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Powering Business Worldwide

Circuit Protection- Overcurrent

What is the termination finish and terminal material?

Please contact technical support [click here](#).

What is the MSL level?

Please contact technical support [click here](#).

Do you have 3D models (.STEP)?

Please contact technical support [click here](#) for availability.

What is the FIT/MTBF rate?

There is no FIT/MTBF data for fuses. When an overcurrent event occurs, the fuse opens as designed and interrupts the flow of current. This is not a "fuse failure," but a proper function of the fuse design. What are perceived as fuse and/or fuse holder "failures" are mostly reactions to excess heat produced by loose or corroded connections, improper component sizing or application outside the device's operating temperature range. These are not device failures, but rather inappropriate device selection. Fuses do not require maintenance until an overcurrent event causes them to open – then they need replacing after properly addressing the cause of the overcurrent event.

Do you have a cross for.....?

Please visit our on-line cross reference search [click here](#) or contact technical support [click here](#)

How do I select a fuse?

Please visit our parametric search [click here](#) or contact technical support [click here](#).

Can fuses with an AC voltage rating be used in a DC voltage application?

Fuses should be rated for the voltage AC or DC in which they will be used. The data sheet will usually have both an AC and DC voltage rating if they are recommended for both types of applications.

Do fuses need to be derated to account for the operating temperature?

Yes. Please contact technical support [click here](#) if the temperature derating information is not on the data sheet.

What is the difference between interrupting rating (breaking capacity) and the fuse's ampere rating?

The breaking capacity or interrupting rating for a protective device is the maximum available current, at rated voltage, that the device can safely open. The ampere rating is the normal current the fuse is designed to carry at +25 °C. It is recommended, however, that the fuse's current rating be at least 125 percent of the nominal operating current passing through the fuse. Both ratings are determined through testing.

My circuit is "x" amperes. What amperage fuse should I select?

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 percent 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 1 A is usually not recommended in circuits with normal operating currents of more than 800 mA. Further derating is required at elevated ambient temperatures.

Do fuse holders need derating?

Yes. Generally this derating factor is in line with fuse derating of 80 percent but could be more depending on additional environmental or operating factors such as temperature and/or current cycling.

Can a time delay fuse be used to replace a fast acting fuse?

Fast acting fuses are typically used to protect sensitive components from damage. Time delay fuses are typically used in circuits that may have periodic spikes in current to avoid nuisance openings. Replacing fast acting fuses with a time delay fuse could result in damage to equipment.

What clip, block, or holder is available for xxx fuse?

Please see our Fuse accessory guide [click here](#) or contact technical support [click here](#).

Can ferrule fuses be soldered?

Typically we do not recommend soldering of ferrule fuses. Please contact technical support [click here](#) for further questions.

Circuit Protection- Overvoltage

What is the termination finish and terminal material?

Please contact technical support [click here](#).

What is the MSL level?

Please contact technical support [click here](#).

Do you have a cross for.....?

Please visit our on-line cross reference search [click here](#) or contact technical support [click here](#)

How do I select an ESD suppressor?

Please visit our parametric search parametric search [click here](#) or contact technical support [click here](#).

Do you have MOV and high voltage TVS?

No. Currently our overvoltage product lines are low voltage ESD only devices.

Can the ESD suppressor be wave soldered?

Yes. Soldering profiles are typically listed on the data sheets. If there are questions please contact technical support [click here](#)

Circuit Protection- Terminal blocks

Do you have a cross for.....?

Please visit our on-line cross reference search [click here](#) or contact technical support [click here](#).

How do I select a terminal block?

Please visit our parametric search [click here](#) or contact technical support [click here](#).

What is the MSL level?

MSL is only applicable to surface mount devices. We do not currently offer any surface mount terminal block.

Magnetics

What is the operating temperature range?

It is the minimum and maximum range of ambient temperatures that a component can be safely operated. The maximum operating temperature is defined as the magnetics device internal self temperature rise plus the maximum application ambient temperature exposed to the magnetics.

The minimum operating temperature is defined as the absolute minimum application ambient temperature exposed to the magnetics. See Magnetics operating temperature defined application note [click here](#) for more detail.

