R	3.9	3.61	10.40	10.6	20.0	7.90	10.0
HC7-4R7-R	4.7	4.81	9.80	9.2	17.3	9.00	12.6

1) Test Parameters: 100KHz, 1.0Vrms
2) Irms Amperes for approximately ΔT of 40°C above 85°C ambient
3) Isat Amperes Peak for approximately 15% rolloff (@20°C)
4) Isat Amperes Peak for approximately 30% rolloff (@20°C)
5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at operating frequency necessary to generate additional core loss which contributes to the 40°C temperature rise. De-rating of the Irms is required to prevent excessive temperature rise. The 100% V-uS rating is equivalent to a ripple current Ip-p of 20% of Isat (30% rolloff option).

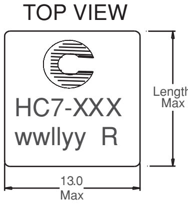
It is recommended that the temperature of the part not exceed 155°C under worst case operating conditions verified in the end application.

Units supplied in tape and reel packaging. 13" reels 610 parts per reel. Carrier tape width = 24 mm. Meets EIA standard

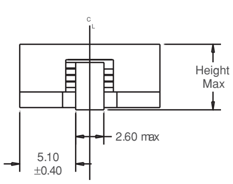
Part number definition:
HC7-XXX-R
HC7 = Product code and size
XXX = Inductance value in uH.
R = Decimal point. If no R is present, third character = #of zeros
-R suffix indicates RoHS compliant

Mechanical Diagrams

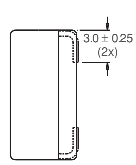
TOP VIEW



FRONT VIEW



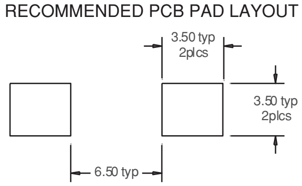
SIDE VIEW



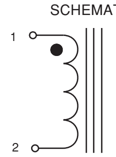
Maximum Dimension

Part Number	Height mm	Length mm
HC7-R20-R	6.0	14.25
HC7-R47-R	5.5	13.8
HC7-1R0-R	5.5	13.8
HC7-1R5-R	5.5	13.8
HC7-2R2-R	5.5	13.8
HC7-3R9-R	5.5	13.8
HC7-4R7-R	5.5	13.8

RECOMMENDED PCB PAD LAYOUT



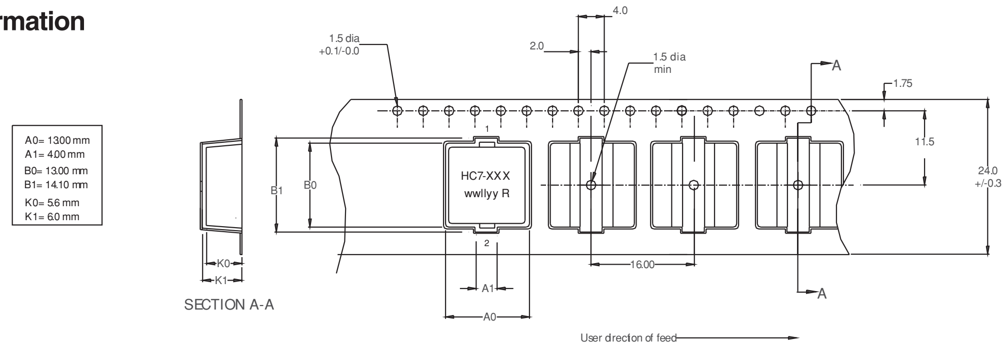
SCHEMATIC



Dimensions in Millimeters.
All dimensions I+/- 0.2 mm unless otherwise specified.
All soldering surfaces are coplanar within 0.15 mm.

wwllyy = Date code R = Revision level

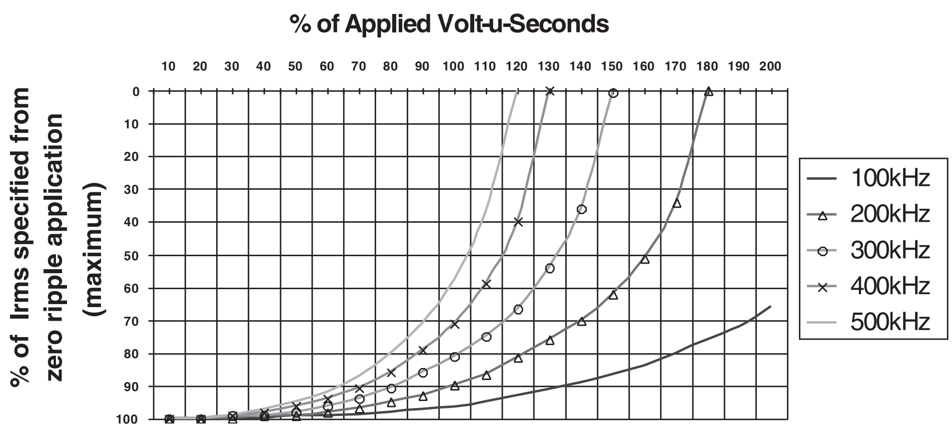
Packaging Information



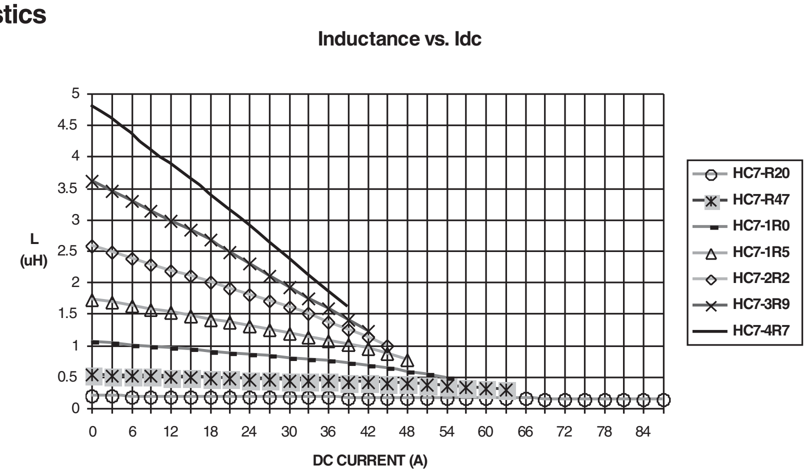
Dimensions in Millimeters

Core Loss

Irms DERATING WITH CORE LOSS



Inductance Characteristics



HC8 Series HIGH CURRENT 8 Power Inductors

Description

RoHS 2002/95/EC

- Surface mount inductors, 4.0mm height, designed for higher speed switch mode applications requiring low voltage and high current
- 155°C maximum total operating temperature
- Design utilizes high temperature powder iron material with a non-organic binder to eliminate thermal aging
- Inductance offering expanded for applications requiring higher inductance.
- Inductance Range from 0.175 uH to 47.3 uH
- Current Range from 39.0 to 2.4 Amps
- Frequency Range 1kHz to 500kHz

Applications

- Next generation microprocessors
- High current DC-DC converters
- VRM, multi-phase buck regulator
- PC, Workstations, Routers
- Telecom soft switches, Base Stations

Environmental Data

- Storage temperature range: -40°C to +155°C
- Operating ambient temperature range: -40°C to +155°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging

- Supplied in tape and reel packaging, 800 parts per reel

Part Number	Rated Inductance µH	OCL (1) nominal +/-20% µH	Irms (2) Amperes (Typ.)	Isat (3) Amperes 15% rolloff	Isat (4) Amperes 30% rolloff	DCR (mΩ) max. @ 20°C	Volts (5) µSec (VµS) (ref.)
HC8-R15-R	0.15	0.175	39.0	43	76	0.80	1.5
HC8-R39-R	0.39	0.390	28.3	26	45	1.55	2.5
HC8-R75-R	0.75	0.766	18.8	18.5	32.7	3.40	3.5
HC8-1R2-R	1.2	1.32	16.0	14.4	25.5	4.70	4.5
HC8-1R9-R	1.9	1.90	12.4	11.8	20.9	7.7	5.5
HC8-2R6-R	2.6	2.65	10.2	10.0	17.7	11.4	6.5
HC8-3R5-R	3.5	3.52	8.50	8.7	15.3	16.5	7.5
HC8-4R5-R	4.5	4.52	8.00	7.7	13.5	18.6	8.5
HC8-5R6-R	5.6	5.65	6.70	6.9	12.1	26.3	9.5
HC8-6R9-R	6.9	6.90	6.40	6.2	10.9	28.9	10.5
HC8-8R2-R	8.2	8.27	5.50	5.7	10.0	39.6	11.5
HC8-100-R	10.0	9.77	5.20	5.2	9.2	43.6	12.5
HC8-150-R	15.0	15.02	4.10	4.2	7.4	68.6	15.5
HC8-220-R	22.0	21.40	3.40	3.5	6.2	99.5	18.6
HC8-330-R	33.0	31.65	2.70	2.9	5.1	154	22.6
HC8-470-R	47.0	47.28	2.20	2.4	4.2	237	27.6

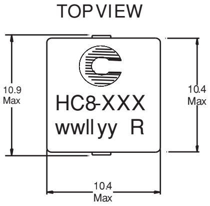
1) Test Parameters: 100KHz, 1.0Vrms
2) Irms Amperes for approximately ΔT of 40°C above 85°C ambient
3) Isat Amperes Peak for approximately 15% rolloff (@20°C)
4) Isat Amperes Peak for approximately 30% rolloff (@20°C)
5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at operating frequency necessary to generate additional core loss which contributes to the 40°C temperature rise. De-rating of the Irms is required to prevent excessive temperature rise. The 100% V-uS rating is equivalent to a ripple current Ip-p of 20% of Isat (30% rolloff option).

It is recommended that the temperature of the part not exceed 155°C under worst case operating conditions verified in the end application.

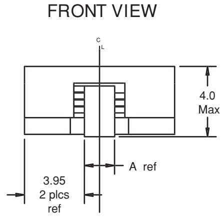
Part number definition:
HC8-XXX-R
HC8 = Product code and size
XXX = Inductance value in uH.
R = Decimal point. If no R is present, third character = #of zeros
-R suffix indicates RoHS compliant

Mechanical Diagrams

TOP VIEW



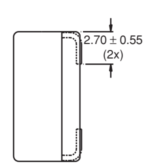
FRONT VIEW



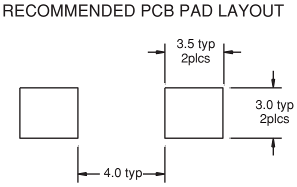
FRONT VIEW TABLE

PN	A mm
R15	2.1
R39	2.1
R75	2.1
1R	2.1
1R9 thru 470	2.7

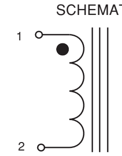
SIDE VIEW



RECOMMENDED PCB PAD LAYOUT



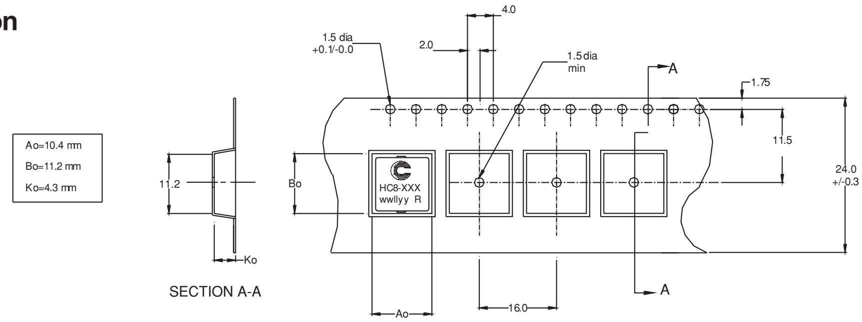
SCHEMATIC



wwllyy = Date code R = Revision level
xxx = Inductance value

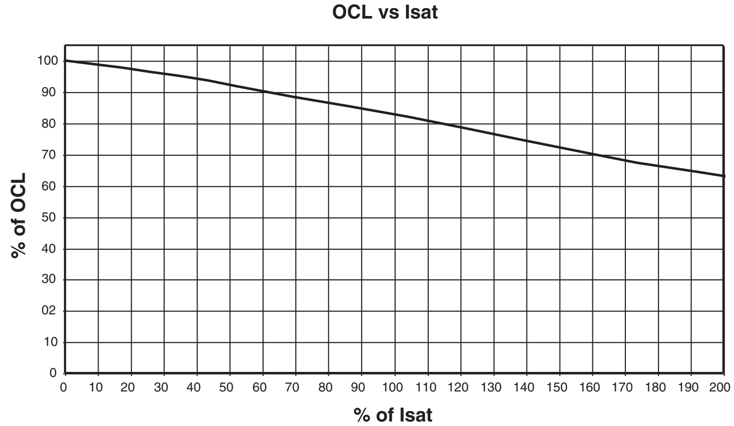
HIGH CURRENT (HC8)

Packaging Information

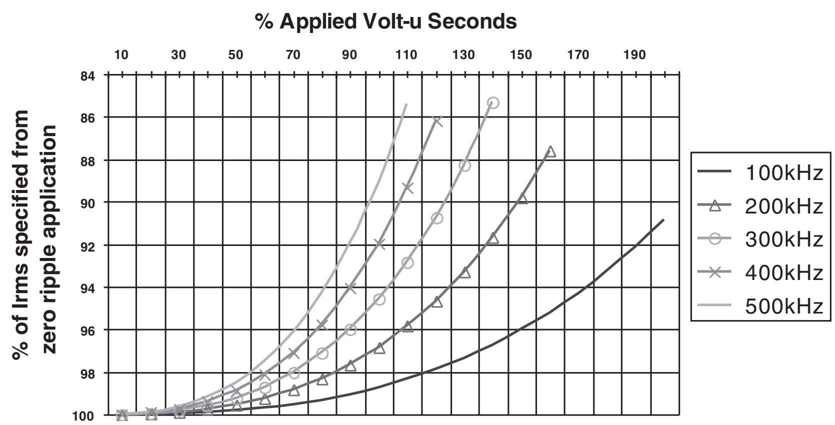


Dimensions in Millimeters

Inductance Characteristics



Core Loss



COOPER Bussmann

HC8LP Series Power Inductors

Description

RoHS 2002/95/EC

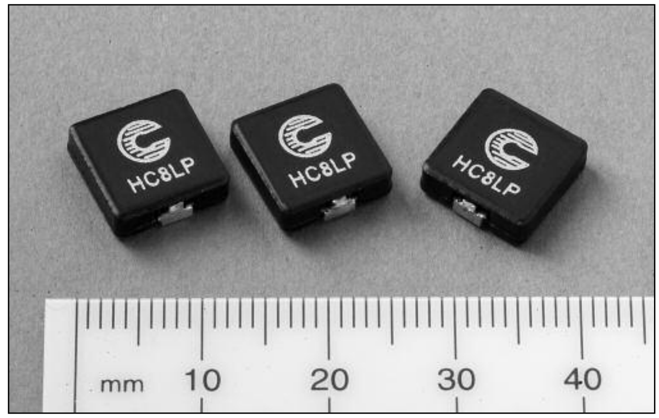
- 155°C maximum temperature operation
- Low profile surface mount inductors designed for higher speed switch mode applications requiring low voltage, and high current
- Design utilizes high temperature powder iron material with a non-organic binder to eliminate thermal aging
- Inductance range from 0.17 uH to 47.9 uH
- Current range from 29 Amps to 1.8 Amps
- Frequency range 1kHz to 500kHz

Applications

- Next generation processors
- High current DC-DC converters
- VRM, multi-phase buck regulator
- PC Workstations, Routers, Servers
- Telecom soft switches, Base stations

Environmental Data

- Storage temperature range: -40°C to +155°C
- Operating temperature range: -40°C to +155°C (Range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds max.



Packaging

- Supplied in tape and reel packaging, 800 parts per reel

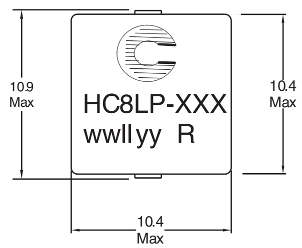
Part Number	Rated Inductance µH	OCL (1) nominal +/-20% µH	Irms (2) Amperes (Typ.)	Isat (3) Amperes 15% rolloff	Isat (4) Amperes 30% rolloff	DCR (mΩ) max. @ 20°C	Volts (5) µSec (VµS) (ref.)
HC8LP-R15-R	0.15	0.170	29.0	31	56	1.40	7.8
HC8LP-R39-R	0.39	0.430	20.2	19	34	2.80	4.7
HC8LP-R75-R	0.75	0.830	15.6	13.5	24	4.70	3.4
HC8LP-1R2-R	1.2	1.35	12.4	10.1	18.7	7.50	2.6
HC8LP-1R9-R	1.9	1.92	10.1	8.7	15.5	11.5	4.1
HC8LP-2R6-R	2.6	2.67	8.3	7.4	13.1	17.1	4.8
HC8LP-3R5-R	3.5	3.56	6.9	6.4	11.4	24.5	5.6
HC8LP-4R5-R	4.5	4.57	6.5	5.6	10.0	27.6	6.3
HC8LP-5R6-R	5.6	5.71	5.5	5.1	9.0	38.9	7.1
HC8LP-6R9-R	6.9	6.98	5.2	4.6	8.1	42.8	7.8
HC8LP-8R2-R	8.2	8.37	4.5	4.2	7.4	58.0	8.6
HC8LP-100-R	10.0	9.90	4.3	6.8	3.8	62.9	9.3
HC8LP-150-R	15.0	15.20	3.4	3.1	5.5	99.4	11.6
HC8LP-220-R	22.0	21.70	2.8	2.6	4.6	149	13.7
HC8LP-330-R	33.0	32.10	2.3	2.1	3.8	224	16.8
HC8LP-470-R	47.0	47.90	1.8	1.7	3.1	344	20.3

1) Open Circuit Inductance test parameters: 100KHz, 1.0V, 0.0Adc
2) Irms: DC current for an approximate DT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 155°C under worst case operating conditions verified in the end application.
3) Isat Amperes Peak for approximately 15% rolloff (@20°C)
4) Isat Amperes Peak for approximately 30% rolloff (@20°C)
5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at operating frequency necessary to generate additional core loss which contributes to the 40°C temperature rise. De-rating of the Irms is required to prevent excessive temperature rise. The 100% V-uS rating is equivalent to a ripple current Ip-p of 20% of Isat (30% rolloff option).

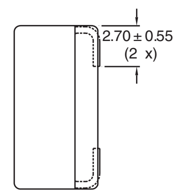
Part number definition:
HC8LP-xxx-R
HC8LP = Product code and size
xxx = Inductance in µH. R = decimal point.
If no R is present third character = # of zeros.
-R suffix indicates RoHS compliant

Mechanical Diagrams

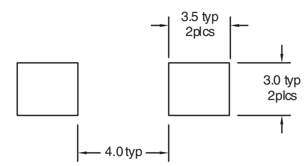
TOP VIEW



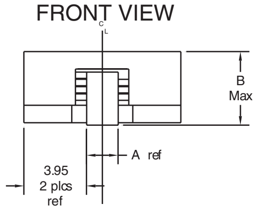
SIDE VIEW



RECOMMENDED PCB PAD LAYOUT



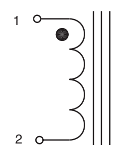
FRONT VIEW



FRONT VIEW
Dimesional Table

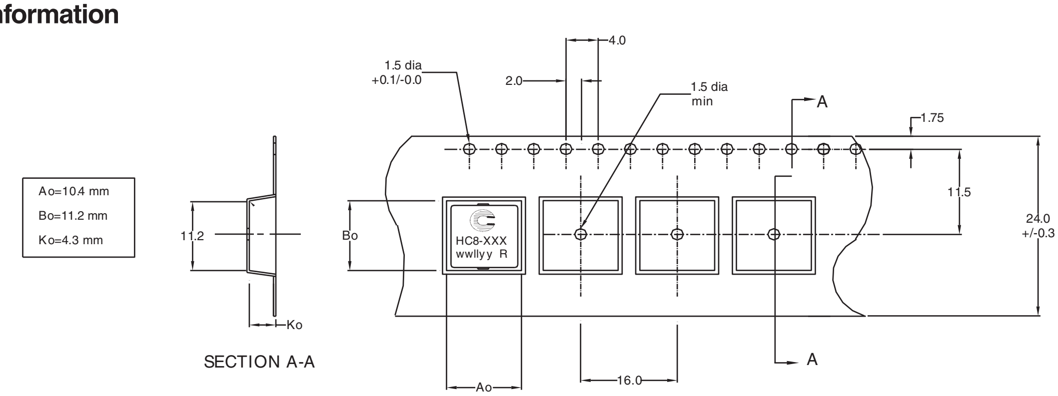
PN	A ref mm	B max mm
R15	2.1	3.5
R39	2.1	3.5
R75	2.1	3.5
1R2	2.1	3.3
1R9 thru 470	2.7	3.5

SCHEMATIC



Dimensions in Millimeters
wwllyy = Date Code, R = Revision Level

Packaging Information

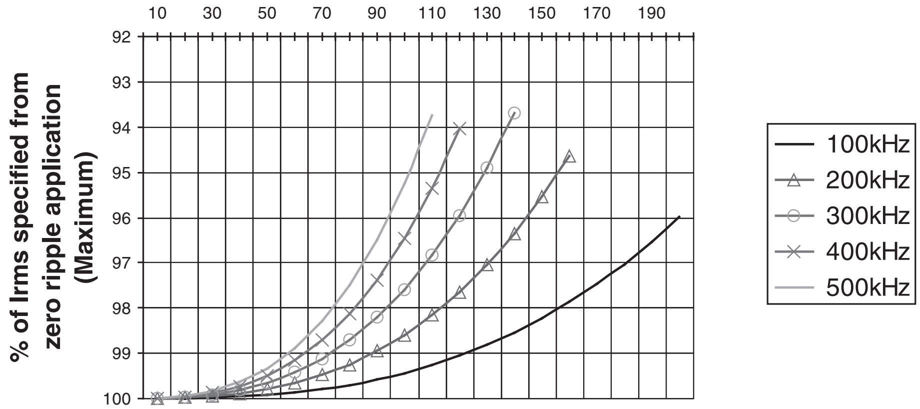


User direction of feed

Packaging Information:
Parts packaged on a
13" Dia. EIA-481 compliant reel.
800 parts per reel.

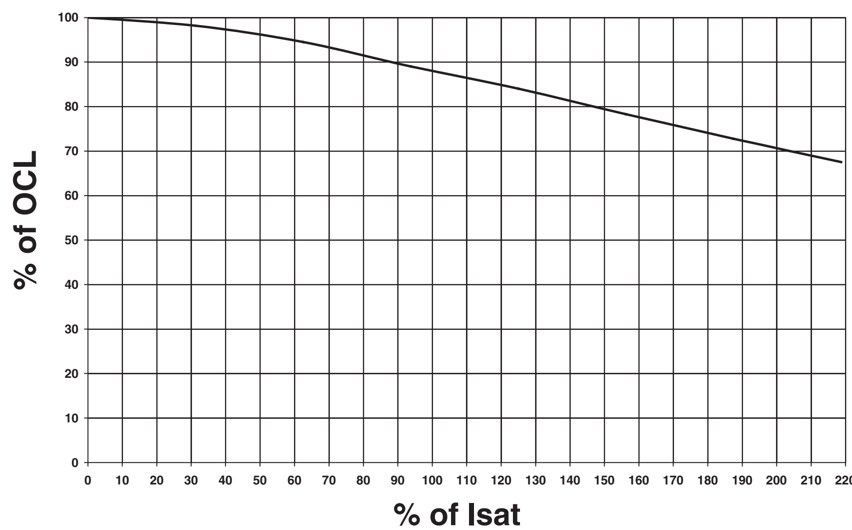
Core Loss

Irms DERATING WITH CORE LOSS



Rolloff

OCL vs Isat



HIGH CURRENT (HC8LP)

HC9 Series HIGH CURRENT 9 Power Inductors

Description

RoHS 2002/95/EC

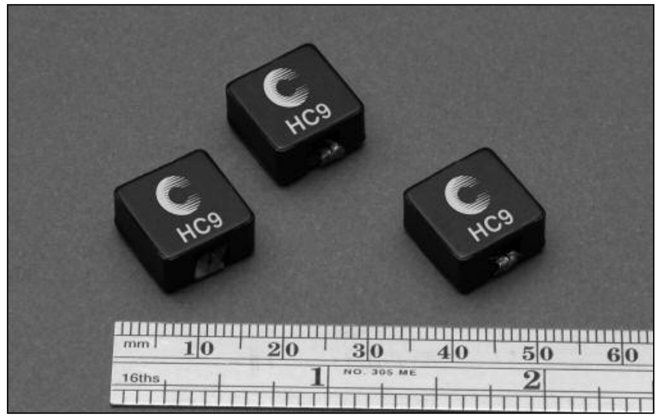
- 155°C maximum total temperature operation
- Surface mount inductors designed for higher speed switch mode applications requiring lower inductance, low voltage and high current
- Design utilizes high temperature powder iron material with a non-organic binder to eliminate thermal aging
- Inductance Range from 0.2 uH to 47.0 uH
- Current Range from 95.0 Amps to 3.65 Amps
- Frequency Range 1kHz to 500kHz

Applications

- Next generation processors
- High current DC-DC converters
- VRM, multi-phase buck regulator
- PC, Workstations, Routers, Servers

Environmental Data

- Storage temperature range: -40°C to +155°C
- Operating temperature range: -40°C to +155°C (range is application specific)
- Solder reflow temperature: +260°C max for 10 seconds maximum



Packaging

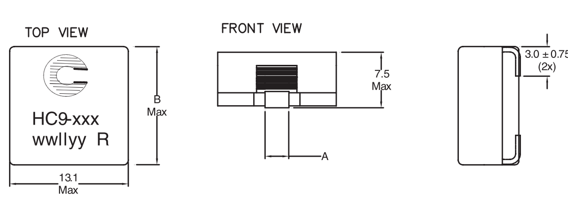
- Supplied in tape and reel packaging, 450 parts per reel

Part Number	Rated Inductance µH	OCL (1) nominal +/-15% µH	Irms (2) Amperes (Typ.)	Isat (3) Amperes 20% rolloff	Isat (4) Amperes 30% rolloff	DCR (mΩ) max. @ 20°C	Volts (5) µSec (VµS)
HC9-R20-R	0.20	0.218	46.7	65	95	0.50	2.87
HC9-R47-R	0.47	0.544	33.7	40	57	0.88	4.78
HC9-1R0-R	1.0	1.04	23.7	28	41	1.87	6.70
HC9-1R5-R	1.5	1.70	21.0	22	32	2.27	8.46
HC9-2R2-R	2.2	2.53	17.2	18	26	3.37	10.4
HC9-3R3-R	3.3	3.52	14.3	15	22	4.87	12.4
HC9-4R3-R	4.3	4.67	13.0	13.2	19.1	5.90	14.4
HC9-6R8-R	6.8	7.45	10.3	11.4	15.1	9.40	18.1
HC9-100-R	10.0	10.9	8.50	8.6	12.5	14.0	22.0
HC9-220-R	22.0	22.4	6.30	6.0	8.7	25.7	31.5
HC9-330-R	33.0	34.5	4.42	4.8	7.0	48.8	37.3
HC9-470-R	47.0	49.2	3.65	3.9	5.7	72.3	44.8

1) Test Parameters: 100KHz, 1.0Vrms
2) Irms Amperes for approximately ΔT of 40°C without core loss. De-rating is necessary for AC currents. PCB layout, trace thickness and width, airflow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 155°C under worst case conditions verified in the end application.
3) Peak current for approximately 20% rolloff @20°C
4) Peak current for approximately 30% rolloff @20°C
5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at operating frequency necessary to generate additional core loss which contributes to the 40°C temperature rise. De-rating of the Irms is required to prevent excessive temperature rise. The 100% V-uS rating is equivalent to a ripple current Ip-p of 20% of Isat (30% rolloff option).

Part number definition:
First 3 characters = Product code and size.
Last 3 characters = Inductance in µH. R = decimal point.
If no R is present third character = # of zeros.

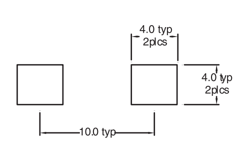
Mechanical Diagrams



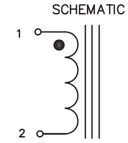
TABLE

PN	A mm	B mm
R20	3.4 ±0.30	13.4 max
R47	3.4 ±0.30	13.4 max
1R0	3.4 ±0.30	13.4 max
1R5	3.4 ±0.30	13.4 max
2R2 thru 470	3.7 ±0.20	13.8 max

RECOMMENDED PCB PAD LAYOUT

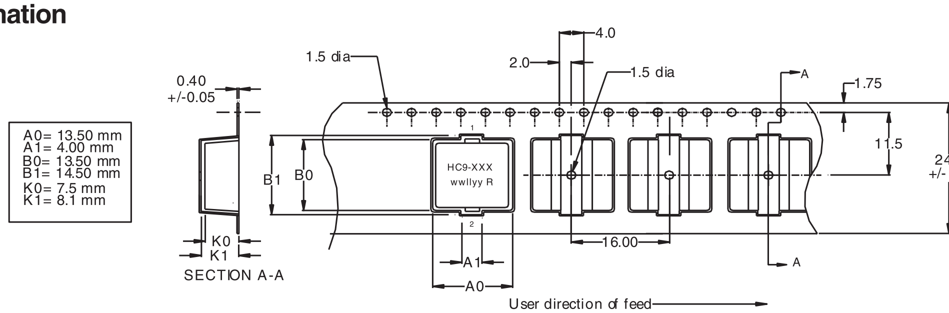


SCHEMATIC



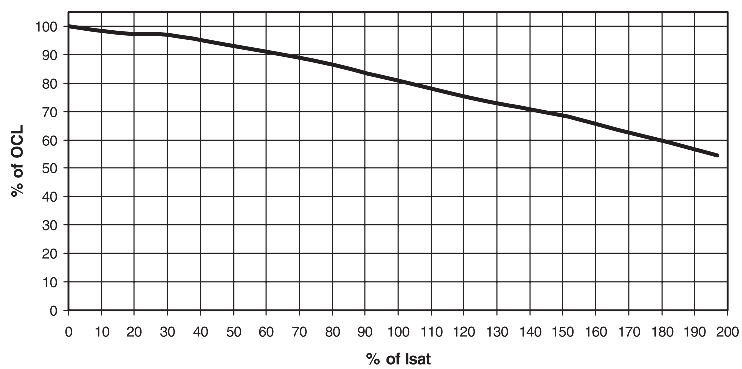
Dimensions in Millimeters. All dimensions +/-0.2 mm unless otherwise specified.
wwllyy = Date Code, R = Revision Level

Packaging Information

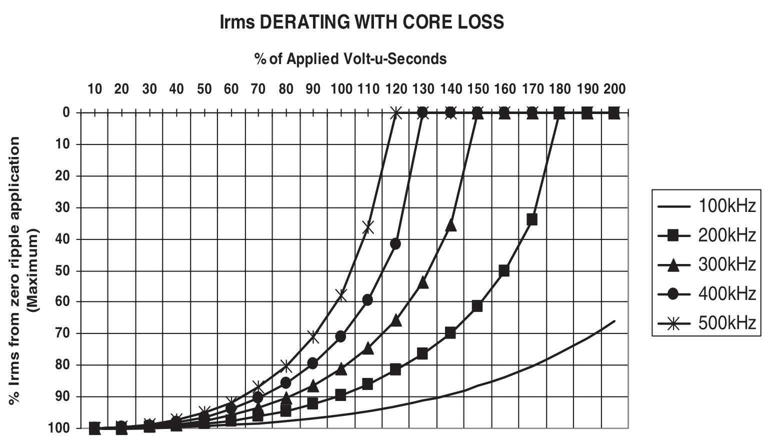


Dimensions in Millimeters

Rolloff



Core Loss



HIGH CURRENT (HC9)

HCPT1309 Series Power Inductors

Description

RoHS 2002/95/EC

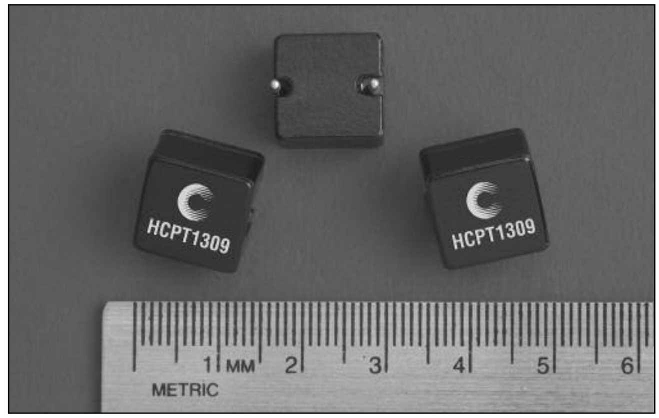
- 105°C maximum total temperature operation
- 13.2mm x 13.2mm x 9.0mm through hole package
- Core material: Powder Iron
- Inductance range from 0.20µH to 3.3µH
- Current range from 90.0 Amps to 11.4 Amps
- Frequency range up to 1MHz

Applications

- Next generation processors
- High current DC-DC converters
- VRM, multi-phase buck regulator
- Desktop computers
- Video game power

Environmental Data

- Storage temperature range: -40°C to +105°C
- Operating temperature range: -40°C to +105°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



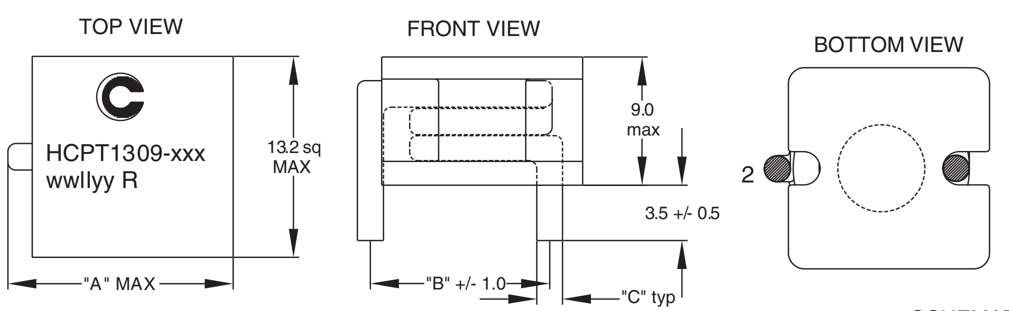
Packaging

- Supplied in bulk packaging, 100 parts per tray

Part Number	OCL (1) nominal +/- 20% (µH)	Irms (2) Amperes	Isat Amperes (3) Peak 20% rolloff @20°C	Isat Amperes (4) Peak 30% rolloff @20°C	DCR (mΩ) nom @20°C	K-factor (5)
HCPT1309-R20-R	0.20	43.1	72.2	90.0	0.426	154.1
HCPT1309-R47-R	0.49	34.0	43.3	55.0	0.624	92.4
HCPT1309-1R0-R	0.96	19.4	30.9	40.0	1.90	66.0
HCPT1309-1R5-R	1.59	13.7	24.1	30.6	3.82	51.4
HCPT1309-2R2-R	2.27	12.5	19.7	25.0	4.10	42.0
HCPT1309-3R3-R	3.31	11.4	16.7	21.0	4.80	35.6

(1) OCL: Open Circuit Inductance test parameters: 100kHz, 0.1Vrms, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 105°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 20% rolloff (@20°C)
(4) Isat Amperes peak for approximately 30% rolloff (@20°C)
(5) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p: (Gauss), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).

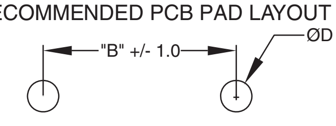
Mechanical Diagrams



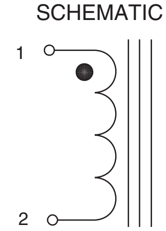
Dimension Table

Part No	"A"	"B"	"C"	"D"
HCPT1309-R20	14.0	12.2	1.63	2.13
HCPT1309-R47	14.0	12.2	1.63	2.13
HCPT1309-1R0	13.7	12.0	1.29	1.6
HCPT1309-1R5	13.5	11.8	1.15	1.40
HCPT1309-2R2	13.5	11.8	1.15	1.40
HCPT1309-3R3	13.5	11.8	1.15	1.40

RECOMMENDED PCB PAD LAYOUT



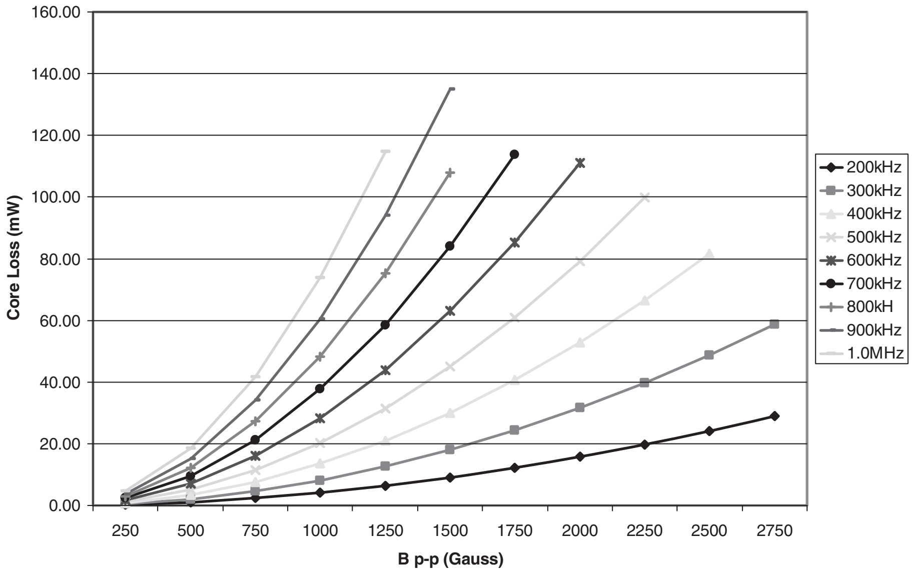
SCHEMATIC



Dimensions are in millimeters.
wwllyy = Date Code. R = Revision Level.

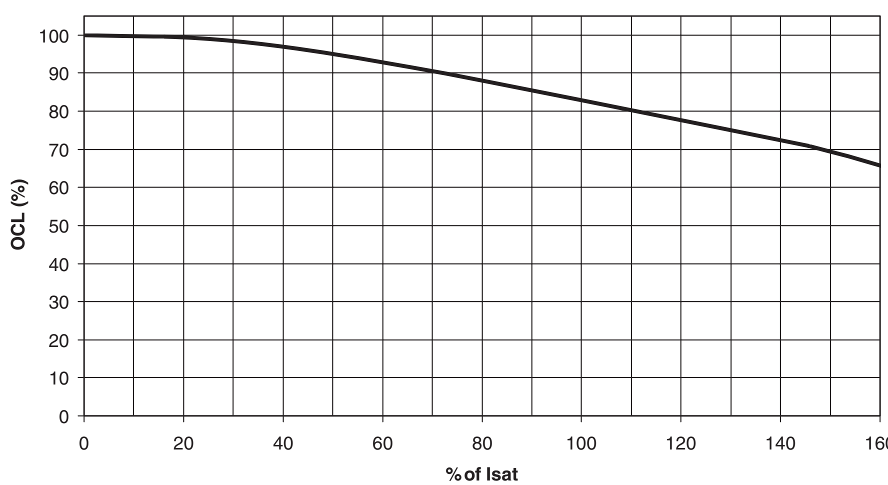
Core Loss

Core Loss vs. B p-p



Inductance Characteristics

OCL vs Isat



CPL Series Multi-Phase Power Inductors

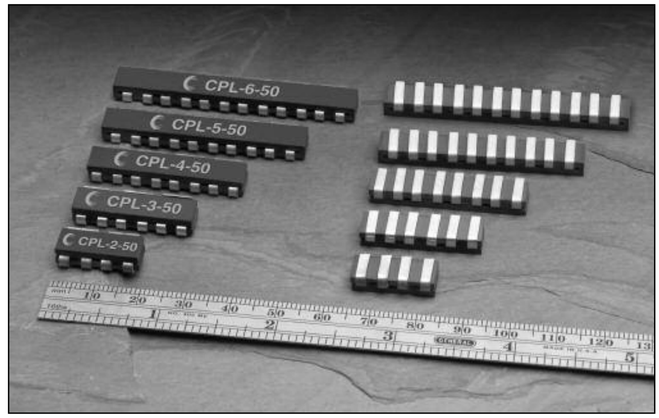
Description

RoHS 2002/95/EC

- Designed exclusively for use with Volterra VPR-Devices[(A)]
- High current multi-phase inductor applications
- Ferrite core material
- 50nH per phase coupled inductor
- 125°C maximum temperature operation
- Frequency range up to 2MHz
- Patents pending
- For tape and reel parts add TR after part number: CPL-x-xxTR-R

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



Packaging

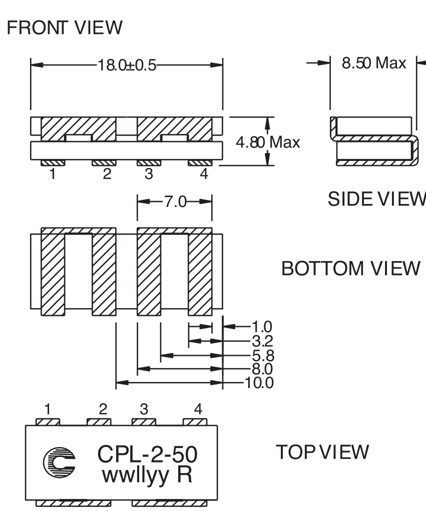
- Supplied in bulk trays or tape and reel:
  CPL-2-50-R: 120 per tray CPL-2-50TR-R: 750 per reel
  CPL-3-50-R: 90 per tray CPL-3-50TR-R: 750 per reel
  CPL-4-50-R: 75 per tray CPL-4-50TR-R: 750 per reel
  CPL-5-50-R: 60 per tray CPL-5-50TR-R: 750 per reel
  CPL-6-50-R: 45 per tray CPL-6-50TR-R: 750 per reel

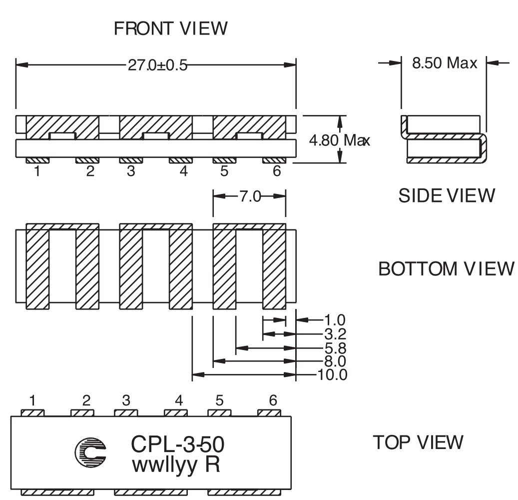
	Functional Specifications					Test Specifications				
Part Number	Inductance Phases	DCR (Ω) nom. @ 25°C	DCR (Ω) max. @ 25°C	Rated (3) Inductance per phase (nH)	I Rated per phase (Adc) (3)	Pin Number	OCL (nH) notes 1&2	Pin Number	OCL (nH) notes 1&2	Magnetizing Inductance @ 5Adc (25°C)
CPL-2-50-R	2	0.0005	0.0006	50 ± 20%	40	(1-2)	365 ± 18%	(3-4)	365 ± 18%	300
CPL-3-50-R	3	0.0005	0.0006	50 ± 20%	40	(3-4)	490 ± 20%	(1-2), (5-6)	365 ± 18%	400
CPL-4-50-R	4	0.0005	0.0006	50 ± 20%	40	(3-4), (5-6)	490 ± 20%	(1-2), (7-8)	365 ± 18%	400
CPL-5-50-R	5	0.0005	0.0006	50 ± 20%	40	(3-4), (5-6), (7-8)	490 ± 20%	(1-2), (9-10)	365 ± 18%	400
CPL-6-50-R	6	0.0005	0.0006	50 ± 20%	40	(3-4), 5-6), (7-8), (9-10)	490 ± 20%	(1-2), (11-12)	365 ± 18%	400

(1) OCL (Open Circuit Inductance)
(2) Test parameters: 1MHz, 0.1Vrms, 0.0Adc.
(3) The rated current and rated inductance per phase is determined by Volterra's testing and circuit design. Additional information can be provided by contacting Volterra.

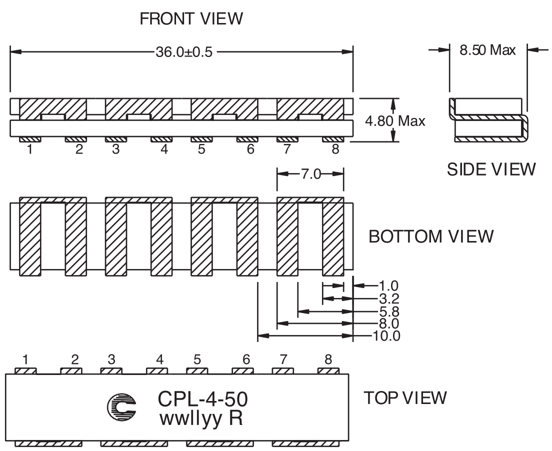
(A) This device is licensed for use only when incorporated within a voltage regulator employing power regulating devices manufactured by Volterra Semiconductor Corp. No license is granted expressly or by implication to use this device with power regulating devices manufactured by any company other than Volterra.

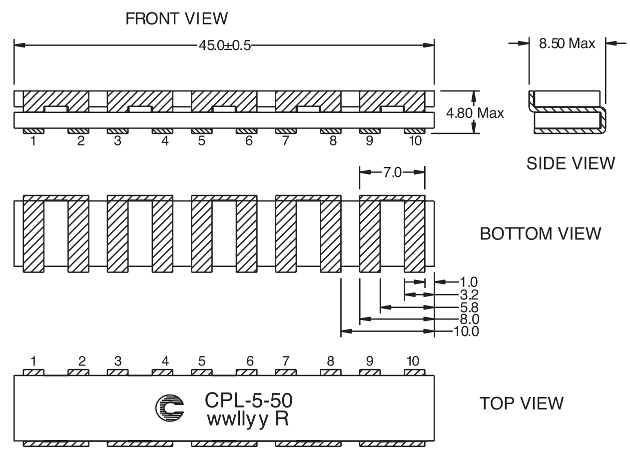
Mechanical Diagrams

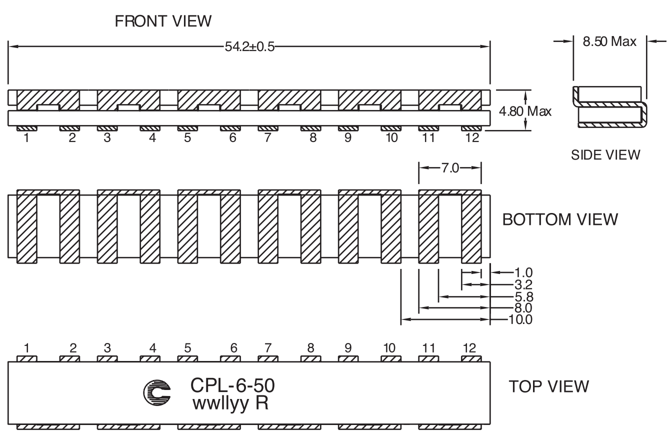




Mechanical Diagrams

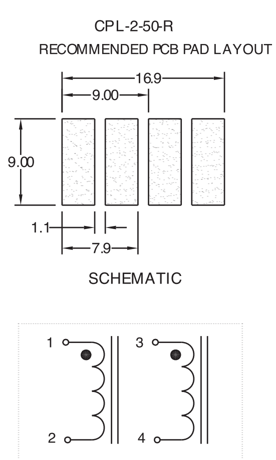


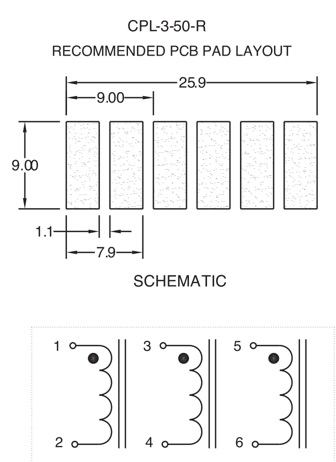


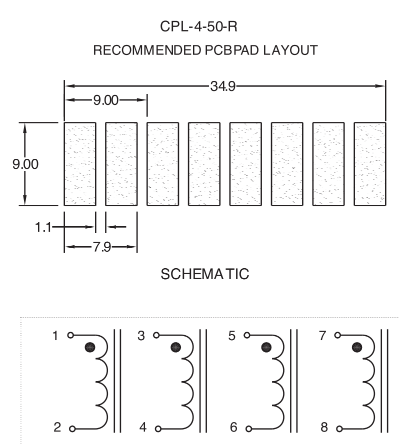


Dimensions are in millimeters. All dimensions +/-0.2 mm unless otherwise specified. wwllyy = (date code) R = revision level

Schematic/PCB Layout

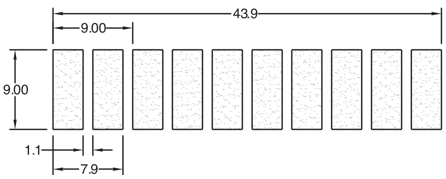




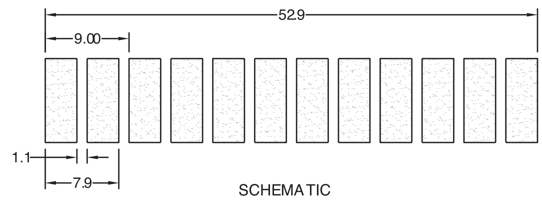


Schematic/PCB Layout

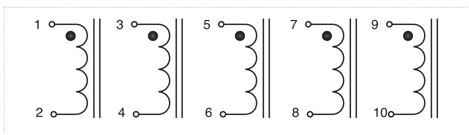
CPL-5-50-R
RECOMMENDED PCB PAD LAYOUT



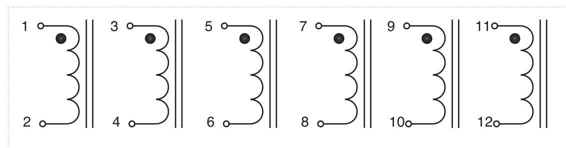
CPL-6-50-R
RECOMMENDED PCB PAD LAYOUT



SCHEMATIC



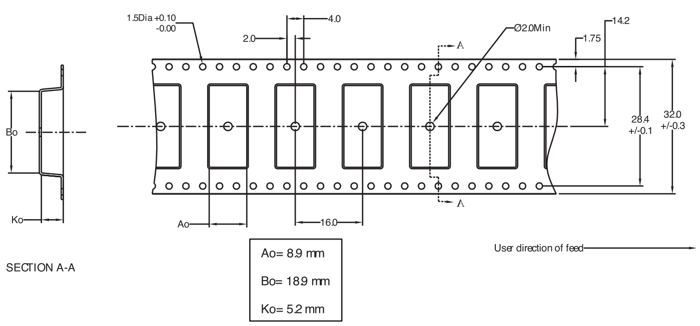
SCHEMATIC



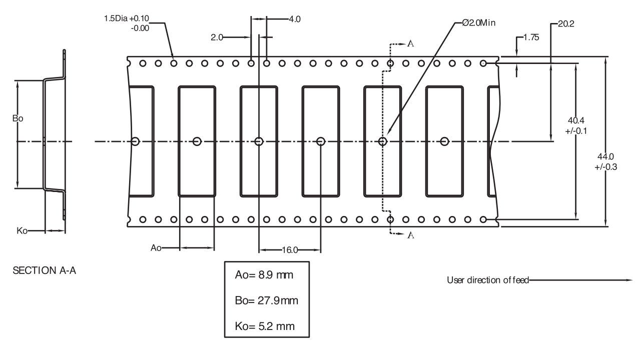
Dimensions are in millimeters. All dimensions +/-0.2 mm unless otherwise specified.

Packaging Information (Tape and Reel)

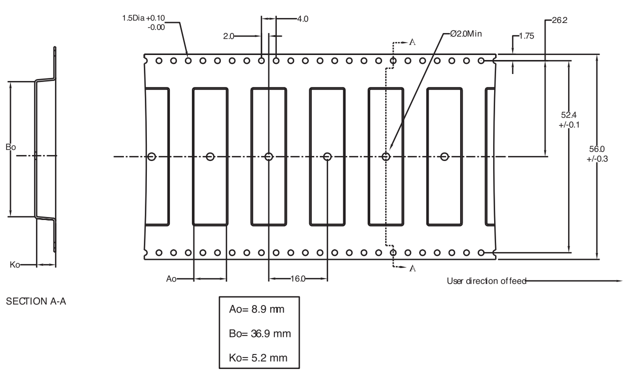
CPL-2-50TR-R



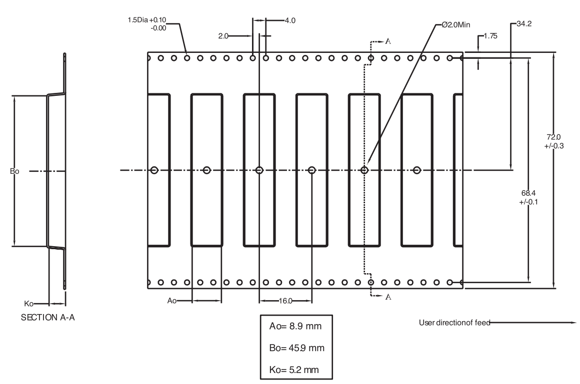
CPL-3-50TR-R



CPL-4-50TR-R

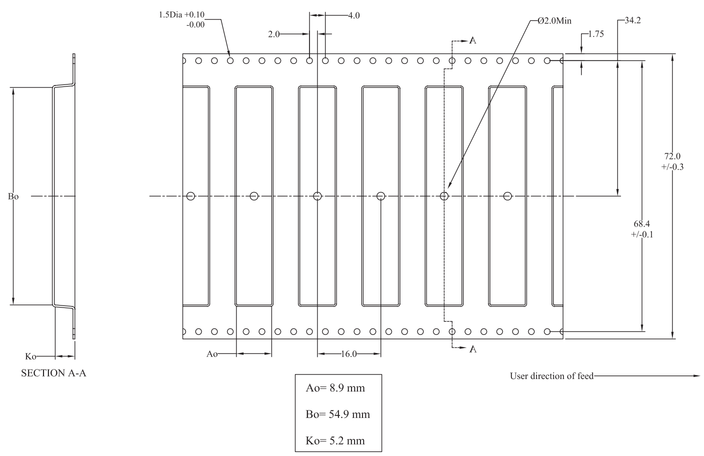


CPL-5-50TR-R



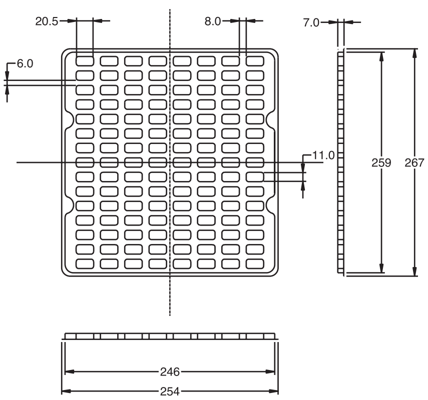
Packaging Information (Tape and Reel)

CPL-6-50TR-R

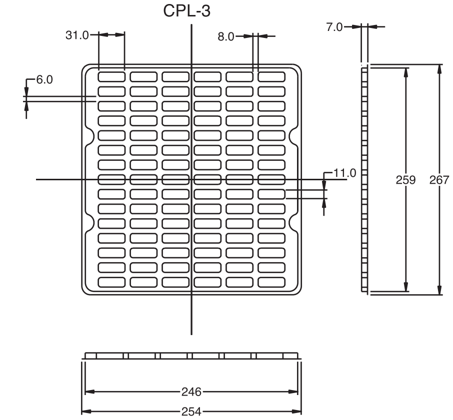


Packaging Information (Bulk Tray)

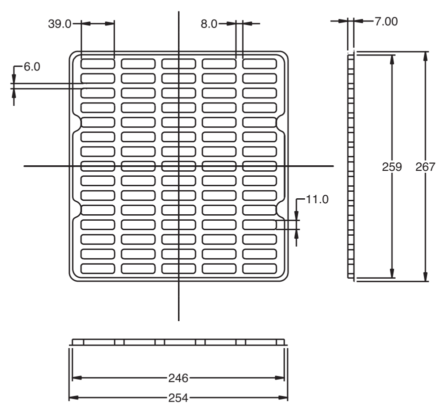
CPL-2



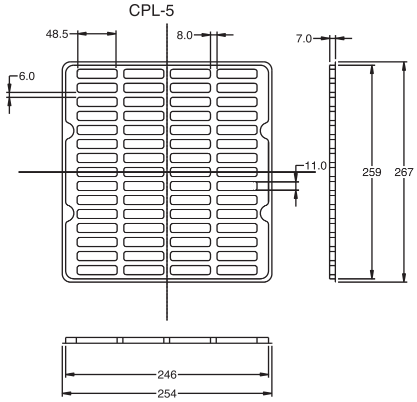
CPL-3



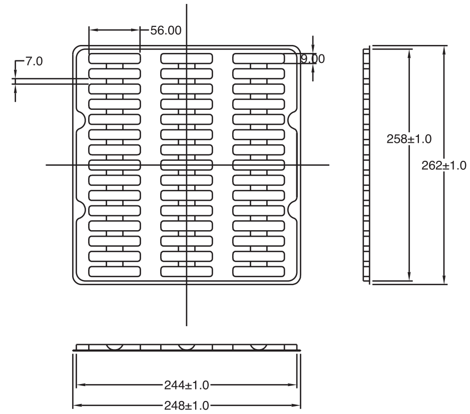
CPL-4



CPL-5



CPL-6



Notes:
Material: 0.8 PVC with internal Anti-Stat
Tolerances: x.xx = ± 0.20, x.x = ± 0.50, x = ± 2.0 unless otherwise specified.
Trays are stackable when rotated 180°.
All dimensions are in mm.

HIGH CURRENT (CPL)

COILTRONICS®

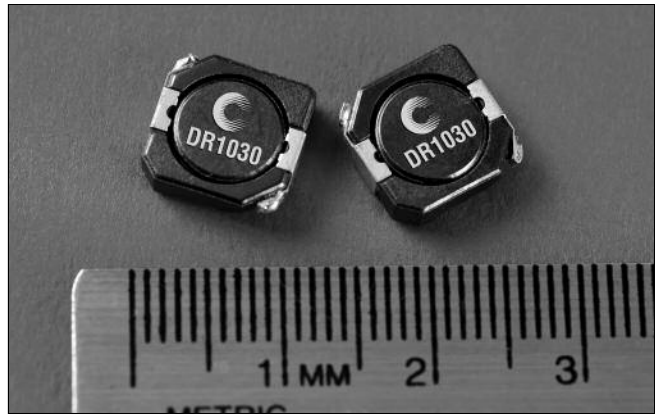
COOPER Bussmann

DR1030 Series
Low Profile Power Inductors

Description

- 125°C maximum total temperature operation
- Low profile surface mount inductors
- 10.3mm x 10.5mm x 3.0mm shielded drum core
- Ferrite core material
- Inductance range from 1.1µH to 150µH
- Current range from 9.5 Amps to 0.68 Amps
- Frequency range up to 1MHz

RoHS 2002/95/EC



Applications

- Computer, DVD players, and portable power devices
- Notebook power, LCD panels
- DC-DC converters
- Input/output filter, Buck/Boost regulators

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

Packaging

- Supplied in tape and reel packaging, 1000 parts per reel

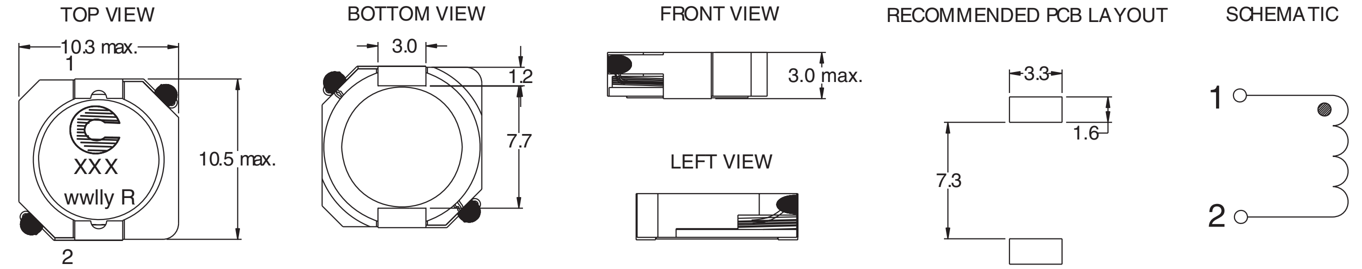
Part Number	Rated Inductance (µH)	OCL (1) µH ± 30%	Irms (2) Amperes	Isat (3) Amperes	DCR mΩ@20°C (Typical)	DCR mΩ@20°C (Maximum)	K-factor (4)
DR1030-1R1-R	1.1	1.1	7.0	9.50	6.5	7.9	22
DR1030-1R8-R	1.8	1.9	5.9	7.41	9.1	11.0	17
DR1030-2R8-R	2.8	2.8	5.1	6.08	12.1	14.5	14
DR1030-3R9-R	3.9	4.0	4.3	5.13	16.4	20.0	12
DR1030-5R2-R	5.2	5.2	3.7	4.75	22.9	27.5	10
DR1030-6R8-R	6.8	6.8	3.5	3.90	24.9	30.0	9.0
DR1030-8R2-R	8.2	8.4	3.3	3.54	28.4	34.1	8.0
DR1030-100-R	10	10.4	2.8	3.18	40.2	48.0	7.0
DR1030-150-R	15	14.8	2.3	2.66	57.3	68.8	6.0
DR1030-220-R	22	22.8	1.8	2.19	95.5	114.6	4.5
DR1030-330-R	33	32.4	1.6	1.81	113.6	136.3	4
DR1030-470-R	47	47.9	1.3	1.52	166.6	200.0	3.4
DR1030-680-R	68	66.6	1.1	1.24	253.1	303.7	2.9
DR1030-820-R	82	82.4	1.0	1.14	332.4	382.3	2.6
DR1030-101-R	100	100	0.86	1.05	375.0	450.0	2.4
DR1030-121-R	120	119.3	0.8	0.95	523.4	602.0	1.9
DR1030-151-R	150	155.3	0.68	0.86	590.0	700	1.4

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 35% rolloff max. (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number definition: DR1030-xxx-R
DR1030 = Product code and size, xxx = Inductance value in µH, R = decimal point. If no R is present third character = # of zeros. -R suffix = RoHS compliant

SHIELDED DRUM (DR1030)

DR1030 Series
Low Profile Power Inductors

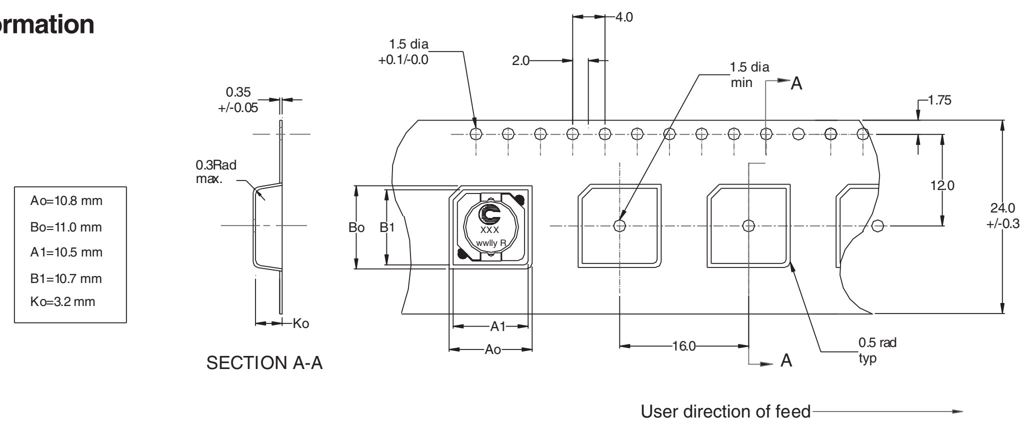
Mechanical Diagrams



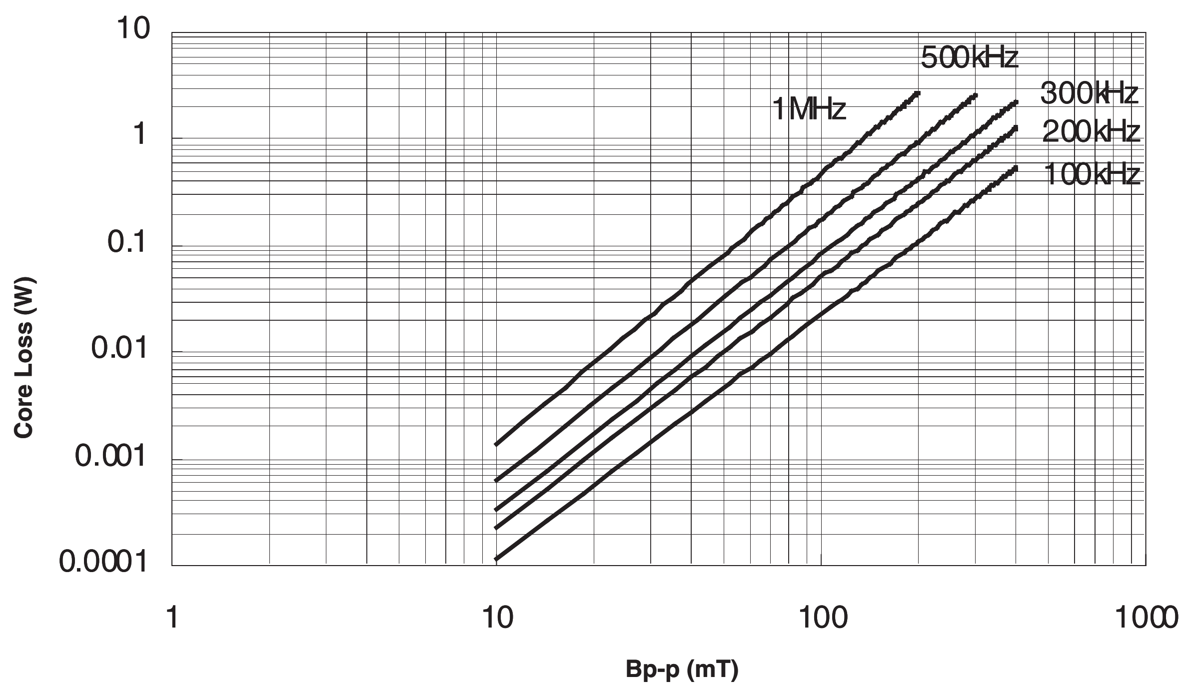
Dimensions are in millimeters.

XXX = Inductance in µH. R = decimal point. If no R is present third character = #of zeros.
wwlly = Date Code. R = Revision Level.

Packaging Information

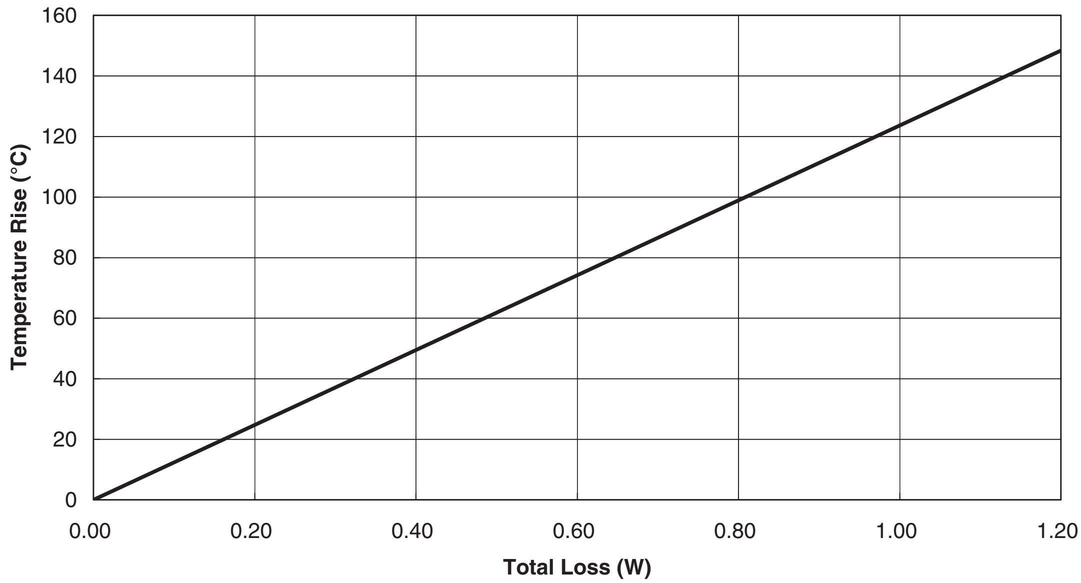


Core Loss



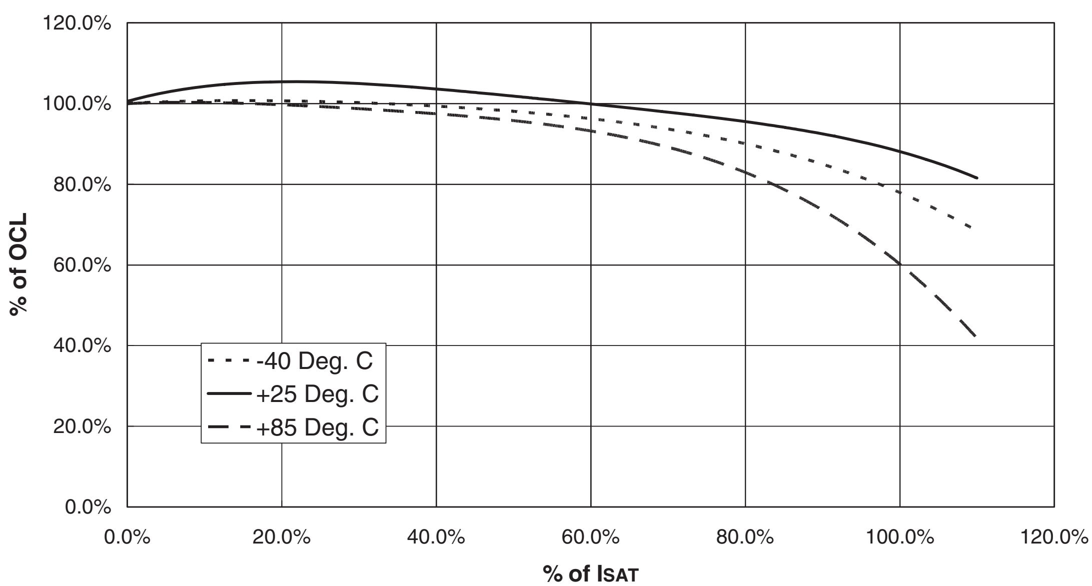
SHIELDED DRUM (DR1030)

Temperature Rise vs. Total Loss



Inductance Characteristics

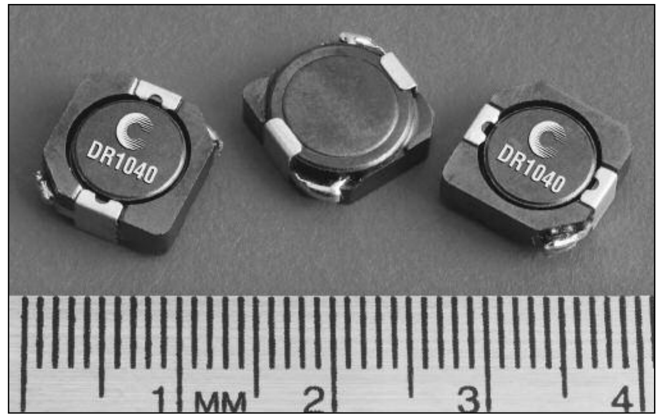
OCL vs. ISAT



COOPER Bussmann

DR1040 Series
Low Profile Power Inductors

RoHS 2002/95/EC



Description

- 125°C maximum total temperature operation
- Low profile surface mount inductor
- 10.3mm x 10.5mm x 4.0mm shielded drum core
- Ferrite core material
- Inductance range from 1.5µH to 330µH
- Current range from 10.0 Amps to 0.52 Amps
- Frequency range up to 1MHz

Applications

- Notebook power, Portable devices
- Wireless modems, ADSL line cards
- Point of load power supplies
- Battery chargers, Video Cards
- MP3 player, PDA's, DVD players
- LED driver for notebook computer
- Navigation system, LCD backlighting
- Buck, Boost, or Forward inductor

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

Packaging

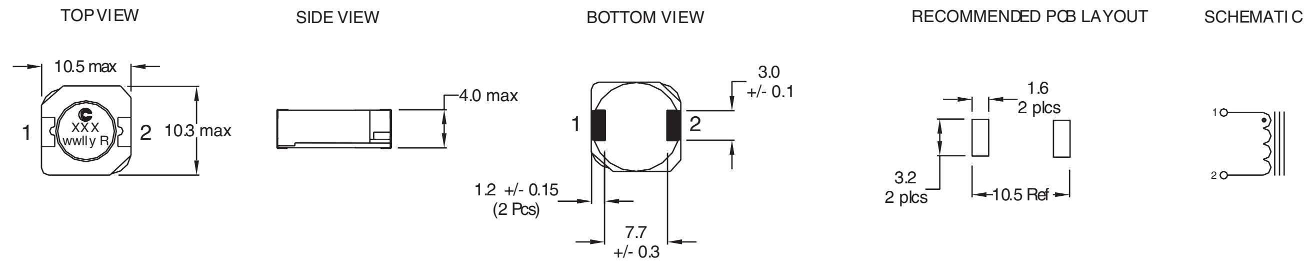
- Supplied in tape and reel packaging, 850 per reel

Part Number	Rated Inductance (µH)	OCL (1) µH±30%	Irms(2) Amperes	Isat (3) Amperes	DCR (Ω) mΩ @20°C (Typical)	DCR (Ω) mΩ @20°C (Maximum)	K-factor (4)
DR1040-1R5-R	1.5	1.4	6.50	10.00	6.0	8.1	15.48
DR1040-2R5-R	2.5	2.4	6.10	7.80	7.0	9.0	12.04
DR1040-3R8-R	3.8	3.6	5.50	6.40	9.6	13.0	9.85
DR1040-5R2-R	5.2	5.2	5.40	5.50	14.0	17.0	8.33
DR1040-7R0-R	7.0	6.8	4.50	4.80	17.0	20.0	7.22
DR1040-8R2-R	8.2	8.1	3.98	4.60	24.0	29.0	6.37
DR1040-100-R	10	9.6	3.80	4.40	26.0	35.0	5.70
DR1040-150-R	15	14.9	3.10	3.60	37.0	50.0	4.71
DR1040-220-R	22	21.1	2.50	2.90	54.0	73.0	4.01
DR1040-330-R	33	32.6	2.20	2.45	69.0	93.0	3.28
DR1040-470-R	47	45.8	1.90	2.10	95.0	128	2.78
DR1040-680-R	68	65.3	1.42	1.65	152	183	2.30
DR1040-820-R	82	86.8	1.29	1.47	214	260	2.04
DR1040-101-R	100	101.4	1.25	1.35	225	304	1.90
DR1040-151-R	150	148.3	0.85	1.15	356	430	1.57
DR1040-221-R	220	216.2	0.70	0.92	530	640	1.27
DR1040-331-R	330	323.4	0.52	0.70	810	1090	1.03

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.25V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 30°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 35% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in µH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: DR1040-xxx-R
DR1040 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

DR1040 Series
Low Profile Power Inductors

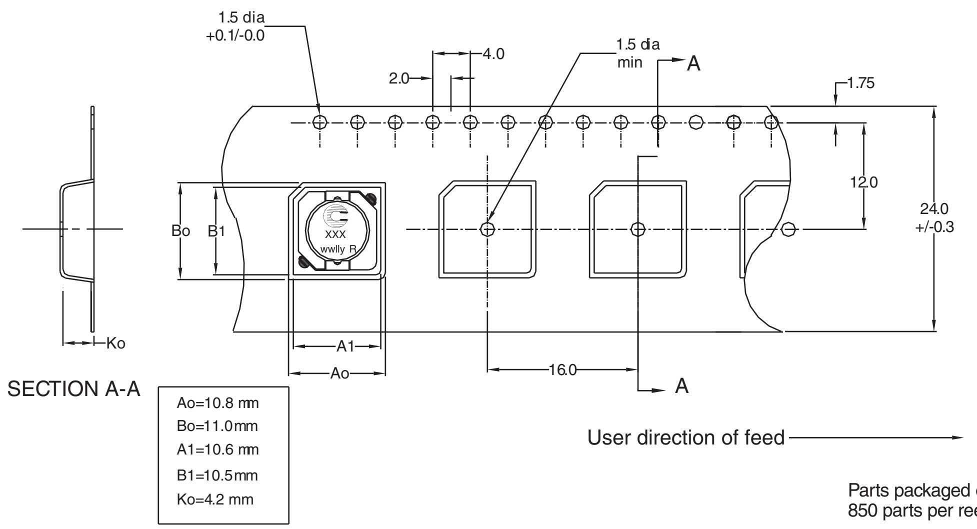
Mechanical Diagrams



Dimensions are in millimeters.

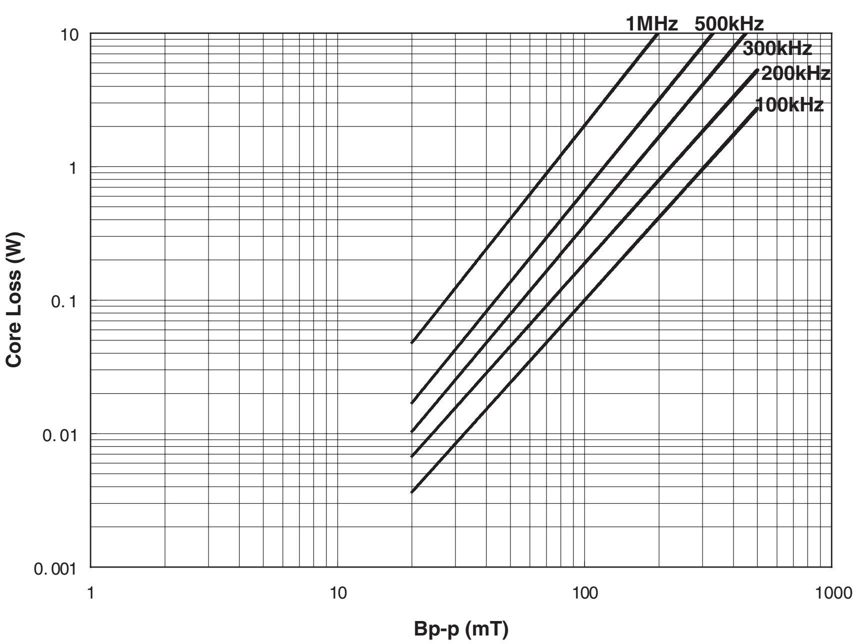
xxx = Inductance value in uH. R = decimal point. If no R is present third character = # of zeros. wwllyy = Date code, R = Revision level.

Packaging Information

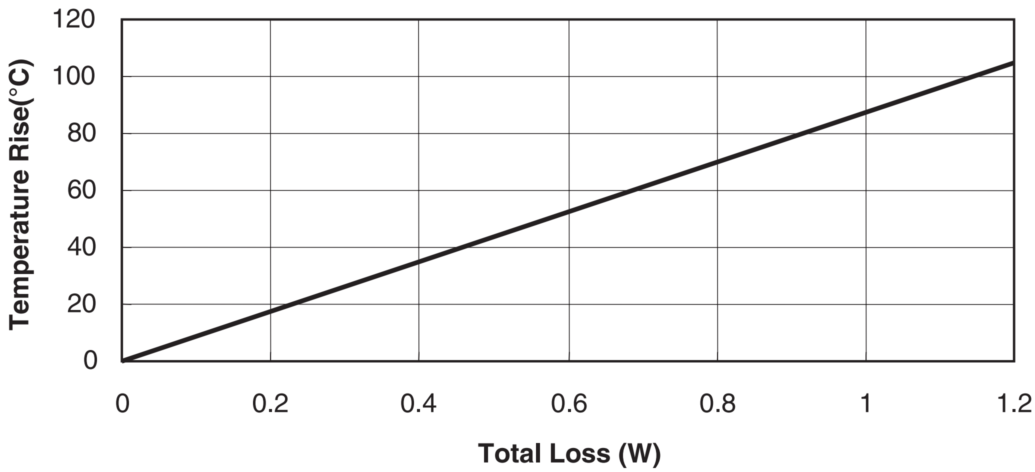


Parts packaged on 13" Diameter reel,
850 parts per reel.

Core Loss

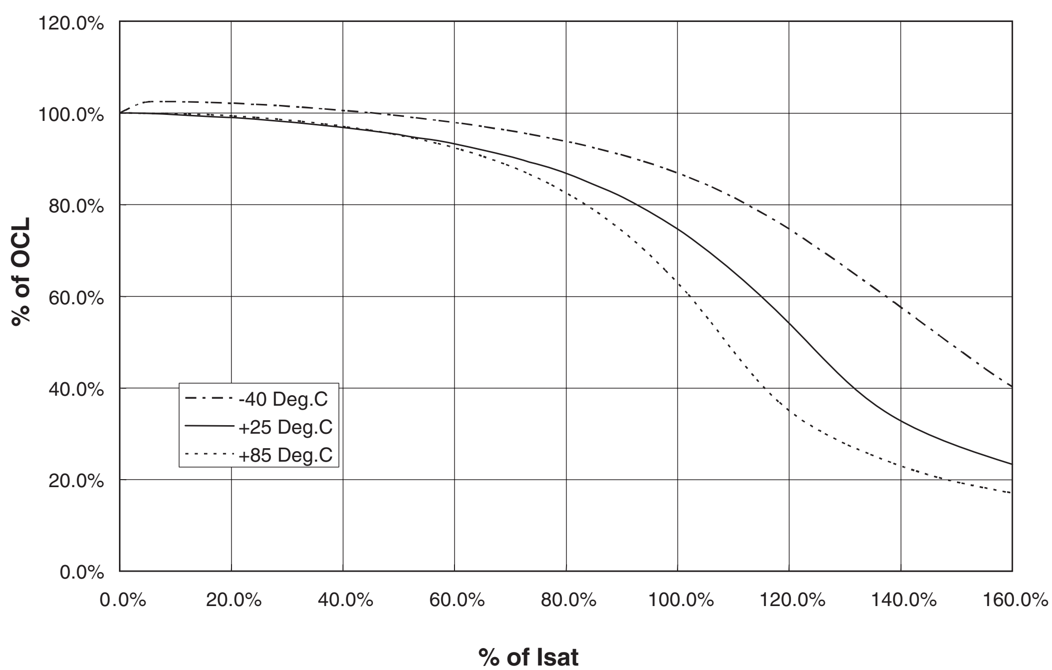


Temperature Rise vs. Loss



Inductance Characteristics

OCL vs. Isat



COOPER Bussmann

DR1050 Series
Low Profile Power Inductors

Description

RoHS 2002/95/EC

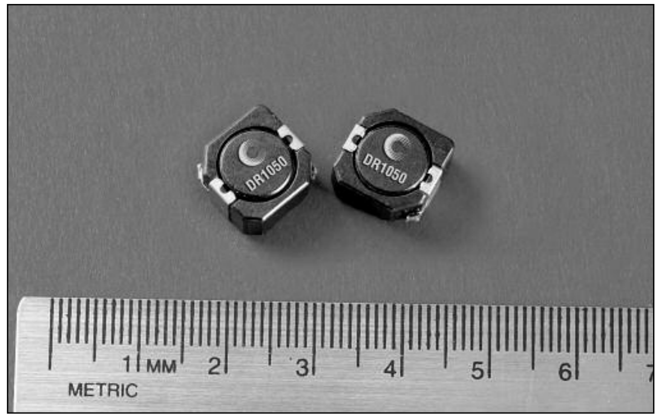
- 125°C maximum total temperature operation
- Low profile surface mount inductor
- 10.3mm x 10.5mm x 5.0mm shielded drum core
- Ferrite core material
- Inductance range from 0.7μH to 1000μH
- Current range from 13.5 Amps to 0.43 Amps
- Frequency range up to 1MHz

Applications

- Computer, DVD players, and portable power devices
- Notebook power, LCD panels
- DC-DC converters
- Buck, boost, forward, and resonant converters
- Noise filtering and filter chokes

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



Packaging

- Supplied in tape and reel packaging, 500 per reel

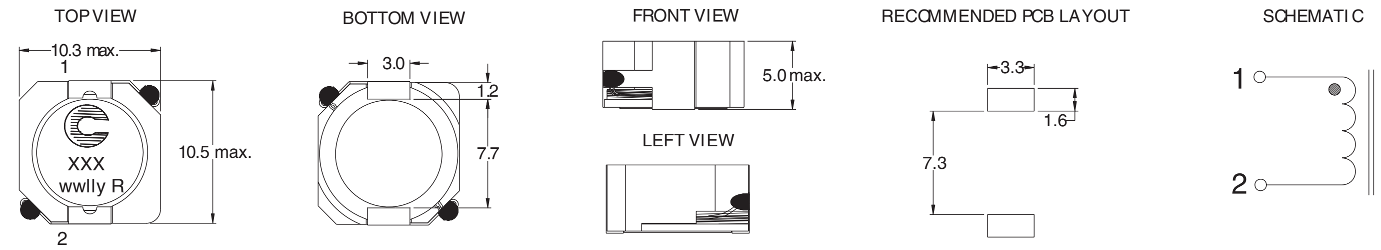
Part Number	Rated Inductance (μH)	OCL (1) μH±30%	Irms(2) Amperes	Isat (3) Amperes	DCR (Ω) mΩ @20°C (Typical)	DCR (Ω) mΩ @20°C (Maximum)	K-factor (4)
DR1050-R80-R	0.8	0.70	9.70	13.50	3.2	4.0	20.47
DR1050-1R5-R	1.5	1.37	8.60	10.50	4.0	5.0	14.62
DR1050-2R2-R	2.2	2.27	7.52	9.25	5.6	6.8	11.37
DR1050-3R3-R	3.3	3.21	6.50	8.20	8.0	10.0	9.30
DR1050-4R7-R	4.7	4.43	6.13	6.70	9.5	11.9	7.87
DR1050-6R8-R	6.8	6.30	5.45	5.80	13.0	16.5	6.82
DR1050-8R2-R	8.2	8.09	5.24	5.00	15.1	19.0	6.02
DR1050-100-R	10	10.1	4.80	4.58	18.0	22.5	5.39
DR1050-120-R	12	11.6	3.94	4.10	24.3	30.4	4.87
DR1050-150-R	15	14.8	3.80	3.70	26.0	32.5	4.45
DR1050-180-R	18	17.5	3.39	3.30	32.8	41.0	4.09
DR1050-220-R	22	23.5	3.12	3.00	38.7	48.4	3.53
DR1050-270-R	27	26.9	2.82	2.80	42.6	53.3	3.30
DR1050-330-R	33	34.3	2.56	2.50	57.5	71.9	2.92
DR1050-390-R	39	38.3	2.35	2.35	60.7	75.9	2.77
DR1050-470-R	47	47.1	2.06	2.10	89.0	111	2.50
DR1050-560-R	56	56.7	1.96	1.94	98.0	123	2.27
DR1050-680-R	68	67.2	1.84	1.70	111	139	2.09
DR1050-820-R	82	84.4	1.60	1.58	147	184	1.86
DR1050-101-R	100	97.5	1.52	1.45	164	205	1.73
DR1050-121-R	120	118.3	1.30	1.30	223	279	1.57
DR1050-151-R	150	149.2	1.26	1.15	238	298	1.40
DR1050-181-R	180	183.7	1.18	1.08	273	341	1.26
DR1050-221-R	220	221.8	1.00	0.98	377	472	1.15
DR1050-271-R	270	263.5	0.96	0.90	410	513	1.06
DR1050-331-R	330	320.6	0.83	0.80	554	693	0.96
DR1050-391-R	390	396.5	0.76	0.72	648	810	0.86
DR1050-471-R	470	480.5	0.64	0.62	855	1069	0.78
DR1050-561-R	560	572.6	0.62	0.60	970	1213	0.72
DR1050-681-R	680	707.9	0.56	0.55	1095	1369	0.64
DR1050-821-R	820	818.7	0.54	0.50	1185	1481	0.60
DR1050-102-R	1000	1000.2	0.43	0.48	1528	1950	0.54

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 35% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in μH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: DR1050-xxx-R
DR1050 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

COOPER Bussmann

DR1050 Series
Low Profile Power Inductors

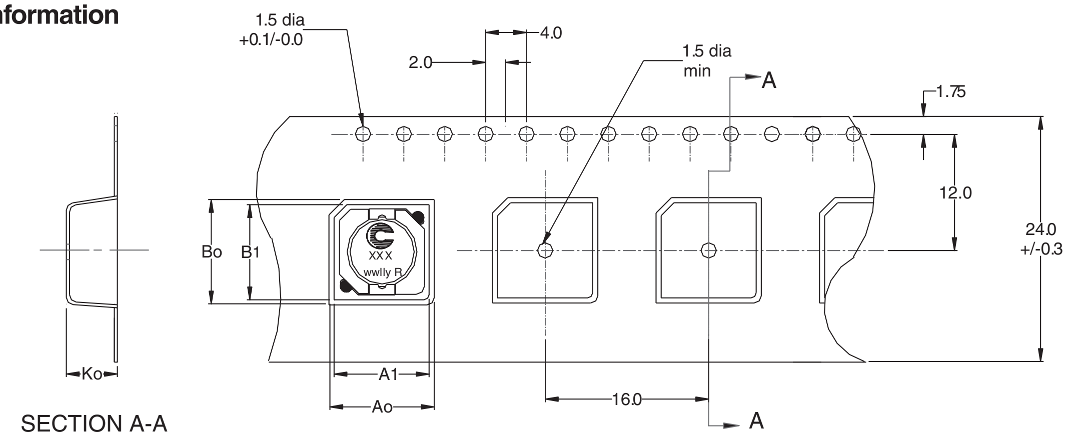
Mechanical Diagrams



Dimensions are in millimeters.

xxx = Inductance value in uH. R = decimal point. If no R is present third character = # of zeros. wwllyy = Date code, R = Revision level.

Packaging Information

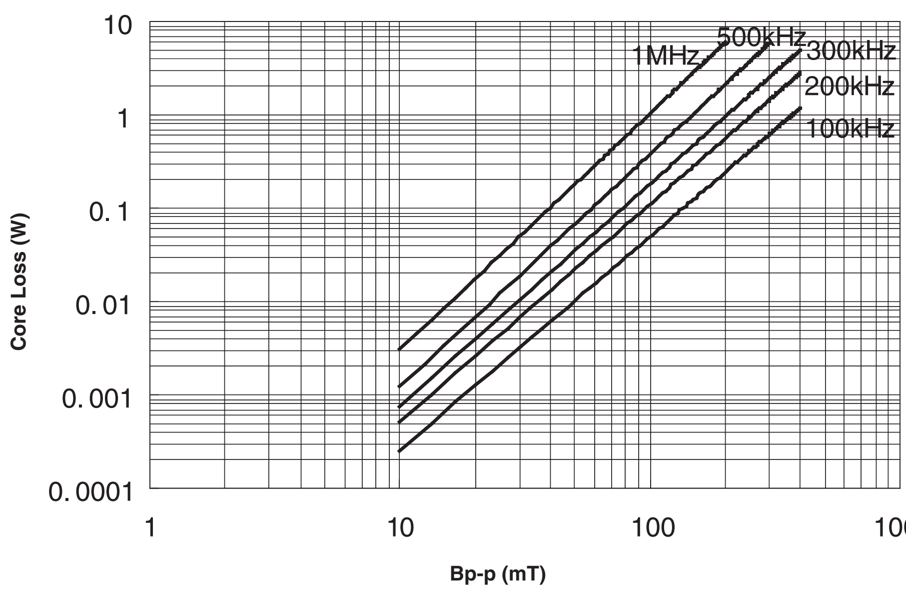


Ao=10.8 mm
Bo=11.0 mm
A1=10.5 mm
B1=10.7 mm
Ko=5.3 mm

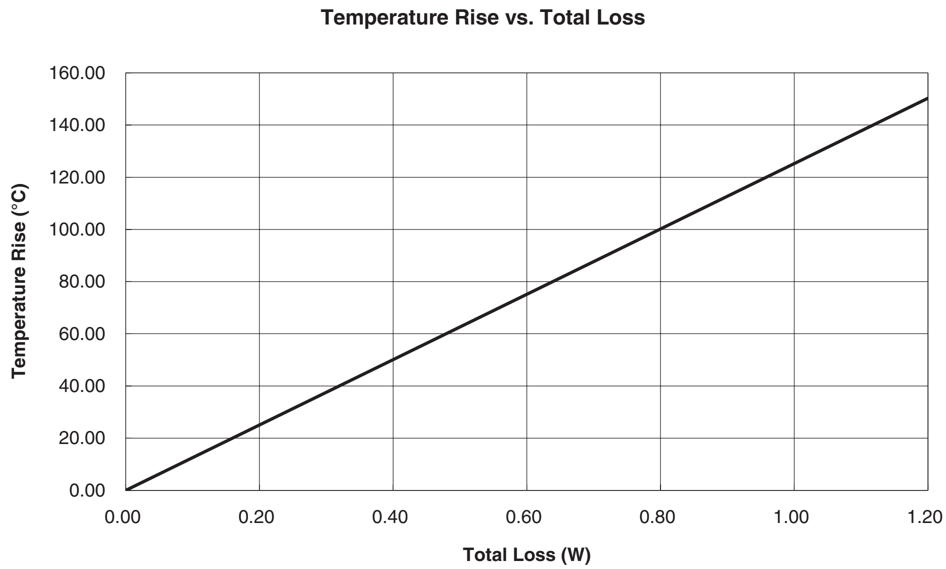
User direction of feed

Parts packaged on 13" Diameter reel, 500 parts per reel.

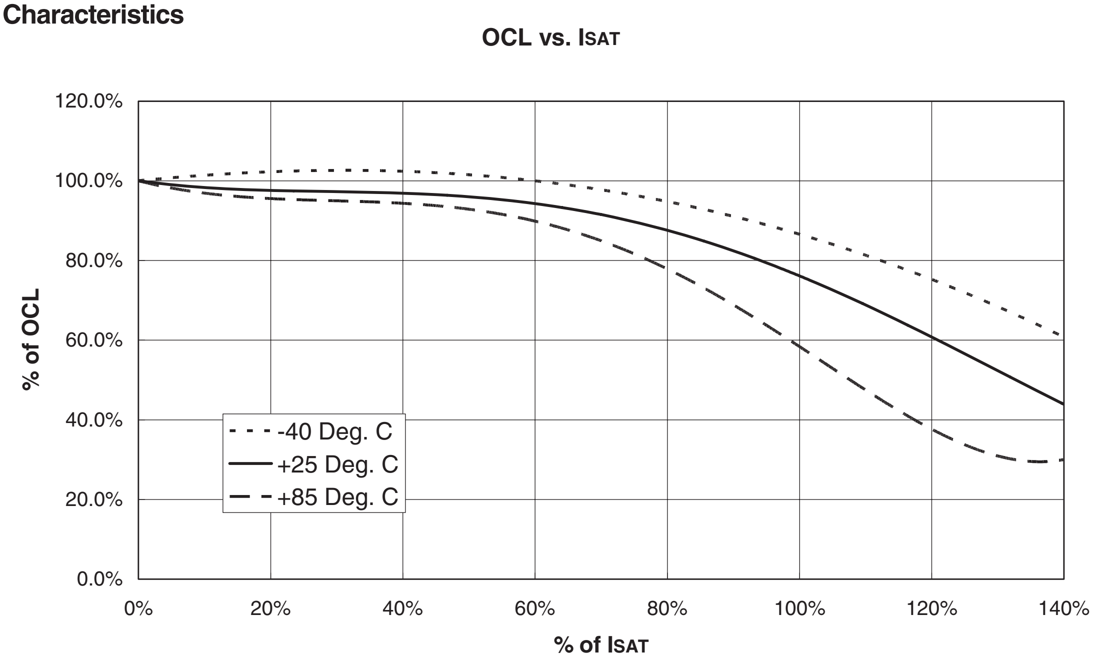
Core Loss



Temperature Rise vs. Loss



Inductance Characteristics



COILTRONICS®

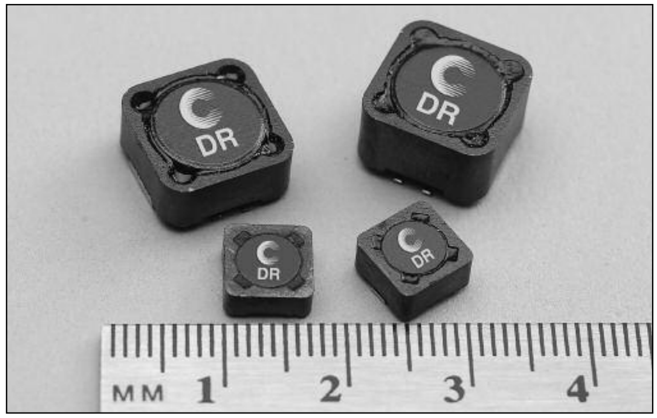
COOPER Bussmann

DR Series
High Power Density, High Efficiency, Shielded Inductors

Description

RoHS 2002/95/EC

- 125°C maximum total temperature operation
- Four sizes of shielded drum core inductors
- Inductance range from 0.33uH to 1000uH
- Current range up to 56 Amps peak
- Magnetic shielding
- Secure mounting
- Ferrite core material



Applications

- Computer, DVD players, and portable power devices
- LCD panels
- DC-DC converters
- Buck, boost, forward, and resonant converters
- Noise filtering and filter chokes

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging

- Supplied in tape and reel packaging, 1350 (DR73), 1100 (DR74), 600 (DR125), and 350 (DR127) per reel

Part Number	Rated Inductance (µH)	OCL(1) +/-20% (µH)	Irms(2) Amperes	Isat(3) Amperes Peak	DCR(4) (Ω) Typ.	Volt-uSec(5) Typ.
DR73-R33-R	0.33	0.306	6.21	14.4	0.0073	1.98
DR73-1R0-R	1.00	0.992	5.28	7.97	0.0102	3.56
DR73-1R5-R	1.50	1.482	4.67	6.52	0.0130	4.36
DR73-2R2-R	2.20	2.070	4.15	5.52	0.0165	5.15
DR73-3R3-R	3.30	3.540	3.31	4.22	0.0259	6.73
DR73-4R7-R	4.70	4.422	3.09	3.78	0.0297	7.52
DR73-6R8-R	6.80	6.480	2.55	3.12	0.0435	9.11
DR73-8R2-R	8.20	8.930	2.19	2.66	0.0592	10.7
DR73-100-R	10.0	10.30	2.08	2.47	0.0656	11.5
DR73-150-R	15.0	15.01	1.83	2.05	0.0844	13.9
DR73-220-R	22.0	22.65	1.62	1.67	0.107	17.0
DR73-330-R	33.0	34.41	1.31	1.35	0.166	21.0
DR73-470-R	47.0	48.62	1.08	1.14	0.241	24.9
DR73-680-R	68.0	68.91	0.89	0.96	0.358	29.7
DR73-820-R	82.0	80.37	0.86	0.89	0.384	32.1
DR73-101-R	100	101.4	0.73	0.79	0.527	36.0
DR73-151-R	150	150.9	0.58	0.65	0.851	44.0
DR73-221-R	220	223.3	0.52	0.53	1.05	53.5
DR73-331-R	330	325.5	0.42	0.44	1.59	64.5
DR73-471-R	470	465.8	0.35	0.37	2.36	77.2
DR73-681-R	680	676.5	0.29	0.31	3.47	93.1
DR73-821-R	820	821.7	0.27	0.28	3.93	103
DR73-102-R	1000	995.0	0.26	0.25	4.34	113
DR74-R33-R	0.33	0.294	6.26	18.4	0.0074	1.71
DR74-1R0-R	1.00	0.952	5.39	10.2	0.0099	3.08
DR74-1R5-R	1.50	1.422	4.94	8.35	0.0118	3.76
DR74-2R2-R	2.20	1.986	4.76	7.06	0.0126	4.45
DR74-3R3-R	3.30	3.396	3.94	5.40	0.0183	5.81
DR74-4R7-R	4.70	5.182	3.34	4.37	0.0254	7.18
DR74-6R8-R	6.80	7.344	2.60	3.67	0.0418	8.55
DR74-8R2-R	8.20	8.566	2.53	3.40	0.0441	9.23
DR74-100-R	10.0	9.882	2.41	3.17	0.0489	9.92
DR74-150-R	15.0	16.09	2.11	2.48	0.0637	12.7
DR74-220-R	22.0	21.73	1.75	2.13	0.0925	14.7

(1) Open Circuit Inductance Test Parameters: 100KHz, 0.25Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
(3) Peak current for approximate 30% roll off at 20°C.
(4) DCR limits @ 20°C.
(5) Applied Volt-Time product (V-µS) across the inductor. This value represent the applied V-µS at 100KHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.

