

Circuit Protection Products Catalog 2013-2014

- Overtemperature Protection
- Overvoltage Protection
- Overcurrent Protection
- Hybrid Protection

TE connectivity

This catalog is intended to present application, product, and technical data to assist the user in selecting circuit protection products, including PolySwitch Polymeric Positive Temperature Coefficient (PPTC) resettable devices, Reflowable Thermal Protection (RTP) devices, Metal Hybrid PPTC (MHP) devices, PolyZen devices, 2Pro devices, Electrostatic Discharge (ESD) protection devices, Silicon ESD (SESD), chip fuses and gas discharge tubes (GDTs).

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NEW

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TE Circuit Protection

TE Connectivity is a $13 billion world leader in connectivity, designing and manufacturing products at the heart of electronic connections for the world's leading industries. Our company's long-standing commitment to innovation and engineering excellence helps our customers solve the need for more energy efficiency, always-on communications and ever-increasing productivity. With nearly 90,000 employees in over 50 countries, TE Connectivity makes connections the world relies on to work flawlessly every day.

TE Connectivity's business unit, TE Circuit Protection, began almost 40 years ago as Raychem Corporation. From the first, we defined ourselves as industry pioneers in the field of PPTC (polymeric positive temperature coefficient) technology with our PolySwitch product line. Developing the first patents for the use of a PPTC device as a variable resistor in circuit protection applications in the 1970s and 1980s, we have continued to expand the PolySwitch family to include wider voltage, current and temperature ranges in a variety of form factors.

Today our circuit protection devices help to make your world safer and your electronics more reliable. Our products can be found in your cellphone, tablet, car, home appliances, LED lighting fixtures and a myriad of other everyday applications.

Overcurrent Protection

- PolySwitch devices — PolySwitch PPTC devices provide resettable circuit protection. Device types include: Automotive, Radial-leaded, Strap Battery and Surface-mount Devices (SMDs)
- Single-use fuses — These devices are for applications that need to disable the circuit rather than isolate it. The family comprises: Fast-acting Chip, High-current Rated, Slow-blow Chip and Telecom fuses

Overvoltage Protection

- Gas discharge tubes (GDTs) — Low-capacitance GDT devices help protect applications such as telecom and appliances from potentially harmful surge events

ESD (Electrostatic Discharge) Protection

- Silicon ESD (SESD) and Polymer ESD (PESD) devices — These ESD devices help provide protection for today's highest-speed interface applications (USB, HDMI, DisplayPort, etc.). The ultra-compact SESD devices offer the industry's lowest capacitance
- ChipSESD devices — Bi-directional, silicon-based devices in 0201 and 0402 sizes are easier to install and re-work than traditional semiconductor-packaged ESD devices

Hybrid Protection

- Metal Hybrid PPTC (MHP) devices — A hybrid device combining the best attributes of a PPTC and bimetal breaker in one device helps protect lithium battery applications. Families include MHP-SA (Smart Activation) and MHP-TA (Thermal Activation) devices
- PolyZen devices — Each PolyZen device integrates a precision Zener diode and a PolySwitch PPTC device. Devices are offered in "LS" and "CE" options to help protect a broad range of applications requiring overcurrent/overvoltage protection
- 2Pro devices — Combining an MOV and PPTC in a single device helps provide space-efficient protection against overvoltage/overcurrent events. The 2Pro AC device family provides AC-line protection and offers better space and reliability benefits than discrete solutions

Thermal Protection

- Reflowable Thermal Protection (RTP) devices — The surface-mount-packaged RTP device helps manufacturers dramatically speed assembly time and reduce board space, while helping protect against potential damage from thermal runaway in automotive and industrial designs

To date, billions of TE Circuit Protection devices are being used to help protect a wide range of electronic products in the computer, battery and portable electronics, consumer, automotive, industrial, home appliance, HVAC and telecommunications markets. Our products help manufacturers meet strict regulatory standards while diminishing warrantee returns.

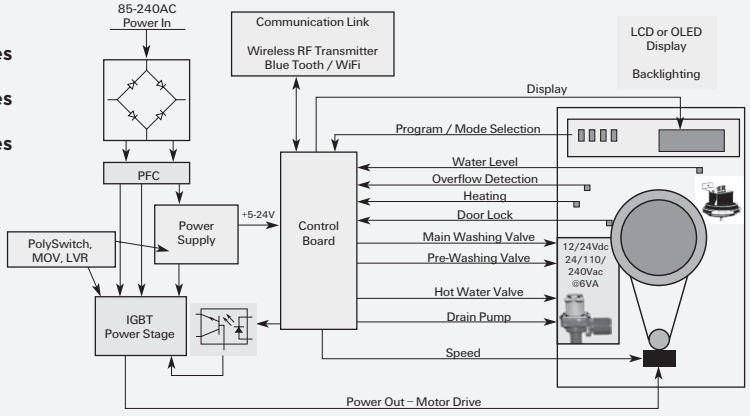
TE Circuit Protection offers a dedicated engineering sales force along with worldwide manufacturing and design centers. Our history in circuit protection, combined with local engineering support, enables us to think globally – and act locally – to meet our customers' needs.

Application Summaries

Washing Machines

A number of circuit protection devices can be used to help provide overtemperature, overcurrent and overvoltage protection for the small electric motors, LED displays and control electronics found in home appliances.

- **Line-voltage radial-leaded PolySwitch devices**
- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **ESD devices**
- **Surface-mount fuses**
- **RTP devices**
- **GDTs**

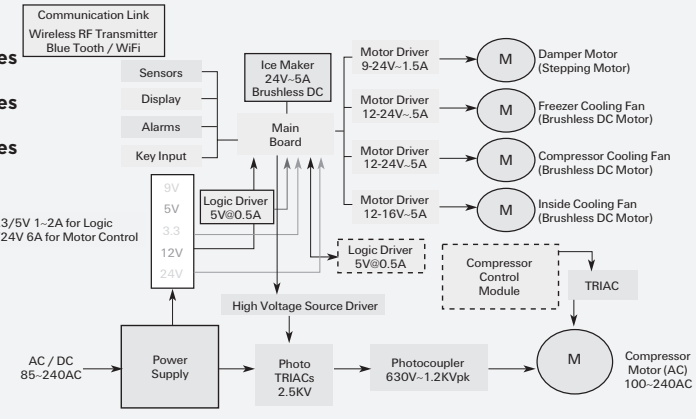




Refrigerators / Freezers

Our circuit protection devices help protect the small electric motors and fans, controllers, touchpads, displays and interface circuitry required by sophisticated appliances.

- **Line-voltage radial-leaded PolySwitch devices**
- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **ESD devices**
- **Surface-mount fuses**
- **RTP devices**

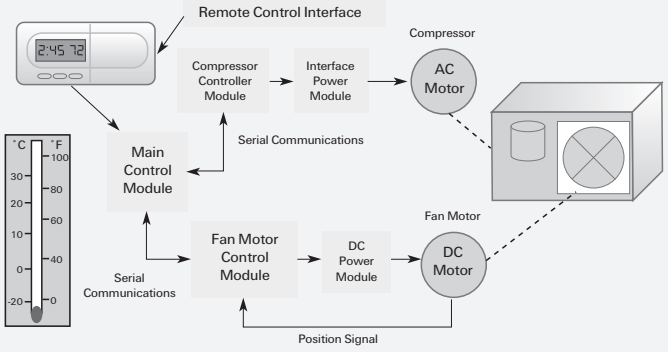




Air Conditioning Units

Resettable PolySwitch devices, ESD devices and chip fuses help provide coordinated overcurrent and overvoltage protection for the small electric motors, fans, displays and interface circuits used in modern HVAC equipment.

- **Line-voltage radial-leaded PolySwitch devices**
- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **ESD devices**
- **Surface-mount fuses**
- **RTP devices**

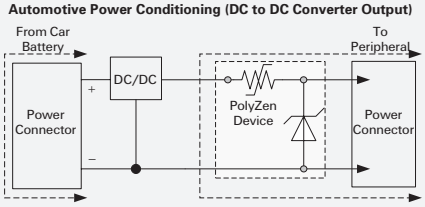




Automotive Electronics

PolyZen devices help protect automotive electronics and peripherals and/or portable electronics that can be charged in the vehicle from damage caused by inductive voltage spikes, voltage transients and reverse polarity. Providing coordinated overcurrent, overvoltage and reverse polarity protection, the PolySwitch device protects like a Zener diode but is capable of withstanding the high-power fault conditions that can occur in automotive applications.

- **PolyZen devices**



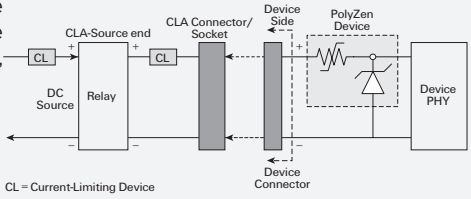


DC Cigarette Lighters and Power Plug Adapters

Charger circuits for mobile phones, iPods, after-market hands-free devices, or other rechargeable battery operated equipment, use connectors to plug into automobile cigarette lighter or power outlets. These assemblies must operate over a wide range of temperatures, charging conditions and in harsh automotive environments.

Typically, overcurrent protection, such as a PolySwitch polymer positive temperature coefficient (PPTC) device, and overvoltage protection are coordinated at the input to the charger to help meet the stringent electrical requirement. A single PolyZen device or PolyZen-AS device can be used to help protect against damage caused by overcurrent, overvoltage, or reverse polarity faults.

- **PolySwitch automotive devices**
- **Surface-mount fuses**
- **PolyZen devices**





Liquid Crystal Display Backlight Heaters

There are an increasing number of displays -- such as navigation systems, instrumentation displays, video and TV screens -- being designed into automobiles. A temperature-sensing PolySwitch PPTC current-limiting device can be employed to help prevent thermal runaway due to a failure in the control circuitry. In most cases, the circuit will be powered off on a regular basis (i.e., when the ignition is turned off) and a resettable PolySwitch device may be desired. In other cases, a single-use RTP (Reflowable Thermal Protector) device or singe-use fuse may be perferred.

- **PolySwitch automotive devices**
- **Surface-mount fuses**
- **RTP devices**



Driver-Side Door Console

The switch console on the driver-side door allows the driver to control multiple functions, including power windows, side mirrors and power door locks. Small Surface-mount PolySwitch devices help protect low current membrane switches and PCB traces against damage caused by overheating in the event of an overcurrent or short circuit condition. A variety of designs include PolySwitch devices that help protect PCB traces leading to high-current power window motors, as well as low-current delicate carbon membrane microswitches, transistors in LED backlighting circuits and small traces of the side mirror control circuits.

- **PolySwitch automotive devices**
- **Surface-mount fuses**

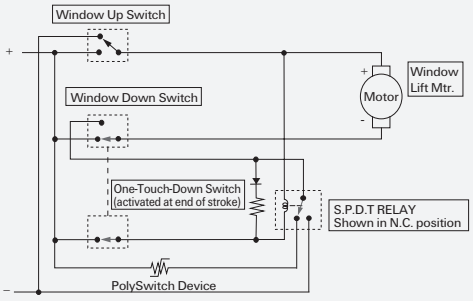


One-Touch-Down Circuits for Power Windows and Power Sunroofs

Lower cost one-touch-down circuits can employ a PolySwitch PPTC device to function both as a sense component and a switch component. This functionality allows a PolySwitch device to replace a number of other devices, such as the sense resistor, comparator, driver and control circuitry used in traditional power window and sunroof circuits. As a result, designers can help to achieve net cost savings through reduced component count and reduction in wire size.

- **PolySwitch automotive devices**

PolySwitch Device Employed in One-Touch-Down Circuit





Printed Circuit Board Traces

The width of the copper traces must be reduced to provide more space for the tighter-packed and smaller printed circuit boards. These “Black Box” control modules handle a large number of high-powered accessories such as power windows, power seat adjusters, remotely controlled door locks, and radio & GPS antennae. PolySwitch resettable devices can be used to help protect these delicate printed circuit board traces against damage caused by overcurrent conditions.

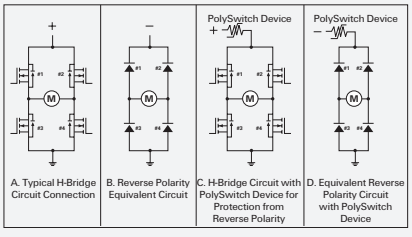
- **PolySwitch automotive devices**
- **Surface-mount fuses**
- **RTP devices**



H-Bridge Circuits

Automotive FET switched H-bridges must be protected from reverse polarity power sources. This may occur when jumper cables are connected to the wrong polarity of a dead or excessively discharged battery or when a new battery is installed backwards. Without protection, excessive heating can lead to failures in electronic modules or inadvertent activation of vehicle loads such as solenoids and motors, which can lead to unsafe conditions.

- **PolySwitch automotive devices**
- **RTP devices**





Automotive Control Application and Multimedia Busses

Connecting lifestyles from the home to the vehicle has become a reality in the automotive industry. MOST, Flexray, IEEE1394 and other networks now co-exist with CAN and LIN. Their main goal is to facilitate equipment interfacing and information sharing for embedded equipment, while also enabling after-market electronic equipment such as Portable Navigation (PNDs), smart phones, DVD players, etc. In a hot-pluggable automotive environment, where the consumer is connecting and disconnecting peripherals on a powered port, the potential for short-circuit damage is clearly present. PolySwitch devices and ESD protection devices can be used to help protect the connected equipment.

- **PolySwitch automotive devices**
- **Surface-mount fuses**
- **ESD devices**



Navigation and Infotainment Systems

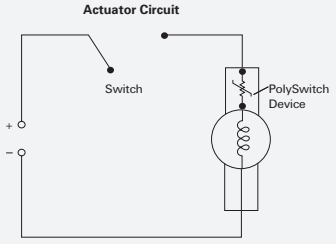
Infotainment and navigation systems are packed with electronics and connectivity elements. Circuit protection devices help protect a wide variety of functions such as powered antennae, CAN-bus, touch screen, USB ports, HDMI ports, RF tuners, I/O lines, HDD, etc. Overcurrent and overvoltage protection devices help prevent system breakdown and enhance design safety.

- **PolySwitch automotive devices**
- **ESD devices**
- **Surface-mount fuses**
- **PolyZen devices**



Automotive Actuators and Medium-Size DC Motors

Automotive electric motors can overheat and cause damage to internal temperature sensitive components. To help protect these components, custom and semi-custom PolySwitch devices can be designed to meet specific customer thermal protection needs. Installing a PolySwitch device in close proximity to the motor or solenoid offers the added benefit by limiting current due to excessive heat. In particularly high-current motor applications, such as engine cooling fans, HVAC fans, electric power steering motors and ABS pump motors, the higher currents or continuous duty cycles may be more appropriately supported by the use of an RTP (Reflowable Thermal Protection) device.

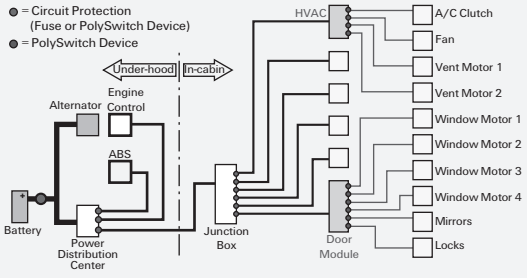


- **PolySwitch automotive devices**
- **Surface-mount fuses**
- **RTP devices**

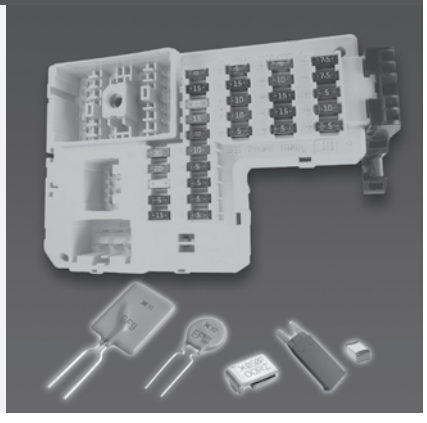


Automobile Harnesses

The wiring harness architectures of light and heavy vehicles have undergone considerable change due to increased electrical and electronic content. PolySwitch PPTC resettable circuit protection devices, which do not require driver accessibility, can be embedded in distributed electronic control modules and power controlling switches throughout the vehicle. This approach of creating separate circuits helps to enable fault isolation as well as the downsizing of wire gauges and PCB traces.