Can the inductor be run at higher current levels than the Irms rating?

Yes. As long as the peak current rating is not exceeded and the device surface temperature is limited to its maximum rating.

Why is the Irms rating higher than the Isat rating?

The ratings for Irms and Isat are an indication of the inductor performance, in practice the inductor should not be used beyond its Isat rating.

On some product data sheets a maximum frequency of over 1 MHz is shown but the Irms derating curve only goes up to a few hundred kHz, why?

The maximum frequency shown is the frequency at which the inductance will start to roll off. The de-rating curve is limited by the information the core manufacture supplies, generally the inductors can be used beyond the highest de-rating frequency without any issues. For example the SD family has been used at up to 2 MHz (with relatively low applied V-μs, about 10-20 percent of the rated V-μs).

What is the termination finish and terminal material?

Please contact technical support [click here](#).

What is the MSL level?

Typically magnetics MSL=1. Please contact technical support [click here](#) for verification.

Do you have 3D models (.STEP)?

Please contact technical support [click here](#) for availability.

What is the Junction temperature?

Theta JA, Theta JC, Rja and Rjb are terms applicable only to active devices, such as integrated circuits. Inductors do not contain semiconductor material junctions and so do not have the same potential failure modes. Theta JA and Theta JC are therefore not applicable to inductors.

Are inductors polarity sensitive?

Unlike capacitors or diodes, single winding inductors do not have a functional polarity and work equally in either direction, so polarity is not important in the vast majority of end-use circuits. On rare occasions, it has been reported that some inductors perform better when mounted in one particular orientation, due to interaction with nearby components or ground plane conductors. Any asymmetrical performance is very much a function of the application, especially board layout.

Do you have 115/230 Vac 60 Hz transformers?

No.

Do you have UL, CSA, VDE recognized transformers and inductors?

No.

Do you have 10/100 Base-T transformers or modules?

No.

What is the inductor thermal resistance ?

Thermal resistance is not typically specified for inductors because inductors are rated by current and not by power. You can approximate the thermal resistance by dividing the temperature rise due to Irms current (e.g. 40 °C rise) by the DCR times the square of the Irms rating:

$R_{th} \text{ (in } ^\circ\text{C/W)} = 40 \text{ } ^\circ\text{C} \div (\text{DCR} \times \text{Irms}^2)$ where DCR is in Ohms and Irms is in amps.

What is the inductor power rating?

Inductor power ratings are not specified because the more meaningful rating for inductors is the Rms current rating. Inductor Rms current ratings are derived by applying DC or low frequency AC current and measuring the temperature rise.

What is the FIT/MTBF rate?

Please contact technical support [click here](#).

I need -55 °C storage. Your parts are listed at -40 °C—can I still use them?

We do not believe storage temperature of -55 °C will be an issue. However, we have not tested these parts at -55 °C and do not have any data to confirm or deny this theory.

How do I select an inductor?

Please visit our parametric search [click here](#) or contact technical support [click here](#).

Do you have a cross for.....?

Please visit our on-line cross reference search [click here](#) or contact technical support [click here](#).

Do you perform ESD testing on your components?

ESD testing is typically performed on active devices. Our magnetics products are passive devices and not typically susceptible to ESD damage so we do not usually test for ESD damage. We recommend customers perform their own application specific ESD testing if necessary. Please contact technical support [click here](#) if you have further questions.

Supercapacitors

What is the termination finish and terminal material?

Please contact technical support [click here](#).

What is the MSL level?

MSL is only applicable to surface mount devices. We do not currently offer any surface mount supercapacitors.

Do you have 3D models (.STEP)?

Please contact technical support [click here](#) for availability.

How can I use a supercapacitor for higher voltage applications?

Higher voltage is achieved by placing supercapacitors in series

$$C = 1/(1/C1 + 1/C2)$$

$$ESR = ESR1 + ESR2$$

Do I need to balance supercapacitors if connected in series?

All of our standard packs and modules have balancing built in. Single cell product will require balancing when connected in series.

How can I achieve higher capacitance or higher power?