DR Series
High Power Density, High Efficiency, Shielded Inductors

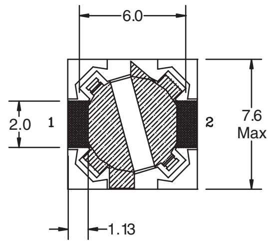
Part Number	Rated Inductance (µH)	OCL[1] +/-20% (µH)	Irms[2] Amperes	Isat[3] Amperes Peak	DCR[4] (Ω) Typ.	Volt-uSec[5] Typ.
DR74-330-R	33.0	33.01	1.41	1.73	0.143	18.1
DR74-470-R	47.0	49.64	1.15	1.41	0.216	22.2
DR74-680-R	68.0	69.67	1.03	1.19	0.265	26.3
DR74-820-R	82.0	80.95	0.91	1.11	0.345	28.4
DR74-101-R	100	101.6	0.86	0.99	0.383	31.8
DR74-151-R	150	150.0	0.69	0.81	0.591	38.6
DR74-221-R	220	227.0	0.56	0.66	0.907	47.5
DR74-331-R	330	335.6	0.45	0.54	1.41	57.8
DR74-471-R	470	465.3	0.40	0.46	1.74	68.1
DR74-681-R	680	671.2	0.33	0.38	2.58	81.7
DR74-821-R	820	812.7	0.31	0.35	2.93	89.9
DR74-102-R	1000	1009	0.27	0.31	3.89	100
DR125-R47-R	0.47	0.456	17.6	33.0	0.0018	3.17
DR125-1R0-R	1.00	0.894	15.0	23.6	0.0024	4.43
DR125-1R5-R	1.50	1.478	13.8	18.3	0.0029	5.70
DR125-2R2-R	2.20	2.208	10.9	15.0	0.0045	6.97
DR125-3R3-R	3.30	3.084	9.26	12.7	0.0063	8.23
DR125-4R7-R	4.70	5.274	7.18	9.71	0.0105	10.8
DR125-6R8-R	6.80	6.588	6.64	8.68	0.0123	12.0
DR125-8R2-R	8.20	8.048	5.54	7.86	0.0176	13.3
DR125-100-R	10.0	9.654	5.35	7.17	0.0189	14.6
DR125-150-R	15.0	15.35	4.27	5.69	0.0298	18.4
DR125-220-R	22.0	22.36	3.70	4.71	0.0396	22.2
DR125-330-R	33.0	33.74	3.28	3.84	0.0505	27.2
DR125-470-R	47.0	47.47	2.71	3.24	0.0740	32.3
DR125-680-R	68.0	67.91	2.22	2.70	0.101	38.6
DR125-820-R	82.0	86.89	2.05	2.39	0.128	43.7
DR125-101-R	100	102.7	1.78	2.20	0.170	47.5
DR125-151-R	150	151.1	1.48	1.81	0.248	57.6
DR125-221-R	220	216.8	1.19	1.51	0.384	69.0
DR125-331-R	330	332.6	1.06	1.22	0.482	85.5
DR125-471-R	470	473.1	0.87	1.02	0.718	102
DR125-681-R	680	679.8	0.70	0.85	1.10	122
DR125-821-R	820	828.0	0.60	0.77	1.49	135
DR125-102-R	1000	1008	0.57	0.70	1.69	149
DR125-124-R	120000	120630	0.060	0.069	150	1521
DR127-R47-R	0.47	0.419	17.9	56.0	0.00195	3.50
DR127-1R0-R	1.00	0.821	15.5	40.0	0.00313	4.90
DR127-1R5-R	1.50	1.357	13.5	31.1	0.00341	6.30
DR127-2R2-R	2.20	2.027	12.5	25.5	0.00402	7.70
DR127-3R3-R	3.30	2.831	10.5	21.5	0.00567	9.10
DR127-4R7-R	4.70	4.841	8.25	16.5	0.00917	11.9
DR127-6R8-R	6.80	7.387	7.34	13.3	0.0116	14.7
DR127-8R2-R	8.20	8.861	6.32	12.2	0.0157	16.1
DR127-100-R	10.0	10.47	6.04	11.2	0.0172	17.5
DR127-150-R	15.0	14.09	5.03	9.66	0.0247	20.3
DR127-220-R	22.0	22.93	4.00	7.57	0.0391	25.9
DR127-330-R	33.0	33.92	3.23	6.22	0.0600	31.5
DR127-470-R	47.0	47.05	2.95	5.28	0.0719	37.1
DR127-680-R	68.0	66.48	2.44	4.44	0.105	44.1
DR127-820-R	82.0	79.75	2.09	4.06	0.143	48.3
DR127-101-R	100	99.31	1.96	3.64	0.163	53.9
DR127-151-R	150	144.9	1.59	3.01	0.247	65.1
DR127-221-R	220	221.5	1.29	2.43	0.376	80.5
DR127-331-R	330	323.6	1.04	2.01	0.574	97.3
DR127-471-R	470	467.1	0.85	1.68	0.861	117
DR127-681-R	680	676.7	0.76	1.39	1.08	141
DR127-821-R	820	818.1	0.65	1.27	1.47	155
DR127-102-R	1000	1005	0.61	1.14	1.66	172

(1) Open Circuit Inductance Test Parameters: 100KHz, 0.25Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
(3) Peak current for approximate 30% roll off at 20°C.
(4) DCR limits @ 20°C.
(5) Applied Volt-Time product (V-µS) across the inductor. This value represent the applied V-µS at 100KHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.

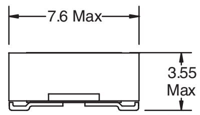
Mechanical Diagrams

DR73 Series

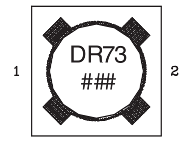
BOTTOM VIEW



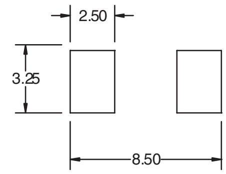
FRONT VIEW



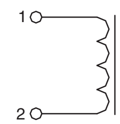
TOP VIEW



RECOMMENDED PCB LAYOUT

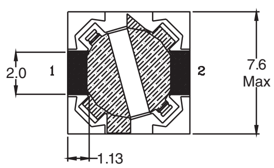


SCHEMATIC

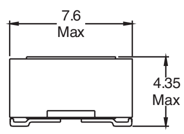


DR74 Series

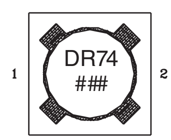
BOTTOM VIEW



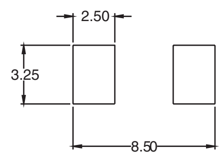
FRONT VIEW



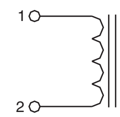
TOP VIEW



RECOMMENDED PCB LAYOUT

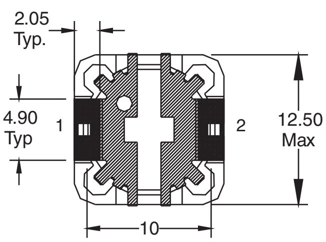


SCHEMATIC

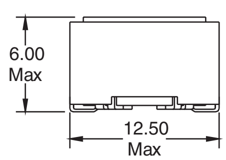


DR125 Series

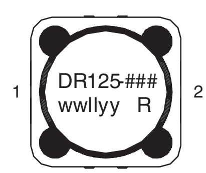
BOTTOM VIEW



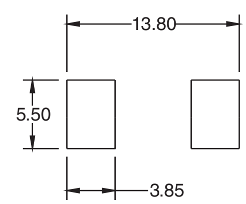
FRONT VIEW



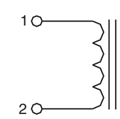
TOP VIEW



RECOMMENDED PCB LAYOUT

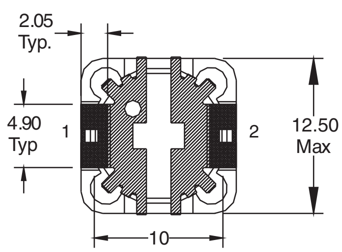


SCHEMATIC

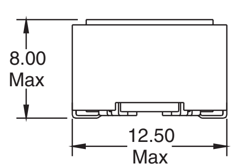


DR127 Series

BOTTOM VIEW

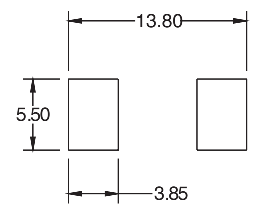


FRONT VIEW

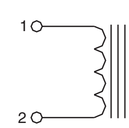


TOP VIEW

RECOMMENDED PCB LAYOUT



SCHEMATIC



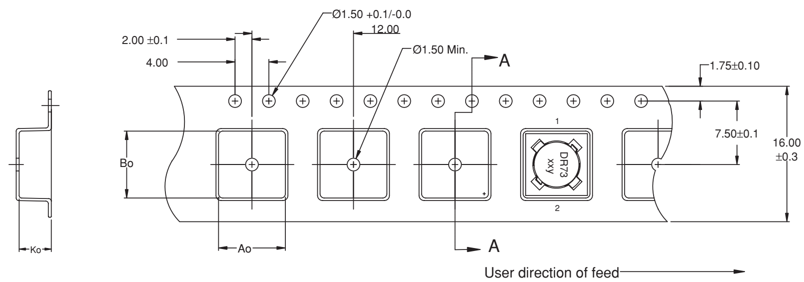
Dimensions in Millimeters.

= Inductance value per family chart
wwllyy = (date code) R = revision level

SHIELDED DRUM (DR)

Packaging Information

DR73 Series



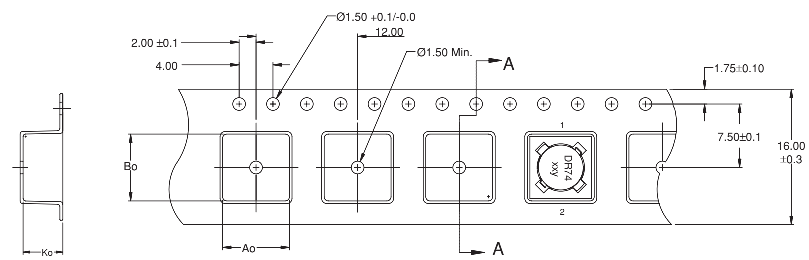
Ao=7.90mm
Bo=7.90mm
Ko=3.80mm

SECTION A-A

ACTUAL SIZE
DR73

Parts packaged on 13" Diameter reel, 1,350 parts per reel.

DR74 Series



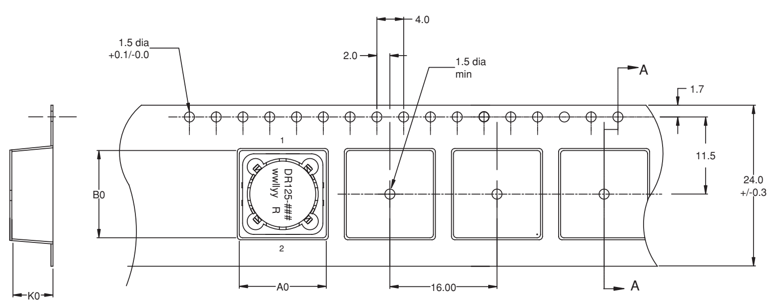
Ao=7.90mm
Bo=7.90mm
Ko=4.70mm

SECTION A-A

ACTUAL SIZE
DR74

Parts packaged on 13" Diameter reel, 1,100 parts per reel.

DR125 Series



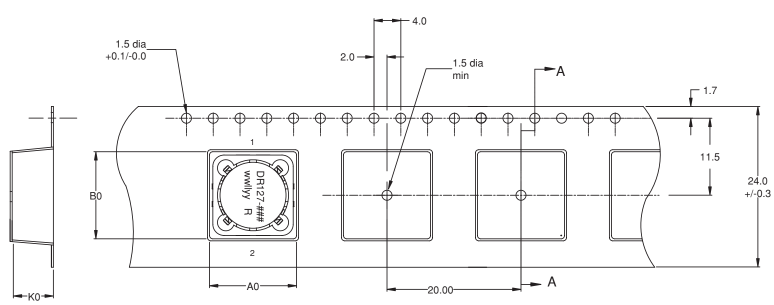
Ao=13.0mm
Bo=13.0mm
Ko=6.30mm

SECTION A-A

ACTUAL SIZE
DR125

Parts packaged on 13" Diameter reel, 600 parts per reel.

DR127 Series



Ao=13.0mm
Bo=13.0mm
Ko=8.30mm

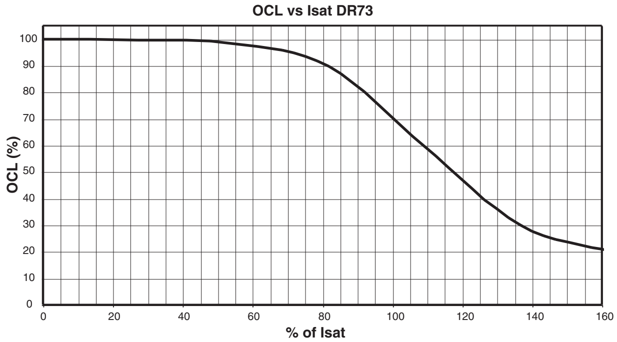
SECTION A-A

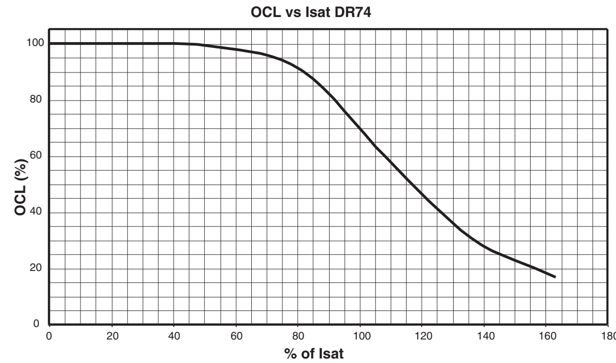
ACTUAL SIZE
DR127

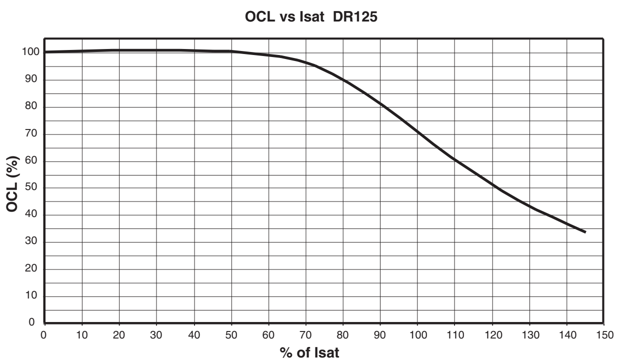
Parts packaged on 13" Diameter reel, 350 parts per reel.

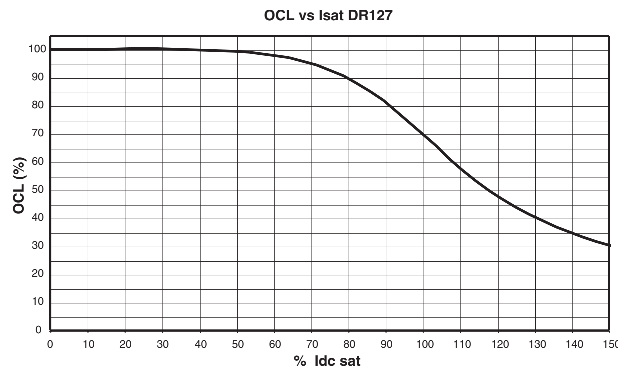
Dimensions are in millimeters.

Inductance Characteristics

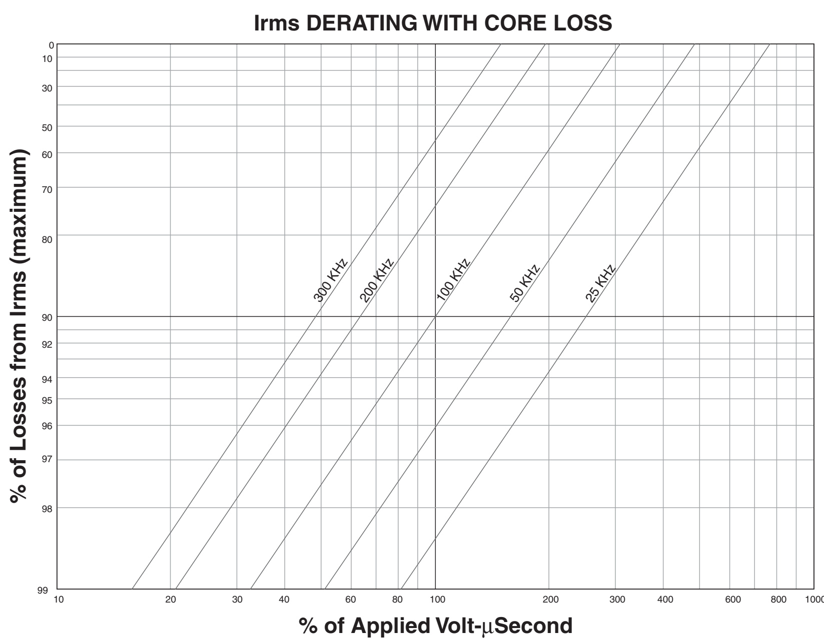








Core Loss



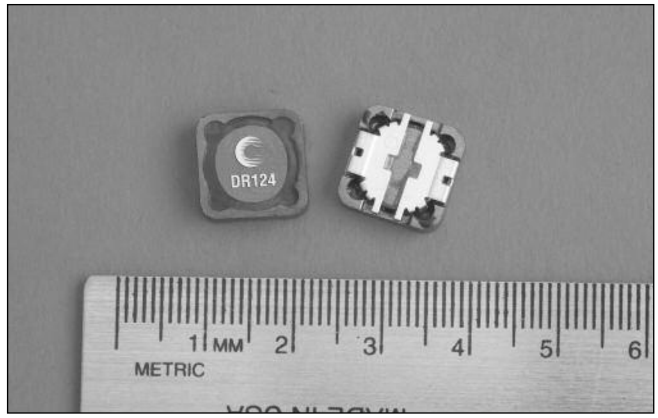
DR124 Series
Low Profile Power Inductors

RoHS
2002/95/EC

Description
- 125°C maximum total temperature operation
- Low profile surface mount inductor
- 12.3mm x 12.3mm x 4.5mm shielded drum core
- Ferrite core material
- Inductance range from 0.47µH to 1000µH
- Current range from 24.4 Amps to 0.44 Amps
- Frequency range up to 1MHz

Applications
- Notebook power, LCD panels
- Computer, DVD players, and portable power devices
- DC-DC converters
- Buck, boost, forward, and resonant converters
- Noise filtering and filter chokes

Environmental Data
- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

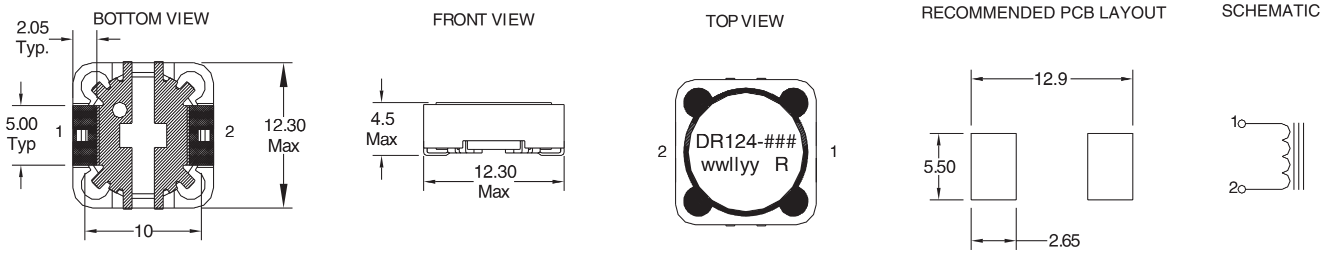


Packaging
- Supplied in tape and reel packaging, 750 per reel

Part Number	Rated Inductance (µH)	OCL (1) µH±20%	Irms(2) Amperes	Isat (3) Amperes	DCR (Ω) mΩ @20°C (Typical)	DCR (Ω) mΩ @20°C (Maximum)	K-factor (4)
DR124-R47-R	0.47	0.42	16.0	24.40	2.2	2.7	17.51
DR124-1R0-R	1.0	0.83	13.9	18.00	3.00	3.6	12.50
DR124-1R5-R	1.5	1.37	11.1	14.00	4.75	5.7	9.73
DR124-2R2-R	2.2	2.04	9.1	11.45	5.92	7.1	7.96
DR124-3R9-R	3.9	3.80	7.0	8.40	12.50	15.0	5.84
DR124-4R7-R	4.7	4.88	6.5	7.65	13.50	16.2	5.15
DR124-6R8-R	6.8	6.10	5.6	6.47	18.06	21.7	4.61
DR124-8R2-R	8.2	7.45	5.2	6.22	21.67	26.0	4.17
DR124-100-R	10	8.94	4.5	5.80	23.33	28.0	3.81
DR124-120-R	12	11.5	4.1	4.96	31.67	38.0	3.50
DR124-150-R	15	14.2	3.6	4.62	37.30	44.8	3.02
DR124-180-R	18	16.2	3.4	4.32	46.97	56.4	2.82
DR124-220-R	22	20.7	3.2	3.83	53.99	64.8	2.50
DR124-270-R	27	25.7	2.8	3.44	66.67	80.0	2.24
DR124-330-R	33	31.2	2.6	3.12	80.83	97.0	2.04
DR124-390-R	39	37.3	2.3	2.85	110.00	132.0	1.86
DR124-470-R	47	44.0	2.2	2.63	124.66	149.6	1.72
DR124-560-R	56	54.9	2.0	2.35	144.32	173.2	1.54
DR124-680-R	68	67.1	1.8	2.13	183.33	220.0	1.39
DR124-820-R	82	80.5	1.7	1.94	212.72	255.3	1.27
DR124-101-R	100	95.1	1.5	1.79	256.67	308.0	1.17
DR124-121-R	120	111	1.3	1.65	311.18	373.4	1.08
DR124-151-R	150	146	1.3	1.44	371.02	445.2	0.94
DR124-181-R	180	179	1.1	1.30	501.66	602.0	0.87
DR124-221-R	220	216	1.0	1.15	558.00	669.6	0.77
DR124-271-R	270	256	0.88	1.09	725.00	870.0	0.71
DR124-331-R	330	327	0.83	0.92	825.00	990.0	0.63
DR124-471-R	470	460	0.68	0.74	1242.50	1491.0	0.53
DR124-681-R	680	669	0.56	0.65	1845.83	2215.0	0.45
DR124-821-R	820	825	0.53	0.62	2109.17	2351.0	0.40
DR124-102-R	1000	998	0.44	0.53	2898.00	3477.00	0.37

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.25V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 25% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in µH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: DR124-xxx-R
DR124 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

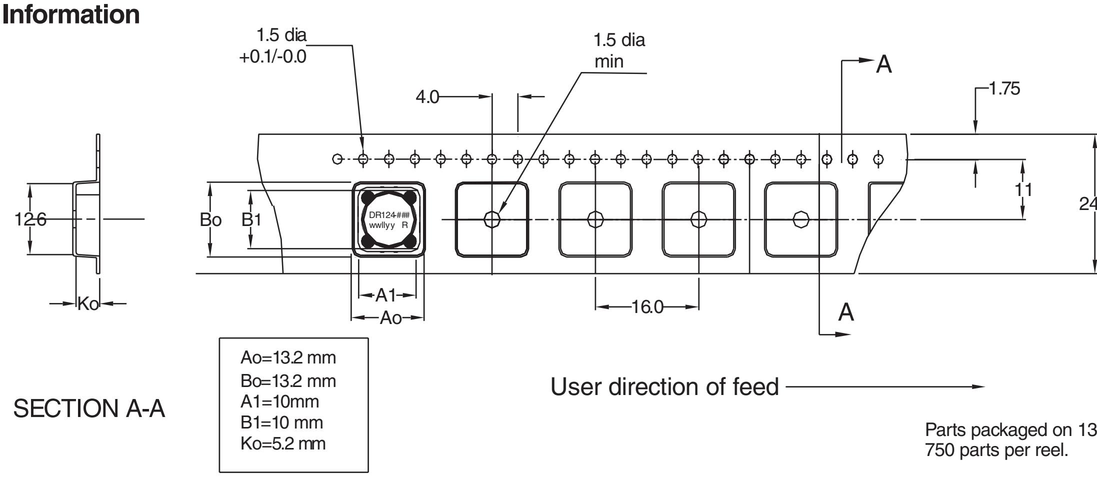
Mechanical Diagrams



Dimensions are in millimeters.

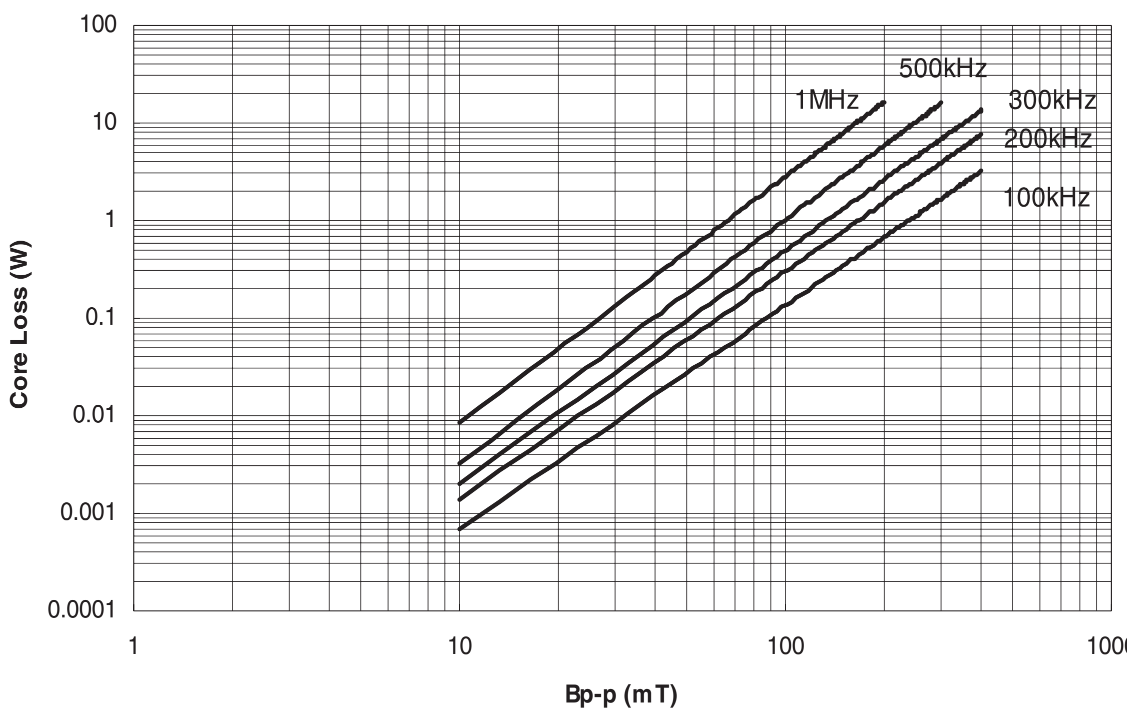
wwlly = Date code, R = Revision level.

Packaging Information



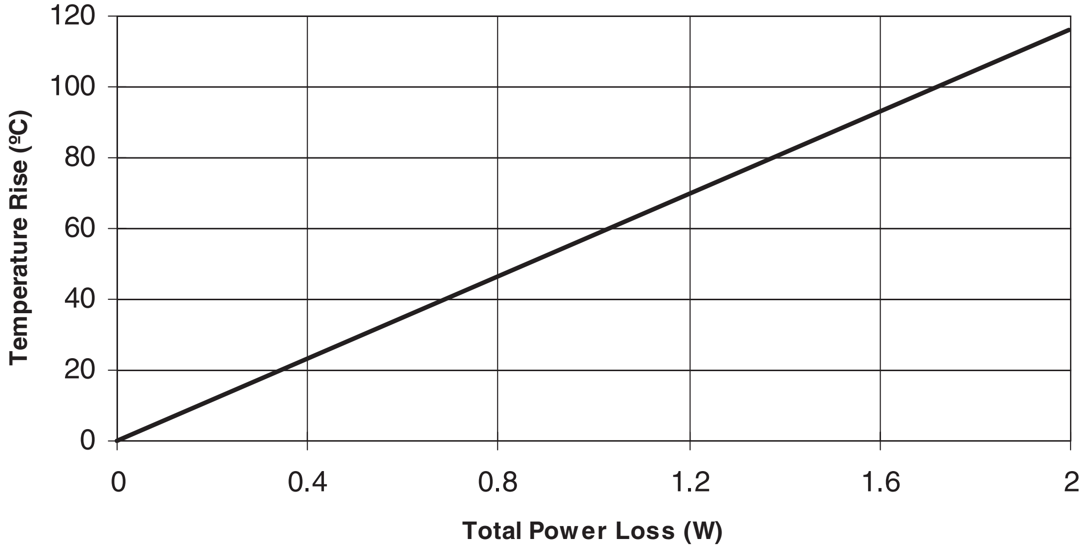
Parts packaged on 13" Diameter reel, 750 parts per reel.

Core Loss

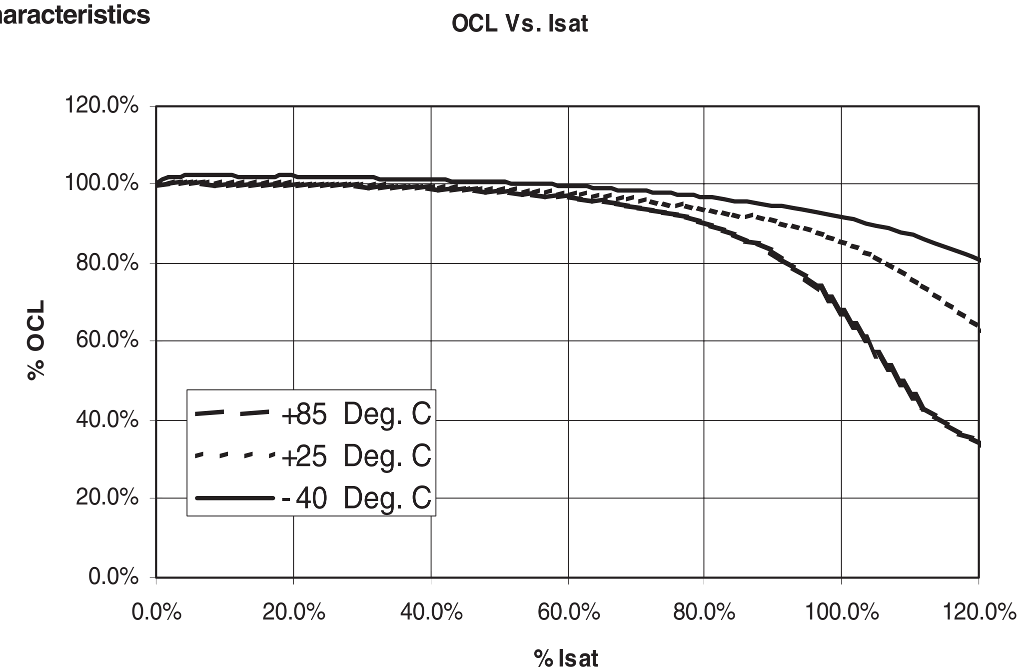


SHIELDED DRUM (DR124)

Temperature Rise vs. Loss



Inductance Characteristics



DRQ Series Dual Winding, Shielded Inductors/Transformer

COOPER Bussmann

Description

RoHS 2002/95/EC

- 125°C maximum total temperature operation
- Dual winding inductors that can be used as either a single inductor, or in coupled inductor/transformer applications (1:1 turns ratio)
- Four sizes of shielded drum core inductors
- Windings can be connected in series or parallel, offering a broad range of inductance and current ratings
- Peak current ratings from 0.13 Amps to 56 Amps
- RMS current ratings from 0.128 Amps to 17.9 Amps
- Inductance ratings from 0.33µH to 4.02mH
- Surface Mount
- 200 VAC Isolation between windings
- Ferrite core material

Applications

- As a transformer: SEPIC, flyback
- As an inductor: Buck, boost, coupled inductor
- DC/DC converters
- VRM inductor for CPU and DDR power supplies
- Input and output filter chokes

Environmental Data

- Storage temperature: -40°C to +125°C
- Operating temperature: -40°C to +125°C (Range is application specific).
- Solder reflow temperature: 260°C max. for 10 seconds max.

Packaging

- Supplied in tape and reel packaging, 1350 (DRQ73), 1100 (DRQ74), 600 (DRQ125), and 350 (DRQ127) per reel

		Parallel Ratings					Series Ratings				
Part Number	Rated Inductance (µH)	OCL (1) +/-20% (µH)	I rms (2) Amperes	I sat (3) Amperes Peak	DCR Ω (4) typ.	Volt (5) µ-Sec	OCL (1) +/-20% (µH)	I rms (2) Amperes	I sat (3) Amperes Peak	DCR Ω (4) typ.	Volt (5) µ-Sec
DRQ73-R33-R	0.33	0.306	6.19	14.4	0.0074	1.98	1.224	3.10	7.18	0.0296	3.96
DRQ73-1R0-R	1.00	0.992	5.25	7.97	0.0103	3.56	3.968	2.63	3.99	0.0411	7.12
DRQ73-1R5-R	1.50	1.482	4.64	6.52	0.0132	4.36	5.928	2.32	3.26	0.0527	8.72
DRQ73-2R2-R	2.20	2.070	4.11	5.52	0.0167	5.15	8.280	2.06	2.76	0.0669	10.3
DRQ73-3R3-R	3.30	3.540	3.31	4.22	0.0259	6.73	14.16	1.66	2.11	0.1035	13.5
DRQ73-4R7-R	4.70	4.422	3.09	3.78	0.0297	7.52	17.69	1.55	1.89	0.1188	15.0
DRQ73-6R8-R	6.80	6.480	2.55	3.12	0.0435	9.11	25.92	1.28	1.56	0.1742	18.2
DRQ73-8R2-R	8.20	8.930	2.19	2.66	0.0592	10.7	35.72	1.10	1.33	0.2368	21.4
DRQ73-100-R	10.0	10.30	2.08	2.47	0.0656	11.5	41.20	1.04	1.24	0.2623	23.0
DRQ73-150-R	15.0	15.01	1.83	2.05	0.0844	13.9	60.04	0.916	1.03	0.339	27.8
DRQ73-220-R	22.0	22.65	1.62	1.67	0.107	17.0	90.60	0.811	0.83	0.429	34.0
DRQ73-330-R	33.0	34.41	1.31	1.35	0.166	21.0	137.6	0.653	0.68	0.665	42.0
DRQ73-470-R	47.0	48.62	1.08	1.14	0.241	24.9	194.5	0.542	0.57	0.965	49.8
DRQ73-680-R	68.0	68.91	0.89	0.96	0.358	29.7	275.6	0.444	0.48	1.43	59.4
DRQ73-820-R	82.0	80.37	0.86	0.89	0.384	32.1	321.5	0.430	0.44	1.54	64.2
DRQ73-101-R	100	101.4	0.73	0.79	0.527	36.0	405.6	0.367	0.39	2.11	72.0
DRQ73-151-R	150	150.9	0.58	0.65	0.851	44.0	603.6	0.289	0.32	3.41	88.0
DRQ73-221-R	220	223.3	0.52	0.53	1.05	53.5	893.2	0.260	0.27	4.20	107
DRQ73-331-R	330	325.5	0.42	0.44	1.59	64.5	1302	0.211	0.22	6.36	129
DRQ73-471-R	470	465.8	0.35	0.37	2.36	77.2	1863	0.173	0.18	9.44	154
DRQ73-681-R	680	676.5	0.29	0.31	3.47	93.1	2706	0.143	0.15	13.88	186
DRQ73-821-R	820	821.7	0.27	0.28	3.93	103	3287	0.134	0.14	15.72	206
DRQ73-102-R	1000	995.0	0.26	0.25	4.34	113	3980	0.128	0.13	17.36	226

SHIELDED DRUM (DRQ)

1) Open Circuit Inductance Test Parameters: 100kHz, 0.25 Vrms, 0.0 Adc Parallel: (1,2 - 4,2) Series: (1 - 4) tie (2 - 3)
2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
3) Peak current for approximately 30% roll-off at 20°C
4) DCR limits @ 20°C
5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 100KHz necessary to generate a core loss equal to 10% of the total losses for a 40°C temperature rise.
6) Turns Ratio (1-2):(3-4) 1:1

DRQ Series
Dual Winding, Shielded Inductors/Transformer

		Parallel Ratings					Series Ratings				
Part Number	Rated Inductance (µH)	OCL (1) +/-20% (µH)	I rms (2) Amperes	I sat (3) Amperes Peak	DCR Ω (4) typ.	Volt (5) µ-Sec	OCL (1) +/-20% (µH)	I rms (2) Amperes	I sat (3) Amperes Peak	DCR Ω (4) typ.	Volt (5) µ-Sec
DRQ74-R33-R	0.33	0.294	6.20	18.4	0.0074	1.71	1.176	3.10	9.18	0.0295	3.42
DRQ74-1R0-R	1.00	0.952	5.33	10.2	0.0100	3.08	3.808	2.66	5.10	0.0400	6.16
DRQ74-1R5-R	1.50	1.422	4.96	8.35	0.0115	3.76	5.688	2.48	4.17	0.0461	7.52
DRQ74-2R2-R	2.20	1.986	4.66	7.06	0.0130	4.45	7.944	2.33	3.53	0.0521	8.9
DRQ74-3R3-R	3.30	3.396	3.94	5.40	0.0183	5.81	13.58	1.97	2.70	0.0732	11.6
DRQ74-4R7-R	4.70	5.182	3.34	4.37	0.0254	7.18	20.73	1.67	2.19	0.102	14.4
DRQ74-6R8-R	6.80	7.344	2.60	3.67	0.0418	8.55	29.38	1.30	1.84	0.167	17.1
DRQ74-8R2-R	8.20	8.566	2.53	3.40	0.0441	9.23	34.26	1.27	1.70	0.177	18.5
DRQ74-100-R	10.0	9.882	2.41	3.17	0.0489	9.92	39.53	1.20	1.58	0.196	19.8
DRQ74-150-R	15.0	16.09	2.11	2.48	0.0637	12.7	64.36	1.05	1.24	0.255	25.4
DRQ74-220-R	22.0	21.73	1.75	2.13	0.0925	14.7	86.92	0.874	1.07	0.371	29.4
DRQ74-330-R	33.0	33.01	1.41	1.73	0.143	18.1	132.0	0.702	0.87	0.574	36.2
DRQ74-470-R	47.0	49.64	1.15	1.41	0.216	22.2	198.6	0.573	0.71	0.865	44.4
DRQ74-680-R	68.0	69.67	1.03	1.19	0.265	26.3	278.7	0.517	0.60	1.06	52.6
DRQ74-820-R	82.0	80.95	0.91	1.11	0.345	28.4	323.8	0.453	0.55	1.38	56.8
DRQ74-101-R	100	101.6	0.86	0.99	0.383	31.8	406.4	0.430	0.49	1.53	63.6
DRQ74-151-R	150	150.0	0.69	0.81	0.591	38.6	600.0	0.346	0.41	2.37	77.2
DRQ74-221-R	220	227.0	0.56	0.66	0.907	47.5	908.0	0.279	0.33	3.63	95
DRQ74-331-R	330	335.6	0.45	0.54	1.41	57.8	1342	0.224	0.27	5.66	116
DRQ74-471-R	470	465.3	0.40	0.46	1.74	68.1	1861	0.202	0.23	6.97	136
DRQ74-681-R	680	671.2	0.33	0.38	2.58	81.7	2685	0.166	0.19	10.3	163
DRQ74-821-R	820	812.7	0.31	0.35	2.93	89.9	3251	0.156	0.17	11.7	180
DRQ74-102-R	1000	1009	0.27	0.31	3.89	100	4036	0.135	0.16	15.6	200
DRQ125-R47-R	0.47	0.456	17.6	33.0	0.0018	3.17	1.824	8.80	16.5	0.0078	6.34
DRQ125-1R0-R	1.00	0.894	15.0	23.6	0.0024	4.43	3.576	7.51	11.8	0.0096	8.86
DRQ125-1R5-R	1.50	1.478	13.8	18.3	0.0029	5.70	5.912	6.89	9.15	0.0114	11.40
DRQ125-2R2-R	2.20	2.208	10.9	15.0	0.0045	6.97	8.832	5.46	7.50	0.0182	13.9
DRQ125-3R3-R	3.30	3.084	9.26	12.7	0.0063	8.23	12.34	4.63	6.35	0.0253	16.5
DRQ125-4R7-R	4.70	5.274	7.18	9.71	0.0105	10.8	21.10	3.59	4.86	0.0420	21.6
DRQ125-6R8-R	6.80	6.588	6.64	8.68	0.0123	12.0	26.35	3.32	4.34	0.0492	24.0
DRQ125-8R2-R	8.20	8.048	5.54	7.86	0.0176	13.3	32.19	2.77	3.93	0.0705	26.6
DRQ125-100-R	10.0	9.654	5.35	7.17	0.0189	14.6	38.62	2.67	3.59	0.0757	29.2
DRQ125-150-R	15.0	15.35	4.27	5.69	0.0298	18.4	61.40	2.13	2.85	0.120	36.8
DRQ125-220-R	22.0	22.36	3.70	4.71	0.0396	22.2	89.44	1.84	2.36	0.159	44.4
DRQ125-330-R	33.0	33.74	3.28	3.84	0.0505	27.2	135.0	1.64	1.92	0.203	54.4
DRQ125-470-R	47.0	47.47	2.71	3.24	0.0740	32.3	189.9	1.35	1.62	0.297	64.6
DRQ125-680-R	68.0	67.91	2.22	2.70	0.101	38.6	271.6	1.11	1.35	0.440	77.2
DRQ125-820-R	82.0	86.89	2.05	2.39	0.128	43.7	347.6	1.03	1.20	0.515	87.4
DRQ125-101-R	100	102.7	1.78	2.20	0.170	47.5	410.8	0.892	1.10	0.682	95.0
DRQ125-151-R	150	151.1	1.48	1.81	0.248	57.6	604.4	0.739	0.905	0.991	115.2
DRQ125-221-R	220	216.8	1.19	1.51	0.384	69.0	867.2	0.594	0.755	1.54	138
DRQ125-331-R	330	332.6	1.06	1.22	0.482	85.5	1330	0.530	0.610	1.93	171
DRQ125-471-R	470	473.1	0.87	1.02	0.718	102	1892	0.434	0.510	2.87	204
DRQ125-681-R	680	679.8	0.70	0.85	1.10	122	2719	0.350	0.425	4.42	244
DRQ125-821-R	820	828.0	0.60	0.77	1.49	135	3312	0.301	0.385	5.96	270
DRQ125-102-R	1000	1008	0.57	0.70	1.69	149	4032	0.283	0.350	6.76	298

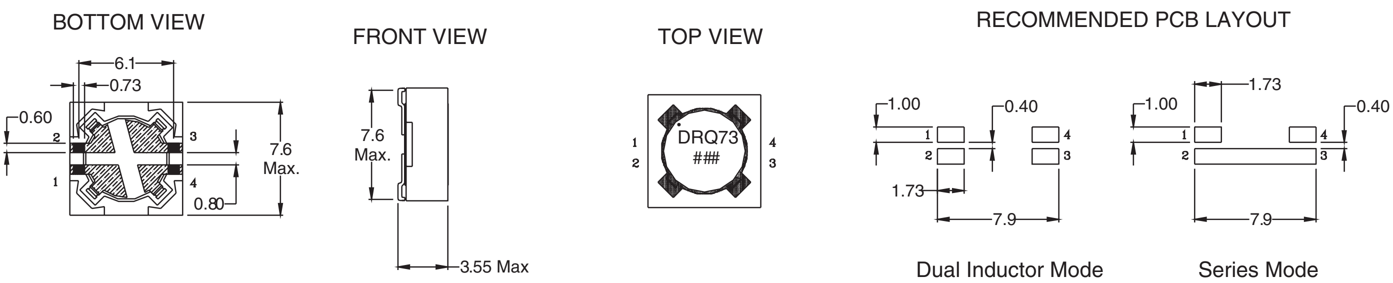
1) Open Circuit Inductance Test Parameters: 100kHz, 0.25 Vrms, 0.0 Adc
Parallel: (1,2 - 4,2) Series: (1 - 4) tie (2 - 3)
2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
3) Peak current for approximately 30% roll-off at 20°C
4) DCR limits @ 20°C
5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 100KHz necessary to generate a core loss equal to 10% of the total losses for a 40°C temperature rise.
6) Turns Ratio (1-2):(3-4) 1:1

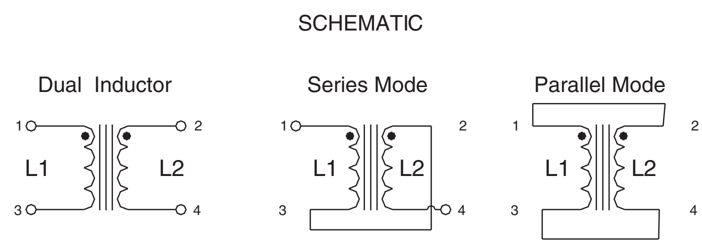
		Parallel Ratings					Series Ratings				
Part Number	**Rated Inductance (µH)**	**OCL (1) +/-20% (µH)**	**I rms (2) Amperes**	**I sat (3) Amperes Peak**	**DCR Ω (4) typ.**	**Volt (5) µ-Sec**	**OCL (1) +/-20% (µH)**	**I rms (2) Amperes**	**I sat (3) Amperes Peak**	**DCR Ω (4) typ.**	**Volt (5) µ-Sec**
DRQ127-R47-R	0.47	0.419	17.9	56.0	0.00195	3.50	1.676	8.94	28	0.0078	7.00
DRQ127-1R0-R	1.00	0.821	15.5	40.0	0.00261	4.90	3.284	7.74	20	0.0104	9.80
DRQ127-1R5-R	1.50	1.357	13.5	31.1	0.00341	6.30	5.428	6.77	15.6	0.0137	12.60
DRQ127-2R2-R	2.20	2.027	12.5	25.5	0.00373	7.70	8.108	6.23	12.7	0.0161	15.4
DRQ127-3R3-R	3.30	2.831	10.4	21.5	0.00567	9.10	11.32	5.23	10.8	0.0229	18.2
DRQ127-4R7-R	4.70	4.841	8.25	16.5	0.00917	11.9	19.36	4.13	8.24	0.0367	23.8
DRQ127-6R8-R	6.80	7.387	7.34	13.3	0.0116	14.7	29.55	3.67	6.67	0.0465	29.4
DRQ127-8R2-R	8.20	8.861	6.32	12.2	0.0157	16.1	35.44	3.16	6.09	0.0627	32.2
DRQ127-100-R	10.0	10.47	6.04	11.2	0.0172	17.5	41.88	3.02	5.60	0.0686	35.0
DRQ127-150-R	15.0	14.09	5.03	9.66	0.0247	20.3	56.36	2.51	4.83	0.0990	40.6
DRQ127-220-R	22.0	22.93	4.00	7.57	0.0391	25.9	91.72	2.00	3.78	0.157	51.8
DRQ127-330-R	33.0	33.92	3.23	6.22	0.0600	31.5	135.7	1.61	3.11	0.241	63.0
DRQ127-470-R	47.0	47.05	2.95	5.28	0.0719	37.1	188.2	1.47	2.64	0.288	74.2
DRQ127-680-R	68.0	66.48	2.44	4.44	0.105	44.1	265.9	1.22	2.22	0.421	88.2
DRQ127-820-R	82.0	79.75	2.09	4.06	0.143	48.3	319.0	1.04	2.03	0.573	96.6
DRQ127-101-R	100	99.31	1.96	3.64	0.163	53.9	397.2	0.980	1.82	0.653	107.8
DRQ127-151-R	150	144.9	1.59	3.01	0.247	65.1	579.6	0.796	1.51	0.989	130.2
DRQ127-221-R	220	221.5	1.29	2.43	0.376	80.5	886.0	0.645	1.22	1.50	161
DRQ127-331-R	330	323.6	1.04	2.01	0.574	97.3	1294	0.522	1.01	2.30	195
DRQ127-471-R	470	467.1	0.85	1.68	0.861	117	1868	0.427	0.838	3.44	234
DRQ127-681-R	680	676.7	0.76	1.39	1.08	141	2707	0.380	0.697	4.32	282
DRQ127-821-R	820	818.1	0.65	1.27	1.47	155	3272	0.325	0.633	5.88	310
DRQ127-102-R	1000	1005	0.61	1.14	1.66	172	4020	0.307	0.571	6.64	344

1) Open Circuit Inductance Test Parameters: 100kHz, 0.25 Vrms, 0.0 Adc
Parallel: (1,2 - 4,2) Series: (1 - 4) tie (2 - 3)
2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
3) Peak current for approximately 30% roll-off at 20°C
4) DCR limits @ 20°C
5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 100KHz necessary to generate a core loss equal to 10% of the total losses for a 40°C temperature rise.
6) Turns Ratio (1-2):(3-4) 1:1

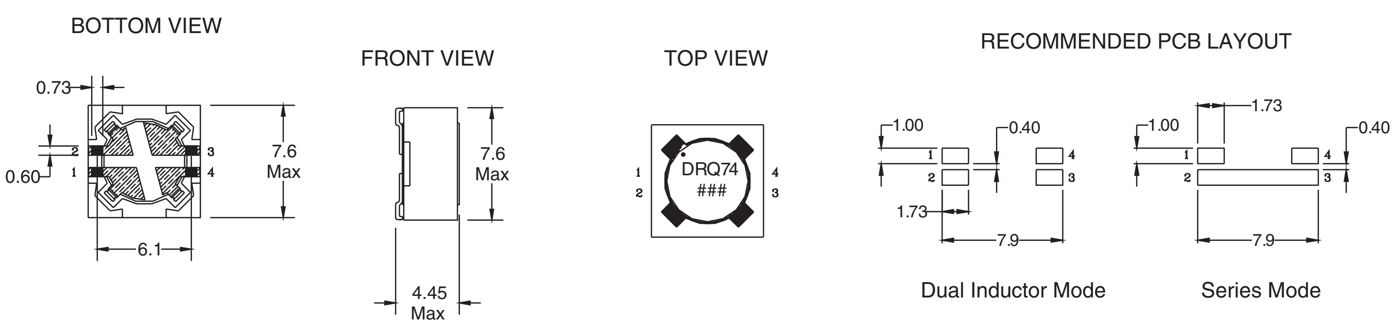
Mechanical Diagrams

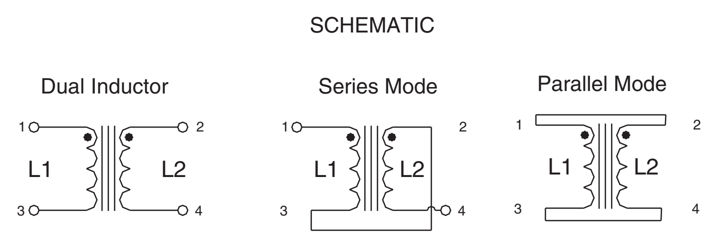
DRQ73 Series





DRQ74 Series





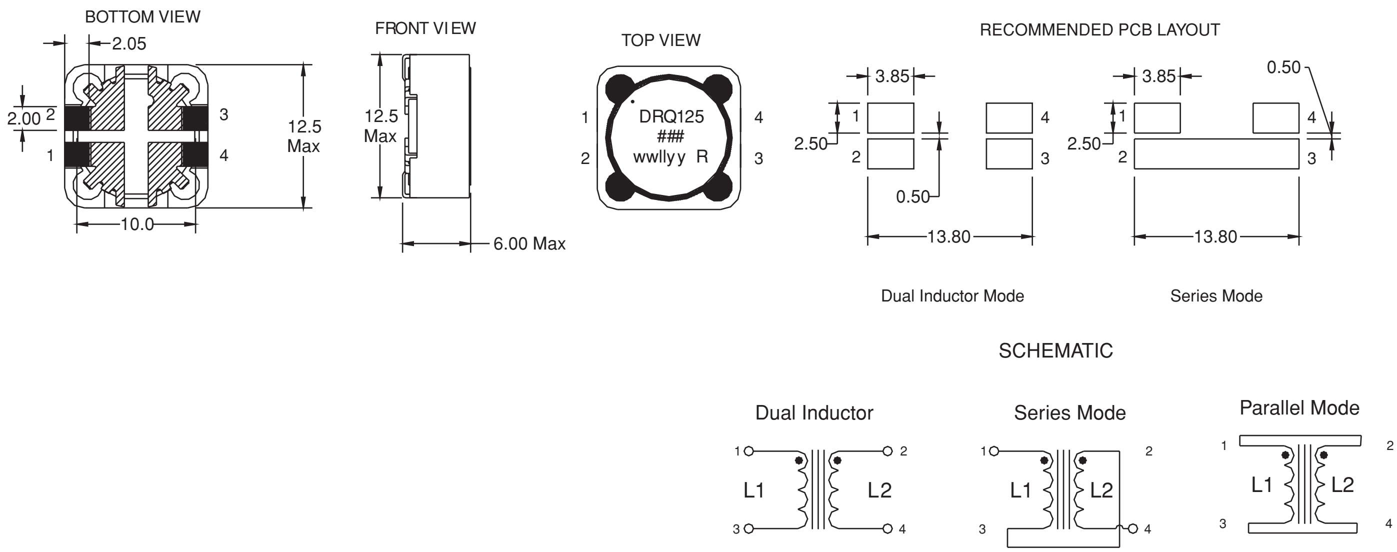
Dimensions in Millimeters.

= Inductance value per family chart
Dot indicates pin #1

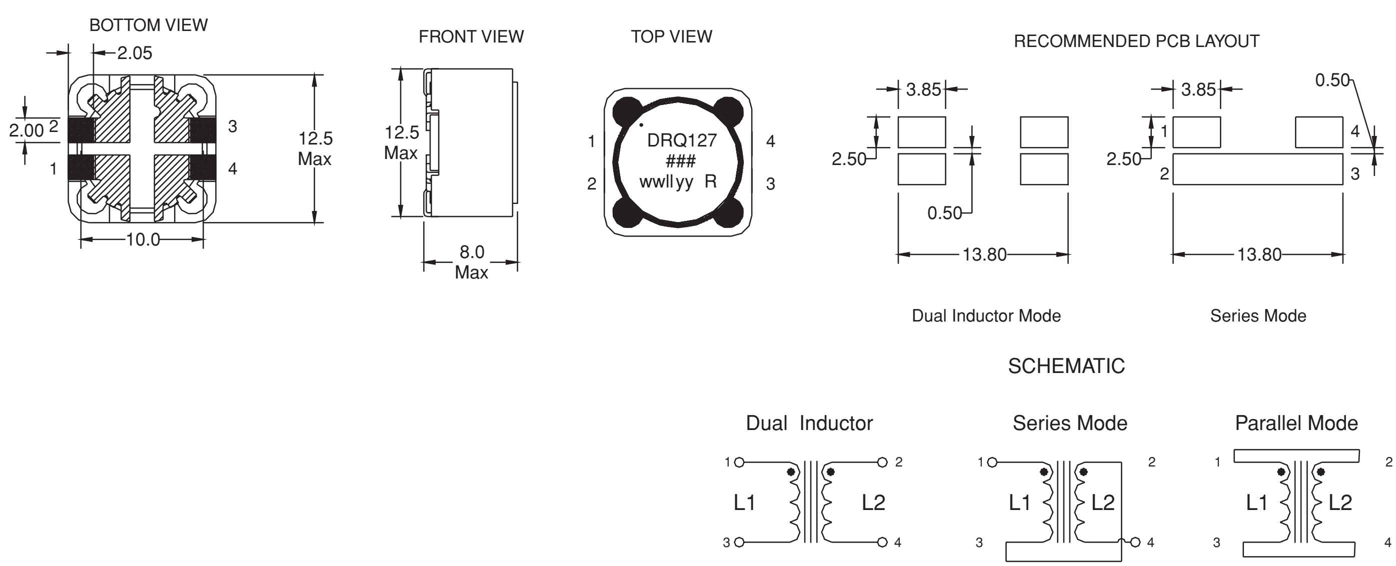
DRQ Series
Dual Winding, Shielded Inductors/Transformer

Mechanical Diagrams

DRQ125 Series



DRQ127 Series

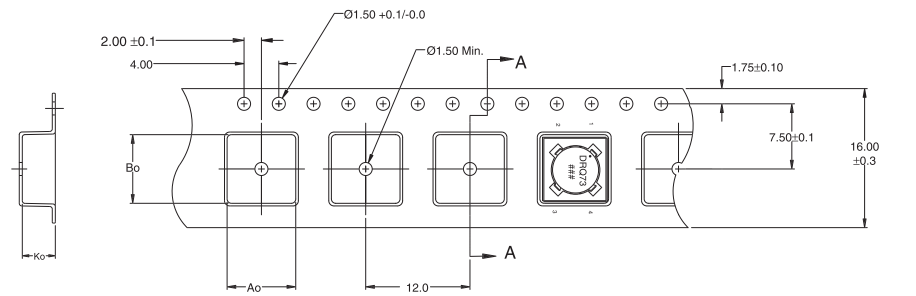


Dimensions in Millimeters.

= Inductance value per family chart
wwllyy = (date code) R = revision level
Dot indicates pin #1

Packaging Information

DRQ73 Series



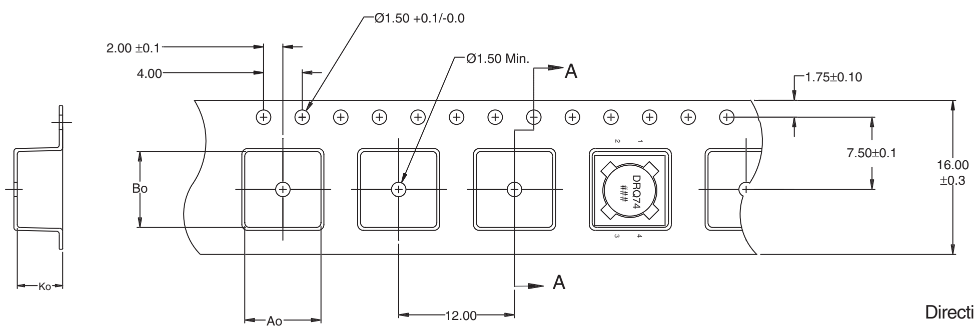
ACTUAL SIZE
DRQ73

Ao=7.90mm
Bo=7.90mm
Ko=3.80mm

Direction of Feed ⟶

Parts packaged on 13" Diameter reel, 1,350 parts per reel.

DRQ74 Series



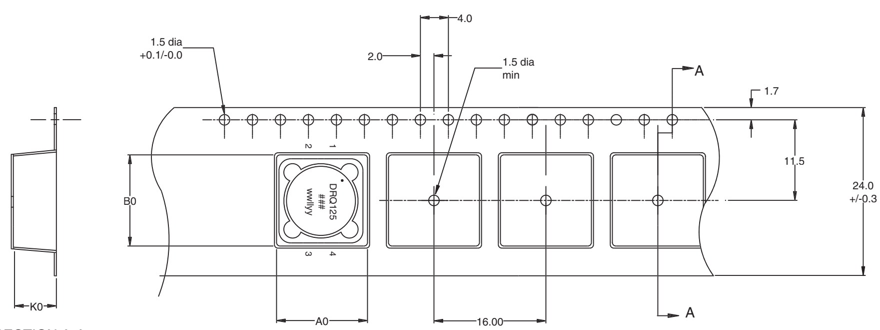
ACTUAL SIZE
DRQ74

Ao=7.90mm
Bo=7.90mm
Ko=4.70mm

Direction of Feed ⟶

Parts packaged on 13" Diameter reel, 1,100 parts per reel.

DRQ125 Series



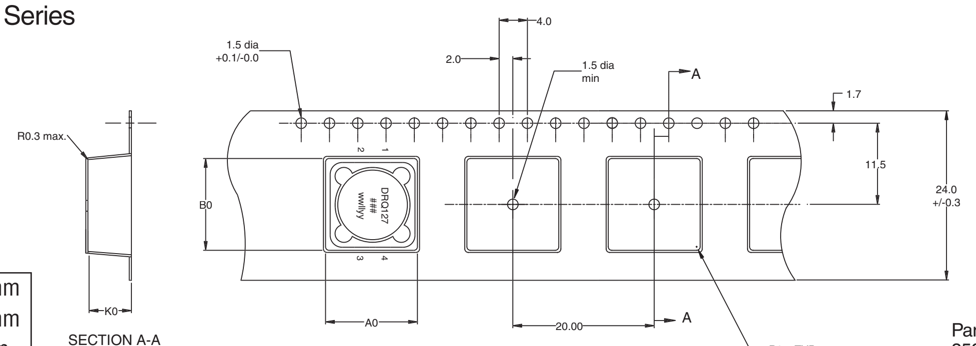
ACTUAL SIZE
DRQ125

Ao=13.00mm
Bo=13.00mm
Ko=6.30mm

Direction of Feed ⟶

Parts packaged on 13" Diameter reel, 600 parts per reel.

DRQ127 Series



ACTUAL SIZE
DRQ127

Ao=13.00mm
Bo=13.00mm
Ko=8.30mm

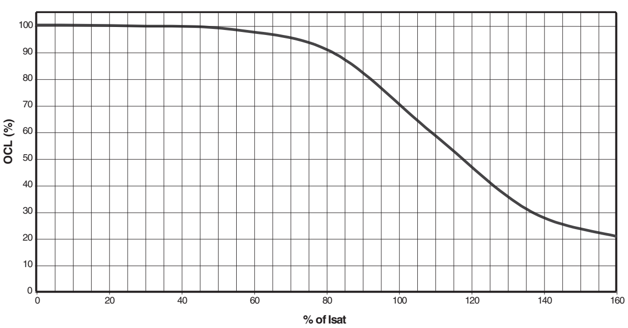
Direction of Feed ⟶

Parts packaged on 13" Diameter reel, 350 parts per reel.

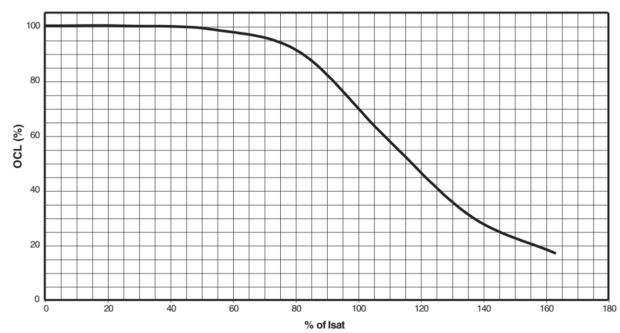
Dimensions are in millimeters.

Inductance Characteristics

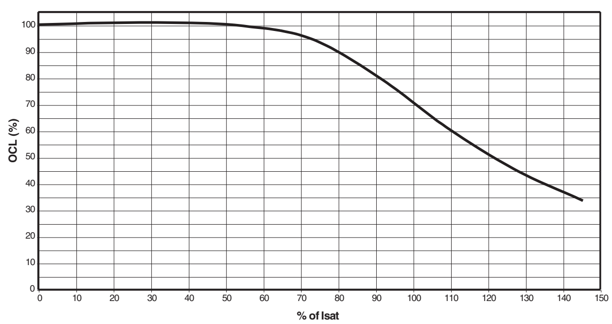
OCL vs Isat DRQ73



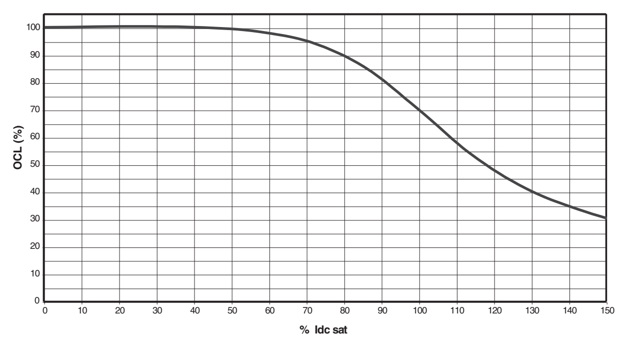
OCL vs Isat DRQ74



OCL vs Isat DRQ125

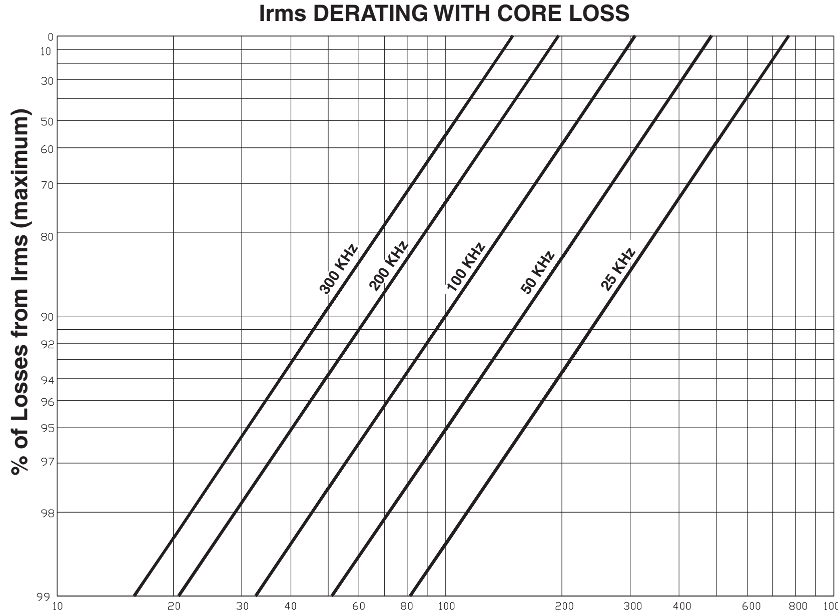


OCL vs Isat DRQ127



Core Loss

Irms DERATING WITH CORE LOSS



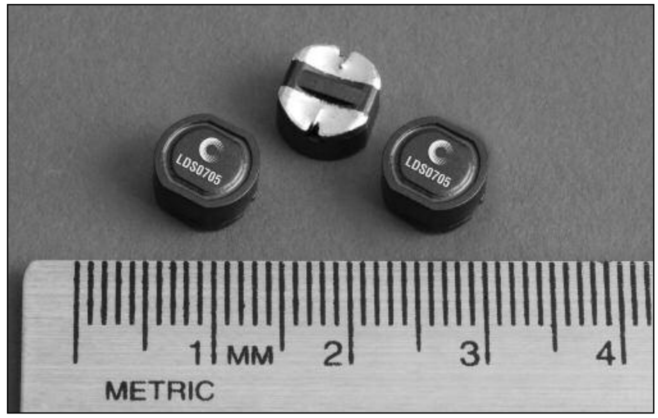
COOPER Bussmann

LDS0705 Series
Shielded Power Inductors

Description

RoHS 2002/95/EC

- 125°C maximum temperature operation
- 7.8mm x 7.0mm x 5.0mm shielded drum core
- Ferrite core material
- Metalized core mounting utilizes board space
- Inductance range from 0.82µH to 470µH
- Current range from 8.57 Amps to 0.368 Amps
- Frequency range up to 1MHz



Applications

- Buck or Boost Inductor
- Noise filtering and output filter chokes
- Battery Power, DC-DC converters
- Notebook power, PDA's, Hand held computers
- DVD players
- Cellular phones

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

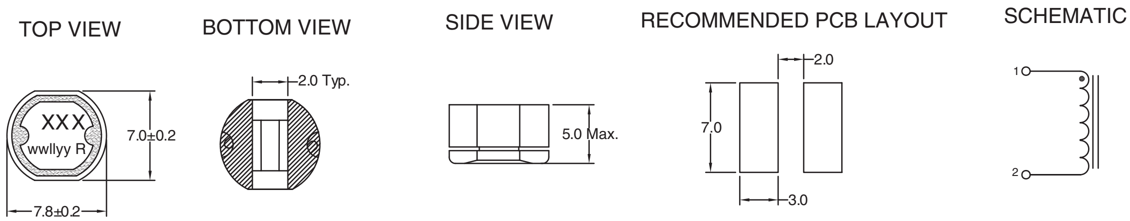
Packaging

- Supplied in tape and reel packaging, 1000 per reel

Part Number	Rated Inductance (µH)	OCL (1) µH	Irms(2) Amperes	Isat (3) Amperes	DCR (Ω) @20°C (Typical)	K-factor (4)
LDS0705-R82M-R	0.82	0.861±20%	7.68	8.57	0.0040	24.8
LDS0705-1R5M-R	1.5	1.42±20%	6.17	6.67	0.0061	19.3
LDS0705-2R2M-R	2.2	2.13±20%	5.06	5.45	0.009	15.8
LDS0705-3R3M-R	3.3	2.97±20%	4.19	4.62	0.013	13.4
LDS0705-4R7M-R	4.7	5.08±20%	3.32	3.53	0.021	10.2
LDS0705-6R8M-R	6.8	6.34±20%	3.11	3.16	0.024	9.2
LDS0705-8R2M-R	8.2	7.75±20%	2.67	2.86	0.033	8.3
LDS0705-100M-R	10.0	9.30±20%	2.54	2.61	0.036	7.6
LDS0705-150M-R	15.0	14.78±20%	2.04	2.07	0.056	6.0
LDS0705-220M-R	22.0	21.53±20%	1.66	1.71	0.084	5.0
LDS0705-330M-R	33.0	32.50±20%	1.48	1.40	0.107	4.0
LDS0705-470M-R	47.0	45.71±20%	1.21	1.18	0.158	3.4
LDS0705-680M-R	68.0	69.76±20%	0.985	0.952	0.240	2.8
LDS0705-820M-R	82.0	83.67±20%	0.850	0.870	0.323	2.5
LDS0705-101M-R	100.0	98.9±20%	0.808	0.800	0.357	2.3
LDS0705-151M-R	150.0	152.0±20%	0.649	0.645	0.554	1.9
LDS0705-221M-R	220.0	216.5±20%	0.584	0.541	0.68	1.6
LDS0705-331M-R	330.0	329.9±20%	0.470	0.438	1.06	1.3
LDS0705-471M-R	470.0	467.0±20%	0.387	0.368	1.56	1.1

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 30°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 15% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in µH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: LDS0705-xxx-R
LDS0705 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
M = Inductance tolerance +/- 20%   -R suffix = RoHS compliant

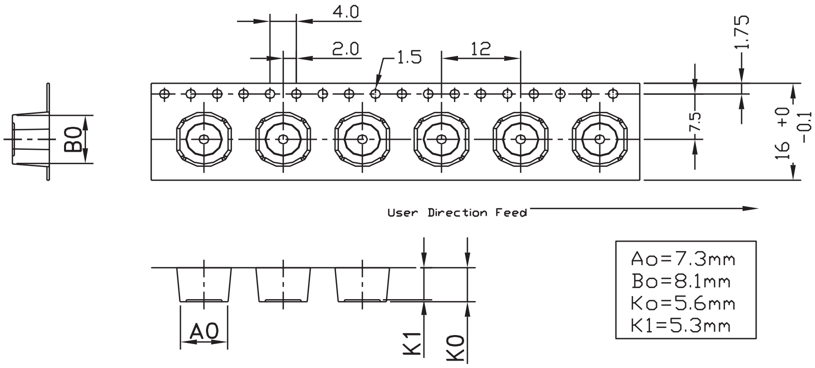
Mechanical Diagrams



Dimensions are in millimeters.

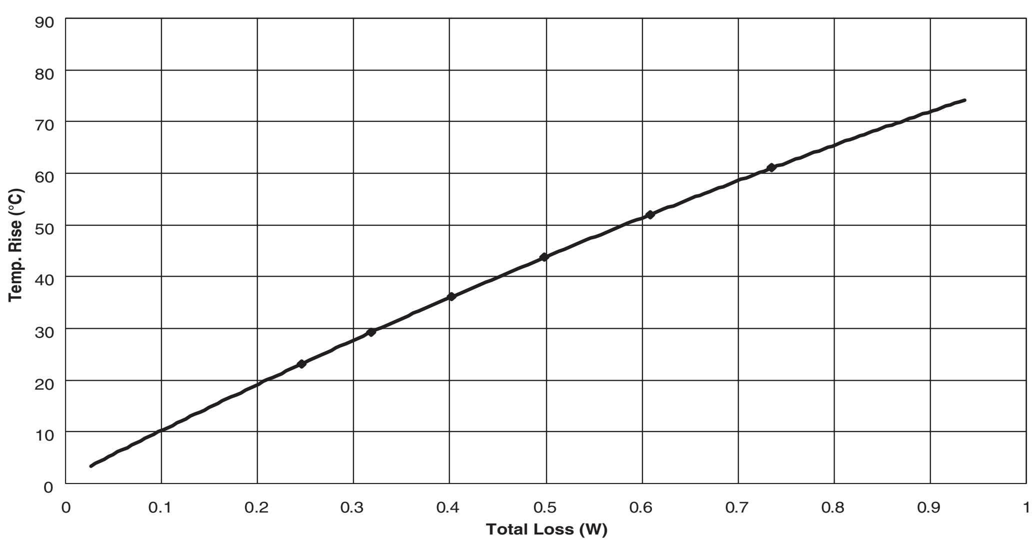
xxx = Inductance in uH. R = decimal point. If no R is present third character = # of zeros.
wwllyy = Date code, R = Revision level.

Packaging Information



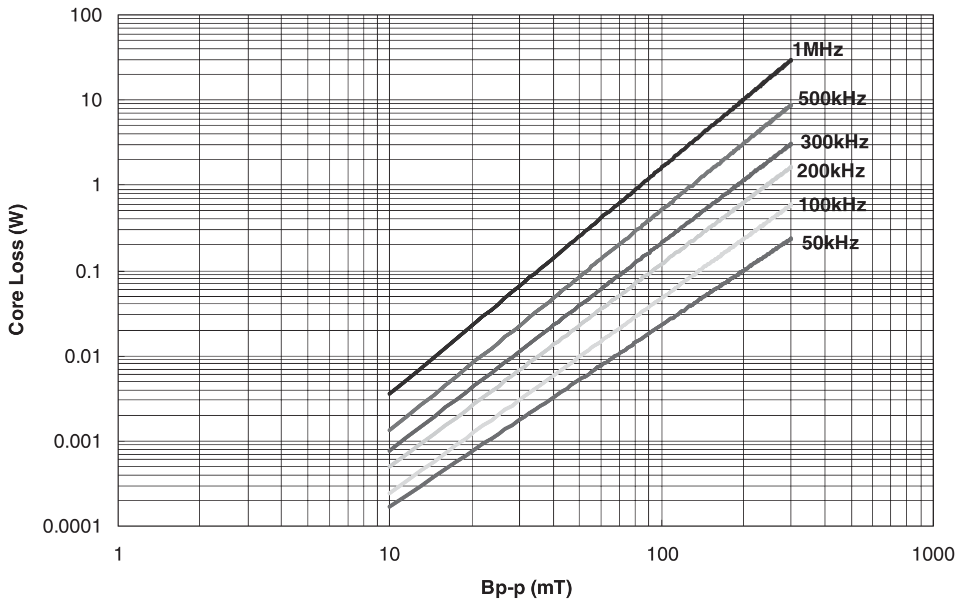
Parts packaged on 13" Diameter reel, 1,000 parts per reel.

Temperature Rise vs. Watt Loss

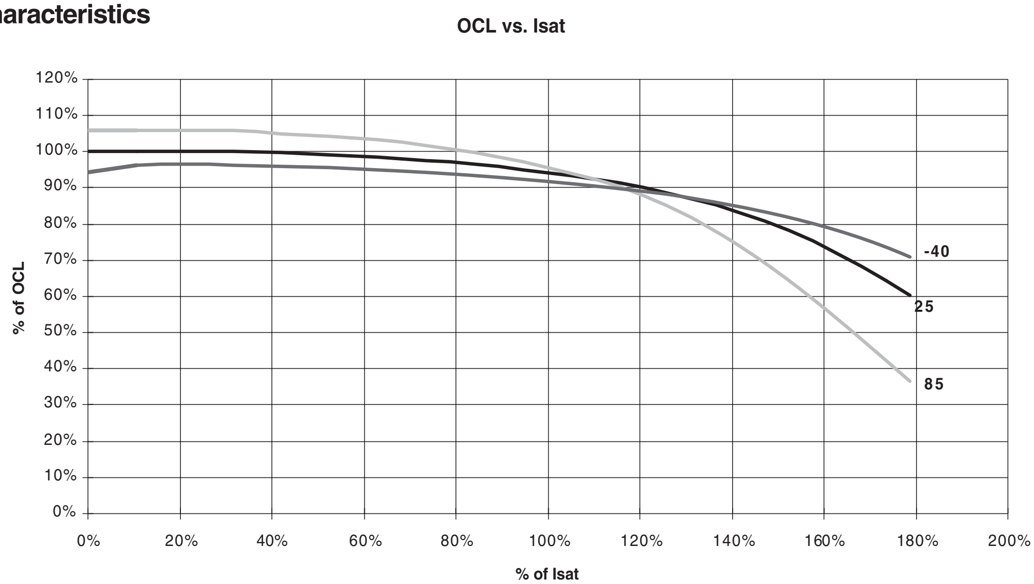


SHIELDED DRUM (LDS0705)

Core Loss



Inductance Characteristics



COILTRONICS®

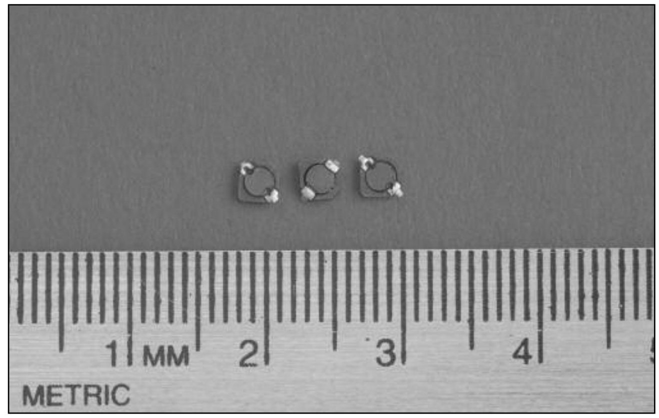
COOPER Bussmann

SD3110 Series
Low Profile Power Inductors

Description

- 125°C maximum total temperature operation
- 3.1mm x 3.1mm x 1.0mm shielded drum core
- Ferrite core material
- Inductance range from 0.5uH to 220uH
- Current range from 2.27 Amps to 0.106 Amps
- Frequency range up to 1MHz

RoHS 2002/95/EC



Applications

- Cellular phones, Digital cameras, CD players, PDA's
- Small LCD displays
- LED driver and LED flash circuits
- Hard disk drives
- Backlighting
- EL panel

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

Packaging

- Supplied in tape and reel packaging, 4100 per reel

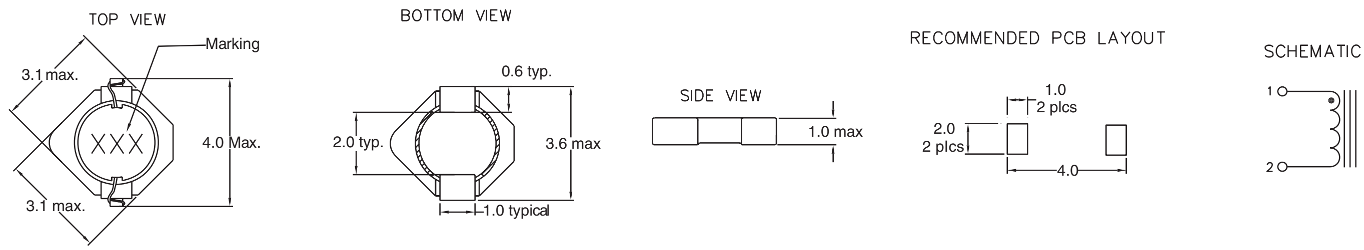
Part Number	Rated Inductance (µH)	OCL (1) (µH)	Part Marking Designator	Irms (2) Amperes	Isat (3) Amperes	DCR (Ω) typ. @ 20°C	K-factor (4)
SD3110-R50-R	0.50	0.44+/-30%	A	1.54	2.27	0.0420	216
SD3110-R82-R	0.82	0.82+/-30%	B	1.30	1.67	0.0589	191
SD3110-1R0-R	1.0	1.05+/-30%	C	1.21	1.47	0.0683	169
SD3110-1R5-R	1.5	1.60+/-30%	D	0.99	1.19	0.103	137
SD3110-2R2-R	2.2	2.27+/-30%	E	0.82	1.00	0.149	115
SD3110-3R3-R	3.3	3.48+/-30%	F	0.72	0.81	0.195	93
SD3110-4R7-R	4.7	4.96+/-30%	G	0.59	0.68	0.285	78
SD3110-6R8-R	6.8	6.70+/-30%	H	0.54	0.58	0.346	67
SD3110-8R2-R	8.2	8.01+/-30%	I	0.48	0.53	0.432	61
SD3110-100-R	10.0	10.18+/-30%	J	0.44	0.47	0.505	54
SD3110-150-R	15.0	15.32+/-20%	K	0.36	0.38	0.764	44
SD3110-220-R	22.0	21.49+/-20%	L	0.30	0.32	1.13	37
SD3110-330-R	33.0	32.72+/-20%	M	0.26	0.26	1.50	30
SD3110-470-R	47.0	46.29+/-20%	N	0.22	0.22	2.06	25
SD3110-680-R	68.0	68.04+/-20%	O	0.179	0.182	3.13	21
SD3110-820-R	82.0	82.65+/-20%	P	0.167	0.166	3.57	19
SD3110-101-R	100	101+/-20%	Q	0.146	0.150	4.72	17
SD3110-151-R	150	149+/-20%	R	0.127	0.123	6.16	14
SD3110-221-R	220	219+/-20%	S	0.106	0.120	9.46	12

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate DT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 30% rolloff (@20°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).

COOPER Bussmann

SD3110 Series
Low Profile Power Inductors

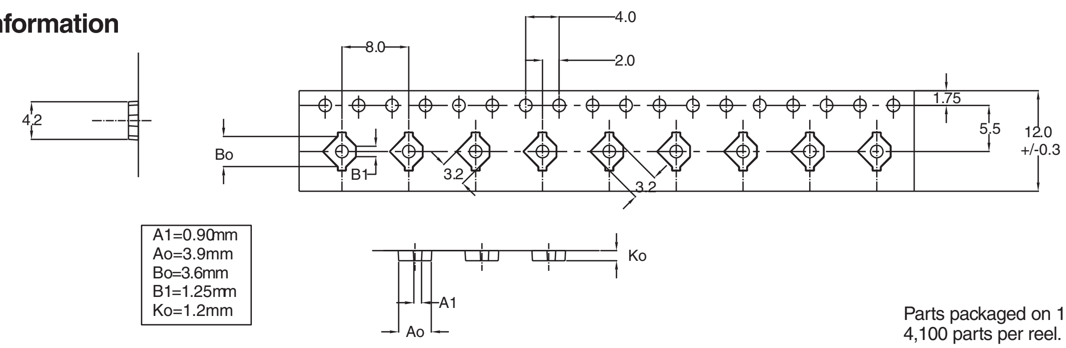
Mechanical Diagrams



Dimensions are in millimeters.

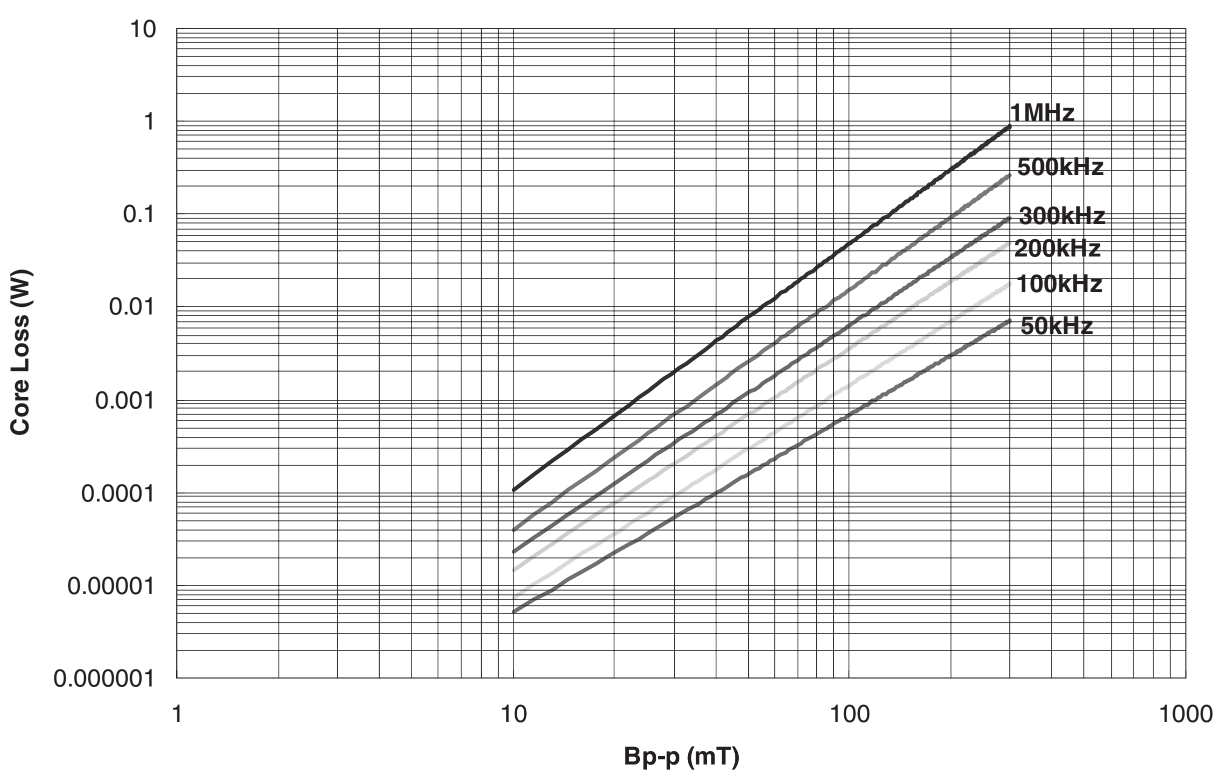
Part Marking:
3 Digit Marking: (1st digit: Indicates inductance value per letter in Part Marking Designator); (2nd digit: Bi-weekly production date code); (3rd digit: Last digit of the year produced).

Packaging Information

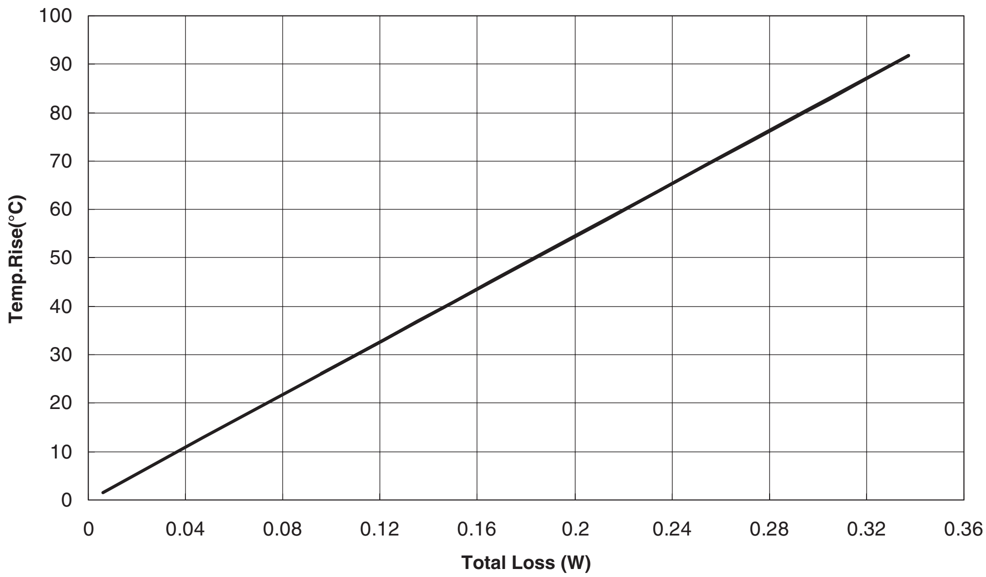


Parts packaged on 13" Diameter reel,
4,100 parts per reel.

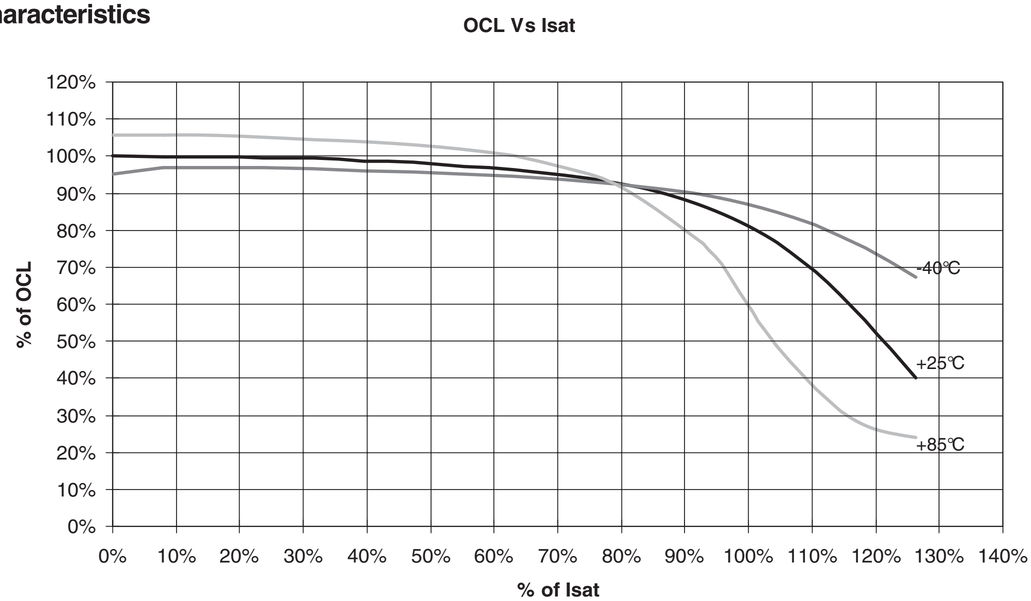
Core Loss



Temperature Rise vs. Loss



Inductance Characteristics



COOPER Bussmann

SD3112 Series
Low Profile Power Inductors

Description

- 125°C maximum total temperature operation
- 3.1mm x 3.1mm x 1.2mm shielded drum core
- Ferrite core material
- Inductance range from 1.0uH to 220uH
- Current range from 1.65 Amps to 0.113 Amps
- Frequency range up to 4MHz

RoHS 2002/95/EC

Applications

- Cellular phones, Digital cameras, CD players, PDA's
- Small LCD displays
- LED driver and LED flash circuits
- Hard disk drives
- Backlighting
- EL panel

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

Packaging

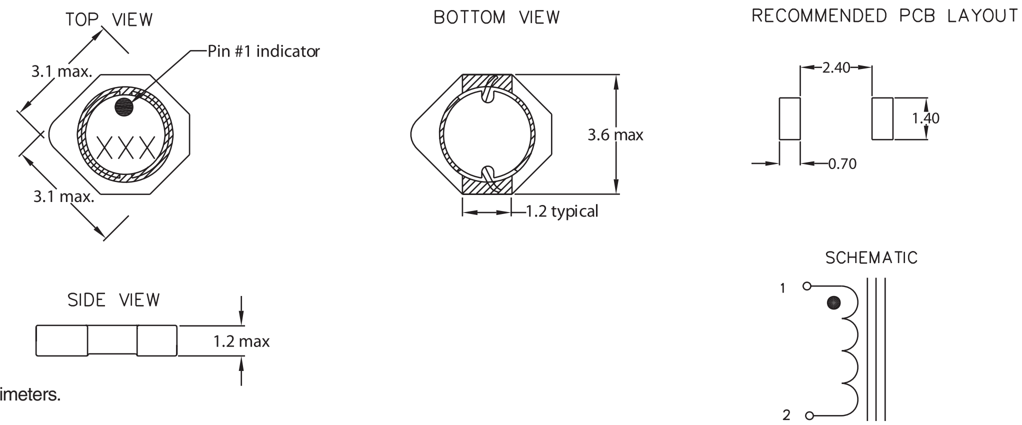
- Supplied in tape and reel packaging, 4100 per reel

Part Number	Rated Inductance (µH)	OCL (1) (µH)	Part Marking Designator	Irms (2) Amperes	Isat (3) Amperes	DCR (Ω) typ. @ 20°C	K-factor (4)
SD3112-1R0-R	1.0	1.11+/-30%	A	1.39	1.65	0.069	135
SD3112-1R5-R	1.5	1.70+/-30%	B	1.16	1.33	0.099	110
SD3112-2R2-R	2.2	2.41+/-30%	C	0.97	1.12	0.140	92
SD3112-3R3-R	3.3	3.24+/-30%	D	0.90	0.97	0.165	79
SD3112-4R7-R	4.7	4.72+/-30%	E	0.74	0.80	0.246	66
SD3112-6R8-R	6.8	6.47+/-30%	F	0.68	0.68	0.291	56
SD3112-8R2-R	8.2	8.50+/-30%	G	0.57	0.60	0.408	49
SD3112-100-R	10.0	10.01+/-30%	H	0.55	0.55	0.446	45
SD3112-150-R	15.0	15.28+/-20%	I	0.45	0.44	0.654	37
SD3112-220-R	22.0	21.66+/-20%	J	0.37	0.37	0.953	31
SD3112-330-R	33.0	33.30+/-20%	K	0.30	0.30	1.48	25
SD3112-470-R	47.0	47.44+/-20%	L	0.270	0.25	1.85	21
SD3112-680-R	68.0	68.10+/-20%	M	0.228	0.211	2.56	17
SD3112-820-R	82.0	83.19+/-20%	N	0.213	0.190	2.93	16
SD3112-101-R	100.0	99.8+/-20%	O	0.184	0.174	3.95	14
SD3112-151-R	150.0	149.4+/-20%	P	0.149	0.142	6.01	12
SD3112-221-R	220.0	219.9+/-20%	Q	0.121	0.117	9.12	10

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate DT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 30% rolloff (@20°C)
(4) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).

SD3112 Series
Low Profile Power Inductors

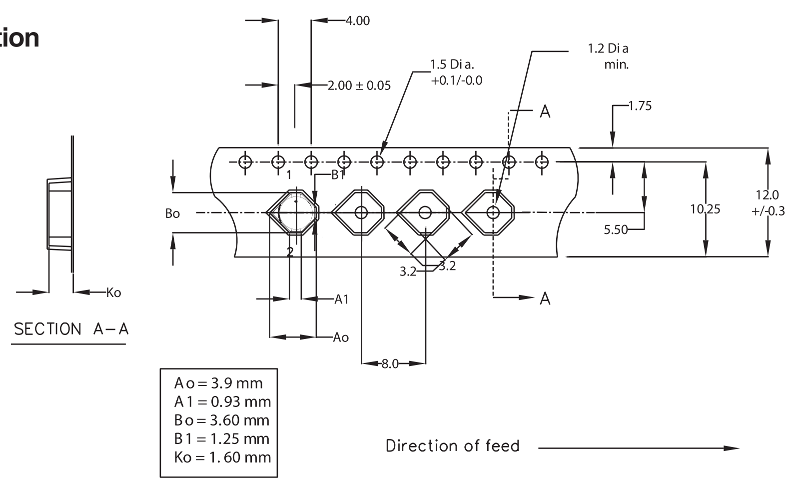
Mechanical Diagrams



Dimensions are in millimeters.

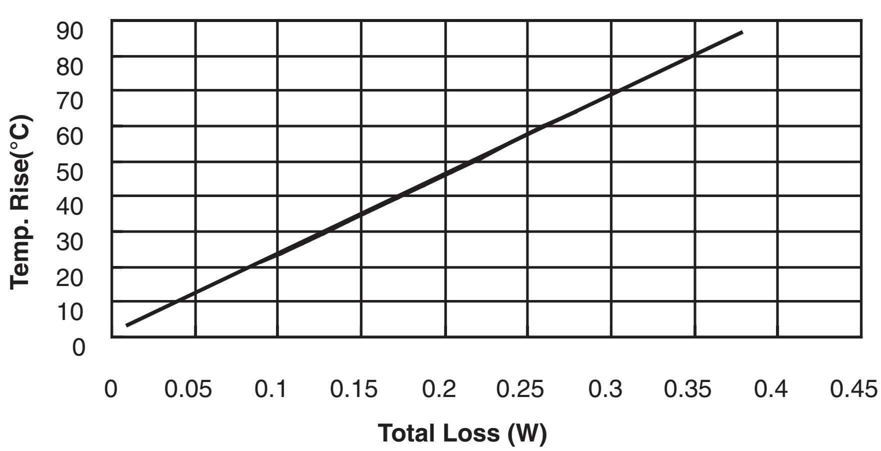
Part Marking:
3 Digit Marking: (1st digit: Indicates inductance value per letter in Part Marking Designator); (2nd digit: Bi-weekly production date code); (3rd digit: Last digit of the year produced).

Packaging Information

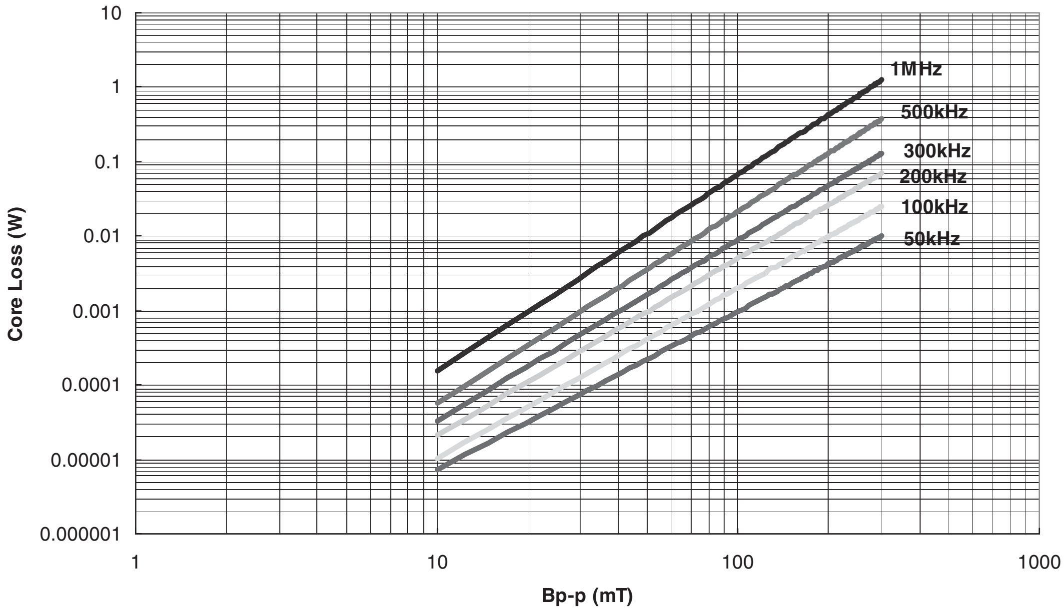


Parts packaged on 13" Diameter reel, 4,100 parts per reel.