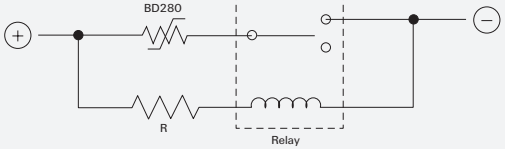


- **PolySwitch automotive devices**
- **Surface-mount fuses**



Automobile Relays

Relay contacts can pit during high current interrupt events. A PolySwitch PPTC device helps reduce current prior to contact switching events. This circuit design becomes a tuned system that uses the normally open contacts and works in coordination with relay inertia. During an overload condition, the relay energizes and latches in the off state. Once the power is cycled and/or the load is removed, the relay de-energizes and the circuit immediately resets and is able to deliver full power. The use of a PolySwitch device in this circuit can help achieve vehicle power outlet protection, but it can also be used to help protect isolated trailer lighting circuits.



- **PolySwitch device**

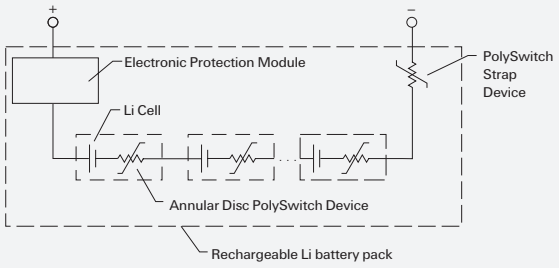


Lithium Cells and Battery Packs

External shorts, runaway charging conditions, or abusive charging can cause considerable damage to primary and secondary lithium (Li) cells. PolySwitch disc and strap circuit protection devices can help protect rechargeable lithium batteries used in notebook computers and cellular phones, as well as other portable electronic applications.

- **PolySwitch strap devices**
- **PolySwitch disc devices**

Typical Rechargeable Lithium Battery Pack Circuit



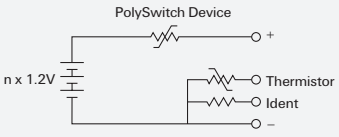


Rechargeable Battery Packs

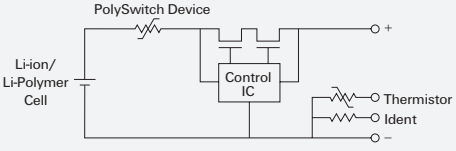
Due to external shorts, runaway charging conditions, or abusive charging, considerable damage can be sustained in both battery cells and pack surroundings. The most common applications for PolySwitch devices are for helping to protect lithium-ion (Li-ion) battery packs used in cellular phones, digital cameras and laptop/notebook computers, or for helping to protect nickel-cadmium (NiCd) and nickel-metal-hydride (NiMH) battery packs used in other portable electronic applications.

- **PolySwitch strap devices**

NiMH/NiCd Battery Pack Circuit Diagram



Single Cell Li-ion/Li-Polymer Battery Pack Circuit Diagram



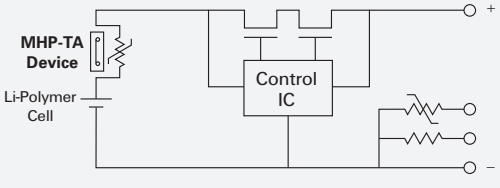


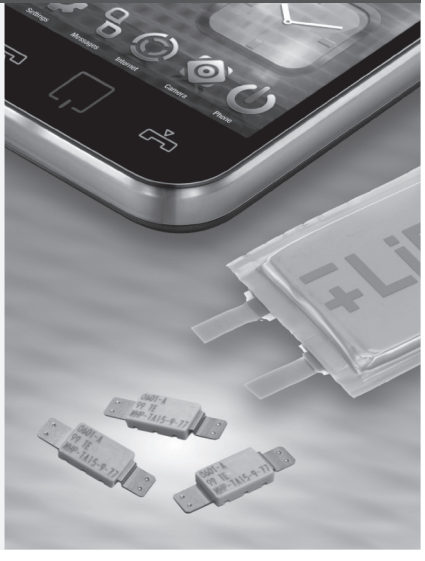
Rechargeable Lithium Polymer Cells

Tablets, ultra-thin notebook PCs and other small portable electronics use high-capacity lithium polymer and prismatic cells require overtemperature protection to help prevent the cells from overheating. The combination of thin form factors, high cell capacities and high battery discharge rates typical of these applications create a unique set of circuit protection requirements, which are low thermal cut-off temperatures (<90°C), high hold current ratings (>6A) and compact size.

The MHP-TA series of MHP (Metal Hybrid PPTC) devices addresses these design concerns by offering two levels of current carrying capacity (6A or 15A hold current at 25°C) as well as an ultra-thin package (L:5.8mm x W: 3.85mm x H: 1.15mm).

- **MHP devices**

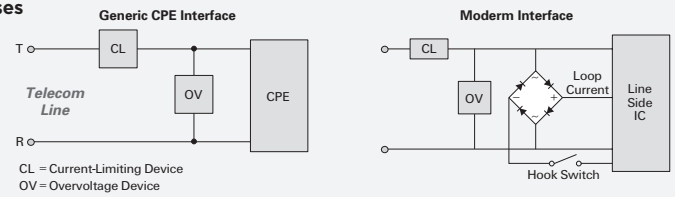




Customer Premise Equipment

To protect subscribers against damage caused by faults entering from outside wiring, customer premise equipment (CPE) is designed with power cross and lightning protection components. The following are recommended circuit protection solutions based on regional requirements.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**
- **2Pro devices**



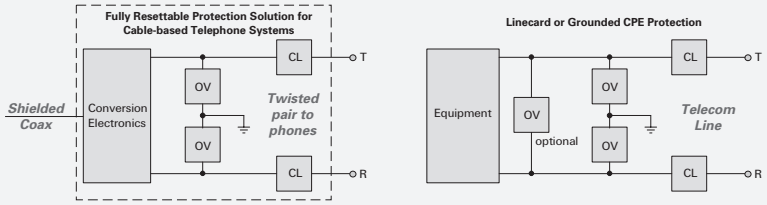
CL = Current-Limiting Device
OV = Overvoltage Device



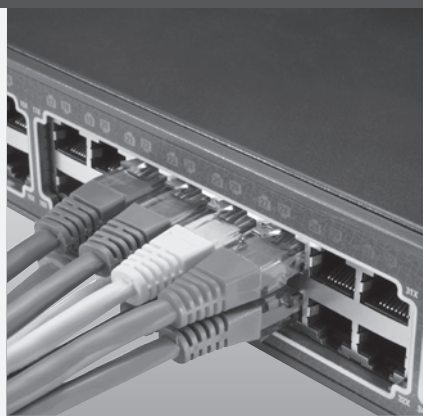
Short-haul/Intrabuilding Protection Requirements

Communications equipment that is not directly connected to the PSTN is subjected to lower level hazards. Here are a few circuit protection recommendations for LAN, WLL, VoIP and other intrabuilding applications.

- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**



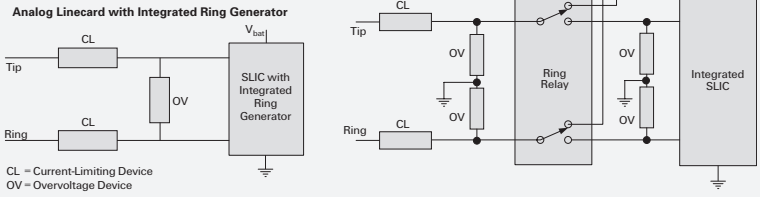
CL = Current Limiting Device
OV = Overvoltage Device



Analog Linecards

Central office linecards are subject to transient overcurrent and overvoltage faults, which may be generated from nearby power cross, power induction and lightning events. Circuit protection recommendations based on regional agency specifications are provided below.

- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**



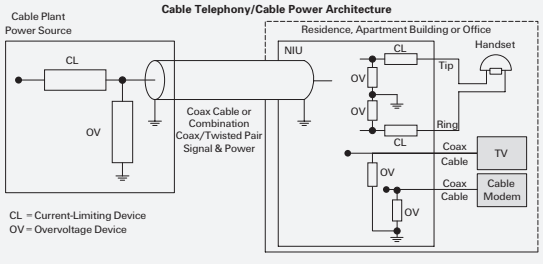
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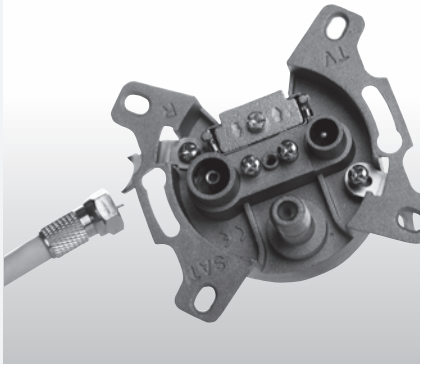
Cable Telephony/Cable Power Passing Taps

Cable telephony electronics that are powered via twisted pair or coaxial cable are susceptible to power faults passed through the cable plant. The circuit protection solutions listed below can help decrease the risk of these faults in power passing taps.

- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**



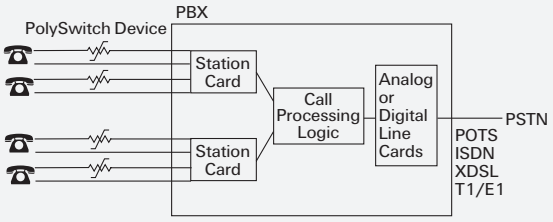
CL = Current-Limiting Device
OV = Overvoltage Device



PBX and Key Telephone Systems

Below are circuit protection device recommendations to help protect PBX and key telephone systems against damage caused by power faults and short circuits.

- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**

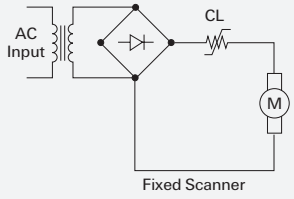




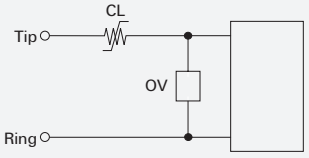
POS Equipment

Equipment connected to telephone lines can be subject to power cross, induction, and lightning surge hazards. We recommend the devices below to help protect scanner motors and ditherers against damage caused by jams and stalls.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **2Pro devices**



Fixed Scanner



Credit Card Verification

CL = Current-Limiting Device
OV = Overvoltage Device

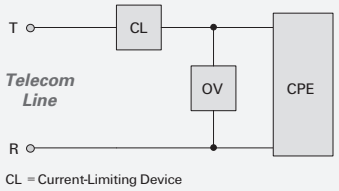


UL60950 and TIA-968-A, (formerly FCC part 68) Requirements

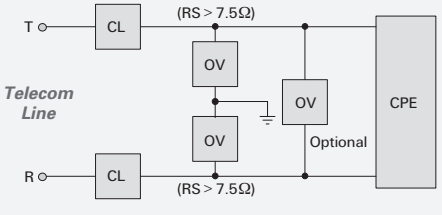
The UL60950 and TIA-968-A cover standards electrical hazards from which customer premise equipment (CPE) in North America must be protected. Below are resettable circuit protection recommendations.

- **PolySwitch telecom devices**
- **2Pro devices**
- **Surface-mount fuses**
- **GDTs**

Suggested Arrangement to Meet TIA-968-A for a Ungrounded CPE Design



Suggested Arrangement to Meet TIA-968-A for a Grounded CPE Design



CL = Current-Limiting Device
OV = Overvoltage Device

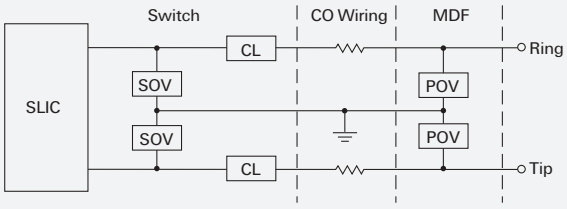


GR-1089 : Public Switched Telephone Network Equipment

GR-1089 describes the electrical hazards which public switched telephone network (PSTN) equipment in North America should be protected against. The figure below shows several recommended resettable circuit protection solutions for a simplified model of the central office end of a subscriber loop system.

- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**

Simplified Model of Central Office End of Subscriber Loop



CL = Current-Limiting Device
CO = Central Office
MDF = Main Distribution Frame
POV = Primary Overvoltage Protection Device
SLIC = Subscriber Line Interface Card
SOV = Secondary Overvoltage Protection Device

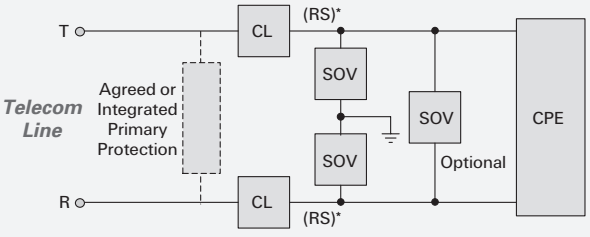


GR-1089-CORE, Issue 5: Public Switched Telephone Network Equipment

According to the GR-1089-CORE, Issue 5 standard, to help prevent damage to telecom equipment, circuits connected to outside lines generally need protection from lightning and power fault events. The equipment must be able to withstand the surges that the primary protector lets through. For this reason, secondary, and even tertiary, protection is included to help limit the potential damage of the surge let through. To be effective, the secondary protection must coordinate with the primary protection.

TE Circuit Protection offers a broad line of overcurrent and overvoltage devices that can help Public Switched Telephone Networks equipment conserve valuable board space and meet emerging safety and performance standards.

- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**



CL = Current-Limiting Device
SOV = Secondary Overvoltage Device
* RS is equal to the total coordinating resistance of the application

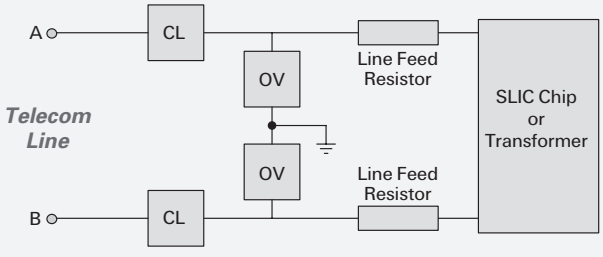


ITU-T Recommendations

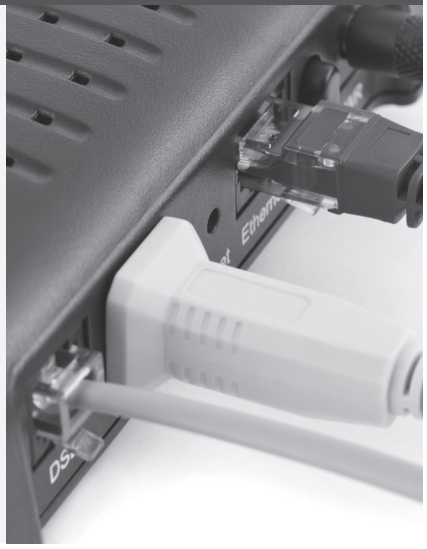
The ITU-T standard lists several recommendations for central office (K.20), customer premise (K.21) and access network (K.45) equipment. Below is an overview of our device recommendations, including resettable circuit protection solutions.

- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**

Typical Protection System for Network Equipment



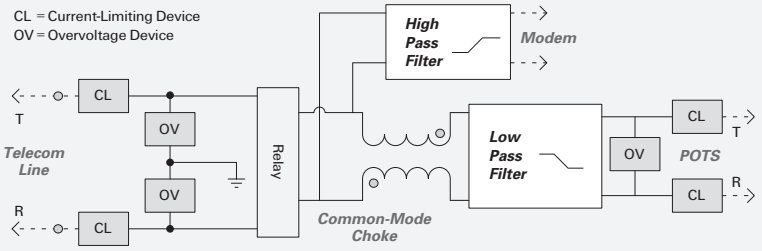
CL = Current-Limiting Device
OV = Overvoltage Device



DSL Equipment

DSL equipment, such as splitters, must be protected against damage caused by both external and intrabuilding faults. Recommendations for resettable protection solutions are provided here, based on regional requirements.

- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**

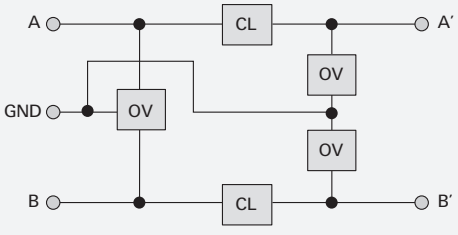




Main Distribution Frame (MDF) Modules

Telecom systems, such as MDF modules, typically have multi-stage circuit protection. Primary protection is used closest to the "outside world" where the highest surge withstand capability is typically needed. Secondary protection is needed to help protect against damage caused by hazardous power cross and lightning faults until the primary protection component activates. The following devices are recommended for helping to protect these systems.

- **PolySwitch telecom devices**
- **Surface-mount fuses**
- **GDTs**



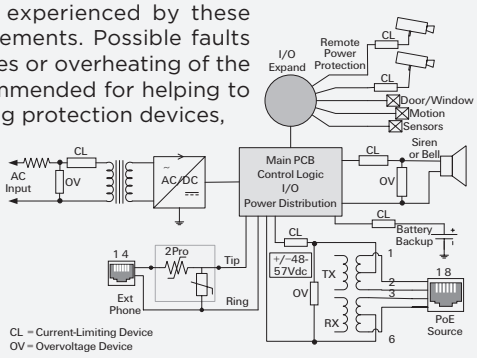
CL = Current-Limiting Device
OV = Overvoltage Device



Security and Fire Alarm Systems

Security and fire alarm systems have a need for circuit protection, due to fault conditions experienced by these applications as well as safety requirements. Possible faults include short circuits in the sensor lines or overheating of the battery. The devices below are recommended for helping to protect these systems. When choosing protection devices, it is also important to consider the different currents and what is needed to meet the requirements of UL864.

- **Radial-leaded PolySwitch devices**
- **PolySwitch telecom devices**
- **GDTs**
- **ESD devices**
- **2Pro devices**

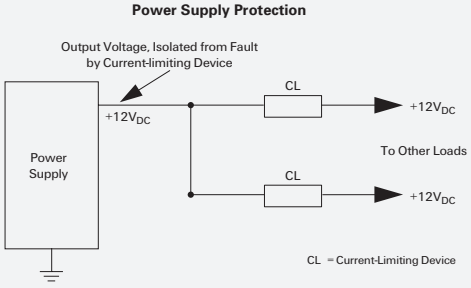


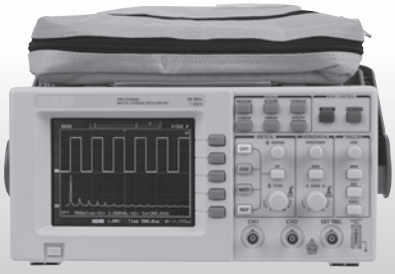


Test and Measurement Equipment

Power supplies, communication ports, test probes, and battery packs are all vulnerable to overcurrent faults and and electrostatic discharge (ESD). Incorrect termination of outputs may lead to system damage.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **PolySwitch telecom devices**
- **ESD devices**
- **Surface-mount fuses**
- **PolyZen devices**

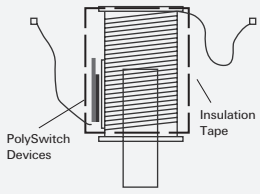


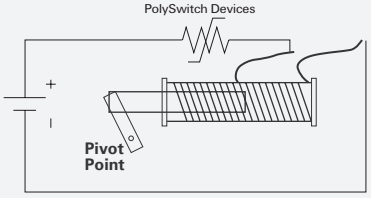


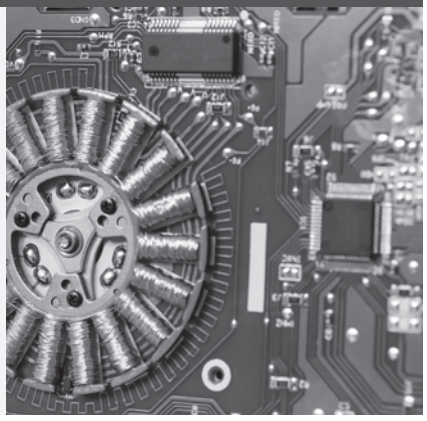
Solenoids

Solenoids are used in various PC and peripheral applications such as printer feed trays and CD/CD-RW/DVD tray mechanisms. A PolySwitch device can be used to help protect the coil assembly of the solenoid when a sensor fails or if the armature fails to retract, thus causing the coil temperature to increase and burn out the coil wire.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**



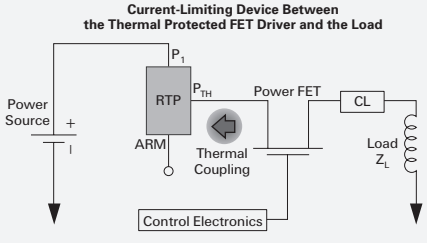


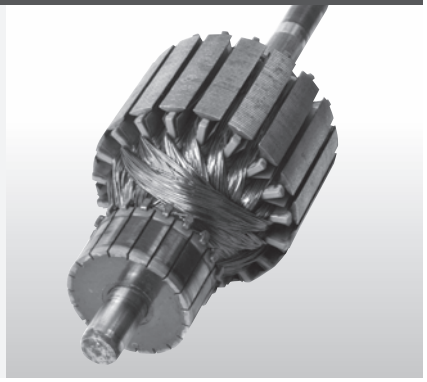


Electromagnetic Loads

Electromagnetic loads can be susceptible to many problems. Incorrect use of solenoids, valves and motors can potentially lead to device failure and circuit damage. The devices below are recommended as circuit protection solutions for these applications.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**
- **RTP devices**

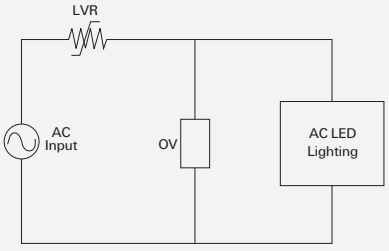




Protection for AC LEDs

Lighting fixtures powered by AC power can be put at risk from high voltage or power transients due to lightning strikes, load switching transients and their associated surge currents. We recommend the following circuit protection devices to help protect AC LEDs.

- **Line-voltage-rated PolySwitch**
- **Surface-mount PolySwitch devices**
- **2Pro devices**



OV = Overvoltage Device

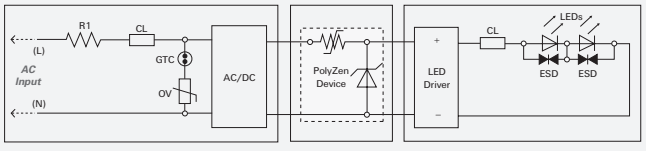


Protection for DC Solid State Lighting (SSL)/LED Lighting

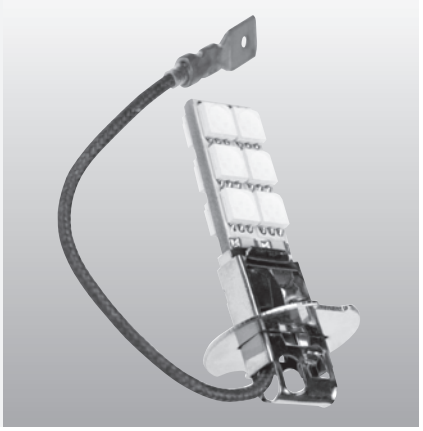
LED driver integrated circuits (ICs) used in many LED applications require a protected DC input to provide a regulated-current output to the LED. Listed below are device that help protect these lighting applications.

A PolySwitch device placed in series with the LED driver IC and combined with a parallel voltage-limiting device, such as a Zener or transient suppression diode, can help provide effective protection against damage caused by faulty DC input voltages. A PolyZen device with an integrated PolySwitch PPTC device and Zener diode help provide both protection capabilities in one package.

- **PolyZen devices**
- **ZEN**
- **Radial-leaded PolySwitch devices**
- **GDTs**
- **Surface-mount fuses**
- **ESD devices**



CL = Current Limiting Device
OV = Overvoltage Device



CFL Electronic Ballasts

There are two types of ballasts in compact fluorescent lamps (CFLs): electronic ballasts and magnetic ballasts. The electronic ballasts help prevent the fluorescent light from flickering when turning on. The electronic ballasts are more delicate and can be at risk from high-voltage or power transients due to lightning strikes, load switching transients and their associated surge currents.

A PolySwitch device helps provide effective protection for the electronic components inside the ballast against damage caused by faulty transients. TE Circuit Protection's 2Pro device and surface-mount fuses also help to provide effective protection in CFL ballasts.

- **2Pro devices**
- **Surface-mount fuses**



Street Lighting Electronic Ballasts

Lighting ballasts for street lighting can be at risk from high-voltage or power transients due to lightning strikes, load switching transients and their associated surge currents.

"A PolySwitch device in series with the LED driver IC, and combined with a parallel voltage limiting device such as metal oxide varistors, can help provide effective protection against damage caused by faulty transients. Our recommended devices for street lighting also include the following:

- **Telecom PolySwitch devices**
- **Telecom fuses**
- **GDTs**

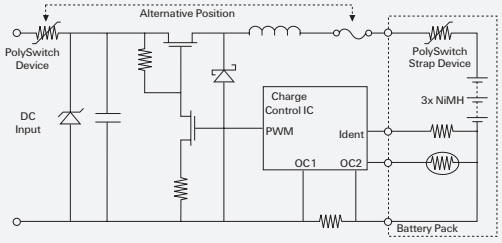


Portable Electronics Input Ports

The use of an incorrect or faulty adapter/charger can irreparably damage unprotected portable electronics equipment. Typical applications include cell phones, digital cameras, and tablets. The devices listed below are recommended for these applications.

- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**
- **PolyZen devices**

Typical Portable Electronics Charging Circuit with Protection





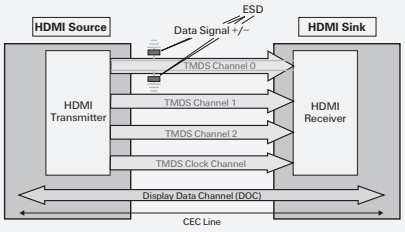
HDMI: LCD & Plasma Displays, HDTVs, Set-top Boxes, DVD Players

High definition multimedia interface (HDMI) applications, such as LCD displays, plasma displays, high-definition television set-top boxes and DVD players, are susceptible to electrostatic discharge (ESD devices). To help protect the high-speed TMDS lines against damage caused by our ESD or SESD protection devices can be used two-per-line in HDMI designs.

- **Surface-mount PolySwitch devices**
- **ESD devices**
- **Surface-mount fuses**
- **PolyZen devices**

Note : HDMI 1.3 reference layout, whitepaper and testing results available upon request

HDMI Source



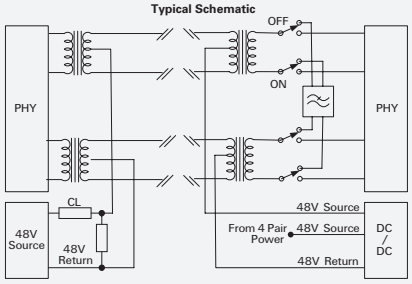


IEEE 802.3 Ethernet LAN (Powered Ethernet)

The auxiliary unit interface (AUI) consists of signal circuits, power and ground. Per the IEEE 802.3 standard, the Voltage Plus circuit is capable of operating at 12-15V_{DC} for currents up to 500mA. In addition, per section 7.5.2.5, the source shall provide protection for this circuit against damage caused by an overload condition. Powering IP devices such IP phones over the Ethernet cable introduces the potential for a short circuit and/or FET failure, causing service interruption. Devices recommended for circuit protection are:

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**

Typical Schematic



CL = Current-Limiting Device

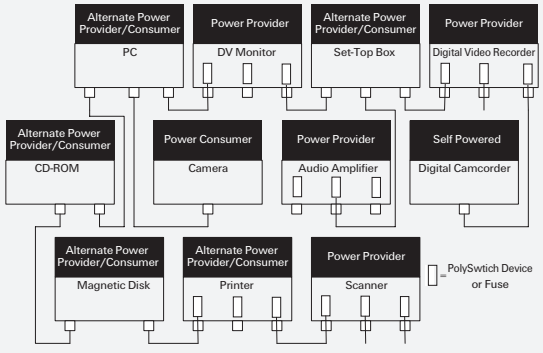


IEEE 1394: FireWire, i.Link

The IEEE 1394's complex power architecture provides up to 1.5A at voltages of 8-33V. PolySwitch devices help provide short-circuit protection in this high-power, hot-plugging environment.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**

Example of an IEEE 1394 Network

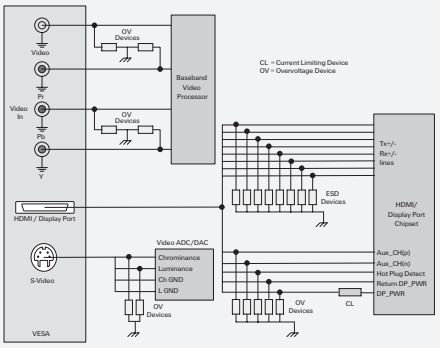


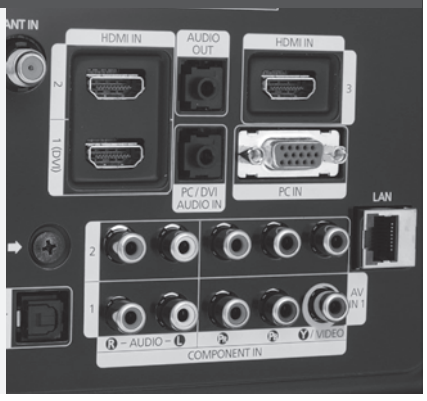


Video Ports: VESA, DDC, DVI, HDMI, DisplayPort

PolySwitch devices help protect video ports on PCI video cards and motherboard video ports from faults on the 5V interface line in Display Data Channel (DDC) circuits. These ports are designed for Energy Star compliance. TE Circuit Protection devices suitable for these applications include:

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**
- **PolyZen devices**
- **ESD devices**

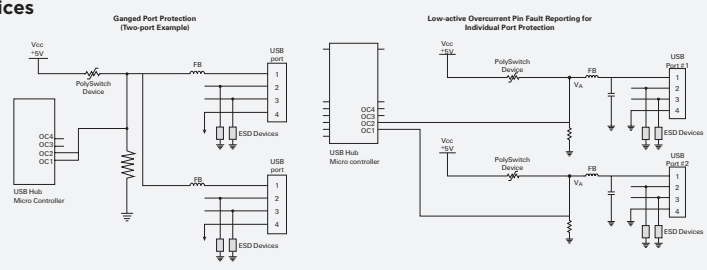




Universal Serial Bus (USB)

PolySwitch devices help provide short-circuit protection in this hot-plugging environment for USB hosts, self-powered and bus-powered hubs. Recommended circuit protection devices are:

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**
- **PolyZen devices**
- **ESD devices**





Audio Input/Output Ports

ESD protection devices can help protect analog audio ports from electrostatic discharge (ESD) during installation, or any time the user disconnects the source from the receiver. Additionally, our PolySwitch surface-mount devices and surface-mount fuses can be used.

- **ESD devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**



Power Input

PolySwitch devices help protect against overcurrent and overtemperature fault conditions by limiting the flow of current in the DC input power port circuit. Surface-mount fuses and PolyZen devices are also recommended for this application.

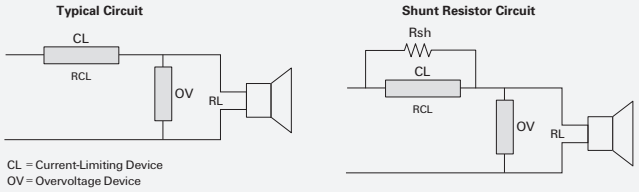
- **Surface-mount fuses**
- **PolyZen devices**
- **Surface-mount PolySwitch devices**



Loudspeakers

High-powered amplifiers used with low-powered speakers may overdrive the speaker coils with excessive power during sustained high volumes. Low-powered amplifiers may be overdriven so that clipping occurs. This causes an upward frequency shift of power that can overload the tweeters. Digital recordings, with their ability to reproduce high-frequency material, place extra strain on tweeters. TE Circuit Protection devices, including PolySwitch devices, can help the design engineer solve these problems.