Higher capacitance or higher power is achieved by connecting supercapacitors in parallel

$$C = C1 + C2$$

$$ESR = 1/(1/ESR1 + 1/ESR2)$$

Do I need to balance supercapacitors if connected in parallel?

No.

Can I connect two packs in series to get higher voltage?

Yes, but is not recommended.

What happens if the supercapacitor voltage exceeds the rated operating or surge voltage or exposed to a negative voltage?

In both cases, if the condition occurs briefly, then there will not be an issue. After long exposure (minutes) excessive voltage will lead to gas generation and leakage or rupture of the safety vent.

What will happen if you reverse supercapacitors polarity?

Eaton supercapacitors have 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, the electrodes become polarized. Although supercapacitors can be shorted to zero volts - electrodes maintain a very small amount of charge. The longer they are held charged in one direction, the more polarized they become. If reversed charged after prolonged charging in one direction, will reduce supercapacitor life.

What is the charging current?

Maximum recommended charge current is:

$$\text{Charge Voltage} \div (5 \times \text{ESR})$$

This can be exceeded in applications where the charge/discharge duty cycle is low. ESR will limit the practical charge current, in applications where charging is frequent care should be taken not to exceed the maximum recommended temperature rise of 3 °C for small cells and 15 °C for large cells and modules.

What is the discharge current?

Repeated charge/discharge cycles can cause damage if the temperature of the capacitor exceeds the recommended limit.

During discharge the voltage at the capacitor terminals will instantaneously drop by a voltage;

$$= \text{Discharge Current} \times \text{ESR}$$

Total voltage drop over duration of the discharge;

$$= \text{Discharge Current} \times (\text{ESR} + t/C)$$

t = duration of discharge, C = capacitance.

What is the FIT/MTBF rate for supercapacitors?

The typical 'failure' mode of supercapacitors is a drop in capacitance over time then the MTBF will vary from application to application depending upon the amount of design margin.

It also means that the device MTBF will vary depending on what arbitrary limit you set as being device failure and is voltage and temperature dependent. MTBF data misleading when compared to Arrhenius plots.

What effect do high and low temperatures have on the supercapacitor?

At sub-zero temperatures the electrolyte will start to freeze resulting in increased ESR and reduced capacitance. The part will return to "normal" when the temperature is raised.

Continued exposure to high ambient temperatures will dry out the electrolyte causing the ESR to increase and capacitance to fall, this condition is irreversible.

How to clean circuit board with supercapacitors? Can the supercapacitors be washed?

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

What type of soldering can be used with supercapacitors?

Through-hole supercapacitors should be wave soldered or manually soldered. Do not use reflow soldering. See Supercapacitor soldering guideline application note [click here](#) for more details or contact technical support [click here](#)

How do I select or size a supercapacitor?

To select or size a supercapacitor visit our supercapacitor on-line calculator [click here](#) or our parametric search [click here](#) or contact technical support [click here](#).

Do you have a cross for.....?

Please visit our on-line cross reference search [click here](#) or contact technical support [click here](#).

Miscellaneous

Can you provide a REACH certificate stating the REACH status

Please see our REACH statement [click here](#) for contact information.

Are your part RoHS compliant?

Can you provide a RoHS certificate?

Please visit the on-line search to retrieve RoHS certificates. Any exceptions will be listed on the certificate [click here](#). If there are still questions please contact technical support [click here](#).

Can you please provide Conflict Mineral information?

Please direct conflict mineral inquiries to ConflictMaterials@Eaton.com.

Can you please provide ECCN, country of origin, HS code, cage code?

Please direct all trade compliance inquiries to BU-BussTradeCompliance@Eaton.com

Do you have qualification testing information?

Yes. please contact technical support [click here](#).

What is Fit Form and Function?

We define fit, form and function as follows:

Fit – the ability of a part to physically interface with, connect to, or become an integral part of another part (i.e footprint)

Form – the shape, size, dimensions, mass, weight and other visual parameters that uniquely distinguish a part.

Function – the action or actions that a part is designed to perform (i.e electrical characteristics, performance curves)

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