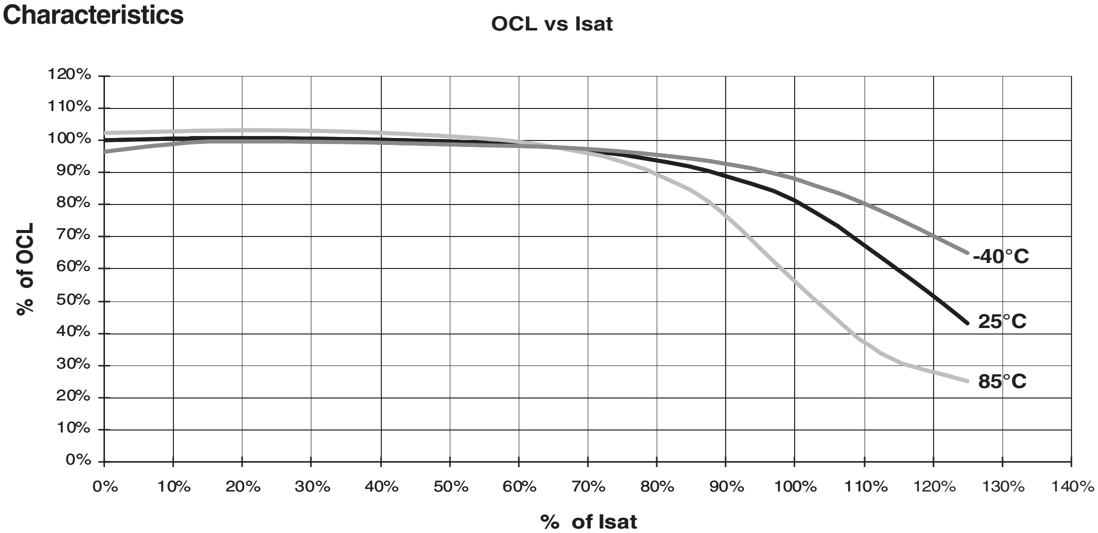
DC Current vs. Temperature



Core Loss



Inductance Characteristics



COILTRONICS®

COOPER Bussmann

SD3114 Series
Low Profile Power Inductors

RoHS
2002/95/EC

Description

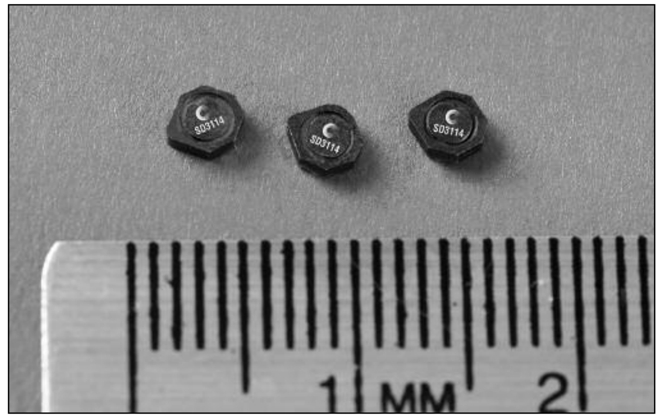
- 125°C maximum total temperature operation
- 3.1mm x 3.1mm x 1.4mm shielded drum core
- Ferrite core material
- Inductance range from 1.0uH to 330uH
- Current range from 2.59 Amps to 0.106 Amps
- Frequency range up to 4MHz

Applications

- Cellular phones, Digital cameras, CD players, PDA's
- Small LCD displays
- LED driver and LED flash circuits
- Hard disk drives
- Backlighting
- EL panel

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



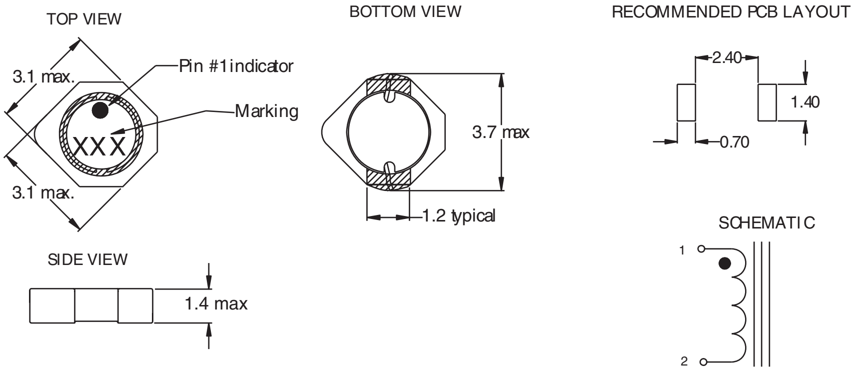
Packaging

- Supplied in tape and reel packaging, 4100 per reel

Part Number	Rated Inductance (µH)	OCL (1) (µH)	Part Marking Designator	Irms (2) Amperes	Isat (3) Amperes	DCR (Ω) typ. @ 20°C	K-factor (4)
SD3114-1R0-R	1.0	1.16+/-30%	A	1.60	2.35	0.058	98
SD3114-1R5-R	1.5	1.44+/-30%	B	1.39	2.11	0.077	79
SD3114-2R2-R	2.2	2.12+/-30%	C	1.17	1.74	0.110	67
SD3114-3R3-R	3.3	3.36+/-30%	D	0.95	1.38	0.167	54
SD3114-4R7-R	4.7	4.90+/-30%	E	0.77	1.14	0.251	45
SD3114-6R8-R	6.8	6.72+/-30%	F	0.71	0.98	0.296	37
SD3114-8R2-R	8.2	8.10+/-30%	G	0.68	0.89	0.329	34
SD3114-100-R	10.0	10.4+/-30%	H	0.57	0.78	0.458	30
SD3114-150-R	15.0	14.9+/-20%	I	0.48	0.66	0.650	25
SD3114-220-R	22.0	22.5+/-20%	J	0.43	0.53	0.821	21
SD3114-330-R	33.0	33.1+/-20%	K	0.35	0.44	1.23	17
SD3114-470-R	47.0	47.5+/-20%	L	0.280	0.37	1.86	14
SD3114-680-R	68.0	68.6+/-20%	M	0.239	0.305	2.62	12
SD3114-820-R	82.0	81.8+/-20%	N	0.227	0.280	2.91	11
SD3114-101-R	100.0	101.1+/-20%	O	0.213	0.252	3.30	10
SD3114-151-R	150.0	149.0+/-20%	P	0.172	0.207	5.07	8
SD3114-221-R	220.0	220.9+/-20%	Q	0.140	0.170	7.67	6
SD3114-331-R	330.0	329.5+/-20%	R	0.113	0.139	11.78	5

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate DT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 30% rolloff (@20°C)
(4) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).

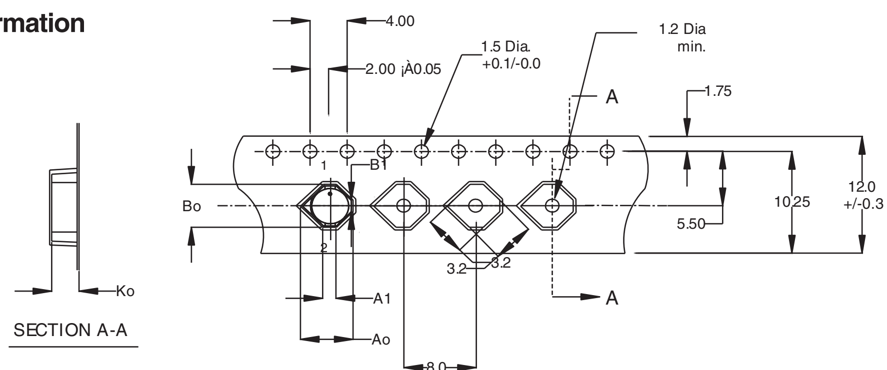
Mechanical Diagrams



Dimensions are in millimeters.

Part Marking:
3 Digit Marking: (1st digit: Indicates inductance value per letter in Part Marking Designator); (2nd digit: Bi-weekly production date code); (3rd digit: Last digit of the year produced).

Packaging Information

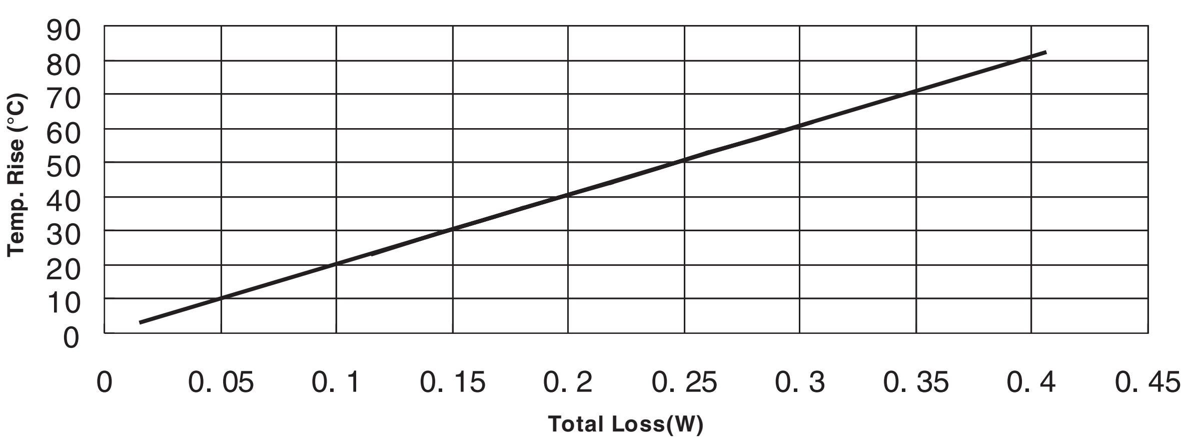


Ao = 3.9 mm
A1 = 0.93 mm
Bo = 3.60 mm
B1 = 1.25 mm
Ko = 1.60 mm

Direction of feed

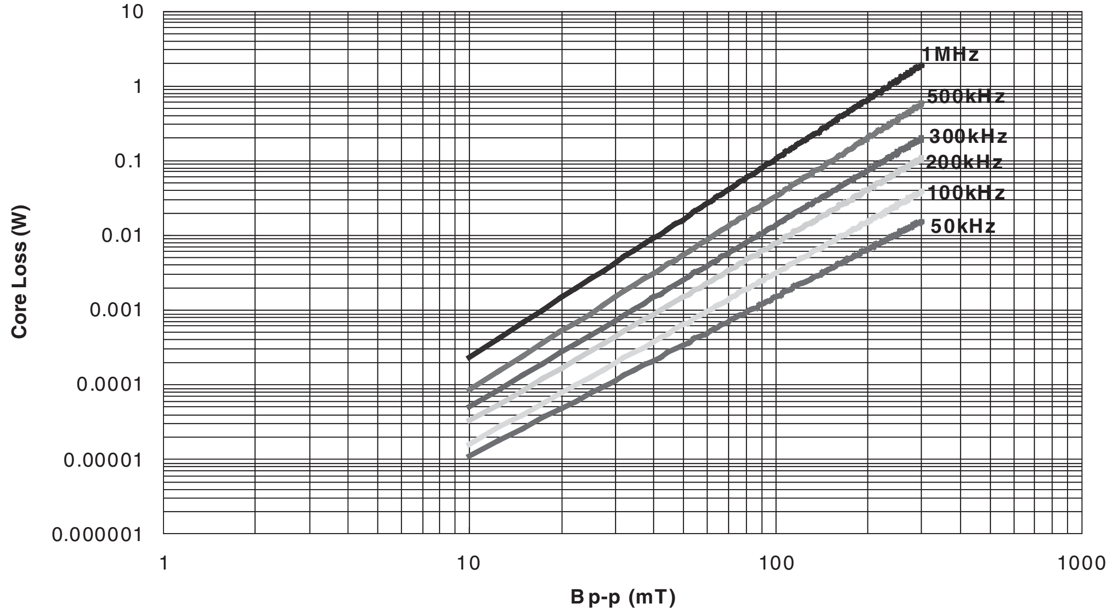
Parts packaged on 13" Diameter reel,
4,100 parts per reel.

DC Current vs. Temperature

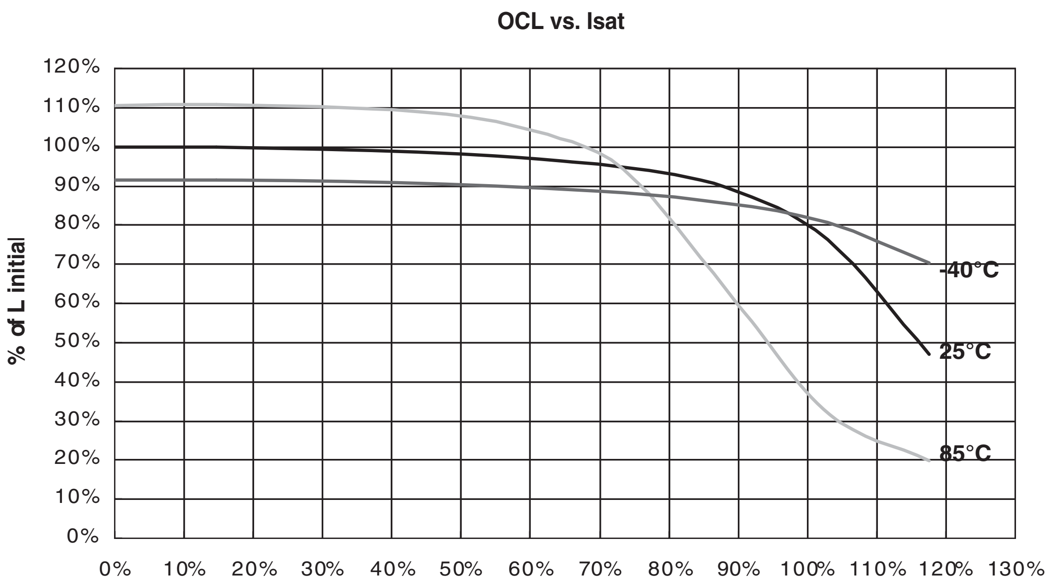


SD3114 Series
Low Profile Power Inductors

Core Loss



Inductance Characteristics



COILTRONICS®

COOPER Bussmann

SD3118 Series
Low Profile Power Inductors

Description

RoHS 2002/95/EC

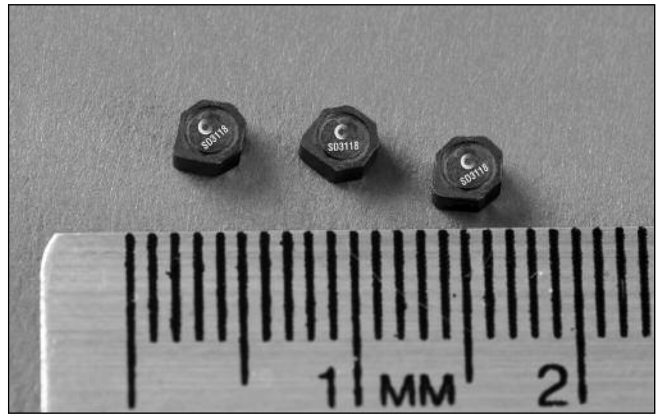
- 125°C maximum total temperature operation
- 3.1mm x 3.1mm x 1.8mm shielded drum core
- Ferrite core material
- Inductance range from 1.0uH to 1000uH
- Current range from 2.94 Amps to 0.083 Amps
- Frequency range up to 4MHz

Applications

- Cellular phones, Digital cameras, CD players, PDA's
- Small LCD displays
- LED driver and LED flash circuits
- Hard disk drives
- Backlighting
- EL panel

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



Packaging

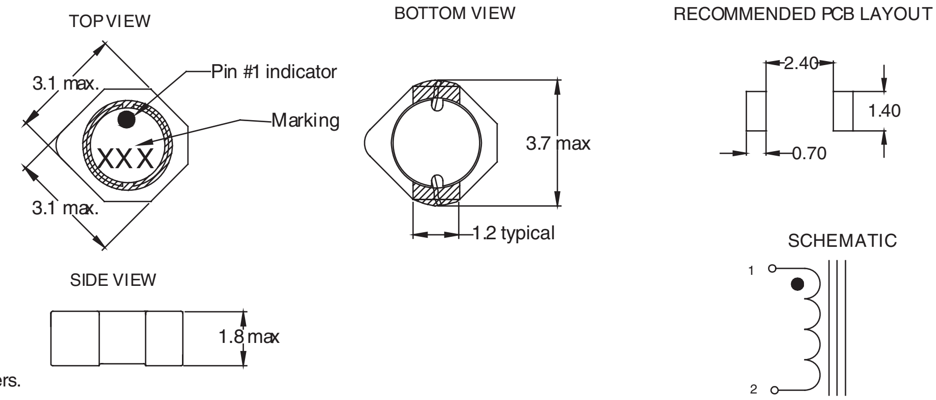
- Supplied in tape and reel packaging, 4100 per reel

Part Number	Rated Inductance (µH)	OCL (1) (µH)	Part Marking Designator	Irms (2) Amperes	Isat (3) Amperes	DCR (Ω) typ. @ 20°C	K-factor (4)
SD3118-1R0-R	1.0	1.04+/-30%	A	2.01	3.07	0.041	84
SD3118-1R5-R	1.5	1.44+/-30%	B	1.81	2.42	0.051	68
SD3118-2R2-R	2.2	2.12+/-30%	C	1.50	2.00	0.074	57
SD3118-3R3-R	3.3	3.36+/-30%	D	1.22	1.59	0.113	56
SD3118-4R7-R	4.7	4.90+/-30%	E	1.02	1.31	0.162	39
SD3118-6R8-R	6.8	6.72+/-30%	F	0.85	1.12	0.232	32
SD3118-8R2-R	8.2	8.10+/-30%	G	0.81	1.02	0.257	29
SD3118-100-R	10.0	10.4+/-30%	H	0.75	0.90	0.295	26
SD3118-150-R	15.0	14.9+/-20%	I	0.62	0.75	0.440	21
SD3118-220-R	22.0	22.5+/-20%	J	0.50	0.61	0.676	18
SD3118-330-R	33.0	33.1+/-20%	K	0.41	0.51	0.986	14
SD3118-470-R	47.0	47.5+/-20%	L	0.370	0.42	1.21	12
SD3118-221-R	220.0	221.9+/-20%	M	0.182	0.177	4.77	6
SD3118-331-R	330.0	329.9+/-20%	N	0.146	0.145	7.40	5
SD3118-471-R	470.0	470.1+/-20%	O	0.131	0.122	9.20	4
SD3118-681-R	680.0	680.3+/-20%	P	0.107	0.101	13.70	3
SD3118-102-R	1000.0	999.4+/-20%	Q	0.087	0.083	20.90	3

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate DT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 30% rolloff (@20°C)
(4) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).

SD3118 Series
Low Profile Power Inductors

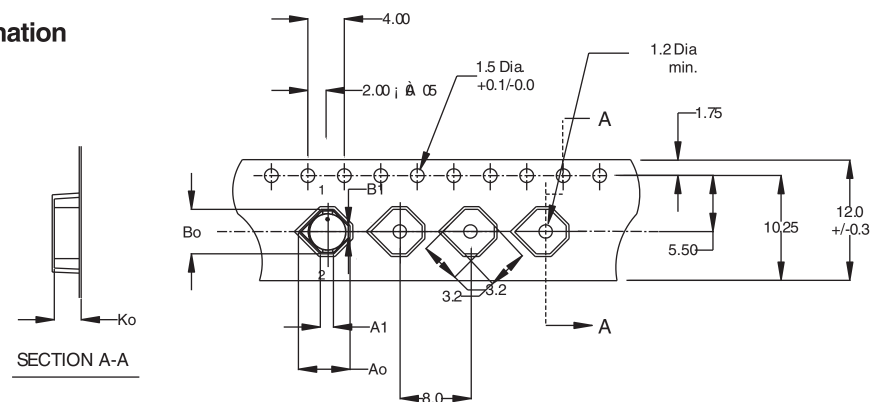
Mechanical Diagrams



Dimensions are in millimeters.

Part Marking:
3 Digit Marking: (1st digit: Indicates inductance value per letter in Part Marking Designator); (2nd digit: Bi-weekly production date code); (3rd digit: Last digit of the year produced).

Packaging Information

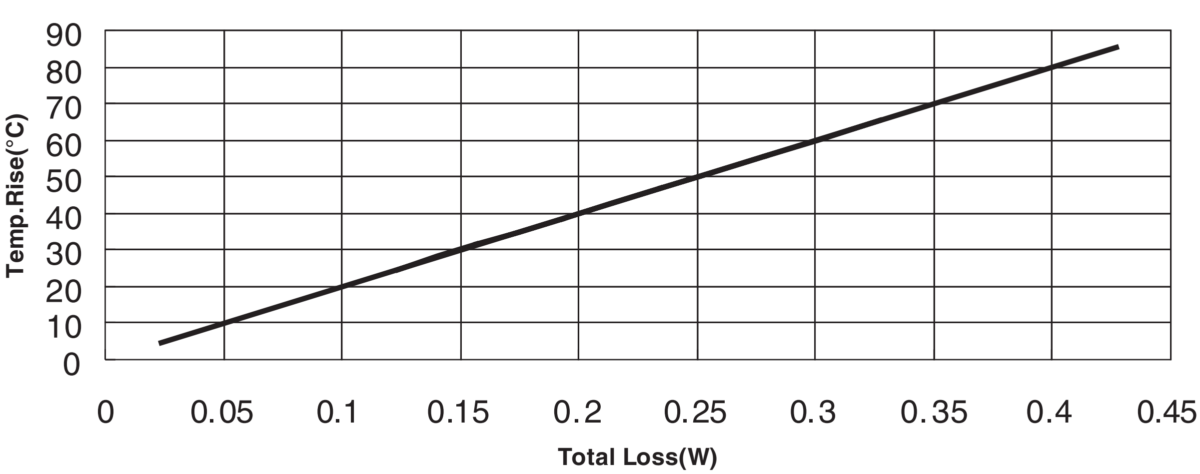


Ao = 3.9mm
A1 = 0.93 mm
Bo = 3.70 mm
B1 = 1.25 mm
Ko = 2.00 mm

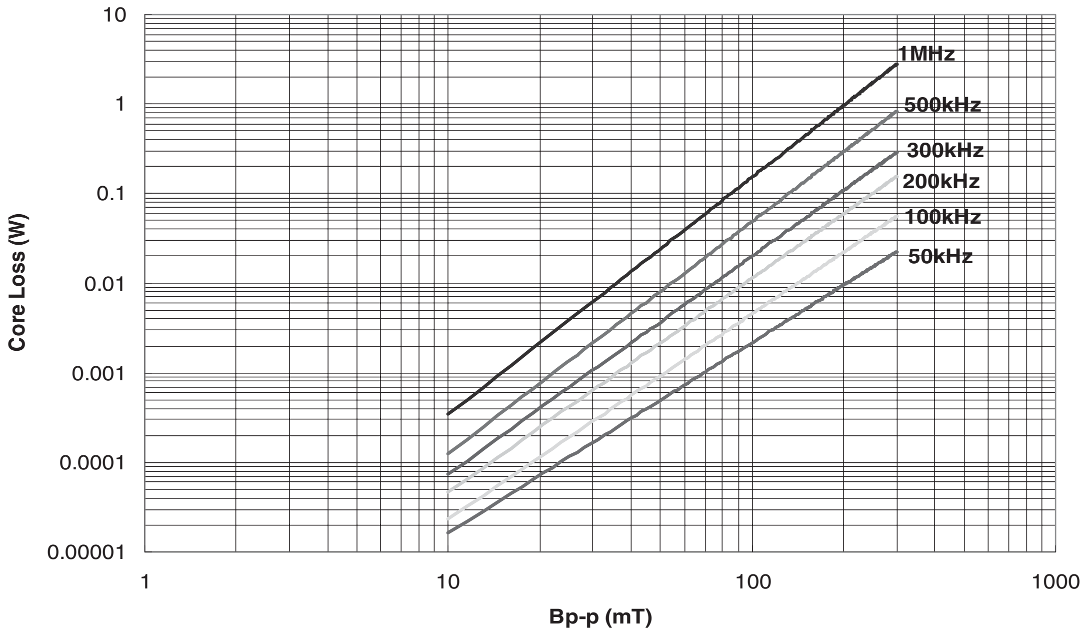
Direction of feed

Parts packaged on 13" Diameter reel, 4,100 parts per reel.

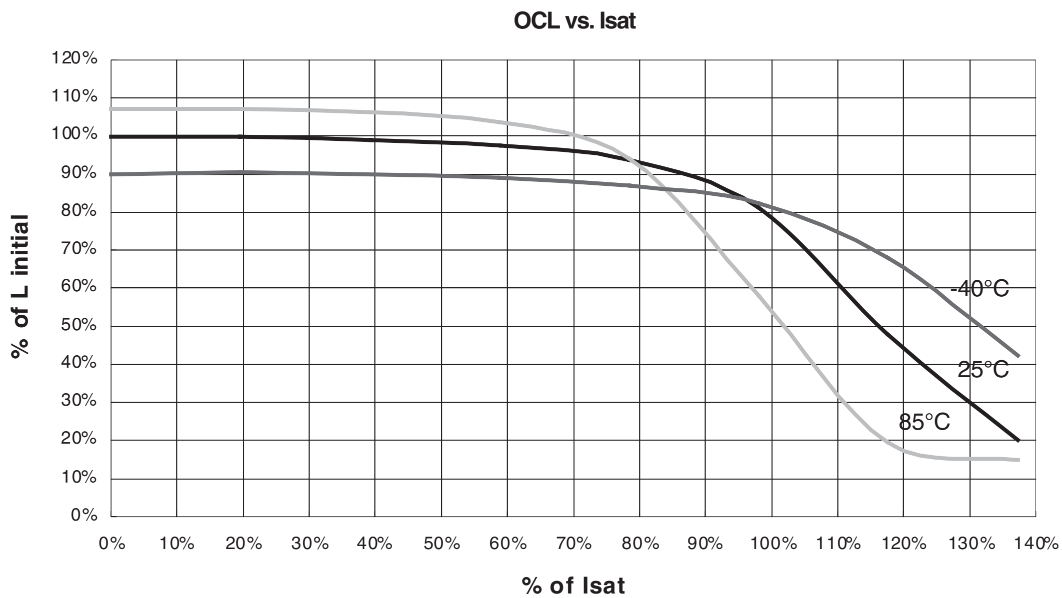
DC Current vs. Temperature



Core Loss



Inductance Characteristics



COOPER Bussmann

SD38 Series
Low Profile, Shielded Inductors

Description

RoHS 2002/95/EC

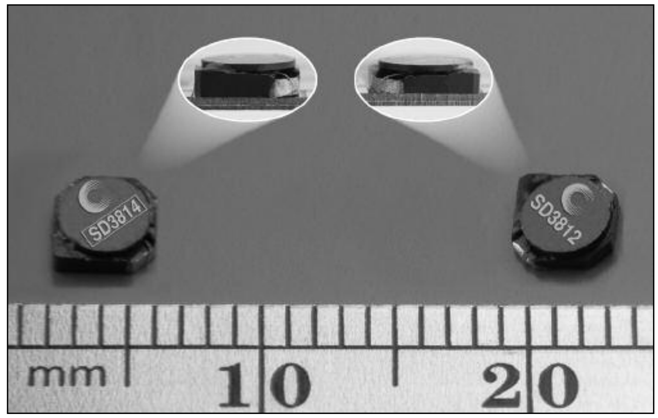
- 3.8mm x 3.8mm shielded drum cores available in two heights: 1.2mm and 1.4mm
- Current range from 4.44 to 0.100 Amps
- Inductance range from 0.47 uH to 680 uH
- Ferrite shielded, low EMI
- Ferrite core material

Applications

- Digital cameras, cellular phones, CD players, and PDAs
- PCMCIA cards
- GPS systems

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific). Temperature rise is approximately 40°C at rated rms current
- Solder reflow temperature: +260°C max for 10 seconds max.



Packaging

- Supplied in tape and reel packaging, 4,150 parts per 13" reel

Part Number	Rated Inductance (µH)	OCL (1) +/-15% (µH)	Part Marking Designator	Irms (2) Amperes	Isat (3) Amperes	DCR (4) (Ω) Typ.	Volt (5) u-sec Typ.
SD3812-R47-R	0.47	0.405	A	2.53	3.89	0.030	2.52
SD3812-1R0-R	1.0	0.845	B	2.00	2.69	0.048	3.64
SD3812-1R2-R	1.2	1.125	C	1.71	2.33	0.066	4.20
SD3812-1R5-R	1.5	1.445	D	1.58	2.06	0.078	4.76
SD3812-2R2-R	2.2	2.205	E	1.32	1.67	0.111	5.88
SD3812-3R3-R	3.3	3.125	F	1.10	1.40	0.159	7.0
SD3812-4R7-R	4.7	4.805	G	0.87	1.13	0.256	8.7
SD3812-6R8-R	6.8	6.845	H	0.80	0.95	0.299	10.4
SD3812-8R2-R	8.2	8.405	I	0.690	0.854	0.406	11.5
SD3812-100-R	10.0	10.125	J	0.662	0.778	0.441	12.6
SD3812-150-R	15.0	15.125	K	0.539	0.636	0.665	15.4
SD3812-220-R	22.0	21.125	L	0.499	0.538	0.776	18.2
SD3812-330-R	33.0	32.805	M	0.399	0.432	1.212	22.7
SD3812-470-R	47.0	47.045	N	0.327	0.361	1.809	27.2
SD3812-680-R	68.0	68.445	O	0.269	0.299	2.666	32.8
SD3812-820-R	82.0	80.645	P	0.259	0.276	2.885	36
SD3812-101-R	100.0	99.405	Q	0.217	0.248	4.099	39
SD3812-151-R	150.0	149.645	R	0.178	0.202	6.130	48
SD3812-221-R	220.0	218.405	S	0.160	0.167	7.585	59
SD3814-R47-R	0.47	0.360	A	2.81	4.44	0.020	2.16
SD3814-R82-R	0.82	0.752	B	2.18	3.08	0.033	3.12
SD3814-1R2-R	1.2	1.001	C	1.85	2.67	0.046	3.60
SD3814-1R5-R	1.5	1.286	D	1.76	2.35	0.051	4.08
SD3814-2R2-R	2.2	1.962	E	1.43	1.90	0.077	5.04
SD3814-3R3-R	3.3	2.781	F	1.31	1.60	0.093	6.0
SD3814-4R7-R	4.7	4.276	G	1.06	1.29	0.141	7.4
SD3814-6R8-R	6.8	6.768	H	0.87	1.03	0.207	9.4
SD3814-8R2-R	8.2	8.228	I	0.753	0.930	0.279	10.3
SD3814-100-R	10.0	9.830	J	0.713	0.851	0.311	11.3
SD3814-150-R	15.0	14.458	K	0.574	0.702	0.481	13.7
SD3814-220-R	22.0	21.186	L	0.519	0.580	0.589	16.6
SD3814-330-R	33.0	32.151	M	0.418	0.471	0.908	20.4
SD3814-470-R	47.0	47.210	N	0.346	0.388	1.322	24.7
SD3814-680-R	68.0	67.324	O	0.285	0.325	1.951	29.5

(1) Test Parameters: 100KHz, 0.100Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C. De-rating is necessary for AC currents.
(3) Peak current for approximately 30% rolloff at 20°C.
(4) DCR limits @ 20°C.
(5) Applied Volt-Time product (V-uS) across the inductor at 100kHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise. De-rating of the Irms is required to prevent excessive temperature rise.

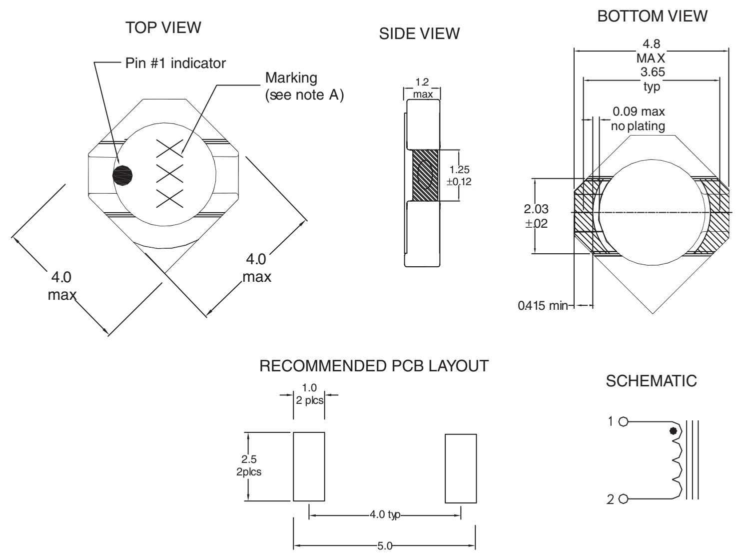
SD38 Series
Low Profile, Shielded Inductors

Part Number	Rated Inductance (µH)	OCL (1) +/-15% (µH)	Part Marking Designator	Irms (2) Amperes	Isat (3) Amperes	DCR (4) (Ω) Typ.	Volt (5) u-sec Typ.
SD3814-820-R	82.0	81.101	P	0.270	0.296	2.174	32
SD3814-101-R	100.0	98.794	Q	0.228	0.268	3.048	36
SD3814-151-R	150.0	149.026	R	0.191	0.219	4.359	44
SD3814-221-R	220.0	217.342	S	0.170	0.181	5.480	53
SD3814-331-R	330.0	326.812	T	0.136	0.148	8.59	65
SD3814-471-R	470.0	470.031	U	0.111	0.123	12.85	78
SD3814-681-R	680.0	680.320	V	0.100	0.102	15.78	94

(1) Test Parameters: 100KHz, 0.100Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C. De-rating is necessary for AC currents.
(3) Peak current for approximately 30% rolloff at 20°C.
(4) DCR limits @ 20°C.
(5) Applied Volt-Time product (V-uS) across the inductor at 100kHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise. De-rating of the Irms is required to prevent excessive temperature rise.

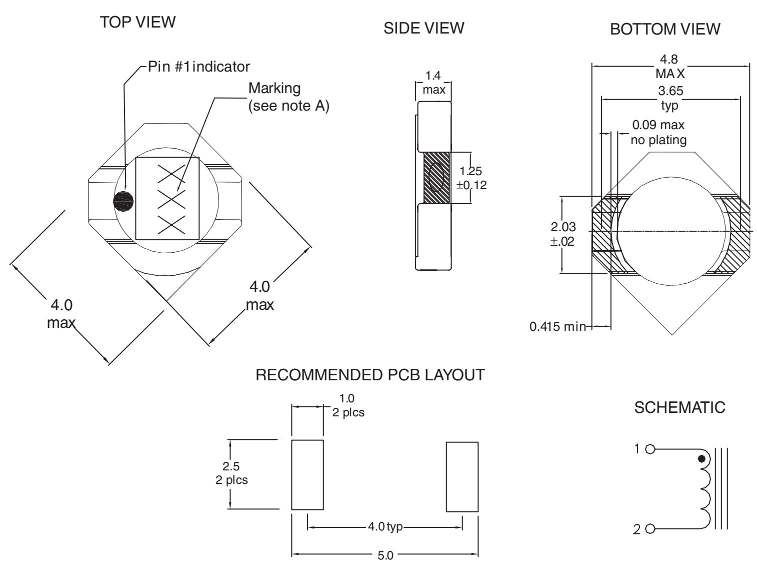
Mechanical Diagrams

SD3812 Series



Note A: 3 digit marking. First digit indicates inductance value per chart above.
Second digit indicates bi-weekly date code.
Third digit of year produced. Box indicates SD3814 part.

SD3814 Series

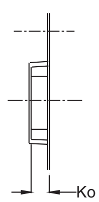


Note A: 3 digit marking. First digit indicates inductance value per chart above.
Second digit indicates bi-weekly date code.
Third digit of year produced. Box indicates SD3814 part.

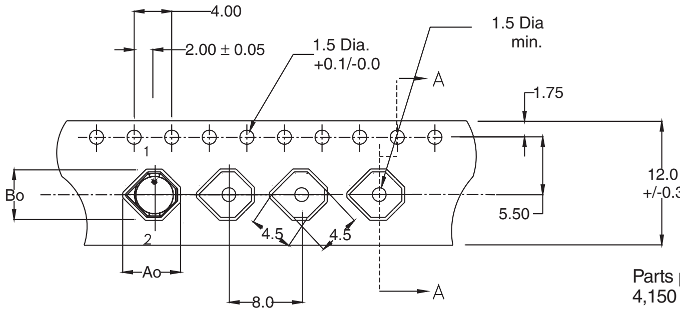
Packaging Information

SD3812/SD3814 Series

Ao=5.1mm
Bo=4.6mm
Ko=1.6mm



SECTION A-A

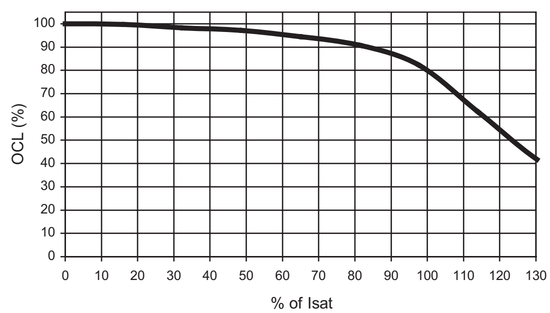


Parts packaged on 13" Diameter reel,
4,150 parts per reel.

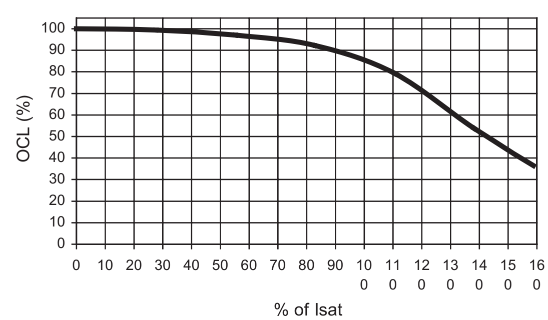
Direction of feed

Inductance Characteristics

OCL vs Isat
SD3812

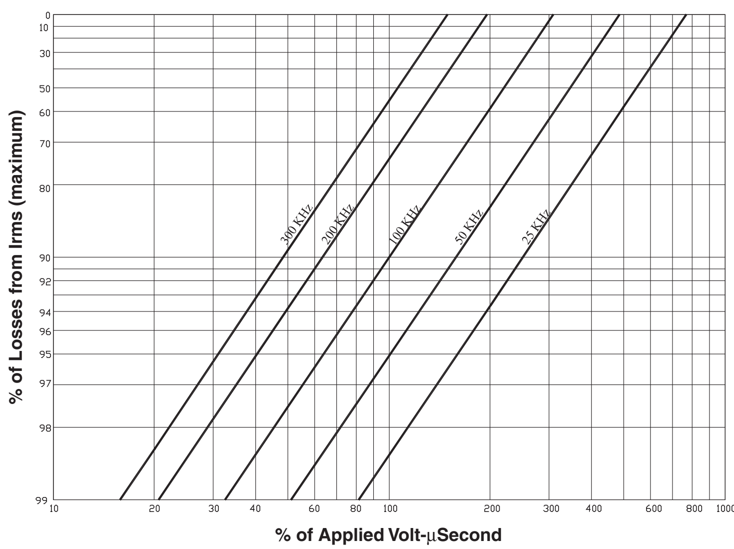


OCL vs Isat
SD3814



Core Loss

Irms DERATING WITH CORE LOSS



COILTRONICS®

COOPER Bussmann

SDH3812 Series
Low Profile, High Power, Shielded Inductors

Description

RoHS 2002/95/EC

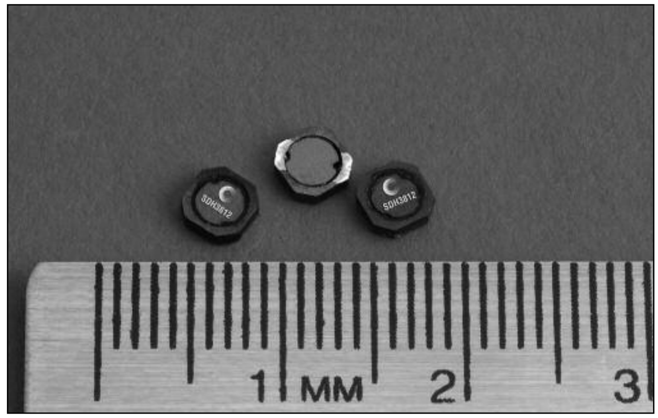
- 125°C maximum total temperature operation
- 3.8mm x 3.8mm x 1.2mm shielded drum core
- High power density, compact footprint
- Inductance range from 0.47uH to 220uH
- Current range from 4.2 Amps to 0.16 Amps
- Ferrite shielded, low EMI
- Ferrite core material

Applications

- Buck or Boost inductor
- Noise filtering output filter chokes
- LED photo flash
- Handheld devices
- Notebook and battery power
- Cellular phones / PDA's / GPS systems
- Digital cameras / MP3 players / IP phones

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



Packaging

- Supplied in tape and reel packaging, 4150 per reel

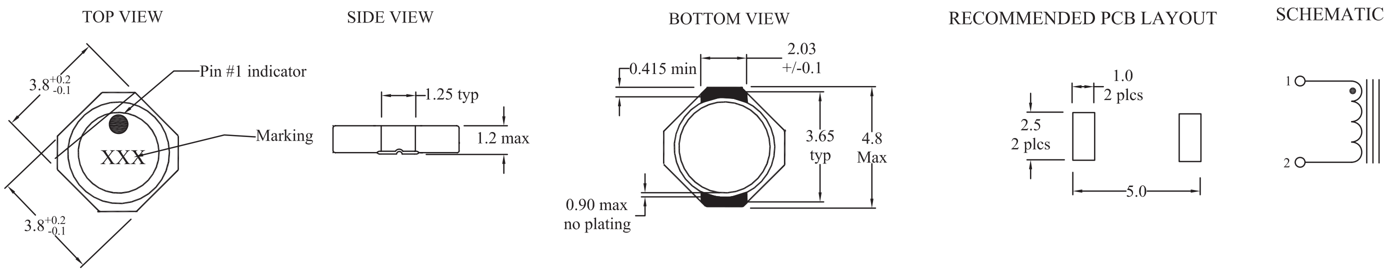
Part Number	Rated Inductance (µH)	OCL (1) µH ± 20%	Part Marking Designator	Irms (2) Amperes	Isat (3) Amperes	DCR Ω @20°C (Typical)	DCR Ω @20°C (Maximum)	K-factor (4)
SDH3812-R47-R	0.47	0.43	A	2.69	4.20	0.027	0.032	145.2
SDH3812-1R0-R	1.0	0.89	B	2.07	3.00	0.045	0.054	100.6
SDH3812-1R2-R	1.2	1.17	C	1.77	2.60	0.062	0.074	87.1
SDH3812-1R5-R	1.5	1.49	D	1.67	2.30	0.069	0.083	76.9
SDH3812-2R2-R	2.2	2.23	E	1.37	1.90	0.104	0.124	62.2
SDH3812-3R3-R	3.3	3.17	F	1.14	1.60	0.148	0.177	52.3
SDH3812-4R7-R	4.7	4.96	G	0.94	1.25	0.220	0.264	42.2
SDH3812-6R8-R	6.8	6.70	H	0.85	1.05	0.265	0.317	35.3
SDH3812-8R2-R	8.2	8.01	I	0.73	0.96	0.342	0.410	33.5
SDH3812-100-R	10.0	9.67	J	0.69	0.88	0.398	0.478	30.4
SDH3812-150-R	15.0	14.45	K	0.56	0.72	0.612	0.735	23.8
SDH3812-220-R	22.0	22.00	L	0.50	0.61	0.750	0.900	20.1
SDH3812-330-R	33.0	32.90	M	0.41	0.49	1.132	1.358	16.1
SDH3812-470-R	47.0	46.20	N	0.34	0.41	1.583	1.900	13.8
SDH3812-680-R	68.0	67.40	O	0.31	0.34	2.000	2.400	11.4
SDH3812-820-R	82.0	81.80	P	0.26	0.31	2.750	3.300	10.3
SDH3812-101-R	100.0	97.50	Q	0.25	0.28	3.042	3.650	9.4
SDH3812-151-R	150.0	149.00	R	0.20	0.22	4.542	5.450	7.6
SDH3812-221-R	220.0	218.50	S	0.16	0.19	7.017	8.420	6.3

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for 30% maximum rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: SDH3812-xxx-R
SDH3812 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

COOPER Bussmann

SDH3812 Series
Low Profile, High Power, Shielded Inductors

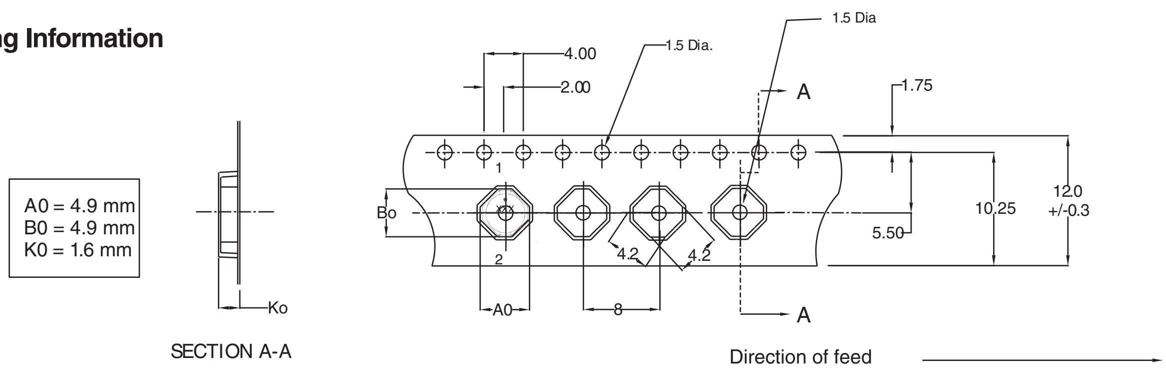
Mechanical Diagrams



Dimensions are in millimeters.

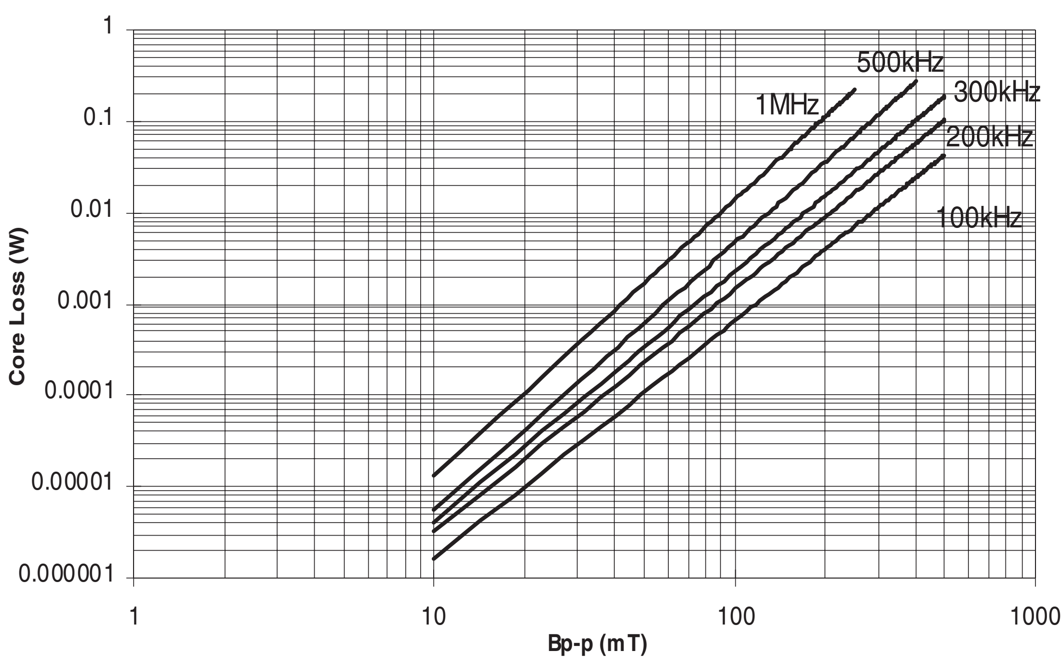
Part Marking:
3 Digit Marking: (1st digit: Indicates inductance value per Part Marking Designator in chart above); (2nd digit: Bi-weekly production date code); (3rd digit: Last digit of the year produced).

Packaging Information

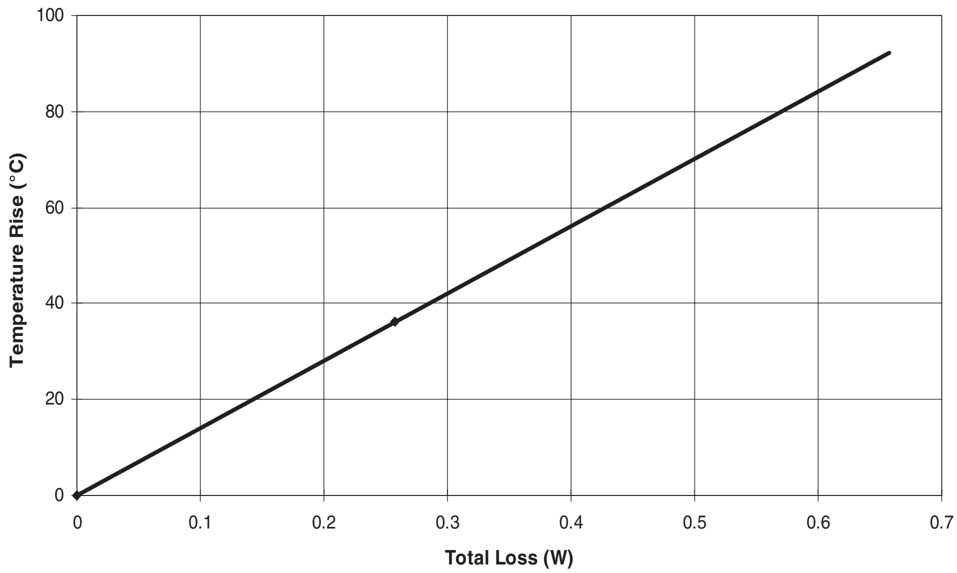


Parts packaged on 13" Diameter reel,
4,150 parts per reel.

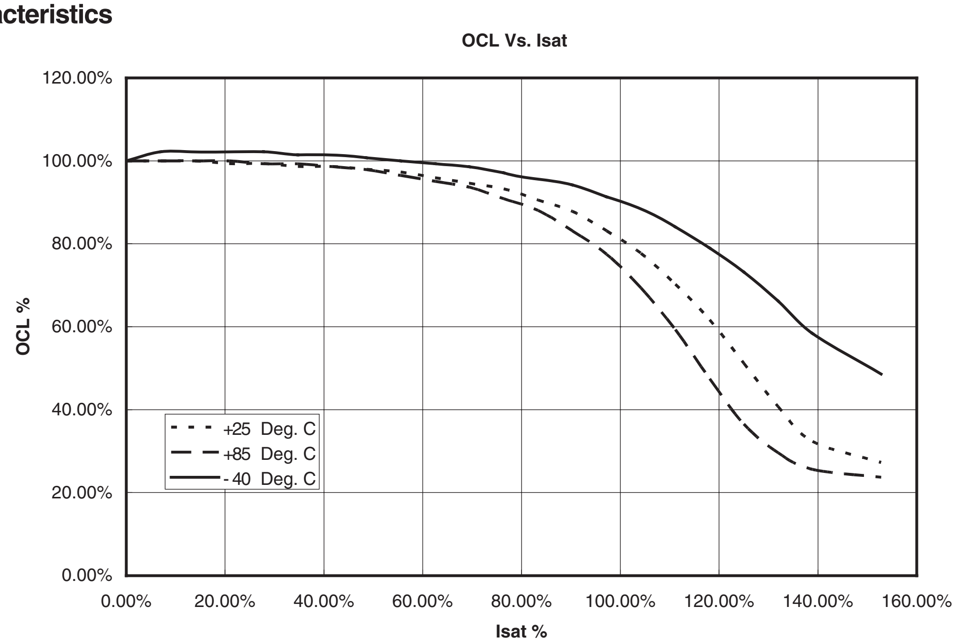
Core Loss



Temperature Rise vs. Loss



Inductance Characteristics



COILTRONICS®

COOPER Bussmann

SD Series High Power Density, Low Profile, Shielded Inductors

RoHS 2002/95/EC

Description

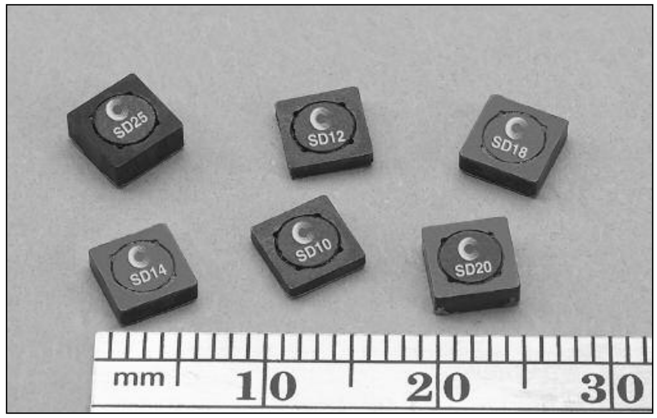
- Six sizes of shielded drum core inductors with low profiles (as low as 1.0mm) and high power density
- Inductance range from .47uH to 1000uH
- Current range from 6.00 to 0.088 Amps
- Ferrite shielded, low EMI
- Ferrite core material

Applications

- Digital cameras, CD players, cellular phones, and PDAs
- PCMCIA cards
- GPS systems

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific). Temperature rise is approximately 40°C at rated rms current
- Solder reflow temperature: +260°C max. for 10 seconds max.



Packaging

- Supplied in tape and reel packaging, 3800 (SD10, SD12, SD14 and SD18), 2900 (SD20 and SD25) per reel

Part Number	Rated Inductance (µH)	OCL (1) +/-20% (µH)	Part Marking	Irms (2) Amperes	Isat (3) Amperes	DCR (4) (Ω) Typ.	Volt u-sec Typ.
SD10-R47-R	0.470	0.453	A	2.59	3.54	0.0249	2.1
SD10-1R0-R	1.00	1.119	B	1.93	2.25	0.0448	3.3
SD10-1R5-R	1.50	1.563	C	1.60	1.91	0.0653	3.9
SD10-2R2-R	2.20	2.081	D	1.35	1.65	0.0912	4.5
SD10-3R3-R	3.30	3.339	E	1.24	1.31	0.1078	5.7
SD10-4R7-R	4.70	4.893	F	1.04	1.08	0.1535	6.9
SD10-6R2-R	6.20	6.743	G	0.94	0.92	0.218	8.1
SD10-8R2-R	8.20	8.889	H	0.800	0.800	0.2607	9.3
SD10-100-R	10.0	10.07	J	0.760	0.752	0.336	9.9
SD10-150-R	15.0	15.55	K	0.613	0.605	0.4429	12.3
SD10-220-R	22.0	22.21	L	0.498	0.506	0.6718	14.7
SD10-330-R	33.0	32.20	M	0.412	0.420	0.9807	17.7
SD10-470-R	47.0	46.63	N	0.337	0.349	1.47	21.3
SD10-680-R	68.0	70.01	O	0.301	0.285	1.84	26.1
SD10-820-R	82.0	83.48	P	0.258	0.261	2.50	28.5
SD10-101-R	100	102.0	Q	0.225	0.236	3.29	31.5
SD10-151-R	150	149.2	R	0.200	0.195	4.15	38.1
SD10-221-R	220	222.2	S	0.161	0.160	6.41	46.5
SD10-331-R	330	330.4	T	0.130	0.131	9.83	56.7
SD10-471-R	470	468.3	U	0.117	0.110	12.10	67.5
SD12-R47-R	0.470	0.490	A	3.19	3.86	0.0246	2.84
SD12-1R2-R	1.20	1.21	B	2.62	2.45	0.0366	4.47
SD12-1R5-R	1.50	1.69	C	2.19	2.08	0.0521	5.28
SD12-2R2-R	2.20	2.25	D	1.83	1.80	0.0747	6.09
SD12-3R3-R	3.30	3.61	E	1.55	1.42	0.1043	7.71
SD12-4R7-R	4.70	4.41	F	1.46	1.29	0.1177	8.53
SD12-6R2-R	6.20	6.25	G	1.21	1.08	0.1699	10.15
SD12-8R2-R	8.20	8.41	H	1.02	0.931	0.2399	11.77
SD12-100-R	10.0	10.89	J	0.938	0.818	0.2844	13.40
SD12-150-R	15.0	15.21	K	0.782	0.692	0.4089	15.83
SD12-220-R	22.0	22.09	L	0.628	0.574	0.6338	19.08
SD12-330-R	33.0	32.49	M	0.519	0.474	0.9289	23.14
SD12-470-R	47.0	47.61	N	0.428	0.391	1.37	28.01
SD12-680-R	68.0	68.89	O	0.341	0.325	2.16	33.70

(1) Open Circuit Inductance Test Parameters: 100KHz, 0.25Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
(3) SD10,12,18,25 Peak current for approximate 30% roll off at 20°C.
SD14 Peak current for approximate 20% roll off at 20°C.
(4) DCR limits @ 20°C.
5) Applied Volt-Time product (V-uS) across the inductor at 100kHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.

SD Series
High Power Density, Low Profile, Shielded Inductors

Part Number	Rated Inductance (µH)	OCL (1) +/-20% (µH)	Part Marking	Irms (2) Amperes	Isat (3) Amperes	DCR (4) (Ω) Typ.	Volt u-sec Typ.
SD12-820-R	82.0	82.81	P	0.326	0.297	2.36	36.95
SD12-101-R	100	98.0	Q	0.308	0.273	2.64	40.19
SD12-151-R	150	151.3	R	0.251	0.220	3.96	49.94
SD12-221-R	220	222.0	S	0.229	0.181	4.76	60.49
SD12-331-R	330	334.9	T	0.186	0.148	7.25	74.30
SD12-471-R	470	462.3	U	0.167	0.126	8.95	87.29
SD12-681-R	680	670.8	V	0.149	0.104	11.30	105
SD12-821-R	820	800.9	W	0.129	0.095	14.93	115
SD12-102-R	1000	992.3	X	0.121	0.086	17.20	128
SD14-R58-R	0.58	0.61	A	3.52	4.84	0.0220	3.38
SD14-R87-R	0.87	0.88	B	3.2	3.96	0.0243	4.13
SD14-1R2-R	1.2	1.23	C	2.7	3.35	0.0344	4.88
SD14-1R5-R	1.5	1.63	D	2.53	2.91	0.0390	5.63
SD14-2R0-R	2	2.09	E	2.37	2.56	0.0445	6.38
SD14-2R5-R	2.5	2.62	F	2.05	2.29	0.0595	7.1
SD14-3R2-R	3.2	3.19	G	1.94	2.08	0.0663	7.9
SD14-4R5-R	4.5	4.53	H	1.64	1.74	0.0935	9.4
SD14-6R9-R	6.9	6.98	J	1.35	1.41	0.1363	11.6
SD14-8R8-R	8.8	8.88	K	1.14	1.25	0.1913	13.1
SD14-100-R	10	9.93	L	1.1	1.18	0.2058	13.9
SD14-150-R	15	14.68	M	0.98	0.969	0.2609	16.9
SD14-220-R	22	21.93	N	0.806	0.793	0.3853	20.6
SD14-330-R	33	32.55	O	0.654	0.651	0.5852	25.1
SD14-470-R	47	47.57	P	0.525	0.538	0.9055	30.4
SD14-680-R	68	68.21	Q	0.474	0.449	1.11	36
SD14-820-R	82	83	R	0.408	0.407	1.50	40
SD14-101-R	100	99.25	S	0.386	0.373	1.68	44
SD14-151-R	150	152.4	T	0.315	0.301	2.52	54
SD14-221-R	220	222	U	0.258	0.249	3.77	66
SD14-331-R	330	335.1	V	0.206	0.203	5.92	81
SD14-471-R	470	471.4	W	0.173	0.171	8.34	96
SD14-681-R	680	683.3	X	0.156	0.142	10.3	115
SD14-821-R	820	823.4	Y	0.134	0.129	13.9	126
SD14-102-R	1000	1008	Z	0.126	0.117	15.8	140
SD18-R47-R	0.47	0.49	A	3.58	4.63	0.0201	2.35
SD18-R82-R	0.82	0.81	B	3.24	3.60	0.0247	3.02
SD18-1R2-R	1.20	1.21	C	2.97	2.95	0.0294	3.70
SD18-1R5-R	1.50	1.69	D	2.73	2.49	0.0345	4.37
SD18-2R2-R	2.20	2.25	E	2.55	2.16	0.0398	5.04
SD18-3R3-R	3.30	3.61	F	2.07	1.71	0.0605	6.38
SD18-4R7-R	4.70	4.41	G	1.77	1.54	0.0824	7.06
SD18-6R2-R	6.20	6.25	H	1.61	1.30	0.1000	8.40
SD18-8R2-R	8.20	8.41	J	1.38	1.12	0.1351	9.74
SD18-100-R	10.0	10.89	K	1.28	0.982	0.1584	11.09
SD18-150-R	15.0	15.21	L	1.06	0.831	0.2278	13.10
SD18-220-R	22.0	22.09	M	0.876	0.689	0.3366	15.79
SD18-330-R	33.0	32.49	N	0.715	0.568	0.5057	19.15
SD18-470-R	47.0	47.61	O	0.578	0.470	0.7732	23.18
SD18-680-R	68.0	68.89	P	0.514	0.390	0.9798	27.89
SD18-820-R	82.0	82.81	Q	0.446	0.356	1.30	30.58
SD18-101-R	100	102.01	R	0.419	0.321	1.47	33.94
SD18-151-R	150	151.29	S	0.345	0.263	2.18	41.33
SD18-221-R	220	222.01	T	0.296	0.217	2.95	50.06
SD18-331-R	330	334.89	U	0.248	0.177	4.20	61.49
SD18-471-R	470	479.61	V	0.201	0.148	6.39	73.58
SD18-681-R	680	681.21	W	0.167	0.124	9.28	87.70
SD18-821-R	820	823.69	X	0.145	0.113	12.35	96.43
SD18-102-R	1000	1004	Y	0.136	0.102	14.01	107

(1) Open Circuit Inductance Test Parameters: 100KHz, 0.25Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
(3) SD10,12,18,25 Peak current for approximate 30% roll off at 20°C. SD14 Peak current for approximate 20% roll off at 20°C.
(4) DCR limits @ 20°C.
5) Applied Volt-Time product (V-uS) across the inductor at 100kHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.

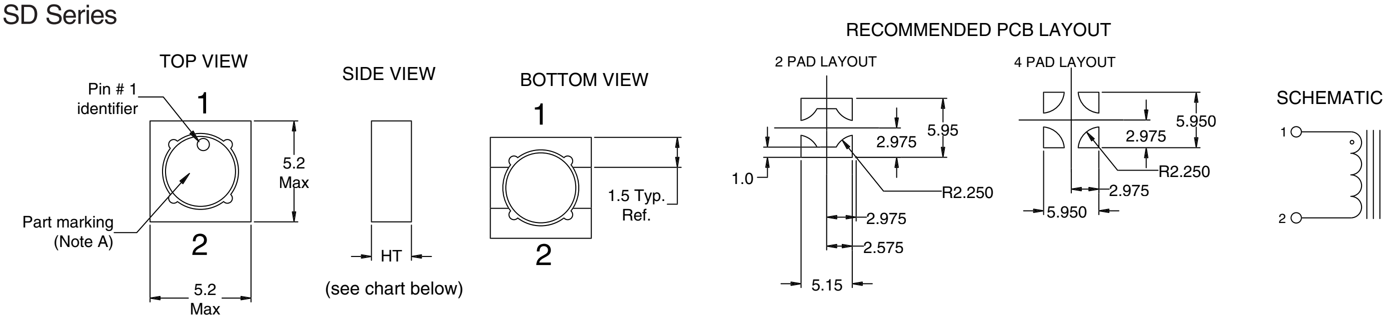
Part Number	Rated Inductance (µH)	OCL (1) +/-20% (µH)	Part Marking	Irms (2) Amperes	Isat (3) Amperes	DCR (4) (Ω) Typ.	Volt u-sec Typ.
SD20-R47-R	0.47	0.490	A	3.59	4.00	0.0200	2.28
SD20-1R2-R	1.20	1.21	B	3.07	2.55	0.0275	3.58
SD20-1R5-R	1.50	1.69	C	2.88	2.15	0.0312	4.23
SD20-2R2-R	2.20	2.25	D	2.45	1.87	0.0429	4.88
SD20-3R3-R	3.30	3.61	E	2.17	1.47	0.0547	6.18
SD20-4R7-R	4.70	4.41	F	2.05	1.33	0.0612	6.83
SD20-6R2-R	6.20	6.25	G	1.89	1.12	0.0720	8.13
SD20-8R2-R	8.20	8.41	H	1.61	0.966	0.1000	9.43
SD20-100-R	10.0	9.61	J	1.53	0.903	0.1100	10.08
SD20-150-R	15.0	15.21	K	1.25	0.718	0.1655	12.68
SD20-220-R	22.0	22.09	L	1.12	0.596	0.2053	15.28
SD20-330-R	33.0	32.49	M	0.913	0.491	0.3100	18.53
SD20-470-R	47.0	47.61	N	0.745	0.406	0.4650	22.43
SD20-680-R	68.0	68.89	O	0.610	0.337	0.6947	26.98
SD20-820-R	82.0	82.81	P	0.576	0.308	0.7785	29.58
SD20-101-R	100	98.01	Q	0.495	0.283	1.06	32.18
SD20-151-R	150	151.3	R	0.435	0.228	1.37	39.98
SD20-221-R	220	222.0	S	0.356	0.188	2.04	48.43
SD20-331-R	330	327.6	T	0.294	0.155	2.99	58.83
SD20-471-R	470	470.9	U	0.263	0.129	3.74	70.53
SD20-681-R	680	681.2	V	0.216	0.107	5.56	84.83
SD20-821-R	820	823.7	W	0.204	0.098	6.22	93.28
SD20-102-R	1000	1004.9	X	0.172	0.088	8.73	103
SD25-R47-R	0.47	0.466	A	3.88	6.00	0.0177	2.13
SD25-R82-R	0.82	0.770	B	3.58	4.67	0.0208	2.74
SD25-1R2-R	1.20	1.15	C	3.33	3.81	0.0240	3.34
SD25-1R5-R	1.50	1.61	D	3.12	3.23	0.0274	3.95
SD25-2R2-R	2.20	2.14	E	2.93	2.80	0.0311	4.56
SD25-3R3-R	3.30	3.43	F	2.64	2.21	0.0384	5.78
SD25-4R7-R	4.70	5.03	G	2.39	1.83	0.0467	6.99
SD25-6R8-R	6.80	6.93	H	2.19	1.56	0.0556	8.21
SD25-8R2-R	8.20	7.99	J	1.92	1.45	0.0724	8.82
SD25-100-R	10.0	10.35	K	1.80	1.27	0.0824	10.03
SD25-150-R	15.0	14.45	L	1.67	1.08	0.0956	11.86
SD25-220-R	22.0	22.81	M	1.34	0.857	0.1478	14.90
SD25-330-R	33.0	33.07	N	1.11	0.711	0.2149	17.94
SD25-470-R	47.0	47.89	O	0.919	0.592	0.3156	21.58
SD25-680-R	68.0	68.64	P	0.741	0.482	0.4850	25.84
SD25-820-R	82.0	82.17	Q	0.713	0.441	0.5242	28.27
SD25-101-R	100	100.79	R	0.670	0.398	0.5937	31.31
SD25-151-R	150	148.4	S	0.553	0.328	0.8723	38.00
SD25-221-R	220	222.4	T	0.446	0.268	1.34	46.51
SD25-331-R	330	332.2	U	0.359	0.219	2.07	56.85
SD25-471-R	470	472.4	V	0.293	0.184	3.10	67.79
SD25-681-R	680	677.2	W	0.262	0.154	3.88	81.17
SD25-821-R	820	826.7	X	0.230	0.139	5.04	89.68
SD25-102-R	1000	1003.4	Y	0.216	0.126	5.70	98.80

(1) Open Circuit Inductance Test Parameters: 100KHz, 0.25Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
(3) SD10,12,18,25 Peak current for approximate 30% roll off at 20°C.
SD14 Peak current for approximate 20% roll off at 20°C.
(4) DCR limits @ 20°C.
5) Applied Volt-Time product (V-uS) across the inductor at 100kHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.

SD Series
High Power Density, Low Profile, Shielded Inductors

Mechanical Diagrams

SD Series

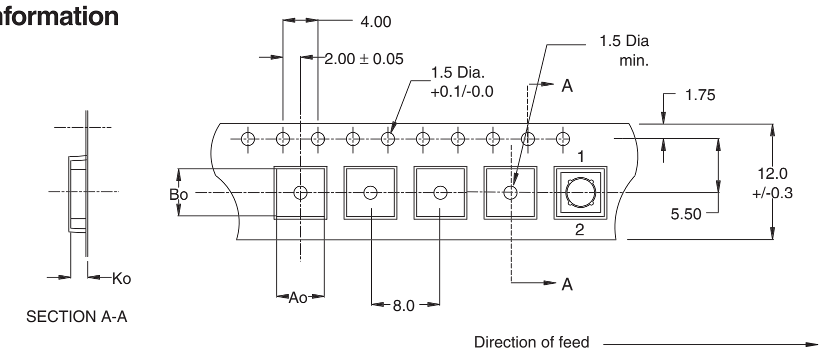


Series	HT
SD10	1.0mm max
SD12	1.2mm max
SD14	1.45mm max
SD18	1.8mm max
SD20	2.0mm max
SD25	2.5mm max

A) Part Marking: Line 1: (1st digit indicates the inductance value per part marking designator in chart above)
(2nd digit is a bi-weekly production date code)
(3rd digit is the last digit of the year produced)
Line 2: XX (indicates the product size code)

Packaging Information

SD10 Series

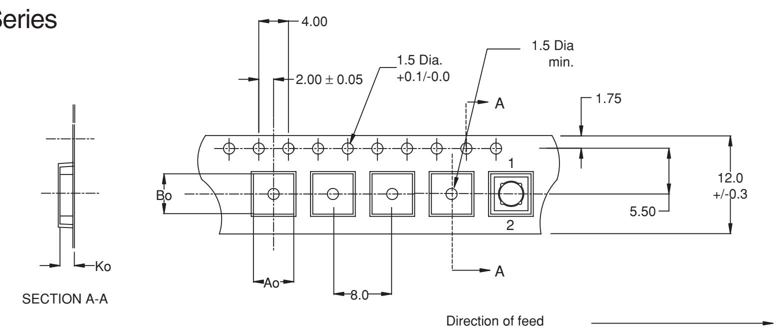


Ao=5.45mm
Bo=5.45mm
Ko=1.20mm

ACTUAL SIZE
SD10

Parts packaged on 13" Diameter reel, 3,800 parts per reel.

SD12/14/18 Series



Ao=5.45mm
Bo=5.45mm
Ko=2.00mm

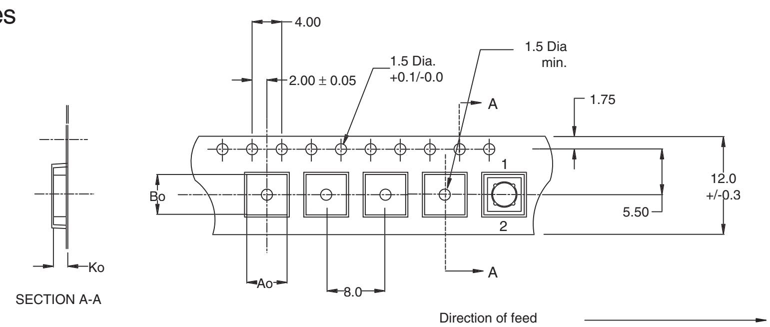
ACTUAL SIZE
SD12

ACTUAL SIZE
SD14

ACTUAL SIZE
SD18

Parts packaged on 13" Diameter reel, 3,800 parts per reel.

SD20/25 Series



Ao=5.45mm
Bo=5.45mm
Ko=2.70mm

ACTUAL SIZE
SD20

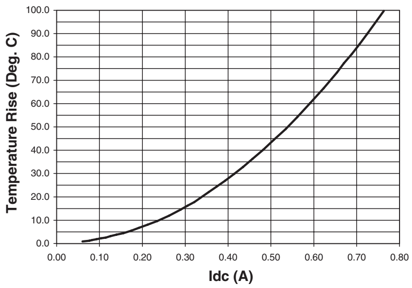
ACTUAL SIZE
SD25

Parts packaged on 13" Diameter reel, 2,900 parts per reel.

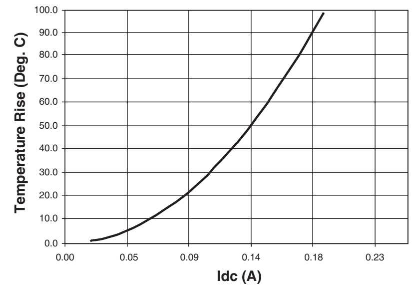
Dimensions are in millimeters.

DC Current vs. Temperature

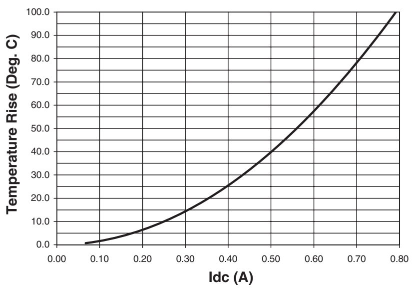
SD10-220



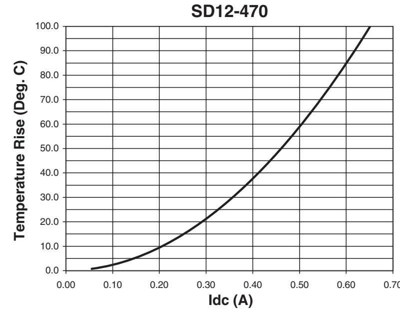
SD10-471



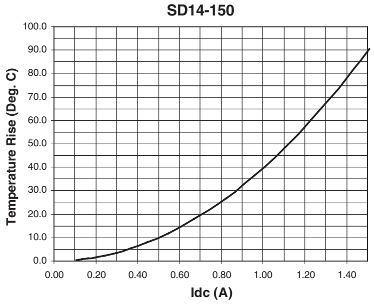
SD12-330



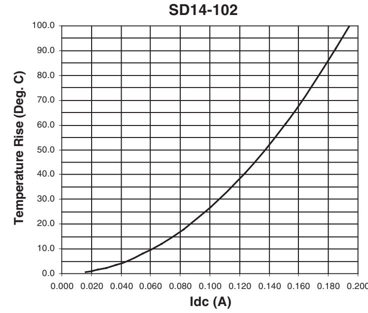
SD12-470



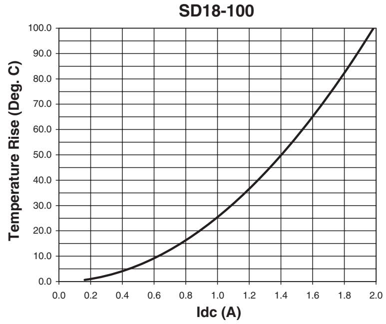
SD14-150



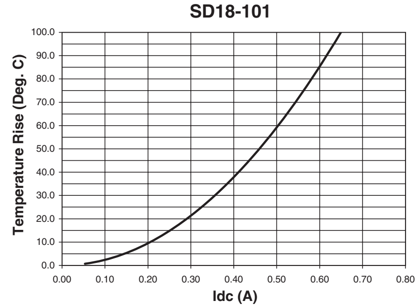
SD14-102



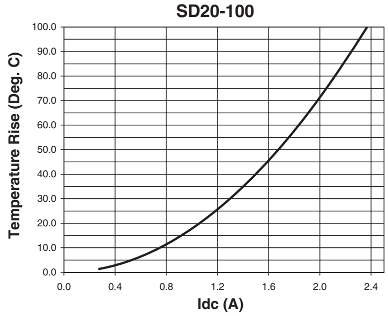
SD18-100



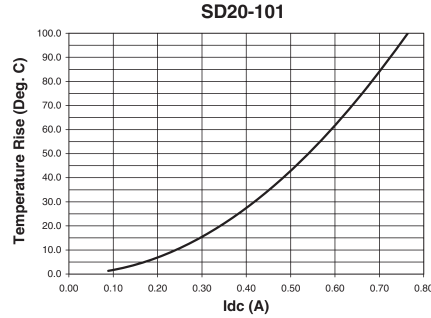
SD18-101



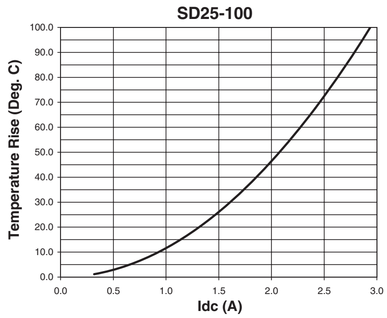
SD20-100

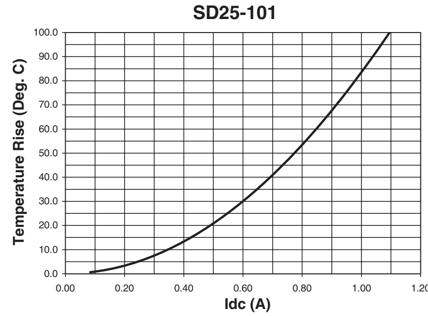


SD20-101

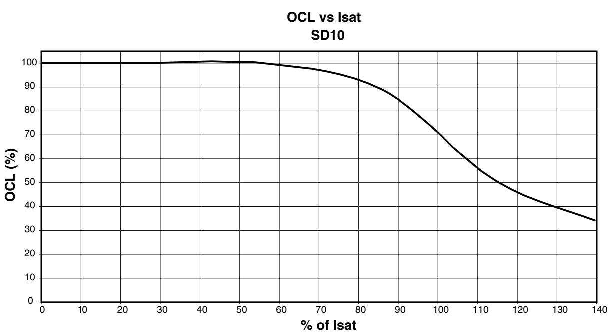


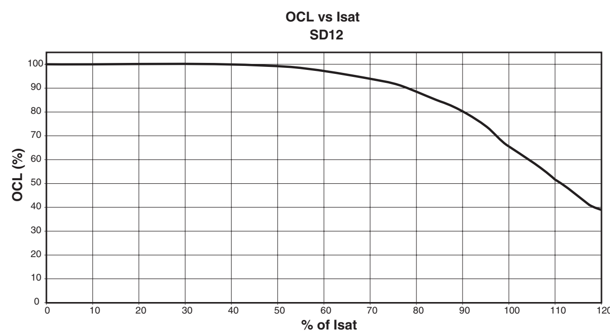
DC Current vs. Temperature

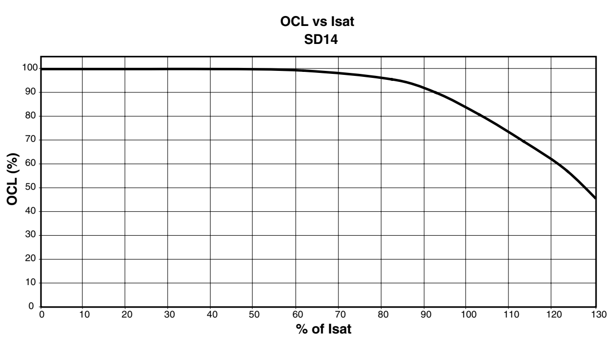


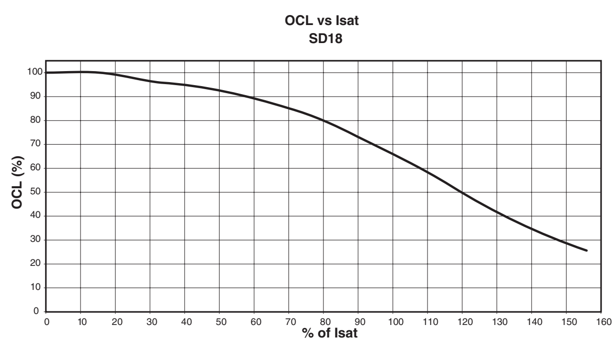


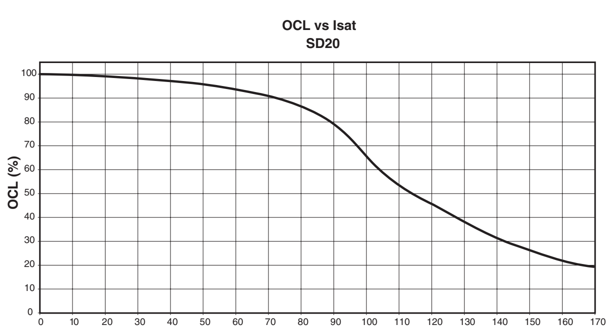
Inductance Characteristics

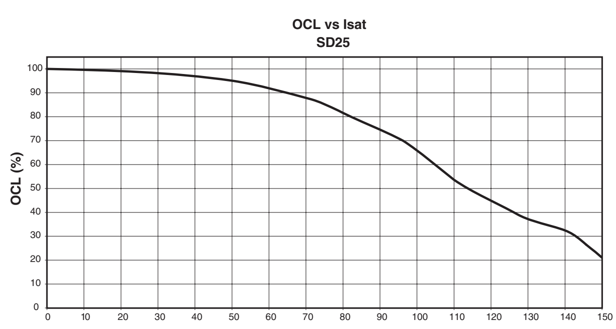






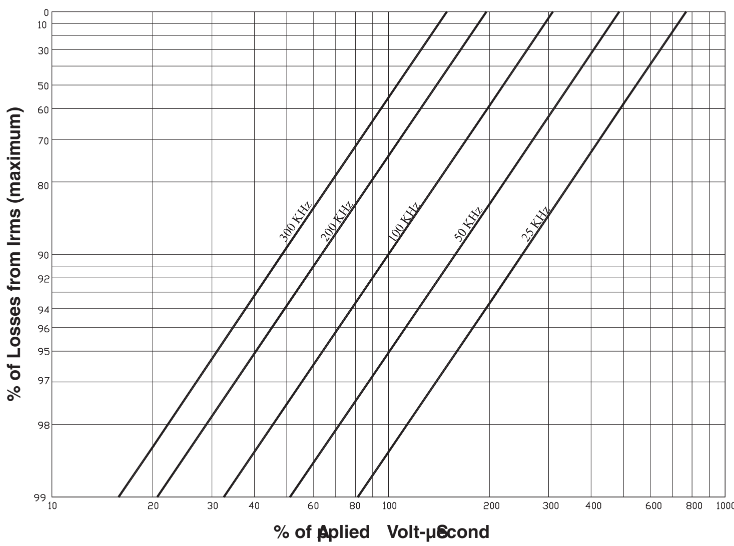






Core Loss

Irms DERATING WITH CORE LOSS

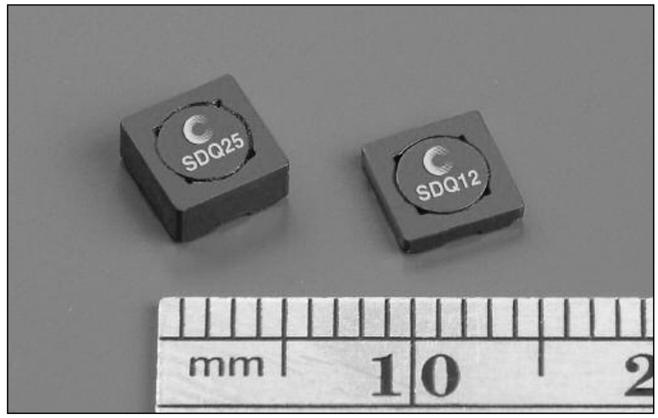


COILTRONICS®

COOPER Bussmann

SDQ Series
Low Profile Dual Winding Shielded Inductor/Transformer

RoHS 2002/95/EC



Description

- Dual winding inductors that can be used as either a single inductor, or in coupled inductor/transformer applications (1:1 turns ratio)
- Windings can be connected in series or parallel, offering a broad range of inductance and current ratings
- Current Range from 6.43 to 0.063 Amps
- Inductance range from 0.47µH to 4.03mH
- Ferrite shielded, low EMI
- Ferrite core material

Applications

- As a transformer: SEPIC, flyback
- As an inductor: Buck, boost, coupled inductor
- Digital cameras, CD players, cellular phones, and PDA's
- PCMCIA cards
- GPS systems

Environmental Data

- Storage temperature: -40°C to +125°C
- Operating temperature: -40°C to +85°C (Range is application specific). Temperature rise is approximately 40°C at rated rms current.
- Solder reflow temperature: 260°C max. for 10 seconds max.

Packaging

- Supplied in tape and reel packaging, SDQ12 (3,800, SDQ25 (2,900) parts per reel

			Parallel Ratings					Series Ratings				
Part Number	**Rated Inductance (µH)**	**Part Marking**	**OCL (1) +/-20% (µH)**	**I rms (2) Amperes**	**I sat (3) Amperes**	**DCR Ω (4) typ.**	**Volt (5) µ-Sec typ.**	**OCL (1) +/-20% (µH)**	**I rms (2) Amperes**	**I sat (3) Amperes**	**DCR Ω (4) typ.**	**Volt (5) µ-Sec typ.**
SDQ12-R47-R	0.47	A	0.49	2.78	4.34	0.0325	2.45	1.96	1.39	2.17	0.1298	4.90
SDQ12-1R0-R	1	B	0.81	2.49	3.38	0.0403	3.15	3.24	1.25	1.69	0.1611	6.30
SDQ12-1R5-R	1.5	C	1.69	1.69	2.34	0.0870	4.55	6.76	0.847	1.17	0.3481	9.10
SDQ12-2R2-R	2.2	D	2.25	1.60	2.03	0.0977	5.25	9.00	0.800	1.01	0.3908	10.5
SDQ12-3R3-R	3.3	E	3.61	1.28	1.60	0.1527	6.65	14.44	0.640	0.800	0.6106	13.3
SDQ12-4R7-R	4.7	F	4.41	1.12	1.45	0.1990	7.35	17.64	0.560	0.724	0.7959	14.7
SDQ12-6R2-R	6.2	G	6.25	1.02	1.22	0.2387	8.75	25.00	0.512	0.608	0.9548	17.5
SDQ12-8R2-R	8.2	H	8.41	0.868	1.05	0.3318	10.15	33.64	0.434	0.524	1.33	20.3
SDQ12-100-R	10	J	9.61	0.831	0.981	0.3620	10.85	38.44	0.416	0.490	1.45	21.7
SDQ12-150-R	15	K	15.21	0.658	0.779	0.5766	13.65	60.84	0.329	0.390	2.31	27.3
SDQ12-220-R	22	L	22.09	0.548	0.647	0.8332	16.45	88.36	0.274	0.323	3.33	32.9
SDQ12-330-R	33	M	32.49	0.439	0.533	1.29	19.95	130.0	0.220	0.267	5.18	39.9
SDQ12-470-R	47	N	47.61	0.401	0.441	1.55	24.15	190.4	0.201	0.220	6.21	48.3
SDQ12-680-R	68	O	68.89	0.326	0.366	2.36	29.05	275.6	0.163	0.183	9.43	58.1
SDQ12-820-R	82	P	82.81	0.309	0.334	2.62	31.85	331.2	0.154	0.167	10.49	63.7

1) Test Parameters: 100kHz,.0.25 Vrms 0.0Adc
2) Rms current for approximately ∆T of 40°C without core loss. It is recommended that the temperature of the part not to exceed 125°C. De-rating is necessary for AC currents
3) Peak current for approximately 30% rolloff @20°C
4) DCR limits @20°C
5) Applied Volt-Time product (V-µS) across the inductor at 100kHz necessary to generate a core loss equal to 10% of the total losses for a 40°C temperature rise. De-rating of the Irms is required to prevent excessive temperature rise.

Part number definition:
First 3 characters = Product code and size.
Last 3 characters = Inductance in uH. R = Decimal point. If no R is present, third character = # of zeros.

SDQ12-XXX-R
SDQ12 = Product code and Size
XXX = Inductance in uH, R = Decimal point
If no R is present, third character = # of zeros.
-R suffix indicated RoHS compliant

COOPER Bussmann

SDQ Series
Low Profile Dual Winding Shielded Inductor/Transformer

			Parallel Ratings					Series Ratings				
Part Number	**Rated Inductance (µH)**	**Part Marking**	**OCL (1) +/-20% (µH)**	**I rms (2) Amperes**	**I sat (3) Amperes**	**DCR Ω (4) typ.**	**Volt (5) µ-Sec typ.**	**OCL (1) +/-20% (µH)**	**I rms (2) Amperes**	**I sat (3) Amperes**	**DCR Ω (4) typ.**	**Volt (5) µ-Sec typ.**
SDQ25-R47-R	0.47	A	0.392	3.71	6.43	0.0181	2.31	1.57	1.86	3.21	0.0725	4.62
SDQ25-R82-R	0.82	B	0.648	3.37	5.00	0.0221	2.97	2.59	1.68	2.50	0.0883	5.94
SDQ25-1R0-R	1	C	0.97	3.15	4.09	0.0252	3.63	3.87	1.58	2.05	0.1007	7.26
SDQ25-1R5-R	1.5	D	1.35	2.97	3.46	0.0283	4.29	5.41	1.49	1.73	0.1130	8.58
SDQ25-2R2-R	2.2	E	2.31	2.67	2.65	0.0351	5.61	9.25	1.34	1.32	0.1402	11.2
SDQ25-3R3-R	3.3	F	2.89	2.50	2.37	0.0399	6.27	11.55	1.25	1.18	0.1595	12.5
SDQ25-4R7-R	4.7	G	5	1.96	1.80	0.0653	8.25	20.00	0.98	0.900	0.2612	16.5
SDQ25-6R8-R	6.8	H	6.73	1.84	1.55	0.0741	9.57	26.91	0.918	0.776	0.2964	19.1
SDQ25-8R2-R	8.2	J	8.71	1.57	1.36	0.1015	10.9	34.85	0.785	0.682	0.4059	21.8
SDQ25-100-R	10	K	9.8	1.53	1.29	0.1068	11.6	39.20	0.765	0.643	0.4273	23.1
SDQ25-150-R	15	L	14.79	1.24	1.05	0.1632	14.2	59.17	0.619	0.523	0.6526	28.4
SDQ25-220-R	22	M	22.47	1.01	0.849	0.2431	17.5	89.89	0.507	0.425	0.9724	35.0
SDQ25-330-R	33	N	33.8	0.812	0.692	0.3795	21.5	135.2	0.406	0.346	1.52	42.9
SDQ25-470-R	47	O	47.43	0.749	0.584	0.4461	25.4	189.7	0.374	0.292	1.78	50.8
SDQ25-680-R	68	P	69.19	0.603	0.484	0.6865	30.7	276.8	0.302	0.242	2.75	61.4
SDQ25-820-R	82	Q	81.61	0.580	0.446	0.7435	33.3	326.4	0.290	0.223	2.97	66.7
SDQ25-101-R	100	R	98.57	0.499	0.405	1.00	36.6	394.3	0.249	0.203	4.02	73.3
SDQ25-151-R	150	S	150.2	0.408	0.328	1.50	45.2	600.6	0.204	0.164	6.00	90.4
SDQ25-221-R	220	T	223.1	0.326	0.269	2.36	55.1	892.4	0.163	0.135	9.42	110
SDQ25-331-R	330	U	329.7	0.292	0.222	2.93	67.0	1318.7	0.146	0.111	11.71	134
SDQ25-471-R	470	V	472.4	0.243	0.185	4.25	80.2	1889.6	0.121	0.093	16.99	160
SDQ25-681-R	680	W	677.4	0.197	0.155	6.45	96.0	2709.8	0.098	0.077	25.78	192
SDQ25-821-R	820	X	824.3	0.186	0.140	7.25	106	3297.3	0.093	0.070	28.99	212
SDQ25-102-R	1000	Y	1008.2	0.160	0.127	9.82	117	4032.8	0.080	0.063	39.26	234

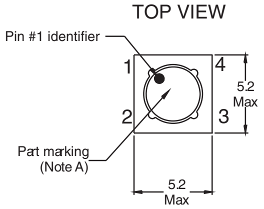
1) Test Parameters: 100kHz,.0.25 Vrms 0.0Adc
2) Rms current for approximately ∆T of 40°C without core loss. It is recommended that the temperature of the part not to exceed 125°C. De-rating is necessary for AC currents
3) Peak current for approximately 30% rolloff @20°C
4) DCR limits @20°C
5) Applied Volt-Time product (V-µS) across the inductor at 100kHz necessary to generate a core loss equal to 10% of the total losses for a 40°C temperature rise. De-rating of the Irms is required to prevent excessive temperature rise.

Part number definition:
First 3 characters = Product code and size.
Last 3 characters = Inductance in uH. R = Decimal point. If no R is present, third character = # of zeros.

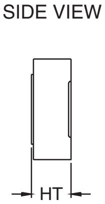
SDQ12-XXX-R
SDQ12 = Product code and Size
XXX = Inductance in uH, R = Decimal point
If no R is present, third character = # of zeros.
-R suffix indicated RoHS compliant

Mechanical Diagrams

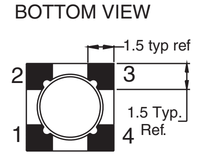
TOP VIEW



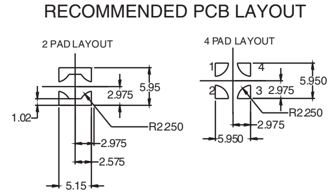
SIDE VIEW



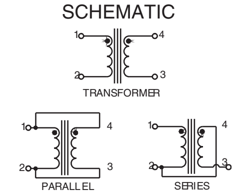
BOTTOM VIEW



RECOMMENDED PCB LAYOUT



SCHEMATIC

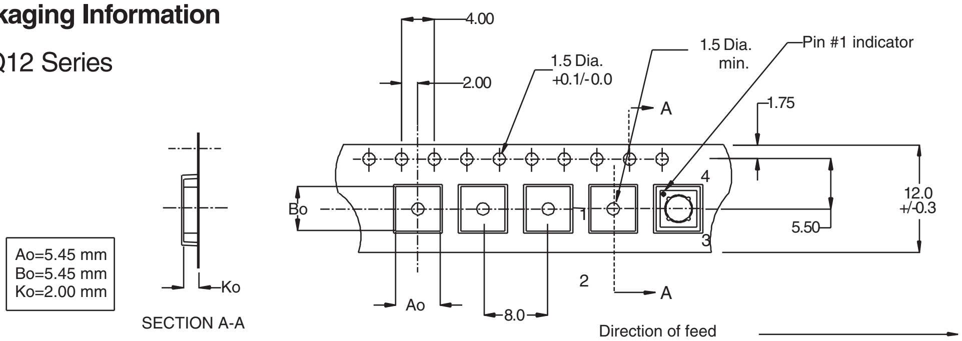


Series	HT
SDQ12	1.2mm max
SDQ25	2.5mm max

A) Part marking: Line 1 (1st digit inductance value per part marking designator in chart above)
(2nd digit is a bi-weekly production date code)
(3rd digit is the last digit of the year produced)
Line 2: xx (indicates the product size code)

Packaging Information

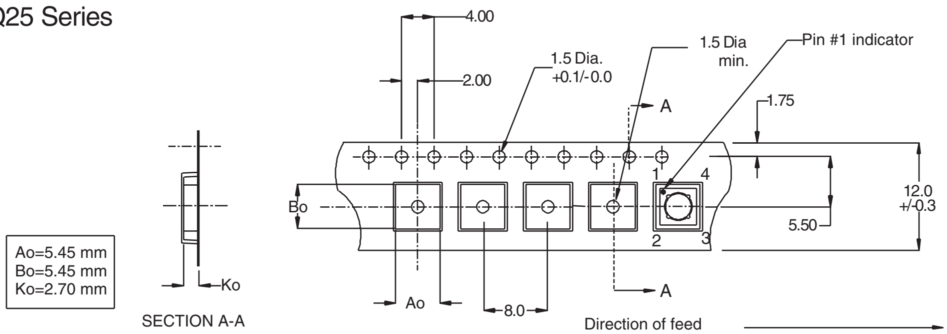
SDQ12 Series




ACTUAL SIZE
SDQ12

Parts packaged on 13" Diameter reel, 3,800 parts per reel.

SDQ25 Series

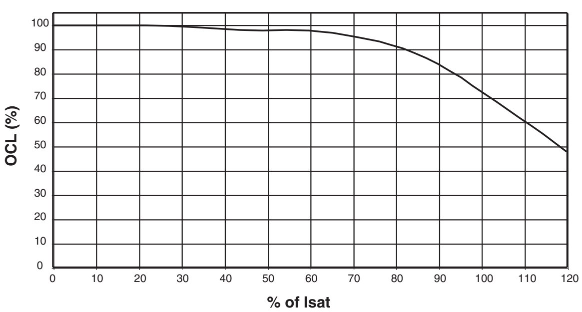



ACTUAL SIZE
SDQ25

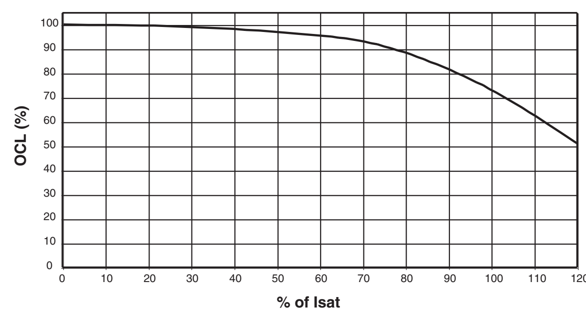
Parts packaged on 13" Diameter reel, 2,900 parts per reel.

Inductance Characteristics

OCL vs Isat
SDQ12

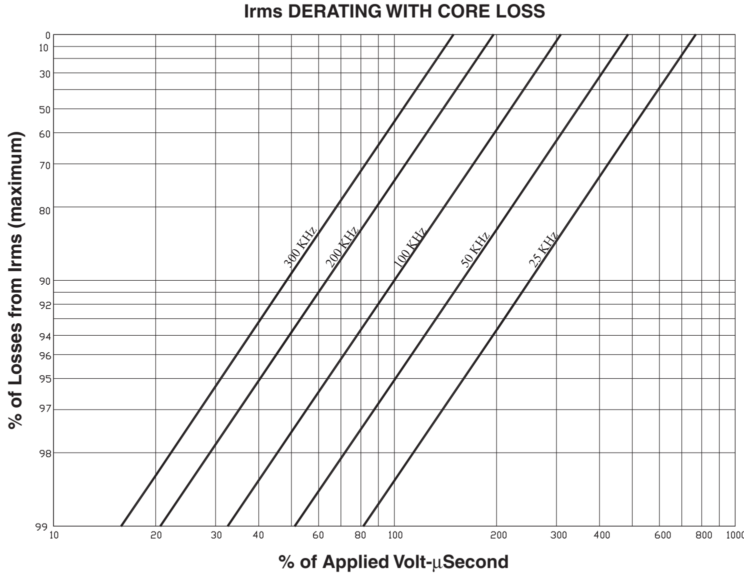


OCL vs Isat
SDQ25



Core Loss

Irms DERATING WITH CORE LOSS



COILTRONICS®

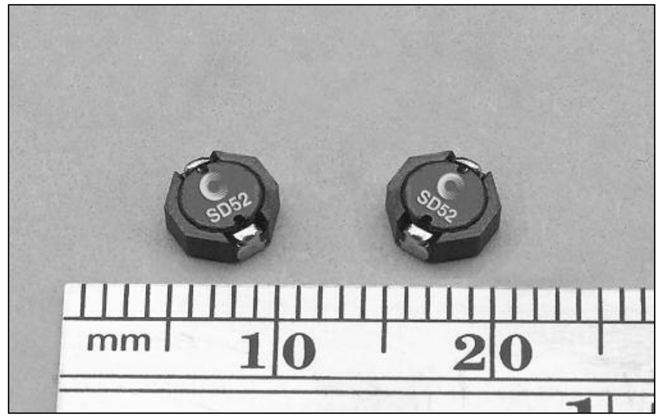
COOPER Bussmann

SD52 Series
High Power Density, Low Profile, Shielded Inductors

Description

RoHS 2002/95/EC

- 125°C maximum total temperature operation
- Octagonal shape shielded drum core
- 2mm max height
- Inductance range from 1.2uH to 100uH
- Current range from 3.14 to 0.35 Amps
- Ferrite shielded, low EMI
- Ferrite core material



Applications

- Digital cameras, CD players, cellular phones, and PDAs
- PCMCIA cards
- GPS systems

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +125°C (range is application specific).
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging

- Supplied in tape and reel packaging, 3500 per reel

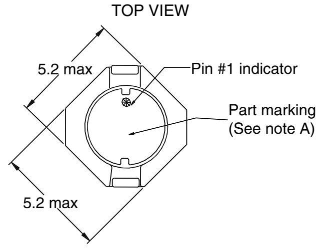
Part Number	Rated Inductance (µH)	OCL (1) +/-20% (µH)	Part Marking	Irms (2) Amperes	Isat (3) Amperes	DCR (4) (Ω) Typ.	Volt u-sec Typ.
SD52-1R2-R	1.20	1.20	A	2.33	3.14	0.0279	1.49
SD52-2R2-R	2.20	2.20	B	1.98	2.30	0.0385	2.03
SD52-3R5-R	3.50	3.50	C	1.73	1.82	0.0503	2.57
SD52-4R7-R	4.70	4.70	D	1.63	1.64	0.0568	2.84
SD52-6R8-R	6.80	6.80	E	1.39	1.28	0.0777	3.65
SD52-100-R	10.0	10.0	F	1.11	1.11	0.1215	4.19
SD52-150-R	15.0	15.0	G	0.97	0.88	0.1618	5.27
SD52-220-R	22.0	22.0	H	0.86	0.73	0.2042	6.35
SD52-270-R	27.0	27.0	J	0.73	0.65	0.2864	7.16
SD52-330-R	33.0	33.0	K	0.70	0.61	0.3074	7.70
SD52-470-R	47.0	47.0	L	0.58	0.50	0.4465	9.32
SD52-680-R	68.0	68.0	M	0.47	0.42	0.6829	11.21
SD52-101-R	100	100	N	0.39	0.35	1.0000	13.37
SD52-151-R	150	150	O	0.31	0.28	1.6100	17.00

(1) Open Circuit Inductance Test Parameters: 100KHz, 0.25Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
(3) Peak current for approximate 30% roll off at 20°C.
(4) DCR limits @ 20°C.
5) Applied Volt-Time product (V-uS) across the inductor at 100kHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.