- **Radial-leaded PolySwitch devices**
- **Surface-mount fuses**
- **PolyZen devices**

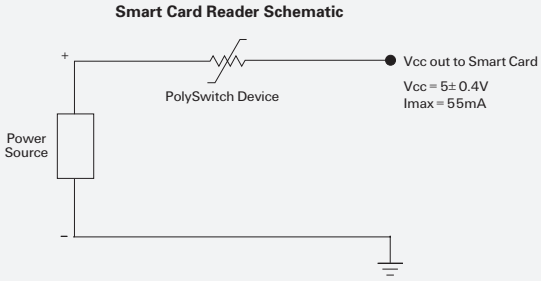




Smart Card Readers

Smart cards are powered from the readers' Vcc output. Defective cards or foreign objects placed into the reader can cause a short circuit and permanently damage the reader. The PolySwitch device can be used for circuit protection in smart card reader designs.

- **Surface-mount PolySwitch devices**

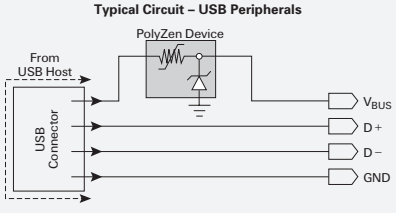


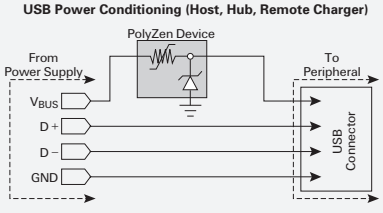


USB Peripherals

PolyZen devices can help protect against damage caused by overvoltage on USB peripherals and devices on the 5V computer bus. The component helps protect sensitive follow — on electronics — such as flash memory and other 6V capable silicon — from inductive voltage spikes, incorrect power supplies, dirty power and other voltage transients. The RoHS-compliant device offers massive power-handling in a 4mm package. PolyZen devices and ESD protection devices are also suitable for this application.

- **Surface-mount PolySwitch devices**
- **PolyZen devices**
- **ESD devices**





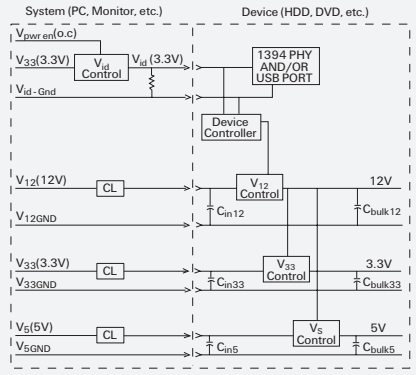


Backplane and Redundant Array of Inexpensive Disks (RAID)

Power backplane applications allow for field-serviceable and field-replaceable cards and drives to maximize the "up-time" of products. During card or drive replacements, the power on the backplane is live. The Circuit Protection devices below can be employed to help minimize safety risks, comply with IEC60950 Safety Requirement Clause 1.2.8.7 – Hazardous Energy Levels and to help protect against damage caused by short circuits caused by incorrect insertion of cards.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**

Typical Schematic



CL = Current-Limiting Device

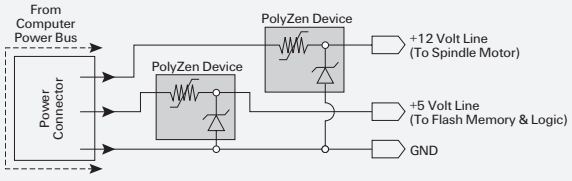


Hard Disk Drives (HDDs)

Integrated PolyZen devices can help protect devices on the 5V and 12V computer bus from overvoltage events and inductive voltage spikes resulting from a rapid change in current. The PolyZen device incorporates a stable Zener diode for precise voltage clamping and a resistively non-linear, polymer positive temperature coefficient (PPTC) layer that responds to either diode heating or overcurrent events by transitioning from a low to a high resistance state. This unique device helps manufacturers meet safety requirements and reduce warranty costs. In addition to the PolyZen device, the following circuit protection products are recommended for HDDs.

- **Surface-mount PolySwitch devices**
- **PolyZen devices**
- **Surface-mount fuses**
- **ESD devices**

Typical Circuit – Hard Disc Drive



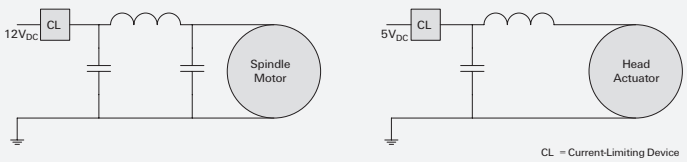


5V/12V Power Lines

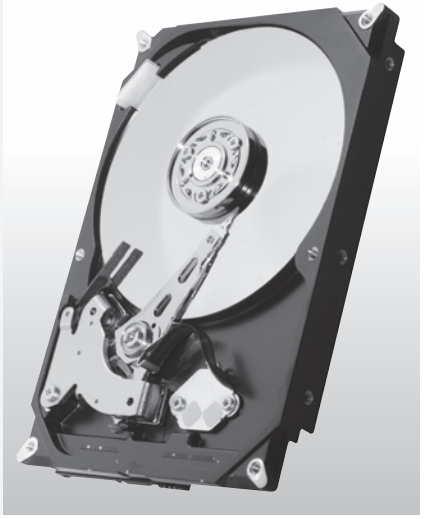
The connection of a 12V line from the power supply instead of a 5V line can cause a high-current inrush that can damage the other components in the circuit. Reverse polarity can cause damage to the tantalum capacitors, causing the capacitor to fail in a short-circuit mode. Applications suitable for the circuit protection devices listed below include hard disk drives, CD-ROM, CD-RW, DVD and other storage devices.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**
- **PolyZen devices**

Protection for Disk Drives



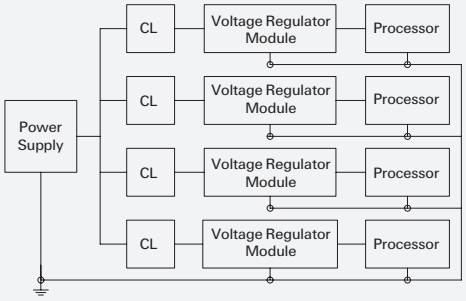
CL = Current-Limiting Device



Voltage Regulation Modules (VRMs)

Voltage regulation modules (VRMs) are used to supply power to central processing units. Due to load-change transients, processors can draw up to 13A. Also, during normal operation the current demand can change by as much as 7A as processor activity levels change. These high-current immediate demands can cause components to fail. The following Circuit Protection can help prevent the VRM from damaging the processor in the event of a VRM failure.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**



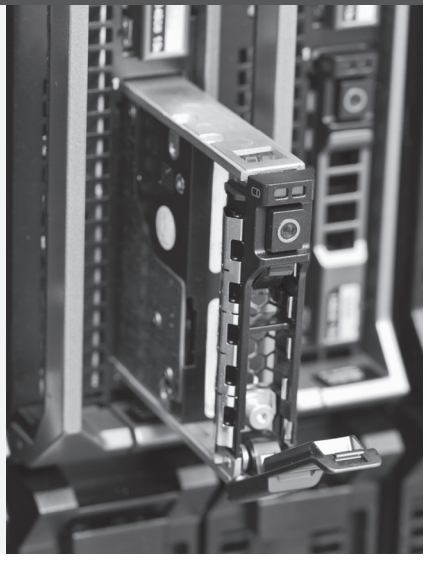
CL = Current-Limiting Device



Device Bays

The specifications for hot-swappable bays used in high-availability applications, such as servers and industrial computers, typically recommend overcurrent protection. An externally accessible port such as IEEE1394 or USB may also be used. The devices below are recommended for hot-swappable bay designs.

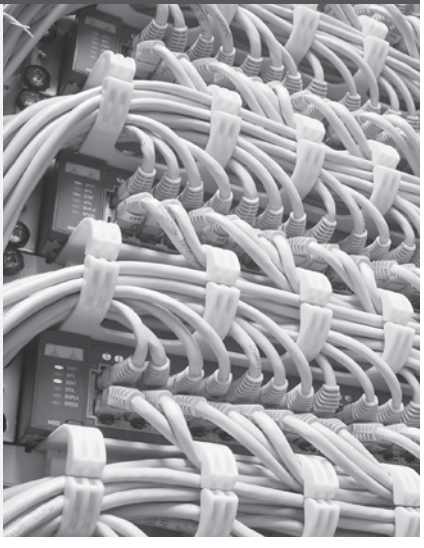
- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**



Fibre Channel

A fault, such as a short circuit, that occurs during testing or hot-swapping a peripheral component interconnect (PCI) card can cause significant damage. Incorrect insertion of the gigabit interface converter (GBIC) or a foreign object placed into the connector can also cause permanent damage to the system. Protection on the PCI bus input is typically used as well as a secondary protector for the GBIC I/O. We recommend the following TE Circuit Protection devices for this application.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**

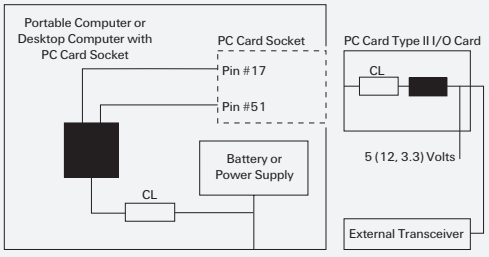


PC Cards and Sockets

Short circuits from external sources are the primary hazards for PC cards. The devices below can help protect against large current inrushes that can damage the PC card or the PC card bus.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**
- **ESD devices**
- **PolyZen devices**

Type II PC Card and Socket



CL = Current-Limiting Device



Motherboard Components

Since power-sensitive computer electronics such as flash memory can be exposed to voltages well in excess of the bus voltage, they require protection. Voltage spikes can result from a hot disconnect of a peripheral, an internal system shutdown or other internal power fluctuation. The integrated PolyZen device protects like a Zener diode while being capable of withstanding the high-power fault conditions that can occur in computer electronics. A coordinated protection scheme using the devices below is recommended as a solution in this application.

- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**
- **ESD devices**



Antennas

When used in antenna applications, PolySwitch devices can help limit the flow of dangerously high currents during fault conditions. As resettable polymer positive temperature coefficient (PPTC) devices, PolySwitch devices can reset back to normal operating mode once the fault condition is removed.

- **Surface-mount PolySwitch devices**



LCD Monitors

Power for LCD monitors is supplied from the 5V and 12V buses. The LCD controller itself and the surrounding controller logic are powered from the 5V bus. The LCD inverter and the electronics on the board are powered from the 12V bus. Misconnections and mishandling of the monitors during assembly or while in use can cause large overloads and short circuits in the system, damaging expensive components. For this reason, the following TE Circuit Protection devices are recommended for LCD monitor applications.

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**
- **ESD devices**



Displays

PolySwitch resettable devices can be thermally linked to the LCD glass. They can protect the power module if the control circuitry fails to turn off the element and help prevent thermal runaway. The following devices are suitable for use in display applications:

- **Radial-leaded PolySwitch devices**
- **Surface-mount PolySwitch devices**
- **Surface-mount fuses**
- **ESD devices**



Application Solution Guide

	Overcurrent Circuit Protection								Overvoltage Circuit Protection			Over-temperature Protection	Hybrid Protection		
	PolySwitch Devices	Chip Fuses					2410 Very Fast-Acting Fuses	Telecom Fuses	GDTs	ESD Protection Devices	SESD Devices	RTP Devices	MHP Devices	2Pro Devices	PolyZen Devices
		Pulse Tolerant	0603 Very Fast Acting	Fast-Acting	High-Current-Rated	Slow Blow									
Appliances															
Buttons										X	X				
Compressors	X														
Displays	X	X	X	X		X	X			X	X				
Motors	X	X				X									
Power Supplies	X	X	X	X			X		X			X		X	X
Transformers	X	X					X					X		X	
TRIACs	X						X					X			
Automotive															
ABS Systems	X	X		X		X	X					X	X		
Antennae	X									X	X				
Cigarette Lighter Accessories	X	X	X	X	X	X									X
Connectors	X														
Displays	X	X	X	X		X	X			X	X				
Electronic Control Units	X	X	X	X	X	X	X			X	X	X	X		
HVAC and Climate Control	X				X							X	X		X
Infotainment and Navigation Systems	X	X	X	X	X	X	X			X	X	X			X
Motors	X				X								X		
Wire Harness	X				X										
Batteries															
Li-ion	X	X		X	X	X				X	X	X	X		
Ni-Cd	X	X		X		X				X	X		X		
Ni-MH	X	X		X		X				X	X		X		
Business and Retail Equipment															
Antennae										X					
Audio Input/Output	X	X	X	X		X	X			X	X				
Batteries	X	X			X	X						X			
Buttons	X														
Displays	X	X	X	X	X	X	X			X	X				
Motherboard Components	X	X	X	X	X	X	X					X			
Ports	X	X	X	X		X	X			X	X				
HDDs	X	X	X	X	X	X	X			X	X				X
Power Input	X	X	X	X	X	X	X					X			X

	Overcurrent Circuit Protection								Overvoltage Circuit Protection			Over-temperature Protection	Hybrid Protection		
	PolySwitch Devices	Chip Fuses					2410 Very Fast-Acting Fuses	Telecom Fuses	GDTs	ESD Protection Devices	SESD Devices	RTP Devices	MHP Devices	2Pro Devices	PolyZen Devices
		Pulse Tolerant	0603 Very Fast-Acting	Fast-Acting	High-Current-Rated	Slow Blow									
Communications															
Antennae									X	X					
Audio Input/Output	X								X	X	X				X
Batteries	X	X			X	X	X	X				X	X		
Buttons	X	X	X	X		X		X		X	X				
Displays	X	X	X	X		X				X	X				
Fans	X	X	X	X		X									
HDDs	X	X	X	X		X				X	X				X
HPNA	X	X	X	X		X			X	X	X				
Low-speed Test Ports	X	X	X	X		X			X	X	X			X	
MoCA	X	X	X	X		X			X	X	X				
Motherboard Components	X	X	X	X		X	X					X			
Networking over Powerline	X	X	X	X		X	X	X	X	X	X			X	
Ports	X	X	X	X		X	X		X	X	X			X	
Power Input	X	X	X	X		X	X		X					X	X
Power over Ethernet	X	X		X		X			X	X	X			X	
Energy and Solar															
Batteries	X	X		X	X	X	X			X	X	X			
Charge Controllers	X	X	X	X	X	X	X		X	X	X	X		X	
Combiner Boxes	X	X			X	X	X		X						
Inverters	X	X			X	X	X		X	X	X	X			
Junction Boxes					X		X			X	X				
Disconnect Boxes	X	X			X	X	X		X	X	X				
Home Entertainment															
Audio Input/Output	X								X						X
Batteries	X	X		X		X	X			X	X		X		
Buttons										X	X				
Displays	X	X	X	X	X	X	X			X	X				
HDDs	X	X	X	X	X	X				X	X				X
Motors	X	X	X	X	X	X									
PCB Components	X											X			
Ports	X								X	X	X				
Power Input	X	X	X	X	X	X	X		X			X		X	X