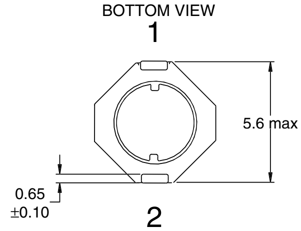
Mechanical Diagrams

SD52 Series

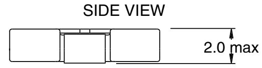
TOP VIEW



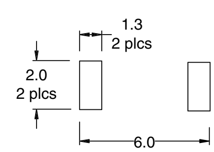
BOTTOM VIEW



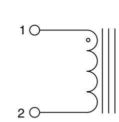
SIDE VIEW



RECOMMENDED PCB LAYOUT



SCHEMATIC

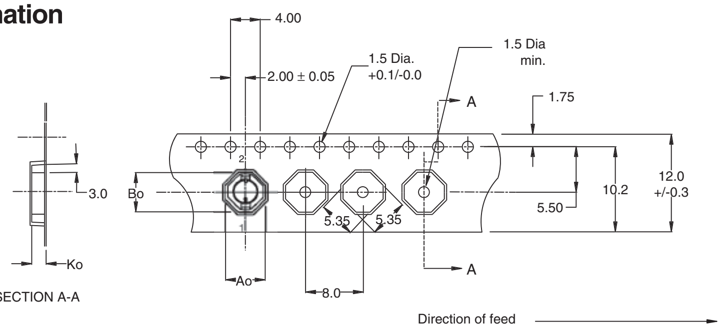


A) Part Marking: Line 1: (1st digit indicates the inductance value per part marking designator in chart above)
(2nd digit is a bi-weekly production date code)
(3rd digit is the last digit of the year produced)
Line 2: 52 (indicates the product size code)

SD52 Series
High Power Density, Low Profile, Shielded Inductors

Packaging Information

SD52 Series



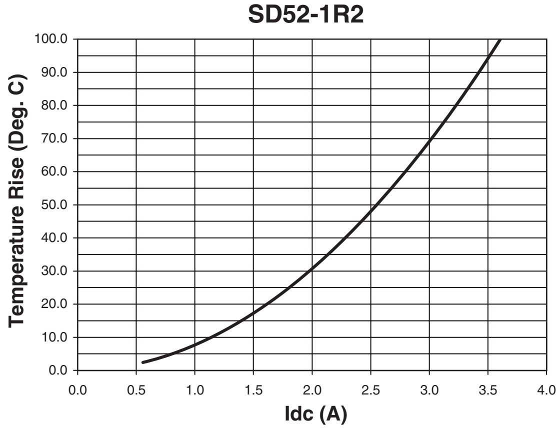
Ao=5.72mm
Bo=5.72mm
Ko=2.30mm

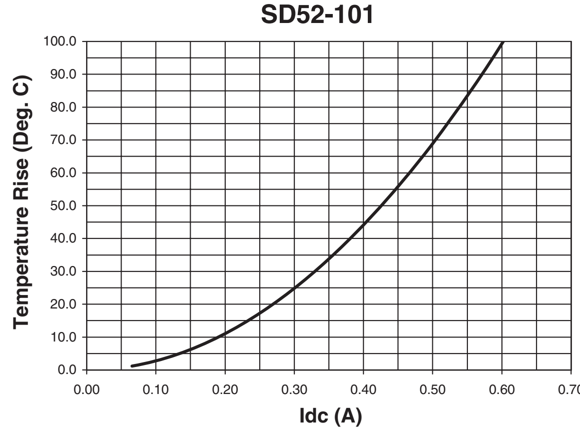
ACTUAL SIZE
SD52

Parts packaged on 13" Diameter reel, 3,500 parts per reel.

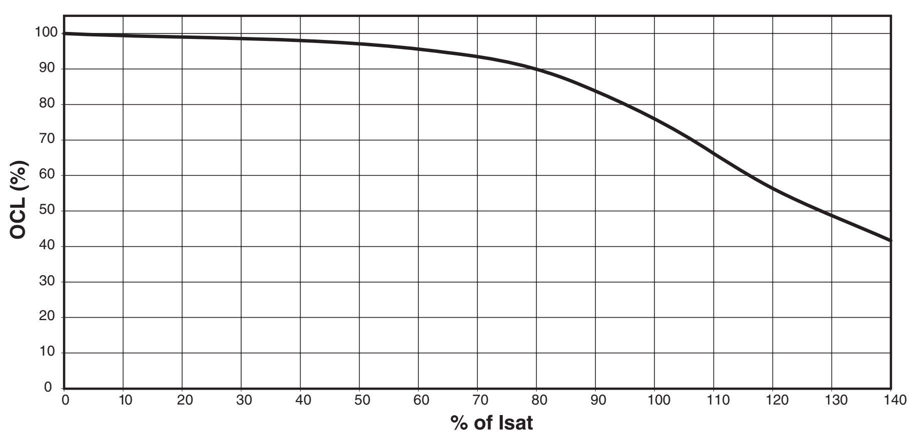
Dimensions are in millimeters.

DC Current vs. Temperature

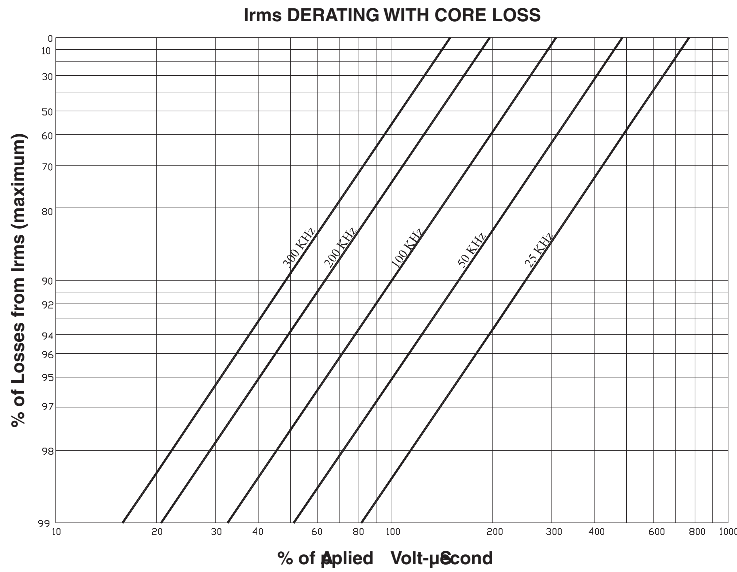




Inductance Characteristics



Core Loss


Irms DERATING WITH CORE LOSS
% of Losses from Irms (maximum)
0
10
30
50
60
70
80
90
92
94
96
95
97
98
99
10
20
30
40
60
80
100
200
300
400
600
800
1000
300 KHz
200 KHz
100 KHz
50 KHz
25 KHz
% of Aplied Volt-µSecond

COILTRONICS®

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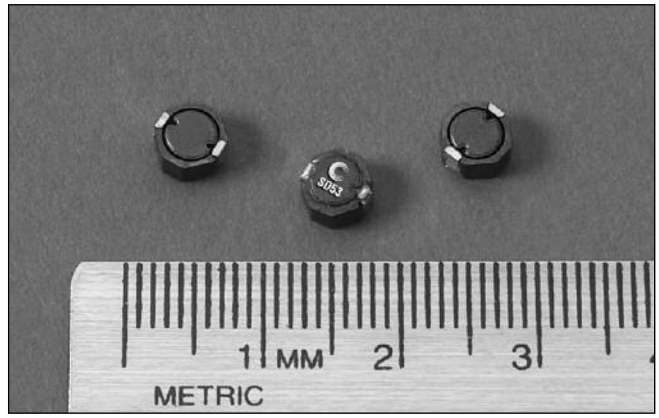
SD53 Series
Low Profile, Shielded Inductors

Description

- 125°C maximum total temperature operation
- Octagonal shape utilizes board space
- 5.2mm x 5.2mm x 3.0mm surface mount package
- Shielded drum core reduces EMI
- Ferrite core material
- Inductance range from 1.1uH to 100uH
- Current range from 4.08 Amps to 0.44 Amps

RoHS 2002/95/EC



Applications

- High Power LED driver
- White LED and OLED displays
- DSL modems, digital cameras
- Buck, Boost Inductor
- Cellular phones, Smart phones
- MP3 players, Digital radio player
- PDA, Palmtop, and wireless handhelds
- Battery power, TFT - LCD Bias supply

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

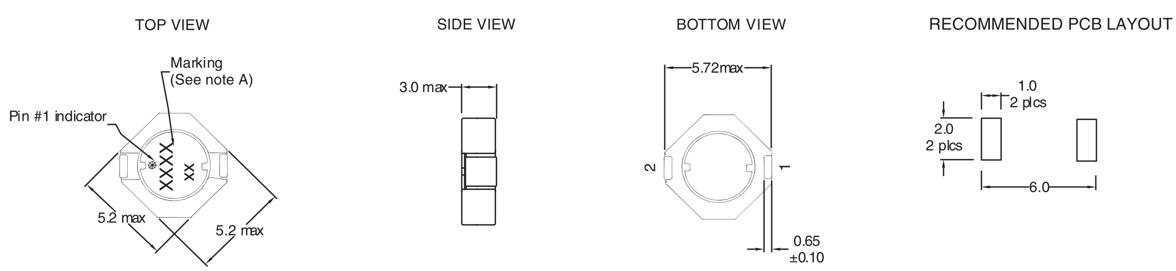
Packaging

- Supplied in tape and reel packaging, 2600 per reel

Part Number	Rated Inductance (µH)	OCL (1) µH ± 20%	Part Marking	Irms (2) Amperes	Isat (3) Amperes	DCR Ω @20°C (Typical)	DCR Ω @20°C (Maximum)	K-factor (4)
SD53-1R1-R	1.10	1.10	A	3.25	4.80	0.017	0.020	48
SD53-2R0-R	2.00	2.00	B	2.64	3.30	0.023	0.027	35
SD53-3R3-R	3.30	3.30	C	2.26	2.60	0.029	0.034	28
SD53-4R7-R	4.70	4.70	D	2.01	2.10	0.039	0.045	21
SD53-6R8-R	6.80	6.80	E	1.65	1.85	0.059	0.068	20
SD53-100-R	10.0	10.0	F	1.41	1.40	0.077	0.090	15
SD53-150-R	15.0	15.0	G	1.10	1.10	0.122	0.142	12
SD53-220-R	22.0	22.0	H	0.81	0.94	0.179	0.208	10
SD53-330-R	33.0	33.0	I	0.75	0.76	0.221	0.257	8
SD53-470-R	47.0	47.0	J	0.64	0.64	0.303	0.352	7
SD53-680-R	68.0	68.0	K	0.52	0.58	0.452	0.525	6
SD53-101-R	100	100	L	0.44	0.45	0.689	0.801	5

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 30% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: SD53-xxx-R
SD53 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

Mechanical Diagrams

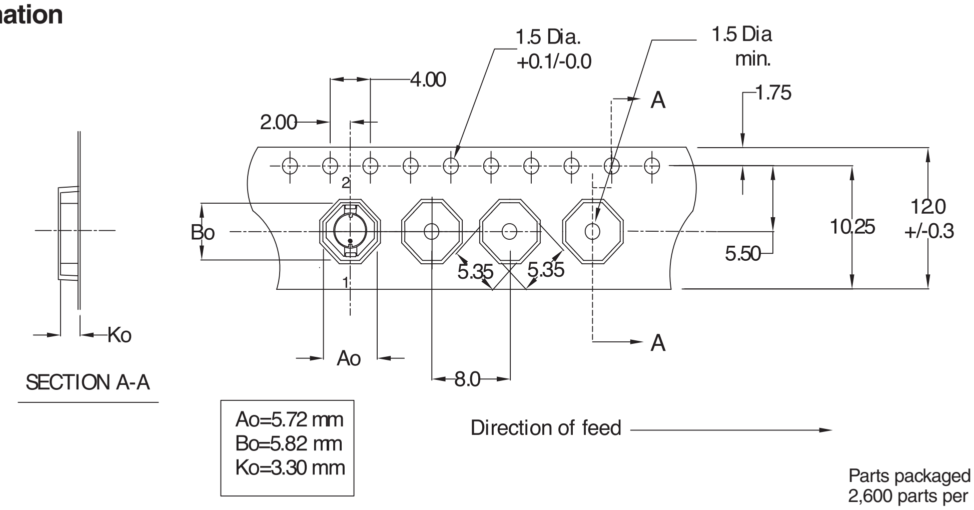


Dimensions are in millimeters.
Note A. Part Marking:
4 Digit Marking: Line 1: (1st digit: Indicates inductance value per Part Marking Designator in chart above); (2nd digit: Bi-weekly production date code); (3rd digit: Last digit of the year produced), (4th digit: Manufacturing code). Line 2: 53 (Indicates the product size code)

COOPER Bussmann

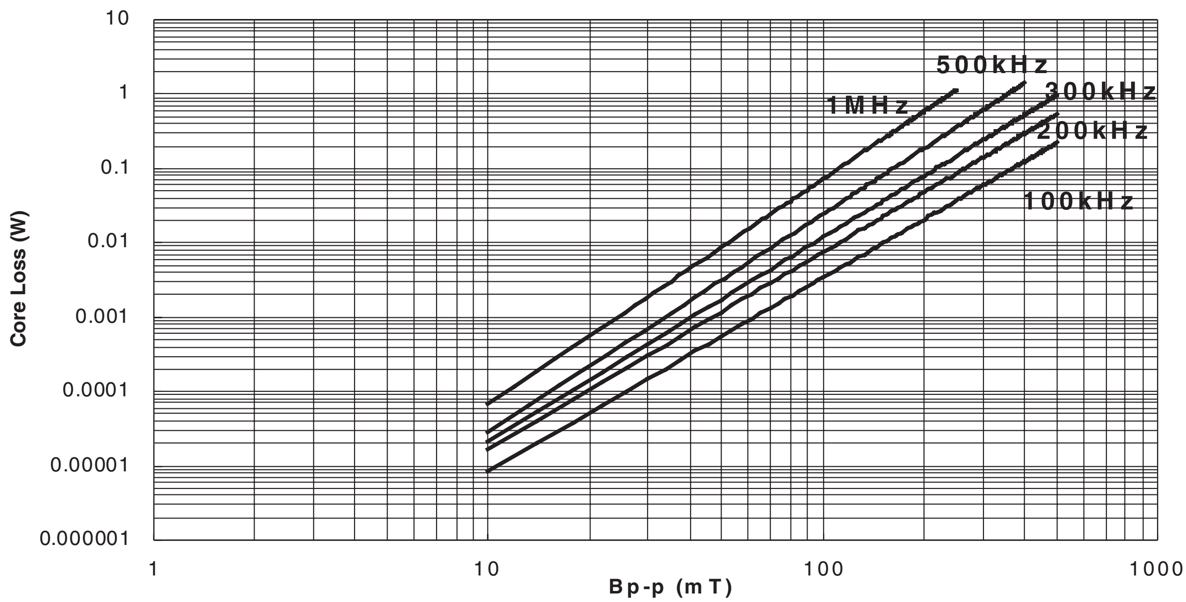
SD53 Series
Low Profile, Shielded Inductors

Packaging Information



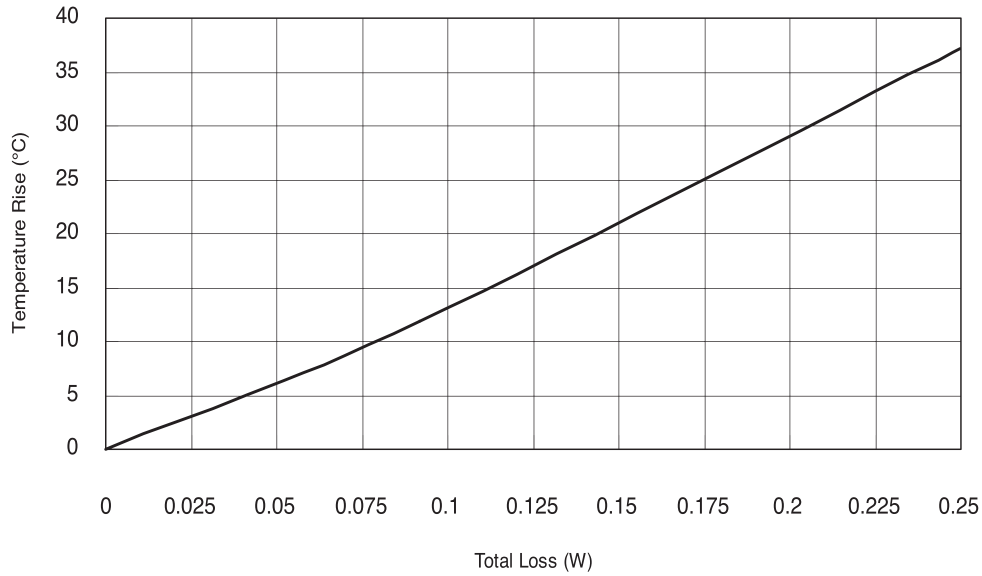
Parts packaged on 13" Diameter reel,
2,600 parts per reel.

Core Loss

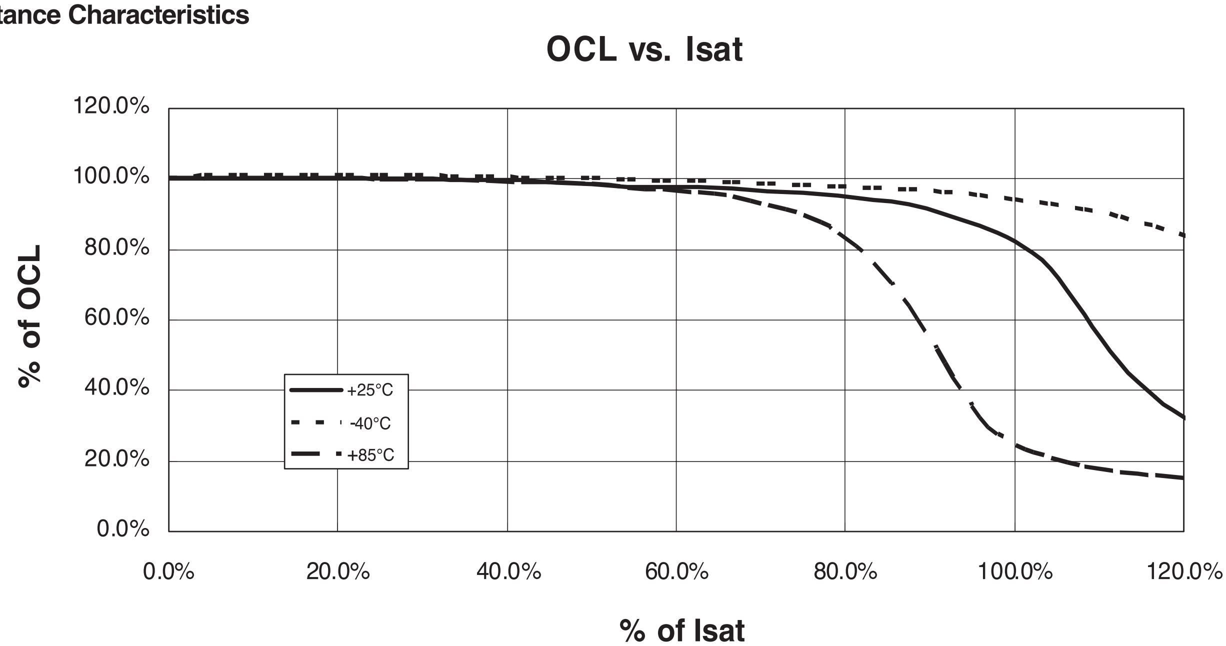


SD53 Series
Low Profile, Shielded Inductors

Temperature Rise vs. Loss



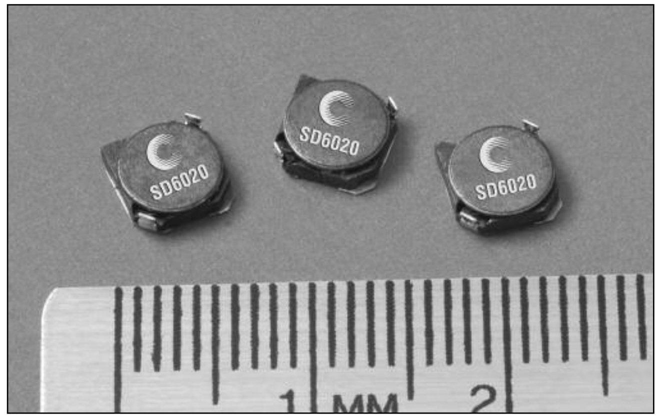
Inductance Characteristics



COOPER Bussmann

SD6020 Series
Low Profile Power Inductors

RoHS 2002/95/EC



Description

- 125°C maximum temperature operation
- Low profile surface mount inductors
- 6.0mm x 6.0mm x 2.0mm shielded drum core
- Ferrite core material
- Inductance range from 4.1uH to 100uH
- Current range from 2.0 Amps to 0.36 Amps
- Frequency range up to 1MHz

Applications

- Palmtop Computers
- Digital Cameras
- Digital Cordless Phones, PCS Phones
- Cable/DSL Modems, PC Cards
- Wireless Handsets, Hand-Held Instruments
- Battery Backup/power
- DC-DC converters, Buck/Boost regulators

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum

Packaging

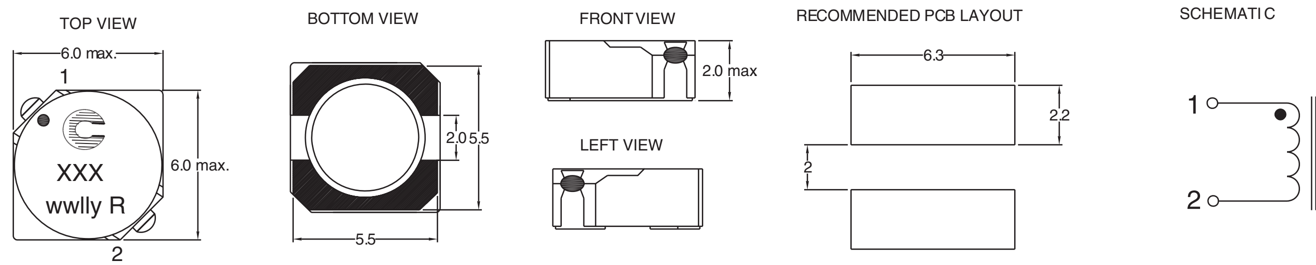
- Supplied in tape and reel packaging, 2600 per reel

Part Number	Rated Inductance (µH)	OCL (1) µH ± 30%	Irms (2) Amperes	Isat (3) Amperes	DCR mΩ@20°C (Typical)	DCR mΩ@20°C (Maximum)	K-factor (4)
SD6020-4R1-R	4.1	3.9	2.22	1.95	47.5	57.0	28.5
SD6020-5R4-R	5.4	5.5	1.80	1.60	63.3	76.0	24.0
SD6020-6R2-R	6.2	6.5	1.63	1.40	80.0	96.0	22.2
SD6020-8R9-R	8.9	8.5	1.47	1.25	96.7	116.0	19.3
SD6020-100-R	10	9.7	1.39	1.20	103.3	124.0	18.1
SD6020-120-R	12	11	1.31	1.10	115.0	138.0	17.1
SD6020-150-R	15	13	1.07	0.97	163.3	196.0	15.4
SD6020-180-R	18	16	1.10	0.85	175.0	210.0	13.9
SD6020-220-R	22	20	0.94	0.80	241.7	290.0	12.7
SD6020-270-R	27	27	0.82	0.75	275.0	330.0	10.9
SD6020-330-R	33	29	0.76	0.65	320.8	385.0	10.5
SD6020-390-R	39	37	0.63	0.57	416.7	500.0	9.2
SD6020-470-R	47	45	0.61	0.54	495.8	595.0	8.2
SD6020-560-R	56	55	0.57	0.50	515.0	618.0	7.8
SD6020-680-R	68	68	0.50	0.43	700.0	840.0	6.7
SD6020-820-R	82	80	0.48	0.41	815.0	978.0	6.3
SD6020-101-R	100	94	0.42	0.36	1000.0	1200.0	5.8

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for 35% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: SD6020-xxx-R
SD6020 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

SD6020 Series
Low Profile Power Inductors

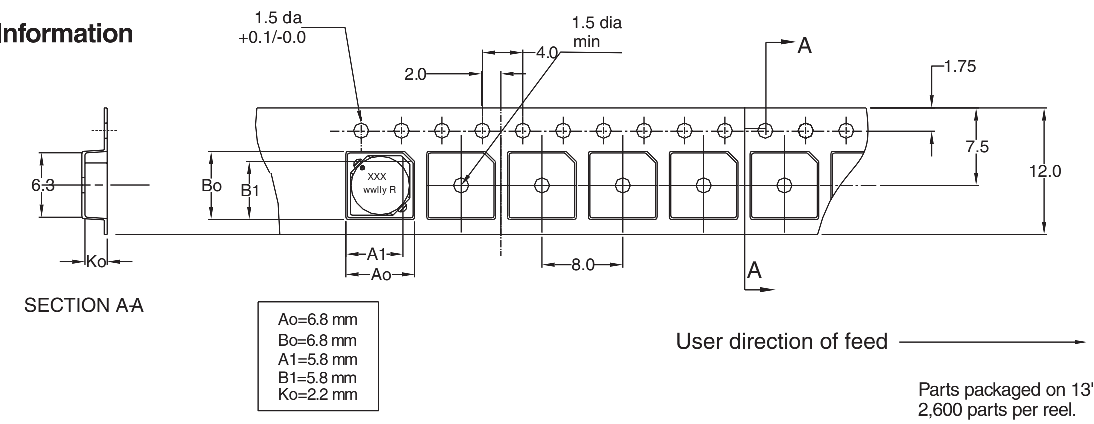
Mechanical Diagrams



Dimensions are in millimeters.

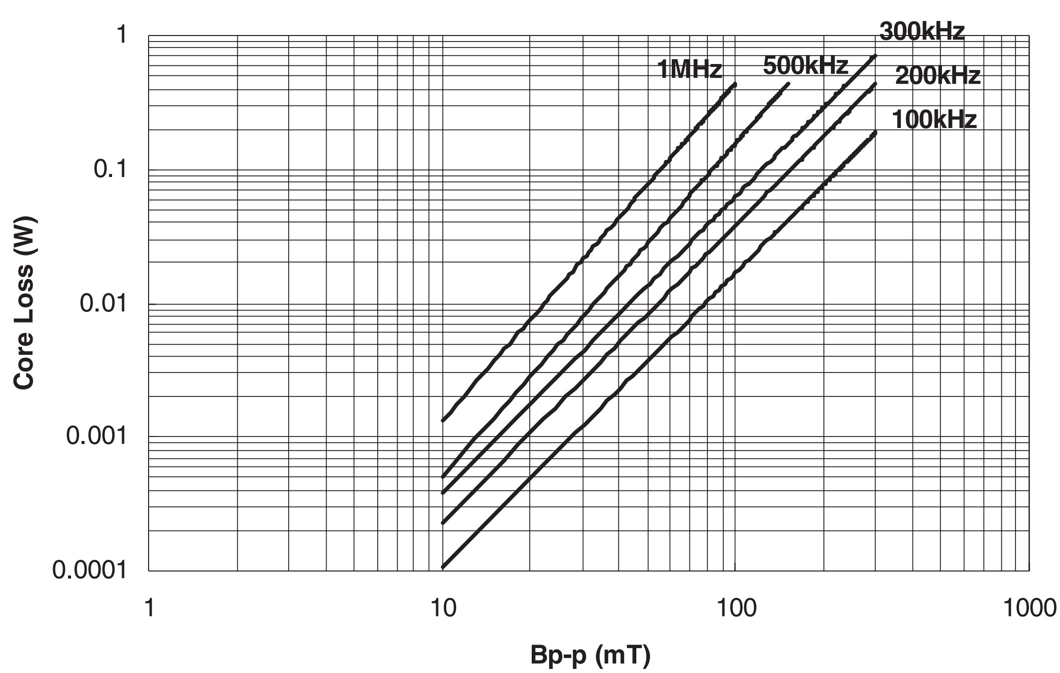
xxx = Inductance value in uH. R = decimal point. If no R is present third character = #0f zeros.
wwllyy = Date code, R = Revision level.

Packaging Information

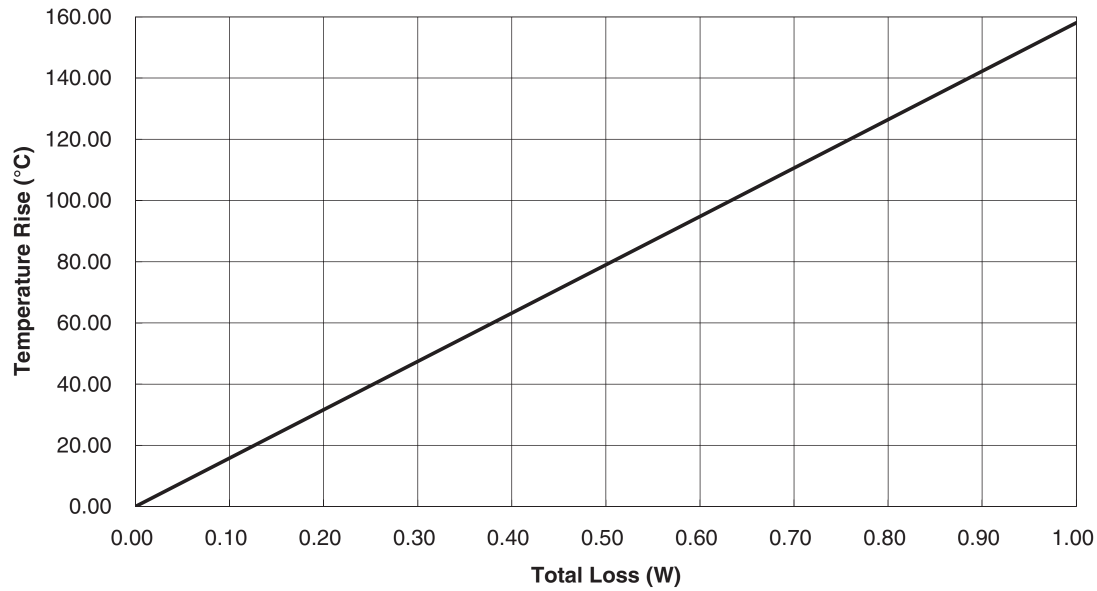


Parts packaged on 13" Diameter reel, 2,600 parts per reel.

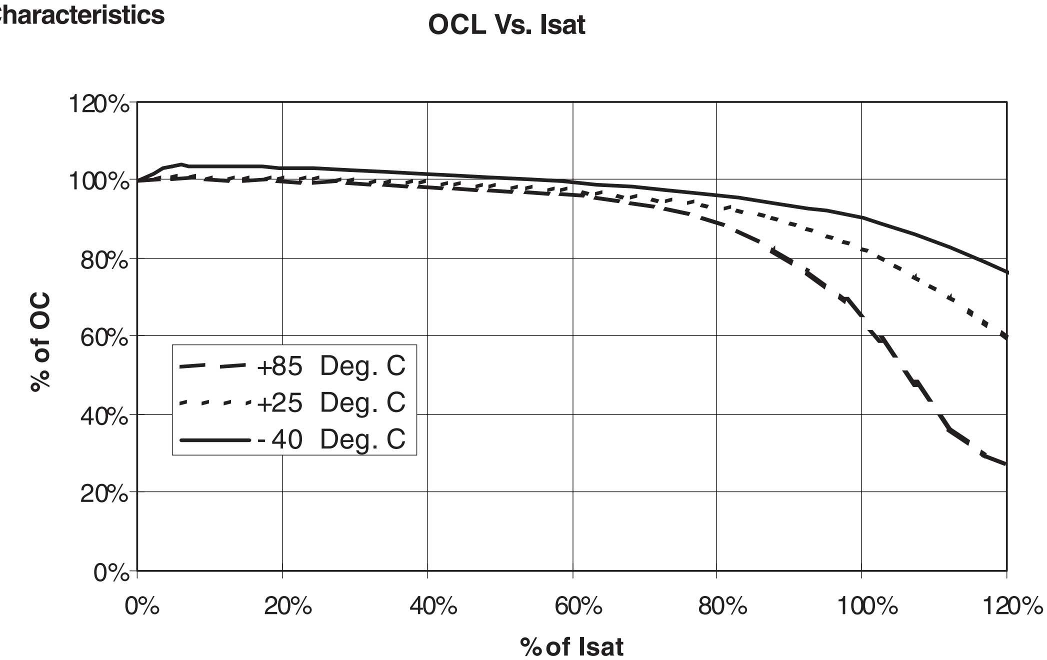
Core Loss



Temperature Rise vs. Loss



Inductance Characteristics



COILTRONICS®

COOPER Bussmann

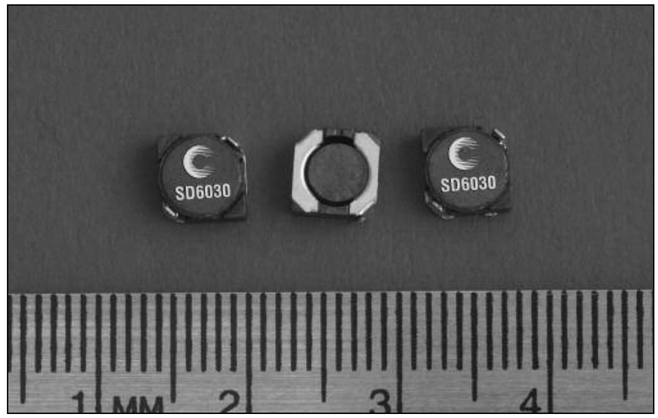
SD6030 Series
Low Profile Power Inductors

RoHS 2002/95/EC

Description
- 125°C maximum total temperature operation
- Low profile surface mount inductors
- 6.0mm x 6.0mm x 3.0mm surface mount package
- Ferrite core material
- Shielded drum core reduces EMI
- Inductance range from 2.7μH to 680μH
- Current range from 4.08 Amps to 0.16 Amps
- Frequency range up to 1MHz

Applications
- Notebook computers, Digital cameras
- DSL modems, PDA's
- High Power LED driver
- MP3, CD players, GPS receivers
- Cellular phones, Smart phones
- Wireless notebook adapters
- Battery power, TFT-LCD Bias supplies
- PCMCIA, Cardbus32, MiniPCI cards

Environmental Data
- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



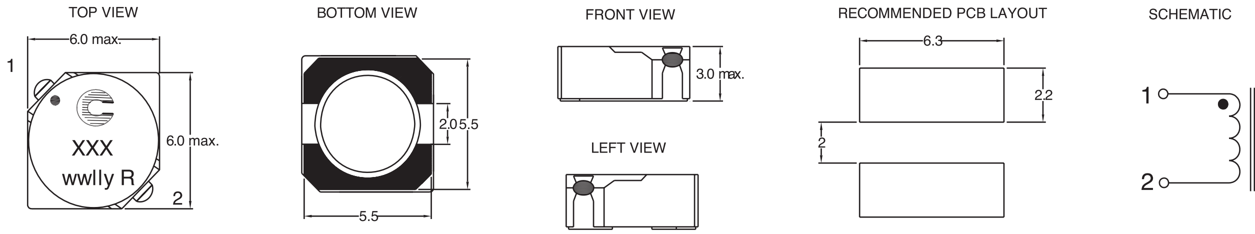
Packaging
- Supplied in tape and reel packaging, 2600 per reel

Part Number	Rated Inductance (μH)	OCL (1) μH ± 30%	Irms (2) Amperes	Isat (3) Amperes	DCR mΩ@20°C (Typical)	DCR mΩ@20°C (Maximum)	K-factor (4)
SD6030-2R7-R	2.7	2.7	4.08	2.60	13	18	34
SD6030-3R3-R	3.3	3.3	3.54	2.40	18	24	30
SD6030-4R2-R	4.2	4.1	3.11	2.20	23	31	27
SD6030-5R0-R	5.0	4.9	2.81	1.90	28	38	24
SD6030-5R8-R	5.8	5.8	2.58	1.80	33	45	22
SD6030-7R8-R	7.8	7.8	2.38	1.60	39	53	19
SD6030-100-R	10	9.3	2.15	1.30	48	65	17
SD6030-120-R	12	11.3	1.99	1.20	56	76	16
SD6030-150-R	15	14.1	1.71	1.10	76	103	14
SD6030-180-R	18	17.1	1.65	1.00	82	110	13
SD6030-220-R	22	20.4	1.57	0.90	90	122	12
SD6030-270-R	27	26.0	1.31	0.85	130	175	11
SD6030-330-R	33	32.4	1.26	0.75	140	189	9.3
SD6030-360-R	36	34.4	1.19	0.70	157	212	8.7
SD6030-440-R	44	44.0	1.10	0.62	185	250	7.9
SD6030-520-R	52	52.0	0.99	0.58	226	305	7.2
SD6030-680-R	68	65.6	0.92	0.52	263	355	6.5
SD6030-820-R	82	81.6	0.80	0.46	343	463	5.9
SD6030-101-R	100	94.4	0.76	0.42	385	520	5.6
SD6030-121-R	120	110.1	0.70	0.40	517	620	5.6
SD6030-151-R	150	144.5	0.64	0.35	608	730	5.0
SD6030-181-R	180	175.7	0.55	0.32	817	980	4.5
SD6030-221-R	220	210.9	0.50	0.30	1000	1200	4.0
SD6030-271-R	270	264.2	0.44	0.27	1300	1560	3.6
SD6030-331-R	330	313.5	0.38	0.25	1733	2080	3.3
SD6030-391-R	390	373.7	0.35	0.22	2083	2500	3.0
SD6030-471-R	470	460.0	0.33	0.20	2250	2700	2.8
SD6030-561-R	560	546.2	0.30	0.18	2767	3320	2.5
SD6030-681-R	680	659.4	0.27	0.16	3458	4150	2.3

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for 35% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph).
B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: SD6030-xxx-R
SD6030 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

SD6030 Series
Low Profile Power Inductors

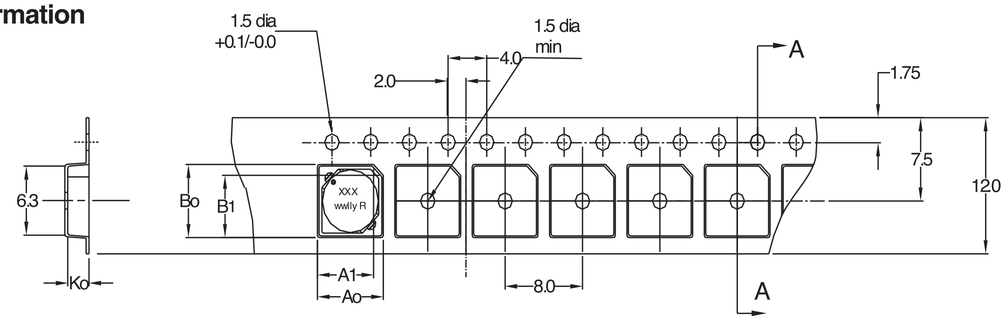
Mechanical Diagrams



Dimensions are in millimeters.

xxx = Inductance value in uH. R = decimal point. If no R is present third character = # of zeros.
wwllyy = Date code, R = Revision level.

Packaging Information



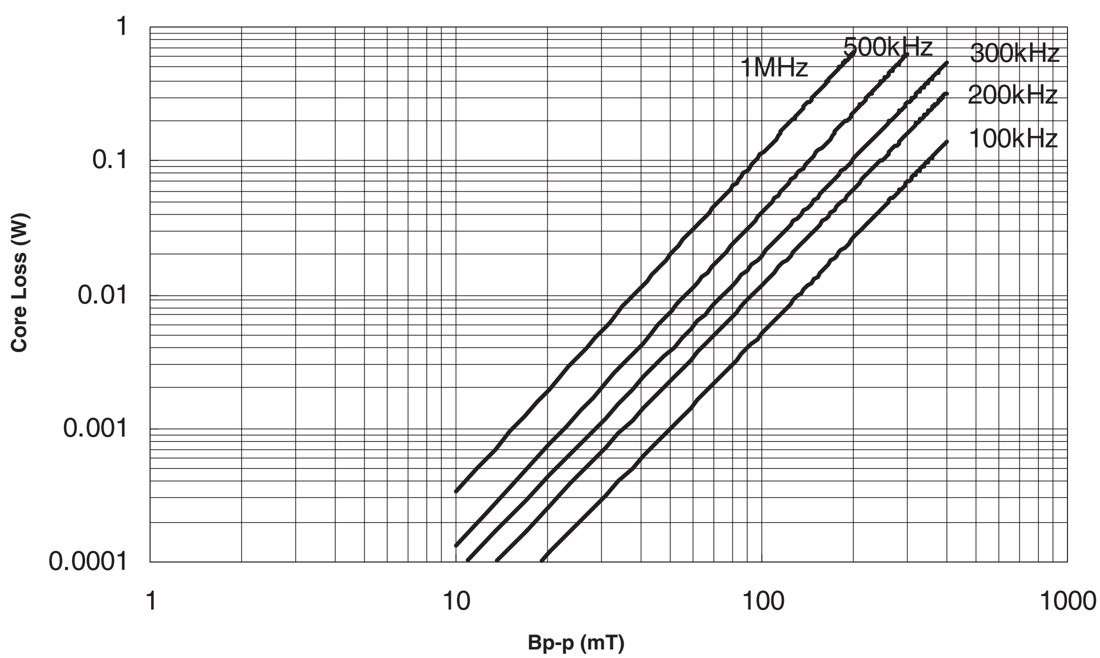
SECTION A-A

Ao=6.8 mm
Bo=6.8 mm
A1=5.8 mm
B1=5.8 mm
Ko=3.2 mm

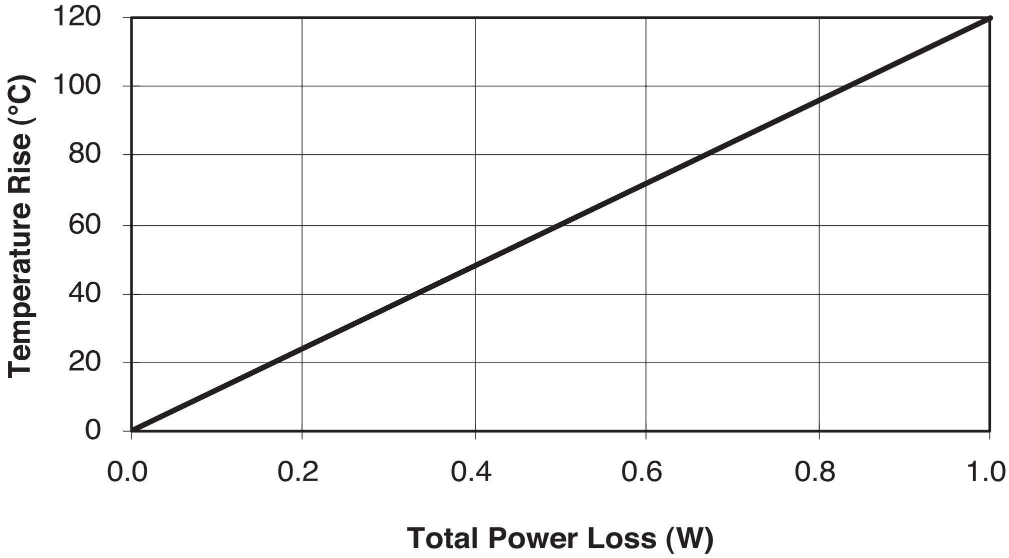
User direction of feed →

Parts packaged on 13" Diameter reel,
2,600 parts per reel.

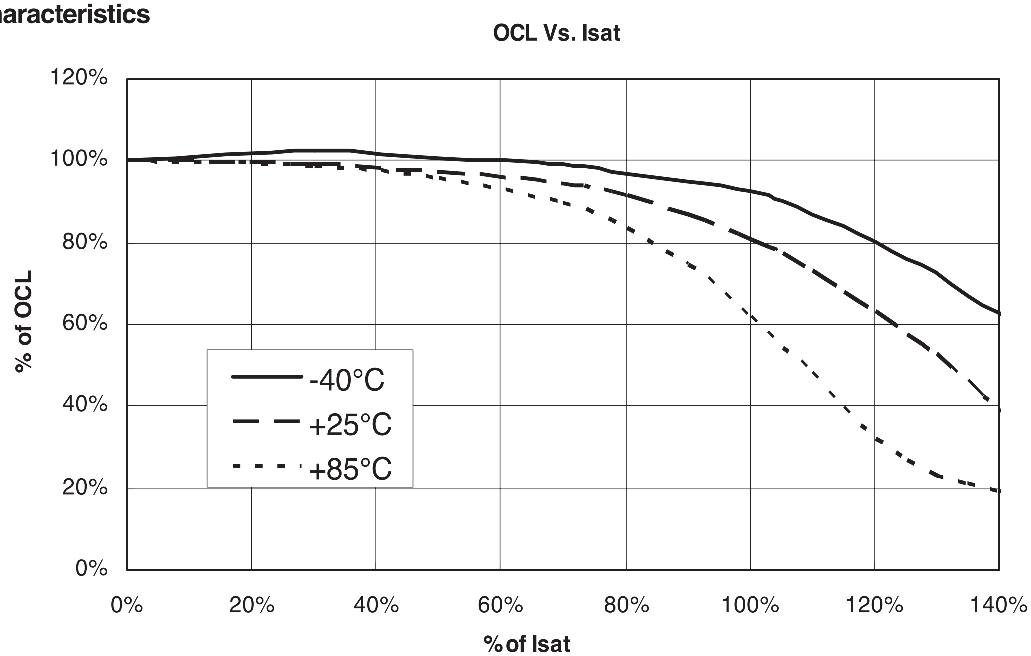
Core Loss



Temperature Rise vs. Loss



Inductance Characteristics



COOPER Bussmann

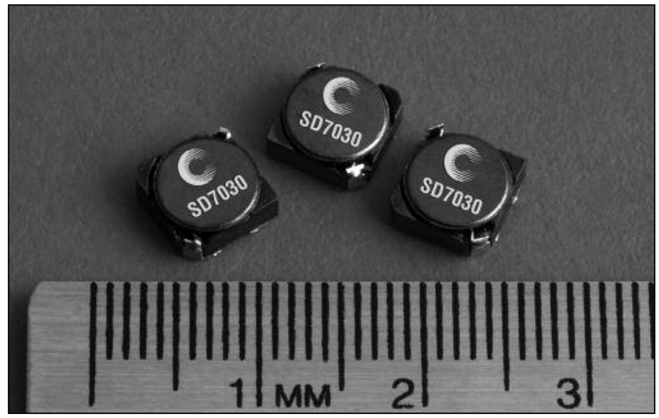
SD7030 Series
Low Profile Power Inductors

Description
- 125°C maximum total temperature operation
- Low profile surface mount inductors
- 7.0mm x 7.0mm x 3.0mm shielded drum core
- Ferrite core material
- Inductance range from 3.3µH to 680µH
- Current range from 3.7 Amps to 0.21 Amps
- Frequency range up to 1MHz

RoHS 2002/95/EC

Applications
- PDA's, Wireless handsets
- Handheld computers
- MP3 players, CD players, organizers
- Portable computers, GPS receivers
- ADSL/DSL/Cable modems
- Buck and Boost inductor
- Battery power, Li-Ion, 2-cell
- Digital still camera
- White LED driver

Environmental Data
- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



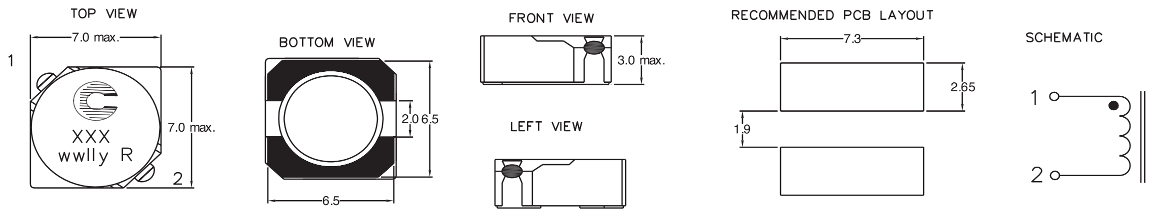
Packaging
- Supplied in tape and reel packaging, 1500 per reel

Part Number	Rated Inductance (µH)	OCL (1) µH ± 30%	Irms (2) Amperes	Isat (3) Amperes	DCR mΩ@25°C (Typical)	DCR mΩ@25°C (Maximum)	K-factor (4)
SD7030-3R3-R	3.3	3.3	3.7	3.00	20	24	22
SD7030-3R9-R	3.9	4.1	3.4	2.60	22	27	19
SD7030-5R0-R	5.0	4.9	3.2	2.40	26	31	17
SD7030-6R0-R	6.0	5.8	2.8	2.25	29	35	16
SD7030-7R3-R	7.3	7.0	2.3	2.10	45	54	13
SD7030-8R0-R	8.0	7.8	2.2	1.85	48	58	12
SD7030-100-R	10	10.0	2.1	1.70	54	65	11
SD7030-120-R	12	11.5	1.9	1.55	58	70	10
SD7030-150-R	15	14.6	1.7	1.40	70	84	9.3
SD7030-180-R	18	17.3	1.7	1.32	79	95	8.8
SD7030-220-R	22	21.0	1.4	1.20	107	128	7.6
SD7030-260-R	26	24.9	1.3	1.05	118	142	6.9
SD7030-300-R	30	30.0	1.2	0.97	138	165	6.4
SD7030-390-R	39	39.7	1.1	0.86	175	210	5.7
SD7030-440-R	44	43.4	1.1	0.80	198	238	5.3
SD7030-560-R	56	54.4	0.99	0.73	231	277	4.9
SD7030-680-R	68	66.6	0.85	0.65	253	304	4.3
SD7030-820-R	82	81.4	0.82	0.60	325	390	4.0
SD7030-101-R	100	95.5	0.70	0.54	446	535	3.6
SD7030-121-R	120	115.2	0.67	0.50	629	755	3.3
SD7030-151-R	150	145	0.57	0.44	715	858	2.9
SD7030-181-R	180	174	0.54	0.40	805	966	2.7
SD7030-221-R	220	211	0.51	0.36	1102	1322	2.4
SD7030-271-R	270	264	0.44	0.33	1259	1475	2.2
SD7030-331-R	330	317	0.38	0.30	1438	1725	2.0
SD7030-391-R	390	381	0.36	0.27	1857	2228	1.8
SD7030-471-R	470	460	0.34	0.25	2150	2581	1.7
SD7030-561-R	560	561.0	0.29	0.23	2857	3428	1.5
SD7030-681-R	680	677.2	0.28	0.21	3206	3847	1.4

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 35% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in uH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: SD7030-xxx-R
SD7030 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

SD7030 Series
Low Profile Power Inductors

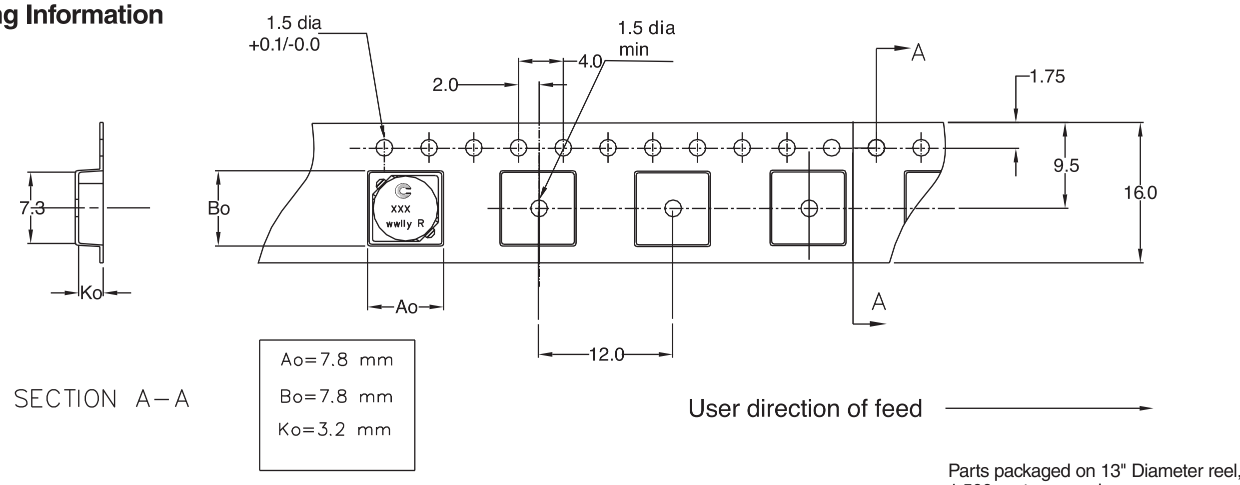
Mechanical Diagrams



Dimensions are in millimeters.

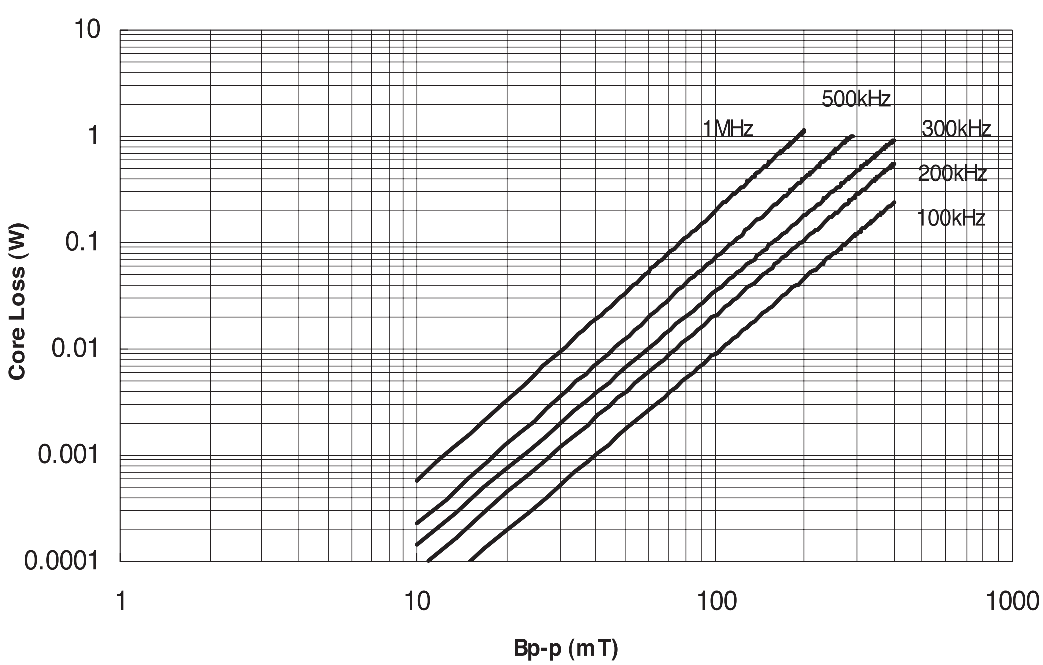
xxx = Inductance value in uH. R = decimal point. If no R is present third character = # of zeros.
wwllyy = Date code, R = Revision level.

Packaging Information

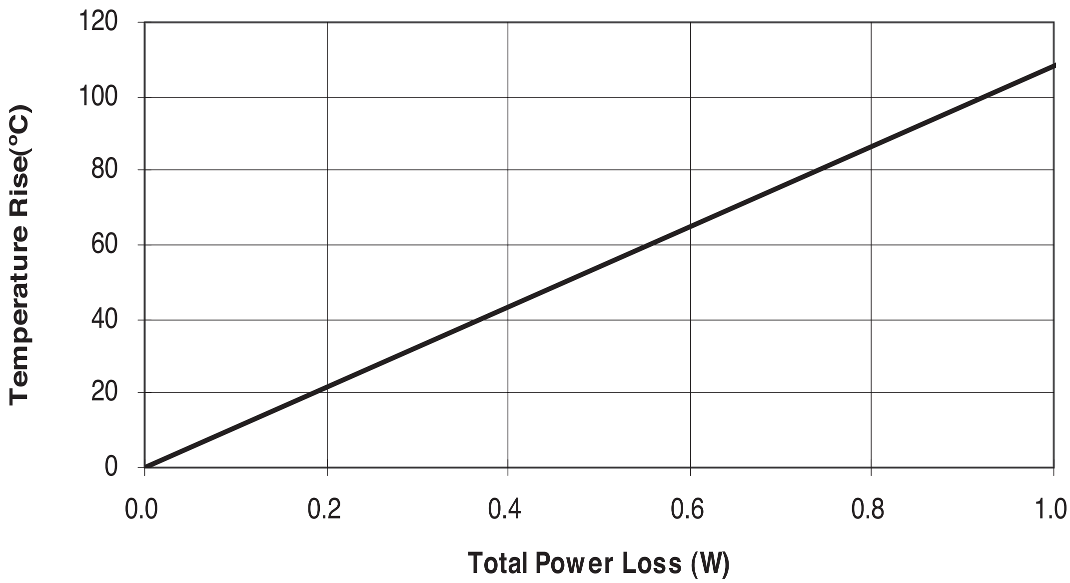


Parts packaged on 13" Diameter reel,
1,500 parts per reel.

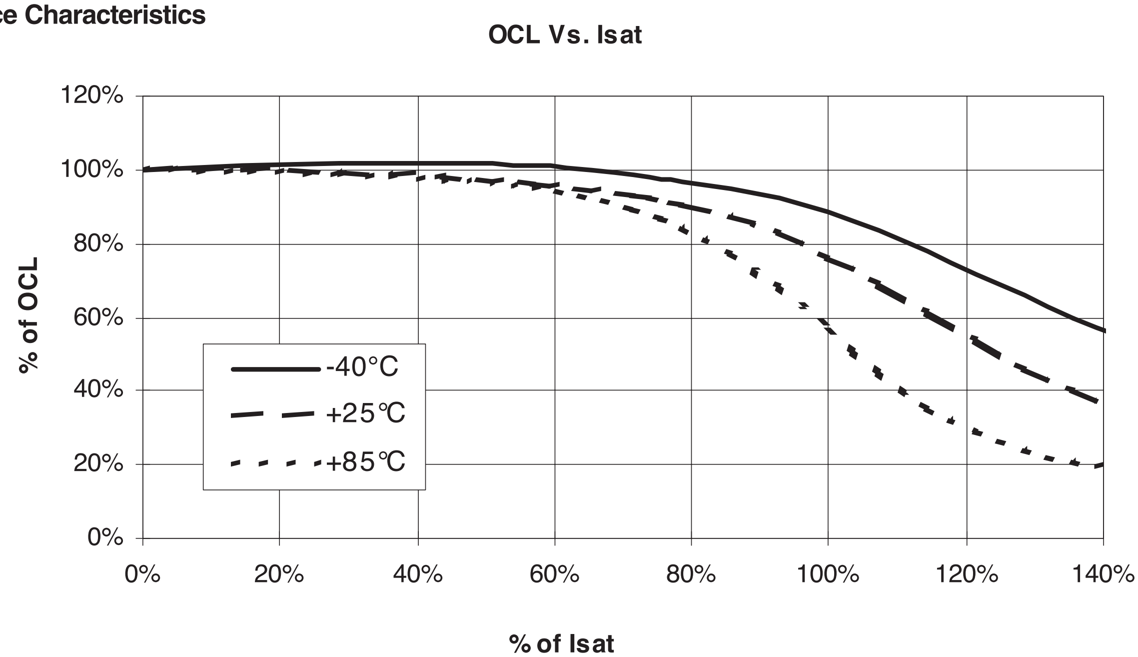
Core Loss



Temperature Rise vs. Loss



Inductance Characteristics



COILTRONICS®

COOPER Bussmann

SD8328 Series
Low Profile Power Inductors

RoHS 2002/95/EC

Description

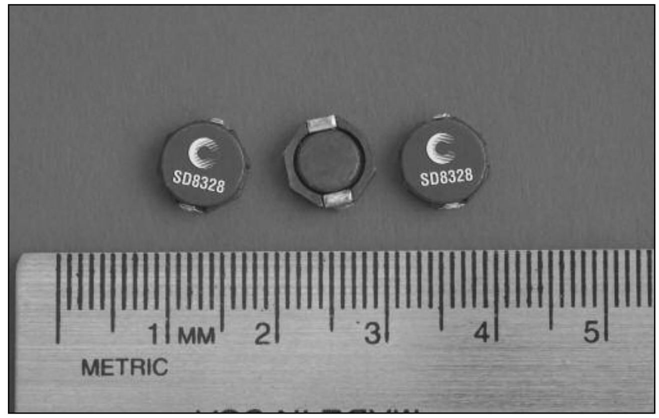
- 125°C maximum temperature operation
- Low profile surface mount inductor
- 8.3mm x 9.5mm x 3.0mm shielded drum core
- Ferrite core material
- Inductance range from 2.7µH to 100µH
- Current range from 6.6 Amps to 0.8 Amps
- Frequency range up to 1MHz

Applications

- Buck or Boost inductor
- Noise filtering output filter chokes
- Notebook power/display
- LCD Monitors/Displays/Televisions
- Battery chargers, LCD bias supplies
- Battery and Industrial power systems
- Computer, DVD players
- Portable power devices, DC-DC converters

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



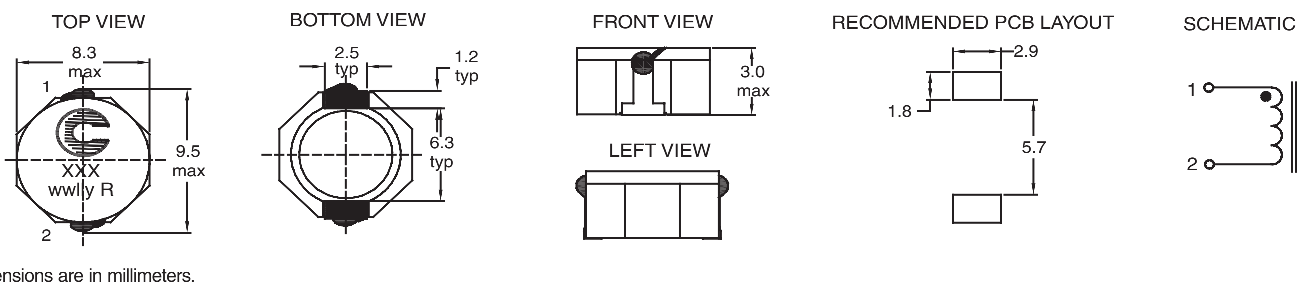
Packaging

- Supplied in tape and reel packaging, 1280 per reel

Part Number	Rated Inductance (µH)	OCL (1) µH±30%	Irms(2) Amperes	Isat (3) Amperes	DCR (Ω) mΩ @20°C (Typical)	DCR (Ω) mΩ @20°C (Maximum)	K-factor (4)
SD8328-2R5-R	2.5	2.7	6.6	4.5	12	15.6	43
SD8328-3R3-R	3.3	3.4	6.1	4.0	14	18.0	33
SD8328-4R7-R	4.7	5.0	4.5	3.6	19	24.7	23
SD8328-7R3-R	7.3	7.6	3.4	2.9	30	39	15
SD8328-100-R	10	9.1	3.3	2.6	36	45	11
SD8328-150-R	15	14.5	2.35	2.0	53	69	7.2
SD8328-220-R	22	21.1	1.85	1.7	76	99	4.9
SD8328-330-R	33	31.9	1.45	1.4	120	156	3.3
SD8328-470-R	47	44.9	1.30	1.2	150	194	2.3
SD8328-680-R	68	64.2	0.98	1.0	220	286	1.6
SD8328-101-R	100	97.0	0.80	0.8	330	430	1.1

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 35% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in µH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: SD8328-xxx-R
SD8328 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

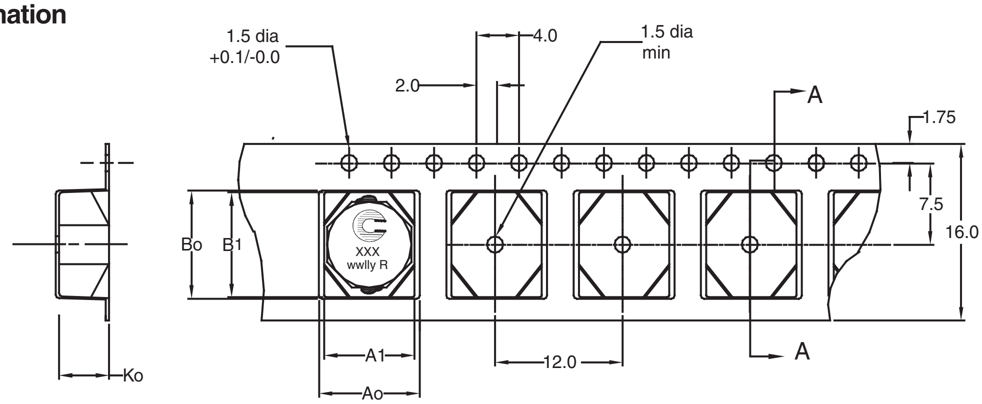
Mechanical Diagrams



Dimensions are in millimeters.

xxx = Inductance value in uH. R = decimal point. If no R is present third character = # of zeros. wwllyy = Date code, R = Revision level.

Packaging Information



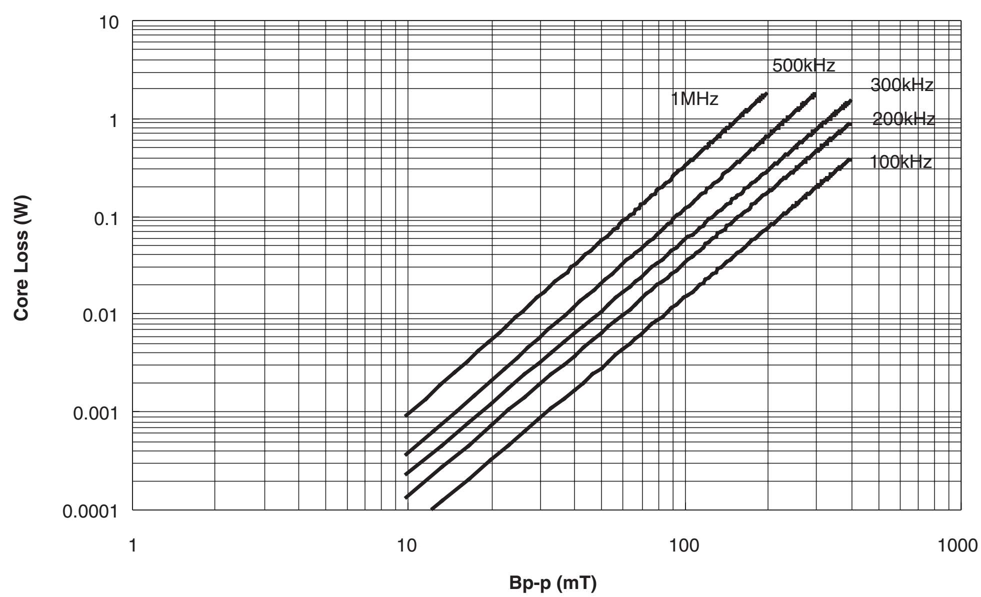
SECTION A-A

Ao=9.5 mm
Bo=10.0 mm
A1=8.5 mm
B1=9.7 mm
Ko=3.2 mm

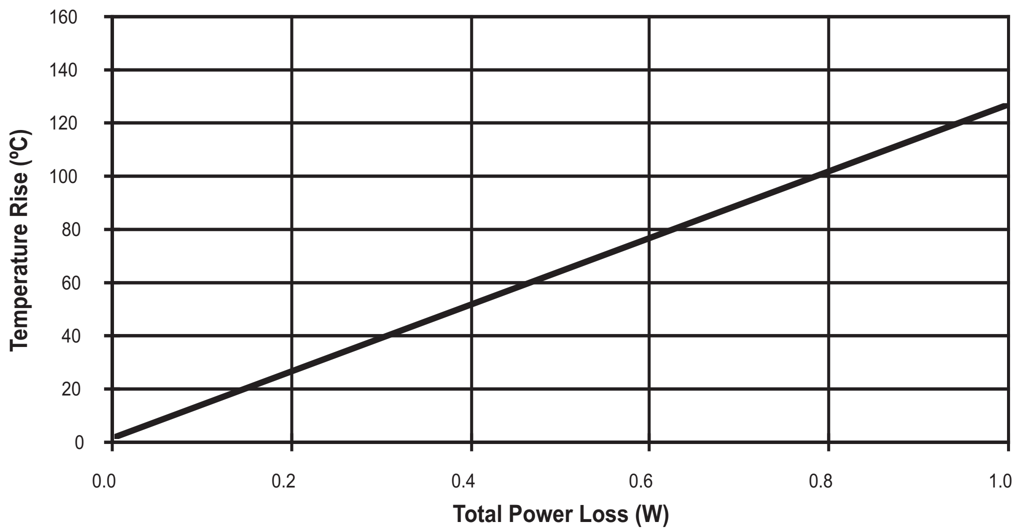
User direction of feed →

Parts packaged on 13" Diameter reel,
1,280 parts per reel.

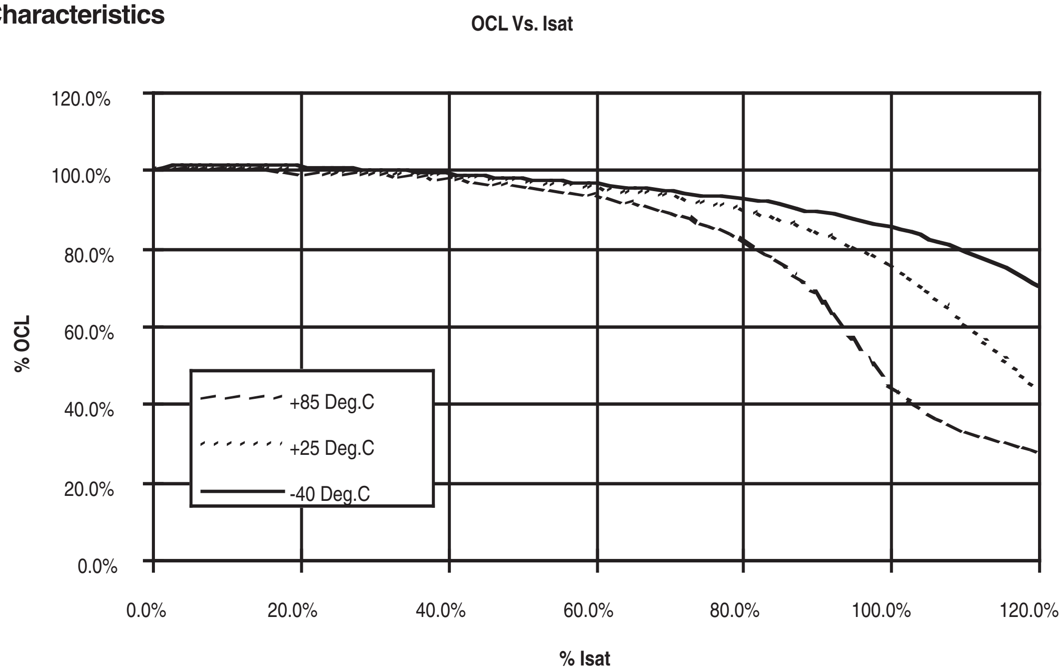
Core Loss



Temperature Rise vs. Loss



Inductance Characteristics



COILTRONICS®

COOPER Bussmann

SD8350 Series
Shielded Power Inductors

Description

RoHS 2002/95/EC

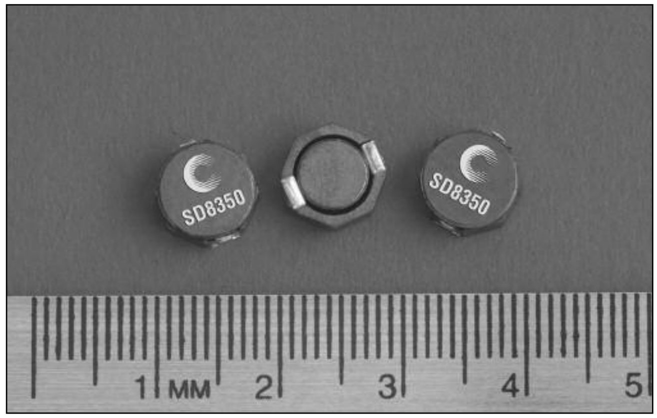
- 125°C maximum total temperature operation
- Low profile surface mount inductor
- 8.3mm x 9.5mm x 4.5mm shielded drum core
- Ferrite core material
- Inductance range from 1.5µH to 100µH
- Current range from 9.1 Amps to 0.8 Amps
- Frequency range up to 1MHz

Applications

- Server/Notebook power
- High Power LED driver, Portable devices
- Base Station, Telecom, and Networking
- Battery Chargers, RAM power supply
- Industrial and Automotive power systems
- Noise filtering output filter chokes
- Buck/Boost converters, Output converters

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating temperature range: -40°C to +125°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



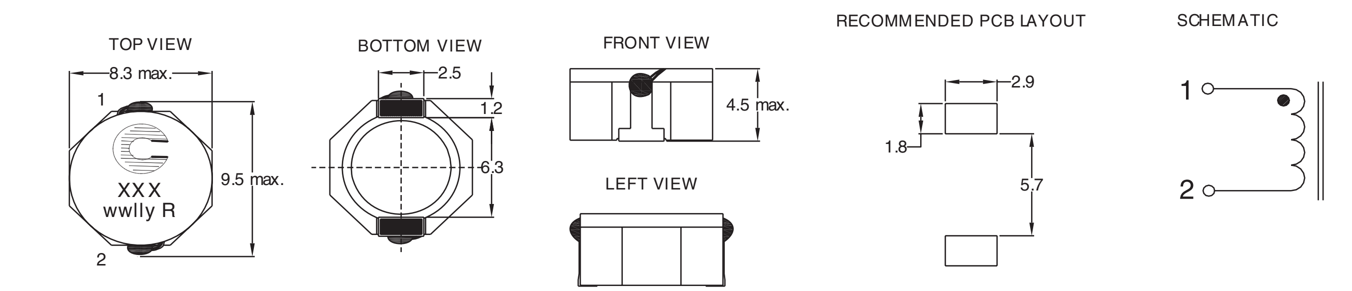
Packaging

- Supplied in tape and reel packaging, 750 per reel

Part Number	Rated Inductance (µH)	OCL (1) µH±30%	Irms(2) Amperes	Isat (3) Amperes	DCR (Ω) mΩ @20°C (Typical)	DCR (Ω) mΩ @20°C (Maximum)	K-factor (4)
SD8350-1R8-R	1.8	1.5	5.50	9.1	11.8	14.0	16.0
SD8350-3R9-R	3.9	3.2	4.50	6.3	16.2	19.0	9.6
SD8350-4R7-R	4.7	4.2	4.10	5.5	18.5	22.0	8.5
SD8350-6R8-R	6.8	6.8	3.90	4.4	20.8	25.0	7.6
SD8350-100-R	10	9.9	3.20	4.0	31.4	36.0	6.3
SD8350-150-R	15	13.6	2.30	2.9	45.0	53.0	5.3
SD8350-220-R	22	20.4	1.80	2.6	63.5	75.0	4.4
SD8350-330-R	33	31.4	1.40	2.2	111.4	125.0	3.5
SD8350-470-R	47	44.9	1.30	1.8	130.0	150.0	2.9
SD8350-680-R	68	65.1	1.00	1.5	200.8	240.0	2.4
SD8350-101-R	100	99.7	0.80	1.3	308.0	360.0	2.0

(1) Open Circuit Inductance Test Parameters: 100kHz, 0.1V, 0.0Adc.
(2) Irms: DC current for an approximate ΔT of 40°C without core loss. Derating is necessary for AC currents. PCB layout, trace thickness and width, air-flow, and proximity of other heat generating components will affect the temperature rise. It is recommended that the temperature of the part not exceed 125°C under worst case operating conditions verified in the end application.
(3) Isat Amperes peak for approximately 35% rolloff (@25°C)
(4) K-factor: Used to determine B p-p for core loss (see graph). B p-p = K*L*ΔI, B p-p(mT), K: (K factor from table), L: (Inductance in µH), ΔI (Peak to peak ripple current in Amps).
(5) Part Number Definition: SD8350-xxx-R
SD8350 = Product code and size; -xxx = Inductance value in uH;
R = decimal point; If no R is present, third character = # of zeros.
-R suffix = RoHS compliant

Mechanical Diagrams

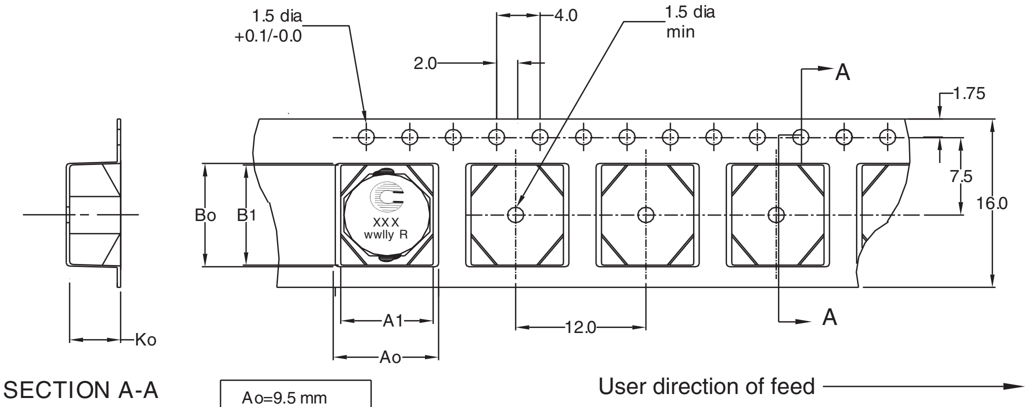


Dimensions are in millimeters.

xxx = Inductance value in uH. R = decimal point. If no R is present third character = # of zeros. wwllyy = Date code, R = Revision level.

LOW PROFILE SHIELDED DRUM (SD8350)

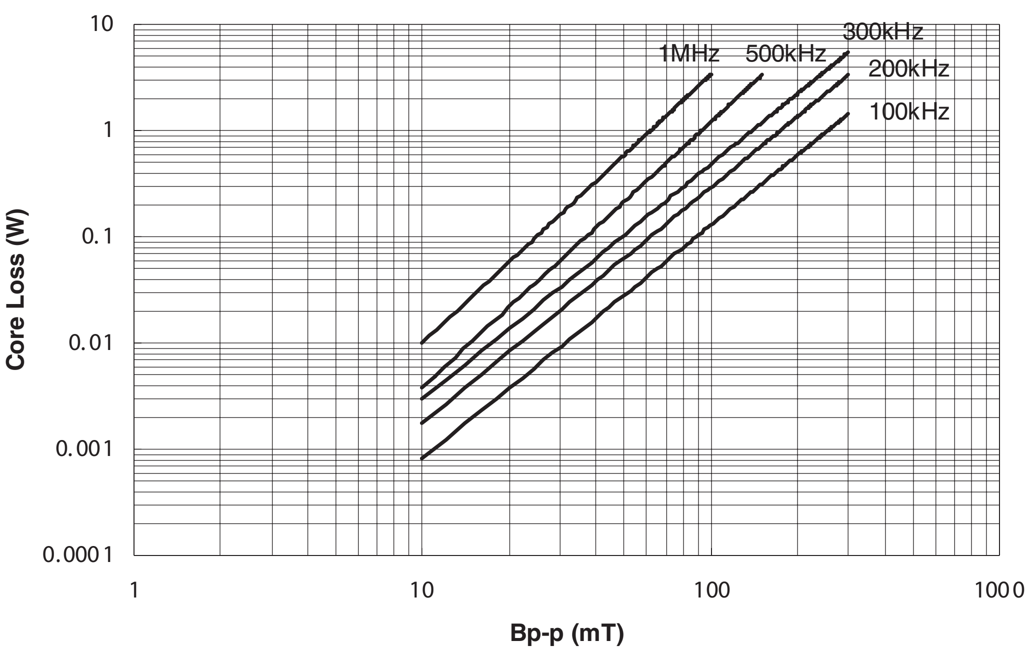
Packaging Information



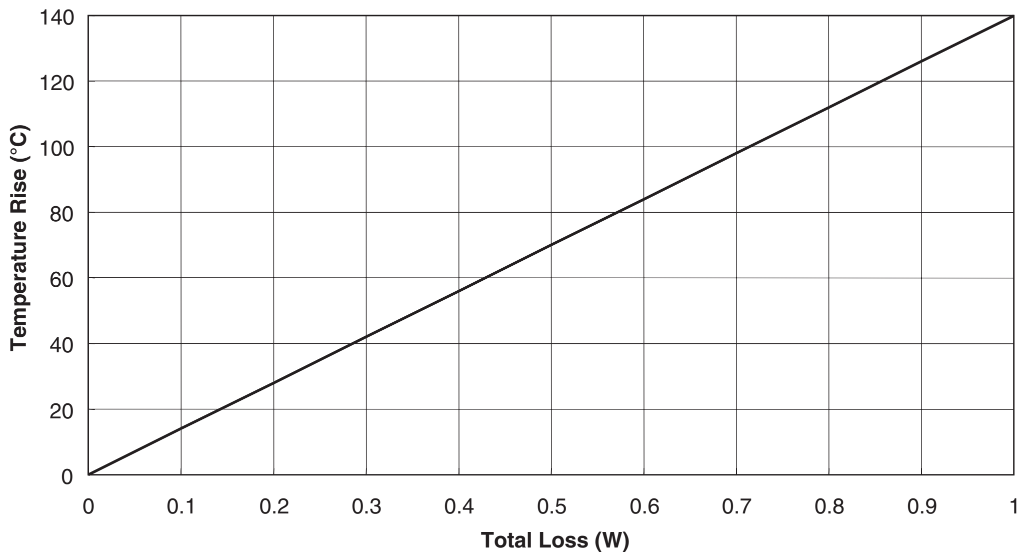
Ao=9.5 mm
Bo=10.0 mm
A1=8.5 mm
B1=9.7 mm
Ko=4.6 mm

Parts packaged on 13" Diameter reel, 750 parts per reel.

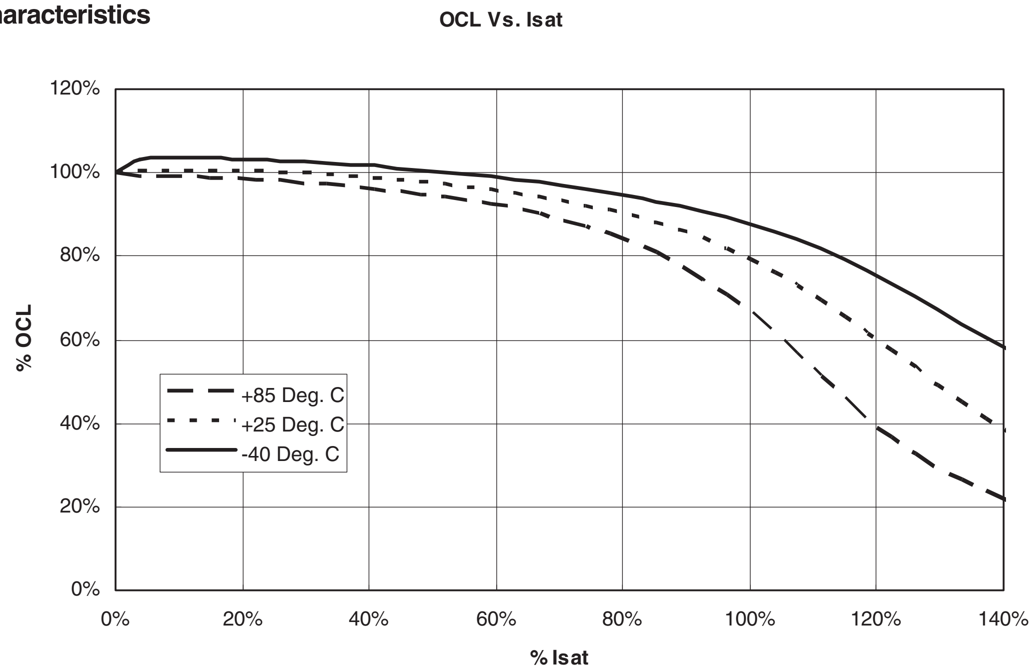
Core Loss



Temperature Rise vs. Loss



Inductance Characteristics



COILTRONICS

COOPER Bussmann

UNI-PAC™ 2.8
Low Cost, Low Profile 2.8mm Power Inductors (Surface Mount)

RoHS 2002/95/EC

Description
• Miniature size and rugged construction
• Low DCR and high efficiency
• Suited for IR and vapor reflow solder
• Designed for high shock environments
• Frequency range 1kHz to 2MHz
• Ferrite core material

Applications
- DC-DC converters
- Filter inductors
- Signal conditioning
- Energy storage applications
- Computer, pager and battery powered equipment

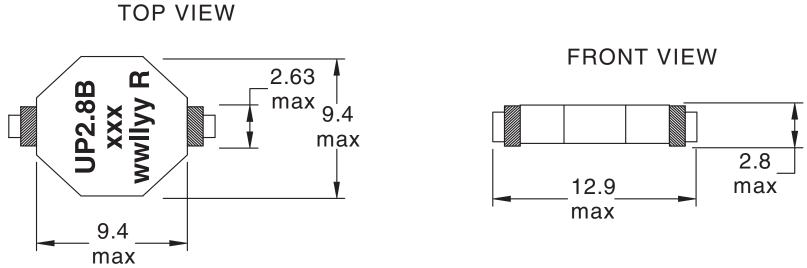
Environmental Data
- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C range is application specific. Temperature rise is approximately 40°C at rated RMS current. Maximum operating temperature is 125°C including ambient.
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging
- Supplied in tape and reel packaging, 1,750 per reel

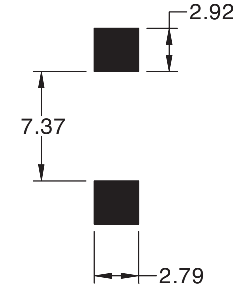
Part Number	Inductance µH (Rated)	OCL (1) µH ± 20%	Irms (2) Amperes	Isat (3) Amperes	DCR (4) Ohms (Max.)
UP2.8B-1R0-R	1.0	0.98	3.6	8.0	.0286
UP2.8B-1R5-R	1.5	1.59	3.3	6.4	.0349
UP2.8B-2R2-R	2.2	2.44	3.1	5.2	.0356
UP2.8B-3R3-R	3.3	3.24	2.8	4.5	.0474
UP2.8B-4R7-R	4.7	4.15	2.7	3.9	.0478
UP2.8B-6R8-R	6.8	6.73	2.4	3.2	.067
UP2.8B-100-R	10	10	2.1	2.7	.080
UP2.8B-150-R	15	15	1.7	2.2	.120
UP2.8B-220-R	22	22	1.5	1.7	.190
UP2.8B-330-R	33	33	1.3	1.5	.250
UP2.8B-470-R	47	47	1.0	1.2	.340
UP2.8B-680-R	68	68	.89	1.0	.480
UP2.8B-101-R	100	100	.78	.84	.622
UP2.8B-151-R	150	150	.62	.74	.971

1) Open Circuit Inductance Test Parameters: 100kHz, 0.250 Vrms, 0.0 Adc
2) RMS current, delta temp. of 40° C ambient temperature of 85° C
3) Peak current for approximately 10% roll-off @ 20°C
4) Values @ 20° C

Mechanical Diagrams



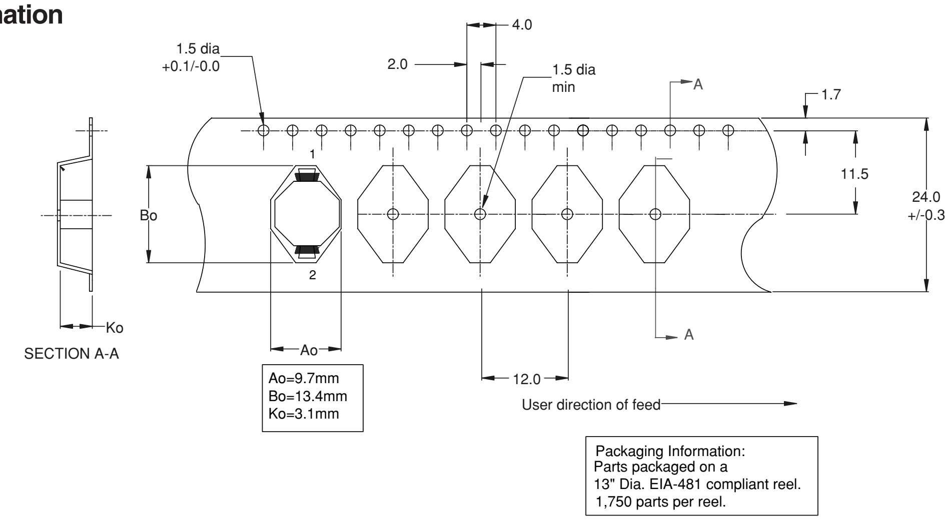
Recommended PCB Layout



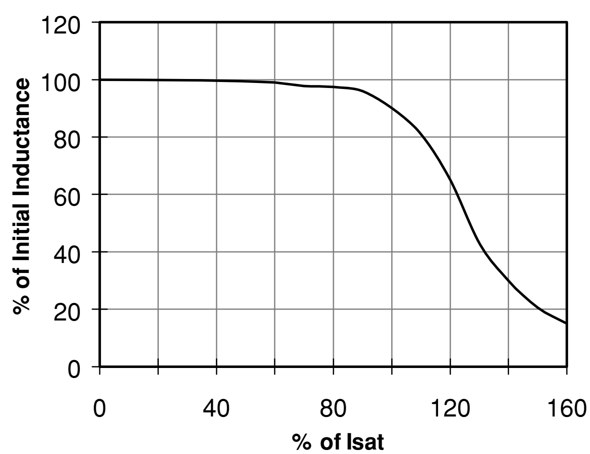
Component View

Dimensions in Millimeters.
wwllyy = date code   R = (revision level)
xxx = Inductance value per family chart

Packaging Information



Inductance Characteristics



COILTRONICS®

COOPER Bussmann

UNI-PAC™ 0.4C
Low Cost, Low Profile Power Inductors (Surface Mount)

RoHS 2002/95/EC

Description

- Miniature size and rugged construction
- Designed for high shock environments
- Suited for IR and vapor reflow solder
- Frequency range 1kHz to 2MHz
- Ferrite core material

Applications

- Computer, pager and battery powered equipment

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C range is application specific. Temperature rise is approximately 40°C at rated RMS current. Maximum operating temperature is 125°C including ambient.
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging

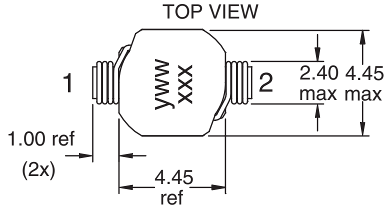
- Supplied in tape and reel packaging, 2,500 per reel

Part Number	Inductance µH (Rated)	OCL (1) µH ± 20%	Irms (2) Amperes	Isat (3) Amperes	DCR (4) Ohms (Max)
UP0.4C-1R0-R	1.0	1.16	2.88	3.33	0.030
UP0.4C-1R5-R	1.5	1.49	2.58	2.94	0.034
UP0.4C-2R2-R	2.2	2.27	2.15	2.38	0.050
UP0.4C-3R3-R	3.3	3.22	1.89	2.00	0.060
UP0.4C-4R7-R	4.7	4.95	1.55	1.61	0.088
UP0.4C-6R8-R	6.8	7.06	1.30	1.35	0.128
UP0.4C-100-R	10	9.53	1.16	1.16	0.156
UP0.4C-150-R	15	14.5	0.95	0.94	0.250
UP0.4C-220-R	22	21.8	0.76	0.77	0.360
UP0.4C-270-R	27	27.5	0.69	0.68	0.480
UP0.4C-330-R	33	32.2	0.64	0.63	0.560
UP0.4C-390-R	39	39.0	0.59	0.57	0.650
UP0.4C-470-R	47	46.5	0.53	0.53	0.820
UP0.4C-680-R	68	68.2	0.45	0.43	1.10
UP0.4C-101-R	100	102.5	0.37	0.35	1.58

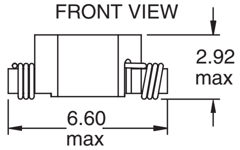
1) Open Circuit Inductance Test Parameters: 100kHz, 0.250 Vrms, 0.0 Adc
2) RMS current, delta temp. of 40°C ambient temperature of 85°C
3) Peak current for approximately 30% roll-off @ 20°C
4) Values @ 20°C

Mechanical Diagrams

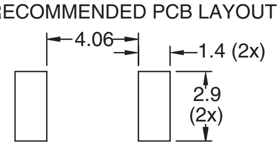
TOP VIEW



FRONT VIEW

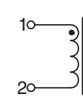


RECOMMENDED PCB LAYOUT



COMPONENT VIEW

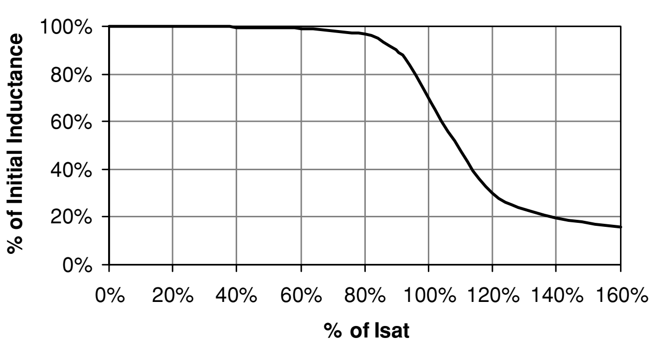
SCHEMATIC



Dimensions in Millimeters.

yww = Date Code   xxx = Inductance value per family chart

Inductance Characteristics



COILTRONICS®

COOPER Bussmann

UNI-PAC™ 2C
Low Cost Power Inductors (Surface Mount)

RoHS 2002/95/EC

Description

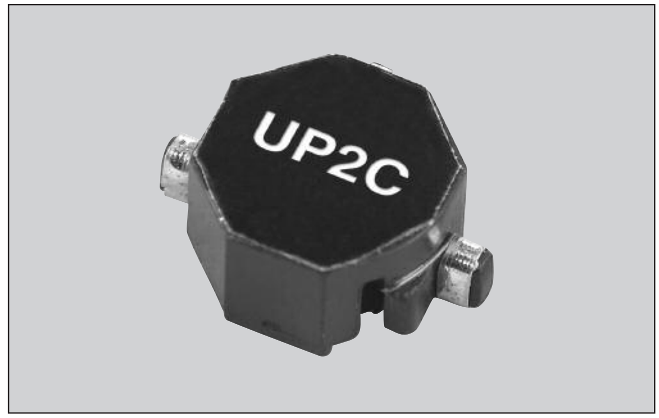
- Miniature surface mount design with rugged case to eliminate core breakage
- Inductance range from 0.470uH to 1000uH
- Current range up to 18.6 Amps peak
- Meets UL94V-0 flammability standard
- Ferrite core material

Applications

- PDA, computer, and flash memory programs

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds max.



Packaging

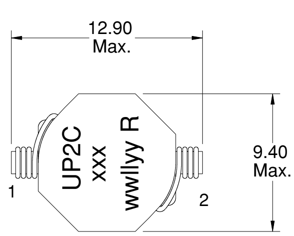
- Supplied in tape and reel packaging, 900 per reel

Part Number	Inductance µH (rated)	OCL(1) µH±20%	I RMS(2) Amperes	I SAT(3) Amperes	DCR(4) mΩ typ.	Volts(5) µS (typ)
UP2C-R47-R	0.470	0.48	12.2	18.6	2.5	4.15
UP2C-1R0-R	1.0	1.03	9.80	11.8	3.9	7.0
UP2C-1R5-R	1.5	1.45	8.10	10.0	5.6	8.3
UP2C-2R2-R	2.2	2.00	7.50	8.67	6.6	9.6
UP2C-3R3-R	3.3	3.30	5.90	6.84	10.5	12.1
UP2C-4R7-R	4.7	4.41	5.62	6.20	11.7	13.4
UP2C-6R8-R	6.8	7.16	4.42	4.82	18.0	17.3
UP2C-100-R	10.0	10.56	3.61	3.94	28.3	21.1
UP2C-150-R	15.0	15.97	3.17	3.17	36.9	26.2
UP2C-220-R	22.0	22.33	2.61	2.65	54.0	31.3
UP2C-330-R	33.0	32.11	2.16	2.20	79.7	37.7
UP2C-470-R	47.0	47.90	1.77	1.83	118.5	45.4
UP2C-680-R	68.0	65.03	1.57	1.53	151.7	54.3
UP2C-101-R	100.0	97.85	1.26	1.24	233.1	67.1
UP2C-151-R	150.0	141.9	1.04	1.02	351.4	81.2
UP2C-221-R	220.0	207.8	0.82	0.85	545.0	97.8
UP2C-331-R	330.0	318.2	0.67	0.70	824.3	120
UP2C-471-R	470.0	470.8	0.56	0.58	1191.4	144
UP2C-681-R	680.0	689.7	0.46	0.48	1774.2	173
UP2C-102-R	1000.0	1080.0	0.38	0.40	2657.1	209

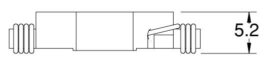
Notes: (1) Open Circuit Inductance Test Parameters: 100KHz, .250Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C without core loss, at an ambient temperature of 85˚C.
(3) Peak current for approximately 30% rolloff @ 20°C.
(4) DCR limits 20°C.
(5) Applied volt-time product (V-uS) across the inductor. This value represents the applied v-us at 300KHz necessary to generate a core loss equal to 10% of the total losses for a 40° temperature rise.

Mechanical Diagrams

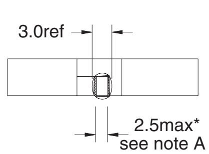
TOP VIEW



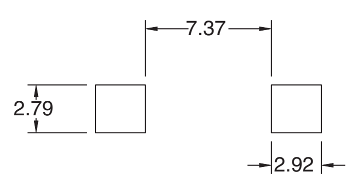
FRONT VIEW



SIDE VIEW

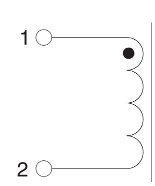


PCB PAD LAYOUT



COMPONENT VIEW

SCHEMATIC



Dimensions in Millimeters.
wwllyy = (date code) R = revision level
xxx = Inductance value per family chart

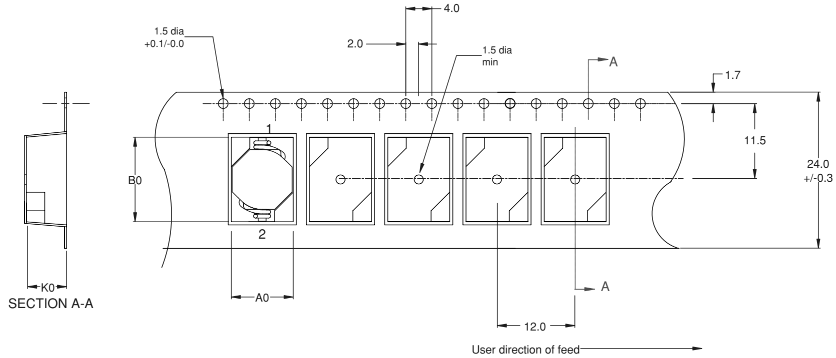
(A) 2.5mm max is width of copper at seating plane. The width above the seating plane may exceed 2.5mm.