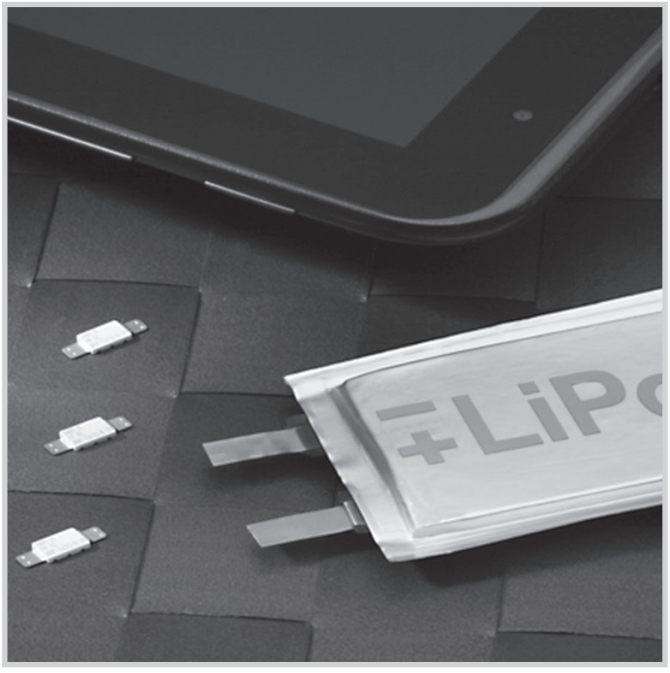
	Overcurrent Circuit Protection								Overvoltage Circuit Protection			Over-temperature Protection	Hybrid Protection		
	PolySwitch Devices	Chip Fuses					2410 Very Fast-Acting Fuses	Telecom Fuses	GDTs	ESD Protection Devices	SESD Devices	RTP Devices	MHP Devices	2Pro Devices	PolyZen Devices
		Pulse Tolerant	0603 Very Fast-Acting	Fast-Acting	High-Current-Rated	Slow Blow									
Industrial															
Buttons	X								X	X	X				
Compressors	X				X								X		
Displays	X	X	X	X		X	X			X	X				
Electromagnetic Loads	X	X				X									
Motors	X	X				X									
Power Input	X	X	X	X		X	X		X			X		X	
Transformers	X				X		X					X			
UPS Backup	X				X		X		X			X	X		
Lighting															
CFL Electronic Ballasts	X						X							X	
LED Ballasts	X	X	X	X			X					X		X	
LED Controllers	X	X	X	X	X	X	X					X		X	X
LED Drivers	X	X	X	X	X	X	X							X	X
PN Junction					X							X			
Power Input	X	X	X	X	X	X	X							X	X
Power Supplies	X	X	X	X	X	X	X					X		X	X
TRIACs	X				X							X			
Mobile Devices															
Antennae										X	X				
Audio Input/Output	X	X	X	X		X	X			X	X				X
Batteries	X	X				X						X	X		
Buttons	X	X	X	X		X	X			X	X				
Displays	X	X	X	X		X	X			X	X				
LEDs	X	X	X	X		X	X								
Ports	X	X	X	X		X	X			X	X				
Power Input	X	X	X	X		X	X								X
Personal Computers															
Antennae	X									X	X				
Audio Input/Output	X	X	X	X		X	X			X	X				
Batteries	X	X		X	X	X	X			X	X	X			
Buttons	X									X	X				
Displays	X	X	X	X		X	X			X	X				
Motherboard Components	X	X	X	X	X	X	X			X	X	X			
Ports	X									X	X				
Power Input	X	X	X	X	X	X	X								X



MHP-TA Device: MHP with Thermal Activation

The rapidly expanding market for ultra-thin portable electronic devices, such as media tablets and ultra-thin PCs, has created demand for very thin, low-profile, light-weight and high-capacity Lithium Polymer (LiP) and prismatic cells.

A new MHP (Metal Hybrid PPTC) device, the MHP-TA device, offers a $9V_{DC}$ rating and a higher current rating than typical battery strap devices. This helps them meet the battery safety requirements of higher-capacity LiP and prismatic batteries found in the latest tablet and ultra-thin computing products. Hybrid MHP technology connects a bimetal protector in parallel with a PPTC (polymeric positive temperature coefficient) device. The resulting MHP-TA (Thermal Activation) series helps provide resettable overtemperature protection, while utilizing the PPTC device to act as a heater and to help keep the bimetal latched until the fault is removed.



Benefits

- Capable of handling the higher voltages and battery discharge rates found in high-capacity LiP and prismatic cell applications
- Helps provide resettable overtemperature protection in high-capacity LiP and prismatic cell applications

Features

- $9V_{DC}$ rating
- Two levels of current carrying capacity:
  - Low current (nominal 6A hold current @25°C)
  - High current (nominal 15A hold current @25°C)
- Multiple activation temperature ratings (72°C, 77°C, 82°C, 85°C, 90°C)
- Compact size (L: 5.8mm x W: 3.85mm x H: 1.15mm) allows for ultra-thin battery pack designs

Applications

Battery cell protection for high-capacity Lithium Polymer and prismatic cells used in:

- Media tablets
- Ultra-thin notebook PCs
- E-readers
- Smart phones

Table MHP-TA: Electrical Characteristics for MHP-TA Devices

Table M1 Electrical Characteristics for the MHP-TA15 Series

	Rating [°C]	Operation Temperature [°C]		Reset Temperature [°C]		Reference Resistance [mohms] 25°C	
Model Number	**Nominal**	**Min**	**Max**	**Min**	**△T1**	**Typ**	**Max**
MHP-TA15-9-72	72	67	77	≥40	≥7	2.5	5
MHP-TA15-9-77	77	72	82	≥40	≥10	2.5	5
MHP-TA15-9-82	82	77	87	≥40	≥10	2.5	5
MHP-TA15-9-85	85	80	90	≥40	≥10	2.5	5
MHP-TA15-9-90	90	85	95	≥40	≥10	2.5	5

Maximum breaking current $5V_{DC}$ / 80A (100 cycles)
Contact Rating $9V_{DC}$ / 25A (6000 cycles)

4

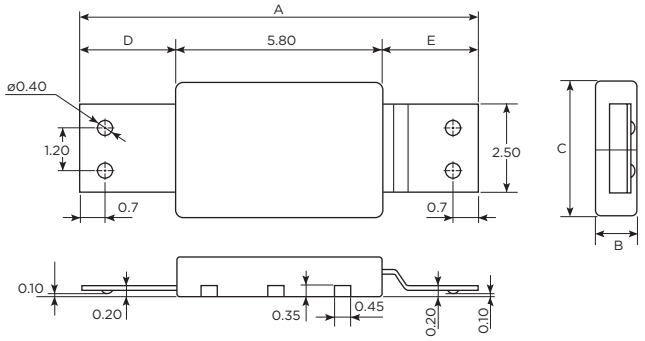
Table M2 Electrical Characteristics for the MHP-TA6 Series

	Rating [°C]	Operation Temperature [°C]		Reset Temperature [°C]		Reference Resistance [mohms] 25°C	
Model Number	**Nominal**	**Min**	**Max**	**Min**	**T1**	**Typ**	**Max**
MHP-TA6-9-72	72	67	77	≥40	≥7	10	15
MHP-TA6-9-77	77	72	82	≥40	≥10	10	15
MHP-TA6-9-82	82	77	87	≥40	≥10	10	15
MHP-TA6-9-85	85	80	90	≥40	≥10	10	15

Maximum breaking current $5V_{DC}$ / 40A (100 cycles)
Contact Rating $9V_{DC}$ / 12A (6000 cycles)
[1]△T is the minimum temperature differential between the actual operation temperature of the device and the reset temperature

Table M3 Dimensions and Mechanical Characteristics for MHP-TA Devices

	A		B	C		D		E	
	Min	**Max**	**Typ**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
mm:	10.9	11.4	1.15	3.75	3.85	2.6	2.8	2.6	2.8



RoHS Compliant, ELV Compliant

Figures M1-M2 Hold Current vs. Temperature Curves (Typical) for the MHP-TA6/MHP-TA15 Series

Figure M1

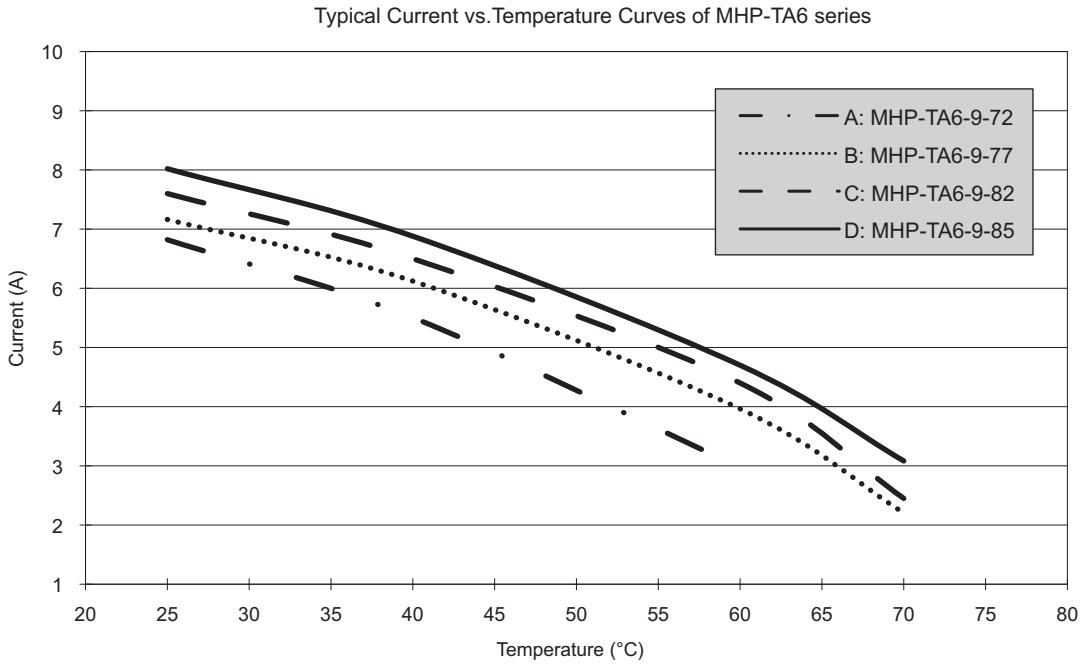
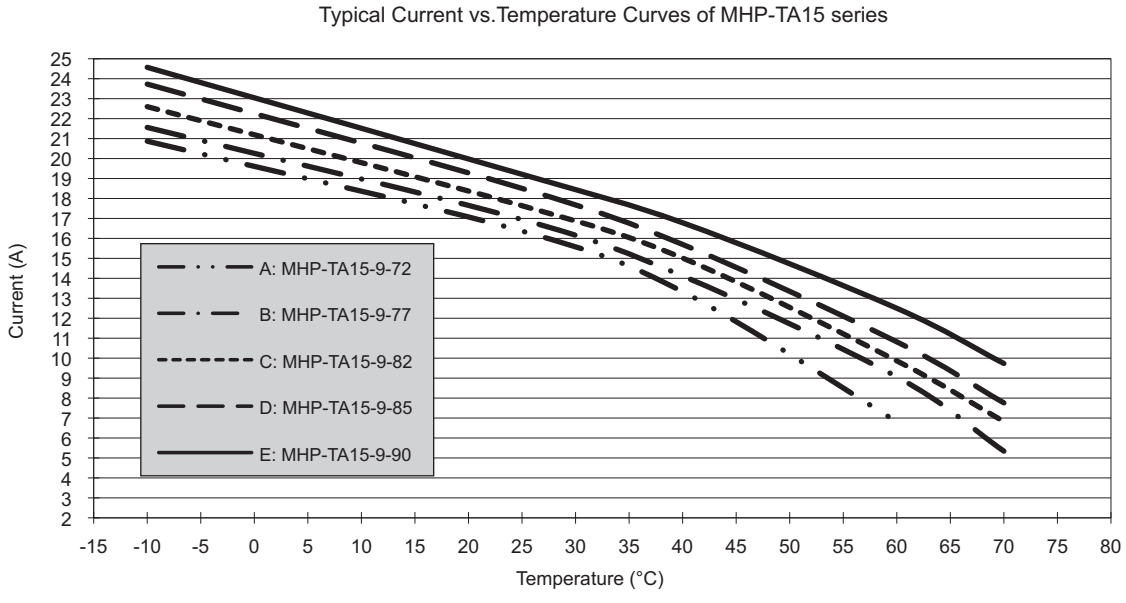


Figure M2



Physical Characteristics

Terminals	Copper Alloy
Molding Plastic	LCP (Liquid Crystal Polymer)

RoHS and Halogen-Free Compliance

RoHS Compliant

Halogen Free per IEC 61249-2-21

Storage Conditions

Device must be stored in the original, unopened bag.

Suggested storage temperature (except for packaging material)

Temperature: -10°C – 40°C

Humidity: 75%RH (max)

The following environments should be avoided for storage:

Areas with salt air or with corrosive gas, such as Cl_2, H_2S, NH_3, SO_2 and NO_x.

Areas exposed to direct sunlight.

Areas outside of the suggested storage temperature range, as indicated above.

Precautions for Handling

The device is composed of plastic parts, please do not clamp or dent the housing with a tool as this might cause a resistance increase and product damage.

When welding product terminals or mounting the breaker on a battery (cell), please be careful not to apply excessive bending, twisting or force on the product and terminals. The excessive stress might cause a resistance increase or product damage.

Please refer to following cautions:

1. Do not apply more than 10N bend force to product. (Fig. M3)
2. Do not apply more than 1.5cN/m twist torque to the product. (Fig. M4)
3. Do not apply more than 20N deflection force to product. (Fig. M5)
4. Do not apply more than 2N force to the terminals. (Fig. M6)
5. Do not apply more than 0.6cN/m twisting torque to the terminals. (Fig. M7)
6. Do not bend the terminal base more than 20° when the product is mounted in a fixed position. (Fig. M8)

Figure M3

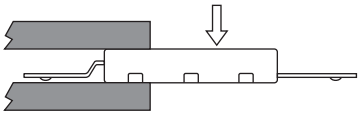


Figure M4

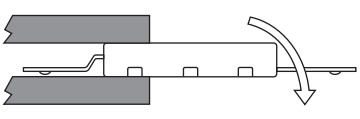


Figure M5

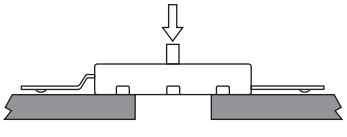


Figure M6

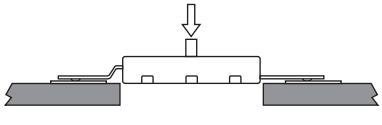


Figure M7

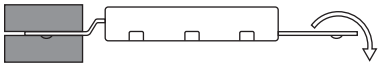
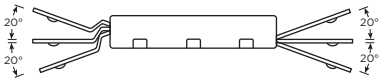


Figure M8



Product terminals can be welded using direct welding and series welding methods. In either case, please use a suitable jig so that the device will not be subjected to the stress conditions listed above.

Pull strength and detach strength of the terminal welds are per user requirements. However, if the welding is controlled by resistance, the measurement should be made as close as possible to the weld point by a "4-point clip method" using milliohm meter to ensure accuracy.

Avoid putting stress on the device, as listed above, when a jig, fitting or additional welding process is used. Please reconfirm the resistance value whenever a new process is added.

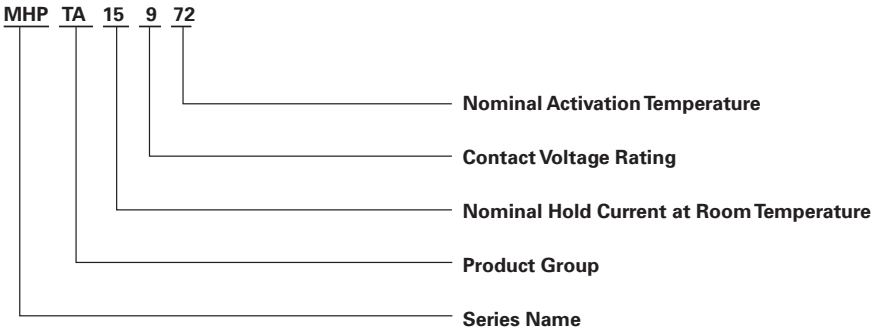
Table M4 Packaging and Marking Information for MHP-TA Devices

Part Number	Bag Quantity	T&R Quantity	Standard Package	Part Marking	Agency Recognition
MHP-TA15 Series					
MHP-TA15-9-72	2,500	-	50,000	Lot ID#, Control# & Co. Logo, Product #	UL 873 Recognized File No. E349829
MHP-TA15-9-77	2,500	-	50,000	Lot ID#, Control# & Co. Logo, Product #	UL 873 Recognized File No. E349829
MHP-TA15-9-82	2,500	-	50,000	Lot ID#, Control# & Co. Logo, Product #	UL 873 Recognized File No. E349829
MHP-TA15-9-85	2,500	-	50,000	Lot ID#, Control# & Co. Logo, Product #	UL 873 Recognized File No. E349829
MHP-TA15-9-90	2,500	-	50,000	Lot ID#, Control# & Co. Logo, Product #	UL 873 Recognized File No. E349829
MHP-TA6 Series					
MHP-TA6-9-72	2,500	-	50,000	Lot ID#, Control# & Co. Logo, Product #	UL 873 Recognized File No. E349829
MHP-TA6-9-77	2,500	-	50,000	Lot ID#, Control# & Co. Logo, Product #	UL 873 Recognized File No. E349829
MHP-TA6-9-82	2,500	-	50,000	Lot ID#, Control# & Co. Logo, Product #	UL 873 Recognized File No. E349829
MHP-TA6-9-85	2,500	-	50,000	Lot ID#, Control# & Co. Logo, Product #	UL 873 Recognized File No. E349829

Table M5 Ordering Information for MHP-TA Devices

Bag	2,500	pieces
Box	50,000	pieces

Part Numbering System for MHP-TA Devices



4

Notice:

Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Tyco Electronics Corporation and its affiliates in the TE Connectivity Ltd. group of companies ("TE") reserve the right to change or update, without notice, any information contained in this publication; to change, without notice, the design, construction, processing, or specification of any product; and to discontinue or limit production or distribution of any product. This publication supersedes and replaces all information previously supplied. Without express written consent by an officer of TE, TE does not authorize the use of any of its products as components in nuclear facility applications, aerospace, or in critical life support devices or systems. TE expressly disclaims all implied warranties regarding the information contained herein, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. TE's only obligations are those in the TE Standard Terms and Conditions of Sale and in no case will TE be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of its products.