COILTRONICS®

COOPER Bussmann

UNI-PAC™ 2C
Low Cost Power Inductors (Surface Mount)

Packaging Information

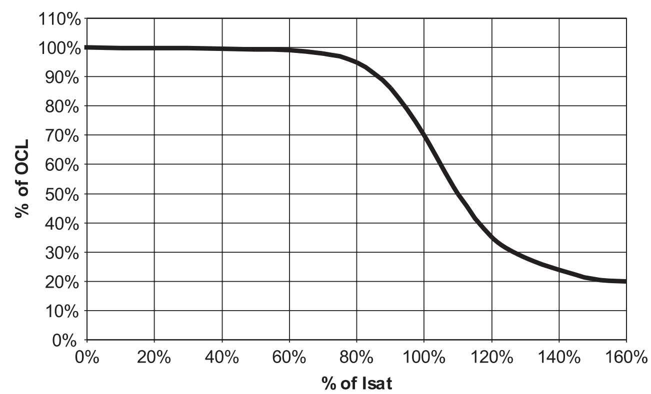


Ao=9.50mm
Bo=13.0mm
Ko=5.7mm

ACTUAL SIZE
UNIPAC 2C

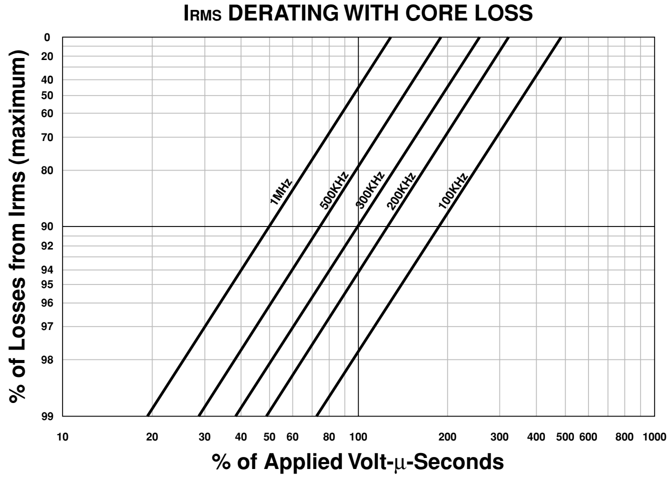
Inductance Characteristics

OCL vs. Isat



Core Loss

IRMS DERATING WITH CORE LOSS



COILTRONICS®

COOPER Bussmann

UNI-PAC™ Power Inductors (Surface Mount)

RoHS 2002/95/EC

Description

- Miniature surface mount design
- Inductance range from 0.470uH to 1000uH
- Current range from 19.2 to .47 Amps
- Maximum power density
- Ideal for applications requiring low inductance and high current in a miniature package
- Modified standard products are available
- Protective case eliminates core breakage
- Meets UL 94V-0 flammability standard
- Ferrite core material

Applications

- DC-DC converters on board level and industrial products

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging

- Supplied in tape and reel packaging, 900 (UP1B), 550 (UP2B), 450 (UP3B), and 275 (UP4B) per reel

Part Number	Inductance µH (rated)	OCL(1) µH±20%	I RMS(2) Amperes	I SAT(3) Amperes	DCR(4) Ohms max.
UP1B-R47-R	0.47	0.569	6.0	7.7	0.0097
UP1B-1R0-R	1.0	1.20	4.4	5.3	0.0177
UP1B-1R5-R	1.5	1.61	4.2	4.5	0.0200
UP1B-2R2-R	2.2	2.62	3.1	3.5	0.0363
UP1B-3R3-R	3.3	3.79	2.9	3.0	0.0428
UP1B-4R7-R	4.7	5.15	2.2	2.6	0.0544
UP1B-6R8-R	6.8	6.87	1.7	2.2	0.0897
UP1B-100-R	10.0	11.00	1.5	1.9	0.1107
UP1B-150-R	15.0	16.00	1.2	1.5	0.1747
UP1B-220-R	22.0	23.50	1.0	1.2	0.2541
UP1B-330-R	33.0	36.00	0.82	0.99	0.3670
UP1B-470-R	47.0	48.50	0.72	0.87	0.4740
UP1B-680-R	68.0	73.52	0.58	0.67	0.7320
UP1B-101-R	100.0	112.67	0.47	0.53	1.11
UP1B-151-R	150.0	152.40	0.40	0.46	1.61
UP1B-221-R	220.0	223.10	0.36	0.38	1.96
UP1B-331-R	330.0	331.90	0.28	0.31	3.10
UP2B-R47-R	0.47	0.595	10.6	11.4	0.0049
UP2B-1R0-R	1.0	1.00	9.3	9.9	0.0065
UP2B-1R5-R	1.5	1.46	8.3	7.9	0.0081
UP2B-2R2-R	2.2	2.56	7.2	6.1	0.0107
UP2B-3R3-R	3.3	3.23	6.5	5.1	0.0128
UP2B-4R7-R	4.7	4.77	5.5	4.2	0.0165
UP2B-6R8-R	6.8	6.63	5.0	3.6	0.0202
UP2B-100-R	10.0	9.73	4.3	3.3	0.0267
UP2B-150-R	15.0	15.43	3.5	2.4	0.0410
UP2B-220-R	22.0	22.50	2.8	2.0	0.0617
UP2B-330-R	33.0	33.13	2.1	1.7	0.0917
UP2B-470-R	47.0	48.65	1.7	1.4	0.1388
UP2B-680-R	68.0	68.17	1.5	1.2	0.1787
UP2B-820-R	82.0	84.1	1.34	1.03	0.2235
UP2B-101-R	100.0	102.60	1.2	0.95	0.2707
UP2B-151-R	150.0	150	1.0	0.77	0.4100

Notes: (1) Open Circuit Inductance Test Parameters: 100KHz, .250Vrms, 0.0Adc.
(2) RMS current for an approximate ΔT of 40°C. at an ambient temperature of 85˚C.
(3) Peak current for approximately 30% rolloff UP1B, 3B, 4B. 10% rolloff UP2B @ 20°C
(4) DCR limits 20°C.

COILTRONICS®

COOPER Bussmann

UNI-PAC™ Power Inductors (Surface Mount)

Part Number	Inductance µH (rated)	OCL(1) µH±20%	I RMS(2) Amperes	I SAT(3) Amperes	DCR(4) Ohms max.
UP2B-221-R	220.0	223	0.773	0.637	0.6717
UP2B-331-R	330.0	338	0.676	0.510	0.8783
UP2B-471-R	470.0	471	0.553	0.427	1.31
UP2B-681-R	680.0	700	0.452	0.355	1.97
UP2B-821-R	820.0	823	0.423	0.334	2.24
UP2B-102-R	1000.0	1005	0.369	0.300	2.96
UP3B-R47-R	0.47	0.452	16.0	25.1	0.0021
UP3B-1R0-R	1.0	1.34	12.5	15.3	0.0034
UP3B-1R5-R	1.5	2.08	10.0	12.0	0.0053
UP3B-2R2-R	2.2	3.01	9.2	10.2	0.0074
UP3B-3R3-R	3.3	3.96	8.0	9.3	0.0083
UP3B-4R7-R	4.7	5.00	6.5	7.7	0.0114
UP3B-6R8-R	6.8	7.70	5.8	6.2	0.0183
UP3B-100-R	10.0	11.00	4.3	5.2	0.0260
UP3B-150-R	15.0	16.38	3.9	4.3	0.0317
UP3B-220-R	22.0	23.93	3.1	3.7	0.0490
UP3B-330-R	33.0	33.85	2.4	3.0	0.0688
UP3B-470-R	47.0	51.00	1.9	2.4	0.1082
UP3B-680-R	68.0	69.50	1.6	2.0	0.1558
UP3B-101-R	100.0	101.40	1.4	1.8	0.2053
UP3B-151-R	150.0	152.9	1.2	1.4	0.2960
UP3B-331-R	330.0	332.80	0.75	0.98	0.7330
UP4B-R47-R	0.47	0.473	19.2	51.7	0.0019
UP4B-1R0-R	1.0	0.916	17.3	37.3	0.0023
UP4B-1R5-R	1.5	1.52	13.4	28.9	0.0039
UP4B-2R2-R	2.2	2.27	12.0	23.7	0.0048
UP4B-3R3-R	3.3	3.14	11.0	20.2	0.0057
UP4B-4R7-R	4.7	5.34	8.6	15.6	0.0093
UP4B-6R8-R	6.8	6.66	8.3	14.1	0.0100
UP4B-100-R	10.0	9.77	6.8	11.5	0.0150
UP4B-150-R	15.0	15.61	5.5	9.1	0.0230
UP4B-220-R	22.0	22.61	4.5	7.6	0.0340
UP4B-330-R	33.0	34.30	3.7	6.1	0.0520
UP4B-470-R	47.0	48.10	3.1	5.2	0.0740
UP4B-680-R	68.0	69.14	2.4	4.3	0.1200
UP4B-101-R	100.0	99.42	2.0	3.6	0.1700
UP4B-151-R	150.0	146.90	1.7	3.0	0.2392
UP4B-221-R	220.0	221.40	1.4	2.4	0.3571
UP4B-331-R	330.0	330.00	1.1	2.0	0.5800
UP4B-471-R	470.0	470.10	0.91	1.7	0.8330

Notes: (1) Open Circuit Inductance Test Parameters: 100KHz, .250Vrms, 0.0Adc.
(2) RMS current for an approximate ∆T of 40°C. at an ambient temperature of 85˚C.
(3) Peak current for approximately 30% rolloff UP1B, 3B, 4B. 10% rolloff UP2B @ 20°C
(4) DCR limits 20°C.

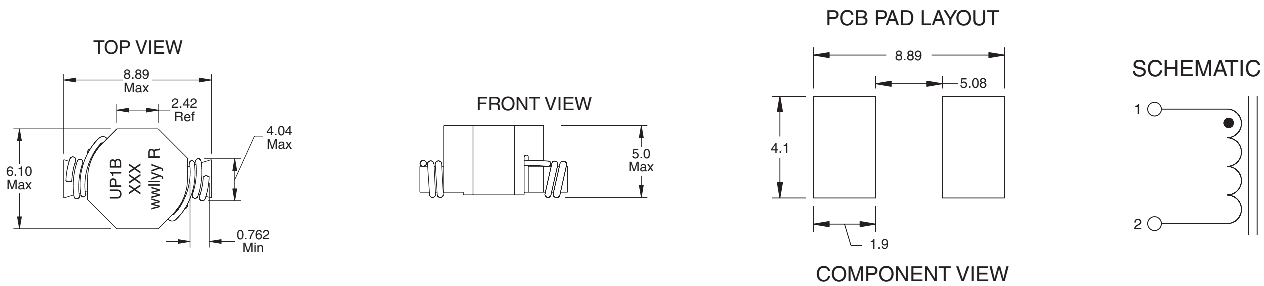
COOPER Bussmann

COILTRONICS®

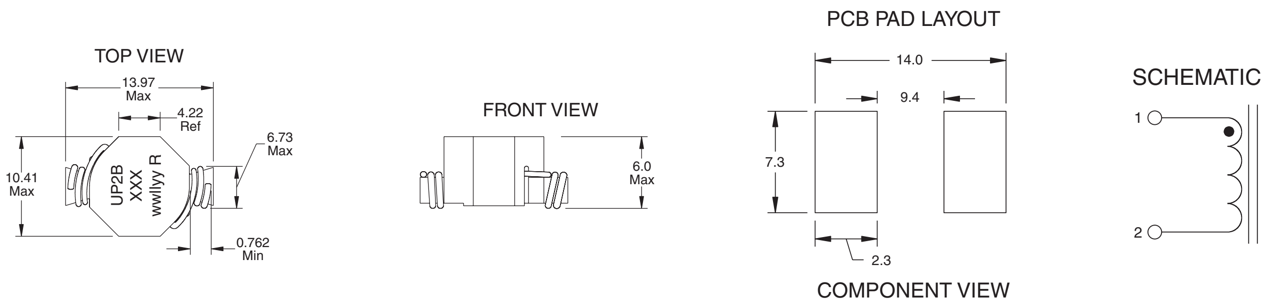
UNI-PAC™ Power Inductors (Surface Mount)

Mechanical Diagrams

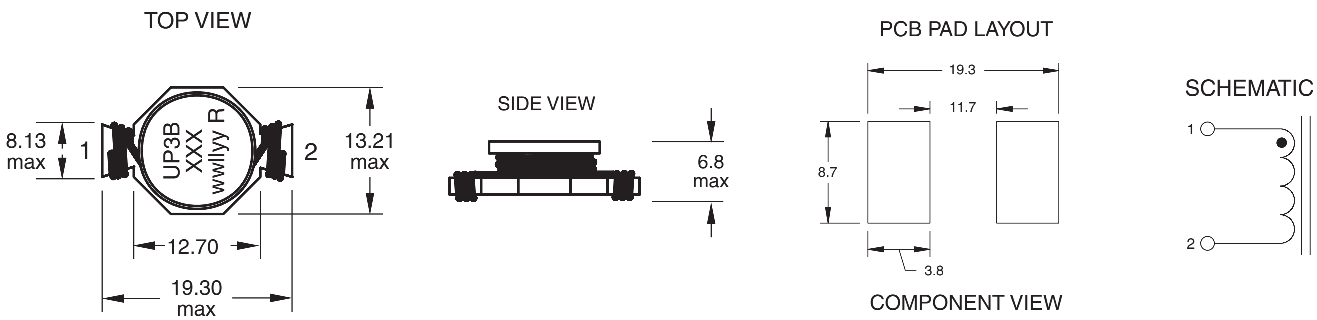
UP1B Series



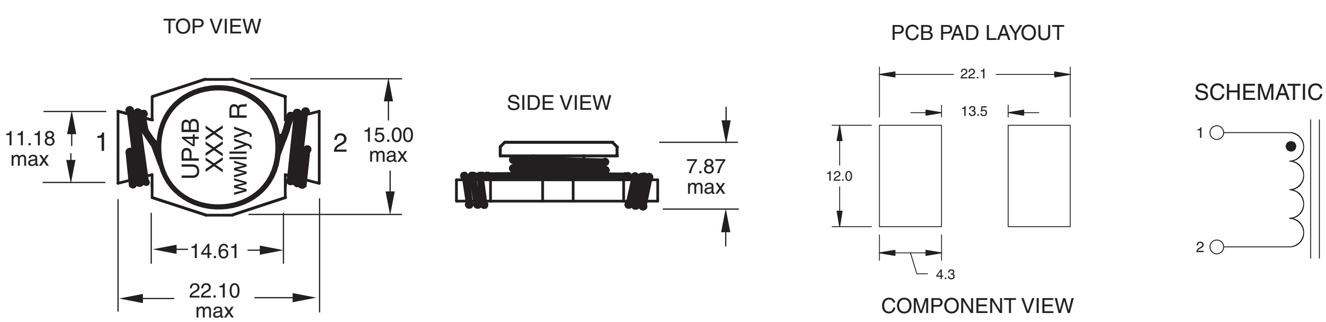
UP2B Series



UP3B Series



UP4B Series



Dimensions in Millimeters.

wwllyy = (date code) R = revision level
xxx = Inductance value per family chart

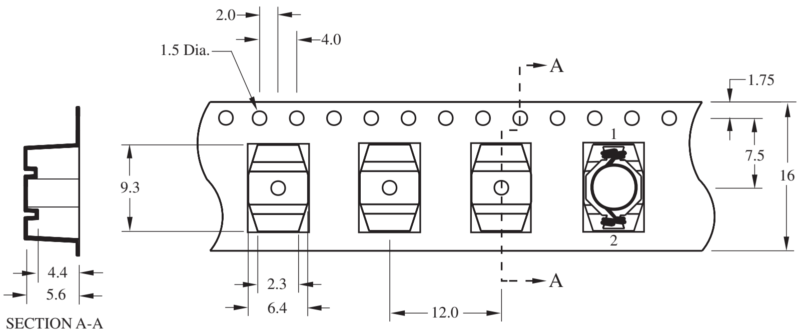
COILTRONICS®

COOPER Bussmann

UNI-PAC™ Power Inductors (Surface Mount)

Packaging Information

UP1B Series

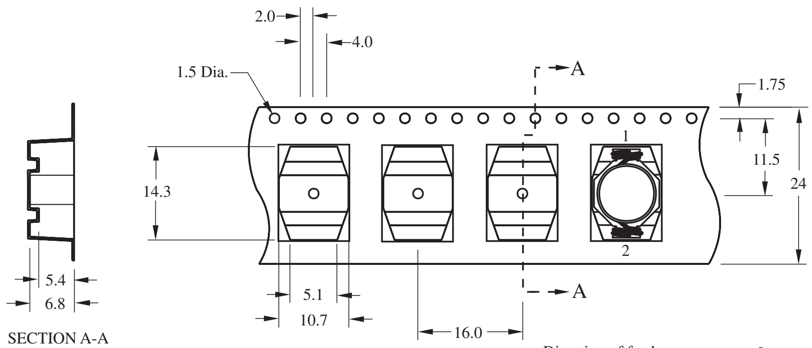


Direction of feed
Dimensions in millimeters.

ACTUAL SIZE
UNI-PAC 1B

Parts packaged on 13" Diameter reel, 900 parts per reel.

UP2B Series

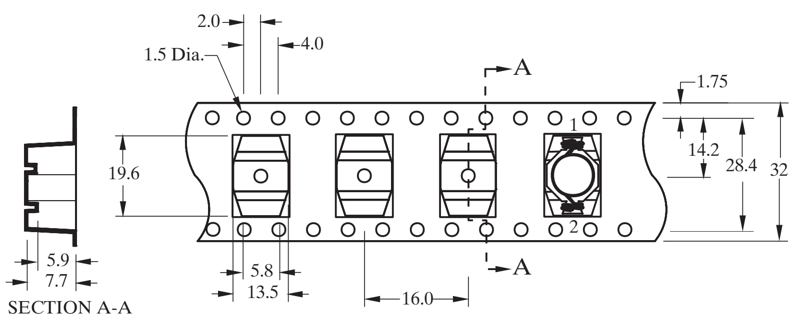


Direction of feed
Dimensions in millimeters.

ACTUAL SIZE
UNI-PAC 2B

Parts packaged on 13" Diameter reel, 550 parts per reel.

UP3B Series

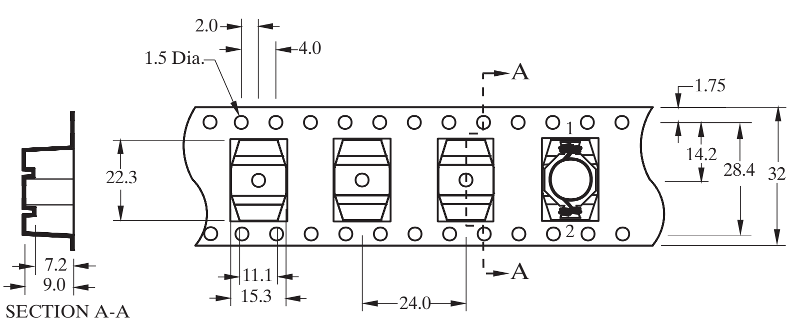


Direction of feed
Dimensions in millimeters.

ACTUAL SIZE
UNI-PAC 3B

Parts packaged on 13" Diameter reel, 450 parts per reel.

UP4B Series



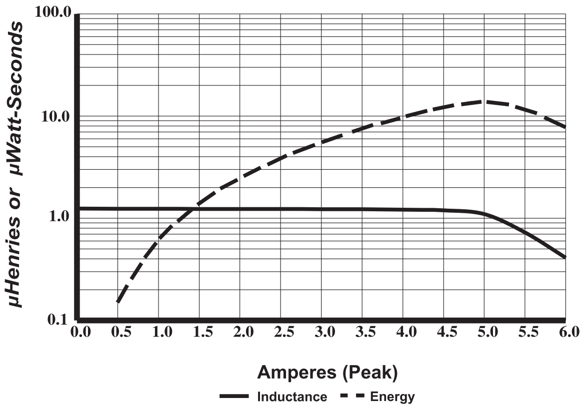
Direction of feed
Dimensions in millimeters.

ACTUAL SIZE
UNI-PAC 4B

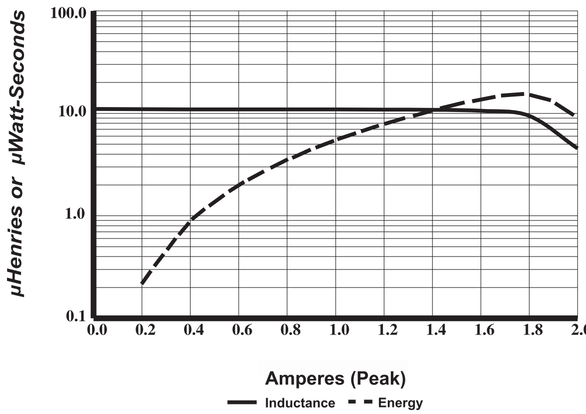
Parts packaged on 13" Diameter reel, 275 parts per reel.

Inductance Characteristics

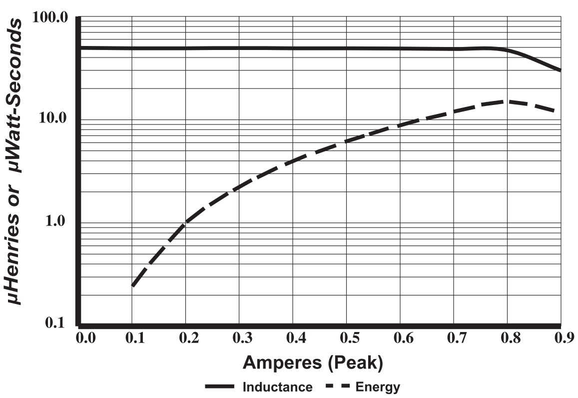
UP1B-1R0
Typical Inductance & Energy vs Saturation Current



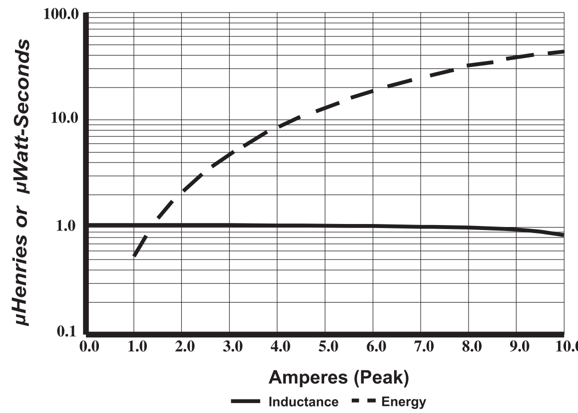
UP1B-100
Typical Inductance & Energy vs Saturation Current



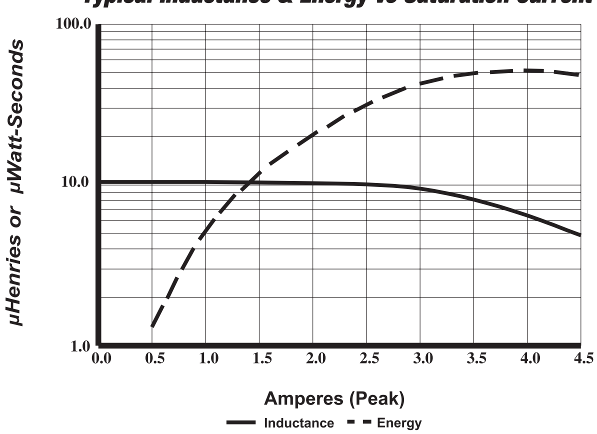
UP1B-470
Typical Inductance & Energy vs Saturation Current



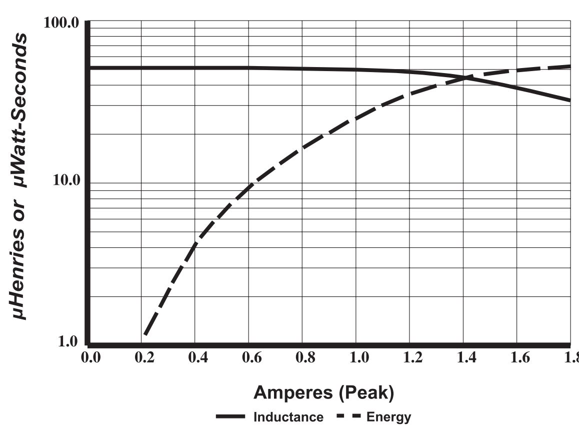
UP2B-1R0
Typical Inductance & Energy vs Saturation Current



UP2B-100
Typical Inductance & Energy vs Saturation Current



UP2B-470
Typical Inductance & Energy vs Saturation Current



COILTRONICS®

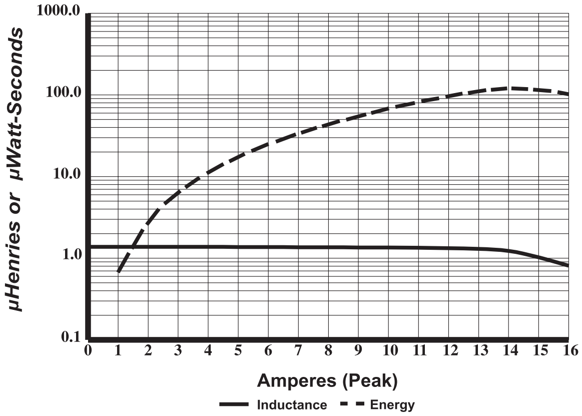
COOPER Bussmann

UNI-PAC™
Power Inductors
(Surface Mount)

Inductance Characteristics

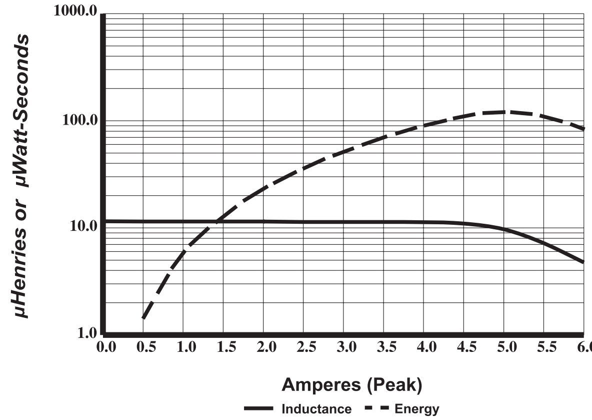
UP3B-1R0

Typical Inductance & Energy vs Saturation Current



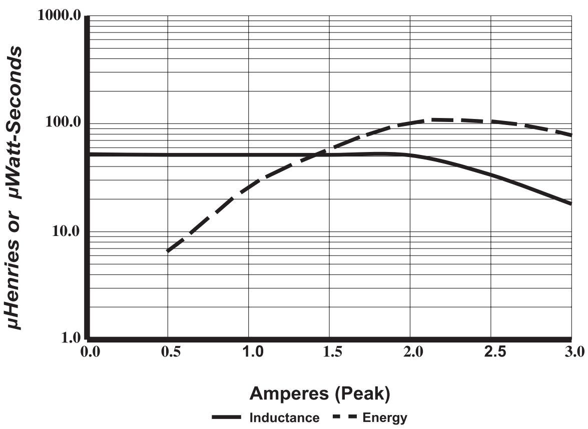
UP3B-100

Typical Inductance & Energy vs Saturation Current



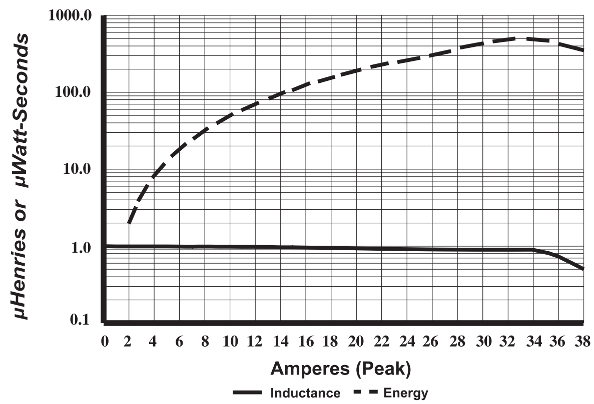
UP3B-470

Typical Inductance & Energy vs Saturation Current



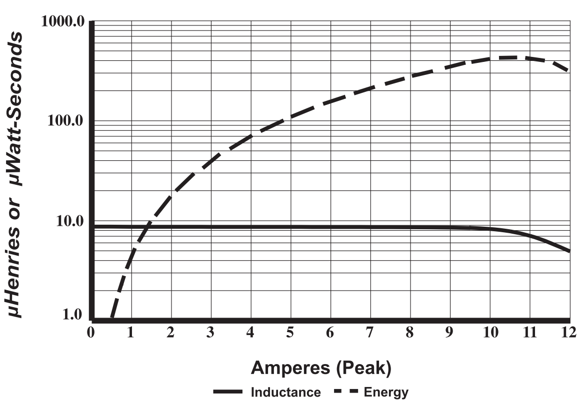
UP4B-1R0

Typical Inductance & Energy vs Saturation Current



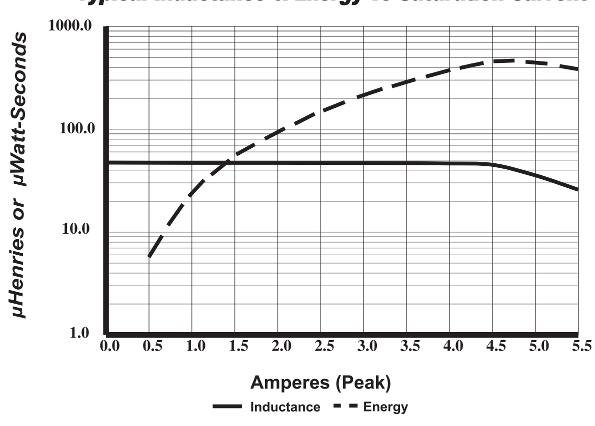
UP4B-100

Typical Inductance & Energy vs Saturation Current



UP4B-470

Typical Inductance & Energy vs Saturation Current



COOPER Bussmann

LD Series
Metalized Drum Core Power Inductor

Description

RoHS 2002/95/EC

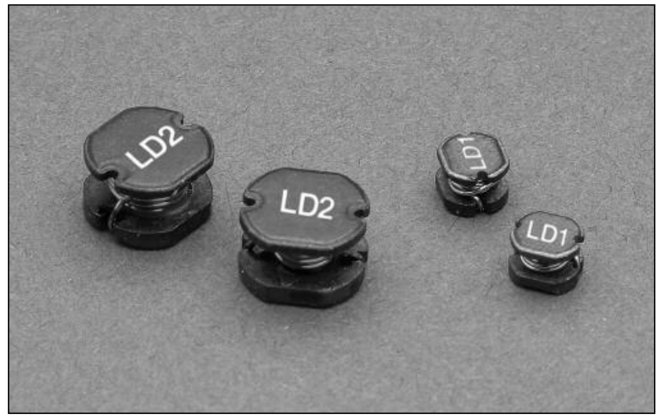
- Metalized drum core design utilizes board space
- Current Range from 4.46 to 0.52 Amps
- Inductance range from 1.0 uH to 470uH
- Ferrite core material

Applications

- Buck or Boost inductor
- Noise filtering and output filter chokes
- Computers
- Power Supplies
- Test Equipment Instrumentation

Environmental Data

- Storage temperature: -25°C to +85°C
- Operating ambient temperature: -20°C to +80°C (Range is application specific). Temperature rise is approximately 40°C at rated rms current.
- Solder reflow temperature: 260°C max. for 10 seconds max.



Packaging

- Supplied in tape and reel packaging, LD1 (2,000), LD2 (1,000) parts per reel

Part Number	Rated Inductance (µH)	OCL (1) Nominal	Irms (2) Amperes	Isat (3) Amperes	DCR (4) (Ω) (Max.)
LD1-1R0-R	1.0	1.00	2.66	4.46	0.0330
LD1-1R4-R	1.4	1.40	2.47	3.41	0.0380
LD1-1R8-R	1.8	1.80	2.35	3.05	0.0420
LD1-2R2-R	2.2	2.20	2.22	2.76	0.0470
LD1-2R7-R	2.7	2.70	2.11	2.52	0.0520
LD1-3R3-R	3.3	3.30	2.00	2.32	0.0580
LD1-3R9-R	3.9	3.90	1.75	2.14	0.0760
LD1-4R7-R	4.7	4.70	1.57	2.00	0.0940
LD1-5R6-R	5.6	5.60	1.51	1.75	0.1010
LD1-6R8-R	6.8	6.80	1.41	1.56	0.1170
LD1-8R2-R	8.2	8.20	1.32	1.41	0.1320
LD1-100-R	10	10.0	1.13	1.28	0.1820
LD1-120-R	12	12.0	1.05	1.18	0.2100
LD1-150-R	15	15.0	0.99	1.05	0.2350
LD1-180-R	18	18.0	0.83	0.98	0.3380
LD1-220-R	22	22.0	0.78	0.89	0.3780
LD1-270-R	27	27.0	0.67	0.87	0.5220
LD1-330-R	33	33.0	0.66	0.75	0.5400
LD1-390-R	39	39.0	0.63	0.68	0.5870
LD1-470-R	47	47.0	0.52	0.61	0.8440
LD1-560-R	56	56.0	0.50	0.57	0.9370
LD1-680-R	68	68.0	0.46	0.52	1.12

Notes:
1) Open Circuit Inductance Test Parameters: 100kHz, 0.25Vrms, 0.0Adc +/-20% except for LD1-330 to LD1-680 and LD2-470 to LD2-471 which is +/-10%
2) RMS current for for an approximate T of 40°C. It is recommended that the temperature of the part not exceed 125°C
3) Peak current for an approximate 10% rolloff at 20°C
4) DCR limits @ 20°C

COILTRONICS®

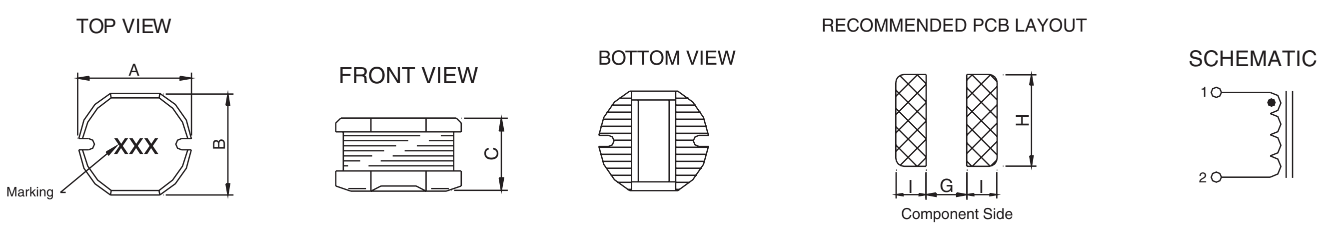
COOPER Bussmann

LD Series Metalized Drum Core Power Inductor

Part Number	Rated Inductance (µH)	OCL (1) Nominal	Irms (2) Amperes	Isat (3) Amperes	DCR (4) (Ω) (Max.)
LD2-100-R	10	10.0	3.83	3.45	0.0700
LD2-120-R	12	12.0	3.57	3.20	0.0800
LD2-150-R	15	15.0	3.38	2.85	0.0900
LD2-180-R	18	18.0	3.19	2.60	0.1000
LD2-220-R	22	22.0	3.13	2.45	0.1100
LD2-270-R	27	27.0	2.81	2.10	0.1200
LD2-330-R	33	33.0	2.70	2.01	0.1300
LD2-390-R	39	39.0	2.42	1.85	0.1600
LD2-470-R	47	47.0	2.25	1.64	0.1800
LD2-560-R	56	56.0	1.96	1.50	0.2400
LD2-680-R	68	68.0	1.88	1.35	0.2800
LD2-820-R	82	82	1.63	1.28	0.3700
LD2-101-R	100	100	1.53	1.15	0.4300
LD2-121-R	120	120	1.43	1.09	0.4700
LD2-151-R	150	150	1.23	0.95	0.6400
LD2-181-R	180	180	1.15	0.87	0.7100
LD2-221-R	220	220	1.00	0.79	0.9600
LD2-271-R	270	270	0.94	0.73	1.11
LD2-331-R	330	330	0.83	0.64	1.26
LD2-391-R	390	390	0.78	0.58	1.77
LD2-471-R	470	470	0.74	0.55	1.96

Notes:
1) Open Circuit Inductance Test Parameters: 100kHz, 0.25Vrms, 0.0Adc +/-20% except for LD1-330 to LD1-680 and LD2-470 to LD2-471 which is +/-10%
2) RMS current for for an approximate T of 40°C. It is recommended that the temperature of the part not exceed 125°C
3) Peak current for an approximate 10% rolloff at 20°C
4) DCR limits @ 20°C

Mechanical Diagrams



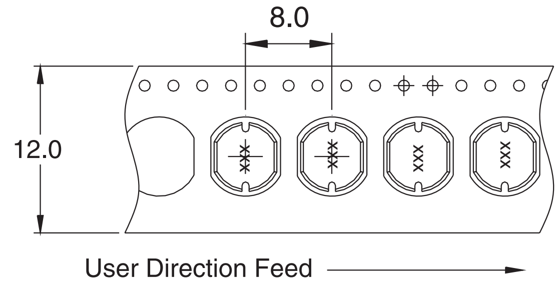
Marking:
LD1: xxx=inductance value per family chart
LD2: "C" logo
xxx=inductance value

Dimension	A +/-0.3	B +/-0.3	C +/-0.3	G ref	H ref	I ref
LD1	4.5	4.0	3.2	1.5	4.5	1.75
LD2	7.8	7.0	5.0	2.0	7.5	3.0

Dimensions in millimeters.

Packaging Information

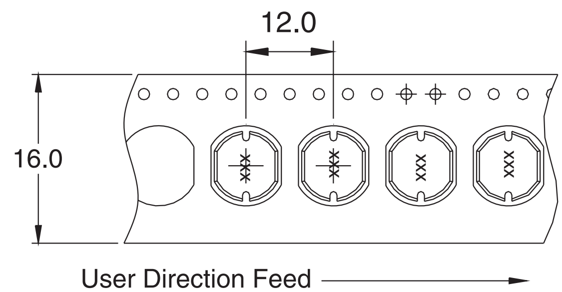
LD1 Series



ACTUAL SIZE
LD1

Parts packaged on 13" Diameter reel, 2,000 parts per reel.

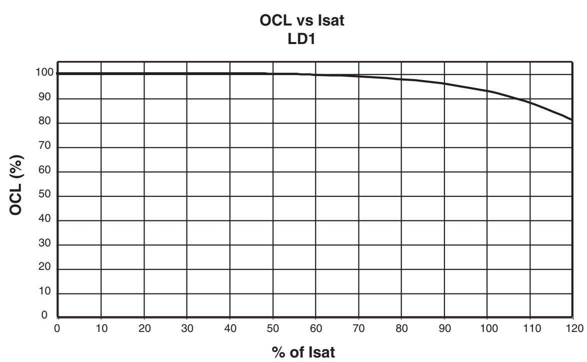
LD2 Series

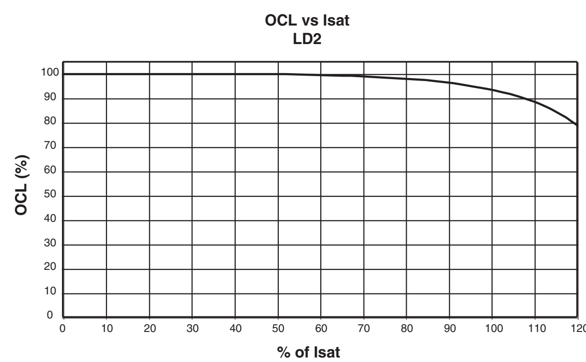


ACTUAL SIZE
LD2

Parts packaged on 13" Diameter reel, 1,000 parts per reel.

Inductance Characteristics





COOPER Bussmann

MICRO-PAC™
Low Profile Power Inductors (Surface Mount)

Description

RoHS 2002/95/EC

- High performance, ferrite-based, low profile, surface mount inductors
- Small footprint and closed magnetic field construction allow for low EMI
- Low DCR and high efficiency
- Ferrite core material

Applications

- PC cards, cellular telephones, pagers, and disk drives
- GPS systems

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific).
- Solder reflow temperature: +260°C max. for 10 seconds max.

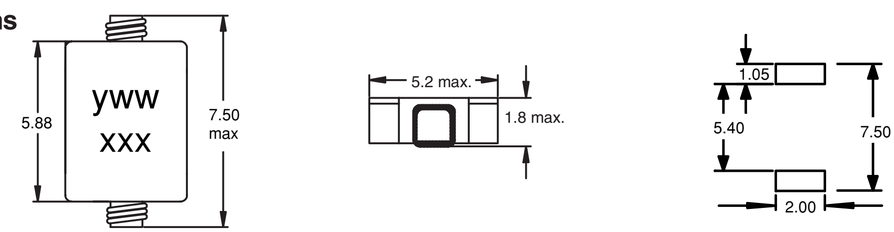
Packaging

- Supplied in tape and reel packaging, 3900 per reel

Part Number	Inductance µH	OCL (1) µH ± 20%	Irms (2) Amperes (Typ.)	Isat (3) Amperes (Typ.)	DCR (4) Ohms (Max.)	Q (5) (Typ.)	SRF MHz (Typ.)
MP2-R47-R	0.47	0.40	2.02	3.40	0.075	10	300
MP2-1R0-R	1.0	1.02	1.67	2.10	0.103	20	160
MP2-1R5-R	1.5	1.59	1.51	1.70	0.118	25	155
MP2-2R2-R	2.2	2.29	1.39	1.40	0.130	32	150
MP2-3R3-R	3.3	3.58	1.25	1.10	0.156	42	140
MP2-4R7-R	4.7	4.60	1.18	1.00	0.180	46	130
MP2-6R8-R	6.8	7.02	1.06	0.80	0.202	46	110
MP2-100-R	10.0	9.95	0.98	0.68	0.240	55	100
MP2-150-R	15.0	15.30	0.88	0.54	0.300	65	60
MP2-220-R	22.0	21.80	0.80	0.45	0.360	65	45
MP2-330-R	33.0	33.70	0.64	0.37	0.556	65	35
MP2-470-R	47.0	46.40	0.52	0.31	0.833	65	28

1) Open Circuit Inductance Test Parameters: 100kHz, 0.250 Vrms, 0.0 Adc
2) RMS current, delta temp. of 40° C ambient temperature of 85° C
3) Peak current for approximately 30% roll-off
4) Values @ 20° C
5) Measured @ 300KHz

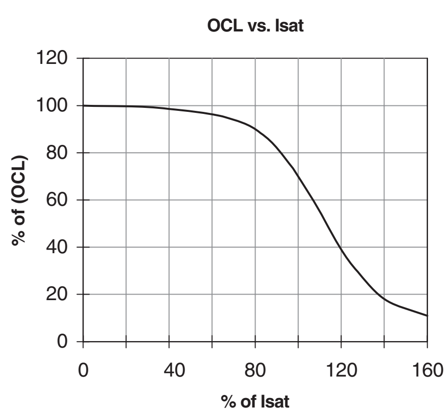
Mechanical Diagrams



Dimensions in Millimeters.
Specifications are subject to change without notice.

yww = Date Code
xxx = Inductance value per family chart

Inductance Characteristics



COILTRONICS®

COOPER Bussmann

MICRO-PAC PLUS™
Low Profile Power Inductors
(Surface Mount)

RoHS 2002/95/EC

Description

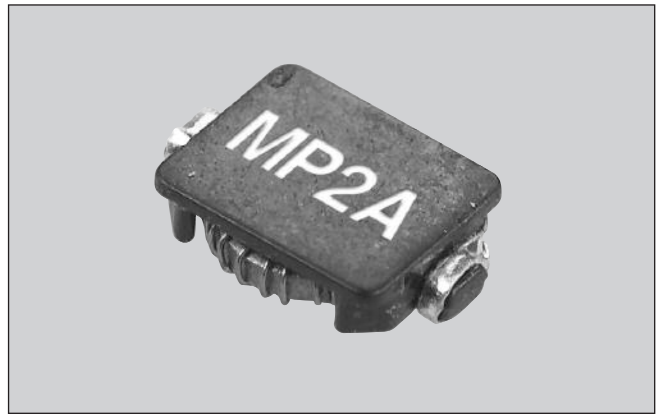
- High performance, low profile, surface mount power inductors with a molybdenum permalloy core
- Small footprint and closed magnetic field construction ensure low EMI
- Low DCR and high efficiency
- Frequency range up to 500kHz
- MPP core material

Applications

- PC cards, cellular telephones, pagers, and disk drives
- GPS systems

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific).
- Solder reflow temperature: +260°C max for 10 seconds max



Packaging

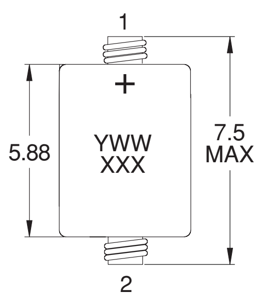
- Supplied in tape and reel packaging, 3900 per reel

Part Number	Inductance µH (rated)	OCL(1) µH±20%	DCR(2) typ. Ω	I RMS(3) Amperes	I SAT(4) Amperes	Volt(5) µsec
MP2A-R47-R	0.47	0.47	0.024	3.52	5.80	1.20
MP2A-R68-R	0.68	0.68	0.027	3.31	4.83	1.27
MP2A-1R0-R	1.00	1.21	0.067	2.11	3.63	2.00
MP2A-1R5-R	1.50	1.54	0.073	2.02	3.22	2.09
MP2A-2R2-R	2.20	2.30	0.086	1.87	2.64	2.26
MP2A-3R3-R	3.30	3.21	0.098	1.75	2.23	2.42
MP2A-4R7-R	4.70	4.86	0.117	1.60	1.81	2.64
MP2A-6R8-R	6.80	6.85	0.136	1.49	1.53	2.84
MP2A-8R2-R	8.20	8.54	0.167	1.34	1.54	3.15
MP2A-100-R	10.00	10.02	0.179	1.29	1.42	3.26
MP2A-150-R	15.00	15.18	0.217	1.18	1.16	3.59
MP2A-220-R	22.00	21.40	0.311	0.98	0.97	4.30
MP2A-330-R	33.00	32.74	0.476	0.79	0.79	5.32
MP2A-470-R	47.00	46.48	0.727	0.64	0.66	6.57
MP2A-680-R	68.00	68.53	1.108	0.52	0.54	8.11
MP2A-820-R	82.00	81.15	1.463	0.45	0.50	9.32
MP2A-101-R	100.00	99.65	2.015	0.39	0.45	10.94

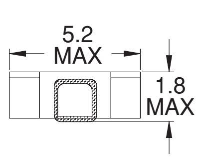
Notes: (1) Open Circuit Inductance Test Parameters: 100 kHz, .25Vrms, 0.0Adc.
(2) DCR limits 20°C.
(3) RMS current for an approximate ΔT of 40°C without core loss. It is recommended that the temperature of the part not exceed 125°C.
(4) Peak current for approximately 30% rolloff at 20°C.
(5) Applied Volt-Time product (V-µS) across the inductor. This value represents the applied V-µS at 300KHz necessary to generate a core loss equal to 10% of the total losses for 40°C temperature rise.

Mechanical Diagrams

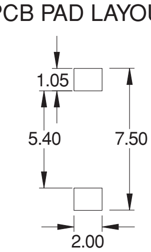
TOP VIEW



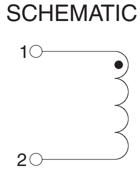
SIDE VIEW



PCB PAD LAYOUT



SCHEMATIC



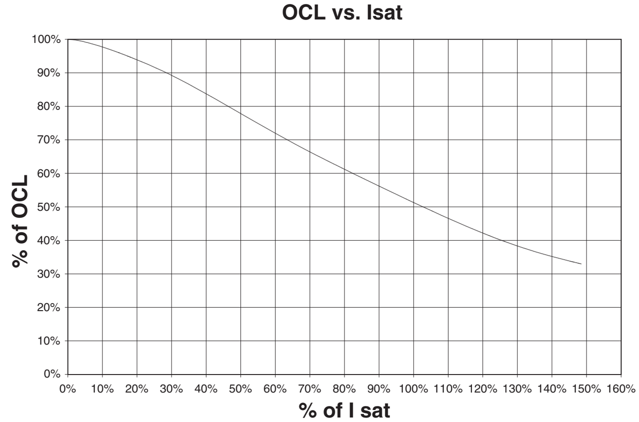
Dimensions in Millimeters.

Specifications are subject to change without notice.

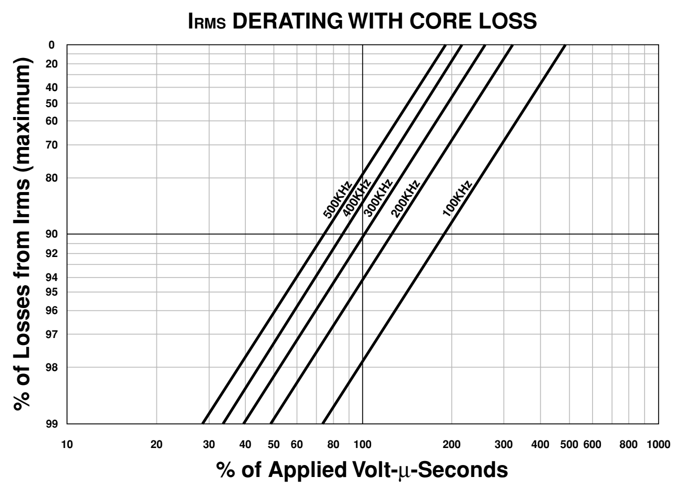
yww = Date Code

xxx = Inductance value per family chart

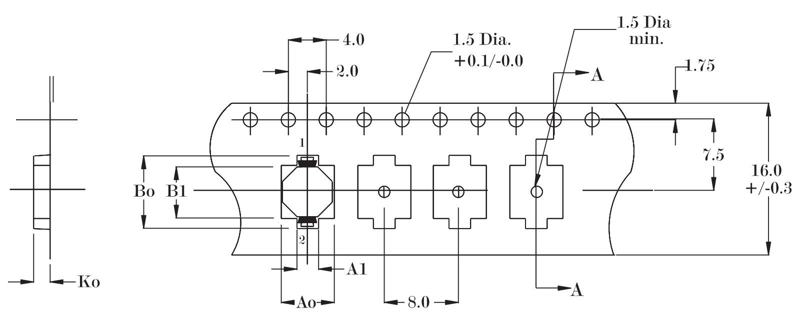
Inductance Characteristics



Core Loss



Packaging Information for MICRO-PAC™ & MICRO-PAC™ PLUS



Ao=5.6mm
A1=2.3mm
Bo=8.5mm
B1=6.3mm
Ko=2.1mm

ACTUAL SIZE
MICRO-PAC PLUS

Parts packaged on 13" Diameter reel, 3,900 parts per reel.

COOPER Bussmann

ECONO-PAC™/OCTA-PAC®
OCTA-PAC® PLUS
Power Inductors and Transformers

Description

RoHS 2002/95/EC

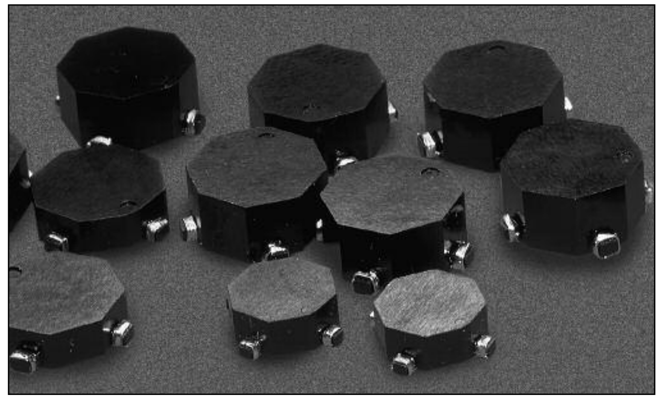
- Surface mount magnetics that can be used as single or coupled inductors or 1:1 transformers that provide isolation between two windings
- OCTA-PAC's are designed around high frequency, low loss MPP core material
- ECONO-PAC's are a lower cost version of OCTA-PAC's offering high saturation flux density, Powder Iron core material
- OCTA-PAC PLUS's offer higher current ratings and higher saturation flux densities than OCTA-PAC and ECONO-PAC, Amorphous metal core material
- Secure 4 Terminal Mounting
- Inductor more versatile inductance combination by series or parallel connections

Applications

- Computer and portable power devices
- LCD panels, DVD players
- Inductor: DC-DC converters
- Buck, boost, forward, and resonant converters
- Noise filtering and filter chokes
- Transformers: 1:1 300Vdc isolation, flyback, sepic

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific).
- Solder reflow temperature: +260°C max. for 10 seconds max.



Packaging

- Supplied in tape and reel packaging, 1100 (EP01, OPA1, and OP01), 800 (EP02, OP02, OPA2, EP03, OPA3, and OP03), and 600 (EP04, OPA4, and OP04) per reel

Legend

Marking
- CTX___-__ (First three digits CTX; Second 2-3 digits = Inductance Value; Last 1-2 digits, product size & type)

Product Size/Type
- CTX___-1 (-1 = size; no suffix = OCTA-PAC®)
- CTX___-1P (-1 = size; P suffix = ECONO-PAC™)
- CTX___-1A (-1 = size; A suffix = OCTA-PAC® PLUS)

	PARALLEL				SERIES			
Part Number	Open Circuit Inductance µH +/-20%	Full Load Inductance µH min.	Full Load Current Adc	DC Resistance ohms max.	Open Circuit Inductance µH +/-20%	Full Load Inductance µH min.	Full Load Current Adc	DC Resistance ohms max.
CTX0.47-1P-R	.42	.31	5.50	.005	1.67	1.25	2.75	.021
CTX0.68-1P-R	.60	.43	5.10	.006	2.40	1.74	2.55	.025
CTX1-1P-R	1.07	.73	4.50	.008	4.28	2.92	2.25	.032
CTX2-1P-R	2.02	1.36	3.40	.013	8.08	5.44	1.70	.054
CTX5-1P-R	4.83	3.37	2.00	.040	19.31	13.47	1.00	.161
CTX8-1P-R	8.08	5.31	1.80	.052	32.33	21.23	.90	.207
CTX10-1P-R	9.62	6.23	1.70	.057	38.48	24.94	.85	.227
CTX15-1P-R	15.03	9.62	1.40	.087	60.12	38.47	.70	.348
CTX20-1P-R	20.46	14.12	1.00	.158	81.83	56.47	.50	.634
CTX25-1P-R	25.40	17.07	.96	.177	101.60	68.29	.48	.708
CTX33-1P-R	32.33	22.27	.80	.250	129.32	89.06	.40	1.001
CTX50-1P-R	50.52	33.57	.70	.316	202.07	134.27	.35	1.263
CTX68-1P-R	68.40	43.65	.66	.373	273.61	174.61	.33	1.490
CTX100-1P-R	99.01	63.64	.54	.557	396.06	254.55	.27	2.227
CTX150-1P-R	150.72	96.64	.44	.844	602.87	386.56	.22	3.376
CTX200-1P-R	198.41	130.79	.36	1.208	793.65	523.16	.18	4.831
CTX300-1P-R	299.87	190.05	.32	1.525	1199.46	760.19	.16	6.100
CTX0.47-2P-R	.54	.42	5.90	.006	2.18	1.69	2.95	.024
CTX0.68-2P-R	.85	.64	5.40	.007	3.40	2.55	2.70	.029
CTX1-2P-R	1.22	.89	5.00	.008	4.90	3.57	2.50	.033
CTX2-2P-R	2.18	1.56	3.90	.014	8.70	6.26	1.95	.055
CTX5-2P-R	4.90	3.57	2.50	.032	19.58	14.26	1.25	.128
CTX8-2P-R	7.65	5.31	2.30	.040	30.60	21.23	1.15	.158
CTX10-2P-R	9.83	6.73	2.10	.045	39.30	26.92	1.05	.179
CTX15-2P-R	14.99	10.51	1.60	.085	59.98	42.02	.80	.339
CTX20-2P-R	19.58	13.37	1.50	.097	78.34	53.48	.75	.387
CTX25-2P-R	24.79	16.60	1.40	.109	99.14	66.38	.70	.436
CTX33-2P-R	32.67	21.29	1.30	.126	130.70	85.17	.65	.503
CTX50-2P-R	49.10	35.31	.82	.305	196.38	141.24	.41	1.221
CTX68-2P-R	68.85	47.93	.76	.362	275.40	191.71	.38	1.445
CTX100-2P-R	99.14	69.56	.62	.541	396.58	278.22	.31	2.162
CTX150-2P-R	148.10	100.07	.56	.665	592.42	400.27	.28	2.660
CTX200-2P-R	201.59	138.49	.46	.951	806.34	553.97	.23	3.804
CTX300-2P-R	300.42	197.52	.42	1.176	1201.70	790.08	.21	4.703

	PARALLEL				SERIES			
Part Number	Open Circuit Inductance µH +/-20%	Full Load Inductance µH min.	Full Load Current Adc	DC Resistance ohms max.	Open Circuit Inductance µH +/-20%	Full Load Inductance µH min.	Full Load Current Adc	DC Resistance ohms max.
CTX0.47-3P-R	.46	.35	6.20	.006	1.85	1.42	3.10	.025
CTX0.68-3P-R	.67	.50	5.70	.007	2.66	1.98	2.85	.028
CTX1-3P-R	.91	.65	5.40	.008	3.63	2.62	2.70	.032
CTX2-3P-R	1.85	1.24	4.60	.011	7.40	4.97	2.30	.045
CTX5-3P-R	4.74	3.04	3.20	.022	18.94	12.15	1.60	.090
CTX8-3P-R	8.16	4.90	2.80	.030	32.63	19.60	1.40	.119
CTX10-3P-R	9.79	5.71	2.70	.033	39.15	22.85	1.35	.131
CTX15-3P-R	14.50	8.50	2.20	.050	58.02	34.01	1.10	.198
CTX20-3P-R	20.15	13.12	1.50	.111	80.59	52.48	.75	.443
CTX25-3P-R	25.33	16.16	1.40	.125	101.31	64.66	.70	.499
CTX33-3P-R	32.63	20.32	1.30	.146	130.54	81.30	.65	.571
CTX50-3P-R	50.02	33.06	.92	.277	200.10	132.24	.46	1.108
CTX68-3P-R	68.84	44.15	.84	.328	275.35	176.61	.42	1.312
CTX100-3P-R	101.31	65.50	.68	.501	405.22	262.02	.34	2.005
CTX150-3P-R	149.85	90.92	.64	.621	599.40	363.68	.32	2.483
CTX200-3P-R	200.10	116.51	.60	.731	800.38	466.03	.30	2.925
CTX300-3P-R	298.39	172.12	.50	.926	1193.55	688.50	.25	3.702
CTX0.47-4P-R	.49	.37	7.90	.005	1.95	1.49	3.95	.019
CTX0.68-4P-R	.76	.56	7.20	.006	3.05	2.24	3.60	.023
CTX1-4P-R	1.10	.81	5.90	.008	4.39	3.24	2.95	.033
CTX2-4P-R	1.95	1.42	4.60	.014	7.81	5.69	2.30	.055
CTX5-4P-R	5.15	3.56	3.30	.027	20.62	14.23	1.65	.107
CTX8-4P-R	7.81	5.15	3.00	.033	31.23	20.61	1.50	.131
CTX10-4P-R	9.88	6.70	2.50	.047	39.53	26.79	1.25	.187
CTX15-4P-R	14.76	9.52	2.30	.057	59.05	38.09	1.15	.228
CTX20-4P-R	20.62	13.44	1.90	.084	82.47	53.76	.95	.337
CTX25-4P-R	25.65	17.17	1.60	.115	102.60	68.68	.80	.461
CTX33-4P-R	33.21	22.93	1.30	.166	132.86	91.72	.65	.662
CTX50-4P-R	48.80	32.21	1.20	.201	195.20	128.83	.60	.805
CTX68-4P-R	67.37	43.04	1.10	.238	269.50	172.16	.55	.952
CTX100-4P-R	99.09	69.54	.72	.565	396.38	278.15	.36	2.259
CTX150-4P-R	149.45	101.46	.64	.696	597.80	405.83	.32	2.784
CTX200-4P-R	200.11	131.37	.60	.810	800.44	525.47	.30	3.240
CTX300-4P-R	298.93	188.03	.54	1.003	1195.72	752.13	.27	4.011
CTX0.47-1-R	.40	.26	5.50	.005	1.60	1.05	2.75	.020
CTX0.68-1-R	.63	.41	4.50	.006	2.50	1.63	2.25	.024
CTX1-1-R	.90	.56	4.20	.007	3.60	2.24	2.10	.028
CTX2-1-R	2.03	1.00	4.10	.010	8.10	4.01	2.05	.040
CTX5-1-R	4.90	2.66	2.30	.030	19.60	10.64	1.15	.122
CTX8-1-R	8.10	4.08	2.00	.039	32.40	16.34	1.00	.157
CTX10-1-R	10.00	4.85	1.90	.044	40.00	19.40	.95	.176
CTX15-1-R	14.40	8.74	1.10	.080	57.60	34.96	.55	.319
CTX20-1-R	19.60	11.54	1.00	.146	78.40	46.15	.50	.583
CTX25-1-R	25.60	16.35	.74	.167	102.40	65.42	.37	.668
CTX33-1-R	32.40	19.84	.72	.293	129.60	79.37	.36	1.171
CTX50-1-R	50.63	29.34	.64	.365	202.50	117.38	.32	1.461
CTX68-1-R	67.60	39.73	.54	.516	270.40	158.92	.27	2.064
CTX100-1-R	99.23	58.72	.44	.784	396.90	234.88	.22	3.137
CTX150-1-R	148.23	85.16	.38	.965	592.90	340.64	.19	3.861
CTX200-1-R	202.50	107.60	.37	1.142	810.00	430.39	.19	4.567
CTX300-1-R	302.50	191.38	.22	1.431	1210.00	765.54	.11	5.724
CTX0.47-2-R	.42	.29	6.50	.005	1.69	1.17	3.25	.019
CTX0.68-2-R	.75	.50	5.50	.006	3.01	1.98	2.75	.024
CTX1-2-R	1.18	.76	4.60	.007	4.70	3.04	2.30	.028
CTX2-2-R	2.30	1.27	4.50	.010	9.21	5.07	2.25	.038
CTX5-2-R	4.70	2.66	3.00	.021	18.80	10.65	1.50	.084
CTX8-2-R	7.94	4.18	2.60	.027	31.77	16.72	1.30	.108
CTX10-2-R	10.58	5.18	2.50	.031	42.30	20.72	1.25	.125
CTX15-2-R	15.23	8.53	1.70	.059	60.91	34.10	.85	.236
CTX20-2-R	20.73	12.36	1.30	.107	82.91	49.46	.65	.426
CTX25-2-R	24.86	16.09	1.00	.117	99.45	64.35	.50	.466
CTX33-2-R	31.77	15.90	1.40	.105	127.09	63.59	.70	.420
CTX50-2-R	51.18	28.79	.92	.210	204.73	115.16	.46	.839
CTX68-2-R	67.87	38.71	.78	.303	271.47	154.83	.39	1.214
CTX100-2-R	99.45	57.45	.63	.457	397.81	229.79	.32	1.828

Part Number	PARALLEL Open Circuit Inductance µH +/-20%	PARALLEL Full Load Inductance µH min.	PARALLEL Full Load Current Adc	PARALLEL DC Resistance ohms max.	SERIES Open Circuit Inductance µH +/-20%	SERIES Full Load Inductance µH min.	SERIES Full Load Current Adc	SERIES DC Resistance ohms max.
CTX150-2-R	147.39	93.46	.43	.560	589.57	373.84	.22	2.241
CTX200-2-R	198.58	122.94	.39	.796	794.30	491.76	.20	3.184
CTX300-2-R	300.80	169.06	.38	1.231	1203.20	676.24	.19	4.929
CTX0.47-3-R	.38	.27	6.00	.005	1.54	1.08	3.00	.020
CTX0.68-3-R	.60	.42	5.00	.006	2.40	1.67	2.50	.024
CTX1-3-R	.86	.57	4.80	.007	3.46	2.28	2.40	.028
CTX2-3-R	1.94	1.05	4.70	.010	7.78	4.22	2.35	.040
CTX5-3-R	4.70	2.56	3.00	.019	18.82	10.26	1.50	.077
CTX8-3-R	7.78	3.74	2.80	.025	31.10	14.98	1.40	.099
CTX10-3-R	9.60	4.38	2.70	.028	38.40	17.54	1.35	.111
CTX15-3-R	15.00	7.26	2.00	.043	60.00	29.06	1.00	.172
CTX20-3-R	20.18	10.76	1.50	.078	80.74	43.04	.75	.312
CTX25-3-R	24.58	15.64	.98	.086	98.30	62.56	.49	.346
CTX33-3-R	32.86	19.69	.96	.083	131.42	78.77	.48	.331
CTX50-3-R	50.78	27.18	.94	.239	203.14	108.71	.47	.956
CTX68-3-R	67.42	36.53	.80	.277	269.66	146.11	.40	1.109
CTX100-3-R	101.40	52.48	.70	.345	405.60	209.93	.35	1.381
CTX150-3-R	149.78	97.16	.38	.430	599.14	388.63	.19	1.718
CTX200-3-R	198.74	119.18	.39	.619	794.98	476.71	.20	2.475
CTX300-3-R	301.06	157.44	.40	.951	1204.22	629.75	.20	3.083
CTX0.47-4-R	.44	.32	7.00	.004	1.76	1.29	3.50	.016
CTX0.68-4-R	.78	.55	6.00	.005	3.14	2.21	3.00	.020
CTX1-4-R	1.23	.85	5.00	.006	4.90	3.41	2.50	.024
CTX2-4-R	1.76	1.06	4.90	.007	7.06	4.24	2.45	.028
CTX5-4-R	4.90	2.59	4.40	.014	19.60	10.37	2.20	.056
CTX8-4-R	8.28	4.29	3.50	.018	33.12	17.14	1.75	.072
CTX10-4-R	9.60	4.82	3.40	.019	38.42	19.28	1.70	.078
CTX15-4-R	14.16	6.76	3.00	.024	56.64	27.03	1.50	.096
CTX20-4-R	19.60	10.68	2.10	.055	78.40	42.73	1.05	.220
CTX25-4-R	25.92	13.32	2.00	.063	103.68	53.27	1.00	.253
CTX33-4-R	33.12	16.82	1.80	.072	132.50	67.27	.90	.287
CTX50-4-R	50.18	25.03	1.50	.111	200.70	100.11	.75	.443
CTX68-4-R	67.08	35.29	1.20	.157	268.32	141.15	.60	.630
CTX100-4-R	99.23	54.56	.92	.302	396.90	218.25	.46	1.210
CTX150-4-R	148.23	77.17	.82	.372	592.90	308.69	.41	1.488
CTX200-4-R	200.70	111.08	.64	.545	802.82	444.32	.32	2.180
CTX300-4-R	298.12	147.92	.62	.672	1192.46	591.66	.31	2.687

		Parallel Ratings					Series Ratings				
Part Number	Rated Inductance (µH)	OCL (1) nominal +/-25% (µH)	I sat. (2) Amperes Peak	I rms. (3) Amperes	DCR Ω (4) max. @ 20°C.	Volt (7) µ-Sec	OCL (1) nominal +/-25% (µH)	I sat. (2) Amperes Peak	I rms. (3) Amperes	DCR Ω (4) max. @ 20°C.	Volt (7) µ-Sec
CTX0.33-1A-R	0.33	0.402	12.5	10.0	0.0037	.93	1.61	6.25	4.98	0.015	1.86
CTX0.68-1A-R	0.68	0.752	9.4	9.0	0.0046	1.24	3.01	4.69	4.48	0.0185	2.49
CTX1-1A-R	1.0	1.18	7.5	7.26	0.0070	1.55	4.70	3.75	3.63	0.0282	3.11
CTX2-1A-R	2.0	2.30	5.36	5.64	0.012	2.17	9.21	2.68	2.82	0.0470	4.35
CTX5-1A-R	5.0	4.70	3.75	4.27	0.020	3.11	18.8	1.88	2.13	0.082	6.21
CTX8-1A-R	8.0	7.94	2.88	3.37	0.033	4.04	31.77	1.44	1.69	0.130	8.08
CTX10-1A-R	10.0	10.58	2.5	2.84	0.046	4.66	42.30	1.25	1.42	0.183	9.32
CTX15-1A-R	15.0	15.23	2.08	2.07	0.087	5.59	60.91	1.04	1.03	0.348	11.2
CTX20-1A-R	20.0	20.73	1.79	1.71	0.127	6.52	82.91	0.89	0.86	0.507	13.0
CTX25-1A-R	25.0	24.86	1.63	1.46	0.173	7.14	99.45	0.82	0.73	0.693	14.3
CTX33-1A-R	33.0	34.26	1.39	1.22	0.249	8.39	137.1	0.69	0.61	0.995	16.8
CTX50-1A-R	50.0	51.18	1.14	0.99	0.381	10.3	204.7	0.57	0.49	1.524	20.5
CTX68-1A-R	68.0	67.87	0.99	0.92	0.437	11.8	271.5	0.49	0.46	1.749	23.6
CTX100-1A-R	100.0	99.45	0.82	0.74	0.686	14.3	397.8	0.41	0.37	2.745	28.6
CTX150-1A-R	150.0	147.4	0.67	0.67	0.832	17.4	589.6	0.33	0.33	3.329	34.8
CTX200-1A-R	200.0	198.6	0.58	0.62	0.963	20.2	794.3	0.29	0.31	3.854	40.4
CTX300-1A-R	300.0	300.8	0.47	0.56	1.181	24.9	1203	0.23	0.28	4.726	49.7
CTX0.33-2A-R	0.33	0.284	18.8	10.9	0.0033	.85	1.14	9.38	5.47	0.0132	1.71
CTX0.68-2A-R	0.68	0.675	12.5	9.4	0.0045	1.28	2.70	6.25	4.68	0.0180	2.56
CTX1-2A-R	1.0	1.26	9.38	8.22	0.0058	1.71	5.06	4.69	4.11	0.0233	3.42
CTX2-2A-R	2.0	1.98	7.50	6.74	0.0090	2.14	7.90	3.75	3.37	0.035	4.27
CTX5-2A-R	5.0	5.06	4.69	4.34	0.021	3.42	20.22	2.34	2.17	0.084	6.84
CTX8-2A-R	8.0	7.90	3.75	3.50	0.032	4.27	31.60	1.88	1.75	0.129	8.55
CTX10-2A-R	10.0	11.38	3.13	2.89	0.047	5.13	45.50	1.56	1.45	0.188	10.3
CTX15-2A-R	15.0	15.48	2.68	2.69	0.054	5.98	61.94	1.34	1.35	0.218	12.0
CTX20-2A-R	20.0	20.22	2.34	2.24	0.078	6.84	80.90	1.17	1.12	0.313	13.7
CTX25-2A-R	25.0	25.60	2.08	1.89	0.111	7.69	102.38	1.04	0.94	0.443	15.4
CTX33-2A-R	33.0	34.84	1.79	1.56	0.162	8.97	139.4	0.89	0.78	0.649	17.9
CTX50-2A-R	50.0	49.38	1.50	1.28	0.240	10.7	197.5	0.75	0.64	0.961	21.4
CTX68-2A-R	68.0	66.44	1.29	1.07	0.342	12.4	265.8	0.65	0.54	1.367	24.8
CTX100-2A-R	100.0	102.38	1.04	0.75	0.695	15.4	409.5	0.52	0.38	2.778	30.8
CTX150-2A-R	150.0	152.9	0.85	0.68	0.842	18.8	611.8	0.43	0.34	3.366	37.6
CTX200-2A-R	200.0	197.5	0.75	0.64	0.950	21.4	790.0	0.38	0.32	3.800	42.7
CTX300-2A-R	300.0	303.7	0.60	0.58	1.174	26.5	1215	0.30	0.29	4.697	53.0
CTX0.33-3A-R	0.33	0.368	15.0	11.4	0.0032	0.97	1.47	7.50	5.72	0.0128	1.93
CTX0.68-3A-R	0.68	0.688	11.3	9.3	0.0048	1.29	2.75	5.63	4.64	0.0194	2.58
CTX1-3A-R	1.0	1.08	9.0	8.38	0.0059	1.61	4.20	4.50	4.19	0.0238	3.22
CTX2-3A-R	2.0	2.11	6.43	7.26	0.0079	2.26	8.43	3.21	3.63	0.0317	4.51
CTX5-3A-R	5.0	5.20	4.09	5.24	0.015	3.54	20.81	2.05	2.62	0.061	7.09
CTX8-3A-R	8.0	8.43	3.21	4.23	0.023	4.51	33.77	1.61	2.12	0.093	9.02
CTX10-3A-R	10.0	9.68	3.00	3.64	0.032	4.83	38.70	1.50	1.82	0.126	9.67
CTX15-3A-R	15.0	15.52	2.37	3.25	0.039	6.12	62.09	1.18	1.63	0.158	12.2
CTX20-3A-R	20.0	20.81	2.05	2.43	0.071	7.09	83.25	1.02	1.22	0.282	14.2
CTX25-3A-R	25.0	24.77	1.88	2.34	0.076	7.73	99.07	0.94	1.17	0.306	15.5
CTX33-3A-R	33.0	33.71	1.61	1.93	0.112	9.02	134.8	0.80	0.96	0.449	18.0
CTX50-3A-R	50.0	49.71	1.32	1.56	0.171	11.0	198.8	0.66	0.78	0.686	21.9

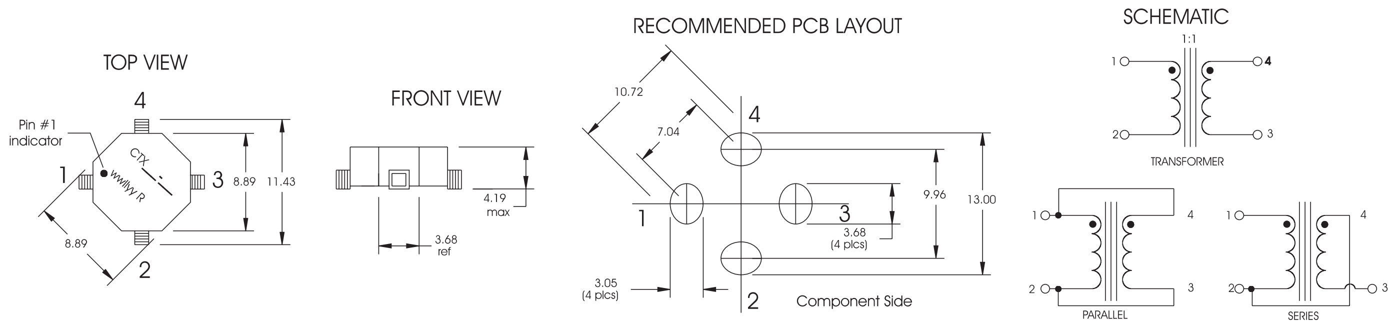
1) Open Circuit Inductance Test Parameters: 100kHz, 0.250 Vrms, 0.0 Adc
   Parallel: (1,4 - 3,2) Series: (1 - 3) tie (2 - 4)
2) Peak current for approximately 30% roll-off
3) RMS current, delta temp. of 40° C ambient temperature of 85° C
4) DCR @ 20°C
5) Hipot rating: winding to winding: 300Vdc min.
6) Turns Ratio: (1-2):(4-3) 1:1
7) Applied volt-time product (v-us) across the inductor. This value represents the applied V-us at 300KHz necessary to generate a core loss equal to 10% of the total losses for a 40°C temperature rise.

		Parallel Ratings					Series Ratings				
Part Number	**Rated Inductance (µH)**	**OCL (1) nominal +/-25% (µH)**	**I sat. (2) Amperes Peak**	**I rms. (3) Amperes**	**DCR Ω (4) max. @ 20°C.**	**Volt (7) µ-Sec**	**OCL (1) nominal +/-25% (µH)**	**I sat. (2) Amperes Peak**	**I rms. (3) Amperes**	**DCR Ω (4) max. @ 20°C.**	**Volt (7) µ-Sec**
CTX68-3A-R	68.0	68.80	1.13	1.28	0.253	12.9	275.2	0.56	0.64	1.013	25.8
CTX100-3A-R	100.0	99.07	0.94	1.05	0.379	15.5	396.3	0.47	0.53	1.514	30.9
CTX150-3A-R	150.0	149.7	0.76	0.86	0.571	19.0	598.7	0.38	0.43	2.283	38.0
CTX200-3A-R	200.0	198.8	0.66	0.71	0.829	21.9	795.3	0.33	0.35	3.315	43.8
CTX300-3A-R	300.0	296.2	0.54	0.56	1.309	26.7	1185	0.27	0.28	5.236	53.5
CTX0.33-4A-R	0.33	0.313	22.5	12.2	0.0030	0.98	1.25	11.25	6.09	0.0119	1.96
CTX0.68-4A-R	0.68	0.744	15.0	10.6	0.0040	1.47	2.98	7.50	5.28	0.0158	2.94
CTX1-4A-R	1.0	1.39	11.25	9.23	0.0052	1.96	5.57	5.63	4.62	0.0207	3.93
CTX2-4A-R	2.0	2.18	9.00	8.38	0.0063	2.45	8.70	4.50	4.19	0.0251	4.91
CTX5-4A-R	5.0	4.26	6.43	7.21	0.0085	3.44	17.05	3.21	3.61	0.0339	6.87
CTX8-4A-R	8.0	8.70	4.50	5.49	0.015	4.91	34.80	2.25	2.74	0.059	9.81
CTX10-4A-R	10.0	10.53	4.09	4.67	0.020	5.40	42.11	2.05	2.33	0.081	10.8
CTX15-4A-R	15.0	14.70	3.46	3.87	0.029	6.38	58.81	1.73	1.94	0.117	12.8
CTX20-4A-R	20.0	19.58	3.00	3.62	0.034	7.36	78.30	1.50	1.81	0.135	14.7
CTX25-4A-R	25.0	25.14	2.65	3.02	0.048	8.34	100.51	1.32	1.51	0.193	16.7
CTX33-4A-R	33.0	34.80	2.25	2.49	0.071	9.81	139.2	1.13	1.25	0.283	19.6
CTX50-4A-R	50.0	50.11	1.88	2.05	0.104	11.8	200.4	0.94	1.03	0.418	23.6
CTX68-4A-R	68.0	68.21	1.61	1.70	0.153	13.7	272.8	0.80	0.85	0.612	27.5
CTX100-4A-R	100.0	100.57	1.32	1.37	0.235	16.7	402.3	0.66	0.69	0.939	33.4
CTX150-4A-R	150.0	153.5	1.07	1.10	0.365	20.6	613.9	0.54	0.55	1.462	41.2
CTX200-4A-R	200.0	200.4	0.94	0.92	0.521	23.6	801.8	0.47	0.46	2.085	47.1
CTX300-4A-R	300.0	302.8	0.76	0.75	0.787	29.0	1211	0.38	0.37	3.148	57.9

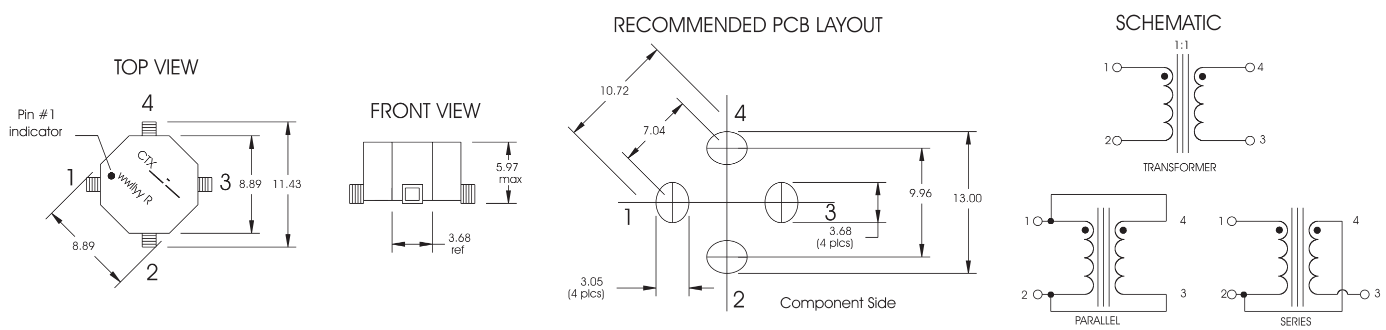
1) Open Circuit Inductance Test Parameters: 100kHz, 0.250 Vrms, 0.0 Adc
   Parallel: (1,4 - 3,2) Series: (1 - 3) tie (2 - 4)
2) Peak current for approximately 30% roll-off
3) RMS current, delta temp. of 40° C ambient temperature of 85° C
4) DCR @ 20°C
5) Hipot rating: winding to winding: 300Vdc min.
6) Turns Ratio: (1-2):(4-3) 1:1
7) Applied volt-time product (v-us) across the inductor. This value represents the applied V-us at 300KHz necessary to generate a core loss equal to 10% of the total losses for a 40°C temperature rise.

Mechanical Diagrams

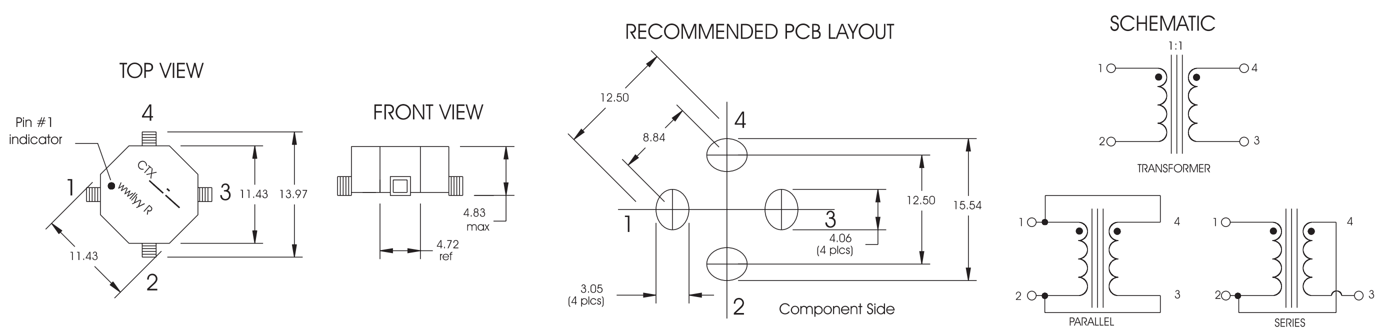
CTX 1, 1P, 1A Series



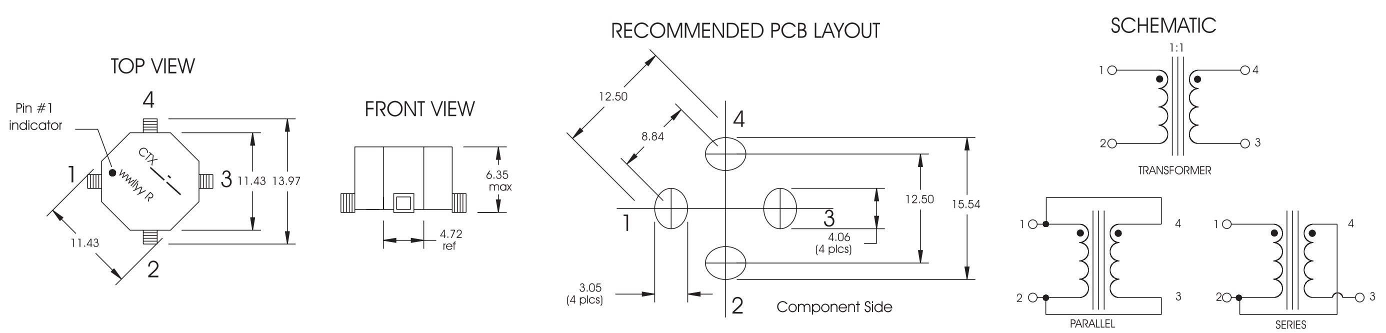
CTX 2, 2P, 2A Series



CTX 3, 3P, 3A Series



CTX 4, 4P, 4A Series

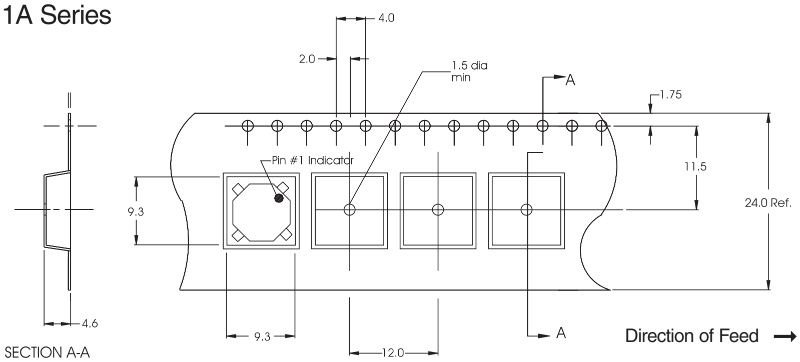


Dimensions in Millimeters.

wwllyy = (date code) R = revision level

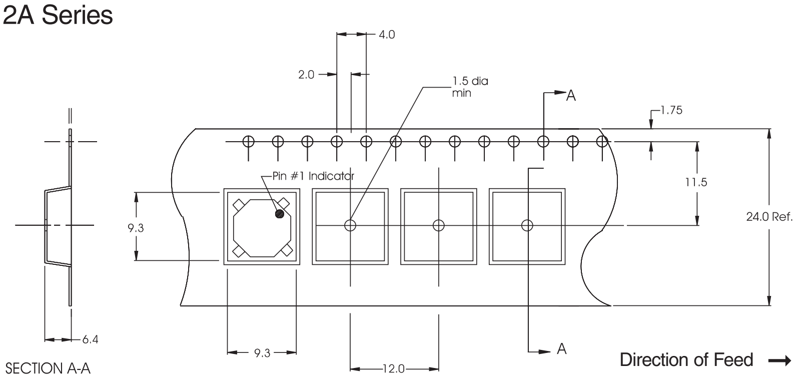
Packaging Information

CTX 1, 1P, 1A Series



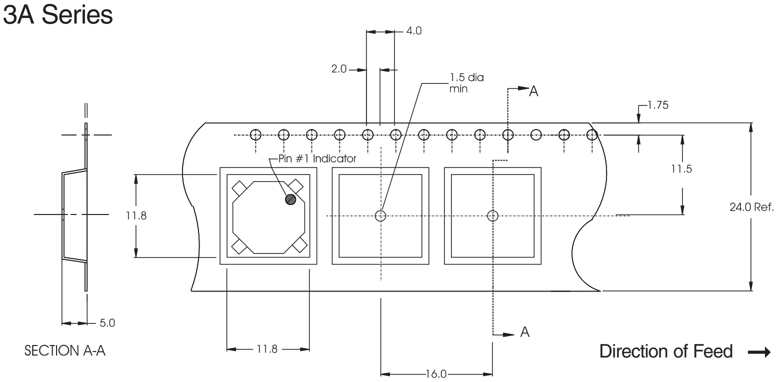
Parts packaged on 13" Diameter reel, 1,100 parts per reel.

CTX 2, 2P, 2A Series



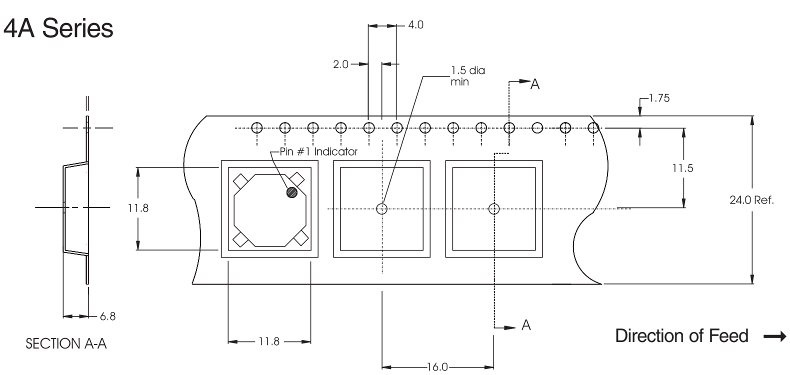
Parts packaged on 13" Diameter reel, 800 parts per reel.

CTX 3, 3P, 3A Series



Parts packaged on 13" Diameter reel, 800 parts per reel.

CTX 4, 4P, 4A Series



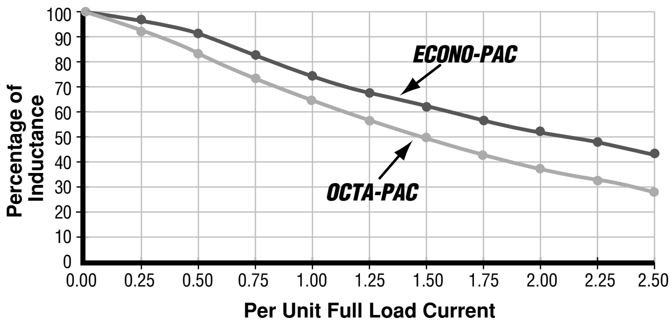
Parts packaged on 13" Diameter reel, 600 parts per reel.

Dimensions are in millimeters.

COOPER Bussmann

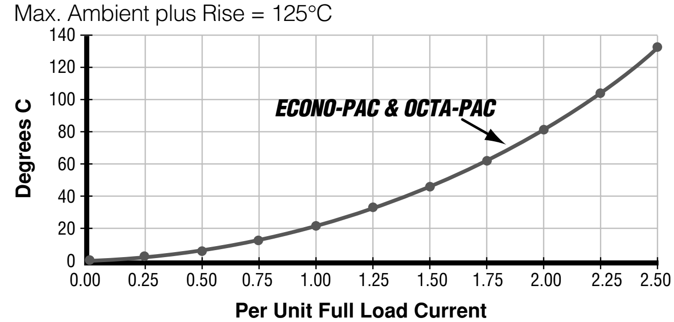
Performance Characteristics

INDUCTANCE VS. CURRENT

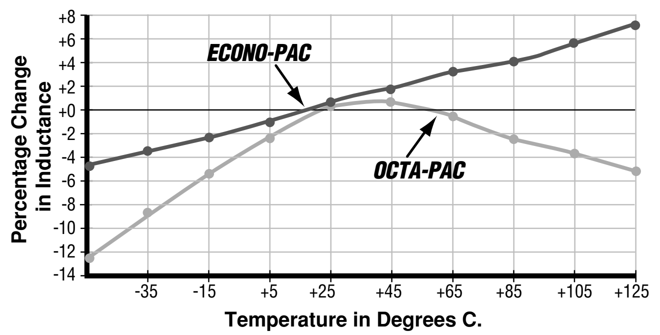


TEMPERATURE RISE VS. RATED CURRENT

Max. Ambient plus Rise = 125°C

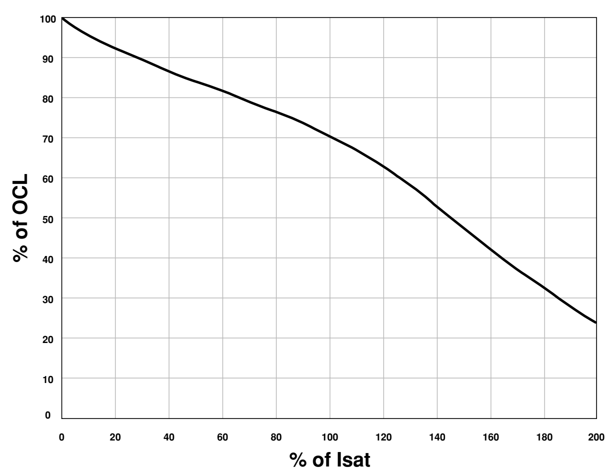


INDUCTANCE VS. TEMPERATURE

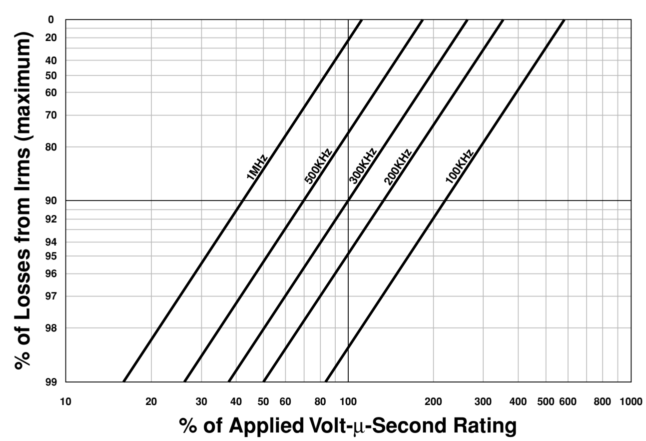


- **INDUCTANCE VS. CURRENT:**
  Inductance will fall off as DC Current is increased.
  (See Inductance vs. Current graph).
- **FREQUENCY RESPONSE:**
  Wide-band frequency response to 1 megaHertz.
- **CURRENT LIMITATION:**
  The maximum allowable currents are defined by the internal "hot-spot" temperatures which are limited to 130°C, including ambient.

OCTA-PAC® PLUS Typical Inductance vs. DC Current



OCTA-PAC® PLUS Winding Loss Derating with Core Loss



VERSA-PAC® Inductors and Transformers (Surface Mount)

RoHS 2002/95/EC

Description

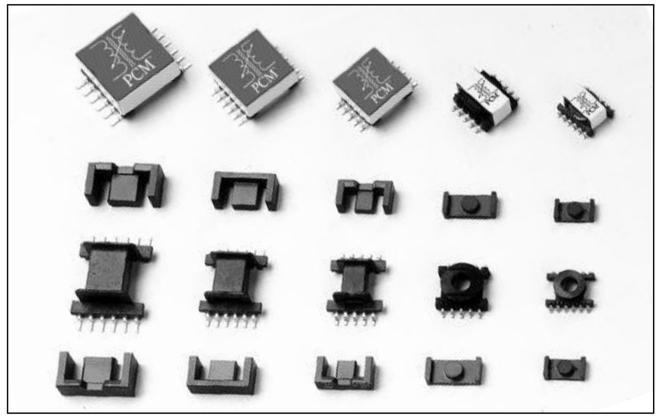
- Six winding, surface mount devices that offer more than 500 usable inductor or transformer configurations
- High power density and low profile
- Low radiated noise and tightly coupled windings
- Power range from 1 Watt – 70 Watts
- Frequency range to over 1MHz
- 500 VAC Isolation
- Ferrite core material

Applications

- Inductors: buck, boost, coupled, choke, filter, resonant, noise filtering, differential, forward, common mode
- Transformers: flyback, feed forward, push-pull, multiple output, inverter, step-up, step-down, gate drive, base drive, wide band, pulse, control, impedance, isolation, bridging, ringer, converter, auto

Environmental Data

- Storage temperature range: -55°C to 125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific). The internal “hot spot” temperature defines the maximum allowable currents, which are limited to 130°C, including ambient
- Solder reflow temperature: +260°C max for 10 seconds max.



Packaging

- Supplied in tape and reel packaging, 600 (VP01), 300 (VP02), and 200 (VP03) per reel
- Supplied in bulk packaging (VP04 and VP05)
- VP04 & VP05 tape and reel packaging available. Please contact factory for details.

Part [1] Number	L(BASE) µH (NOM)[2]	ISAT(BASE) Amps (TYP)[3][4]	IRMS(BASE) Amps (TYP)[3][5]	R(BASE) Ohms (MAX)[6]	Volt-µSEC(BASE) µVs (MAX)[7]	EPEAK(BASE) µJ (TYP)[8]	Leakage Inductance (BASE) µH (TYP)	Thermal Resistance °C/Watt (TYP)[9]
VPH1-1400-R[10]	201.6 +/-30%	0.04	0.55	0.344	32.9	0.11	0.212	60.7
VP1-1400-R[10]	89.6 +/-30%	0.06	0.85	0.145	21.8	0.11	0.096	60.7
VPH1-0190-R	27.4 +/-20%	0.29	0.55	0.344	32.9	0.77	0.212	60.7
VP1-0190-R	12.2 +/-20%	0.43	0.85	0.145	21.8	0.77	0.096	60.7
VPH1-0102-R	14.7 +/-20%	0.53	0.55	0.344	32.9	1.45	0.212	60.7
VP1-0102-R	6.5 +/-20%	0.80	0.85	0.145	21.8	1.45	0.096	60.7
VPH1-0076-R	10.9 +/-20%	0.72	0.55	0.344	32.9	1.92	0.212	60.7
VP1-0076-R	4.9 +/-20%	1.06	0.85	0.145	21.8	1.92	0.096	60.7
VPH1-0059-R	8.5 +/-20%	0.92	0.55	0.344	32.9	2.48	0.212	60.7
VP1-0059-R	3.8 +/-20%	1.37	0.85	0.145	21.8	2.48	0.096	60.7
VPH2-1600-R[10]	160 +/-30%	0.07	0.95	0.159	48.3	0.29	0.165	44.0
VP2-1600-R[10]	78.4 +/-30%	0.10	1.26	0.090	33.7	0.29	0.083	44.0
VPH2-0216-R	21.6 +/-20%	0.53	0.95	0.159	48.3	2.11	0.165	44.0
VP2-0216-R	10.6 +/-20%	0.76	1.26	0.090	33.7	2.11	0.083	44.0
VPH2-0116-R	11.6 +/-20%	0.99	0.95	0.159	48.3	3.94	0.165	44.0
VP2-0116-R	5.7 +/-20%	1.41	1.26	0.090	33.7	3.94	0.083	44.0
VPH2-0083-R	8.3 +/-20%	1.39	0.95	0.159	48.3	5.47	0.165	44.0
VP2-0083-R	4.1 +/-20%	1.95	1.26	0.090	33.7	5.47	0.083	44.0
VPH2-0066-R	6.6 +/-20%	1.74	0.95	0.159	48.3	7.01	0.165	44.0
VP2-0066-R	3.2 +/-20%	2.50	1.26	0.090	33.7	7.01	0.083	44.0
VPH3-0780-R[10]	132 +/-30%	0.07	0.97	0.14	39.8	0.24	0.125	43.4
VP3-0780-R[10]	63.2 +/-30%	0.10	1.47	0.061	27.7	0.24	0.058	43.4
VPH3-0138-R	23.3 +/-20%	0.41	0.97	0.14	39.8	1.36	0.125	43.4
VP3-0138-R	11.2 +/-20%	0.59	1.47	0.061	27.7	1.36	0.058	43.4
VPH3-0084-R	14.2 +/-20%	0.67	0.97	0.14	39.8	2.23	0.125	43.4
VP3-0084-R	6.8 +/-20%	0.97	1.47	0.061	27.7	2.23	0.058	43.4
VPH3-0055-R	9.3 +/-20%	1.02	0.97	0.14	39.8	3.38	0.125	43.4
VP3-0055-R	4.5 +/-20%	1.46	1.47	0.061	27.7	3.38	0.058	43.4
VPH3-0047-R	7.94 +/-20%	1.19	0.97	0.14	39.8	4.00	0.125	43.4
VP3-0047-R	3.8 +/-20%	1.73	1.47	0.061	27.7	4.00	0.058	43.4

Part [1] Number	L(BASE) µH (NOM)[2]	ISAT(BASE) Amps (TYP)[3][4]	IRMS(BASE) Amps (TYP)[3][5]	R(BASE) Ohms (MAX)[6]	Volt-µSEC(BASE) µVs (MAX)[7]	EPEAK(BASE) µJ (TYP)[8]	Leakage Inductance (BASE) µH (TYP)	Thermal Resistance °C/Watt (TYP)[9]
VPH4-0860-R[10]	159.65 +/-30%	0.11	1.41	0.0828	64.6	0.57	0.156	39.4
VP4-0860-R[10]	87.0 +/-30%	0.15	1.70	0.057	44.7	0.57	0.075	39.4
VPH4-0140-R	23.7 +/-20%	0.65	1.41	0.0828	64.6	3.54	0.156	39.4
VP4-0140-R	11.3 +/-20%	0.95	1.70	0.057	44.7	3.54	0.075	39.4
VPH4-0075-R	12.7 +/-20%	1.21	1.41	0.0828	64.6	6.55	0.156	39.4
VP4-0075-R	6.1 +/-20%	1.75	1.70	0.057	44.7	6.55	0.075	39.4
VPH4-0060-R	10.1 +/-20%	1.52	1.41	0.0828	64.6	8.16	0.156	39.4
VP4-0060-R	4.9 +/-20%	2.18	1.70	0.057	44.7	8.16	0.075	39.4
VPH4-0047-R	7.94 +/-20%	1.94	1.41	0.0828	64.6	10.52	0.156	39.4
VP4-0047-R	3.8 +/-20%	2.81	1.70	0.057	44.7	10.52	0.075	39.4
VPH5-1200-R[10]	173 +/-30%	0.14	1.70	0.0711	98.4	1.11	0.235	30.3
VP5-1200-R[10]	76.8 +/-30%	0.20	2.08	0.047	65.6	1.11	0.105	30.3
VPH5-0155-R	22.3 +/-20%	1.05	1.70	0.0711	98.4	8.83	0.235	30.3
VP5-0155-R	9.9 +/-20%	1.60	2.08	0.047	65.6	8.83	0.105	30.3
VPH5-0083-R	12 +/-20%	1.96	1.70	0.0711	98.4	16.07	0.235	30.3
VP5-0083-R	5.3 +/-20%	2.95	2.08	0.047	65.6	16.07	0.105	30.3
VPH5-0067-R	9.65 +/-20%	2.43	1.70	0.0711	98.4	19.83	0.235	30.3
VP5-0067-R	4.3 +/-20%	3.63	2.08	0.047	65.6	19.83	0.105	30.3
VPH5-0053-R	7.63 +/-20%	3.07	1.70	0.0711	98.4	25.10	0.235	30.3
VP5-0053-R	3.4 +/-20%	4.59	2.08	0.047	65.6	25.10	0.105	30.3

(1) The first three digits in the part number signify the size of the package. The next four digits specify the A_L, or nanoHenries per turn squared.