Special Recommendations:

1. The power supply voltage must be less than the rated voltage of the device. Operation above the voltage rating may result in device damage, smoking or flame.
2. Designs must be selected in such a manner that the device hold current is higher than the normal current value in the circuit and that the device trip current is lower than the abnormal current value. Selecting device hold current and trip current values that are too low for the application may interrupt the circuit under normal usage conditions.
3. This product should not be used in an application where the maximum interrupt current can be exceeded in a short circuit condition.
4. The devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
5. The devices may not perform as specified if mechanical pressure is added while the device is in the tripped state or exposed to temperature conditions lower than -30˚C or over 100˚C.



PolyZen Devices

Polymer Protected Zener Diode

PolyZen devices are polymer-enhanced, precision Zener diode micro-assemblies. They offer resettable protection against multi-Watt fault events without the need for multi-Watt heat sinks.

The Zener diode used for voltage clamping a PolyZen micro-assembly was selected due to its relatively flat voltage vs. current response. This helps improve output voltage clamping, even when input voltage is high and diode currents are large.

An advanced feature of the PolyZen micro-assembly is that the Zener diode is thermally coupled to a resistively non-linear, PPTC (polymer positive temperature coefficient) layer. This PPTC layer is fully integrated into the device and is electrically in series between V_{IN} and the diode clamped V_{OUT}.

This advanced PPTC layer responds to either extended diode heating or overcurrent events by transitioning from a low to high resistance state, also known as "tripping." A tripped PPTC will limit current and generate voltage drop. It helps to protect both the Zener diode and the follow-on electronics and effectively increases the diode's power handling capability.

The polymer-enhanced Zener diode helps protect sensitive portable electronics from damage caused by inductive voltage spikes, voltage transients, incorrect power supplies and reverse bias. These devices are particularly suitable for portable electronics and other low-power DC devices.



Benefits

- Stable Zener diode helps shield downstream electronics from overvoltage and reverse bias
- Trip events shut out overvoltage and reverse bias sources
- Analog nature of trip events helps minimize damage from upstream inductive spikes
- Minimal power dissipation requirements
- Single component placement

Features

- Overvoltage transient suppression
- Stable V_Z vs. fault current
- Time delayed, overvoltage trip
- Time delayed, reverse bias trip
- Multi-Watt power handling capability
- Integrated device construction
- RoHS compliant

Applications

- DC power port protection in portable electronics
- DC power port protection for systems using barrel jacks for power input
- Internal overvoltage and transient suppression
- DC output voltage regulation
- Tablet PCs and portable electronics

RoHS Compliant, ELV Compliant

Figure PZ1 Typical Application Block Diagram for PolyZen Devices

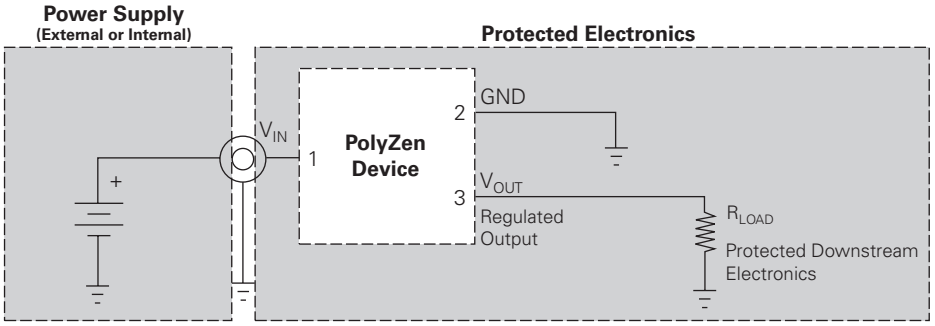


Table PZ1 Electrical Characteristics for PolyZen Devices

(Performance ratings @ 25°C unless otherwise specified)

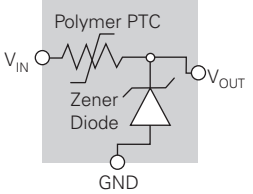
	V_Z(V)							$V_{INT\ MAX}$		$I_{FLT\ MAX}$	
Part Number	Min	Typ	Max	I_{Zt} (A)	I_{HOLD} @ 20°C (A)	R_{Typ} (Ω)	R_{1MAX} (Ω)	$V_{INT\ MAX}$ (V)	Test Current (A)	$I_{FLT\ MAX}$ (A)	Test Voltage (V)
ZEN056V130A24LS	5.45	5.60	5.75	0.10	1.30	0.12	0.16	24V	3A	+10/-40	+24/-16V
ZEN059V130A24LS†	5.80	5.90	6.00	0.10	1.30	0.12	0.15	24V	3A	+6/-40	+24/-16V
ZEN065V130A24LS	6.35	6.50	6.65	0.10	1.30	0.12	0.16	24V	3A	+6/-40	+24/-16V
ZEN098V130A24LS	9.60	9.80	10.00	0.10	1.30	0.12	0.16	24V	3A	+3.5/-40	+24/-16V
ZEN132V130A24LS	13.20	13.40	13.60	0.10	1.30	0.12	0.16	24V	3A	+2/-40	+24/-16V
ZEN164V130A24LS	16.10	16.40	16.60	0.10	1.30	0.12	0.16	24V	3A	+1.25/-40	+24/-16V
ZEN056V230A16LS	5.45	5.60	5.75	0.10	2.30	0.04	0.06	16V	5A	+5/-40	+16/-12V
ZEN065V230A16LS	6.35	6.50	6.65	0.10	2.30	0.04	0.06	16V	5A	+3.5/-40	+16/-12V
ZEN098V230A16LS	9.60	9.80	10.00	0.10	2.30	0.04	0.06	16V	5A	+3.5/-40	+16/-12V
ZEN132V230A16LS	13.20	13.40	13.60	0.10	2.30	0.04	0.06	16V	5A	+2/-40	+20/-12V
ZEN056V075A48LS	5.45	5.60	5.75	0.10	0.75	0.28	0.45	48V	3A	+10/-40	+48/-16V
ZEN132V075A48LS	13.20	13.40	13.60	0.10	0.75	0.28	0.45	48V	3A	+2/-40	+48/-16V
ZEN056V115A24LS	5.45	5.60	5.75	0.10	1.15	0.15	0.18	24V	3A	+10/-40	+24/-16V
ZEN056V130A24CE	5.45	5.60	5.75	0.10	1.30	0.070	0.105	24V	3A	+10/-40	+24/-16V
ZEN056V230A16CE	5.45	5.60	5.75	0.10	2.30	0.032	0.060	16V	5A	+5/-40	+16/-12V
ZEN056V260A16CE	5.45	5.60	5.75	0.10	2.60	0.032	0.045	16V	5A	+5/-40	+16/-12V
ZEN132V130A24CE	13.20	13.40	13.65	0.10	1.30	0.070	0.105	24V	3A	+3/-40	+24/-16V
ZEN132V230A16CE	13.20	13.40	13.65	0.10	2.30	0.032	0.060	16V	5A	+3/-40	+16/-12V
ZEN132V260A16CE	13.20	13.40	13.65	0.10	2.60	0.032	0.045	16V	5A	+3/-40	+16/-12V

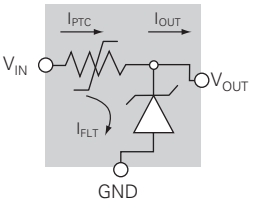
LS module height is 1.7mm typical. CE module height is 1.0mm typical.

† Typical operating current is 500µA @ 5.0V which meets USB suspend mode requirement.

Table PZ2 Definitions of Terms for PolyZen Devices

V_Z	Zener clamping voltage measured at current I_{ZT} and 20°C.
I_{ZT}	Test current at which V_Z is measured.
I_{HOLD}	Maximum steady state current I_{PTC} that will not generate a trip event at the specified temperature. Ratings assume I_{FLT} = 0A.
R_{Typ}	Typical resistance between V_{IN} and V_{OUT} pins when the device is at room temperature.
R_{1MAX}	The maximum resistance between V_{IN} and V_{OUT} pins, at room temperature, one hour after first trip or after reflow soldering.
I_{FLT}	Current flowing through the Zener diode.
$I_{FLT\ MAX}$	Maximum RMS fault current the Zener diode component of the device can withstand and remain resettable; testing is conducted at rated voltage with no load connected to V_{OUT}.
$V_{INT\ MAX}$	The voltage (V_{IN} - V_{OUT} "post trip") at which typical qualification devices (98% devices, 95% confidence) survived at least 100 trip cycles and 24 hours trip endurance when "tripped" at the specified voltage and current (I_{PTC}).
I_{PTC}	Current flowing through the PPTC portion of the circuit.
I_{OUT}	Current flowing out the V_{OUT} pin of the device.
Trip Event	A condition where the PPTC transitions to a high resistance state, thereby limiting I_{PTC}, and significantly increasing the voltage drop between V_{IN} and V_{OUT}.





RoHS Compliant, ELV Compliant

Figures PZ2-PZ9 Typical Performance Curves for PolyZen Devices - LS Series

Figure PZ2

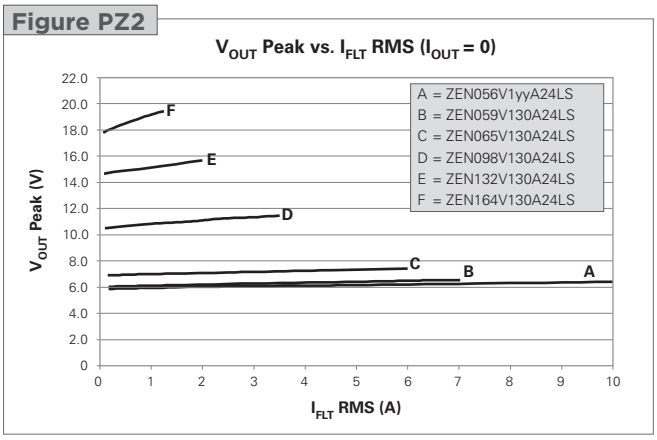


Figure PZ3

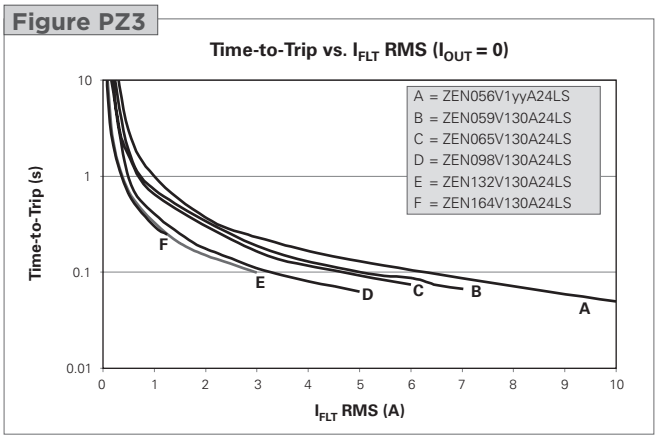


Figure PZ4

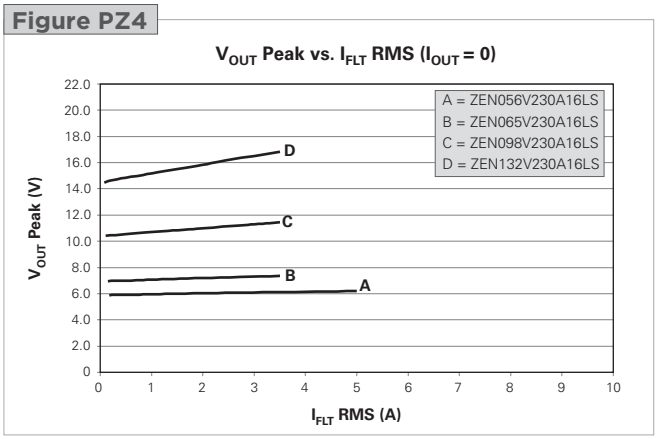


Figure PZ5

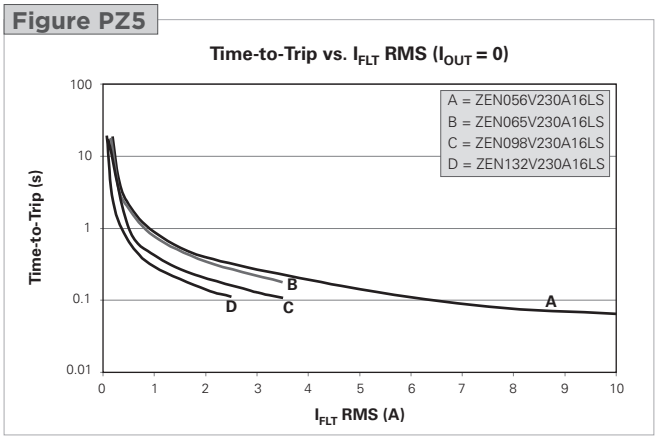


Figure PZ6

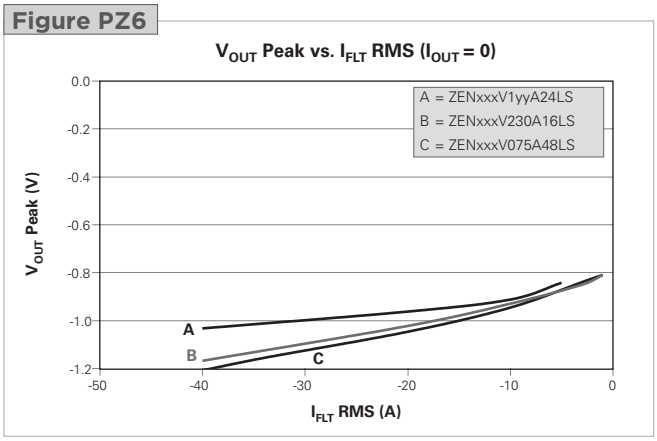


Figure PZ7

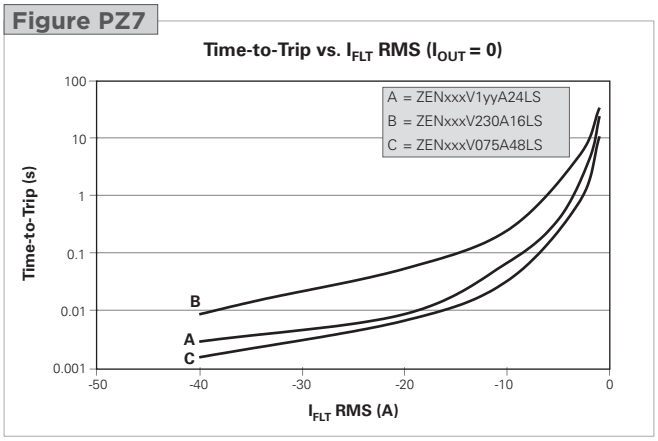


Figure PZ8

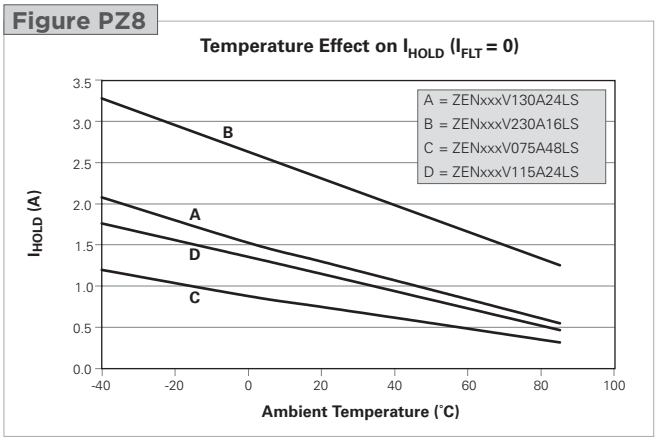
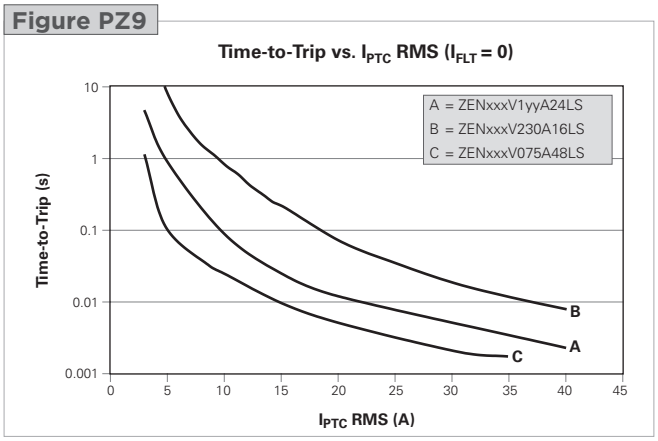


Figure PZ9



Figures PZ10-PZ17 Typical Performance Curves for PolyZen Devices - CE Series

Figure PZ10

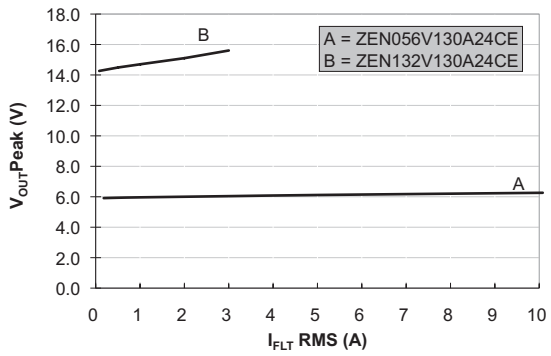


Figure PZ11

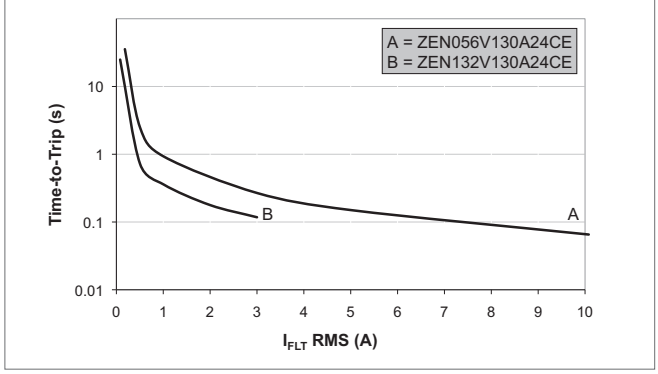


Figure PZ12

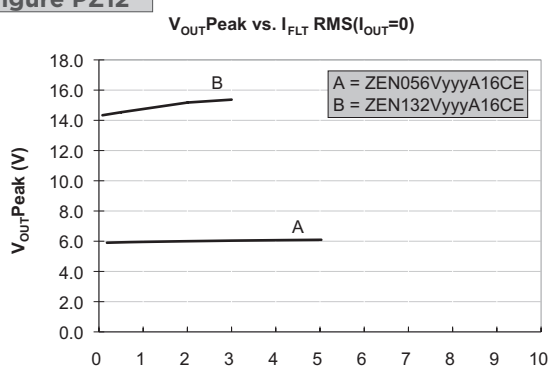


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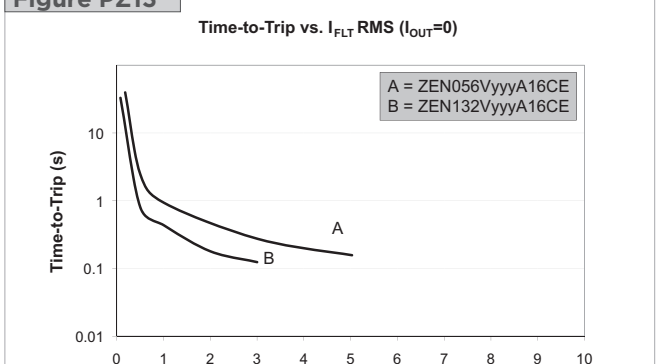


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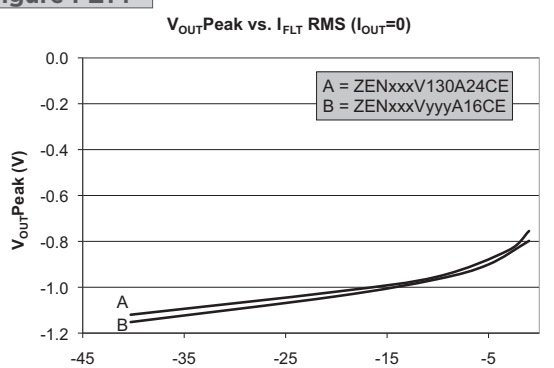


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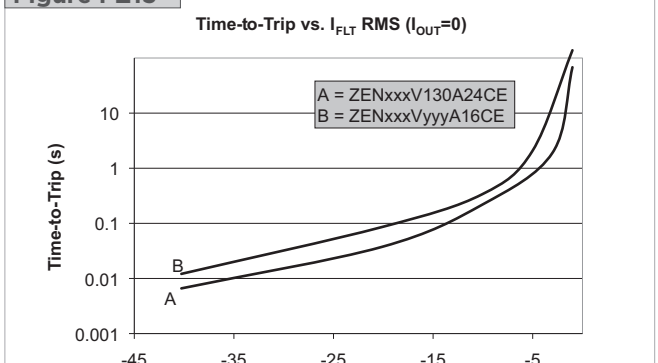


Figure PZ16

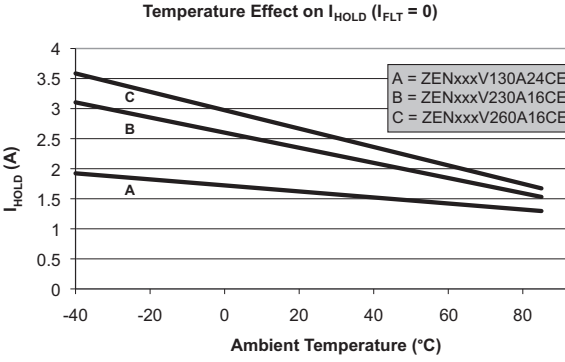
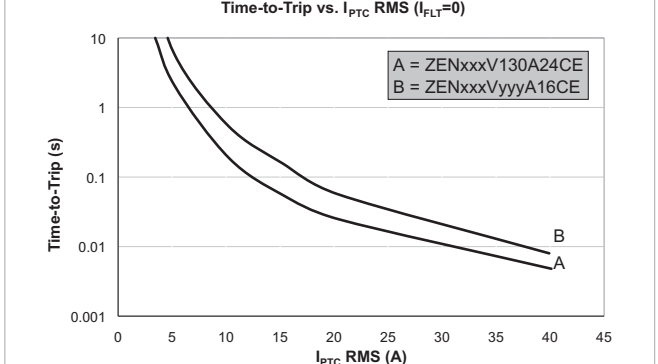


Figure PZ17



RoHS Compliant, ELV Compliant

Table PZ3 General Characteristics for PolyZen Devices

Operating temperature range	-40° to +85°C	
Storage temperature	-40° to +85°C	
ESD withstand	15kV	Human body model
Diode capacitance	4200pF	Typical @ 1MHz, 1V RMS
Construction	RoHS compliant	

Figures PZ18-PZ22 Basic Operation Examples for PolyZen Devices - LS Series

Figure PZ18

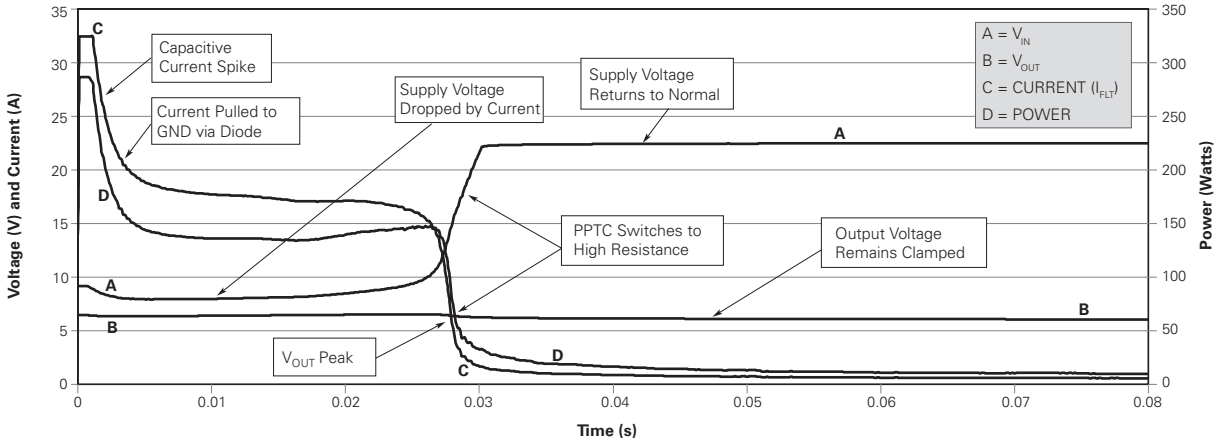


Figure PZ19

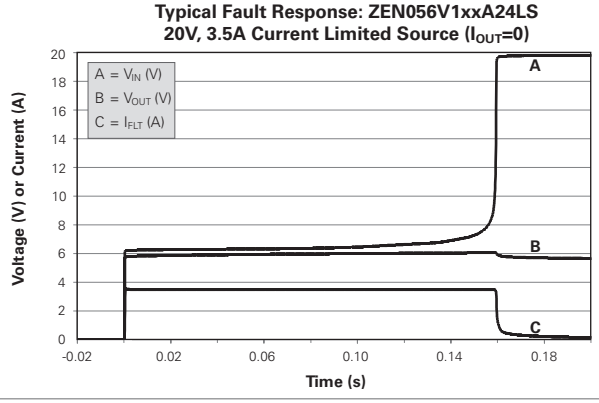


Figure PZ20

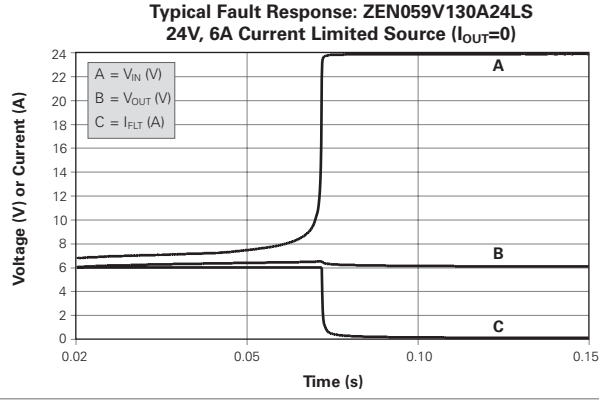


Figure PZ21

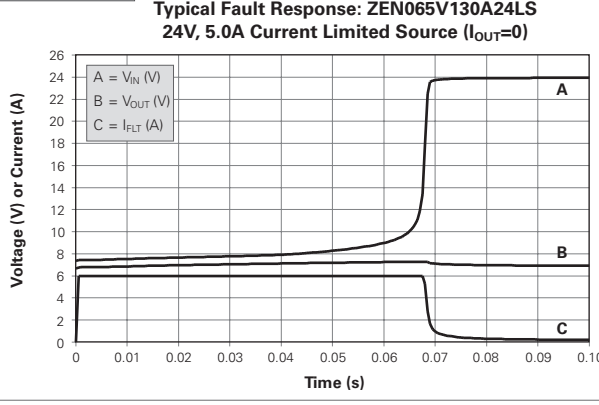


Figure PZ22

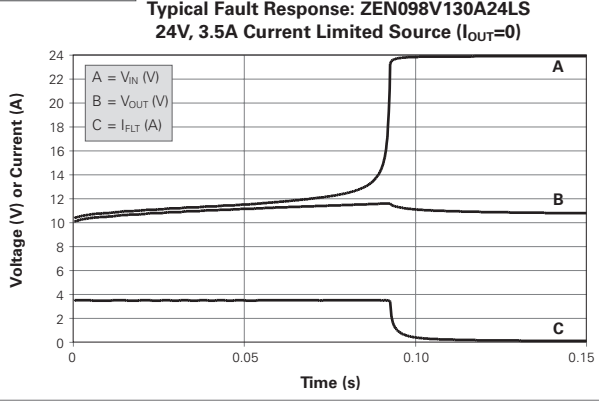


Figure PZ23

Typical Fault Response: ZEN132V130A24LS
24V, 2.0A Current Limited Source (I_{OUT}=0)

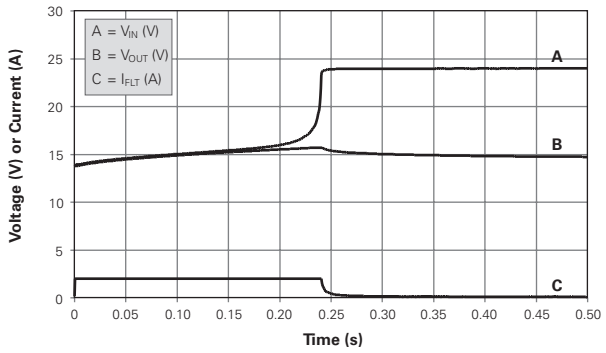


Figure PZ24

Typical Fault Response: ZEN164V130A24LS
24V, 1.0A Current Limited Source (I_{OUT}=0)

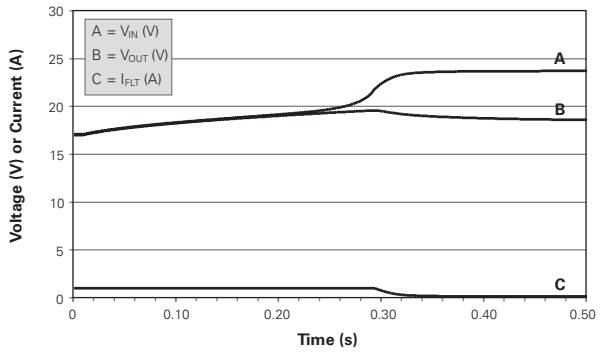


Figure PZ25

Typical Fault Response: ZEN056V230A16LS
16V, 5.0A Current Limited Source (I_{OUT}=0)

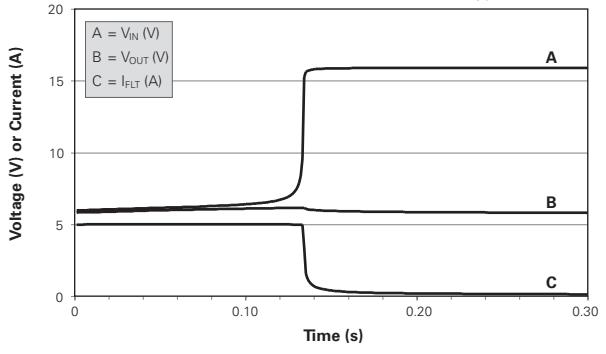


Figure PZ26

Typical Fault Response: ZEN065V230A16LS
16V, 3.5A Current Limited Source (I_{OUT}=0)