(2) L_{BASE} = Nominal Inductance of a single winding.

(3) I_{BASE} is the lessor of $I_{SAT(BASE)}$ and $I_{RMS(BASE)}$.

(4) Peak current that will result in 30% saturation of the core. This current value assumes that equal current flows in all six windings. For applications in which all windings are not simultaneously driven (i.e. flyback, SEPIC, Cuk, etc.), the saturation current per winding may be calculated as follows:

$$I_{SAT} = \frac{6 \text{ x } I_{SAT(BASE)}}{\text{Number of Windings Driven}}$$

(5) RMS Current that results in a surface temperature of approximately 40°C above ambient. The 40°C rise occurs when the specified current flows through each of the six windings.

(6) Maximum DC Resistance of each winding.

(7) For multiple windings in series, the volt-µsecond$_{TOTAL}$ (µVs) capability varies as the number of windings in series (S):

$$\text{Volt-µsec}_{TOTAL} = S \text{ x Volt-µsec}_{(BASE)}$$

For multiple windings in parallel, the volt-µsecond$_{TOTAL}$ (µVs) capability is as shown in the table above.

(8) Maximum Energy capability of each winding. This is based on 30% saturation of the core:

$$\text{Energy}_{SERIES} = S^2 \text{ x } \frac{1}{2} \text{ x } 0.7L_{BASE} \text{ x } I^2_{SAT(BASE)}$$

$$\text{Energy}_{PARALLEL} = P^2 \text{ x } \frac{1}{2} \text{ x } 0.7L_{BASE} \text{ x } I^2_{SAT(BASE)}$$

For multiple windings, the energy capability varies as the square of the number of windings. For example, six windings (either parallel or series) can store 36 times more energy than one winding.

(9) Thermal Resistance is the approximate surface temperature rise per Watt of heat loss under still-air conditions. Heat loss is a combination of core loss and wire loss. The number assumes the underlying PCB copper area equals 150% of the component area.

(10) These devices are designed for feed-forward applications, where load current dominates magnetizing current.

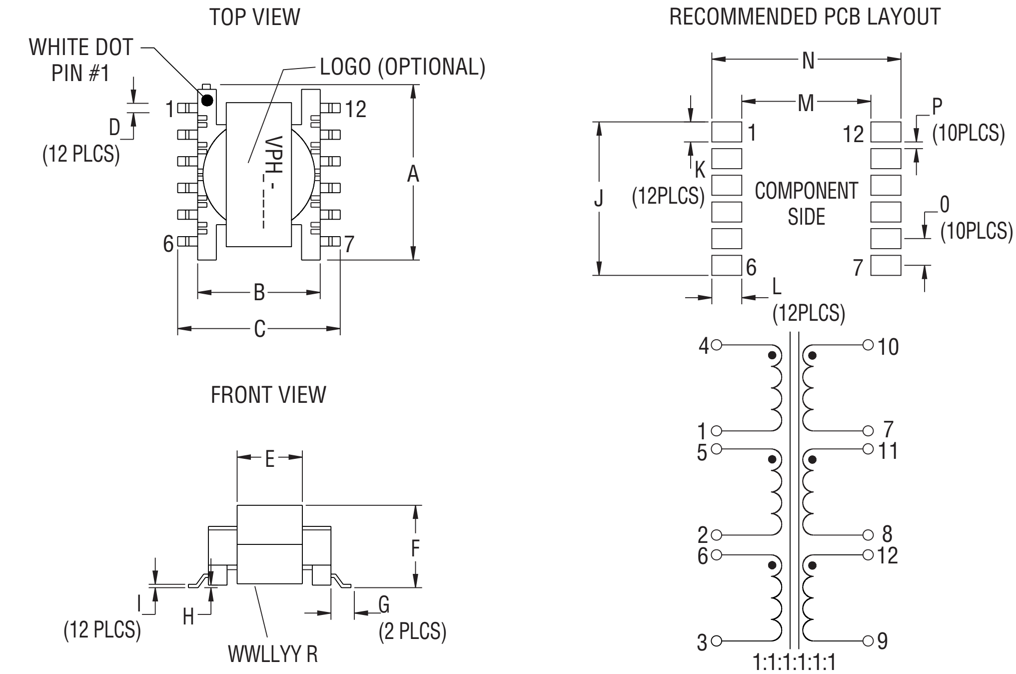
VERSA-PAC temperature rise depends on total power losses and size. Any other **PCM** configurations other than those suggested could run hotter than acceptable.

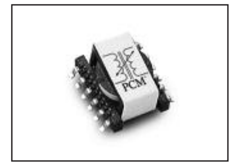
Certain topologies or applications must be analyzed for needed requirements and matched with the best **VERSA-PAC** size and configuration. Proper consideration must be used with all parameters, especially those associated with current rating, energy storage, or maximum volt-seconds.

VERSA-PAC should not be used in off-line or safety related applications. The breakdown voltage from one winding to any other winding is 500 VAC maximum.

Mechanical Diagrams

VP1 and VPH1



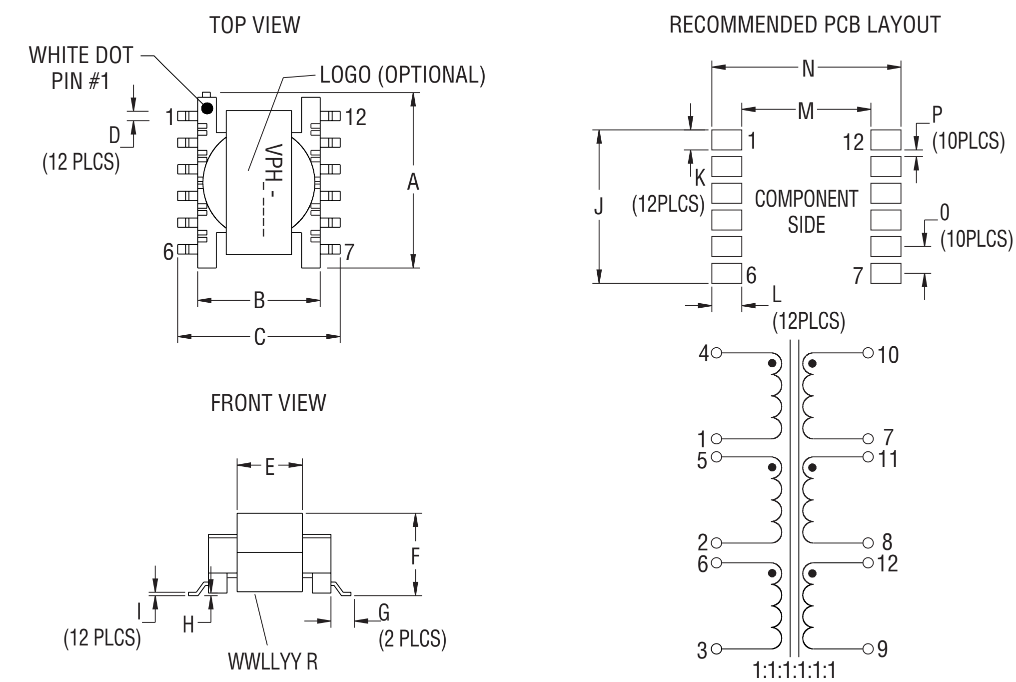


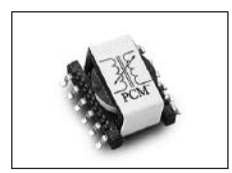
NOTES

1) Tolerances A - I are ± 0.25 mm unless specified otherwise.
2) Tolerances J - P are +/- 0.1 mm unless specified otherwise.
3) Marking as shown
   a) Dot for pin #1 identification
   b) On top of unit: -- VPHx-xxx (product code, size, 4 digit part number per family table.)
   c) On top of unit: Versa Pac Logo (optional)
   d) On bottom of unit: wwllyy = (date code) R = (revision level)
4) All soldering surfaces must be coplanar within 0.102 mm.

	A mm max	B mm ref	C mm max	D mm ref	E mm ref	F mm max	G mm ref	H mm ref	I mm ref	J mm ref	K mm	L mm	M mm ref	N mm max	O mm	P mm
VP1 and VPH1	12.9	9.2	13.0	0.7	5.9	6.2	1.5	0.1	0.25	11.5	1.5	2.25	9.7	14.2	2.0	0.5

VP2 and VPH2





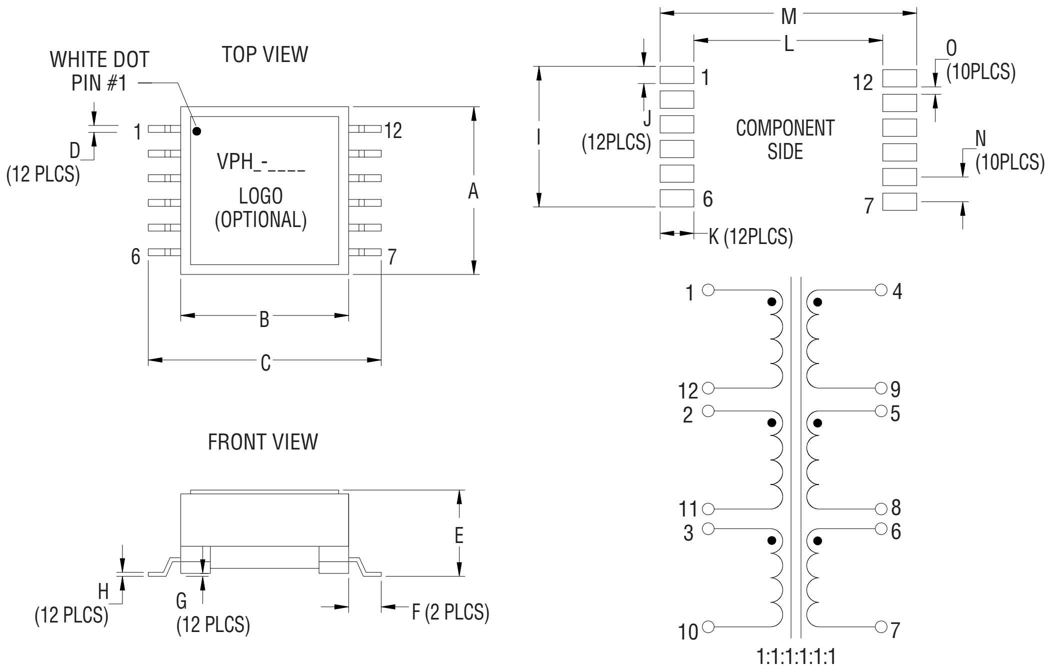
NOTES

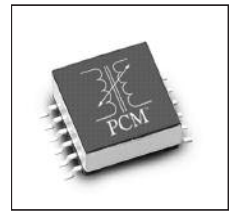
1) Tolerances A - I are ± 0.25 mm unless specified otherwise.
2) Tolerances J - P are +/- 0.1 mm unless specified otherwise.
3) Marking as shown
   a) Dot for pin #1 identification
   b) On top of unit: -- VPHx-xxx (product code, size, 4 digit part number per family table.)
   c) On top of unit: Versa Pac Logo (optional)
   d) On bottom of unit: wwllyy = (date code) R = (revision level)
4) All soldering surfaces must be coplanar within 0.102 mm.

	A mm max	B mm ref	C mm max	D mm ref	E mm ref	F mm max	G mm ref	H mm ref	I mm ref	J mm ref	K mm	L mm	M mm ref	N mm max	O mm	P mm
VP2 and VPH2	16.3	12.0	16.8	0.7	6.7	7.8	2.0	0.1	0.30	14.25	1.75	2.5	13.0	18.0	2.5	0.75

Mechanical Diagrams

VP3 and VPH3



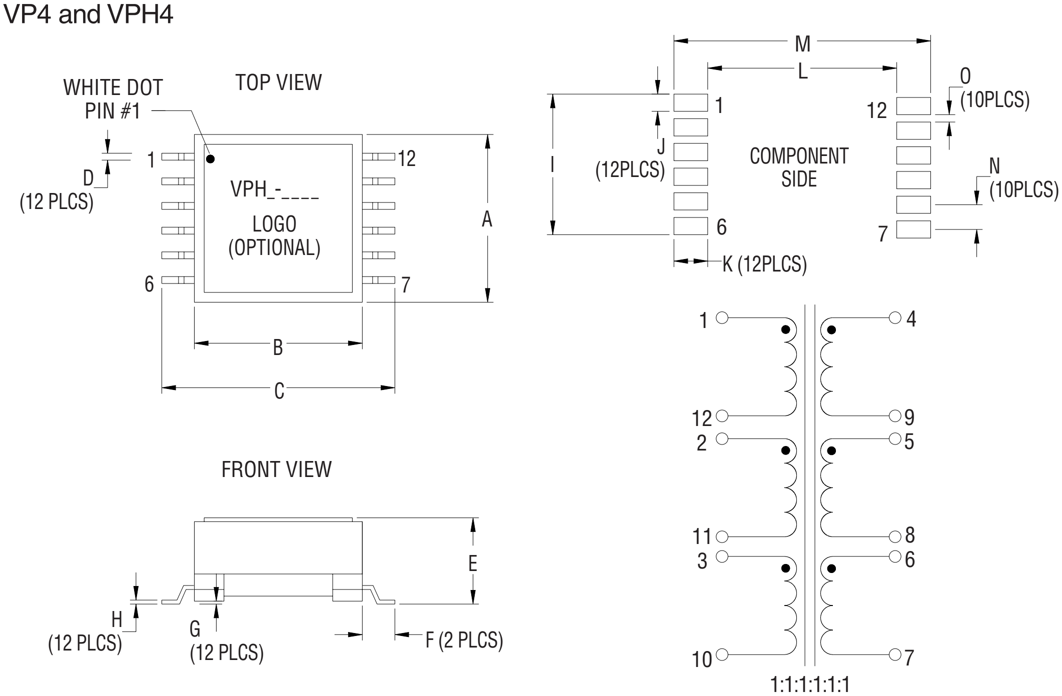


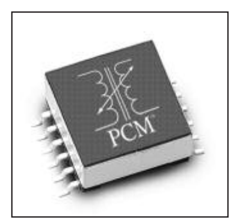
NOTES

1) Tolerances A - I are ± 0.25 mm unless specified otherwise.
2) Tolerances J - P are +/- 0.1 mm unless specified otherwise.
3) Marking as shown
   a) Dot for pin #1 identification
   b) On top of unit: -- VPHx-xxx (product code, size, 4 digit part number per family table.)
   c) On top of unit: Versa Pac Logo (optional)
   d) On bottom of unit: wwllyy = (date code) R = (revision level)
4) All soldering surfaces must be coplanar within 0.102 mm.

	A mm max	B mm ref	C mm max	D mm ref	E mm max	F mm ref	G mm ref	H mm ref	I mm ref	J mm	K mm	L mm ref	M mm max	N mm	O mm
VP3 and VPH3	17.1	16.0	22.3	0.7	8.4	3.0	0.1	0.4	14.49	1.79	3.43	16.88	23.74	2.54	0.75

VP4 and VPH4





NOTES

1) Tolerances A - I are ± 0.25 mm unless specified otherwise.
2) Tolerances J - P are +/- 0.1 mm unless specified otherwise.
3) Marking as shown
   a) Dot for pin #1 identification
   b) On top of unit: -- VPHx-xxx (product code, size, 4 digit part number per family table.)
   c) On top of unit: Versa Pac Logo (optional)
   d) On bottom of unit: wwllyy = (date code) R = (revision level)
4) All soldering surfaces must be coplanar within 0.102 mm.

	A mm max	B mm ref	C mm max	D mm ref	E mm max	F mm ref	G mm ref	H mm ref	I mm ref	J mm	K mm	L mm ref	M mm max	N mm	O mm
VP4 and VPH4	18.0	18.0	24.6	0.7	10.0	3.3	0.1	0.4	14.25	1.75	3.43	19.14	26.0	2.5	0.75

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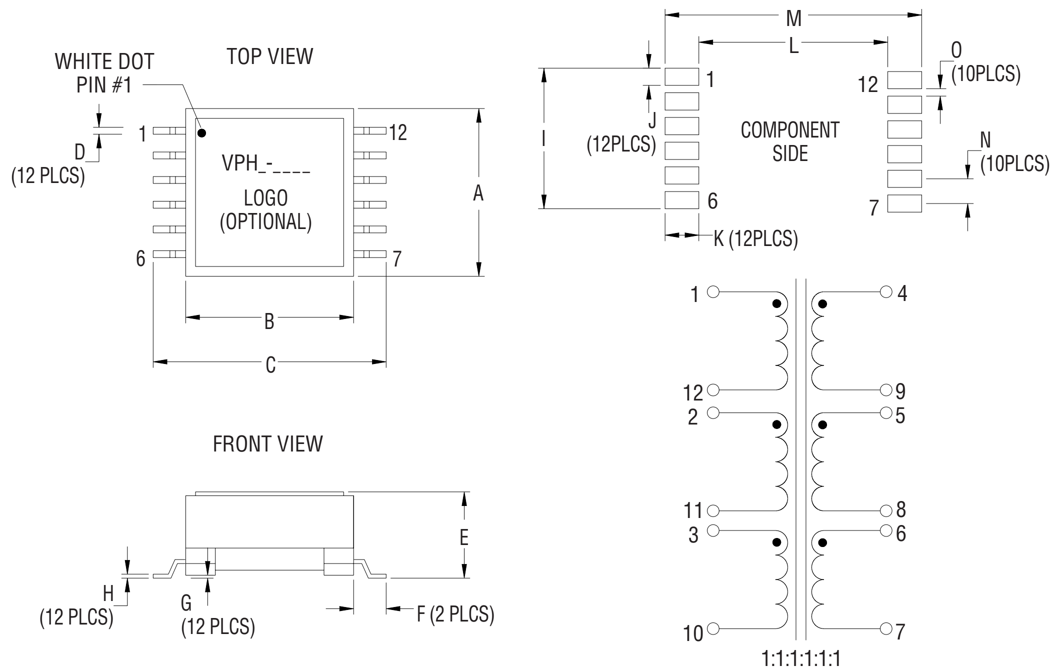
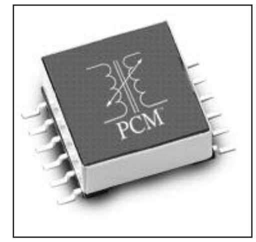
Mechanical Diagrams

VP5 and VPH5



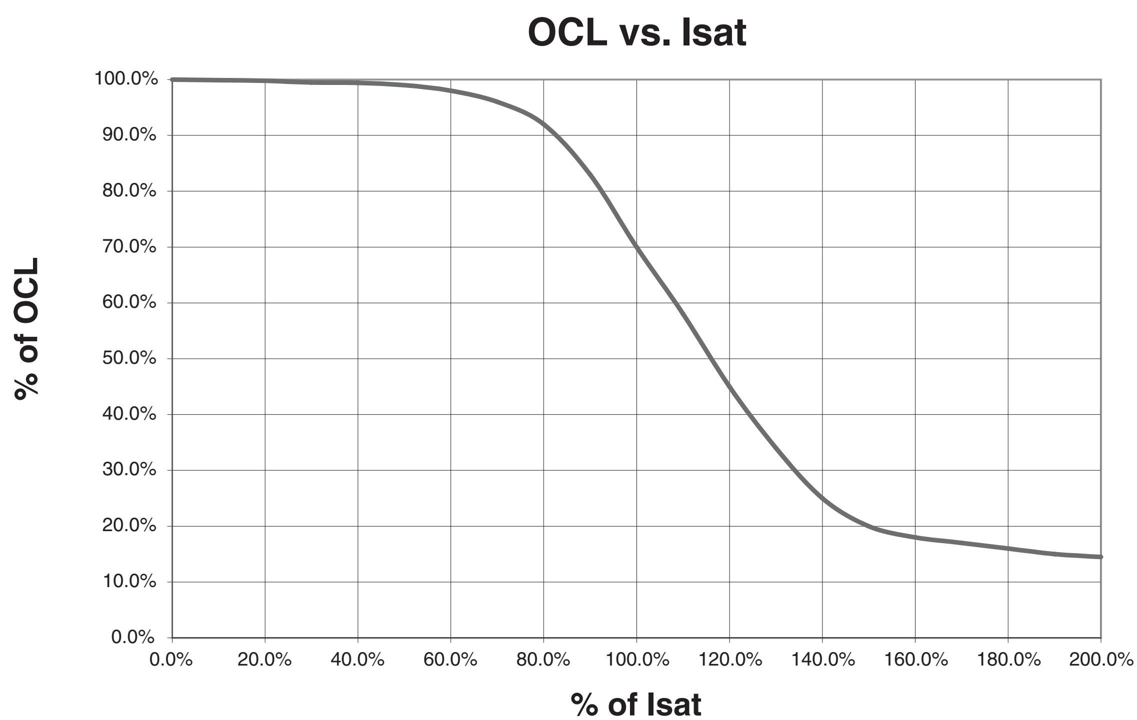


NOTES

1) Tolerances A - I are ± 0.25 mm unless specified otherwise.
2) Tolerances J - P are +/- 0.1 mm unless specified otherwise.
3) Marking as shown
   a) Dot for pin #1 identification
   b) On top of unit: -- VPHx-xxx (product code, size, 4 digit part number per family table.)
   c) On top of unit: Versa Pac Logo (optional)
   d) On bottom of unit: wwllyy = (date code) R = (revision level)
4) All soldering surfaces must be coplanar within 0.102 mm.

	A mm max	B mm ref	C mm max	D mm ref	E mm max	F mm ref	G mm ref	H mm ref	I mm ref	J mm	K mm	L mm ref	M mm max	N mm	O mm
VP5 and VPH5	21.0	21.0	28.5	0.7	10.8	2.95	0.1	0.4	17.25	2.25	3.15	22.7	29.0	3.0	0.75

Inductance Characteristics



HOW TO USE MULTIPLE WINDINGS

Discrete inductors combine like resistors, when connected in series or parallel. For example, inductors in series add and inductors in parallel reduce in a way similar to Ohm's Law.

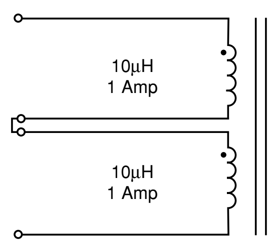
$$L_{Series} = L1 + L2 + L3...Ln$$

$$L_{Parallel} = 1/[1/L1 + 1/L2 + 1/L3....1/Ln]$$

Windings on the same magnetic core behave differently. Two windings in series result in four times the inductance of a single winding. This is because the inductance varies proportionately to the square of the turns.

Paralleled **VERSA-PAC** windings result in no change to the net inductance because the total number of turns remains unchanged; only the effective wire size becomes larger. Two parallel windings result in approximately twice the current carrying capability of a single winding. The net inductance of a given **PCM** configuration is based on the number of windings in series squared multiplied by the inductance of a single winding (L_{BASE}). The current rating of a **PCM** configuration is derived by multiplying the maximum current rating of one winding (I_{BASE}) by the number of windings in parallel. Examples of simple two-winding devices are shown below:

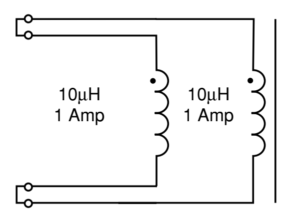
Series Connected (2 Windings)



$$L_{TOTAL} = L_{BASE} \times S^2 = 10\ \mu H \times 2^2 = 40\ \mu H$$

$$I_{MAX} = I_{BASE} \times P = 1\ Amp \times 1 = 1\ Amp$$

Parallel Connected (2 Windings)



$$L_{TOTAL} = L_{BASE} \times S^2 = 10\ \mu H \times 1^2 = 10\ \mu H$$

$$I_{MAX} = I_{BASE} \times P = 1\ Amp \times 2 = 2\ Amps$$

Where:

L_{BASE} = Inductance of a single winding

P = Number of windings in parallel (use 1 with all windings in series)

S = Number of windings in series

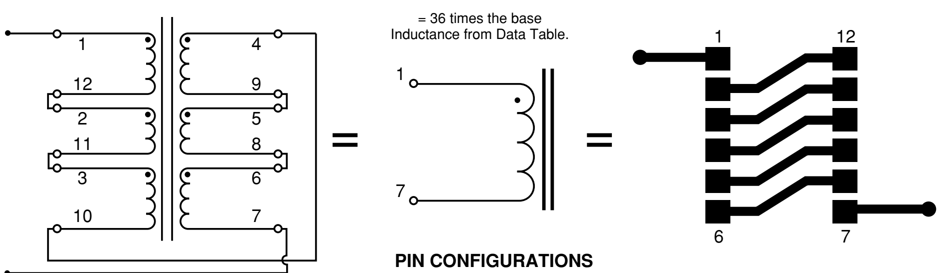
I_{BASE} = Maximum current rating of one winding

HOW TO PIN-CONFIGURE VERSA-PAC®

Each **VERSA-PAC** can be configured in a variety of ways by simply connecting pins together on the Printed Circuit Board (PCB). As shown below, the connections on the PCB are equal to the pin configuration statement shown at the bottom of the schematic symbol. Connecting a number of windings in parallel will increase the current carrying capability, while connecting in series will multiply the inductance. Each **VERSA-PAC** part can be configured in at least 6 combinations for inductor use or configured in at least 15 turns ratios for transformer applications. Given 25 **VERSA-PAC** part numbers, this allows for at least 500 magnetic configurations. The **PCM** configurations can either be created by the designer or simply chosen from the existing **PCM** diagrams. The following inductor example shows 6 windings in series, which result in an inductance of 36 times the base inductance and 1 times the base current.

INDUCTOR EXAMPLE
FOR SIZES VP3, VP4 AND VP5

$L_{TOTAL} = 36 \times L_{BASE}$

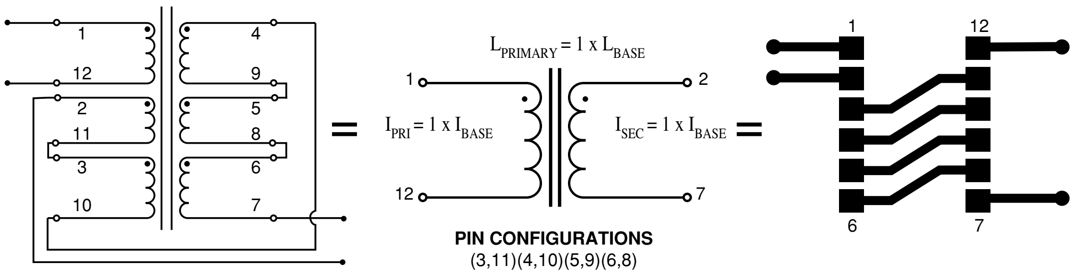


PIN CONFIGURATIONS
(2,12)(3,11)(4,10)(5,9)(6,8)

Each VERSA-PAC may be used in at least 15 transformer applications. More than 375 transformer combinations may be achieved using the available 25 VERSA-PAC parts.

TRANSFORMER EXAMPLE
FOR SIZES VP3, VP4 AND VP5

1:5



PIN CONFIGURATIONS
(3,11)(4,10)(5,9)(6,8)

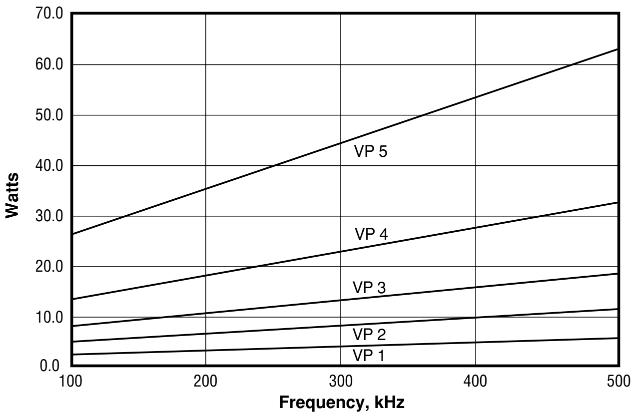
The PCM configurations may be selected from the examples on the following pages or created by the designer. Six PCM inductor and fifteen PCM transformer configurations and equivalent circuit schematics are shown. The printed circuit board layout in each example illustrates the connections to obtain the desired inductance or turns ratio. The examples may be used by the PCB designer to configure **VERSA-PAC** as desired.

To assist the designer, **VERSA-PAC** phasing, coupling and thermal issues have been considered in each of the PCM configurations illustrated. Additionally, the inductance and current ratings, as a function of the respective base values from the following Data Tables, are shown in each PCM example. Turns ratios are also given for each PCM Transformer shown.

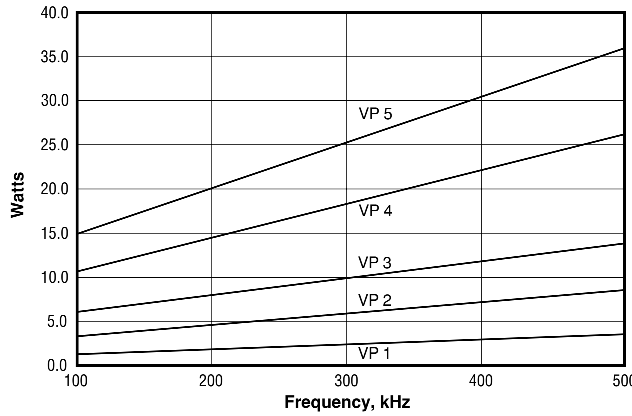
It is important to carefully select the proper **VERSA-PAC** part in order to minimize the component size without exceeding the RMS current capability or saturating the core. The Data Tables indicate maximum ratings.

VERSA-PAC® Performance Characteristics

Bipolar (Push-Pull) Power vs Frequency



Unipolar (Flyback) Power vs Frequency

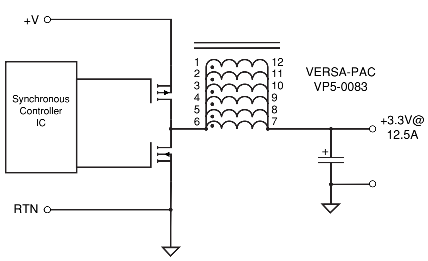


These curves represent typical power handling capability.
Indicated power levels may not be achievable with all configurations.

3.3V Buck Converter

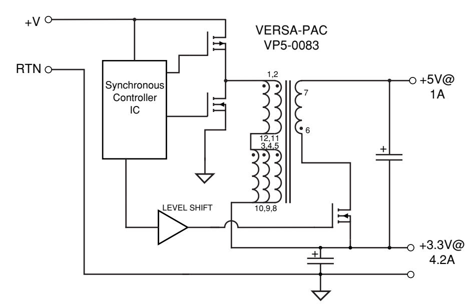
This circuit utilizes the gap of the VP5-0083 to handle the 12.5 Amp output current without saturating. In each of the five **VERSA-PAC** sizes, the gap is varied to achieve a selection of specific inductance and current values (see **VERSA-PAC** Data Table).

All six windings are connected in parallel to minimize AC/DC copper losses and to maximize heat dissipation. With **VERSA-PAC,** this circuit works well at or above 300 KHz. Also, the closed flux-path EFD geometry enables much lower radiation characteristics than open-path bobbin core style components.



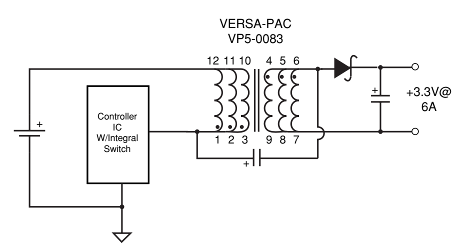
5V to 3.3V Buck Converter With 5V Output

This circuit minimizes both board space and cost by eliminating a second regulator. **VERSA-PAC**'s gap serves to prevent core saturation during the switch on-time and also stores energy for the +5V load which is delivered during the flyback interval. The +3.3V buck winding is configured by placing two windings in series while the +5V is generated by an additional flyback winding stacked on the 3.3V output. Extra windings are paralleled with primary windings to handle more current. The turns ratio of 2:1 adds 1.67V to the +3.3V during the flyback interval to achieve +5V.



LITHIUM-ION BATTERY TO 3.3V SEPIC CONVERTER

The voltage of a Lithium-Ion Battery varies above and below +3.3V depending on the degree of charge. The SEPIC configuration takes advantage of **VERSA-PAC**'s multiple tightly coupled windings. This results in lower ripple current which lowers noise and core losses substantially. The circuit does not require a snubber to control the voltage “spike” associated with switch turn-off, and is quite efficient due to lower RMS current in the windings.



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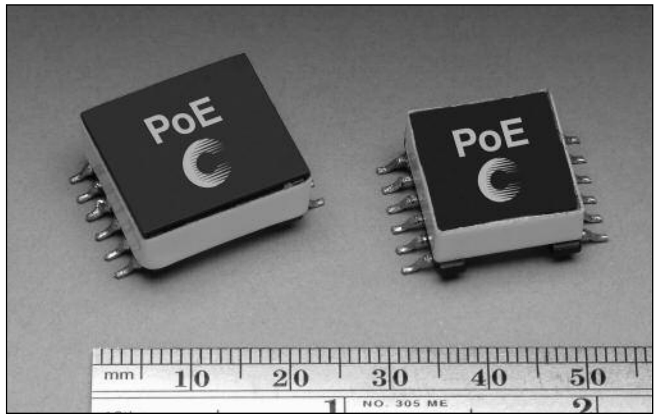
Power Over Ethernet (PoE)/PD Configurable Transformer



Description

RoHS 2002/95/EC

- Versatile design allows multiple output variations
- Flyback topology, 250Khz switching frequency
- Input range from 29.5-60V
- 1500VAC isolation between primary and secondary
- Three power levels 4, 7, and 13watts
- Low leakage inductance
- 11.0 Volt @ 0.10 Amp Feedback Winding
- Ferrite core material

Applications

- For IEEE 802.3af-compliant Power over Ethernet applications
- UPS, VoiP Phone, Wireless LAN Access point, Bluetooth Access point, Network Camera, Building Access Systems
- Retail Point-of-information systems
- Vending/Gaming Machines

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging

- Packaging Information: 4 and 7 Watts 200 parts per 13" reel, 13 Watts 140 parts per 13" reel

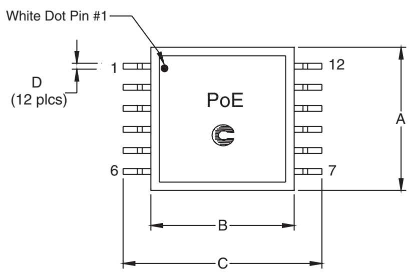
Part Number	Watts	Inductance (uH)	Output	DCR/PRI (ohms)	DCR/SEC (ohms)	Leakage Inductance (uH) typ.	Pri Current Pk (Adc)	Turn Ratio Schematic 1: Pins pri(3-1):fb(5-6):v1(12-7):v2(11-8):v3(10-9) Schematic 2: Pins pri(3-1):fb(5-6):v1(12-10):v2(11-9)	Schematic	Dimensions
PoE4W3x3.3-R	4	200	(3)x3.3V@0.45A	0.500	0.07	2.75	0.65	1 : 0.52 : 0.16 : 0.16 : 0.16 +/-1%	1	Size 1
PoE4W3x5.0-R	4	200	(3)x5.0V@0.30A	0.500	0.27	2.50	0.65	1 : 0.52 : 0.26 : 0.26 : 0.26 +/-1%	1	Size 1
PoE4W2x12-R	4	200	(2)x12.0V@0.20A	0.500	0.740	1.40	0.65	1 : 0.52 : 0.60 : 0.60 +/-1%	2	Size 1
PoE7W3x3.3-R	7	100	(3)x3.3V@0.75A	0.275	0.03	1.00	1.00	1 : 0.529 : 0.176 : 0.176 : 0.176 +/-1%	1	Size 1
PoE7W3x5.0-R	7	100	(3)x5.0V@0.50A	0.275	0.095	1.00	1.00	1 : 0.529 : 0.265 : 0.265 : 0.265 +/-1%	1	Size 1
PoE7W2x12-R	7	100	(2)x12.0V@0.30A	0.275	0.250	1.00	1.00	1 : 0.529 : 0.588 : 0.588 +/-1%	2	Size 1
PoE13W3x3.3-R	13	100	(3)x3.3V@1.35A	0.250	0.032	1.50	1.60	1 : 0.529 : 0.176 : 0.176 : 0.176 +/-3%	1	Size 2
PoE13W3x5.0-R	13	100	(3)x5.0V@0.90A	0.250	0.075	1.20	1.60	1 : 0.529 : 0.265 : 0.265 : 0.265 +/-3%	1	Size 2
PoE13W2x12-R	13	100	(2)x12.0V@0.60A	0.250	0.280	1.00	1.70	1 : 0.529 : 0.647 : 0.647 +/-3%	2	Size 2
Part Number	**Watts**	**Inductance (uH)**	**Output**	**DCR/PRI (ohms)**	**DCR/SEC V1/V2/V3**	**Leakage Inductance (uH) typ.**	**Pri Current Pk (Adc)**	**Turn Ratio Schematic 2: Pins pri(3-1):fb(5-6):v1(12-10):v2(11-9) Schematic 3: Pins pri(1-3):fb(5-6):v3(12-11):v2(8-7)**	**Schematic**	**Dimensions**
PoE13W3VERS-R	13	100	V1:7.0V@1.1A, V2:(1)x3.3V@1.1A, V3:1.8V@1.1A	0.250	0.025/0.042:0/085	1.00	1.70	1 : 0.529 : 0.350 : 0.176 : 0.088 +/-3%	3	Size 2
PoE13W2VERS-R	13	100	V1:5.0V@1.6A, V2:3.3V@1.6A	0.250	0.023/0.038/na	1.20	1.70	1 : 0.529 : 0.265 : 0.176 +/-3%	2	Size 2

1) Test Parameters: 100kHz, 0.100 Vrms, 0.0Adc
2) DCR limits maximum @ 20°C
3) Leakage Inductance 200kHz, 0.01Vrms, 0.0Adc
4) Feedback DCR 1.0 Ohms maximum @20°C

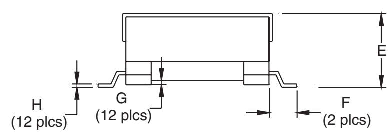
Power Over Ethernet (PoE)/PD Configurable Transformer

Mechanical Diagrams

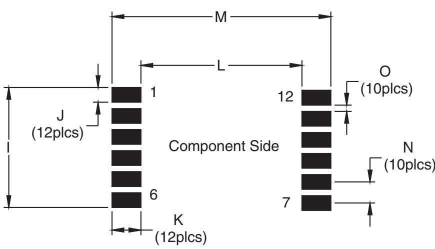
TOP VIEW



FRONT VIEW



RECOMMENDED PCB LAYOUT



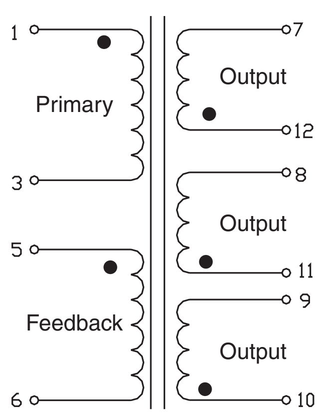
DIMENSIONS

	A mm max.	B mm ref.	C mm max.	D mm ref.	E mm max.	F mm ref.	G mm ref.	H mm ref.	I mm ref.	J mm	K mm	L mm ref.	M mm max.	N mm	O mm
Size 1	17.1	16.0	22.3	0.7	8.4	3.0	0.1	0.4	14.49	1.79	3.43	16.88	23.74	2.54	0.75
Size 2	18.0	18.0	24.6	0.7	10.0	3.3	0.1	0.4	14.25	1.75	3.43	19.14	26.0	2.5	0.75

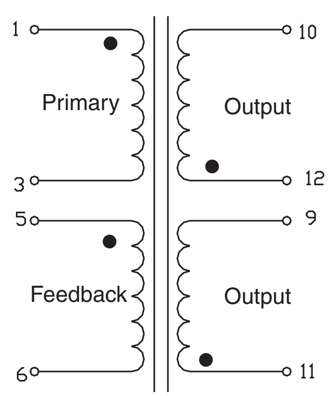
1) Tolerances A - H are ± 0.25mm unless specified otherwise.
2) Tolerances I - O are ± 0.10mm unless specified otherwise
2) All soldering surfaces are coplaner to within ± 0.102mm.

Schematic Diagrams

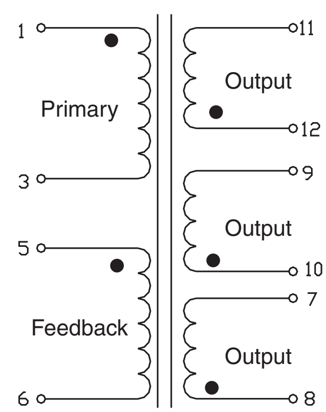
SCHEMATIC 1



SCHEMATIC 2

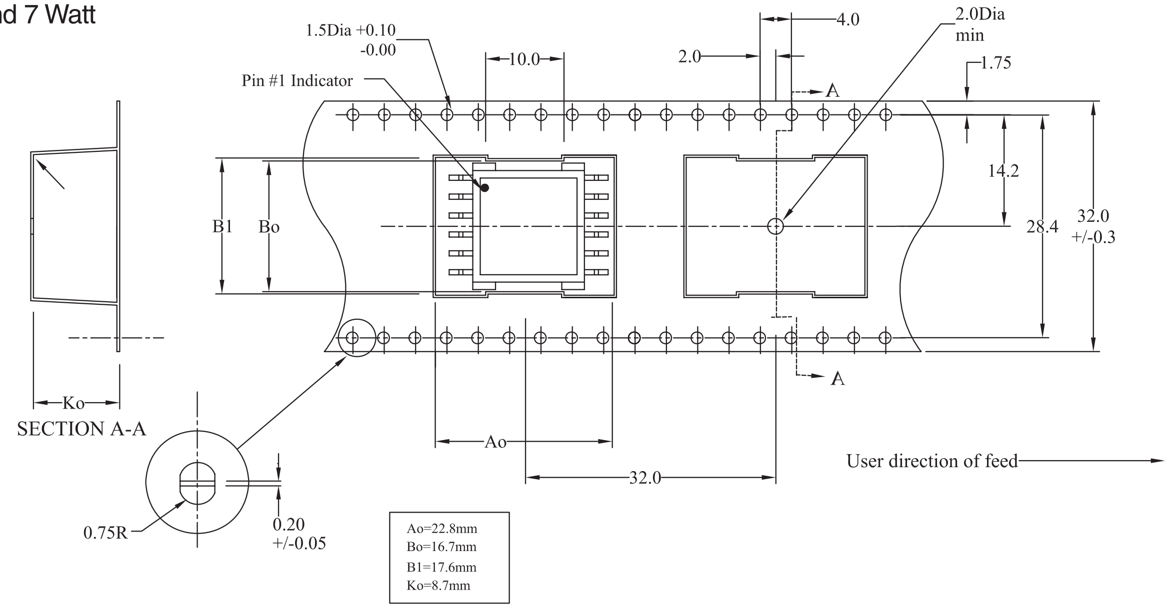


SCHEMATIC 3

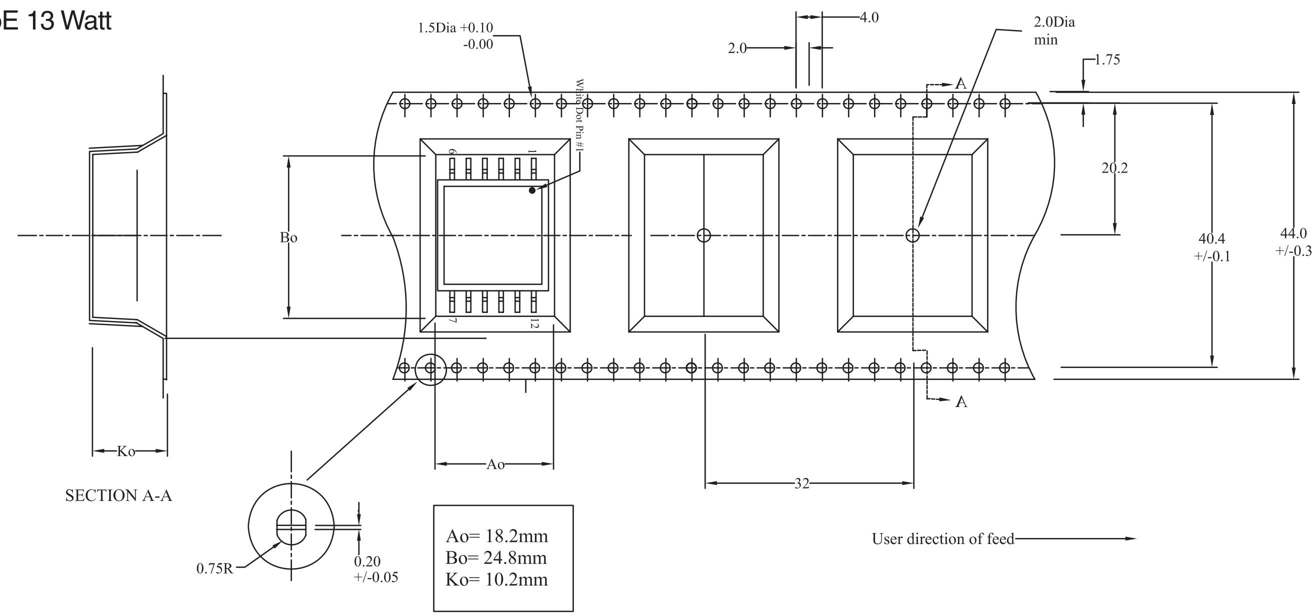


Mechanical Diagrams

PoE 4 and 7 Watt



PoE 13 Watt



COILTRONICS®

COOPER Bussmann

Power Over Ethernet (PoE)/PD Configurable Transformer

RoHS 2002/95/EC

Description

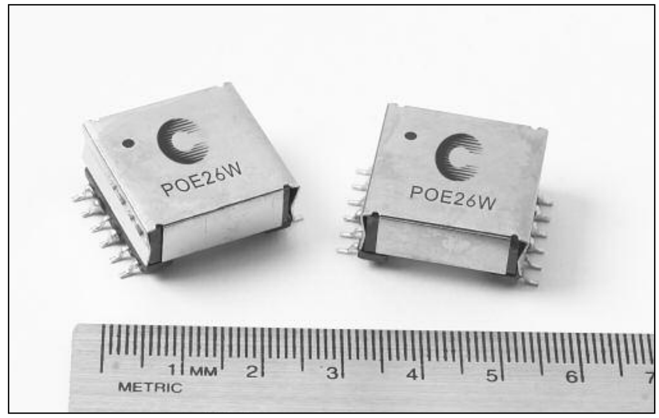
- Versatile design allows multiple output variations
- Forward topology, 300Khz switching frequency
- Input range from 29.5-60V
- 1500VAC isolation between primary and secondary
- Power 26watts
- Low leakage inductance

Applications

- For IEEE 802.3af-compliant Power over Ethernet applications
- UPS, VoiP Phone, Wireless LAN Access point, Bluetooth Access point, Network Camera, Building Access Systems
- Retail Point-of-information systems
- Vending/Gaming Machines

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific)
- Solder reflow temperature: +260°C max. for 10 seconds maximum



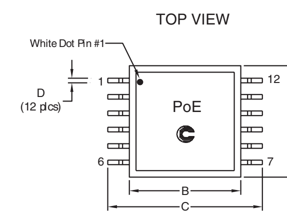
Packaging

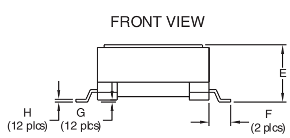
- Packaging information: 115 parts per 13" reel

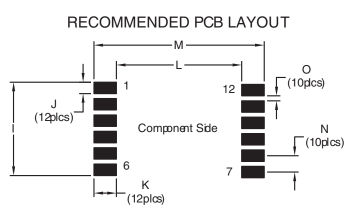
Part Number	Watts	Primary Induct. (uH)	Output	Bias	Sync	DCR/ Pri (ohms) max	DCR/ Sec (ohms) max	DCR/ Bias (ohms) max	DCR/ Sync (ohms) max	Leakage Induct. (uh) typ.	Pri Current Pk (Adc)	Turns ratio pins Pri (2 - 4): V1 (12 - 10): V2 (11 - 9): Bias (1 - 6): Sync (7 - 8)
PoE26W3.3VS5-R	26	160	(2)x3.3V@4.0A	10.0V@0.1A	5V@0.1A	0.100	0.025	0.90	0.42	1.0	2.6	1:0.29:0.29:0.83:0.42 +/-2%
PoE26W3.3VS10-R	26	160	(2)x3.3V@4.0A	10.0V@0.1A	10V@0.1A	0.100	0.025	0.90	0.90	1.0	2.6	1:0.29:0.29:0.83:0.83 +/-2%
PoE26W5V-R	26	160	(2)x5.0V@2.6A	10.0V@0.1A	5.0V@0.1A	0.100	0.050	0.90	0.42	1.0	2.6	1:0.42:0.42:0.83:0.42 +/-2%

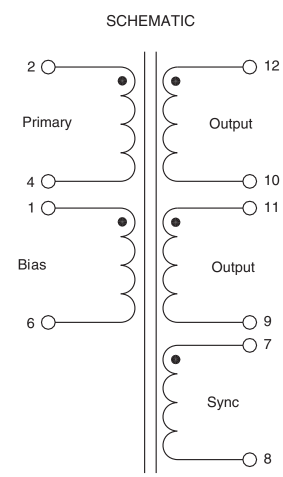
(1) Test parameters: 100kHz, 0.100Vrms, 0.0Adc
(2) DCR limits maximum @ 20°C
(3) Leakage Inductance 300kHz, 0.01Vrms, 0.0Adc

Mechanical Diagram







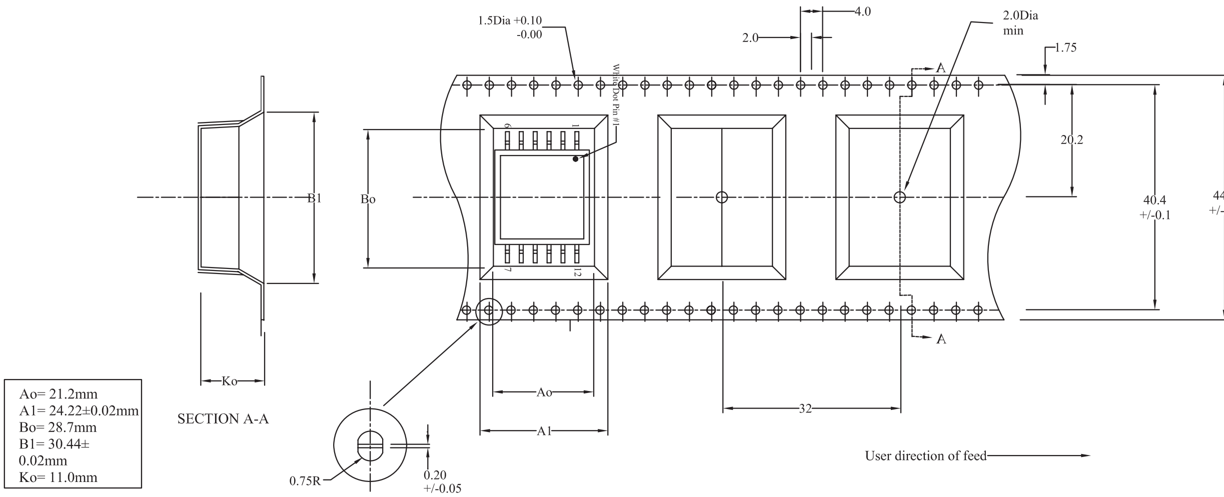


DIMENSIONS

	A mm max.	B mm ref.	C mm max.	D mm ref.	E mm max.	F mm ref.	G mm ref.	H mm ref.	I mm ref.	J mm	K mm	L mm ref.	M mm max.	N mm	O mm
	21.5	22.0	28.5	0.7	10.8	2.95	0.1	0.4	17.25	2.25	3.15	23.2	29.5	3.0	0.75

1) Tolerances A - H are ± 0.25mm unless specified otherwise.
2) Tolerances I - O are ± 0.10mm unless specified otherwise
2) All soldering surfaces are coplaner to within ± 0.102mm.

Packaging Information



CCFL TRANSFORMERS
Cold Cathode Fluorescent Lamp Inverter Transformers

COOPER Bussmann

Description

RoHS 2002/95/EC

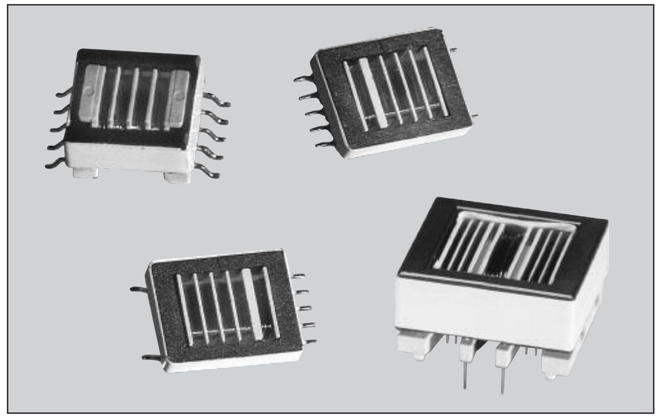
- Transformers for use in CCFL power supplies, available in through-hole and surface mount recess or gull wing versions, incorporating floating or fixed secondary technology
- Supply output current up to 30 milli-Amps
- Frequency range from 40 to 80 KHz
- Deliver output power from 2.5 to 14 Watts
- Operate in royer and other topologies
- Ferrite core material

Applications

- CCFL power supplies

Environmental Data

- Storage temperature range: -40°C to +85°C
- Operating ambient temperature range: 0°C to +70°C
- Solder reflow temperature: +260°C max. for 10 seconds max.



Packaging

- Supplied in bulk packaging

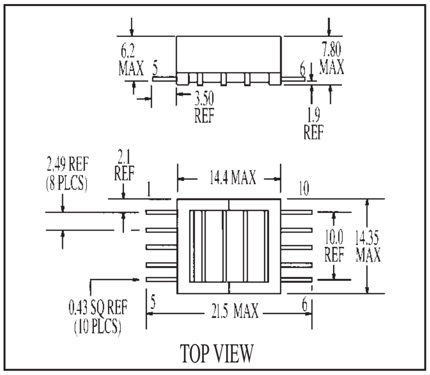
Part Number	Schematic Diagram	Pout Watts	Lp µH[1]	DCRp Ohms Max	DCRs Ohms Max	TR Ns/Np	Vpri Volts Max[2]	Vsec Volts Max[2]	Is Max A rms	Vpri Abnormal[3]	Vsec Abnormal[3]	Mechanical Dimensions	PCB Pad Layout
2.5 WATT VERSIONS													
CTX110652-R	A	2.5	43	0.220	285	67	20	1340	.005	30	2000	A	A
CTX110655-R	B	2.5	43	0.220	285	67	20	1340	.005	30	2000	A	A
CTX110657-R	B	2.5	26	0.212	285	86	15	1340	.005	23	2000	A	A
CTX110659-R	B	2.5	19	0.190	285	100	13	1340	.005	23	2000	A	A
CTX210652-R	A	2.5	43	0.220	285	67	20	1340	.005	30	2000	B	B
CTX210655-R	B	2.5	43	0.220	285	67	20	1340	.005	30	2000	B	B
CTX210657-R	B	2.5	26	0.212	285	86	15	1340	.005	23	2000	B	B
CTX210659-R	B	2.5	19	0.190	285	100	13	1340	.005	23	2000	B	B
4 WATT VERSIONS													
CTX210403-R	C	4	44	0.220	165	50	26	1340	.007	40	2000	C	C
CTX210407-R	C	4	27	0.160	220	86	15	1340	.007	23	2000	C	C
CTX210409-R	C	4	20	0.160	220	100	13	1340	.007	23	2000	C	C
CTX210411-R	C	4	20	0.160	330	125	10	1340	.007	16	2000	C	C
CTX310403-R	C	4	44	0.220	165	50	26	1340	.007	40	2000	D	D
CTX310407-R	C	4	27	0.160	220	86	15	1340	.007	23	2000	D	D
CTX310409-R	C	4	20	0.160	220	100	13	1340	.007	23	2000	D	D
CTX310411-R	C	4	20	0.160	330	125	10	1340	.007	16	2000	D	D
6 WATT VERSIONS													
CTX110600-R	D	6	44	0.160	176	67	20	1340	.011	30	2000	E	E
CTX110603-R	C	6	44	0.160	132	50	26	1340	.011	40	2000	E	E
CTX110605-R	C	6	44	0.160	176	67	20	1340	.011	30	2000	E	E
CTX110607-R	C	6	27	0.132	176	86	15	1340	.011	23	2000	E	E
CTX110609-R	C	6	20	0.132	176	100	13	1340	.011	23	2000	E	E
CTX110611-R	C	6	20	0.132	291	125	11	1340	.011	16	2000	E	E
CTX210600-R	D	6	44	0.160	176	67	20	1340	.011	30	2000	F	C
CTX210603-R	C	6	44	0.160	132	50	26	1340	.011	40	2000	F	C
CTX210605-R	C	6	44	0.160	176	67	20	1340	.011	30	2000	F	C
CTX210607-R	C	6	27	0.132	176	86	15	1340	.011	23	2000	F	C
CTX210609-R	C	6	20	0.132	176	100	13	1340	.011	23	2000	F	C
CTX210611-R	C	6	20	0.132	291	125	11	1340	.011	16	2000	F	C
14 Watt Versions													
CTX410805-R	E	14	24	0.030	262	67	20	1340	.030	30	2000	G	F
CTX410807-R	E	14	16	0.024	272	86	15	1340	.030	23	2000	G	F
CTX410809-R	E	14	16	0.024	314	100	13	1340	.030	23	2000	G	F

[1] Inductances are nominal values [2] Continuous RMS Voltage [3] Maximum Instantaneous RMS Voltage

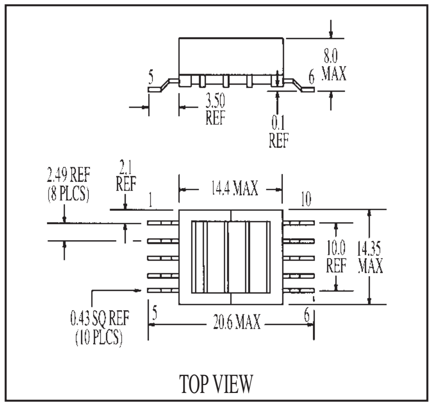
Mechanical Diagrams

2.5 Watt Versions

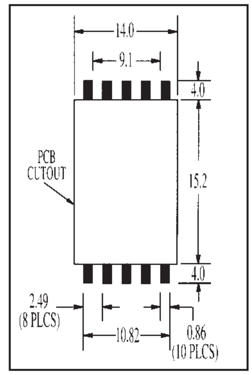
Mechanical A



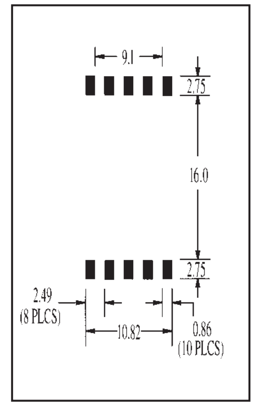
Mechanical B



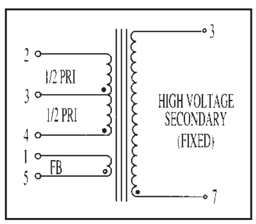
Pad Layout A



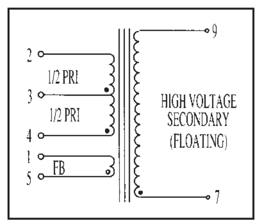
Pad Layout B



Schematic A



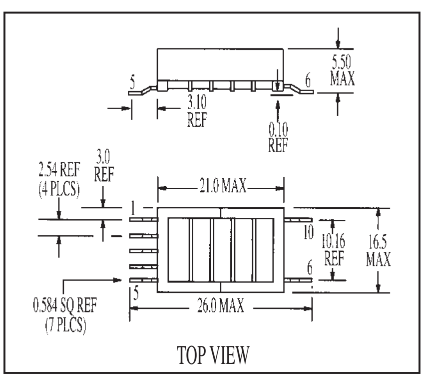
Schematic B



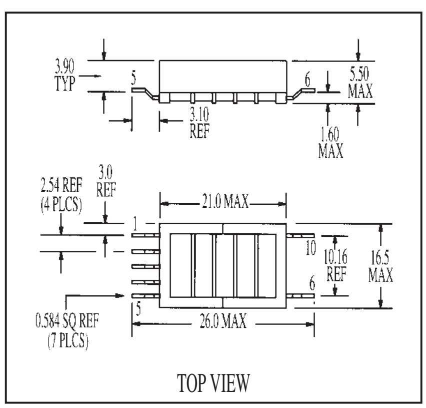
Dimensions are in millimeters

4 Watt Versions

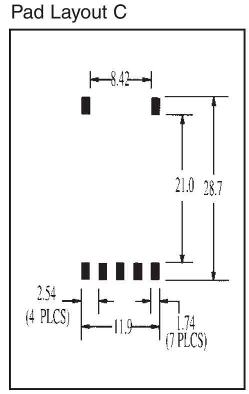
Mechanical C



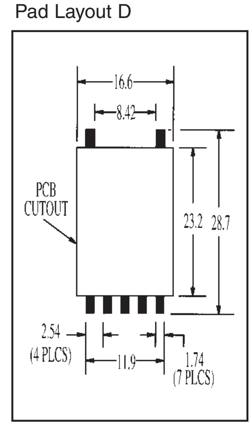
Mechanical D



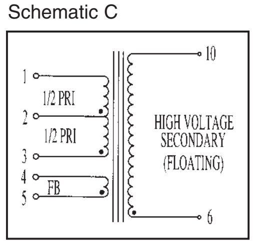
Pad Layout C



Pad Layout D



Schematic C



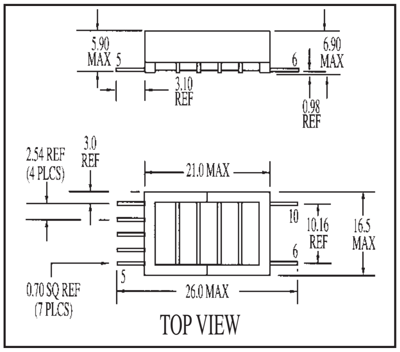
Dimensions are in millimeters

COOPER Bussmann

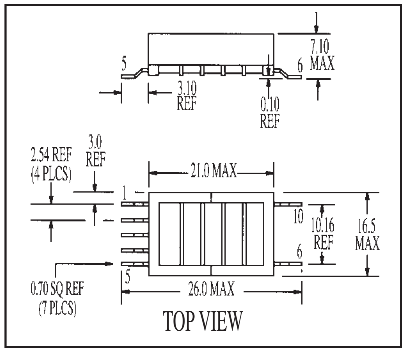
Mechanical Diagrams

6 Watt Versions

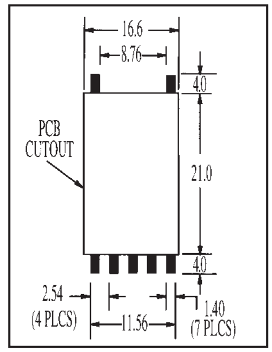
Mechanical E



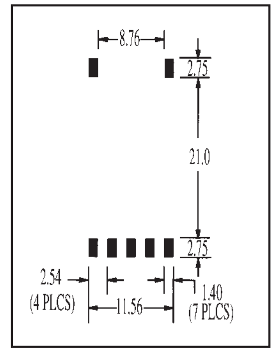
Mechanical F



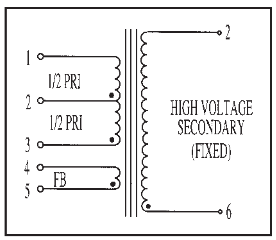
Pad Layout E



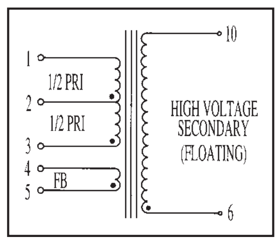
Pad Layout C



Schematic D



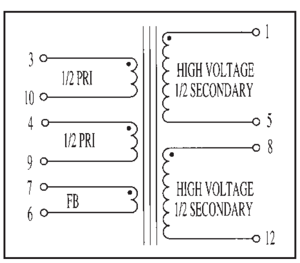
Schematic C



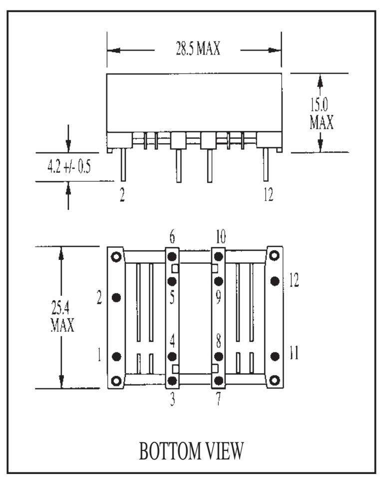
Dimensions are in millimeters

14 Watt Versions

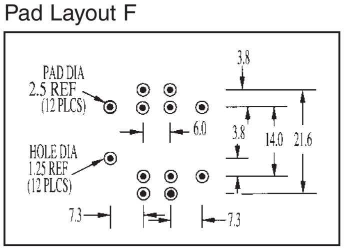
Schematic E



Mechanical G



Pad Layout F



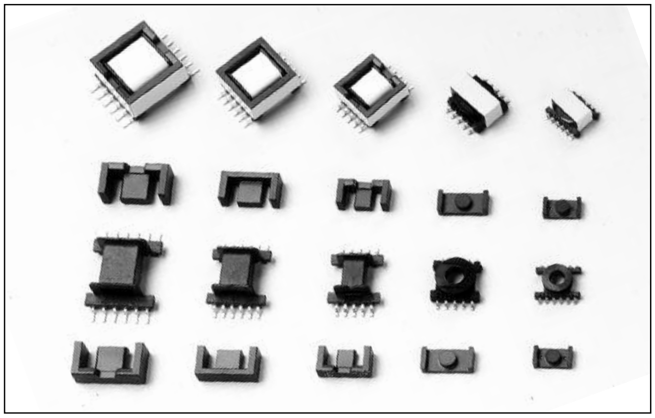
Dimensions are in millimeters

COILTRONICS®

COOPER Bussmann

STANDARD GEOMETRIES
Low Cost Magnetic Components

RoHS 2002/95/EC



Description

- Low cost magnetic components for custom specifications
- Power range from 1 Watt to 120 Watts
- Frequency range from 20kHz to .5MHz
- High power density and low radiated noise
- Meets UL 94V-0 flammability standard
- Ferrite core material

Applications

- Inductors: buck, boost, coupled, choke, filter, resonant, noise filtering, differential, forward, common mode
- Transformers: flyback, feed forward, push-pull, multiple output, inverter, step-up, step-down, gate drive, base drive, wide band, pulse, control, impedance, isolation, bridging, ringer, converter, auto

Environmental Data

- Storage temperature range: -55°C to +125°C
- Operating ambient temperature range: -40°C to +85°C (range is application specific). The internal “hot spot” temperature defines the maximum allowable currents, which are limited to 130°C, including ambient
- Solder reflow temperature: +260°C max. for 10 seconds max.

Packaging

- Supplied in tape and reel packaging (SG01, SG02, SG03, SG06 and SG07)
- Supplied in bulk packaging (SG04, SG05, SG08 and SG09)
- Consult the factory for SG04 and SG05 tape and reel packaging

STANDARD GEOMETRIES SIZES 1 TO 5 CORE AND BOBBIN PARAMETERS

Specifications	SG1	SG2	SG3	SG4	SG5
Core	ER 11/5	ER 14.5/6	EFD 15	EFD 17	EFD 20
AL-1, nH/T^2	1400	1600	780	1028	1200
AL-2, nH/T^2	190	216	138	140	155
AL-3, nH/T^2	102	116	84	75	83
AL-4, nH/T^2	76	83	55	60	67
AL-5, nH/T^2	59	66	47	47	53
Ae, min. core area, cm^2	0.0900	0.1520	0.1220	0.1960	0.3100
le, mag. path lgth., cm	1.46	1.90	3.40	4.12	4.70
Ve, core volume, cm^3	0.170	0.330	0.510	0.940	1.460
MLT, ave. turn length, cm	2.1666	2.7051	2.6805	3.2202	3.8359
Wa, usable wdg. area, cm^2 *	0.0171	0.0302	0.0915	0.1051	0.1441
WaAc, cm^4	0.0015	0.0046	0.0112	0.0206	0.0447
UL flammability rating	94V-0	94V-0	94V-0	94V-0	94V-0

STANDARD GEOMETRIES SIZES 6 TO 9 CORE AND BOBBIN PARAMETERS

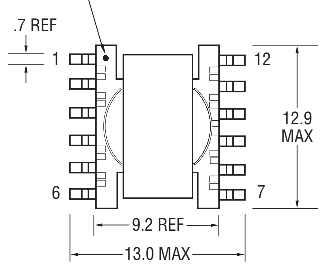
Specifications	SG6	SG7	SG8	SG9
Core	EE8.3	EF12.6	EE13	SEE16
AL-1, nH/T^2	675	1075	1100	1254
AL-2, nH/T^2	96	95	128	153
AL-3, nH/T^2	——	——	——	——
AL-4, nH/T^2	58	57	77	92
AL-5, nH/T^2	——	——	——	——
Ae, min. core area, cm^2	0.0600	0.1003	0.1380	0.1848
le, mag. path lgth., cm	1.92	2.96	3.06	3.55
Ve, core volume, cm^3	0.1564	0.3860	0.5479	0.8552
MLT, ave. turn length, cm	2.0880	2.5480	3.2300	3.7780
Wa, usable wdg. area, cm^2 *	0.0317	0.0769	0.1114	0.1849
WaAc, cm^4	0.00190	0.00772	0.01540	0.03416
UL flammability rating	94V-0	94V-0	94V-0	94V-0

* Fill Factor considered

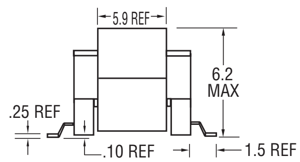
Mechanical Diagrams

SG SIZE 1
ER 11/5

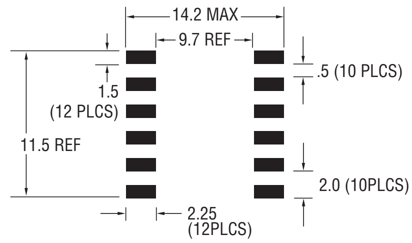
TOP VIEW

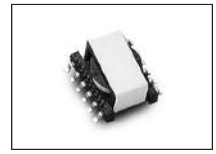


FRONT VIEW



RECOMMENDED PCB PAD PATTERN
COMPONENT VIEW





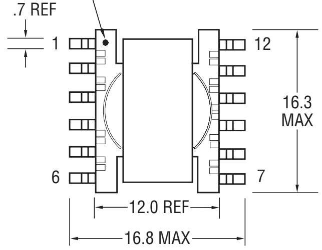
PACKAGING INFORMATION

Parts packaged on 13" reels,
600 parts per reel.

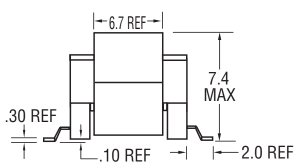
Bulk packaging also available.

SG SIZE 2
ER 14.5/6

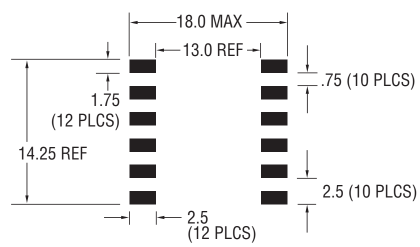
TOP VIEW



FRONT VIEW



RECOMMENDED PCB PAD PATTERN
COMPONENT VIEW



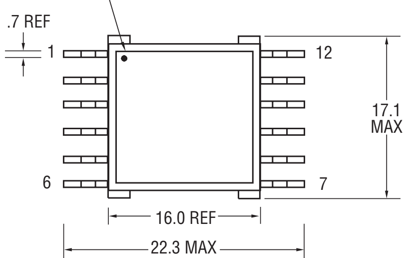
PACKAGING INFORMATION

Parts packaged on 13" reels,
300 parts per reel.

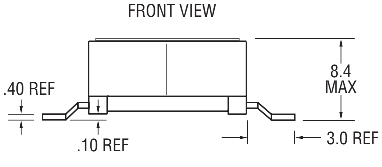
Bulk packaging also available.

SG SIZE 3
EFD 15

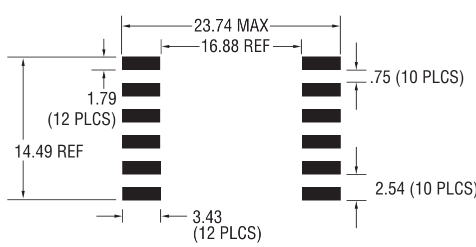
TOP VIEW

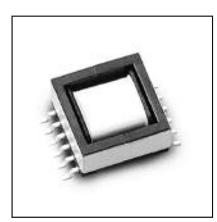


FRONT VIEW



RECOMMENDED PCB PAD PATTERN
COMPONENT VIEW



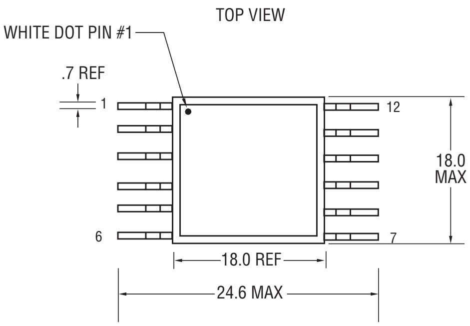


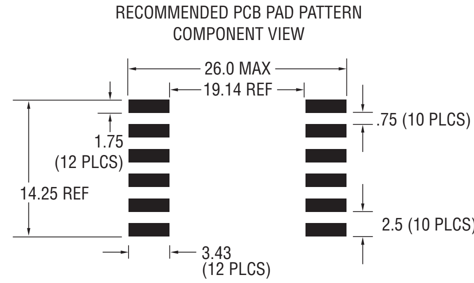
PACKAGING INFORMATION

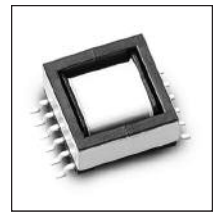
Parts packaged on 13" reels,
200 parts per reel.

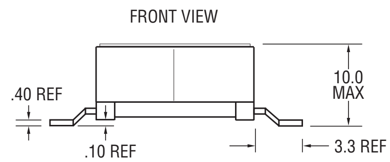
Bulk packaging also available.

SG SIZE 4
EFD 17







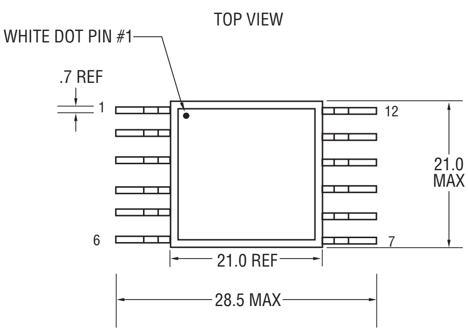


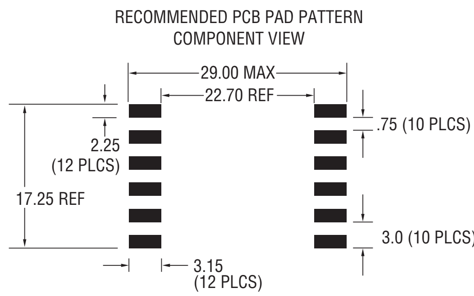
PACKAGING INFORMATION

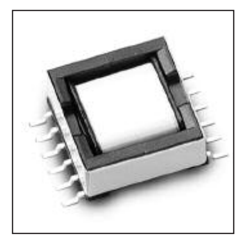
Parts packaged in pick and place compatible bulk trays, 9.8" x 6.7", 6 rows by 7 columns, 42 parts per tray.

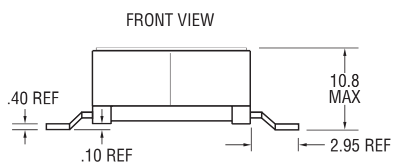
Consult factory for tape and reel packaging.

SG SIZE 5
EFD 20







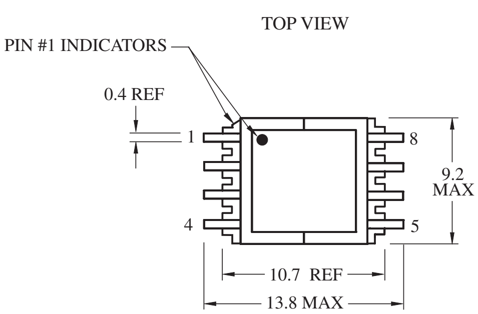


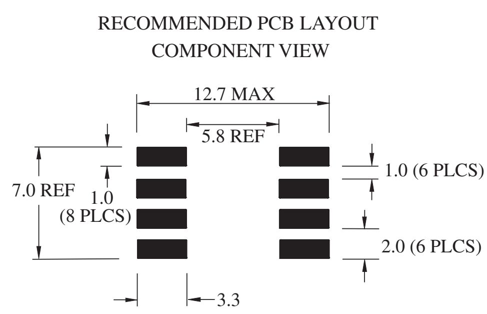
PACKAGING INFORMATION

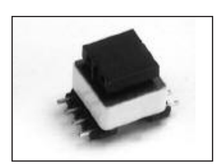
Parts packaged in pick and place compatible bulk trays, 9.8" x 6.7", 5 rows by 7 columns, 35 parts per tray.

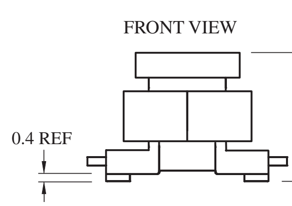
Consult factory for tape and reel packaging.

SG SIZE 6
EE 8.3







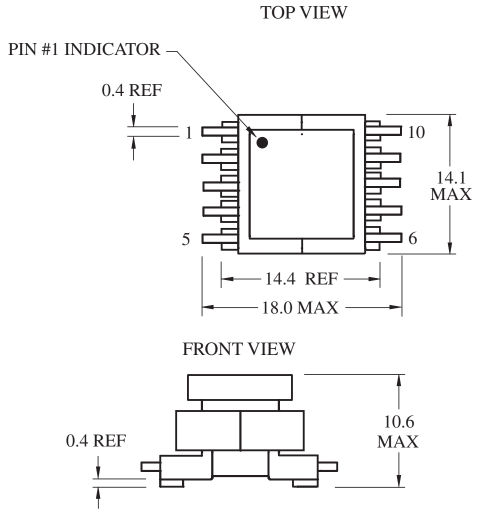


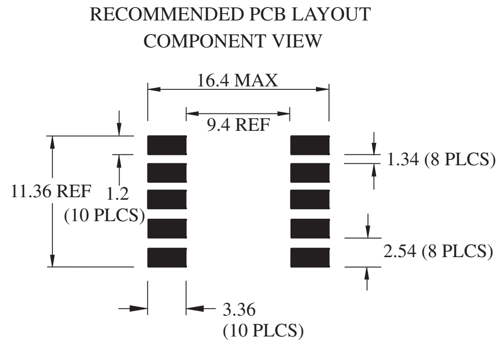
PACKAGING INFORMATION

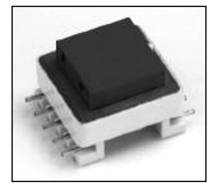
Parts packaged on 13" reels, 400 parts per reel.

Bulk packaging also available.

SG SIZE 7
EF 12.6





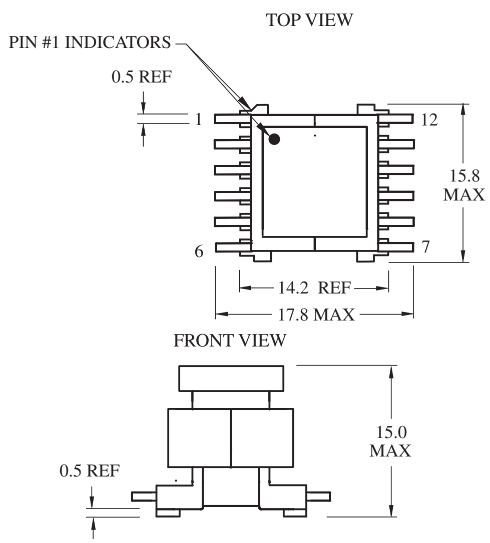


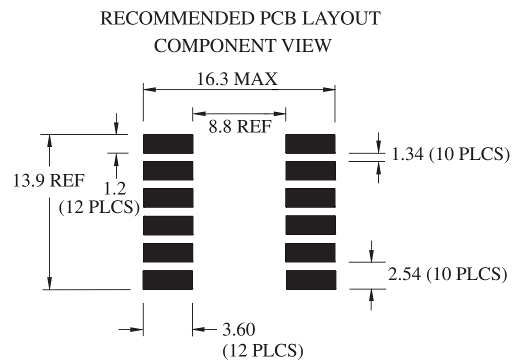
PACKAGING INFORMATION

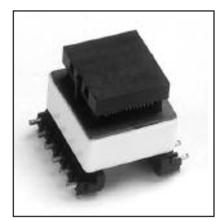
Parts packaged on 13" reels,
250 parts per reel.

Bulk packaging also available.

SG SIZE 8
EE 13



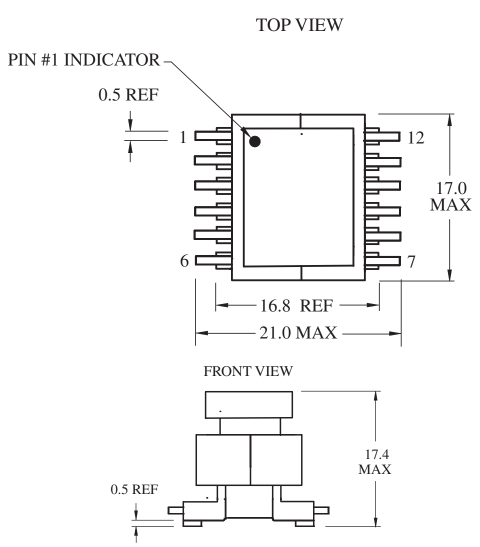


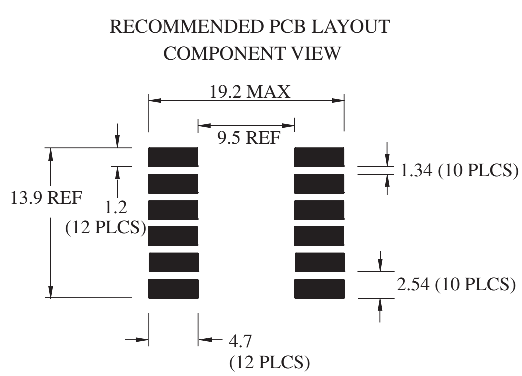


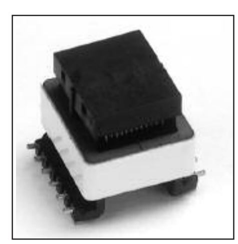
PACKAGING INFORMATION

Parts packaged in pick and
place compatible bulk trays,
6 rows by 10 columns.
Total parts per tray = 60.

SG SIZE 9
SEE 16





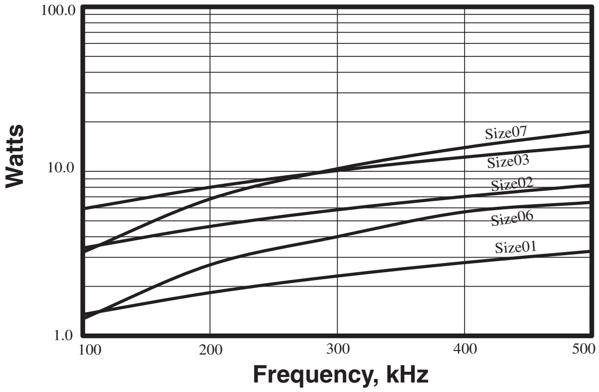


PACKAGING INFORMATION

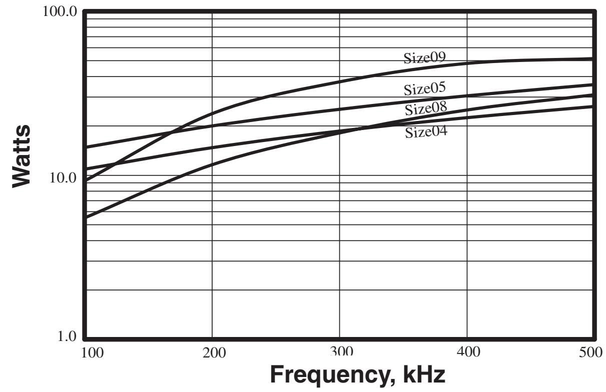
Parts packaged in pick and
place compatible bulk trays,
5 rows by 10 columns.
Total parts per tray = 50.

Performance Specifications

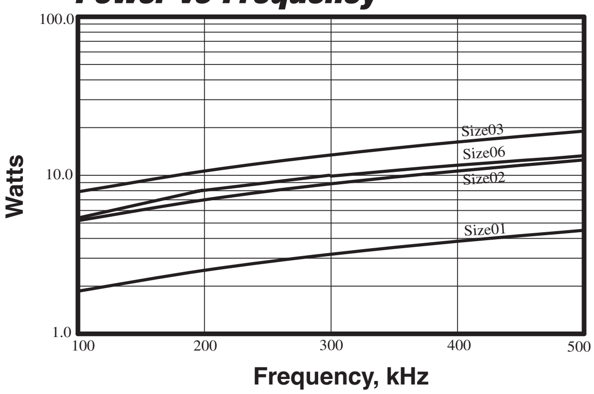
Unipolar *(Flyback)* ***Power vs Frequency***



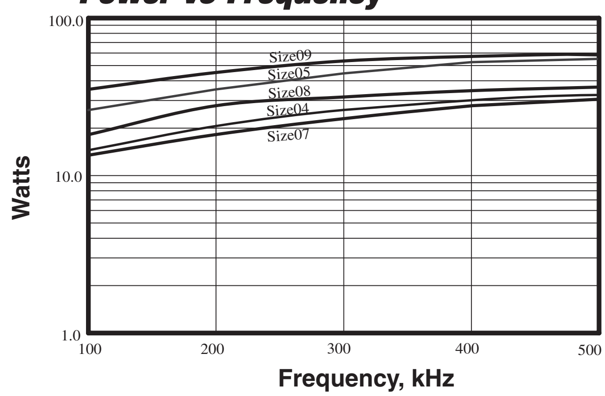
Unipolar *(Flyback)* ***Power vs Frequency***



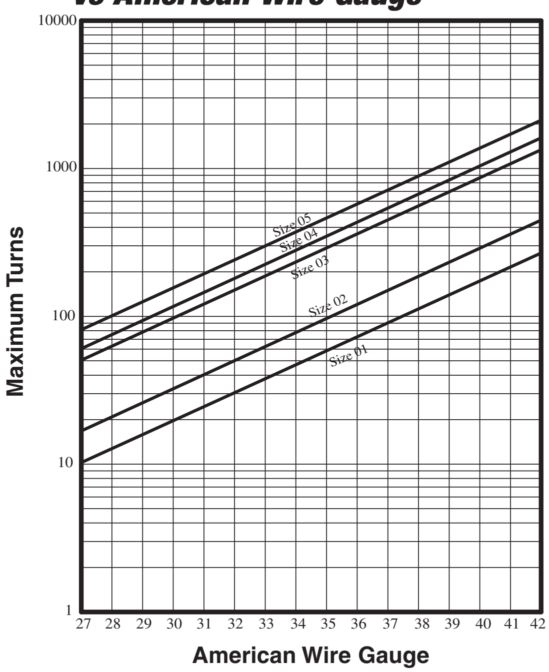
Bipolar *(Push-Pull)* ***Power vs Frequency***



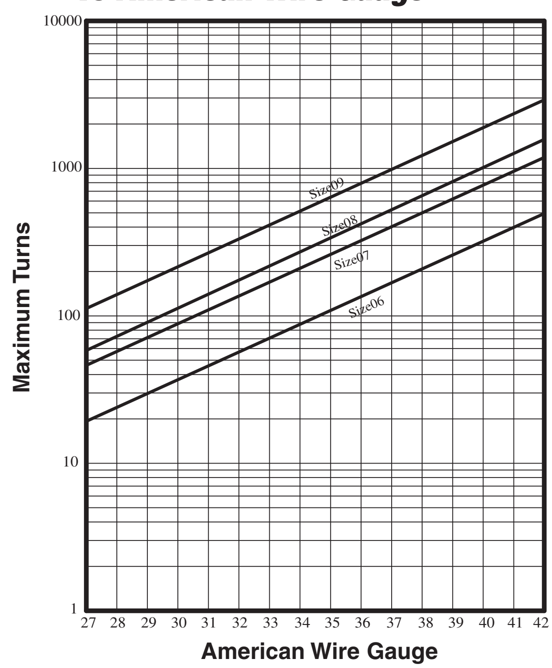
Bipolar *(Push-Pull)* ***Power vs Frequency***



Maximum Turns vs American Wire Gauge



Maximum Turns vs American Wire Gauge



COILTRONICS

COOPER Bussmann

CMS-SERIES
Common Mode Inductors (Surface Mount)

Description

RoHS 2002/95/EC

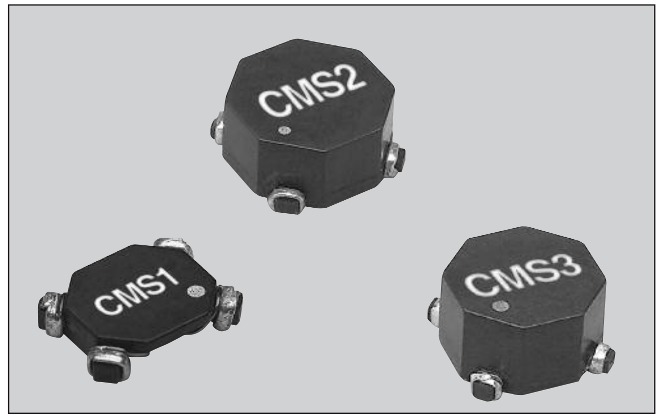
- 160°C maximum total temperature
- Three sizes of surface mount torroidal common mode inductors that provide 300Vdc isolation
- Inductance range from 5.5uH to 1600uH
- Current range up to 7.0 Amps
- Noise attenuation up to 44 dB
- Frequency range up to 100 MHz
- Meets UL94V-0 flammability standard
- Ferrite core material

Applications

- EMI filters
- DC-DC brick power supplies
- Discrete output supplies
- Discrete and point-of-use power supplies (PUPS)

Environmental Data

- Storage temperature range: -40°C to +160°C
- Operating ambient temperature range: -40°C to +160°C (range is application specific)
- Solder reflow temperature: +260°C max for 10 seconds max.



Packaging

- Supplied in tape and reel packaging, 2,000 (CMS1), 800 (CMS2), and 600 (CMS3) per reel

Part Number	OCL (uH) minimum (1-2) & (3-4)	I rms. Amperes Max *	DCR (Ω) typ @ 20°C (1-2)	DCR (Ω) typ @ 20°C (4-3)	Leakage Inductance (uH) typ	Interwinding Capacitance (pF) typ
CMS1-1-R	4.5	7.00	0.0027	0.0027	0.05	2.0
CMS1-2-R	8	5.70	0.0040	0.0040	0.09	2.1
CMS1-3-R	12.6	4.10	0.0077	0.0077	0.14	2.2
CMS1-4-R	18	3.80	0.0089	0.0089	0.20	2.3
CMS1-5-R	25	3.60	0.0100	0.0100	0.28	2.4
CMS1-6-R	32.8	3.10	0.0138	0.0138	0.36	2.5
CMS1-7-R	41.5	2.60	0.019	0.019	0.45	2.6
CMS1-8-R	51.2	2.20	0.026	0.026	0.056	2.7
CMS1-9-R	62	1.90	0.035	0.035	0.68	2.7
CMS1-10-R	73.7	1.65	0.048	0.048	0.81	2.8
CMS1-11-R	100	1.35	0.070	0.070	1.10	2.9
CMS1-12-R	131	1.15	0.100	0.100	1.45	3.0
CMS1-13-R	166	1.00	0.138	0.138	1.83	3.1
CMS1-14-R	205	0.85	0.186	0.186	2.25	3.2
CMS2-1-R	25	5.35	0.005	0.005	0.22	2.0
CMS2-2-R	40	4.40	0.008	0.008	0.34	2.3
CMS2-3-R	57	3.60	0.012	0.012	0.47	2.5
CMS2-4-R	102	2.80	0.019	0.019	0.80	2.8
CMS2-5-R	160	2.30	0.029	0.029	1.25	3.1
CMS2-6-R	230	1.85	0.044	0.044	1.75	3.4
CMS2-7-R	270	1.60	0.060	0.060	2.00	3.6
CMS2-8-R	360	1.35	0.084	0.084	2.60	3.9
CMS2-9-R	460	1.10	0.120	0.120	3.30	4.1
CMS2-10-R	575	0.94	0.170	0.170	4.00	4.3
CMS2-11-R	700	0.80	0.230	0.230	5.00	4.6
CMS2-12-R	915	0.67	0.330	0.330	6.30	4.9
CMS2-13-R	1070	0.58	0.440	0.440	7.30	5.1
CMS2-14-R	1340	0.50	0.620	0.620	9.00	5.4
CMS3-1-R	28	5.70	0.005	0.005	0.31	2.80
CMS3-2-R	45	5.10	0.006	0.006	0.46	3.05
CMS3-3-R	64	4.75	0.007	0.007	0.64	3.30

Definitions:
OCL = Open Circuit Inductance
DCR = Direct Current Resistance
Irms = rms current for approx. a 40°C temperature rise at an ambient temperature of 85°C.
*Operating Temperature: 160°C Max. Inductance values are sustained up to 160°C.

Electrical Characteristics:
OCL (1-2) 0.10Vrms, 100kHz, 0.0Adc: (See Chart)
OCL (4-3) 0.10Vrms, 100kHz, 0.0Adc: (See Chart)
DCR (1-2) typ @ 20°C: (See Chart)
DCR (4-3) typ @ 20°C: (See Chart)
Hipot rating: winding to winding: 300Vdc min. for 1 second.
Turns Ratio: (1-2):(4-3) 1:1

COOPER Bussmann

CMS-SERIES
Common Mode Inductors (Surface Mount)

Part Number	OCL (uH) minimum (1-2) & (3-4)	I rms. Amperes Max *	DCR (Ω) typ @ 20°C (1-2)	DCR (Ω) typ @ 20°C (4-3)	Leakage Inductance (uH) typ	Interwinding Capacitance (pF) typ
CMS3-4-R	88	3.95	0.010	0.010	0.85	3.50
CMS3-5-R	146	3.10	0.017	0.017	1.30	3.70
CMS3-6-R	217	2.85	0.020	0.020	1.90	3.90
CMS3-7-R	258	2.45	0.027	0.027	2.20	4.15
CMS3-8-R	350	2.00	0.040	0.040	3.00	4.40
CMS3-9-R	400	1.70	0.053	0.053	3.30	4.65
CMS3-10-R	518	1.45	0.076	0.076	4.20	4.85
CMS3-11-R	648	1.20	0.107	0.107	5.10	5.10
CMS3-12-R	790	1.05	0.145	0.145	6.10	5.35
CMS3-13-R	1030	0.88	0.210	0.210	7.80	5.55
CMS3-14-R	1310	0.75	0.300	0.300	9.60	5.80

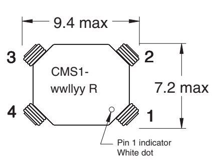
Definitions:
OCL = Open Circuit Inductance
DCR = Direct Current Resistance
Irms = rms current for approx. a 40°C temperature rise at an ambient temperature of 85°C.
*Operating Temperature: 160°C Max. Inductance values are sustained up to 160°C.

Electrical Characteristics:
OCL (1-2) 0.10Vrms, 100kHz, 0.0Adc: (See Chart)
OCL (4-3) 0.10Vrms, 100kHz, 0.0Adc: (See Chart)
DCR (1-2) typ @ 20°C: (See Chart)
DCR (4-3) typ @ 20°C: (See Chart)
Hipot rating: winding to winding: 300Vdc min. for 1 second.
Turns Ratio: (1-2):(4-3) 1:1

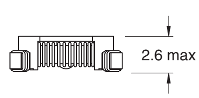
Mechanical Diagrams

CMS1 Series

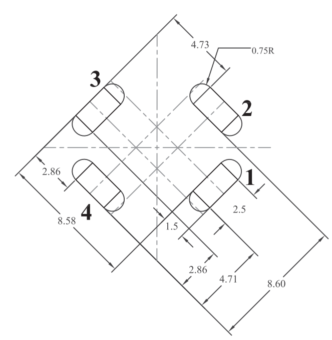
TOP VIEW



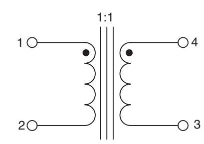
FRONT VIEW



RECOMMENDED PCB LAYOUT

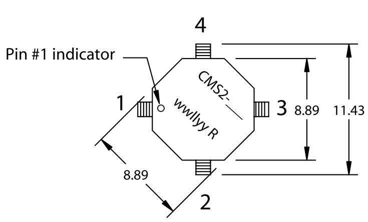


SCHEMATIC

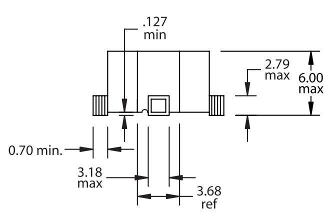


CMS2 Series

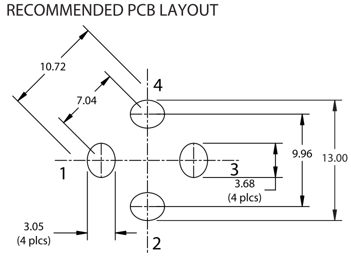
TOP VIEW



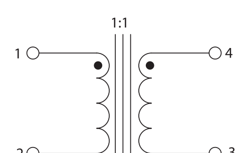
FRONT VIEW



RECOMMENDED PCB LAYOUT

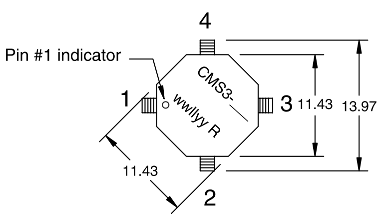


SCHEMATIC

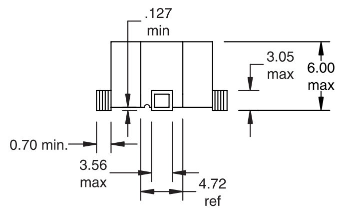


CMS3 Series

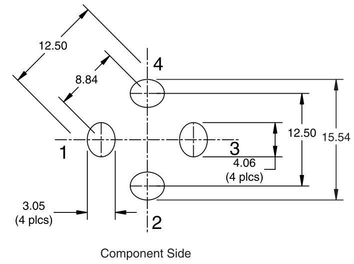
TOP VIEW



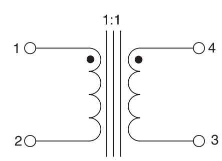
FRONT VIEW



RECOMMENDED PCB LAYOUT



SCHEMATIC



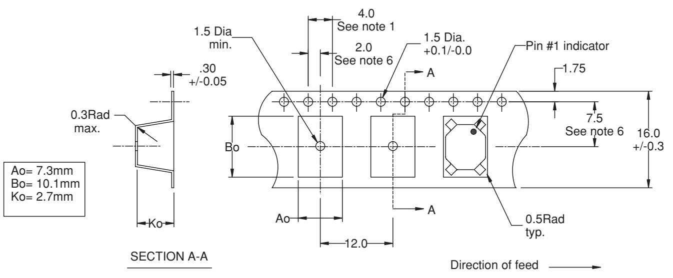
wwllyy = Date code R = Revision level

COOPER Bussmann

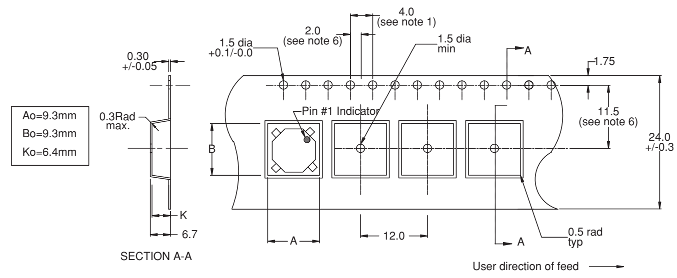
CMS-SERIES
Common Mode Inductors
(Surface Mount)

Packaging Information

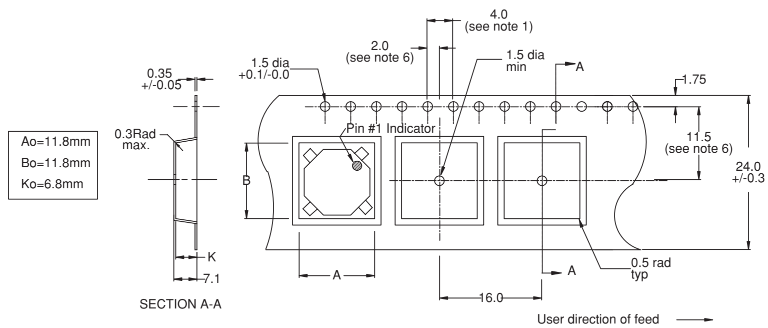
CMS1 Series



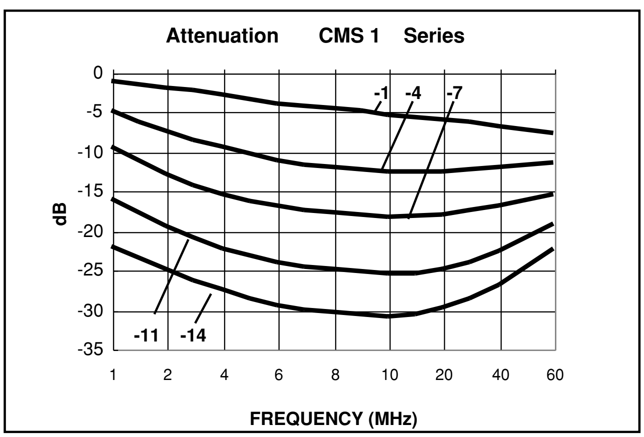
CMS2 Series

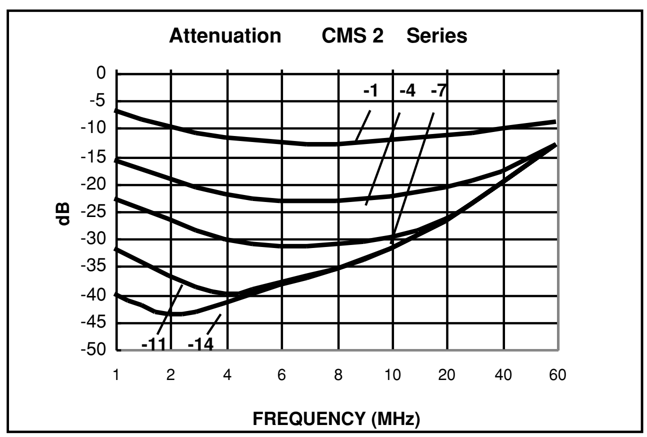


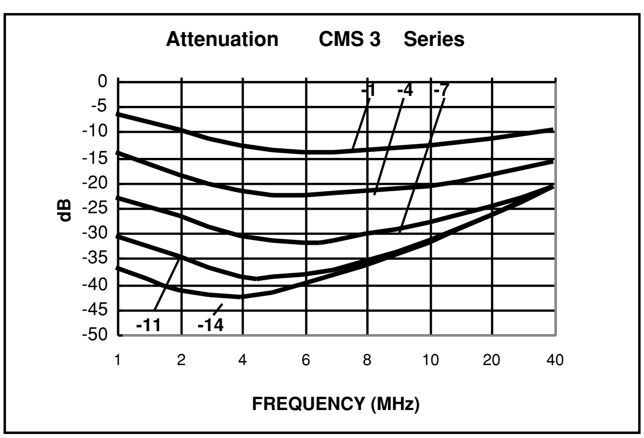
CMS3 Series



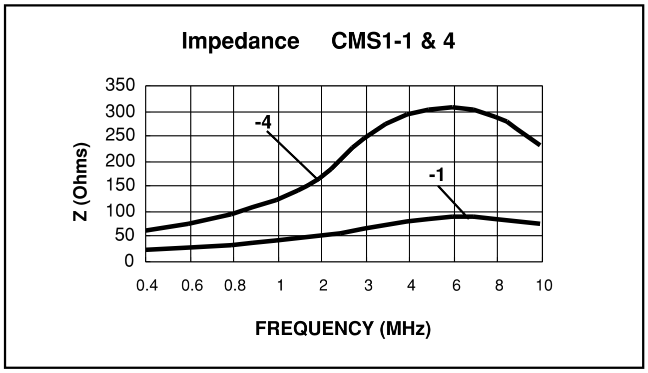
Attenuation Curves

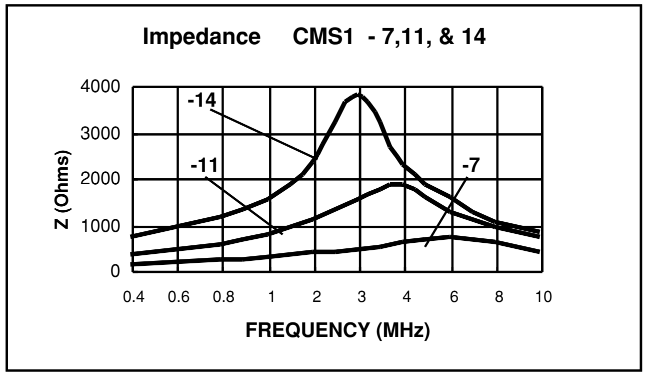


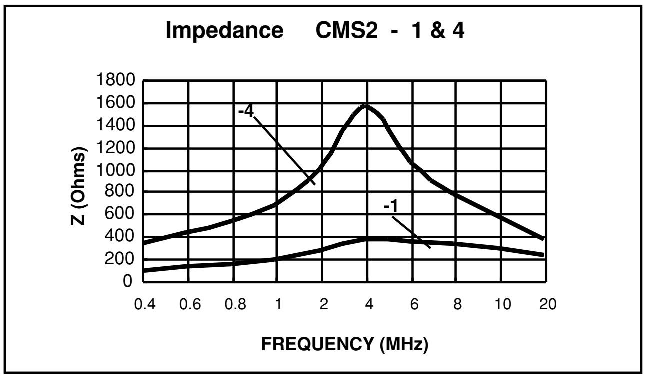


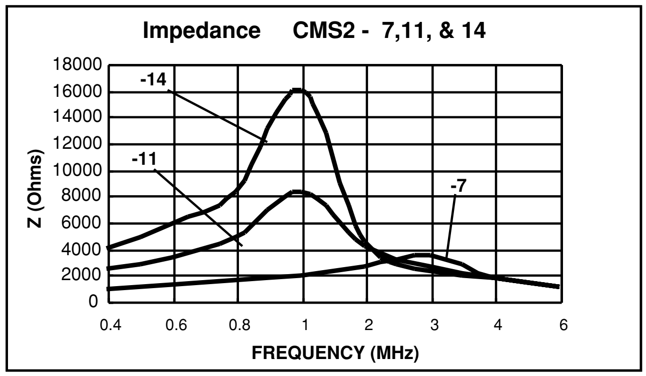


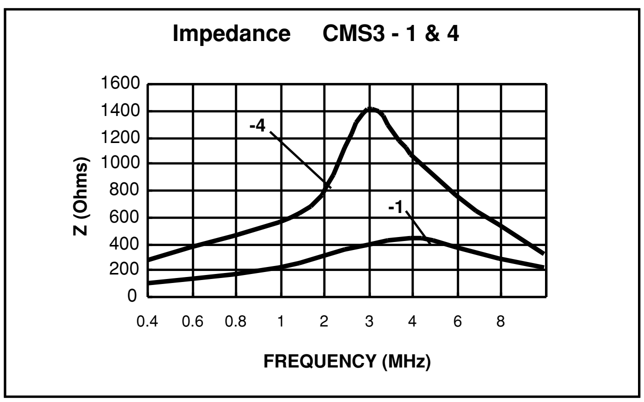
Impedance Curves

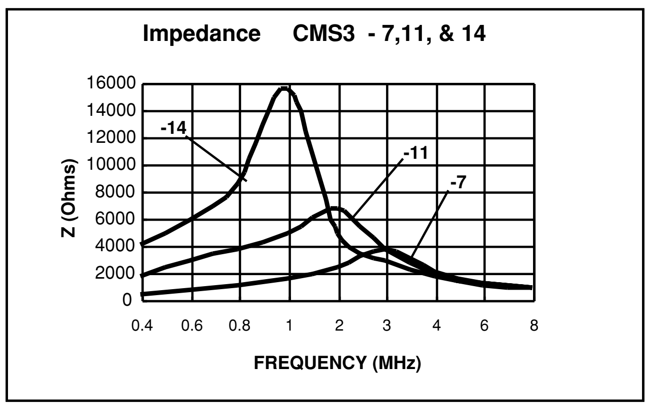












COMMON-MODE (CMS)

COILTRONICS®

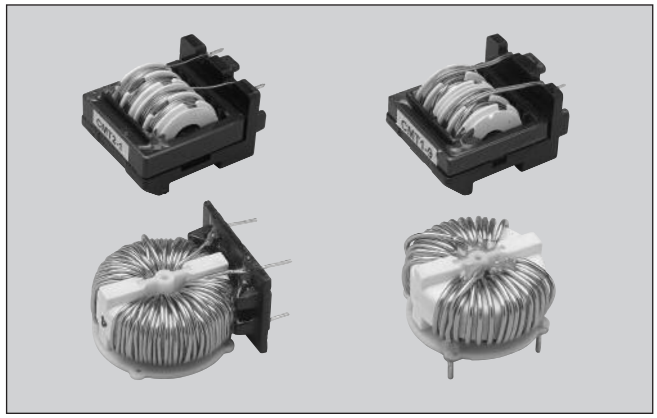
CMT-SERIES
Common Mode Inductors (Through-Hole)

COOPER Bussmann

Description

- Four sizes of through-hole off-line common mode inductors
- Inductance range from 0.53 - 66 mH
- Current range up to 6.5 Amps
- Noise attenuation up to 68 dB
- Frequency range up to 6 MHz
- Meets UL94V-0 flammability standard
- Ferrite core material

RoHS 2002/95/EC



Applications

- Protects AC input from effects of switching regulators
- Off-line power supplies
- EMI filters
- DC-DC converters
- Computer, TV, VCR, audio and office equipment

Environmental Data

- Storage temperature range: -40°C to +125°C
- Operating ambient temperature range: -40°C to +85°C range is application specific. The internal “hot-spot” temperature defines the maximum allowable currents, which are limited to 130°C, including ambient.

Packaging

- Supplied in bulk packaging

Part Number	OCL (mH) min (1-2)	OCL (mH) min (4-3)	I rms. Amperes max	DCR (Ω) typ @ 20°C (1-2)	DCR (Ω) typ @ 20°C (4-3)
CMT1-1-R	66.0	66.0	0.74	1.20	1.20
CMT1-2-R	49.0	49.0	0.88	0.85	0.85
CMT1-3-R	28.0	28.0	1.13	0.50	0.50
CMT1-4-R	21	21	1.37	0.35	0.35
CMT1-5-R	13	13	1.76	0.20	0.20
CMT1-6-R	7.50	7.50	2.27	0.13	0.13
CMT1-7-R	4.20	4.20	2.89	0.08	0.08
CMT1-8-R	2.40	2.40	3.85	0.045	0.045
CMT1-9-R	1.85	1.85	4.53	0.033	0.033
CMT1-10-R	0.94	0.94	6.05	0.018	0.018
CMT2-1-R	30	30	1.50	0.350	0.350
CMT2-2-R	20	20	1.95	0.220	0.220
CMT2-3-R	12	12	2.45	0.135	0.135
CMT2-4-R	8.0	8.0	2.80	0.100	0.100
CMT2-5-R	6.0	6.0	3.40	0.070	0.070
CMT2-6-R	4.8	4.8	3.95	0.053	0.053
CMT2-7-R	3.2	3.2	4.40	0.042	0.042
CMT2-8-R	2.4	2.4	4.75	0.037	0.037
CMT2-9-R	2.0	2.0	5.45	0.028	0.028
CMT2-10-R	1.6	1.6	5.75	0.026	0.026
CMT3-1-R	5.4	5.4	2.0	0.12	0.12
CMT3-2-R	3.5	3.5	2.6	0.08	0.08
CMT3-3-R	2.7	2.7	3.0	0.055	0.055
CMT3-4-R	1.3	1.3	4.0	0.032	0.032
CMT3-5-R	0.92	0.92	5.0	0.021	0.021
CMT3-6-R	0.53	0.53	6.5	0.013	0.013
CMT4-1-R	5.4	5.4	2.0	0.12	0.12
CMT4-2-R	3.5	3.5	2.6	0.08	0.08
CMT4-3-R	2.7	2.7	3.0	0.055	0.055
CMT4-4-R	1.3	1.3	4.0	0.032	0.032
CMT4-5-R	0.92	0.92	5.0	0.021	0.021
CMT4-6-R	0.53	0.53	6.5	0.013	0.013

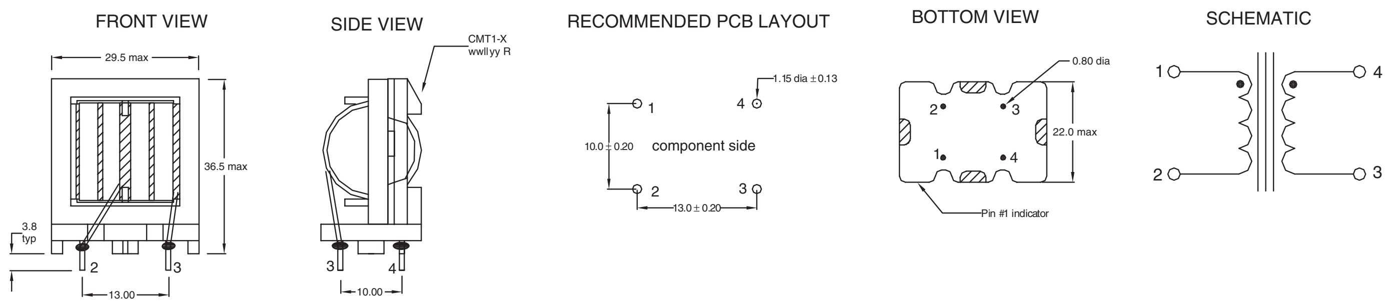
Definitions:
OCL = Open Circuit Inductance
DCR = Direct Current Resistance
Irms = rms current for 40°C max temperature rise at worst case ambient temperature of 85°C

Electrical Characteristics:
OCL (1-2) 0.10Vrms, 10kHz, 0.0Adc: (See Chart)
OCL (4-3) 0.10Vrms, 10kHz, 0.0Adc: (See Chart)
DCR (1-2) typ @ 20°C: (See Chart)
DCR (4-3) typ @ 20°C: (See Chart)
Hipot rating: winding to winding: 2400 Vac for 1 second.
Turns Ratio: (1-2):(4-3) 1:1

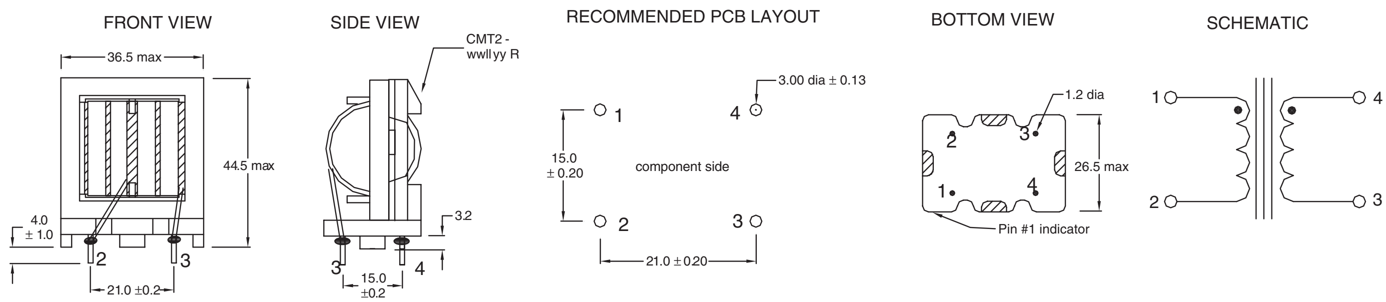
CMT-SERIES
Common Mode Inductors (Through-Hole)

Mechanical Diagrams

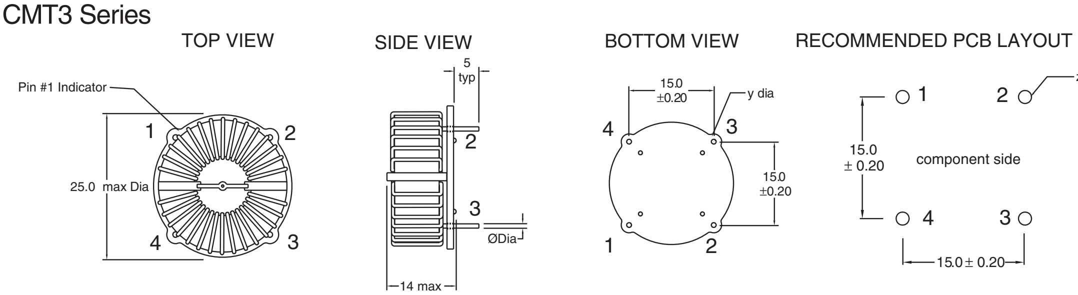
CMT1 Series



CMT2 Series

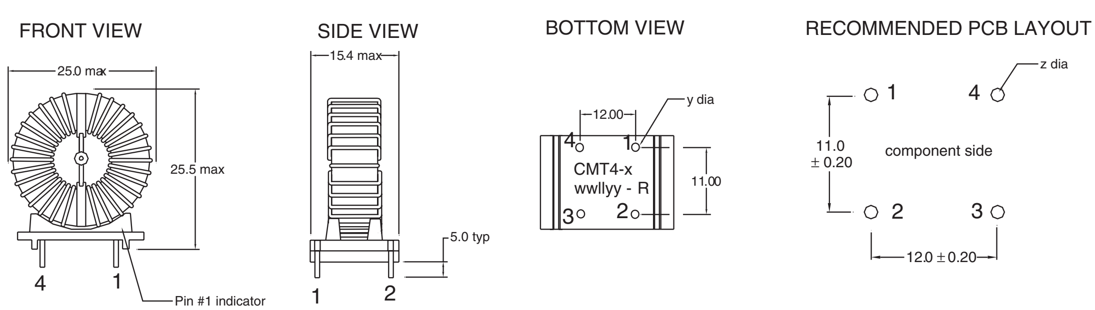


CMT3 Series



	"Y" Dia ref	"Z" Dia ref
CMT3-1	0.58	0.83
CMT3-2	0.64	0.90
CMT3-3	0.71	0.97
CMT3-4	0.80	1.06
CMT3-5	0.89	1.15
CMT3-6	0.99	1.25

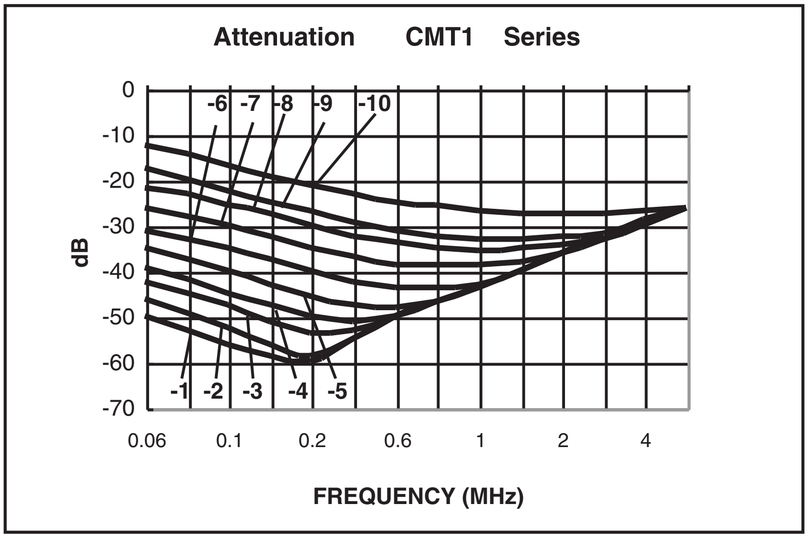
CMT4 Series

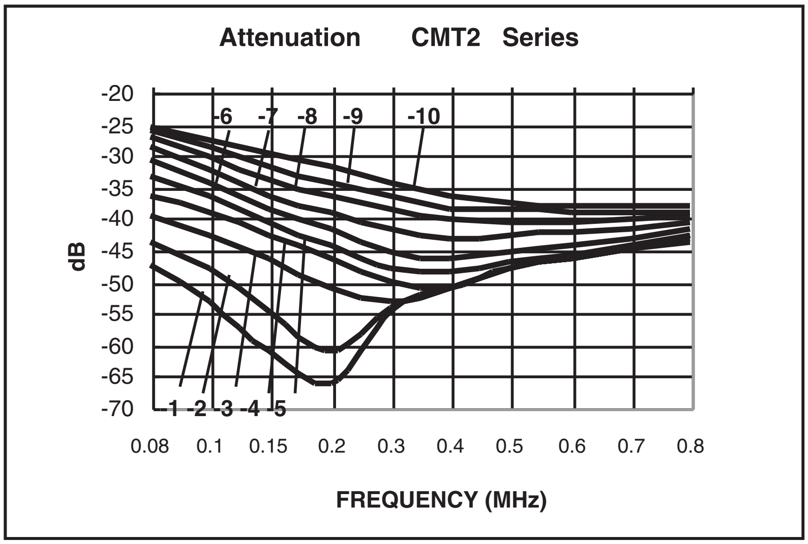


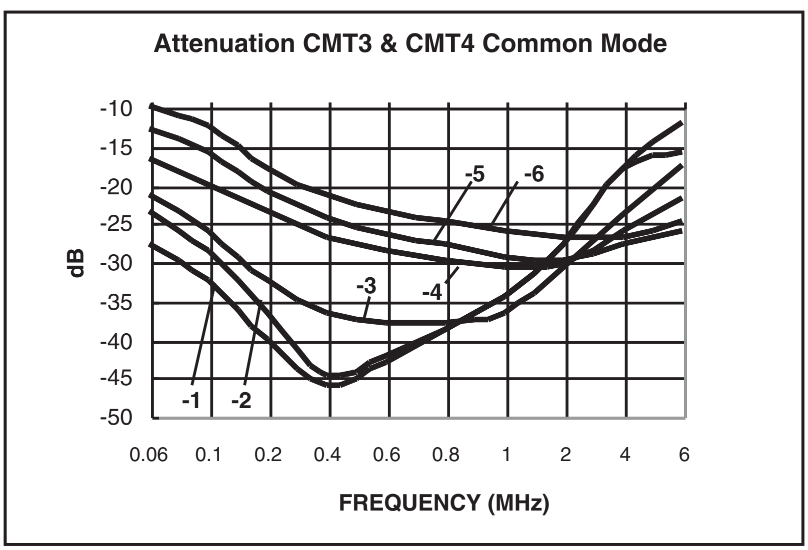
	"Y" Dia ref	"Z" Dia ref
CMT4-1	0.58	0.83
CMT4-2	0.64	0.90
CMT4-3	0.71	0.97
CMT4-4	0.80	1.06
CMT4-5	0.89	1.15
CMT4-6	0.99	1.25

(1) All Dimensions are in millimeters unless otherwise specified
(2) Tolerances are +/- 0.20mm unless stated otherwise.
(3) wwllyy = (Date Code) R = (Revision Level)
Schematic is the same for all the series

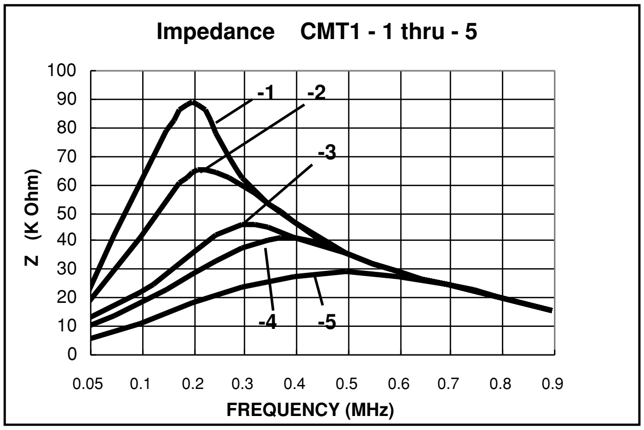
Attenuation Curves

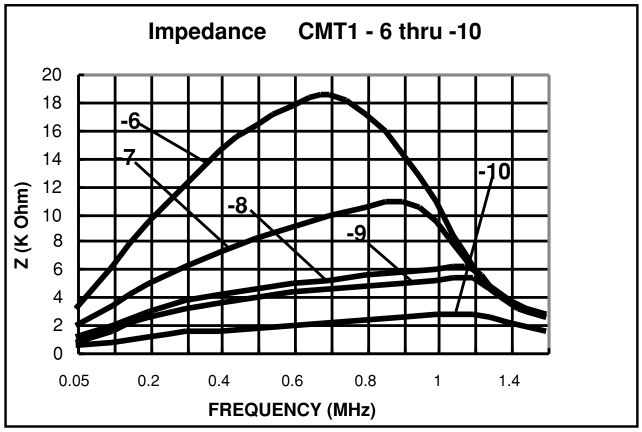


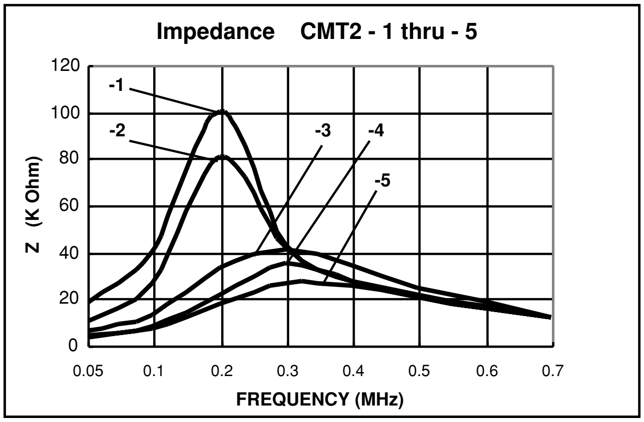


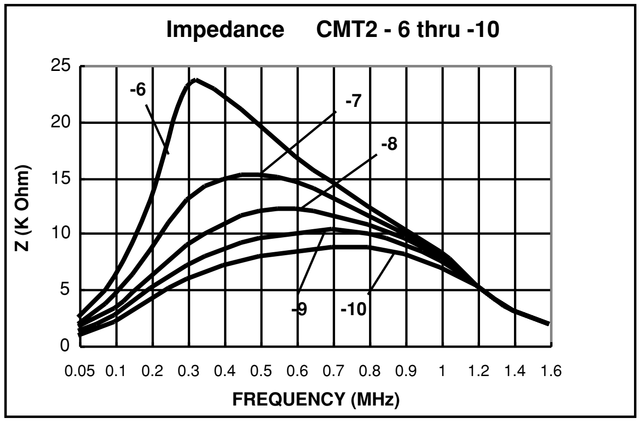


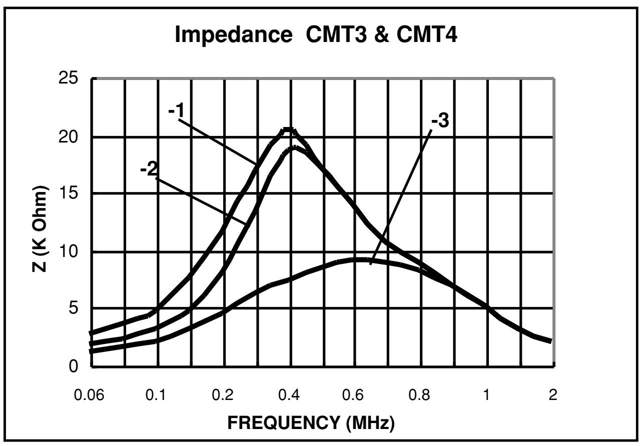
Impedance Curves

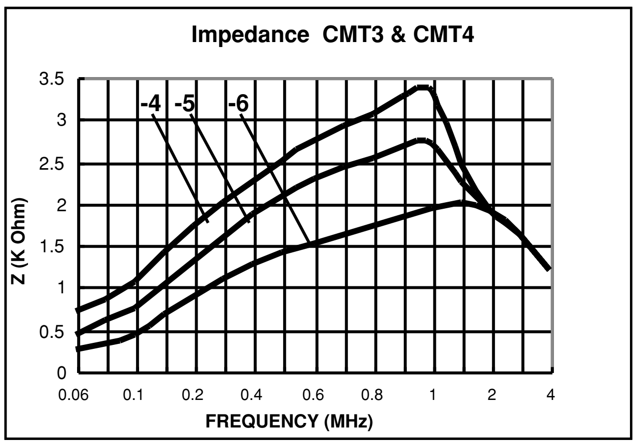












COMMON-MODE (CMT)

COOPER Bussmann

COILTRONICS

CS Series
Current Sense
Current Sense Inductors

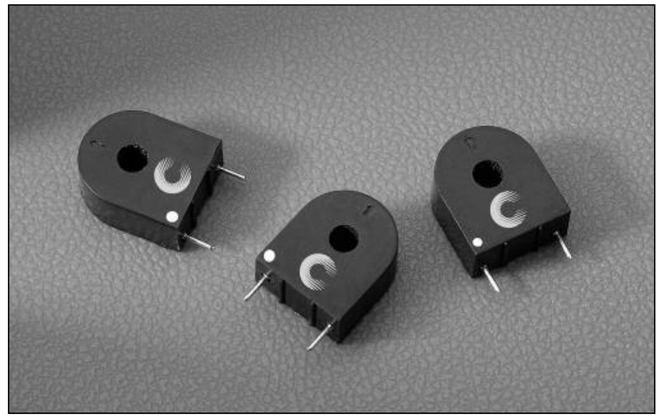
Description

RoHS 2002/95/EC

- Encapsulated Through Hole Design
- Isolation between Pri and Sec of 3750 Volts
- Materials meet UL Class B

Applications

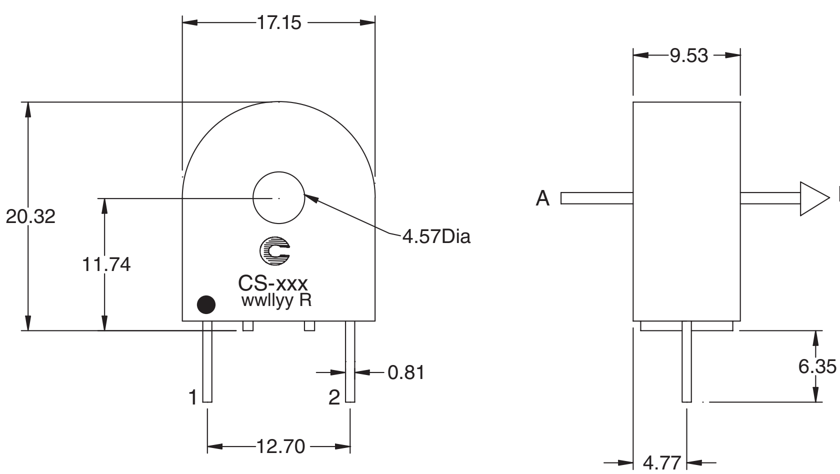
- Feedback elements linking the output and pulse control circuitry
- Switch Mode Power Supplies: PFC, Half-bridge, Full-bridge, Forward
- Off-Line
- Telecom

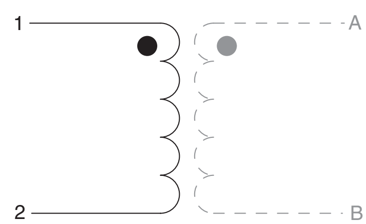


Part Number	Inductance (mH)	Turns +/-1%	Current Range AMPS	DCR (Ω) +/-15% @ 20°C	Recommended Terminating Resistor	Frequency Range
CS-1050-R	5.6	50	1-10	0.60	50 ohms	20k-200kHz
CS-1100-R	22.4	100	2-20	1.3	100 ohms	20k-200kHz
CS-1200-R	89.7	200	4-40	3.3	200 ohms	20k-100kHz

1) Test Parameters: 10kHz, 0.25 Vrms
2) Dimensions in Millimeters
3) Output Voltage is 1v/A with the terminating resistor and is linear over the specified range
4) Hipot is 3750 Volts from winding to test wire A-B
5) Materials meet UL Class B
6) Polarity Indicator Dot: (This lead is in phase with lead A of conductor A-B)

Mechanical Diagrams





xxx = Inductance value
wwllyy = Date code R = Revision level

LOW COST POWER INDUCTORS
Toroidal Inductors

Description

RoHS 2002/95/EC

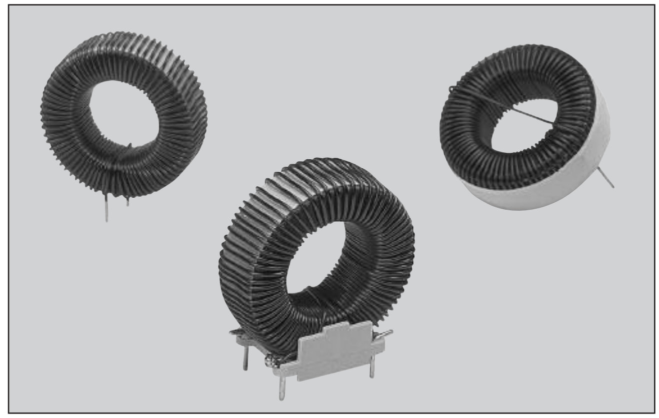
- Low loss, powdered iron cores with stable electrical operating characteristics maximize inductor efficiency by minimizing copper losses
- Available in vertical and horizontal self leaded and header mounted configurations
- Inductance values range from 10uH to 1000uH
- Current values range from 1.5 to 29.5 Amps
- Meets UL 94V-0 flammability standard
- Powder Iron core material

Applications

- Filters
- Buck and boost switches
- Chokes

Environmental Data

- Storage temperature range: -40°C to +105°C
- Operating ambient temperature range: -40°C to +75°C (range is application specific)



Packaging

- Supplied in bulk packaging

Family Table

Vertical Part Number	Horizontal Part Number	Header Mounted Part Number	Inductance µH (rated)	OCL(1) µH +/- 20%	I DC(2) Amperes	I SAT(3) Amperes	Volt-µSec(4) VµS	Energy(5) µJ	DCR (Ω)(6) max
CTX10-1-52-R	CTX10-1-52LP-R	CTX10-1-52M-R	10	10.14	2.4	2.1	5.4	15	0.0481
CTX20-1-52-R	CTX20-1-52LP-R	CTX20-1-52M-R	20	20.22	1.8	2.2	7.8	36	0.0829
CTX50-1-52-R	CTX50-1-52LP-R	CTX50-1-52M-R	50	50.29	2.6	2.7	16.3	130	0.0715
CTX100-1-52-R	CTX100-1-52LP-R	CTX100-1-52M-R	100	100.40	2.5	2.4	27.5	197	0.1060
CTX150-1-52-R	CTX150-1-52LP-R	CTX150-1-52M-R	150	151.70	2.1	2.3	35.7	283	0.1620
CTX250-1-52-R	CTX250-1-52LP-R	CTX250-1-52M-R	250	250.90	1.9	2.2	47.8	421	0.2210
CTX500-1-52-R	CTX500-1-52LP-R	CTX500-1-52M-R	500	505.00	1.7	1.9	77.9	645	0.3610
CTX750-1-52-R	CTX750-1-52LP-R	CTX750-1-52M-R	750	754.40	1.8	2.4	114.3	1530	0.4340
CTX1000-1-52-R	CTX1000-1-52LPR	CTX1000-1-52M-R	1000	1004.00	1.5	2.1	131.9	1530	0.6380
CTX10-2-52-R	CTX10-2-52LP-R	CTX10-2-52M-R	10	9.60	4.7	4.5	6.6	68	0.0183
CTX20-2-52-R	CTX20-2-52LP-R	CTX20-2-52M-R	20	19.60	3.2	3.2	9.4	69	0.0392
CTX50-2-52-R	CTX50-2-52LP-R	CTX50-2-52M-R	50	50.00	4.9	4.9	21.3	420	0.0326
CTX100-2-52-R	CTX100-2-52LP-R	CTX100-2-52M-R	100	101.70	4.4	4.3	35.0	643	0.0534
CTX150-2-52-R	CTX150-2-52LP-R	CTX150-2-52M-R	150	148.00	4.3	4.0	47.6	829	0.0719
CTX250-2-52-R	CTX250-2-52LP-R	CTX250-2-52M-R	250	251.10	4.2	4.2	66.0	1540	0.0833
CTX500-2-52-R	CTX500-2-52LP-R	CTX500-2-52M-R	500	499.40	3.1	3.3	104.0	1890	0.1830
CTX750-2-52-R	CTX750-2-52LP-R	CTX750-2-52M-R	750	749.30	3.4	3.4	147.3	2960	0.2080
CTX10-5-52-R	CTX10-5-52LP-R	CTX10-5-52M-R	10	9.68	8.7	11.1	9.4	417	0.0104
CTX20-5-52-R	CTX20-5-52LP-R	CTX20-5-52M-R	20	21.25	7.8	9.3	16.0	643	0.0260
CTX50-5-52-R	CTX50-5-52LP-R	CTX50-5-52M-R	50	49.60	7.6	9.4	29.3	1530	0.0248
CTX100-5-52-R	CTX100-5-52LP-R	CTX100-5-52M-R	100	97.20	8.2	7.5	45.7	1890	0.0267
CTX150-5-52-R	CTX150-5-52LP-R	CTX150-5-52M-R	150	150.60	7.7	7.5	66.0	2960	0.0401
CTX250-5-52-R	CTX250-5-52LP-R		250	254.40	9.2	8.1	102.4	5860	0.0400
CTX10-7-52-R	CTX10-7-52LP-R	CTX10-7-52M-R	10	10.04	11.4	13.5	11.0	640	0.0080
CTX20-7-52-R	CTX20-7-52LP-R	CTX20-7-52M-R	20	20.96	11.4	14.5	19.1	1540	0.0110
CTX50-7-52-R	CTX50-7-52LP-R	CTX50-7-52M-R	50	52.27	10.5	10.2	33.5	1900	0.0163
CTX100-7-52-R	CTX100-7-52LP-R		100	101.40	12.0	9.1	54.2	2960	0.0167
CTX150-7-52-R	CTX150-7-52LP-R		150	152.80	12.8	10.5	79.3	5900	0.0204
CTX10-10-52-R	CTX10-10-52LP-R		10	10.04	16.9	20.9	13.2	1530	0.0051
CTX20-10-52-R	CTX20-10-52LP-R		20	21.17	16.0	16.0	21.3	1900	0.0070
CTX50-10-52-R	CTX50-10-52LP-R		50	52.37	13.9	12.7	38.9	2960	0.0124
CTX100-10-52-R	CTX100-10-52LPR		100	99.38	17.6	13.0	64.0	5880	0.0109
CTX10-16-52-R	CTX10-16-52LP-R		10	9.90	27.3	29.3	16.9	2970	0.0032
CTX20-16-52-R	CTX20-16-52LP-R		20	19.24	31.5	29.5	28.1	5860	0.0034

Notes:
(1) Open circuit inductance test parameters: 100kHz, 0.250Vrms, 0 Adc.
(2) DC current for an approximate ΔT of 30°C at 75°C Ambient with no core loss. See Chart 2 for derating of IDC with core loss.
(3) Peak current for an approximate 30% roll-off in OCL. For other current levels see Chart 1.
(4) Applied Volt-Time product (VµS) across the inductor. This value represents the VµS at 100kHz necessary to generate a core loss equal to 10% of the total losses for 30°C rise. For other frequencies and operating levels see Chart 2. (Note: skin effect losses not included.)
(5) Energy storage (µJ) at ISAT. For other current levels see Chart 1.
(6) Maximum D.C. resistance at 20°C.

LOW COST POWER INDUCTORS
Toroidal Inductors

Mechanical Diagrams

Vertical and Horizontal Self Leaded Mounting Options

Vertical P/N See Figure 1	Horizontal P/N See Figure 2	OD (max)	ID (typ)	Ht (max)	X (typ)	Y (typ)	T (typ)	H (typ)
CTX10-1-52-R	CTX10-1-52LP-R	8.6	0.0	4.7	3.8	7.3	0.42	0.67
CTX20-1-52-R	CTX20-1-52LP-R	9.1	0.0	6.7	5.6	7.4	0.37	0.62
CTX50-1-52-R	CTX50-1-52LP-R	16.2	4.2	9.0	7.5	13.7	0.58	0.83
CTX100-1-52-R	CTX100-1-52LP-R	15.5	4.2	12.4	10.7	13.7	0.58	0.83
CTX150-1-52-R	CTX150-1-52LP-R	20.7	6.6	9.4	7.8	18.8	0.52	0.77
CTX250-1-52-R	CTX250-1-52LP-R	20.9	6.0	13.0	11.0	18.8	0.52	0.77
CTX500-1-52-R	CTX500-1-52LP-R	24.0	9.0	15.3	14.0	21.2	0.52	0.77
CTX750-1-52-R	CTX750-1-52LP-R	29.8	11.7	17.4	15.6	28.2	0.52	0.77
CTX1000-1-52-R	CTX1000-1-52LP-R	29.8	11.7	17.1	15.5	28.0	0.46	0.71
CTX10-2-52-R	CTX10-2-52LP-R	12.7	0.0	7.8	6.3	11.0	0.71	0.96
CTX20-2-52-R	CTX20-2-52LP-R	12.5	0.0	7.5	6.3	11.0	0.58	0.83
CTX50-2-52-R	CTX50-2-52LP-R	21.6	6.1	13.6	11.0	19.5	0.89	1.14
CTX100-2-52-R	CTX100-2-52LP-R	24.0	8.8	16.6	13.9	21.8	0.89	1.14
CTX150-2-52-R	CTX150-2-52LP-R	30.6	11.2	11.4	9.3	28.5	0.80	1.05
CTX250-2-52-R	CTX250-2-52LP-R	31.2	9.1	19.0	15.7	28.5	0.89	1.14
CTX500-2-52-R	CTX500-2-52LP-R	36.7	11.7	14.8	12.5	34.5	0.71	0.96
CTX750-2-52-R	CTX750-2-52LP-R	43.3	19.9	18.2	15.8	41.5	0.80	1.05
CTX10-5-52-R	CTX10-5-52LP-R	22.2	5.4	13.9	11.5	19.9	1.11	1.36
CTX20-5-52-R	CTX20-5-52LP-R	24.5	8.8	16.6	14.5	22.0	0.89	1.14
CTX50-5-52-R	CTX50-5-52LP-R	32.3	10.1	18.9	16.5	28.8	1.11	1.36
CTX100-5-52-R	CTX100-5-52LP-R	37.8	11.2	16.8	13.6	35.5	1.24	1.49
CTX150-5-52-R	CTX150-5-52LP-R	46.4	18.8	19.8	16.8	43.4	1.24	1.49
CTX250-5-52-R	CTX250-5-52LP-R	53.7	18.8	24.3	20.1	49.4	1.38	1.63
CTX10-7-52-R	CTX10-7-52LP-R	25.7	6.5	18.0	16.0	22.4	1.38	1.63
CTX20-7-52-R	CTX20-7-52LP-R	32.4	8.5	19.8	16.8	29.2	1.38	1.63
CTX50-7-52-R	CTX50-7-52LP-R	39.0	10.8	16.8	13.9	35.7	1.38	1.63
CTX100-7-52-R	CTX100-7-52LP-R	48.5	17.1	21.8	17.2	43.4	1.73	1.98
CTX150-7-52-R	CTX150-7-52LP-R	54.5	17.1	25.4	21.2	50.9	1.73	1.98
CTX10-10-52-R	CTX10-10-52LP-R	34.0	7.0	21.4	17.0	29.6	1.73	1.98
CTX20-10-52-R	CTX20-10-52LP-R	40.5	9.0	18.0	14.3	35.2	1.73	1.98
CTX50-10-52-R	CTX50-10-52LP-R	47.5	17.1	21.3	17.5	42.8	1.73	1.98
CTX100-10-52-R	CTX100-10-52LP-R	57.0	15.0	27.5	21.3	50.6	2.15	2.45
CTX10-16-52-R	CTX10-16-52LP-R	50.3	13.0	24.0	18.6	43.0	2.41	2.70
CTX20-16-52-R	CTX20-16-52LP-R	59.0	13.0	28.0	23.0	50.7	2.69	2.99

Note: All dimensions are in millimeters.

VERTICAL SELF LEADED MOUNT

HORIZONTAL SELF LEADED MOUNT

FIGURE 1

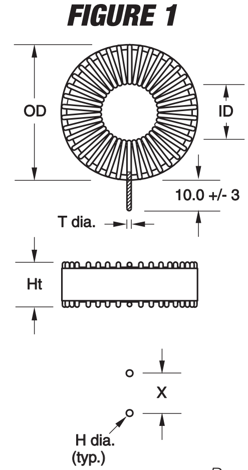
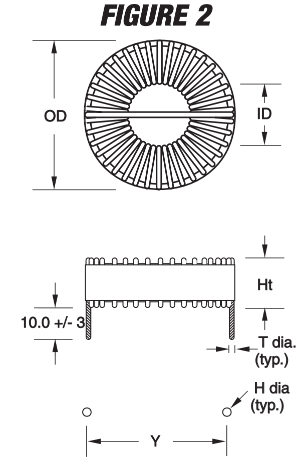


FIGURE 2



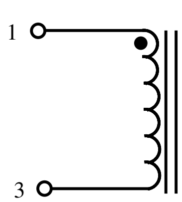
Drawings are not to scale.

Header Mounted Option

Header Mounted Part Number	See Figure #	OD (max)	A (max)	B (max)	C (max)	X (typ)	Y (typ)	T (typ)	H (typ)
CTX10-1-52M-R	3	8.6	9.4	9.4	6.9	6.5	6.5	—	—
CTX20-1-52M-R	3	9.1	9.4	9.4	9.0	6.5	6.5	—	—
CTX50-1-52M-R	4	16.2	19.6	16.1	20.0	15.3	6.4	—	—
CTX100-1-52M-R	4	15.5	19.6	16.1	19.7	15.3	6.4	—	—
CTX150-1-52M-R	4	20.7	19.6	16.1	24.2	15.3	6.4	—	—
CTX250-1-52M-R	5	20.9	31.0	16.0	22.5	20.3	10.2	1.20	1.45
CTX500-1-52M-R	5	24.0	35.4	21.7	25.0	23.0	15.4	1.20	1.45
CTX750-1-52M-R	5	29.8	35.4	21.7	31.6	23.0	15.4	1.20	1.45
CTX1000-1-52M-R	5	29.8	35.4	21.7	31.2	23.0	15.4	1.20	1.45
CTX10-2-52M-R	3	12.7	13.6	11.4	11.7	10.8	7.5	—	—
CTX20-2-52M-R	3	12.5	13.6	11.4	11.4	10.8	7.5	—	—
CTX50-2-52M-R	5	21.6	31.0	16.0	23.5	20.3	10.2	1.20	1.45
CTX100-2-52M-R	5	24.0	35.4	21.7	26.0	23.0	15.4	1.20	1.45
CTX150-2-52M-R	5	30.6	31.0	16.0	32.5	20.3	10.2	1.20	1.45
CTX250-2-52M-R	5	31.2	35.4	21.7	33.4	23.0	15.4	1.20	1.45
CTX500-2-52M-R	5	36.7	31.0	16.0	38.4	20.3	10.2	1.20	1.45
CTX750-2-52M-R	5	43.3	35.4	21.7	45.4	23.0	15.4	1.20	1.45
CTX10-5-52M-R	5	22.2	31.0	16.0	22.7	20.3	10.2	1.20	1.45
CTX20-5-52M-R	5	24.5	35.4	21.7	25.5	23.0	15.4	1.20	1.45
CTX50-5-52M-R	5	32.3	35.4	21.7	33.7	23.0	15.4	1.11	1.36
CTX100-5-52M-R	5	37.8	35.4	21.7	40.2	23.0	15.4	1.24	1.49
CTX150-5-52M-R	5	46.4	35.4	21.7	47.0	23.0	15.4	1.24	1.49
CTX10-7-52M-R	5	25.7	35.4	21.7	26.7	23.0	15.4	1.38	1.63
CTX20-7-52M-R	5	32.4	35.4	21.7	34.2	23.0	15.4	1.38	1.63
CTX50-7-52M-R	5	39.0	35.4	21.7	40.3	23.0	15.4	1.38	1.63

Note: All dimensions are in millimeters.

CONNECTION DIAGRAM



HEADER MOUNT

FIGURE 3

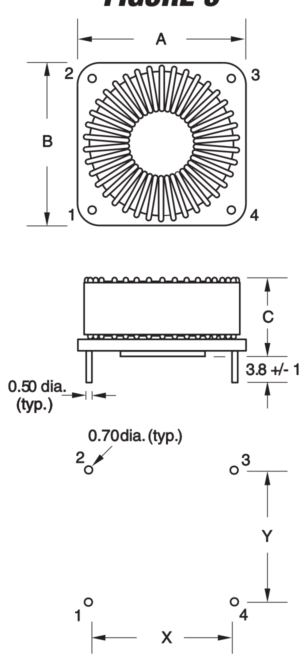


FIGURE 4

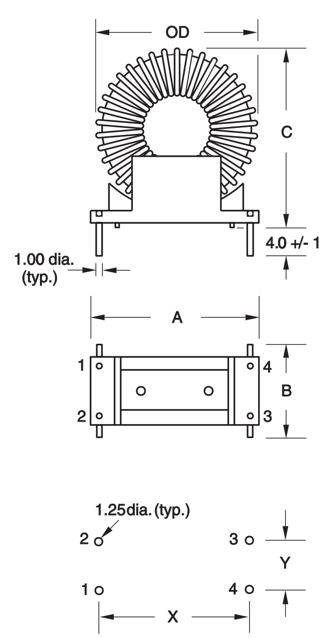
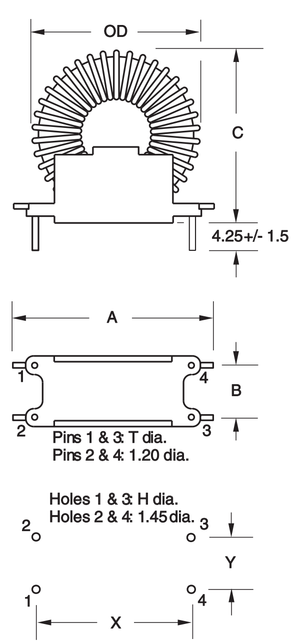


FIGURE 5



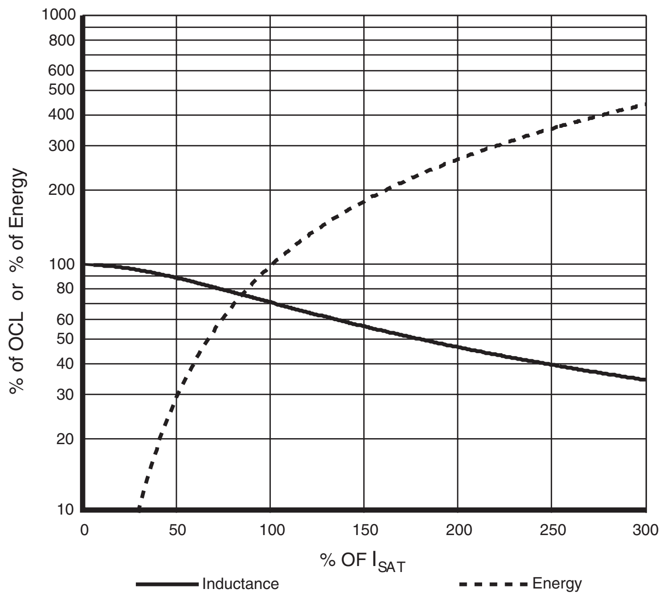
Drawings are not to scale.

COILTRONICS®

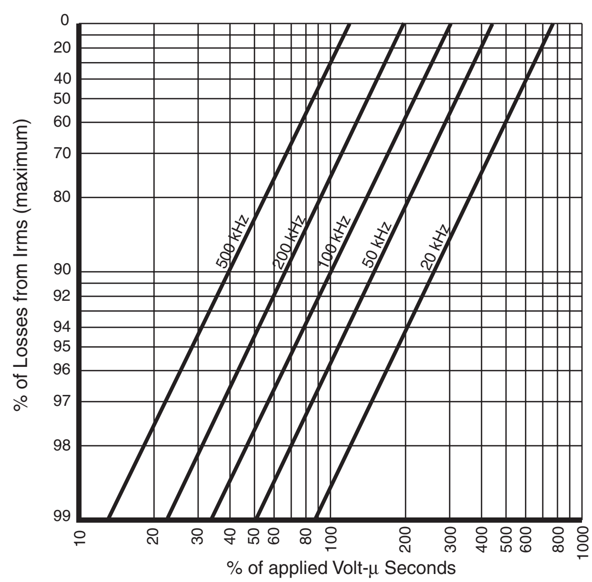
COOPER Bussmann

LOW COST POWER INDUCTORS
Toroidal Inductors

Inductance Characteristics



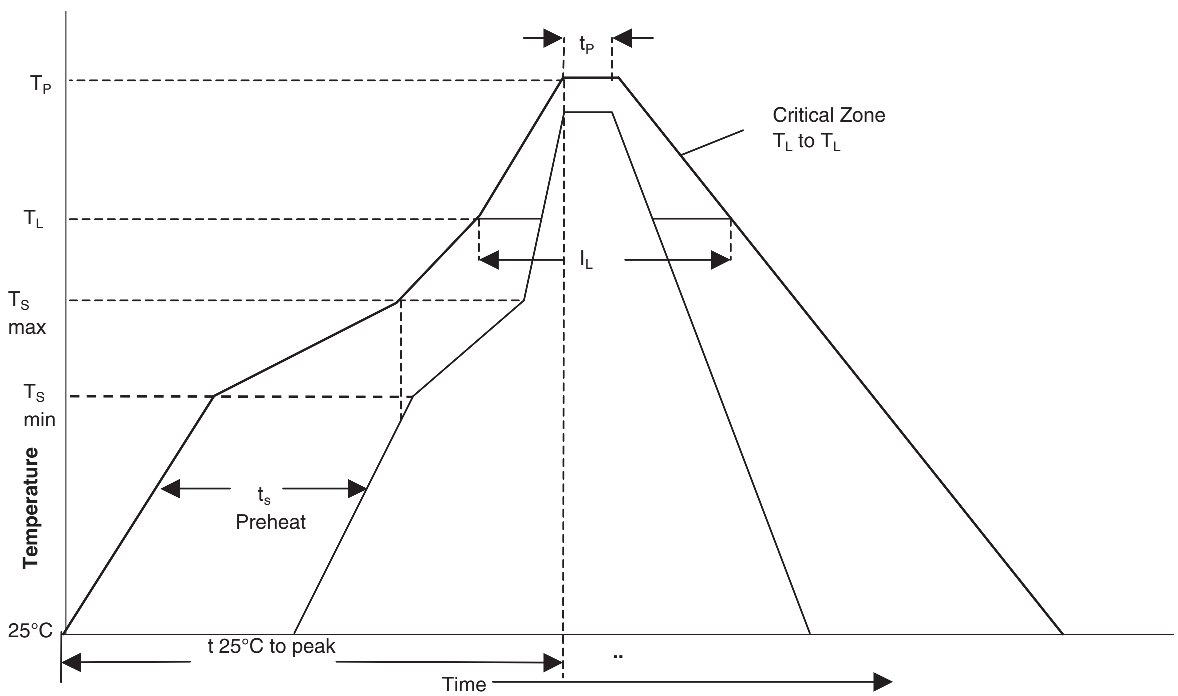
Core Loss



Recommended Solder Reflow Profiles

Profile Feature	Standard SnPb Solder	Lead (Pb) Free Solder
Average Ramp-Up Rate (T_L to T_P)	3°C/Second Max.	3°C/Second Max.
Preheat Temperature Min. (T_{Smin}) Temperature Max. (T_{Smax}) Time (Min to Max) (ts)	 100°C 150°C 60-120seconds	 150°C 200°C 60-120seconds
T_{smax} to T_L Ramp-Up Rate		 3°C/Second Max.
Time Maintained Above: Temperature (T_L) Time (t_L)	 183°C 60-150 Seconds	 217°C 60-150 Seconds
Peak Temperature (T_P)	235°C +/-5°C	255°C +/-5°C
Time Within 5°C of Actual Peak Temperature (t_P)	30 Seconds Max	10 Seconds Max
Ramp Down Rate	6°C/ Second Max.	6°C/ Second Max.
Time 25°C to Peak Temperature	6 Minutes Max	8 Minutes Max

All temperatures refer to the topside of the package, measured on the package body surface
Reference JEDEC J-STD-020B



APPLICATION NOTES

APPLICATION NOTES

Using the Versa-Pac as a Flyback Transformer

The Versa-Pac range of transformers is one of the many products manufactured under the Cooper Coiltronics® brand of power magnetics from Cooper Bussmann. Versa-Pac is available in five sizes and is suitable for flyback circuits with power levels up to 35W and a maximum switching frequencies of 500kHz. The VP series was designed, primarily, for low voltage applications typically 3.3V, 5V and 12V. With the addition of the VPH products to the range the Versa-Pac can now be used for 24V, 48V and, at higher frequencies, even 120V applications. Each transformer has six identical windings that can be configured in series and parallel to produce the required transformer design, the isolation between these windings is 500Vdc. Full product data is available on our website: www.cooperbussmann.com

Design Procedure

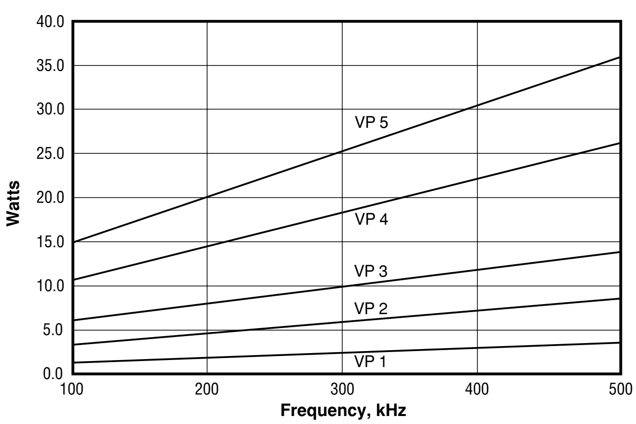
In order to design a flyback transformer using the Versa-Pac the following information is required: nominal, minimum and maximum input voltages (Vin(nom), Vin(min) & Vin(max)), output voltage (Vo), output current (Io) and switching frequency (Fs).

For the purpose of our example let's take the following values:

Vo = 5V, Io = 1A, Vin(min) = 40V, Vin(nom)=48V , Vin(max) = 56V and Fs = 200kHz

Using the graph for Unipolar (Flyback) Power v Frequency from the data sheet select the required Versa-Pac size by reading off your required output power and operating frequency.

Unipolar (Flyback) Power vs Frequency



At 200kHz and 5W this gives a VP3 size.

If the output power requirement can't be met then the Versa-Pac is unable to offer a flyback transformer solution. It may be worth considering a Push-Pull topology, as this will give better transformer utilization allowing high output power levels for the same transformer size.

Calculate the turns ratio for a duty cycle (D) of 0.5 using the equation;

Vo/Vin(nom) = Nsec/Npri x (D/1-D) (1)

Where Nsec is the number of secondary windings and Npri is the number of primary windings, Npri/Nsec is the turns ratio which must be rounded to the nearest achievable value (i.e. 0.5, 0.667, 1, 1.5, 2, 3 etc).

5/48 = Nsec/Npri x 0.5/(1-0.5)
Npri/Nsec = (48x1)/5 = 9.6
Rounding down, Npri/Nsec = 5 (max ratio)

Vin(nom) and 0.5 duty cycle are used only as a starting point, it is possible that using Vin(min) with lower or high duty cycles you may achieve a more suitable turns ratio.

Calculate the actual duty cycle for Vin(max) using equation 1 and the calculated turns ratio rounded up or down to the nearest achievable value.

5/56 = (1/5) x D/(1-D)
0.446-0.446D = D
D = 0.446/1.446 = 0.309

Calculate the primary volt-seconds product using the following equation:

Primary Vs = D x Ts x Vin(max)
Where Ts = 1/Fs (2)

This value should be less than the rated primary Volt-µsec, if the primary uses one winding the rated Volt-µsec is the same as Volt-µsec(Base). If the primary is two windings in series then the rating is then 2 x Volt-µsec(Base) and for 3 series windings 3 x Volt-µsec(Base) etc. If the Volt-µsec rating can not be achieved using the selected Versa-Pac size then you will need to select a larger size or increase the switching frequency.

Primary Vs = 0.309 x 1/200x10^3 x 56 = 86.52Vμsec

The VP3 has a Volt-μsec(Base) of 27.7Vμsec, multiplying this by 5 gives a rating of 138.5Vμsec. So the VP3 size meets the volt-seconds requirements.

If the required volt-seconds rating can't be achieved you can reduce the required rating by increasing the switching frequency. Alternatively you can recalculate the turns ratio using Vin(min) as this may increase the number of series primary windings.

Starting with the highest inductance value for the selected VP size, calculate the output current at which current conduction is at the boundary between continuous and discontinuous.

Io (boundary) = Ts x Vo x (1-D(max))^2/(2 x Ls) (3)

Where Ls is the secondary inductance and Dmax is the duty cycle at Vin(min).

Selecting the VP3-0780:
D(max) = 0.625/1.625 = 0.385
Ls = 63.2μH
Io (boundary) = 5x10^{-6} x 5 x (1-0.385)^2/
(2 x 63.2x10^{-6}) = 0.075A

As the boundary current is less than the maximum output current the transformer is operating in continuous mode.

Calculating the peak and rms primary currents we can determine if the selected Versa-Pac meets the specified requirements.

For Continuous mode conduction:

Peak Primary Current:

Ipri(peak) = Nsec/Npri x (1/1-D(max))
x Io + (Vin(min) x Ts x D(max))/2 x Lpri (4)

Where Lpri is the primary inductance.

In order to calculate the rms primary current you first need to calculate the primary current delta and average peak.

ΔIpri = (Vin(min) x D(max) x Ts)/Lpri (5)

Ipri(avg-pk) = (Ipri(peak) + (Ipri(peak) - ΔIpri))/2 (6)

Ipri(rms) = (D(max) x (Ipri(avg-pk))^2)$^{0.5}$ (7)

Ipri(peak) = 0.2 x 1/(1-0.385) + (40 x 5x10^{-6} x 0.385)/ (2 x 5^2 x 63.2x10^{-6}) = 0.35A

Peak current is higher than the Isat rating for the VP3-0780, which is equal to 6/5 x Isat(base). So moving up to the VP3-0138, we once again find that conduction is mainly continuous mode and so peak primary current:

Ipri(peak) = 0.2 x 1/(1-0.385) + (40 x 5x10^{-6} x 0.385)/ (2 x 5^2 x 11.2x10^{-6}) = 0.462A

ΔIpri = (40 x 0.385 x 5x10^{-6})/(5^2 x 11.2x10^{-6}) = 0.275A
Ipri(avg-pk) = (0.462 + (0.462 – 0.275))/2 = 0.325A
Ipri(rms) = (0.385 x 0.325^2)$^{0.5}$ = 0.202A

For the VP3-0138 the Irms rating is 1.47A and the Isat(base) is 0.59A both of which are sufficiently high to meet the primary current requirements.

For discontinuous mode conduction:

First we need to calculate the average primary current:

Ipri(avg)= (Vo x Io)/(Vin(min) x Efficiency) (8)

Ipri(peak) = (2 x Ipri(avg))/D(max) (9)

Ipri(rms) = ((Ipri(peak)^2 x D(max))/3)$^{0.5}$ (10)

You can now check these results against the Isat and Irms ratings, bearing in mine that the actual Isat rating:

= (6 x Isat(base))/Number of windings driven (11)

The number of windings driven for a flyback transformer is the number of series windings used to make up the primary. So for two series primary windings the rated Isat is actually 3 times Isat(base).

Finally, calculate the maximum rms secondary current,

For continuous mode:

Isec(rms) = ((1-D(max)) x (Io/(1-D(max)))^2)$^{0.5}$ (12)

For discontinuous mode:

$$Isec(rms) = ((1-D(max))/3 \times (Isec(peak))^2)^{0.5} \quad (13)$$

Where, referring to equation 9:

$$Isec(peak) = Ipri(peak) \times Npri/Nsec \quad (14)$$

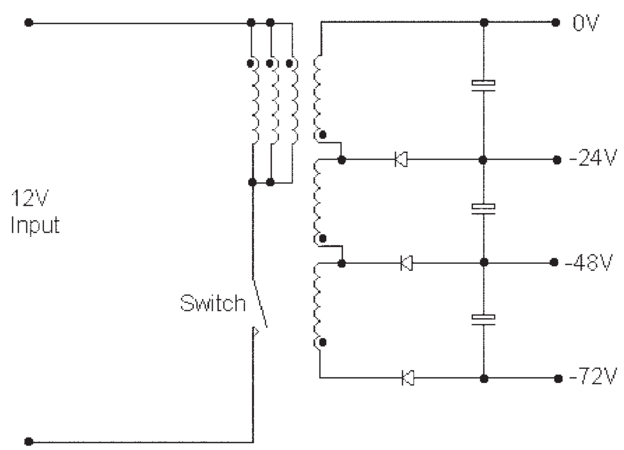
$Isec(rms) = ((1-0.385) \times (1/(1-0.385))^2)^{0.5} = 1.275A$

The VP3-0138 has an Irms(base) rating of 1.47A

Examples:

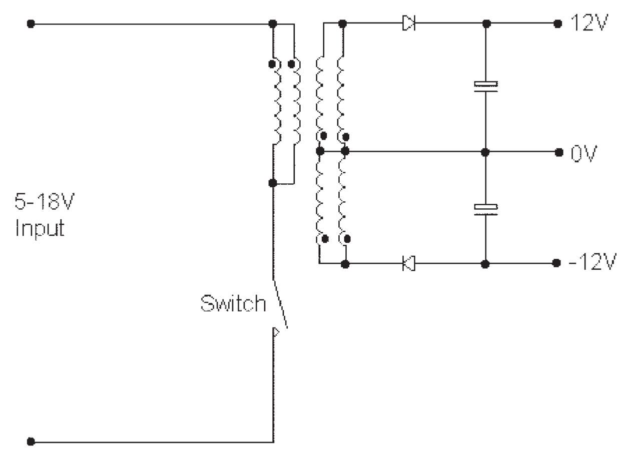
SLIC Power Supply

By connecting three secondary windings in series much higher output voltages can be achieve, in this example each secondary winding has a -24V output therefore providing the -48V and -72V supplies required in SLIC applications.



Split +/-12V Supply

Using a secondary center tap allows the winding to be configured for positive and negative outputs. Extra windings are paralleled with the primary and secondary windings in order handle more current and reduce losses.



Using the Versa-Pac as a Forward Converter Transformer

The Versa-Pac range of transformers is one of the many products manufactured under the Cooper Coiltronics® brand of power magnetics from Cooper Bussmann. Versa-Pac is available in five sizes and is suitable for a maximum switching frequency of 500kHz and power levels up to 30W, for single ended topologies, or 60W for bipolar applications. The VP series was designed, primarily, for low voltage applications typically 3.3V, 5V and 12V. With the addition of the VPH products to the range the Versa-Pac can now be used for 24V, 48V and, at higher frequencies, even 120V applications. Each transformer has six identical windings that can be configured in series and parallel to produce the required transformer design, the isolation between these windings is 500Vdc. Full product data is available on our website: www.cooperbussmann.com

Single Ended Forward Converter Design Procedure

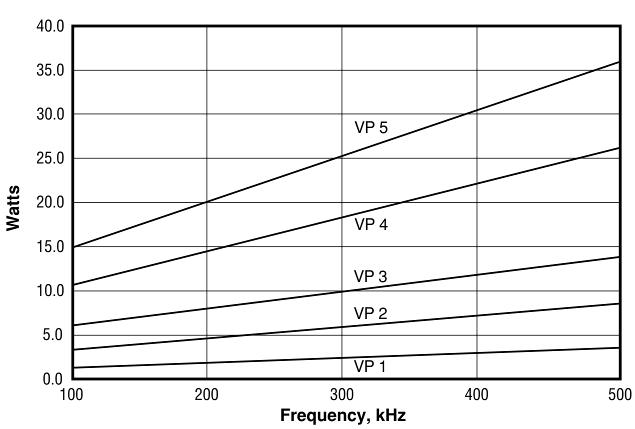
In order to design a forward converter transformer using the Versa-Pac the following information is required: nominal, minimum and maximum input voltages (Vin(nom), Vin(min) & Vin(max)), output voltage (Vo), output current (Io) and switching frequency (Fs).

For the purpose of our example let's take the following values:

Vo = 3.3V, Io = 5A, Vin(min) = 40V, Vin(nom)=48V , Vin(max) = 56V and Fs = 250kHz

Using the graph for unipolar (Flyback) Power v Frequency from the data sheet select the required Versa-Pac size by reading off your required output power and operating frequency.

Unipolar (Flyback) Power vs Frequency



At 250kHz and 16.5W this gives a VP5 size.

Although the data used in the Power v. Frequency curve was derived using a flyback topology, as a guide to Versa-Pac size requirements, it still holds true for unipolar forward converters.

Calculate the turns ratio for a duty cycle (D) of 0.25 using the equation;

Vo/Vin(nom) = D x Nsec/Npri (1)

Where Nsec is the number of secondary windings and Npri is the number of primary windings, Npri/Nsec is the turns ratio which must be rounded to the nearest achievable value (i.e. 0.5, 0.667, 1, 1.5, 2, 3 etc).

3.3/48 = Nsec/Npri x (0.25)
Npri/Nsec = (48x0.25)/3.3 = 3.6
Rounding down, Npri/Nsec = 3

Vin(nom) and 0.25 duty cycle are used only as a starting point, it is possible that using Vin(min) with lower or high duty cycles you may achieve a more suitable turns ratio. Note: Maximum duty cycle for most unipolar forward converters is 0.5.

Calculate the maximum duty cycle for Vin(min) using equation 1 and the calculated turns ratio rounded up or down to the nearest achievable value.

3.3/40 = 1/3 x (D)
(3.3 x 3)/40 = D
D(max) = 0.2475

Calculate the primary volt-seconds product using the following equation:

Primary Vs = D(max) x Ts x Vin(min)
Where Ts = 1/Fs (2)

This value should be less than the rated primary Volt-µsec, if the primary uses one winding the rated Volt-µsec is the same as Volt-µsec(Base). If the primary is two windings in series then the rating is then 2 x Volt-µsec(Base) and for 3 series windings 3 x Volt-µsec(Base) etc. If the Volt-µsec rating can not be achieved using the selected Versa-Pac size then you will need to select a larger size or increase the switching frequency.

Primary Vs = 0.2475 x 1/250x10^3 x 40 = 39.6Vµsec

The VP5 has a Volt-µsec(Base) of 65.6Vµsec, multiplying this by 3 gives a rating of 196.8Vµsec. So the VP5 easily meets the volt-seconds requirements.

If the required volt-seconds rating can't be achieved you can reduce the required rating by increasing the switching frequency. Alternatively you can recalculate the turns ratio using Vin(max) or a high duty cycle as this may increase the number of series primary windings.

Starting with the highest inductance value for the selected VP, calculating the rms primary currents we can determine if the selected Versa-Pac meets the specified requirements.

In order to calculate the rms primary current you first need to calculate the peak current.

Ipri(peak) = Nsec/Npri x (Io + ΔIo/2) + Imag(peak) (3)

Where:
Imag(peak) = (Vin(min) x Ts x D(max))/Lpri (4)

Primary rms current:
Ipri(rms) = (D(max) x (Ipri(avg-pk))^2)$^{0.5}$ (5)

Where:
Ipri(avg-pk) = (Ipri(peak) + (Ipri(peak) - Imag(peak)))/2 (6)

Assuming ΔIo is set to 10% of Io max, which is achieved by selection of the correct output inductor value (see application note EUA001). Using a VP5-1200, the L(base) is 76.8µH therefore:

Imag(peak) = (40 x 1/250x10^3 x 0.248)/ 3^2 x 76.8 x10^{-6}= 0.0574A
Ipri(peak) = 1/3 x (5 + (0.5/2) + 0.0574 = 1.81A
Ipri(avg-pk) = (1.81 + (1.81 – 0.0574))/2 = 1.78A
Ipri(rms) = (0.248 x 1.78^2)$^{0.5}$ = 0.89A

The rms current rating, Irms(base), for the VP5-1200 is 2.08A

Finally, calculate the maximum rms secondary current,

Isec(rms) = (D(max) x (Io + Isec(peak)/2)^2)$^{0.5}$ (7)

Where, referring to equation 3:

Isec(peak) = Ipri(peak) x Npri/Nsec (8)

Isec(peak) = 1.81 x 3 = 5.43A
Isec(rms) = (0.248 x ((5 + 5.43)/2)^2)$^{0.5}$ = 2.6A

The rms current rating, Irms(base), for the VP5-1200 is 2.08A. In order to achieve the required rms current rating at least two parallel windings must be used to make up the secondary. For improved efficiency it would be normal practice to use both the spare windings and have a secondary made up of three parallel windings.

Transformer Reset

In a practical single ended forward converter design you need to consider how transformer reset is going to be achieved. During the switch 'ON' period current proportional to the output current plus the magnetizing current flow in the primary winding, the magnetizing current must be reset to zero during the switch 'OFF' period in order to prevent converter failure. This can be achieved in a number of ways, figure 1 shows a method that uses an auxiliary primary winding connected in anti-phase to the main primary. This additional winding acts in flyback mode during the switch 'OFF' period recovering the magnetizing energy in to the supply rail.

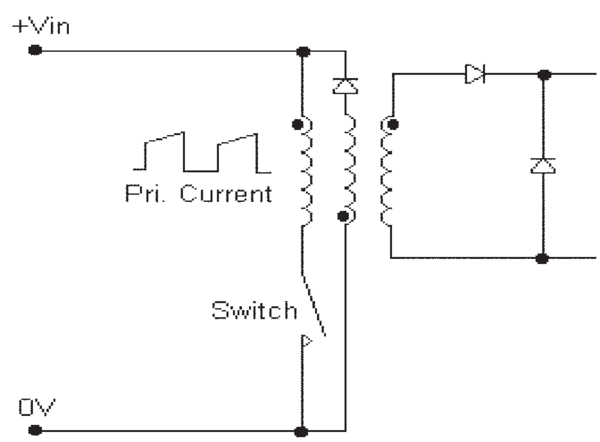


Figure 1

For Versa-Pac designs this method limits the converter maximum duty cycle to 50% and also reduces the number of possible configurations, as only 5 windings will be available. Figure 2 shows a simple way of resetting the transformer using an resistor-capacitor-diode (RCD) network which allows all 6 windings to be used when configuring the transformer.

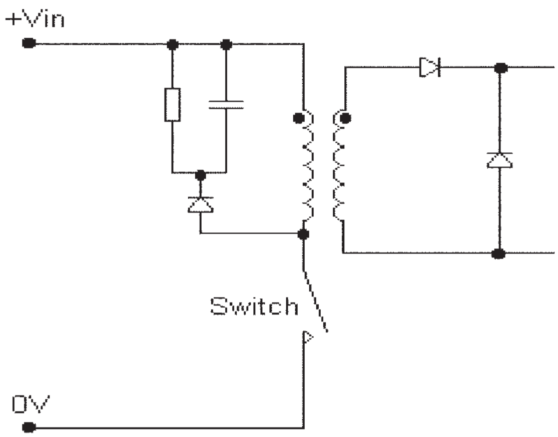


Figure 2

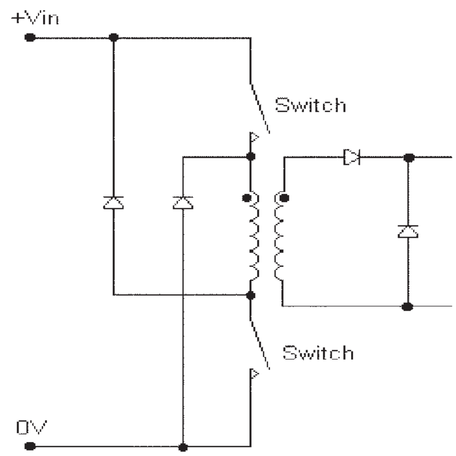
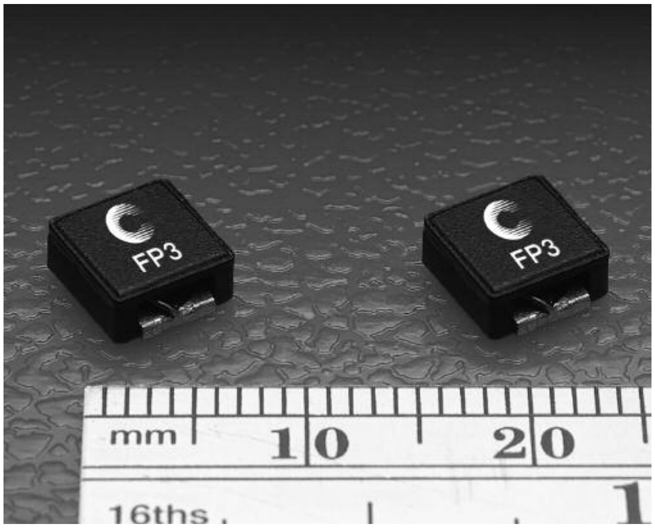


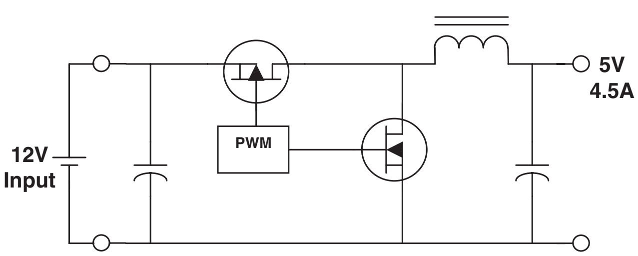
Figure 3

Using an RCD reset network has a number of advantages, it reduces the voltage stress on the switch, it limits turn off voltage spike and permits operation at greater than 50% duty cycle. Figure 3 shows a reset method for a dual switch topology, this method allows the primary winding to operate in flyback mode with the current flowing through the two recovery diodes. This technique is similar to that shown in figure 1, the advantages of this topology include reduced voltage rating requirement for the switches and no requirement for an auxiliary primary winding.

Power Inductors Improve Reliability in High Temperature Designs



The Cooper Coiltronics® brand of High Current FP3™ power inductors from Cooper Bussmann is designed for high density, medium current applications using a high temperature iron powder core material. These inductors do not exhibit the thermal aging issue frequently associated with iron powder core inductors. In fact the FP3 core is rated for 200°C without thermal degradation. The FP3 family is rated for 155°C operation. The calculations below will allow users to take advantage of this high temperature capability.



In this example, a buck regulator will be used to convert a 12V input to a 5V output with a load current of 4.5A. The operating frequency was chosen to be 600 kHz to reduce the size of the filter components, while still maintaining good efficiency. The converter is designed to have 20% ripple current, so a relatively low ESR output filter capacitor will be used, as is typical in switching power supplies.

First calculate the needed inductance value:
V = L * dI/dt where:
V = Vin - Vout (voltage across the inductor)
dT = On time of drive = Vout/Vin/frequency
∆I = Chosen above to be 20%

Calculate the required inductance:
L = V * dt / ∆I = (12-5)*(12/5/600k)/(0.2*4.5)
L= 4.8 µH
Choose 4.7 µH, the nearest standard value
Recalculate ripple current at 23% using 4.7 µH

Second determine peak to peak flux density, Bp-p:
Bp-p = K * L * ∆I where:

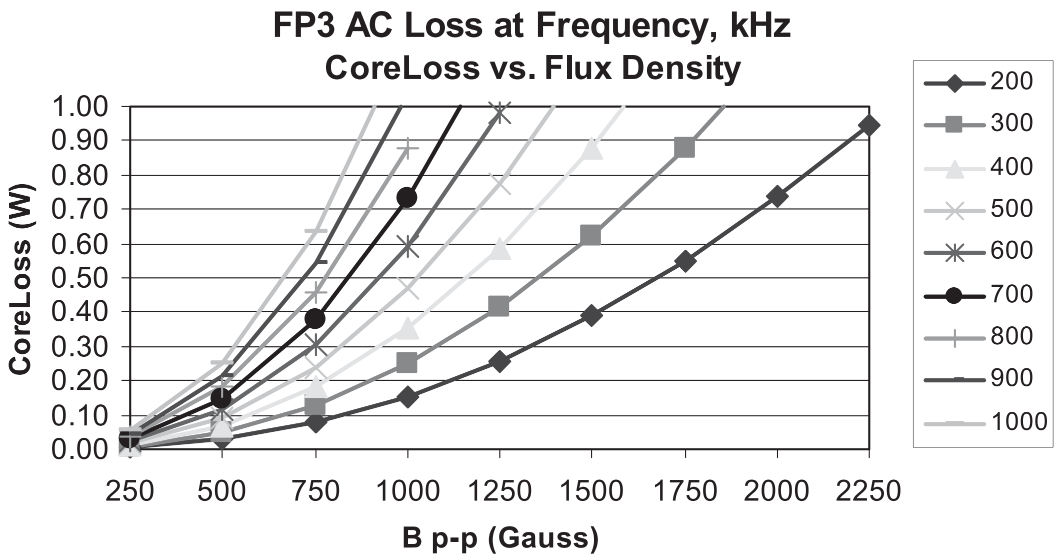
K: K-factor from the adjacent table
L: Inductance µH
∆I: Peak to peak ripple current (Amps)
Bp-p = 105*4.7*0.23*4.5 = 510 Gauss

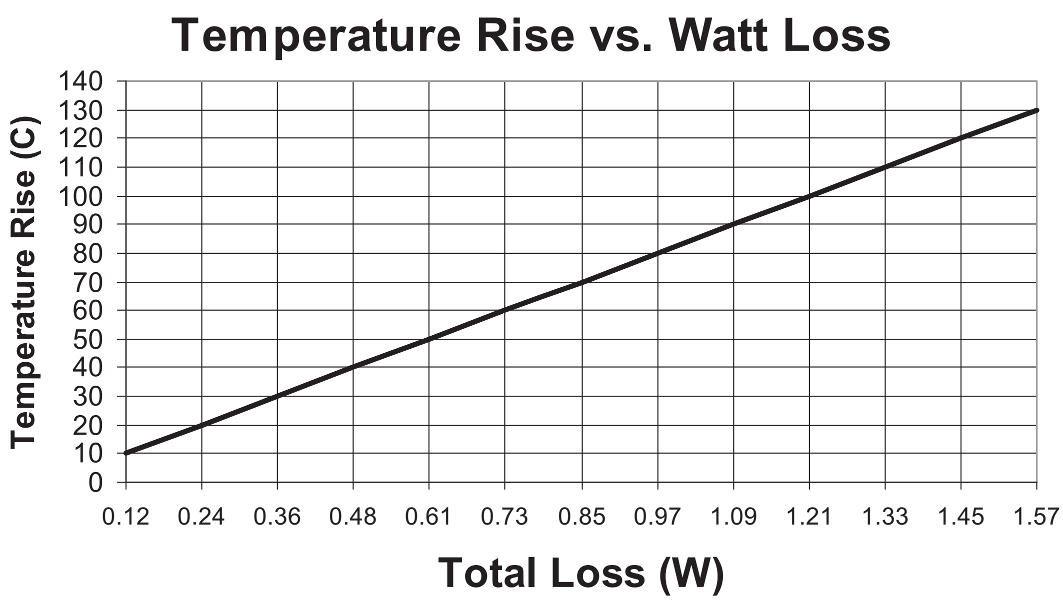
Part Number	K-factor
FP3-R10	803
FP3-R20	482
FP3-R47	344
FP3-R68	268
FP3-1R0	219
FP3-1R5	185
FP3-2R0	161
FP3-3R3	127
FP3-4R7	105
FP3-8R2	78
FP3-150	59

Next determine the total losses in the inductor:
Total losses = DC loss + AC loss
DC loss = I^2 *DCR = 4.5^2 * 0.040 = 0.81 W
(DCR from FP3 datasheet)
AC loss from table at Bp-p of 510 = 0.15 W
Total Loss = DC loss + AC loss = 0.96W

Finally determine the temperature rise.
Total loss = 0.96W, using the table,
Temperature rise is 80°C
Assuming an ambient temperature of 70°C,
The temperature of the inductor is
T = 70 +75 = 150°C

Note the data assumes no cooling airflow. Cooling will reduce the temperature of the inductor. The FP3 is rated for 155°C operation.





Switching Regulator Inductor Design

In switching regulator applications the inductor is used as an energy storage device, when the semiconductor switch is on the current in the inductor ramps up and energy is stored. When the switch turns off this energy is released into the load, the amount of energy stored is given by;

$$\text{Energy} = 1/2L.I^2 \qquad \text{(Joules)} \qquad (1)$$

Where L is the inductance in Henrys and I is the peak value of inductor current.

The amount by which the current changes during a switching cycle is known as the ripple current and is defined by the equation;

$$V_1 = L.di/dt \qquad (2)$$

Where V_1 is the voltage across the inductor, di is the ripple current and dt is the duration for which the voltage is applied. From this we can see that the value of ripple current is dependent upon the value of inductance.

Choosing the correct value of inductance is important in order to obtain acceptable inductor and output capacitor sizes and sufficiently low output voltage ripple.

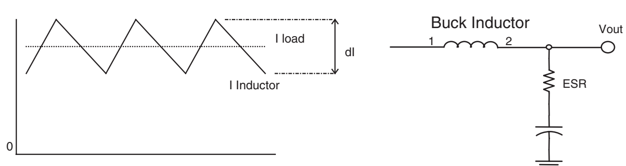


Figure 1

As can be seen from figure 1 inductor current is made up of AC and DC components, because the AC component is high frequency it will flow through the output capacitor as it has a low HF impedance. This will produce a ripple voltage due to the capacitor 'equivalent series resistance' (ESR) that will appear at the output of the switching regulator. This ripple voltage needs to be sufficiently low as not to effect the operation of the circuit the regulator is supplying, normally in the order of 10-500mVpk-pk.

Selecting the correct ripple current also impacts on the size of inductor and output capacitor, the capacitor will need to have a sufficiently high ripple current rating or it will overheat and dry out. In order to get a good compromise between inductor and capacitor size a ripple current value of 10-30% of maximum inductor current should be chosen. This also means that the current in the inductor will be continuous for output currents greater that 5-15% of full load.

Inductor Selection for Buck Converters

When selecting an inductor for a Buck converter, as with all switching regulators, you will need to define or calculate the following parameters:

- Maximum input voltage
- Output voltage
- Switching frequency
- Maximum ripple current
- Duty cycle

For the example shown in figure 2 lets assume a switching frequency of 250kHz, input voltage range of 12V±10% and a max ripple current of 220mA.

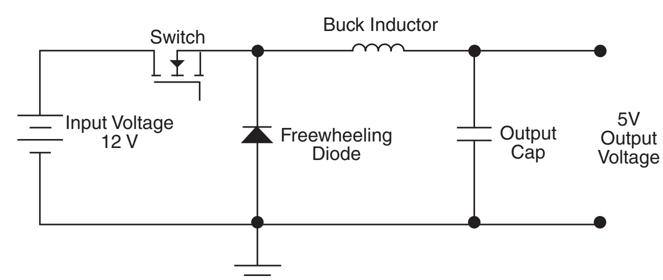


Figure 2

For an input voltage of 13.2V the duty cycle will be:

$$D = V_o/V_i = 5/13.2 = 0.379 \qquad (3)$$

Where V_o is the output voltage and V_i is the input voltage.

Voltage across the inductance:

$$V_1 = V_i - V_o = 8.2V \qquad \text{when the switch is on} \qquad (4)$$
$$V_1 = - V_o = -5V \qquad \text{when the switch is off} \qquad (5)$$

Require inductance:

$$L = V_1.dt/di = (8.2 \times 0.379/250 \times 10^3)/0.22 \qquad (6)$$
$$L = 56.5\mu H$$

Inductor Selection for Boost Converters

In order to calculate the require value of inductance for a Boost converter we follow the same procedure as described for the Buck converter, the difference being that the equations for duty cycle and inductor voltage change.

Taking maximum input voltage as 5.5V, switching frequency as 100kHz and maximum ripple current as 0.1A.

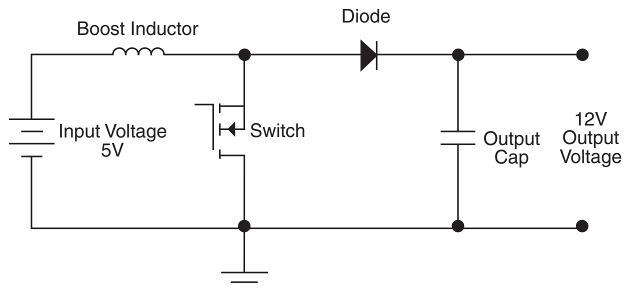


Figure 3

Duty cycle:

$D = 1 - (V_i/V_o) = 1 - (5.5/12) = 0.542$ (7)

Inductor Voltage:

$V_1 = V_i = 5.5V$ when the switch is on (8)

$V_1 = V_o - V_i = 6.5V$ when the switch is off (9)

Using equation 6, inductance:

$L = (5.5 \times 0.542/100 \times 10^3)/0.1$

$L = 298\mu H$

One thing to note about the Boost converter topology is that, unlike the Buck converter, inductor current does not continuously flow to the load. During the switch 'on' period the inductor current flows to ground and the load current is supplied from the output capacitor. This means that the output capacitor must have sufficient energy storage capability and ripple current rating in order to supply the load current during this period.

Inductor Selection for Buck-Boost Converters (including Cuk & SEPIC)

The procedure shown here is for the Cuk converter but it applies equally well to the SEPIC and the single inductor Buck-Boost topologies. Initially we will consider the circuit utilizing two separate inductors of equal value and then look at some of the advantages of using coupled inductors.

For this example we shall use a switching frequency of 200kHz and a maximum ripple current of 200mA.

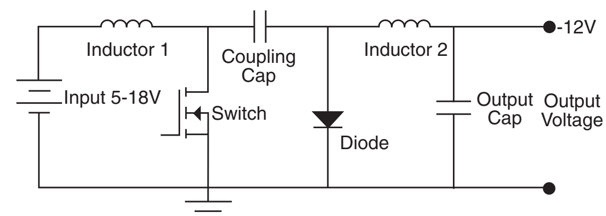


Figure 4

Duty cycle:

$D = V_o/(V_o + V_i) = 12/(12+18) = 0.4$ (10)

Inductor voltages:

$V_1 = V_i = 18V$ when the switch is on (11)

$V_1 = V_o = 12V$ when the switch is off (12)

Using equation 6, inductance:

$L = (18 \times 0.4/200 \times 10^3)/0.2$

$L = 180\mu H$

Both the SEPIC and Cuk topologies offer advantages over the single inductor Buck-Boost design. Input current is continuous resulting in lower peak values, drive circuit requirements are simple due to switch location and the use of a coupled inductor reduces the cost and PCB space penalties of these topologies.

One thing to note when using coupled inductors, for the total ripple current and total inductive energy stored to remain the same the inductance of each winding should be halved (for our example Lcouple = 90µH).

Inductor Selection for SEPIC Designs

The SEPIC (single-ended primary inductance converter) in an increasingly popular topology, particularly in battery powered applications, as the input voltage can be higher or lower than the output voltage. This presents obvious design advantages but for many engineers the circuit operation and component selection is a mystery, for those that understand the basics the addition of a coupled inductor is an added complication. This article looks at the operation of the SEPIC and compares the design procedure for two single winding inductors with a coupled inductor approach.

Basic Operation

Figure 1 shows the simple circuit diagram for a SEPIC, during the switch (SW) ON time the voltage across both inductors is equal to Vin. This is obvious for L1, however it is not so clear for L2. In order to understand this we first need to look at the voltage across Cp, neglecting ripple voltage, this voltage is constantly at the value of Vin. The simplest way to see this is when the circuit is at equilibrium, under these conditions there is no DC voltage across L1 or L2, so one side of the capacitor is at Vin and the other at zero volts.

When the switch is ON capacitor Cp is connected in parallel with L2, hence the voltage across L2 is the same as the capacitor voltage, -Vin. This in turn means that diode D1 is reverse bias and the load current is being supplied by capacitor Cout. During this period energy is being stored in L1 from the input and in L2 from Cp.

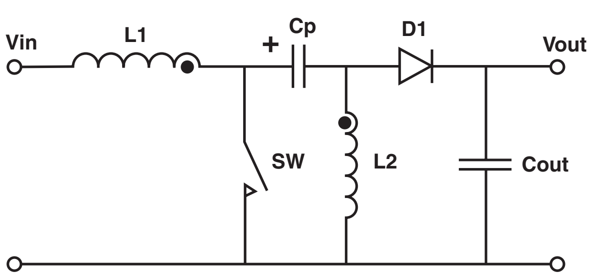


Figure 1 - Simple SEPIC Circuit

When the switch turns off the current in L1 continues to flow through Cp, D1 and into Cout and the load recharging Cp ready for the next cycle. The current in L2 also flows into Cout and the load, ensuring that Cout is recharged ready for the next cycle.

During this period the voltage across both L1 and L2 is equal to Vout, once again this is fairly clear for L2 but no so for L1. However we already know that the voltage across Cp is equal to Vin and that the voltage on L2 is equal to Vout, in order for this to be true the voltage at the node of Cp and L1 must be Vin + Vout. This in turn means that the voltage across L1 is (Vin+Vout) – Vin = Vout.

Inductor Selection

First, let us look at the selection of two separate inductors for L1 and L2 in the following example:

Input voltage (Vin) – 2.8V – 4.5V
Output (Vout & Iout) – 3.3V, 1A
Switching Frequency (Fs) – 250kHz
Efficiency - 90%

First we need to calculate the duty cycle;

D = Vout/(Vout + Vin)

The worst case condition for inductor ripple current is at maximum input voltage so;

D = 3.3/(3.3 + 4.5) = 0.423

Normally, the output inductor is sized to ensure that the inductor current is continuous at minimum load and that the output voltage ripple does not affect the circuit that the converter is powering. In this case we will assume a 20% minimum load thus allowing a 40% peak to peak ripple current in the output inductor L2.

Calculating the value of L2;

V = L di/dt

Where V is the voltage applied to the inductor, L in the inductance, di is the inductor peak to peak ripple current and dt is the duration the voltage is applied for. Hence;

L = V.dt/di

dt = 1/Fs x D
dt = 1/(250 x 10^3) x 0.423 = 1.69 µs

V = Vin during the switch ON time so;

L2 = 4.5 x (1.69 x 10^{-6}/0.4)
L2 = 19 µH

Using the nearest preferred value would lead to the selection of a 22 µH inductor. It is common practice to select the same value for both input and output inductors in SEPIC designs although when two separate parts are being used it is not essential.

Having selected the inductance value we now need to calculate the required RMS and peak current ratings for both inductors.

For input inductor L1;

Irms = (Vout x Iout)/(Vin (min) * efficiency)
Irms = (3.3 x 1)/(2.8 x 0.9) = 1.31A

Ipeak = Irms + (0.5 x Iripple)

Although worst case ripple current is at maximum input voltage the peak current is normally highest at the minimum input voltage.

Iripple = (V.dt)/L
Iripple = (2.8 x 2.2 x 10^{-6})/22 x 10 -6 = 0.28A

Ipeak = 1.31 + 0.14 =1.45A

So a 22µH, 1.31Arms & 1.45Apk rated inductor is required. For example the DR73-220 from Cooper Coiltronics®, this part is 7.5mm square and 3.5mm high with 1.62Arms and 1.67Apk current ratings.

For the output inductor L2

Irms = Iout = 1A

Iripple = (4.5 x 1.69 x 10^{-6})/22 x 10^{-6} = 0.346A

Ipeak = 1 + 0.173 = 1.173A

So a 22µH, 1Arms & 1.173Apk rated inductor is required, which for simplicity could be the same DR73-220 inductor used for L1.

Coupled Inductor Selection
When calculating the value for a coupled inductor you need to bear in mind that all the current is effectively flowing in one inductor and that if the two windings are closely coupled the ripple current will be split equally between them. So calculating the inductance value;

L = V.dt/di

From our earlier example the output ripple current needs to be 0.4Apk-pk, so now we calculate for 0.8A as the ripple current is split between the two windings

L = 4.5 x (1.69 x 10^{-6}/0.8) = 9.5µH

From this it can be seen that by using a coupled inductor the required inductance is halved. It is also important to note that because the two winding are on the same core they must be the same value. If they are not the voltage across each winding will not be equal and Cp will act as a short circuit to the difference.

Continuing with the example using an inductance value of 10µH we now need to calculate the worst case peak current requirement. We already know the RMS current in each winding,

Input inductor RMS current = 1.31A
Output inductor RMS current = 1A

Ipeak = Iin + Iout + (0.5 x Iripple)

Iripple = (2.8 x 2.2 x 10^{-6})/10 x 10^{-6} = 0.62A

Ipeak = 1.31 + 1 + 0.31 = 2.62A @ minimum input voltage

So a 10µH coupled inductor with 2.31Arms and 2.62Apk current ratings is required, for example DRQ74-100. This part has the same 7.5mm square footprint as the DR73-220 that was selected in the example using separate inductors but is 4.35mm high.

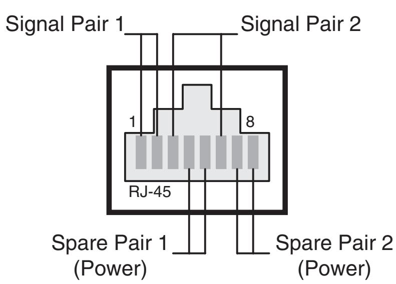
Using a coupled inductor takes up less space on the PCB and tends to be lower cost than two separate inductors. It also offers the option to have most of the inductor ripple current flow in either the input or the output. This is achieved by using a winding construction that positions most of the leakage inductance in one winding, this will cause most of the ripple current to appear in the opposite winding. By doing this the need for input filtering can be minimized or the output ripple voltage can be reduced to very low levels when supplying sensitive circuits.

Cooper Bussmann offers a number of coupled inductor options from the Cooper Coiltronics® range, including the SDQ and DRQ series of shielded drum inductors and the Econo-Pac and Octa-Pac range of toroid inductors. With inductance values from 0.33µH to 1mH and sizes from 5.2mm 2 x 1.2mm high up to 12.5mm 2 x 8mm high Cooper Coiltronics® offers one of the broadest ranges of coupled inductor solutions.

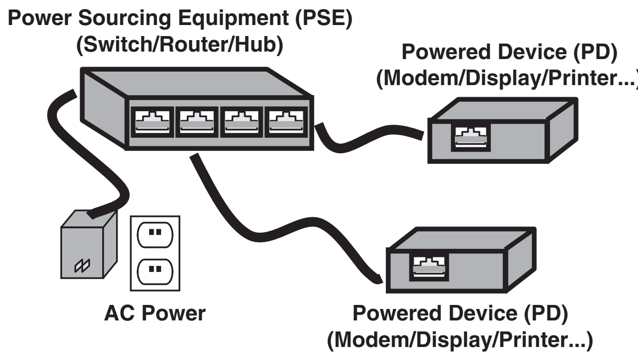
PoE Power Magnetics - Options and Trends

What is Power over Ethernet technology?
Ethernet enabled devices require both data connectivity and a power supply. Power over Ethernet (PoE) technology allows Ethernet devices to receive power as well as data over standard category 5 Ethernet cable. PoE is governed by the standard defined in IEEE802.3af. Specific details of the 802.3af standard are available from the Institute of Electrical and Electronic Engineers at www.ieee.org. This article highlights an easy to use, low cost Cooper Coiltronics® PoE power magnetic selection. In short, the PoE port allows a powered device (PD) to draw up to 12.95W from the power-sourcing equipment (PSE). PSE controls the PoE port and it identifies PDs via detection and classification before powering the port. The big advantage of PoE is the elimination of the nuisance “wall wart” power converters. In this case, the need to install additional AC power outlets and connect electrical wires to each terminal is eliminated. Only one cable is needed for your appliance. PoE promises to create a new world of network appliances by saving space, lower cost, easier maintenance and flexible installation.

What is Power over Ethernet application?
PoE is gaining in popularity and manufacturers already have products on the market such as VoIP (Voice over Internet Protocol) telephones, UPS, Wireless LAN access points, Bluetooth access points, Network cameras, Building access systems, Time and attendance systems, Retail point-of-information systems, Battery chargers for mobile phones and PDAs, Vending machines and Gaming machines.



Cooper Coiltronics Power Over Ethernet Transformer and characteristics
In order to comply with IEEE802.3af PoE standard, Powered Device (PD) must meet the isolation requirement. Dc-Dc converters solve the isolation problem. Forward and Flyback switcher topologies can use Cooper Coiltronics PoE transformers to isolate the PD’s PoE interface from the rest of its circuitry while stepping down the PoE input voltage to power the PD circuitry.



Cooper Coiltronics PoE transformers support 1500VAC isolation in the power converter with feedback voltage of 11V at 0.1A. Available in 4W, 7W and 13W, the transformers accept input voltage range from 29.5V to 60V using a nominal 250KHz switching frequency. An EFD15 core is used in 4W and 7W transformers while an EFD17 core is used in the 13W transformers. The EFD17 is a core developed by Cooper Bussmann to fit in between the EFD15 and EFD20 core sizes, and allows a smaller solution than most competitive devices for the same output power. These components operate in ambient temperatures between -40 and +85 degrees Celsius. Due to the size, Cooper Coiltronics PoE transformers can handle DC current of PoE and are rated for operating temperatures up to 125 degrees Celsius.

Cooper Coiltronics PoE transformers feature split primary and secondary windings to minimize leakage inductance – minimizing the result of imperfect magnetic linking of one winding to another. These components allow multiple output variations. 3.3V and 5V PoE transformers support three outputs while 12V transformers support two outputs. Each of them has same output current and voltage. Alternately, the isolated windings can be combined in series to produce additional voltage combinations.

PoE13W3VERS has three different outputs, 7V, 3.3V and 1.8V respectively. These outputs can be connected in series to produce a converter with 1.8V, 5.1V and 12.1V from the same transformer. The series configuration produces optimal cross regulation between outputs. PoE13W2VERS has two different outputs, 5V and 3.3V. VERS refers to the Cooper Coiltronics Versa-Pac® product lines that offer more than 500 usable inductor or transformer configurations. The same concept has been used in the PoE transformer family. Connecting the windings in parallel will increase the current carrying capability while connecting in series will increase the output voltage. These components provide flexibility in the design to connect the winding in series or parallel, and thereby achieving higher voltage or current.

Future trend- High Power over Ethernet (HPoE)
The current IEEE802.3af standard is restricted to low power devices but the demand to standardize high power PoE is increasing. A standard capable with double the power limit of 13W on a 48V input was proposed. High Power over Ethernet needs same level of safety, reliability and should be backwards compatibility with the IEEE 802.3af standard. Cooper Coiltronics is also introducing 26W HPoE transformers. Due to power and efficiency requirements, Forward converters with synchronous rectification are used. A gate drive winding will be provided on the secondary side. The operating frequency is 300KHz - available in 3.3V and 5V outputs. The new standard delivers power to laptops, advanced network cameras, videophone, flat screen monitor and other high power consumption Ethernet devices.

Conclusion
With the introduction of the IEEE Power over Ethernet standard, the advantages of easy installation and robustness of a powered network has quickly lead to the introduction of many new network appliances. Higher power devices demand the same advantage, since reducing cost is always a driver for implementing new technology. As a key player manufacturing power magnetics, Cooper Coiltronics offers a series of standard PoE products suitable to use in Dc-Dc converters. Samples are available upon request and the datasheet is available in the website: www.cooperbussmann.com.

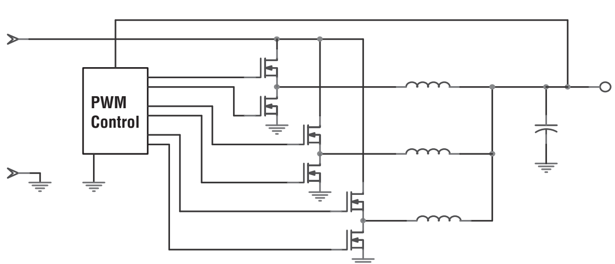
High Current Inductors for DC-DC Converters

State-of-the-art power supply design of DC-DC converters requires maximum thermal efficiency, low switching losses and platform scalability. Overall systems efficiency can be improved by the advancements in strategic power components. When striving for maximum efficiency, low switching components losses and parasitic inductance losses are critical. This is driven by increasing performance requirements of new microprocessors ranging from 10A to120A and starting 50nH.

High current inductors can be found in many DC-DC converter applications such as:

- VRM (Multi-phase for Servers / Desktop / Notebook computers)
- DDR Memory Power Supply(Synchronous Buck and Multi-phase Converters)
- GPU Graphics cards (Buck and Multi-phase Converters)

Voltage Regulators



Multi-phase VRMs for High-End Desktops, Servers, and Notebook Computers

The evolution of today's microprocessors requires high frequency synchronous buck converters to provide highly efficient power to high current low voltage processors with fast transient response. High frequency switching translates back to increased FET losses as the major contributor to switching loss. The combined DC and AC loss in inductors is the next highest contributor of power loss. A roadmap of modern CPU's shows that processor current will keep increasing up to 200Amps by 2006 (5 phases, 40A/phase). High current inductors can positively impact the overall system's efficiency by up to 2%. A well packaged high current inductor: provides higher energy density and low loss (Core and Copper loss) and can be available in both THT and SMT which brings flexibility to chipset developers.

Cooper Coiltronics®

Cooper Coiltronics brand magnetics from Cooper Bussmann offer a wide variety of standard and customized solutions. We specialized in inductors and transformers for DC-DC power conversion and switch-mode applications requiring high frequency magnetics. Our products are used in many standard topologies including:

- EMI/ Noise Filter: Common Mode and Series Mode
- Averaging Choke: Buck and Boost
- Coupled Inductors: Coupled Choke, Flyback, Sepic

The Cooper Coiltronics High Current and Flat-Pac inductor product lines provide an optimal mix of innovative packaging, high efficiency and unbeatable reliability. We invest in new technologies that deliver superior performance by providing high power density and reduced inductor size when compared to conventional solutions. Core and conductor losses become more critical as higher switching frequencies are used. Our designs utilize low loss core materials, new and custom core shapes in combination with innovative construction and packaging to provide power supply designers with the highest performance parts available in the market.

Summary

Cooper Coiltronics magnetic component solutions deliver high performance, innovative packaging, scalability and unbeatable reliability. Our wide variety of High Current and Flat-Pac inductors are specifically developed for today and tomorrow's DC-DC converters. For all your high current inductor and transformer needs, Cooper Coiltronics is your best power magnetics solution partner.

Magnetics Design Specification Form

Company:	Application:
Contact:	Sales Contact: Date:
Address:	Sample Quantity: ☐ Quote Only
Phone:	Target Cost:
Fax: Email:	Estimated Annual Quantity:

Standard Geometry	☐ ER 11/5-SG1	☐ ER 14.5/6-SG2	☐ EFD 15-SG3	☐ EFD 17-SG4	☐ EFD 20-SG5
	☐ EE 8.3-SG6	☐ EF 12.6-SG7	☐ EE 13-SG8	☐ SEE 16-SG9	

Topology	☐ Buck	☐ Boost	☐ Flyback	☐ Coupled inductor
	☐ Forward	☐ Gate Drive	☐ SEPIC	☐ Common Mode

Frequency Range: Duty cycle: ☐ Continuous ☐ Discontinuous

Input Voltage:

Power:

Output Voltage (s) @ Continuous Current:

DESIGN PRIORITY

- Cost ☐
- Size ☐
- Efficiency ☐

Inductance:

Input Switch Current (Ipk):

Max Ambient Temp:

DC Resistance (DCR):

Dielectric Withstanding Voltage (Hypot):

Mounting: ☐ Surface Mount ☐ Thru-Hole Specify mounting pad or hole dimensions below.

Max Dimensions Length: Width: Height:

Agency Approvals? ☐ Yes Agency and Document Number:

Schematic, Notes & Sketch:

MAGNETICS DESIGN SPECIFICATION FORM

NOTES

Power Management

PowerStor®

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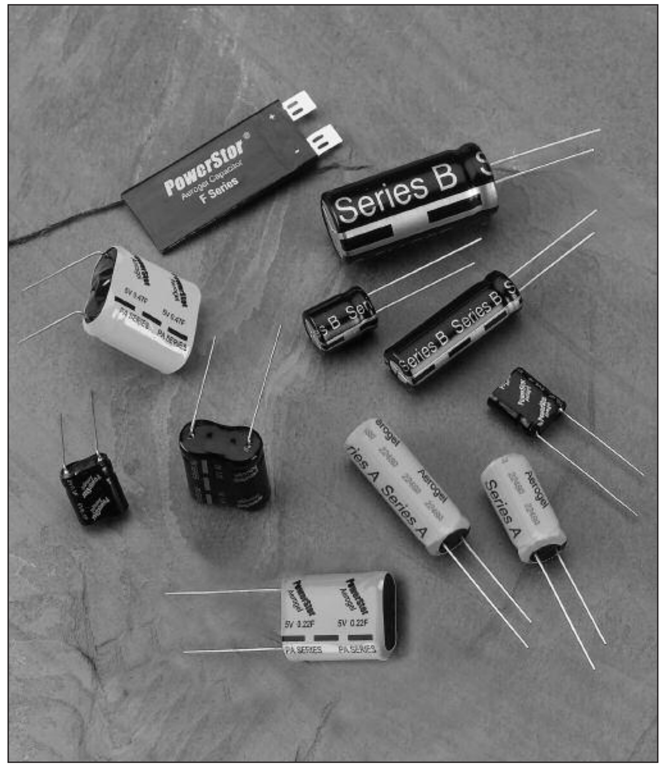
COOPER Bussmann

PowerStor®

Product Overview

RoHS 2002/95/EC



Superior Supercapacitor Technology
- Based on novel Aerogel carbon foam

Broad Standard Product Line
- Cylindrical and prismatic packages
- High power (low ESR) and high energy

Custom Product Capabilities
- Application specific designs
- Size and shape, capacitance, ESR, voltage, temperature

Applications

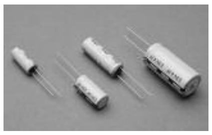
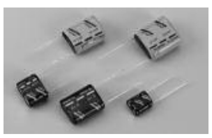
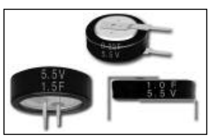
Pulse Power
- Low duty cycle pulse power
- Hybrid battery-supercapacitor systems
- Valve/solenoid actuation, HVAC controls
- Radio transceivers, GSM/GPRS devices
- Automated meters, portable printers

Bridge (or Hold-up) Power
- Portable data terminals
- Tape drives
- Set top gaming devices
- Infusion pumps
- Automotive, avionics, military and medical

Main Power
- Toys
- Solar charged devices (lighting, signaling, remote monitoring systems)
- Uninterruptible power systems

Memory Backup
- Microprocessor and micro-controller backup
- RAM / SRAM memory protection
- Real time clock (RTC) backup

Features	Benefits
Low ESR	High discharge power / rate capability
High capacitance	Long runtime / high energy density
Stable materials	Long life over wide temperature range
Static charge / discharge process; no chemical reactions	Nearly infinite cycle life
Series / parallel configurations	Higher voltage and energy than individual supercapacitors
Supercapacitor properties can be tailored	Custom for specific energy / power requirement
Custom packaging	Meet most mechanical requirements

Product Code	Key Features	Key Benefits	Capacitance	ESR	Voltage (Nominal)	Temperature
A Series 	Ultra-low ESR (Resistance)	Very High pulse power capability	0.47 to 4.7F	0.025 to 0.150 Ohms	2.5V	-25°C to 70°C
B Series 	High energy density	Long run-time capability	0.22 to 50F	0.025 to 3 Ohms	2.5V	-25°C to 70°C
P Series 	Higher Voltage	Designed for 5V applications	0.1 to 1F	As low as 0.2 Ohms	5V	-25°C to 70°C
KR Series 	High energy density & higher voltage	Long back-up time in 5V applications	0.1 to 1.5F	30 to 75 Ohms	5.5V	-25°C to 70°C
F Series 	Polymer-foil laminate packaging	Fits into space constrained applications as thin as 2mm	0.33F	0.250 Ohms	3.6V	-20°C to 60°C

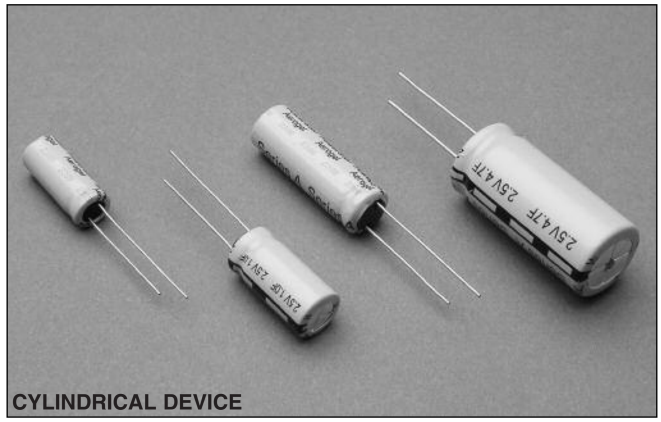
COOPER Bussmann

Aerogel Supercapacitors
A Series

Description

RoHS 2002/95/EC

The PowerStor® Aerogel Capacitor is a unique, ultra-high capacitance device based on a novel type of carbon foam, known as carbon aerogel. Aerogel capacitors are similar to supercapacitors, ultracapacitors and electrochemical double layer capacitors (EDLCs) with the added benefit of low ESR (Equivalent Series Resistance).


CYLINDRICAL DEVICE

Features & Benefits

- Very low ESR
- Low leakage current
- Long cycle life
- High useable capacity
- Very high specific capacitance also available (B Series)

Applications

- Pulse power
- Hold-up power
- DC/DC converters
- Hybrid battery packs
- Valve / solenoid actuation

SPECIFICATIONS	
Working Voltage	2.5 volts
Surge Voltage	3.0 volts
Nominal Capacitance Range	0.47 to 4.7 F
Capacitance Tolerance	-20% to +80% (20°C)
Operating Temperature Range	-25°C to 70°C

STANDARD PRODUCTS

Nominal Capacitance (F)	Part Number	Nominal ESR (Equivalent Series Resistance) Measured @ 1kHz (Ω)	Nominal Dimensions	Typical Mass (grams/1 piece)
0.47	A0820-2R5474-R	0.150	Ø = 8 mm; L = 20 mm	1.8
1.0	A1020-2R5105-R	0.090	Ø = 10 mm; L = 20.5 mm	2.6
1.5	A1030-2R5155-R	0.060	Ø = 10 mm; L = 30 mm	3.8
4.7	A1635-2R5475-R	0.025	Ø = 16 mm; L = 35 mm	10.7

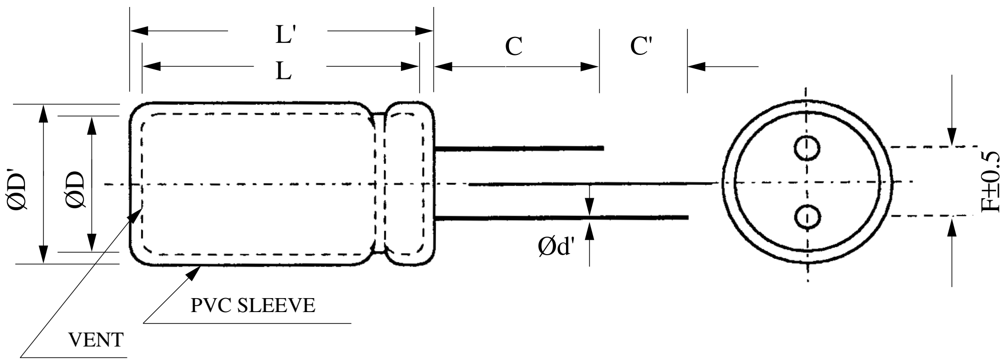
PERFORMANCE

Parameter	Capacitance Change (% of initial measured value)	ESR (% of initial specified value)
Life (1000 hrs @ 70°C @ 2.5 volts DC)	≤ 30	≤ 300
Storage - Low and High Temperature (1000 hrs @ -25°C and 70°C)	≤ 30	≤ 300

COOPER Bussmann

DIMENSIONS (mm)								
Part Number	D	D'	L	L'	F	d'	C	C'
A0820-2R5474-R	8.0	8.5	20.5	21.0	3.5	0.50	20.0	5.0
A1020-2R5105-R	10.0	10.5	21.8	22.3	5.0	0.60	20.0	5.0
A1030-2R5155-R	10.0	10.5	31.0	31.5	5.0	0.60	20.0	5.0
A1635-2R5475-R	16.0	16.5	37.5	38.0	7.5	0.80	20.0	5.0
	Maximum				± 0.5	± 0.02	Minimum	

Note: Longer lead is positive



PART NUMBERING SYSTEM								
A	□ □	□ □	-	2	R	5	□ □	□
Series Code	Dimensions (mm)			Voltage (V) R is decimal			Capacitance (µF)	
B = Very Low ESR	Diameter	Length		2R5 = 2.5V			Value	Multiplier
							Example: 475 = 47 x 10^5 µ F or 4.7 F	

PACKAGING INFORMATION

Standard packaging: Bulk, 100 units per package.

Special packaging available upon request. Contact factory.

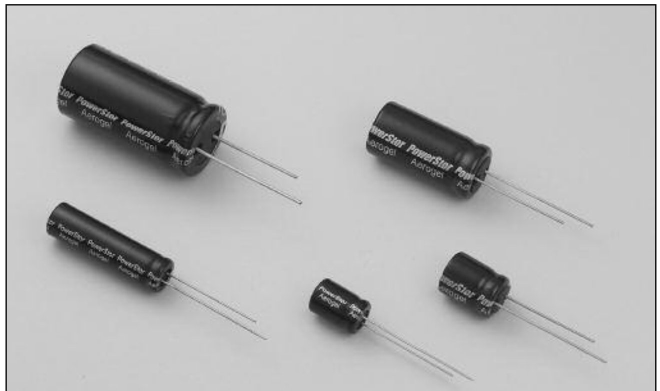
PART MARKING

Manufacturer
Capacitance (F)
Max. Operating Voltage (V)
Series Code (or part number)
Polarity Marking

Description

RoHS 2002/95/EC

The PowerStor® Aerogel Capacitor is a unique, ultra-high capacitance device based on a novel type of carbon foam, known as carbon aerogel. Aerogel capacitors are similar to supercapacitors, ultracapacitors and electrochemical double layer capacitors (EDLCs) with the added benefit of low ESR (Equivalent Series Resistance).



CYLINDRICAL DEVICE

Features & Benefits

- High specific capacitance
- Very low ESR
- Low leakage currents
- Long cycle life
- Ultra low ESR also available (A Series)

Applications

- Main power
- Hybrid battery packs
- Hold-up power
- Pulse power

SPECIFICATIONS	
Working Voltage	2.5 volts
Surge Voltage	3.0 volts
Nominal Capacitance Range	0.22 to 100 F
Capacitance Tolerance	-20% to +80% (20°C)
Operating Temperature Range	-25°C to 70°C

STANDARD PRODUCTS

Nominal Capacitance (F)	Part Number	Nominal ESR (Equivalent Series Resistance) Measured @ 1kHz (Ω)	Nominal Dimensions	Typical Mass (grams/1 piece)
0.22	B0510-2R5224-R	3	Ø = 5 mm; L = 11 mm	0.54
1.0	B0810-2R5105-R	0.400	Ø = 8 mm; L = 13 mm	1.2
1.5	B1010-2R5155-R	0.300	Ø = 10 mm; L = 12.5 mm	1.9
2.2	B0820-2R5225-R	0.200	Ø = 8 mm; L = 20 mm	1.5
3.3	B1020-2R5335-R	0.150	Ø = 10 mm; L = 20.5 mm	2.8
4.7	B0830-2R5475-R	0.150	Ø = 8 mm; L = 30 mm	2.6
6.8	B1030-2R5685-R	0.100	Ø = 10 mm; L = 30 mm	3.9
10	B1325-2R5106-R	0.060	Ø = 13 mm; L = 26 mm	5.6
22	B1635-2R5226-R	0.040	Ø = 16 mm; L = 35 mm	11.0
33	B1835-2R5336-R	0.030	Ø = 18 mm; L = 35 mm	13.5
50	B1840-2R5506-R	0.025	Ø = 18 mm; L = 40 mm	14.7
100	B1860-2R5107-R	0.020	Ø = 18 mm; L = 60 mm	22.0

PERFORMANCE

Parameter	Capacitance Change (% of initial measured value)	ESR (% of initial specified value)
Life (1000 hrs @ 70°C @ 2.5 volts DC)	≤ 30	≤ 300
Storage - low and high temperature (1000 hrs @ -25°C and 70°C)	≤ 30	≤ 300

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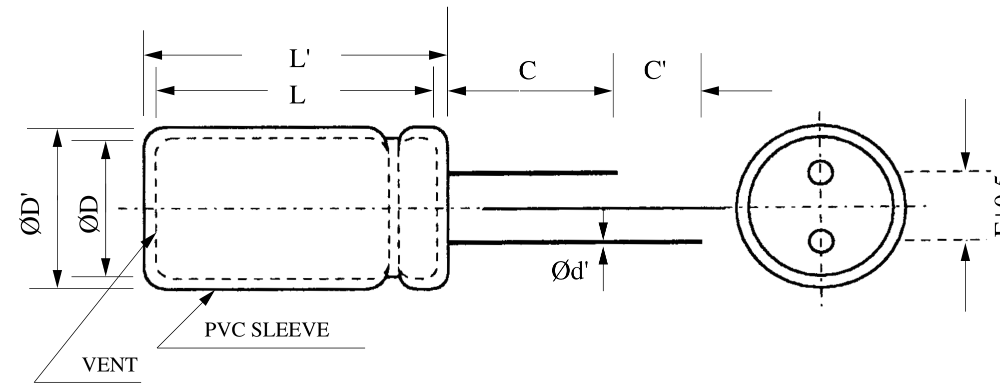
DIMENSIONS (mm)								
Part Number	**D**	**D'**	**L**	**L'**	**F**	**d'**	**C**	**C'**
B0510-2R5224-R	5.0	5.5	11.5	12.0	2.0	0.50	20.0	5.0
B0810-2R5105-R	8.0	8.5	13.0	13.5	3.5	0.50	20.0	5.0
B1010-2R5155-R	10.0	10.5	13.9	14.4	5.0	0.60	20.0	5.0
B0820-2R5225-R	8.0	8.5	20.5	21.0	3.5	0.50	20.0	5.0
B1020-2R5335-R	10.0	10.5	21.8	22.3	5.0	0.60	20.0	5.0
B0830-2R5475-R	8.0	8.5	30.5	31.0	3.5	0.50	20.0	5.0
B1030-2R5685-R	10.0	10.5	31.0	31.5	5.0	0.60	20.0	5.0
B1325-2R5106-R	13.0	13.5	27.9	28.4	5.0	0.60	20.0	5.0
B1635-2R5226-R	16.0	16.5	37.5	38.0	7.5	0.80	20.0	5.0
B1835-2R5336-R	18.0	18.5	37.5	38.0	7.5	0.80	20.0	5.0
B1840-2R5506-R	18.0	18.5	41.5	42.0	7.5	0.80	20.0	5.0
B1860-2R5107-R	18.0	18.5	59.5	60.0	7.5	0.80	20.0	5.0
	Maximum				± 0.5	± 0.02	Minimum	

Note: Longer lead is positive



PART NUMBERING SYSTEM								
B	**□ □**	**□ □**	**-**	**2**	**R**	**5**	**□ □**	**□**
Series Code	Dimensions (mm)			Voltage (V) R is decimal			Capacitance	
B = High Capacitance	Diameter	Length		2R5 = 2.5V			Value	Multiplier
							Example: 475 = 47 x 10^5 µ F or 4.7 F	

PACKAGING INFORMATION

Standard packaging: Bulk, 100 units per package.

Special packaging available upon request. Contact factory.

PART MARKING

Manufacturer
Capacitance (F)
Max. Operating Voltage (V)
Series Code (or part number)
Polarity Marking

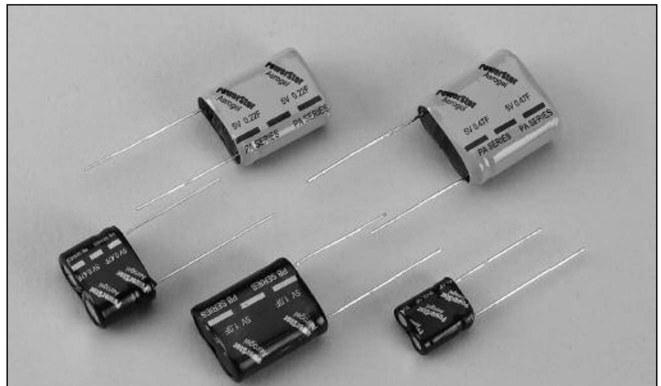
COOPER Bussmann

Description

RoHS 2002/95/EC

The PowerStor® Aerogel Capacitor is a unique, ultra-high capacitance device based on a novel type of carbon foam, known as carbon aerogel. Aerogel capacitors are similar to supercapacitors, ultracapacitors and electrochemical double layer capacitors (EDLCs) with the added benefit of low ESR (Equivalent Series Resistance).

The P Series is available in an ultra-low ESR version, PA or a low ESR but higher energy density version, PB.



LEADED DEVICE

SERIES	FEATURES AND BENEFITS: Generic	FEATURES AND BENEFITS: Specific	APPLICATIONS
PA	5.0 volts Low ESR	Ultra-low ESR	Pulse power Bridge or hold up power
PB	High capacitance Long cycle life Low leakage currents	Low ESR with higher energy density	Bridge or hold up power Memory backup Battery swap out

SPECIFICATIONS	
Working Voltage	5.0 volts
Surge Voltage	6.0 volts
Nominal Capacitance Range	0.1 to 1.0 F
Capacitance Tolerance	-20% to +80% (20°C)
Operating Temperature Range	-25°C to 70°C

STANDARD PRODUCTS

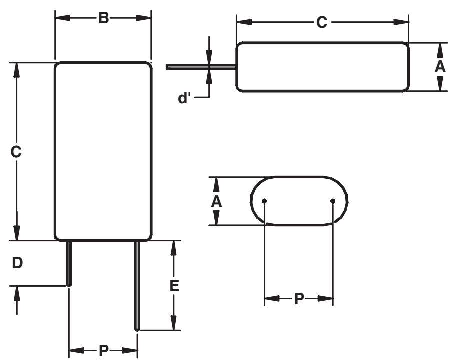
Nominal Capacitance (F)	Part Number	Nominal ESR (Equivalent Series Resistance) Measured @ 1kHz (Ω)	Nominal Dimensions	Typical Mass (grams/1 piece)
LOW ESR (PB SERIES)				
0.1	PB-5R0V104-R PB-5R0H104-R	10	5.5 x 10.8 x 12.5 mm	1.1
0.47	PB-5R0V474-R PB-5R0H474-R	2	8.5 x 16.8 x 14.0 mm	2.4
1.0	PB-5R0V105-R PB-5R0H105-R	1	8.5 x 16.8 x 21.5 mm	3.5
ULTRA-LOW ESR (PA SERIES)				
0.22	PA-5R0V224-R PA-5R0H224-R	0.30	8.5 x 16.8 x 21.5 mm	3.5
0.47	PA-5R0V474-R PA-5R0H474-R	0.20	10.5 x 20.8 x 22.5 mm	5.4

PERFORMANCE

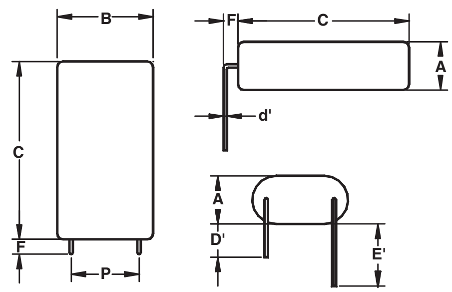
Parameter	Capacitance Change (% of initial measured value)	ESR (% of initial specified value)
Life (1000 hrs @ 70°C @ 5.0 volts DC)	≤ 30	≤ 300
Storage - Low and High Temperature (1000 hrs @ -25°C and 70°C)	≤ 30	≤ 300

DIMENSIONS (mm)										
Part Number	**A**	**B**	**C**	**d'**	**D**	**D'**	**E**	**E'**	**F**	**P**
PB-5R0V104-R PB-5R0H104-R	6.0	11.3	13.0	0.5	20	15	25	20	2.0	7.3
PB-5R0V474-R PB-5R0H474-R	9.0	17.3	14.5	0.5	20	15	25	20	2.0	11.8
PB-5R0V105-R PB-5R0H105-R	9.0	17.3	22.0	0.5	20	15	25	20	2.0	11.8
PA-5R0V224-R PA-5R0H224-R	9.0	17.3	22.0	0.5	20	15	25	20	2.0	11.8
PA-5R0V474-R PA-5R0H474-R	11.0	21.3	23.0	0.6	20	15	25	20	2.0	5.3
Tolerances	Maximum			± 0.02	Minimum				± 0.5	

Note: Longer lead is positive



VERTICAL



HORIZONTAL

PART NUMBERING SYSTEM								
P		**-**	**5**	**R**	**0**		□ □	□
Series Code	Version		Voltage (V) R is decimal			Configuration	Capacitance (µF)	
P = Pack	A = Ultra-low ESR - or - B = High Capacitance		5R0 = 5.0V			V = Vertical - or - H = Horizontal	Value	Multiplier
							Example: 474 = 47 x 10^4 µ F or 0.47 F	

PACKAGING INFORMATION

Standard packaging: Bulk, 100 units per package.

Larger bulk packages available upon request.

PART MARKING

Manufacturer
Capacitance (F)
Max. Operating Voltage (V)
Polarity Marking

COOPER Bussmann

PowerStor®

Aerogel Supercapacitors
KR Series

Description

RoHS 2002/95/EC

The Cooper PowerStor® Aerogel Capacitor is a unique, ultra-high capacitance device based on a novel type of carbon form, known as carbon aerogel. Aerogel capacitors are similar to Supercapacitors, ultracapacitors and electrochemical double layer capacitor (EDLCs) with the added benefit of low ESR (Equivalent Series Resistance)

The KR series offers a wide range of high capacitance coin cell style products for use in memory & RTC back-up applications. End products include computers, cameras, camcorders, telephones, printers, car stereos, CCTV, set top box and PDP.

SPECIFICATIONS	
Working Voltage	5.5 volts
Surge Voltage	6.3 volts
Nominal Capacitance Range	0.1 to 1.5 F
Capacitance Tolerance	-20% to +80% (20°C)
Operating Temperature Range	-25°C to 70°C

STANDARD PRODUCTS

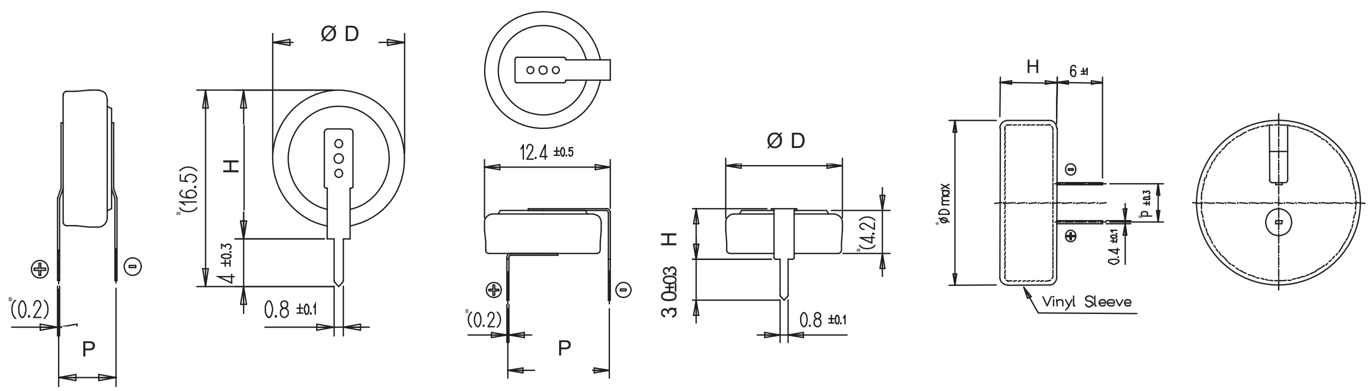
Nominal Capacitance (F)	Part Number	Nominal ESR (Equivalent Series Resistance) Measured @ 1kHz (Ω)	Nominal Dimensions	Typical Mass (grams/1 piece)
0.1	KR-5R5V104-R	75	Ø=11.5mm; L=12.5mm; P=5mm	1.4
0.1	KR-5R5H104-R	75	Ø=11.5mm; L=5mm; P=10mm	1.4
0.1	KR-5R5C104-R	75	Ø=13.5mm; L=7.5mm; P=5mm	3.3
0.22	KR-5R5V224-R	75	Ø=11.5mm; L=12.5mm; P=5mm	1.4
0.22	KR-5R5H224-R	75	Ø=11.5mm; L=5mm; P=10mm	1.4
0.22	KR-5R5C224-R	75	Ø=13.5mm; L=7.5mm; P=5mm	3.3
0.33	KR-5R5V334-R	50	Ø=11.5mm; L=12.5mm; P=5mm	1.4
0.33	KR-5R5H334-R	50	Ø=11.5mm; L=5mm; P=10mm	1.4
0.33	KR-5R5C334-R	50	Ø=13.5mm; L=7.5mm; P=5mm	3.3
0.47	KR-5R5V474-R	50	Ø=11.5mm; L=12.5mm; P=5mm	1.4
0.47	KR-5R5H474-R	50	Ø=11.5mm; L=5mm; P=10mm	1.4
0.47	KR-5R5C474-R	50	Ø=13.5mm; L=7.5mm; P=5mm	3.3
1.0	KR-5R5V105-R	30	Ø=19mm; L=19.5mm; P=5mm	4.2
1.0	KR-5R5H105-R	30	Ø=19mm; L=6.5mm; P=20mm	4.2
1.0	KR-5R5C105-R	30	Ø=21.5mm; L=7.5mm; P=5mm	9.1
1.5	KR-5R5V155-R	30	Ø=19mm; L=19.5mm; P=5mm	4.2
1.5	KR-5R5H155-R	30	Ø=19mm; L=6.5mm; P=20mm	4.2
1.5	KR-5R5C155-R	30	Ø=21.5mm; L=7.5mm; P=5mm	9.1

PERFORMANCE		
Parameter	**Capacitance Change (% of initial measured value)**	**ESR (% of initial specified value)**
Life (1000 hrs @ 70°C @ 5.5 volts DC)	≤ 30	≤ 400
Storage - Low and High Temperature (1000 hrs @ -25°C and 70°C)	≤ 30	≤ 400

DIMENSIONS (mm)			
Part Number	**Ø D**	**H**	**P**
KR-5R5V104-R	11.5	12.5	5
KR-5R5H104-R	11.5	5	10
KR-5R5C104-R	13.5	7.5	5
KR-5R5V224-R	11.5	12.5	5
KR-5R5H224-R	11.5	5	10
KR-5R5C224-R	13.5	7.5	5
KR-5R5V334-R	11.5	12.5	5
KR-5R5H334-R	11.5	5	10
KR-5R5C334-R	13.5	7.5	5
KR-5R5V474-R	11.5	12.5	5
KR-5R5H474-R	11.5	5	10
KR-5R5C474-R	13.5	7.5	5
KR-5R5V105-R	19	19.5	5
KR-5R5H105-R	19	6.5	20
KR-5R5C105-R	21.5	7.5	5
KR-5R5V155-R	19	19.5	5
KR-5R5H155-R	19	6.5	20
KR-5R5C155-R	21.5	7.5	5

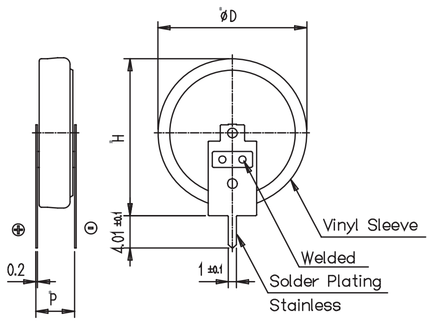
For parts 0.1F to 0.47F

V type **H type** **C type**

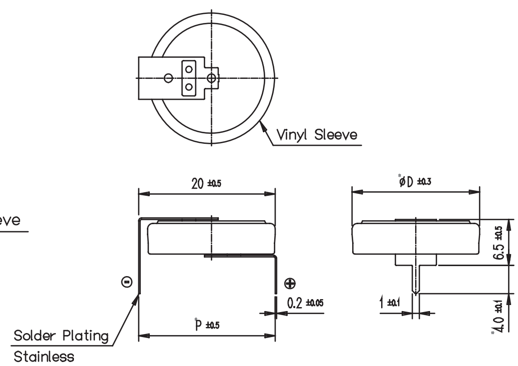


For parts 1.0F to 1.5F

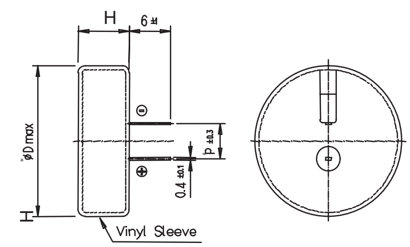
V type



H type



C type



PART NUMBERING SYSTEM

K	R	–	5	R	5				–	R
Series Code	Version		Voltage (V) R is decimal			Configuration	Capacitance (µF)			RoHS Compliant
K = Coin Cell	R = Leaded		5R5 = 5.5V			V = Vertical H = Horizontal C = Cylindrical	Value	Multiplier		
							Example: 474 = 47 x 10^4 µF or 0.47 F			

PACKAGING INFORMATION

Standard packaging: Bulk, 500 units per package.

For 0.1F to 0.47F 500 pcs/bag

For 1.0F to 1.5F 100 pcs/tray, 5 trays per box

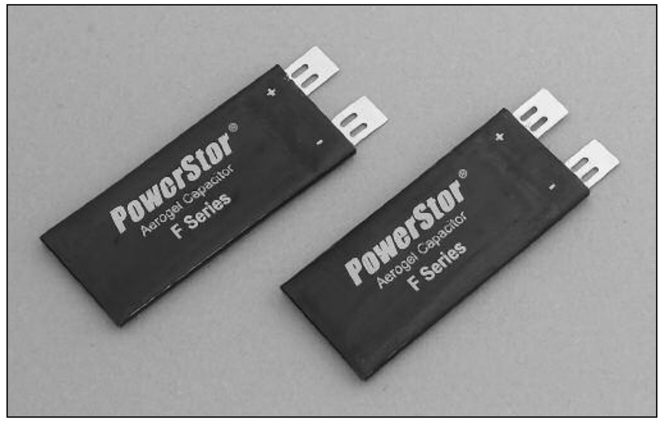
PART MARKING

Manufacturer
Capacitance (F)
Max. Operating Voltage (V)
Polarity Marking

Description

RoHS 2002/95/EC

The PowerStor® Aerogel Capacitor is a unique, ultra-high capacitance device based on a novel type of carbon foam, known as carbon aerogel. Aerogel capacitors are similar to supercapacitors, ultracapacitors and electrochemical double layer capacitors (EDLCs) with the added benefit of low ESR (Equivalent Series Resistance).



Features & Benefits

- Ultra-low ESR
- Long cycle life
- Low leakage current
- Thin design
- High capacitance

Applications – Low ESR

- High rate pulse applications
- GSM / GPRS applications
- PDA / Data Terminals
- Hybrid Battery-Capacitor packs

SPECIFICATIONS		
Voltage	Working (nominal)	3.6 volts
	Working (maximum)	4.2 volts
	Surge	5.0 volts
Temperature Range	Operating @ 3.6 volts	-20°C to 60°C
	Storage	-30°C to 75°C
Capacitance	Nominal	0.33 F
	Tolerance	-20% to +80% (25°C)
Pulse Current (maximum)		2A

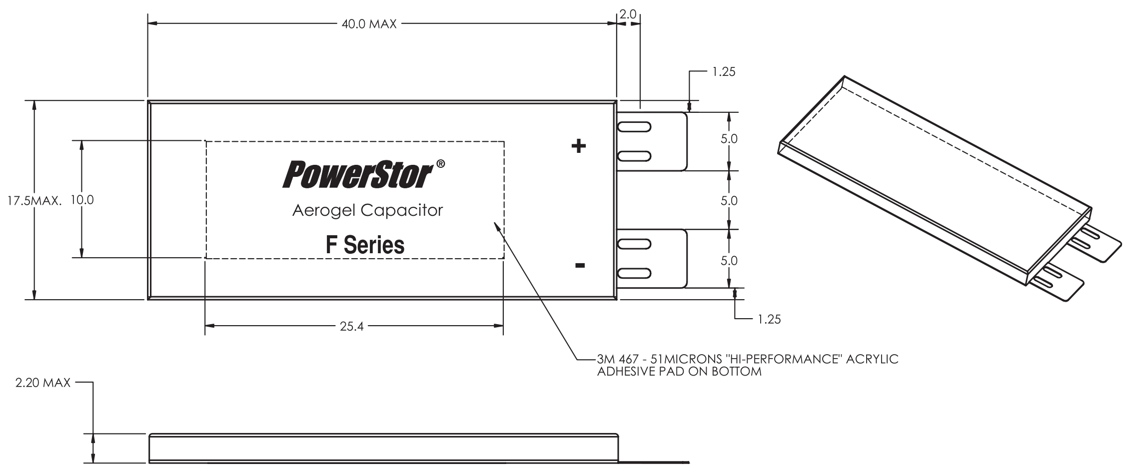
CUSTOM PRODUCT

Nominal Capacitance (F)	Voltage (V)	Part Number	ESR (nominal @ 25°C) Measured @ 1kHz (Ω)	Nominal Dimensions	Typical Mass (grams/1 piece)
0.33	3.6	FC-3R6334-R	0.250	2 x 17 x 40 mm	1.9

PERFORMANCE

Parameter	Capacitance Change (% of initial specified value)	ESR Change (% of initial specified value)
Life (1000 hrs @ 60°C @ 3.6 volts)	≤ 30 %	TBD
Storage - low and high temperature (1000 hrs @ -30°C and 75°C)	≤ 30 %	TBD

DRAWINGS (MM)



ASSEMBLY INSTRUCTIONS

This device should not be put through a solder reflow process. Do not expose the body of the aerogel supercapacitor to either the soldering iron or melted solder. Minimize the time that the soldering iron is in direct contact with the leads of the aerogel supercapacitor. Use appropriate heat sinking to minimize heat transfer to the aerogel supercapacitor.

PART NUMBERING SYSTEM

F	C	-	3	R	6	3	3	4
Series Code	Model		Voltage (V) R is decimal			Capacitance (μ F)		
F = Flat Pack Series			3R6 = 3.6V			Value		Multiplier
						334 = 33 x 10^4 μ F or 0.33 F		

PACKAGING INFORMATION

Packaging: 200 pieces per tray
5 trays (1000 pieces) per box

PART MARKING

Manufacturer Name
Series Code (or Part Number)
Polarity Marking

Description

Cooper Bussmann's supercapacitor solutions, using PowerStor's carbon aerogel technology, offer the added benefit of customization. Application specific supercapacitors can be designed by modifying their size and shape, ESR (Equivalent Series Resistance), capacitance, voltage or temperature capability.

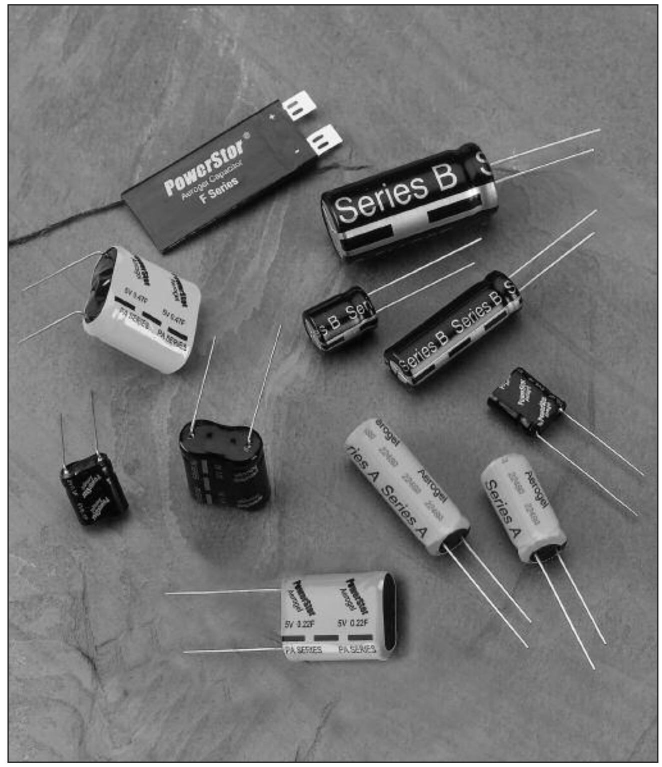
In the portable device market, many applications are space constrained. Using thin aluminum-polymer laminate, supercapacitors under 1mm thick are achievable. These F Series supercapacitors are ideal for PCMCIA cards. Traditional cylindrical can-style A and B Series supercapacitors are available as well as larger, very high capacitance cylindrical and prismatic supercapacitors.

Pulse discharge capability is important for many portable or remote applications to power transmitters, activate solenoids or valves, assist motors or to improve the high rate discharge capability of a low power battery system. PowerStor's carbon aerogel supercapacitors can be modified to achieve very low ESR providing high rate discharge capability. In applications where capacitance is important but ultra-low ESR is not required, the supercapacitor can be modified to provide higher energy density with marginally higher ESR.

A single supercapacitor has a nominal working voltage rating of 2.5V. Any application up to and including 2.5V can be operated by a single supercapacitor, however many applications require 3.6V, 5.0V or even higher. P Series supercapacitors have been designed for 3.6 and 5.0V applications. Custom multi-supercapacitor configurations are available for 12V, 24V or other voltage ratings. Either passive or active voltage balancing is used for all multi-supercapacitor configurations to ensure good reliability.

Some applications require a wider temperature range than the standard –25°C to 70°C. For these industrial or specialized applications, supercapacitors can be designed to meet a more severe range of –40°C to 85°C.

PowerStor Aerogel Supercapacitors provide solutions for a wide range of applications. With a variety of package types, adjustable capacitance and ESR, higher voltage ratings and wider temperature range capability, supercapacitors can be designed to meet the requirements of most applications.



Features and Benefits

- Application specific designs
- Customized form factors to meet most mechanical requirements
- Tailored capacitance, ESR, and temperature capability
- Series configurations for higher voltages
- Complete system solutions

Application Types

- Pulse power
- Bridge or hold-up power
- Main power
- Memory backup

Application Segments

- Industrial
- Consumer
- Medical
- Automotive
- Military

CRITICAL SUPERCAPACITOR PARAMETERS FOR CUSTOMIZATION

Electrical		Mechanical		Environmental	
Working Voltage (V)	_______	Max. Length (mm)	_______	Max. Temperature (°C)	_______
Minimum Voltage (V)	_______	Width/Diam. (mm)	_______	Min. Temperature (°C)	_______
Current draw (A)	_______	Height (mm)	_______		
Discharge time (sec)	_______	Lead/Connector	_______		

The electrical parameters can be used to calculate capacitance and ESR requirements and predict your supercapacitor solution. Use our PowerStor Aerogel Supercapacitor Excel Calculator available at www.cooperbussmann.com.

This document provides basic guidelines for application development using aerogel capacitors, also known as supercapacitors. If questions arise during your development process and are not answered in this document, contact Cooper Bussmann.

Lifetime

PowerStor supercapacitors have a longer lifetime than secondary batteries, but their lifetime is not infinite. The basic end-of-life failure mode for a supercapacitor is an increase in equivalent series resistance (ESR) and/or a decrease in capacitance. The actual end-of-life criteria are dependent on the application requirements. Prolonged exposure to elevated temperatures, high applied voltage and excessive current will lead to increased ESR and decreased capacitance. Reducing these parameters will lengthen the lifetime of a supercapacitor. In general, cylindrical supercapacitors have a similar construction to electrolytic capacitors, having a liquid electrolyte inside an aluminum can sealed with a rubber bung. Over many years, the supercapacitor will dry out, similar to an electrolytic capacitor, causing high ESR and eventually end-of-life.

Voltage

Supercapacitors are rated with a nominal recommended working or applied voltage. The values provided are set for long life at their maximum rated temperature. If the applied voltage exceeds this recommended voltage, the result will be reduced lifetime. If the voltage is excessive for a prolonged time period, gas generation will occur inside the supercapacitor and may result in leakage or rupture of the safety vent. Short-term overvoltage can usually be tolerated by the supercapacitor.

Polarity

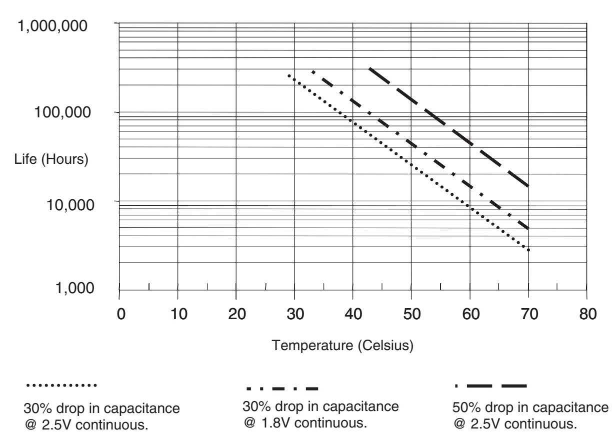
PowerStor supercapacitors are designed with symmetrical electrodes, meaning they are similar in composition. When a supercapacitor is first assembled, either electrode can be designated positive or negative. Once the supercapacitor is charged for the first time during the 100% QA testing operation, the electrodes become polarized. Every supercapacitor either has a negative stripe or sign denoting polarity. Although they can be shorted to zero volts, the electrodes maintain a very small amount of charge. Reverse polarity is not recommended, however previously charged supercapacitors have been discharged to -2.5V with no measurable difference in capacitance or ESR. Note: the longer they are held charged in one direction, the more polarized they become. If reversed charged after prolonged charging in one direction, the life of the supercapacitor may be shortened.

Ambient Temperature

The standard temperature rating for PowerStor supercapacitors is –25°C to 70°C. Temperature in combination with voltage can affect the lifetime of a supercapacitor. In general, raising the ambient temperature by 10°C will decrease the lifetime of a supercapacitor by a factor of two. As a result, it is recommended to use the supercapacitor at the lowest temperature possible to decrease internal degradation and ESR increase. If this is not possible, decreasing the applied voltage to the supercapacitor will assist in offsetting the negative effect of the high temperature. For instance, 85°C ambient temperature can be reached if the applied voltage is reduced to 1.8V per supercapacitor.

At temperatures lower than normal room temperature, it is possible to apply voltages slightly higher than the recommended working voltage without significant increase in degradation and reduction in lifetime. Raising the applied voltage at low temperatures can be useful to offset the increased ESR seen at low temperatures. Increased ESR at higher temperatures is a result of permanent degradation / electrolyte decomposition inside the supercapacitor. At low temperatures, however, increased ESR is only a temporary phenomenon due to the increased viscosity of the electrolyte and slower movement of the ions.

Operating Life vs. Temperature and Charge Voltage



The above plot shows the time taken for capacitance to drop by 30% at 1.8V & 2.5V and by 50% at 2.5V for continuous operation at a given temperature. This can be used to estimate the operating life for specific applications where the minimum allowable capacitance value is known.

Discharge Characteristics

Supercapacitors discharge with a sloping voltage curve. When determining the capacitance and ESR requirements for an application, it is important to consider both the resistive and capacitive discharge components. In high current pulse applications, the resistive component is the most critical. In low current, long duration applications, the capacitive discharge component is the most critical. The formula for the voltage drop, V_{drop}, during a discharge at *I* current for *t* seconds is:

$$V_{drop} = I(R + \frac{t}{C})$$

To minimize voltage drop in a pulse application, use a supercapacitor with low ESR (R value). To minimize voltage drop in a low current application, use a supercapacitor with large capacitance (C value).

An Aerogel Capacitor Calculator program is available online at http://www.cooperbussmann.com for predicting electrical requirements and matching these requirements to various supercapacitor configurations / alternatives.

Charge Methods

Supercapacitors can be charged using various methods including constant current, constant power, constant voltage or by paralleling to an energy source, i.e. battery, fuel cell, DC converter, etc. If a supercapacitor is configured in parallel with a battery, adding a low value resistor in series will reduce the charge current to the supercapacitor and will increase the life of the battery. If a series resistor is used, ensure that the voltage outputs of the supercapacitor are connected directly to the application and not through the resistor, otherwise the low impedance of the supercapacitor will be nullified. Many battery systems exhibit decreased lifetime when exposed to high current discharge pulses.

The maximum recommended charge current, *I*, for a supercapacitor where V_W is the charge voltage and *R* is the supercapacitor impedance is calculated as follows:

$$I = \frac{V_W}{5R}$$

Overheating of the supercapacitor can occur from continuous overcurrent or overvoltage charging. Overheating can lead to increased ESR, gas generation, decreased lifetime, leakage, venting or rupture. Contact the factory if you plan to use a higher charge current or higher voltage than specified.

Self Discharge and Leakage Current

Self discharge and leakage current as essentially the same thing measured in different ways, due to the supercapacitor construction there is a high impedance internal current path from the anode to the cathode. This means that in order to maintain the charge on the capacitor a small amount of additional current is required, during charging this is referred to as leakage current. When the charge voltage is removed, and the capacitor is not loaded, this additional current will discharge the supercapacitor and is referred to as the self discharge current.

In order to get a realistic measurement of leakage or self discharge current the supercapacitor must be charged for in excess of 100 hours, this again is due to the capacitor construction. The supercapacitor can be modeled as several capacitors connected in parallel each with an increasing value of series resistance. The capacitors with low values of series resistance charge quickly thus increasing the terminal voltage to the same level as the charge voltage. However, if the charge voltage is removed these capacitors will discharge in to the parallel capacitors with higher series resistance if they are not fully charged. The result of this being that the terminal voltage will fall giving the impression of high self discharge current. It should be noted that the higher the capacitance value the longer it will take for the device to be fully charged, see figure 2 in the Measurement Techniques section for more details.

Series Configurations of Supercapacitors

Individual supercapacitors are limited to 2.5V (P Series reaches 5V using two supercapacitors in series). As many applications require higher voltages, supercapacitors can be configured in series to increase the working voltage. It is important to ensure that the individual voltages of any single supercapacitor do not exceed its maximum recommended working voltage as this could result in electrolyte decomposition, gas generation, ESR increase and reduced lifetime.

Capacitor voltage imbalance is caused, during charge and discharge, by differences in capacitance value and, in steady state, by differences in capacitor leakage current. During charging series connected capacitors will act as a voltage divider so higher capacitance devices will receive greater voltage stress. For example if two 1F capacitors are connected in series, one at +20% of nominal capacitance the other at –20% the worst-case voltage across the capacitors is given by:

$$V_{cap1} = V_{supply} \text{ x } (C_{cap1} / (C_{cap1} + C_{cap2})$$

where C_{cap1} has the +20% capacitance.
So for a V_{supply} = 5V,

$$V_{cap1} = 5V \text{ x } (1.2 / (1.2 + 0.8) = 3V$$

From this it can be seen that, in order to avoid exceeding the supercapacitor surge voltage rating of 3V, the capacitance values of series connected parts must fall in a +/-20% tolerance range. Alternatively a suitable active voltage balancing circuit can be employed to reduce voltage imbalance due to capacitance mismatch. It should be noted that the most appropriate method of voltage balancing will be application specific.

Passive Voltage Balancing

Passive voltage balancing uses voltage-dividing resistors in parallel with each supercapacitor. This allows current to flow around the supercapacitor at a higher voltage level into the supercapacitor at the lower voltage level, thus balancing the voltage. It is important to choose balancing resistor values that provide for higher current flow than the anticipated leakage current of the supercapacitors, bearing in mind that the leakage current will increase at higher temperatures.

Passive voltage balancing is only recommended for applications that don't regularly charge and discharge the supercapacitor and that can tolerate the additional load current of the balancing resistors. It is suggested that the balancing resistors be selected to give additional current flow of at least 50 times the worst-case supercapacitor leakage current (3.3 kΩ to 22 kΩ depending on maximum operating temperature). Although higher values of balancing resistor will work in most cases they are unlikely to provide adequate protection when significantly mismatched parts are connected in series.

Active Voltage Balancing

Active voltage balancing circuits force the voltage at the nodes of series connected supercapacitors to be the same as a fixed reference voltage; regardless of how any voltage imbalance occurs. As well as ensuring accurate voltage balancing active circuits typically draw much lower levels of current in steady state and only require larger currents when the capacitor voltage goes out of balance. These characteristics make active voltage balancing circuits ideal for applications that charge and discharge the supercapacitors frequently as well as those with a finite energy source such as a battery.

Reverse Voltage Protection

When series connected supercapacitors are rapidly discharged the voltage on low capacitance value parts can potential go negative. As explained previously, this is not desirable and can reduce the operating life of the supercapacitor. One simple way of protecting against reverse voltage is to add a diode across the capacitor, configured so that it is normally reverse bias. By using a suitably rated zener diode in place of a standard diode the supercapacitor can also be protected against overvoltage events. Care must be taken to ensure that the diode can withstand the available peak current from the power source.

Soldering Information

Excessive heat may cause deterioration of the electrical characteristics of the aerogel supercapacitor, electrolyte leakage or an increase in internal pressure.

Follow the specific instructions listed below.
In addition:
- Do not dip aerogel supercapacitor body into melted solder.
- Only flux the leads of the aerogel supercapacitor.
- Ensure that there is no direct contact between the sleeve of the aerogel supercapacitor and the PC board or any other component. Excessive solder temperature may cause sleeve to shrink or crack.
- Avoid exposed circuit board runs under the aerogel supercapacitor to prevent electrical shorts.

Manual Soldering

Do not touch the aerogel supercapacitor's external sleeve with the soldering rod or the sleeve will melt or crack. The recommended temperature of the soldering rod tip is less than 260°C (maximum: 350°C) and the soldering duration should be less than 5 seconds. Minimize the time that the soldering iron is in direct contact with the terminals of the aerogel supercapacitor as excessive heating of the leads may lead to higher equivalent series resistance (ESR).

Wave Soldering

Use a maximum preheating time of 60 seconds for PC boards 0.8 mm or thicker. Preheating temperature should be limited to less than 100°C.

Use the following table for wave soldering on leads only:

Solder Bath	Solder Exposure Time (seconds)	
Temperature (°C)	Recommended	Maximum
220	7	9
240	7	9
250	5	7
260	3	5

Reflow Soldering

Do not use reflow soldering on PowerStor supercapacitors using infrared or convection oven heating methods unless the supercapacitor is specifically rated to withstand reflow soldering temperatures.

Ripple Current

Although PowerStor aerogel supercapacitors have very low resistance in comparison to other supercapacitors, they do have higher resistance than aluminum electrolytic capacitors and are more susceptible to internal heat generation when exposed to ripple current. Heat generation leads to electrolyte decomposition, gas generation, increased ESR and reduced lifetime. In order to ensure long lifetime, the maximum ripple current recommended should not increase the surface temperature of the supercapacitor by more than 3°C.

Circuit Board Design

Do not design exposed circuit board runs under the supercapacitor. An electrical short could occur if the supercapacitor electrolyte leaked onto the circuit board.

Circuit Board Cleaning

Avoid cleaning of circuit boards, however if the circuit board must be cleaned use static or ultrasonic immersion in a standard circuit board cleaning fluid for no more than 5 minutes and a maximum temperature of 60°C. Afterwards thoroughly rinse and dry the circuit boards. In general, treat supercapacitors in the same manner you would an aluminum electrolytic capacitor.

Long Term Storage

Do not store supercapacitors in any of the following environments:

- High temperature and/or high humidity
- Direct contact with water, salt water, oil or other chemicals
- Direct contact with corrosive materials, acids, alkalis, or toxic gases
- Direct exposure to sunlight
- Dusty environment
- Environment subject to excessive shock and/or vibration

Transportation Information

PowerStor supercapacitors are non-regulated by the US DOT (Department of Transport) and IATA. The correct international shipping description is "Electronic Parts – Capacitors".

Emergency Procedures

If a supercapacitor is found to be overheating or if you smell a sweet odor, immediately disconnect any power or load to the supercapacitor. Allow the supercapacitor to cool down, then dispose of properly. Do not expose your face or hands to an overheating supercapacitor. Contact the factory for a Material Safety Data Sheet if a supercapacitor leaks or vents. If exposed to electrolyte:

- Skin Contact: Wash exposed area thoroughly with soap and water.
- Eye Contact: Rinse eyes with water for 15 minutes and seek medical attention.
- Ingestion: Drink milk/water and induce vomiting; seek medical attention.

Note: In general the electrolyte, using the NFPA/HMIS (0 to 4) rating system, has slight (1 out of 4) health and fire hazard and minimal (0 out of 4) reactivity hazard.

Regulatory Information

PowerStor supercapacitors are rated non-hazardous under the OSHA hazard communication standard (29 CFR 1910.1200)

General Safety Considerations

- Supercapacitors may vent or rupture if overcharged, reverse charged, incinerated or heated above 150°C.
- Do not crush, mutilate, nail penetrate or disassemble.
- High case temperature (burn hazard) may result from abuse of supercapacitor.

Disposal Procedures

PowerStor supercapacitors are non-regulated under RCRA Waste Code. Supercapacitors may however be disposed of by a specialized industrial waste processor or by incineration. Use caution when incinerating as the supercapacitor can explode unless it is crushed or punctured prior to incineration. Wear protective gear, such as face shields or goggles, coats/aprons and gloves. Use high temperature to incinerate the supercapacitors as the plastic (poly vinyl chloride) sleeving can produce chlorine gas at lower incineration temperatures.

Methods for Measuring Capacitance, Inflow Current, Internal Resistance and ESR

Capacitance Measurement:

Supercapacitors exhibit considerable “dielectric absorption” charge storage. As such, some traditional methods of measuring capacitance may not yield accurate results when measuring supercapacitors. A method for measuring capacitance in supercapacitors is outlined below. This method is recommended over others such as determining the 63 percent voltage point and using the time in a RC time constant calculation.

The following test circuit can be set up with a common laboratory power supply set to the specified current and voltage limits. The charging waveform, shown in Figure 1, is best recorded with a digital oscilloscope. The cursor function can be conveniently used to directly read the time points between the 1.5 volt and 2.5 volt crossing. The basic equation for the average current in a capacitor is:

$i = C(\frac{\Delta V}{\Delta t})$, solving for C: $C = i(\frac{\Delta t}{\Delta V})$

For i = 1 ampere and ΔV = 1 volt, therefore C = Δt.

Capacitance in this example is numerically equal to the time in seconds for the capacitor to charge from 1.5V to 2.5V.

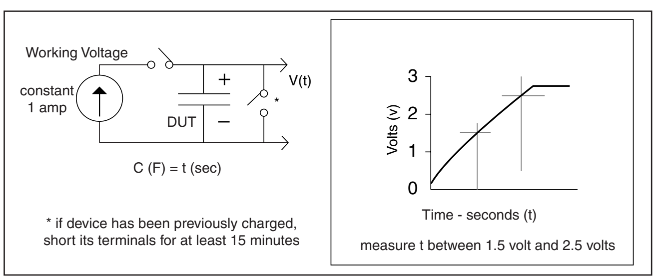


Figure 1

Because dielectric absorption is pronounced, the device under test should be well discharged before beginning the test to ensure consistent results. If the device has previously been charged, then its terminals should be shorted for at least 15 minutes before beginning the test.

Inflow Current Measurement:

Since supercapacitors exhibit pronounced dielectric absorption, the measurement of actual leakage current, or self-discharge current, is made difficult. When a supercapacitor is charged to its working voltage, the inflow current exhibits large, slowly decaying values for long times. The inflow current is the sum of dielectric absorption current flow and actual leakage current. Dielectric absorption current flow represents charge going into storage, but deeply buried in terms of possessing a very long time constant. The inflow current as a function of time is essentially logarithmic, as shown in Figure 2:

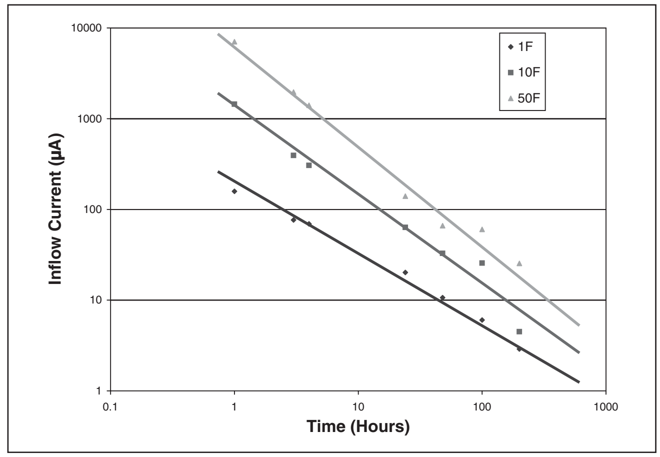


Figure 2

These typical curves are measured with the test circuit below. The parts were short circuited for 2 days prior to beginning the test. Therefore, stored dielectric absorption charge was essentially non-existent.

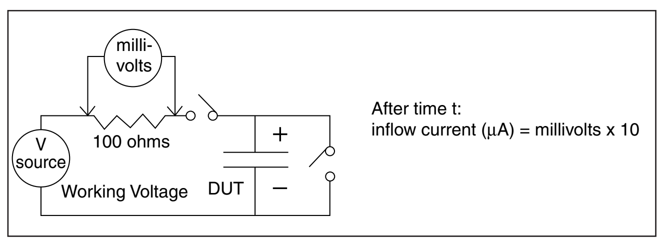


Figure 3

True leakage currents, where dielectric absorption goes to zero, take over 100 hours to reach as shown in Figure 2. These leakage currents are on the order of only a few microamperes. To continue to measure inflow current beyond this point, one needs to use instrumentation capable of accurately measuring microvolts and/or a larger resistor value can be used in the circuit in Figure 3.

Internal Resistance and ESR (equivalent series resistance) Measurement:

For product specification purposes ESR or AC impedance is measured using a commercial LCR bridge at 1 kHz. This produces a rather precise, reproducible value. Another method is used to measure what is called the internal resistance or DC impedance and can be performed with the same instrumentation used to measure capacitance (described above). This method produces a value for internal resistance which is not nearly as precise and reproducible as the ESR measurement. However, internal resistance is more directly related to device behavior in many pulse power applications.

Shown in Figure 4 is the oscilloscope trace obtained using the capacitance test circuit and method. An enlargement of the beginning of the trace is shown in Figure 5. The instantaneous voltage step which occurs the moment the 1 ampere charging current is applied is used to calculate internal resistance. The internal resistance or DC impedance is equal to the step voltage divided by 1 ampere. For devices which exhibit lower internal resistance than this example, a higher constant current is required.

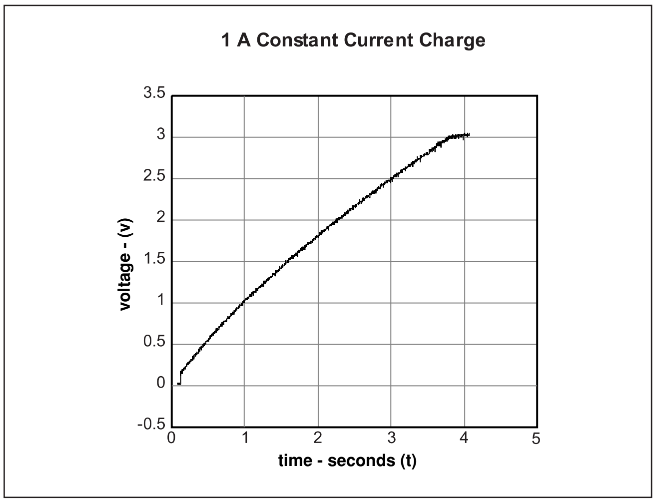


Figure 4

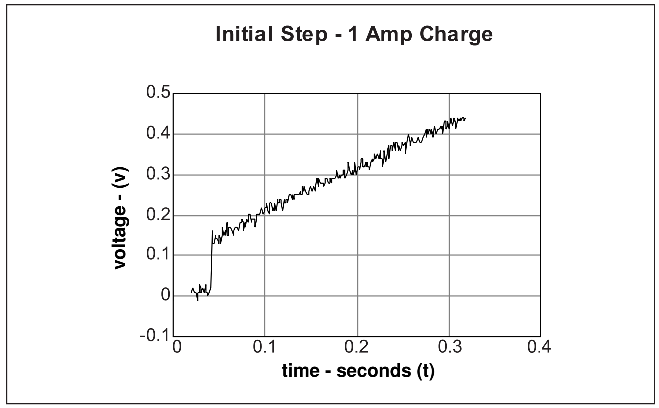


Figure 5

In this example:

$$\text{Internal resistance} = \frac{\text{initial voltage step}}{\text{constant current}} = \frac{0.15\ \text{V}}{1\ \text{A}} = 0.15\ \text{Ohms}$$

Studies have shown that the internal resistance or DC impedance value is usually between 1.1 and 1.5 times the measured ESR or AC impedance value.

Performing supercapacitor calculations and predicting solutions for applications can be tedious, therefore PowerStor® has developed an Aerogel Supercapacitor Calculator in Microsoft Excel®. This program is available online at http://www.cooperbussmann.com. An example of this program is shown on the following page.

To determine the aerogel supercapacitor requirements for an application, four key parameters are required:

- Working voltage, V_W, in Volts
- Minimum voltage, V_{min} in Volts
- Average discharge current, I, in Amps
  - If necessary convert power, P, in Watts to current, where $I = P / V_{avg}$
- Discharge time, t, in seconds

Simply enter these four parameters into the calculator in step 1 and the program will calculate:

- Energy requirement, W, in Joules
- Minimum capacitance requirement, C, in Farads
- Maximum resistance, R, in Ohms

In step 2, select the operating parameters specific to the application including whether the discharge is more similar to a DC pulse or AC pulse at a 1kHz frequency. Next select the operating temperature and use the "deviation from nominal capacitance" factor to build in a safety margin, if necessary. The program will then use these correction factors for both capacitance and resistance throughout the remainder of the calculations.

The pull-down menu in step 3 has a list of PowerStor supercapacitor products. Select the appropriate supercapacitor that meets both the capacitance and resistance requirements from step 1. In this step there is an option to configure supercapacitors in parallel and/or to force the number of supercapacitors in series to a specific number. For example, the calculator would recommend six 2.5V supercapacitors for an automobile voltage of 14.4V (14.4V / 2.5V per supercapacitor = 5.76 supercapacitors, which round up to 6). In practice, increasing the number of supercapacitors to eight in automobile applications lowers the voltage to 1.8V per supercapacitor, providing an increased reliability margin for high temperature exposure, with a direct result of longer life. The number of supercapacitors in series (actual) can be overwritten from the calculated value.

Confirmation of the predicted aerogel supercapacitor solution is done in step 4. First the total capacitance and resistance values calculated are compared to the required values. Next the energy and hold-up time requirements are confirmed. If the energy and hold-up time are insufficient, chose a larger supercapacitor or increase the number of supercapacitors in parallel. Finally, the voltage drop is confirmed. The calculated components of resistive and capacitive discharge are summed and compared to the maximum value allowed. If the maximum voltage drop value is exceeded, simply chose a supercapacitor solution with lower ESR or increase the number of supercapacitors in parallel.

Our goal for this calculator was to assist you in finding a solution for your design challenges. Note: this program is only intended to predict aerogel supercapacitor solutions. All calculated solutions should be tested in the final application. Contact Cooper Bussmann directly for further assistance and application support.

Aerogel Supercapacitor Calculator

PowerStor Aerogel Supercapacitor Calculations for: Enter Company or Project Name

09/04/02

Four Simple Steps for Determining Supercapacitor Requirements

Legend
Input Values in Yellow
Required Values in Gray
Calculated Values in Light Blue
Comments in Green

1. Enter values for Working Voltage, Minimum Voltage, Current and Time

		Enter Known Value	
Working Voltage (Vw)	Vw =	2.5	Volts
Minimum Voltage [Vmin]	Vmin =	1	Volts
Current [I]	I =	1	Amps
Time [t]	t =	1	seconds
Energy needed during hold-up period (Minimum)	W = (Vw+Vmin)/2*I*t =	1.75	Joules
Desired Capacitance (Minimum)	C = 2 Vw*I*t / (Vw^2 - Vmin^2) =	0.6667	Farads
Desired Impedance (Maximum)	R = (Vw - Vmin) / I =	1.500	Ohms

2. Select Operating Parameters and Correction Factors from pull-down menu

Use pull-down menu for Correction Factors to Capacitance and ESR	Discharge Pulse Frequency	Temperature	Deviation from Specified Capacitance (-20% to +80%)
	DC	-20°C	Nominal Capacitance
Capacitance Correction Factors :	1	0.8	1
ESR Correction Factors :	1.5	2.25	

3. Choose Supercapacitor from pull-down menu to meet Desired Capacitance and Desired Impedance

Note 1: Total Capacitance equals 1/2x for two in series, 1/3x for three in series, etc.
Note 2: Total Capacitance equals 2x for two in parallel, 3x for three in parallel, etc.
Note 3: Total Resistance equals 2x for two in series, 3x for three in series, etc.
Note 4: Total Resistance equals 1/2x for two in parallel, 1/3x for three in parallel, etc.

Use pull-down menu to choose a specific model Supercapacitor	Part Number	Capacitance	ESR (AC @ 1 kHz)
	B0820-2R5225	2.2 F	0.225 Ohms

		Standard Values		Corrected Values	
Single Device Capacitance	C =	2.2	Farads	1.76	Farads
Single Device Resistance	R =	0.225	Ohms	0.759375	Ohms
Single Device Max Voltage	Vmax =	2.5	Volts	2.500	Volts

# supercapacitor(s) in parallel	Increase p to increase Capacitance or reduce Resistance	1
# supercapacitor(s) in series (min. calculated)	Vw / Vcap (A = 2.5V; B = 2.5V; P = 5.0V) =	1.00
# supercapacitor(s) in series (actual) (See Note 5	s (rounded up) =	1

Note 5: Formula for # supercapacitor(s) in series (actual) can be manually overwritten if lower or higher Vw per supercapacitor desired. View Corrected Value for actual Single Device Max Voltage.

4. Confirm Time requirement is met for hold-up applications and/or Voltage Drop is acceptable for pulse applications.

Final Supercapacitor Configuration		Calculated Values		Required Values		Comments
Total Capacitance	C =	1.76	Farads	0.6667	Farads	Capacitance Value Met
Total Resistance	R =	0.759375	Ohms	1.500	Ohms	Resistance Value Met

Check Energy and Time Requirements		Calculated Values		Required Values		Comments
Energy available in supercapacitor(s)	W = 1/2 C * (Vw^2 - Vmin^2) =	4.62	Joules	1.75	Joules	Energy Value Met
Max. Hold-up Time with chosen supercapacitor(s)	t = C (Vw - IR -Vmin) / I =	1.30	seconds	1	seconds	Time Requirement Met

If Energy is insufficient, choose a Single Device with higher Capacitance or increase # supercapacitors in parallel.

Check to ensure that Energy available in supercapacitors is greater than Energy needed during hold-up period, or Maximum Hold-up Time is sufficient.

Check Voltage Drop		Calculated Values		Required Values		Comments
Total Voltage Drop of supercapacitor(s) = Vdrop (resistive) + Vdrop (capacitive) =		1.328	Volts	1.500	Volts	Voltage Drop Acceptable
Voltage drop (resistive)	Vdrop (resistive) = IR =	0.759	Volts			
Voltage drop (capacitive)	Vdrop (capacitive) = I (t / C)	0.568	Volts			

If Total Voltage Drop is greater than Maximum Allowed, determine whether resistance or capacitance is the main factor.
Choose supercapacitors with either more capacitance or less resistance, or increase # capacitors in parallel.
If Total Voltage Drop is less than Maximum Voltage Drop Allowed, STOP.

This program is intended to provide product design solutions that will help the user with design applications.
Once a product design solution has been determined, it should be tested by the user in all possible applications.

Design Considerations In Selecting Aerogel Supercapacitors

Two major applications of aerogel supercapacitors are high pulse power applications and short-term hold-up power. Pulse power applications are characterized by very short, but high current delivery to a load, i.e. during the transmit period in a GSM mobile device. Hold-up applications are characterized by the requirement to continue to deliver load power for times on the order of seconds or minutes. An example of a hold-up application is the parking of the read/write head in a disk drive when power to the unit is shut off. Each of these applications emphasize different performance parameters of the device. High pulse power applications benefit primarily from the aerogel supercapacitor's low internal resistance (R), while hold-up power applications benefit from the supercapacitor's large capacitance (C) value.

This Marketing Bulletin presents the formulae used to calculate your application requirements and uses two examples to illustrate their use. A program titled “Aerogel Supercapacitor Calculator” designed in a Microsoft® Excel spreadsheet is also available for your use.

Definitions

The following definitions are used in this note:

Symbol	Unit of Measure	Description
C	Farads	Nominal capacitance value of the aerogel supercapacitor.
R	Ohms	The nominal internal resistance of the aerogel supercapacitor.
ESR	Ohms	Equivalent Series Resistance measured at 1 kHz.
V_{wv}	Volts	Normal or working charge voltage in the circuit application.
V_{min}	Volts	The minimum voltage required to operate the device.
I_{load}	Amps	In a hold-up application this is the average current that continues to be delivered to the load. It is an average as the load current will increase as the voltage decreases from V_{wv} to V_{min}.
t	Seconds	This is the required hold-up time in the circuit, or in pulse applications, t is the pulse duration.
V_{drop}	Volts	The total decrease in working voltage at the end of the discharge or high current pulse.

Hold-Up Power Applications

An approximate calculation can estimate the value of an aerogel supercapacitor needed in most applications. This calculation equates the energy needed during the hold-up period to the energy decrease in the supercapacitor, starting at V_{wv} and ending at V_{min}.

Energy needed during hold-up period: $1/2\ I_{load}\ (V_{wv} + V_{min})\ t$

Energy decrease in supercapacitor: $1/2\ C(V_{wv}^2 - V_{min}^2)$

Therefore, the minimum capacitance value that guarantees hold-up to Vmin (neglecting voltage drop due to IR) is:

$$C = \frac{I_{load}(V_{wv} + V_{min})t}{(V_{wv}^2 - V_{min}^2)} \quad \text{in Farads}$$

Example:
Suppose a tape drive supply is 5.0V and can operate safely down to 3.0V. If the DC motor requires up to 2 seconds of hold-up prior to safe shutdown at 0.5A, then the use of the above equation predicts that the hold-up capacitor must be at least 0.5F.

One A Series supercapacitor can supply the required capacitance. However, the nominal operating voltage of 2.5V is exceeded by the 5V requirement. Therefore, two aerogel supercapacitors must be configured in series. If two equal value supercapacitors are used, then the voltage across each device will be approximately 2.5V, which is the nominal voltage rating.

In the data sheets the A1020-2R5105 supercapacitor is listed with a nominal capacitance of 1.0F and when configured two in series, provides 1.0F / 2 = 0.5F. Theoretically this solution should work, but with a –20% end of the tolerance range, this solution does not provide significant margin. Stepping up to the next supercapacitor, the A1030-2R5155 would provide 1.5F / 2 = 0.75F at 5V. With a –20% tolerance, the minimum value could be as low as 1.2F / 2 = 0.6F. This supercapacitor solution provides a sufficient safety margin. After the high current pulse, the tape drive goes into a very low current mode to hold up the electronics and uses the remaining energy in the supercapacitor.

In this example, balancing the voltage across the series combination is recommended to ensure neither device exceeds the maximum voltage rating. See the notes on voltage balancing in PS-5508 Application Guidelines.

Pulse Power Applications

Pulse power applications are characterized by a relatively low value of continuous current with brief, high current requirements. Applications have pulses that range from less than 1 millisecond to as high as a few seconds, and the pulse current can be orders of magnitude higher than the continuous or background current. The duty cycle of the pulses is usually low, typically less than 20 %.

A worst-case design analysis assumes that the aerogel capacitor is the sole supplier of energy during the pulse. In this case the total drop in working voltage in the circuit consists of two components: the instantaneous voltage drop due to load current supplied through the internal resistance of the capacitor, and the drop in capacitor voltage at the end of the pulse period. This relationship is shown in the following equation.

$V_{drop} = I_{load} (R + t/C)$

Inspection of this equation shows that the capacitor must have low R and a high value of C if the voltage drop is to be small.

For most pulse power applications the value of R is more important than the value of C. This is illustrated using this equation for the A1030-2R5155 supercapacitor. Its internal resistance, R, can be estimated by using the DC ESR, nominally 0.075 Ohms (DC ESR = AC ESR x 1.5 = 0.060 Ohms x 1.5 = 0.090 Ohms). The specified capacitance is 1.5F. For a 0.001 second pulse, t/C is less than 0.001 Ohms. Even for a 0.010 second pulse, t/C is only 0.0067 Ohms. Clearly the value of R (0.090 Ohms) dominates the outcome of V_{drop} in the equation above.

Example:
A GSM/GPRS wireless modem requires a pulse current of up to 2A for 0.6 milliseconds every 4.6 milliseconds. Note the pulse width doubles or quadruples with GPRS. These modems are now available in a PCMCIA card for notebook computers. The constraints of the notebook and the PCMCIA connection are an output voltage of 3.3 +/- 0.3V and a maximum current provided by the notebook of 1A. Many power amplifiers (PA) have a minimum voltage requirement of 3.0V. As it is possible for a notebook computer to output only 3.0V, the voltage to the PA must first be boosted (3.6V is common). With a working voltage of 3.6V and a minimum voltage of 3.0V, the allowable voltage drop due to resistance is 0.6V.

Choosing the F Series Flat Pack FC-3R6334-R supercapacitor yields 0.33F with 0.200 Ohms AC impedance or 0.25 Ohms DC impedance, R. During a 2A transmit pulse the battery provides approximately 1A and the supercapacitor provides the remaining 1A of current. Using the above formula, the voltage drop, IR, due to resistance is 1A x 0.25 Ohms = 0.25V. The capacitive component, I(t/C), is small at 0.002V compared to the resistive voltage drop.

Conclusions

Both hold-up power applications and pulse power applications can be designed by using the simple equations presented above. When the working voltage of the circuit exceeds the maximum operating voltage rating of the aerogel supercapacitor, equal value supercapacitors should be put in series arrangement. Often, the series arrangement should be balanced to ensure equal voltage sharing. In pulse power applications the voltage drop across the internal resistance of the device is usually the critical factor. The aerogel capacitor's ultra-low internal resistance provides a new solution to the high impedance problems characteristic of most battery systems.

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PowerStor®

Aerogel Supercapacitors Provide Both High Energy and High Power Capability

High power aerogel supercapacitors enable new pulse, bridge and main power applications.

The ultimate energy storage device should have high energy density that can be released rapidly. High energy batteries have been developed as single use or rechargeable systems but typically require minutes to hours to discharge, not seconds. For high power, standard capacitors are capable of discharging rapidly but have low energy density.

First generation supercapacitors also referred to as ultracapacitors and Electrochemical Double Layer Capacitors (EDLC), have relatively high energy density but also very high ESR (equivalent series resistance) and are therefore only used in very low power memory backup applications. New aerogel supercapacitors have been developed incorporating both the high energy density of batteries (100 times the energy of electrolytic capacitors) and the high power of capacitors (10 to 100 times the power of batteries) as shown in Figure 1.

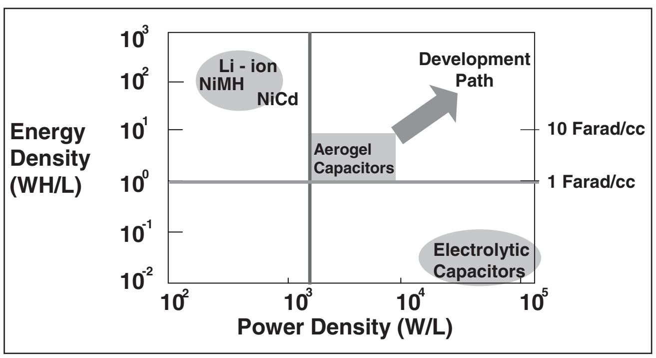

Figure 1

Imagine the possible uses of a high energy, high power energy storage device, sometimes referred to as "A solution looking for a problem". Many engineers have and these new supercapacitors are finding their way into a wide range of new applications. In many instances, the supercapacitor is the enabling technology for these new applications.

High power supercapacitors are designed similar to electrolytic capacitors however supercapacitors use high surface area carbon for accumulation of charge as opposed to the low surface area foils in electrolytic capacitors. An electric double layer is formed at the interface of the solid carbon electrode and liquid electrolyte. Aerogel supercapacitors use aerogel carbon as the active material, while the rest of the industry typically uses activated carbon. Aerogel carbon is known for its high level of purity, high usable surface area and high electrical conductivity. Key features for aerogel supercapacitors include:

- Extremely low ESR for high power and low loss during operation
- High energy density for long run-time
- Ultra low leakage current (can hold a charge for several weeks)
- Wide operating temperature range
- Can be cycled hundreds of thousands of times with very fast charge and discharge rates, as opposed to only hundreds of cycles for batteries.

Aerogel supercapacitors have reasonably high energy density compared with rechargeable batteries. In some applications, batteries have far more energy than is required, take too long to charge, do not like to be held fully charged or shallow discharged (NiCd memory effect) on a continuous basis without periodic maintenance, or do not cycle long enough. In applications such as electronic toys, UPS systems or solar charged lighting, aerogel supercapacitors have replaced batteries as a better alternative.

Aerogel supercapacitor designs include 2.5V radial leaded cylindrical and 5V leaded rectangular devices. There is also a new low profile, flat pack design with thickness ranging from 4 mm to as low as 1 mm. Large cylindrical and prismatic designs up to 2500F are also available.

These supercapacitors have characteristics that make them ideal for applications in electronic circuits, portable devices and systems powered by batteries, fuel cells or dc power supplies. The aerogel supercapacitors can be used in applications ranging from low tech (toys) to medium tech (electronic control systems, valves and solenoids) to high tech (microprocessor- controlled devices).

Aerogel supercapacitors provide:

- Pulse power characterized by short, high current pulses delivered to a load, allowing the use of a smaller power supply or battery
- Hold-up or bridge power to a device or equipment for seconds, minutes or days when the main power or battery fails or when the battery is swapped out
- Main power or battery replacement

Pulse Power

A growing number of applications today require short bursts of power, including phones, wireless modems, radio transceivers, motors, valves and solenoids. An engineer now has two battery design options: (1) use a larger battery (or power supply) capable of the high pulse current or (2) use a smaller battery (or power supply) with higher energy density (at the expense of lower power density) configured in parallel with a high power supercapacitor. The second option is known as a battery-supercapacitor hybrid configuration and results in a high energy / high power device with smaller size, lower weight and lower cost than the first option of a larger battery or power supply

Pulse Power Calculations

Pulse power applications are characterized by a relatively low value of continuous current with brief, high current requirements. Applications have pulses that range from less than 1 msec to as high as a few seconds, and the pulse current can be orders of magnitude higher than the continuous or background current. The duty cycle of the pulses is usually low, typically less than 20 %.

A worst-case design analysis assumes that the aerogel supercapacitor is the sole supplier of current during the pulse. In this case the total drop in working voltage in the circuit consists of two components: (1) instantaneous voltage drop due to the internal resistance of the supercapacitor, and (2) capacitive drop during the discharge pulse. This relationship is:

$V_{drop} = I_{load} (R + t/C)$
V_{drop} = Change in voltage (V)
I_{load} = Load current (A)
R = Internal resistance (Ohms)
t = Time (sec)
C = Capacitance (Farads)

For a small voltage drop, this equation shows that the supercapacitor must have low R and high C. For many pulse power applications where t is small, the value of R is more important than the value of C. For example a lower ESR 1.5F aerogel supercapacitor has an estimated internal resistance of 0.060Ω. For a 0.001sec pulse, t/C is less than 0.001Ω. Even for a 0.010 sec pulse, it is only 0.007Ω. Clearly, the value of R (0.060Ω) dominates the outcome of V_{drop} in Equation (1) for short pulse power applications. Where t is large, 3 seconds for example, t/C = 2Ω and now C dominates the outcome of V_{drop} in Equation (1).

Ultra thin (down to 1mm), low ESR supercapacitors have been developed for GSM / GPRS applications, including wireless PCMCIA modems. Type II PCMCIA cards have only 5mm inside clearance, but with a two-sided 1mm circuit board, the supercapacitor height restriction can be as low as 2mm. New thin supercapacitors using flexible packaging have been developed with very low ESR. The PCMCIA specification allows less than 1A of current to flow from the notebook battery to the PC card but GSM / GPRS transmissions requires up to 2A. GSM transmits for approximately 0.6 milliseconds every 4.6 milliseconds then runs at lower currents for receive and standby modes in the remaining 4 milliseconds. The supercapacitor is charged by the excess or available battery current in 4 milliseconds between the 0.6 millisecond discharges.

The GPRS protocol allows higher transmission rates with double to quadruple transmit times of GSM. Although low ESR is the primary design criteria to minimize the voltage drop from the supplied voltage (3.3V) to the minimum voltage required for the power amplifier (3V), supercapacitors have significantly more capacitance than other capacitor technologies allowing the extended pulse lengths of GPRS.

An example of an application requiring more capacitance to minimize voltage drop during a pulse discharge is digital cameras. Low ESR supercapacitors enable alkaline batteries to last longer in digital cameras. The challenge is to run longer on fewer, low power alkaline batteries. The high power requirement of the zoom motor causes alkaline batteries to fail before they have released all of their stored energy. Due to the relatively long (several seconds) discharge pulse requirement for the zoom motor, larger capacitance (6 to 10F) supercapacitors have been found to extend the useful life of the alkaline batteries.

Figure 2 compares 2 AA alkaline batteries (top) to 2 AA alkaline batteries connected in parallel to a single 6F supercapacitor (bottom), without additional circuitry. To simulate the zoom motor in a digital camera, each system was discharged at 4 Watts for 3 seconds every 3 minutes. This sequence resulted in 55 zoom cycles every 10,000 seconds. The voltage drop was larger for the battery (left) compared to the hybrid (right). The battery-supercapacitor hybrid ran approximately three times longer than the battery alone.

Hold-up or Bridge Power

Hold-up power applications are characterized by a short, high current or "bridge power" pulse followed by a longer, low current drain. Standard memory backup type supercapacitors are capable of the low current drain but unable to handle the short, high current pulse due to their high ESR. During the pulse, the system voltage will drop below the lower voltage allowed by the device's electronics and the system will shut down. For these applications, new low

Aerogel Supercapacitors Provide Both High Energy and High Power Capability

ESR aerogel supercapacitors are capable of handling the high current pulse to minimize the voltage drop.

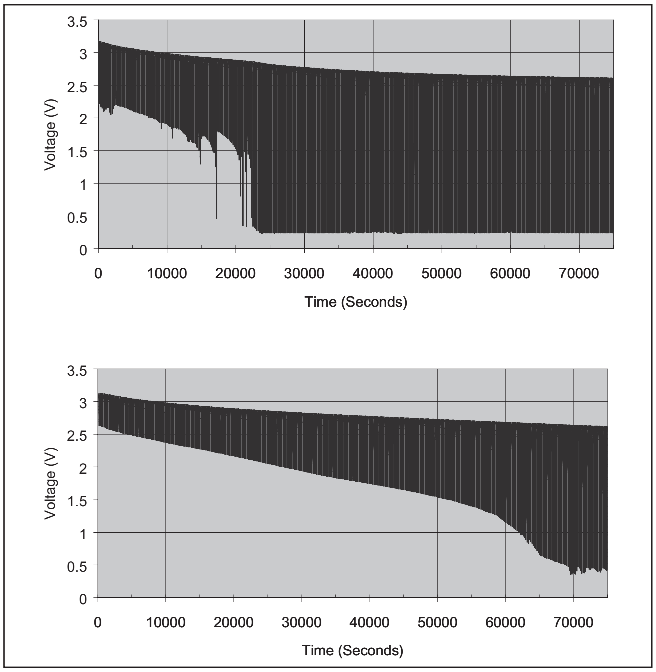

Figure 2

Bridge power examples include solid-state hard drives and portable data terminals. In the solid-state hard drive, all memory is stored in DRAM. When main power is lost, the information in the DRAM must be transferred to non-volatile memory. This requires a high discharge current for a number of seconds after which the device requires a very low current to maintain the system.

Portable data terminals use supercapacitors to "bridge" between swapping of batteries when the device is in operation and not simply in sleep mode. Batteries can also fall out or become temporarily disconnected if the device is dropped. To prevent loss of data, supercapacitors are designed to provide continuous power to the portable data terminal until it is able to safely power down or the battery is swapped or reconnected.

Main Power

The energy density for today's supercapacitors has grown substantially and is now only 3 to 10 times lower than some rechargeable batteries (i.e. lead-acid), but with the added benefits of nearly infinite cycle life, very short recharge times and very high power density. Supercapacitors can be charged directly from alkaline batteries, solar panels or other DC power sources. As a result some portable and remote applications are now using supercapacitors in place of rechargeable batteries.

The toy cars and airplanes that claim "Charge In Under 10 Seconds" all use supercapacitors as the main power source and alkaline batteries to charge them. The fast charge is particularly important for children as their attention spans are not long enough to wait for batteries to charge.

Solar charging is particularly important in remote applications. With 365 charge/discharge cycles per year, rechargeable batteries require frequent replacement. These applications include remote monitoring systems, transmitters, lighting and traffic signs. New portable applications currently under development include flashlights, remote controls and radios all charged using solar power.

Another main power application that is ideal for supercapacitors is local area or restaurant pagers. These pagers run for up to two hours while the patron is waiting for a table. After being returned to the host/hostess, the pager only requires a 10 second charge for the next customer. Nickel cadmium batteries perform poorly in these shallow depth-of-discharge applications due to their "memory" effect (loss of capacity due to continuous shallow discharges). As a result, constant battery replacement is no longer an issue or added cost when supercapacitors designed to last the life of the product are used for main power.

Design Considerations

Energy and Capacitance Calculations
To determine your aerogel supercapacitor requirements, four key parameters are required:

- Working voltage, V_{wv}, in Volts
- Minimum voltage, V_{min}, in Volts
- Average discharge current, I_{load}, in Amps
- (if necessary convert power, P, in Watts, to current, I_{load}, where $I_{load} = P/V_{avg}$)
- Discharge time, t, in seconds

One can estimate the value of an aerogel supercapacitor needed for most applications (Note 1). This calculation equates the energy needed during the discharge period to the energy decrease in the aerogel supercapacitor, from V_{wv} to V_{min}.

Energy needed for discharge:

$$1/2\ I_{load}\ (V_{wv} + V_{min})\ t \quad \text{(Joules)}$$

Energy decrease in supercapacitor:

$$\frac{1}{2} C(V_{wv}^2 - V_{min}^2) \quad \text{(Joules)}$$

Therefore, the minimum capacitance value that guarantees hold-up to Vmin is:

$$C = \frac{I_{load}(V_{wv} + V_{min})t}{(V_{wv}^2 - V_{min}^2)} \quad \text{in Farads}$$

Voltage Balancing

When the working voltage of the circuit exceeds the maximum operating voltage rating of a single supercapacitor, a series configuration is required. Often, the series arrangement requires balancing to ensure equal voltage sharing. Either passive or active balancing can be used to maintain similar voltages among supercapacitors where the leakage currents may be slightly different.

Passive balancing uses equal value resistors in parallel with the supercapacitors. Using high value resistors, small currents are allowed to flow between the supercapacitors to maintain similar voltages. Resistors with high values result in lower leakage currents on the order of microamperes, an important design consideration for hybrid battery-supercapacitor solutions. Lower value resistors lead to higher leakage currents but faster voltage equilibration of mismatched components, and can be used where the main power is delivered by a continuous source of power (power supply or fuel cell).

Active balancing uses a microprocessor to measure voltage differences and open gates allowing equilibration to occur quickly but only when needed. Active balancing does not add significant current leakage in the final configuration, but comes at a higher price than passive balancing. High reliability applications, with higher voltages (> 5V), typically use active balancing.

Summary

High power, high energy aerogel supercapacitors offer solutions for applications by providing pulse, hold-up, or main power.

Note 1: An Aerogel-Supercapacitor-Calculator program is available online at http://www.cooperbussmann.com and can be used to predict required energy, capacitance and ESR for any application.

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Customer / Application Information Worksheet

The following worksheet will enable us to understand your Aerogel Supercapacitor application better and to communicate more effectively when we discuss the application with you. All information provided will be held confidential.

Date______________________________

Company________________________________Contact Name ____

Phone __________________________________Fax ____________________________email___________________________

Application Description:____

____

____

____

Medical? __ No __ Yes If Yes, Class _________ (I, II, or III)

Company Type:

_____OEM _____Systems Integrator _____Distributor _____Consultant

_____Educational _____Government _____Military _____Other ____________________

Application Type:

_____Pulse Power _____Main Power _____Memory Backup or Hold-Up Power

Circuit Information:

Desired working voltage (V) ____________________volts Minimum allowable voltage (Vmin)______________________volts

Average current draw (I) ______________________Amps Duration of current draw (t) ________________________seconds

Capacitor Calculations:
PowerStor has developed a Calculator program using Microsoft® Excel. Knowing a few simple parameters for the application, this program will assist in determining the optimum Aerogel Capacitor Solution by:

1. Calculating Minimum Capacitance, Maximum ESR, and Capacitor Configuration.
2. Using a pull-down menu with all of PowerStor's Aerogel Capacitor offerings for comparison to the calculated values.

The *Powerstor Aerogel Capacitor Calculator* is available at www.cooperbussmann.com for download.

W = Energy (Joules) **C** = Capacitance (Farads) **V** = Voltage (volts) **I** = Current (Amps) **t** = Time (seconds)
Vmin = Min. voltage (volts) **ESR** = Equivalent Series Resistance (Ohms) **Vdrop** = Allowable drop in working voltage (volts)

For Typical Hold-Up Power Applications:

Energy needed during hold up period: $W = IVt =$ ___________ in Joules

Energy decrease in capacitor: $W = 1/2\, C(V^2 - V_{min}^2) =$ ___________ in Joules

Desired C is: $C = \dfrac{2IVt}{V^2 - V_{min}^2}$ = ___________Farads

For Typical Pulse Power Applications:

Maximum ESR: $ESR(maximum) = V_{drop}/I =$ __________Ohms

Customer / Application Information Worksheet

Optimum Solution:

Capacitor Part Number ________________________

# of Capacitors in Series Configuration ______

# of Capacitors in Parallel Configuration ______

Additional Information

Max. Operating Temp. (C) ______ % Time at Max. Temp. ______

Min. Operating Temp. (C) ______ % Time at Min. Temp. ______

Typical Operating Temp. (C) ______ % Time at Typical Temp. ______

Max. Storage Temp. (C) ______

Min. Storage Temp. (C) ______

Dimensional / Package Requirements

Max. Package Size (L, W, H, diam., etc.) ____

Package Style (thru-hole, SMT, etc.) ____

Industry package ____

Additional ____

____

Product Schedule	Date Required	QTY or EAU
Initial Samples	__________________	__________________
Pre-production	__________________	__________________
Production	__________________	__________________

Expected Years of Operation ____________________________________

Target Cost $___________at Estimated Annual Usage Qty.________(pcs.)

Additional Information (Circuit diagram, product configuration, packaging, notes, etc.)

NOTES

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Customer Assistance

Customer Satisfaction Team

The Cooper Bussmann Customer Satisfaction Team is available to answer questions regarding Cooper Bussmann products and services. Calls should be made Monday – Friday, 8:00 a.m. – 4:30 p.m. for all US time zones.

The Customer Satisfaction Team can be reach via:
• Phone: 636-527-3877
• Toll-free fax: 800-544-2570
• E-mail: customerservice@cooperbussmann.com

Emergency and After-Hours Orders

To accommodate time-critical needs, Cooper Bussmann offers emergency and after-hours service for next flight out or will call. Customers pay only standard price for the circuit protection device, rush freight charges and a modest emergency fee for this service. Emergency and after-hours orders should be placed through the Customer Satisfaction Team. Call:

• Monday – Friday, 8:00 a.m. – 4:30 p.m. Central Time 636-527-3877
• After hours 314-995-1342

Application Engineering

Application Engineering assistance is available to all customers. The Application Engineering team is staffed by degreed electrical engineers and available by phone with technical and application support Monday – Friday, 8:00 a.m. – 5:00 p.m. Central Time.

Application Engineering can be reached via phone, fax or e-mail:
• Phone: 636-527-1270 (Cooper Bussmann®, PolySurg™)
• Phone: 561-998-4100 (Coiltronics®, PowerStor®)
• Fax: 636-527-1607
• E-mail: fusetech@cooperbussmann.com

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