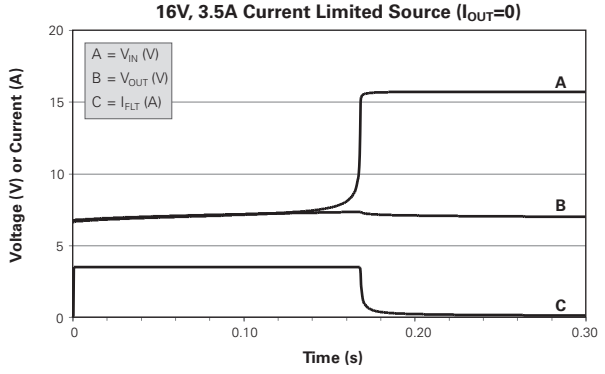


Figure PZ27

Typical Fault Response: ZEN098V230A16LS
16V, 3.5A Current Limited Source (I_{OUT}=0)

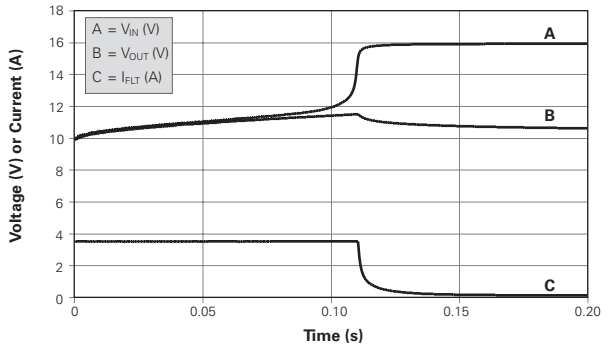


Figure PZ28

Typical Fault Response: ZEN132V230A16LS
20V, 2.0A Current Limited Source (I_{OUT}=0)

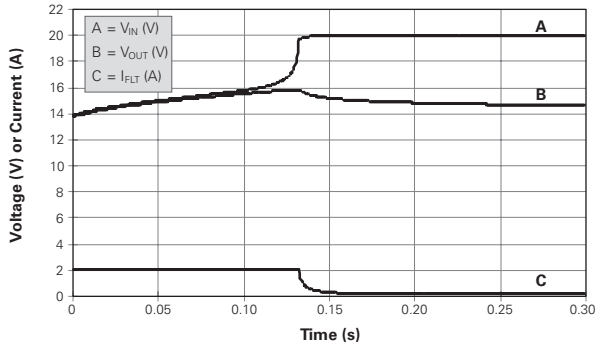


Figure PZ29

Typical Fault Response: ZEN056V075A48LS
48V, 10.0A Current Limited Source (I_{OUT}=0)

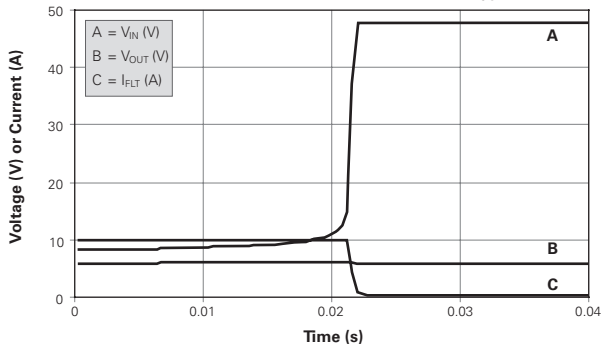
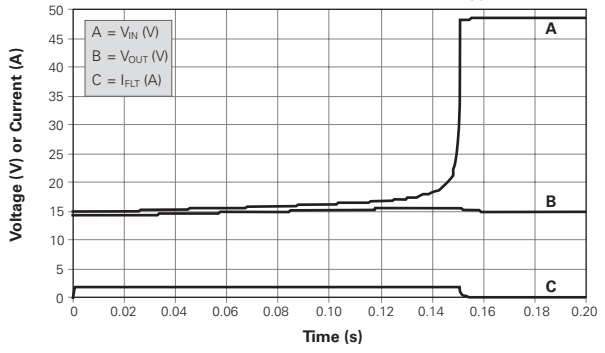


Figure PZ30

Typical Fault Response: ZEN132V075A48LS
48V, 2.0A Current Limited Source (I_{OUT}=0)



Figures PZ31-PZ35 Basic Operation Examples for PolyZen Devices - CE Series

Figure PZ31

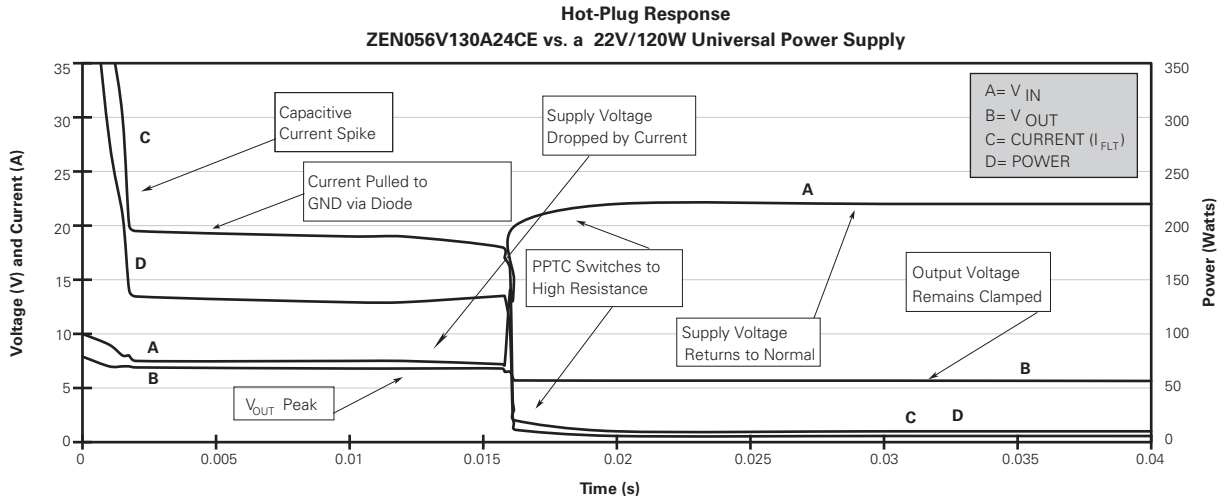


Figure PZ32

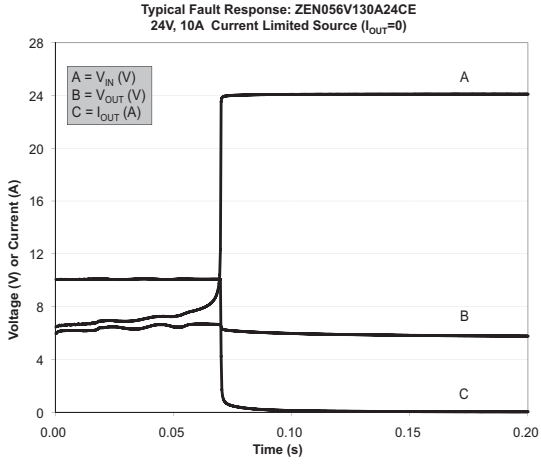


Figure PZ33

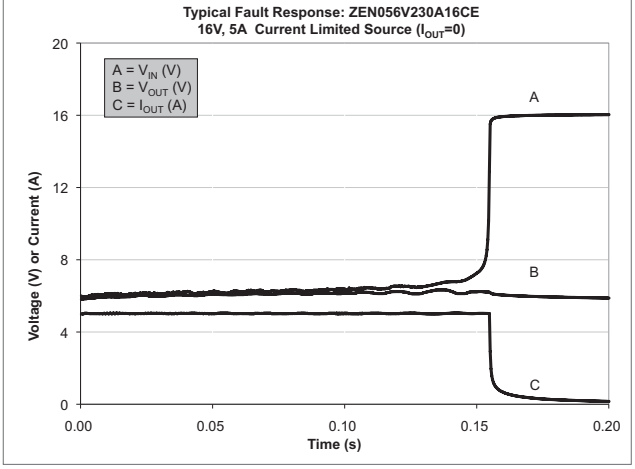


Figure PZ34

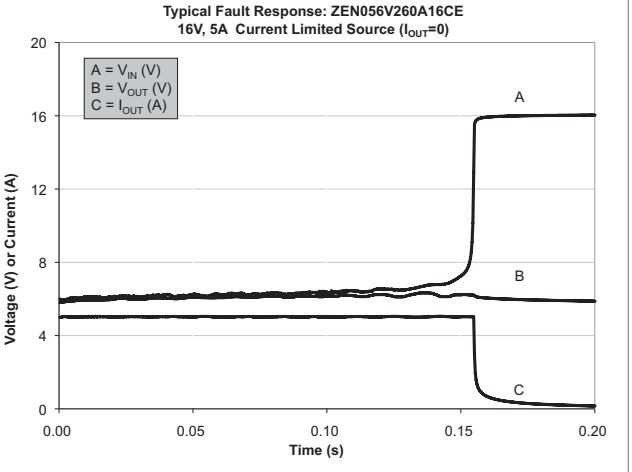


Figure PZ35

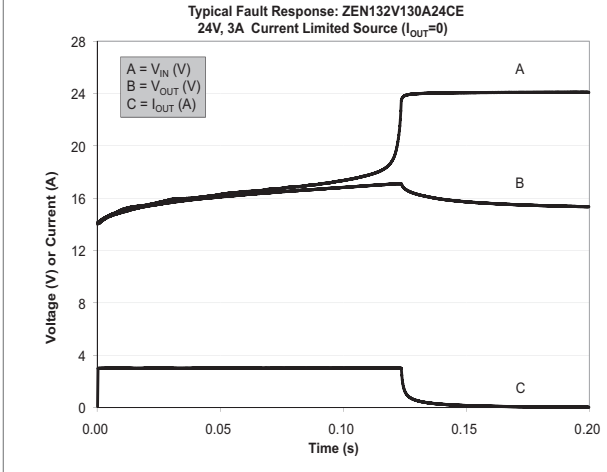


Figure PZ36

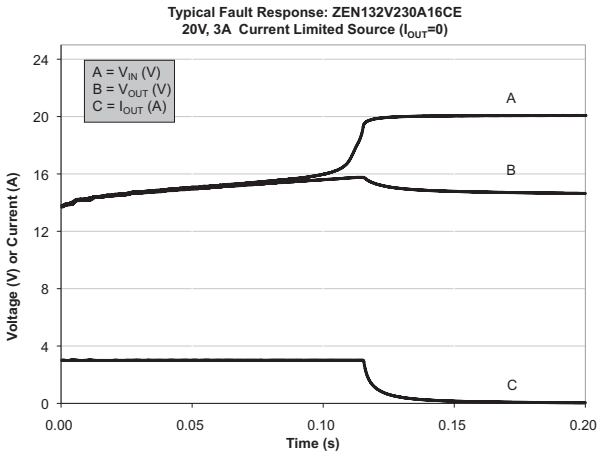
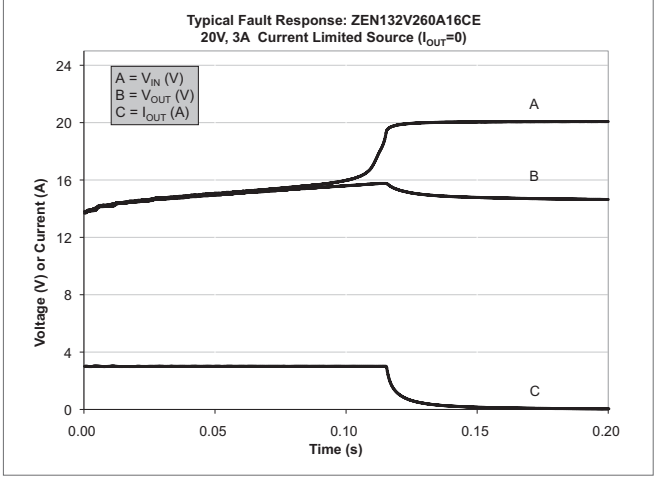


Figure PZ37



5

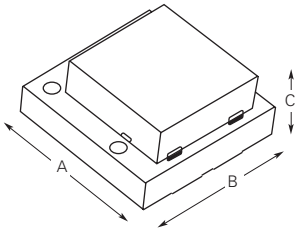
Table PZ4 Packaging and Marking Information for PolyZen Devices

Part Number	Bag Quantity	Tape & Reel Quantity	Standard Package
ZENxxxVyyyAzzLS	-	3,000	15,000
ZENxxxVyyyAzzCE	-	4,000	20,000

Table PZ5 Dimensions for PolyZen Devices in Millimeters and (Inches)

ZENxxxVyyyAzzLS Devices

	A		B		C	
	Min	Max	Min	Max	Min	Max
mm	3.85	4.15	3.85	4.15	1.40	2.00
in	(0.152)	(0.163)	(0.152)	(0.163)	(0.055)	(0.081)



ZENxxxVyyyAzzCE Devices

	A		B		C	
	Min	Max	Min	Max	Min	Max
mm	4.80	5.20	3.80	4.20	0.80	1.20
in	(0.189)	(0.205)	(0.150)	(0.165)	(0.031)	(0.047)

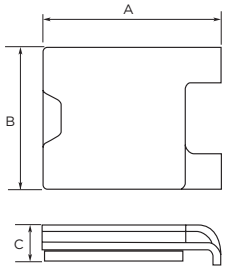
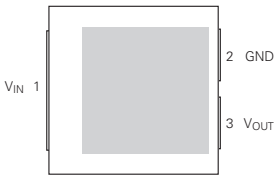


Table PZ6 Pad Layout and Configuration Information for PolyZen Devices

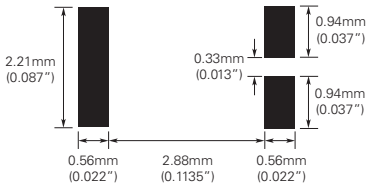
ZENxxxVyyyAzzLS Devices

Pin Number	Pin Name	Pin Function
1	V_{IN}	V_{IN} = Protected input to Zener diode
2	GND	GND = Ground
3	V_{OUT}	V_{OUT} = Zener regulated voltage output

Pin Configuration (Top View)

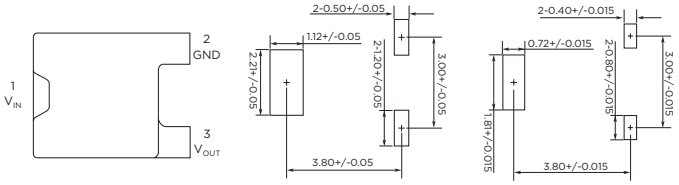


Pad Dimensions



ZENxxxVyyyAzzCE Devices

Pin Number	Pin Name	Pin Function
1	V_{IN}	V_{IN} = Protected input to Zener diode
2	GND	GND = Ground
3	V_{OUT}	V_{OUT} = Zener regulated voltage output



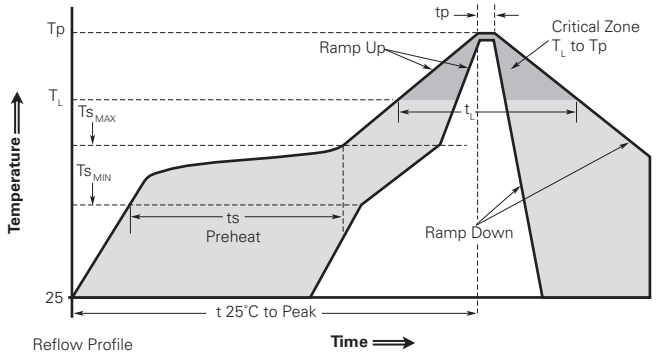
Solder Reflow and Rework Recommendation for PolyZen Devices

Classification Reflow Profiles

Profile Feature	Pb-Free Assembly
Average Ramp Up Rate (Ts_{MAX} to Tp)	3°C/ s Max
Preheat	
• Temperature Min (Ts_{MIN})	150°C
• Temperature Max (Ts_{MAX})	200°C
• Time (ts Preheat)	60-180 s
Time Maintained Above:	
• Temperature (T_L)	217°C
• Time (t_L)	60-150 s
Peak/Classification Temperature (Tp)	260°C
Time within 5°C of Actual Peak Temperature	
Time (tp)	20-40 s
Average Ramp Down Rate (Tp to T_L)	6°C/ s Max
Time 25°C to Peak Temperature	8 Minutes Max

Note: All temperatures refer to the top side of the package, measured on the package body surface.

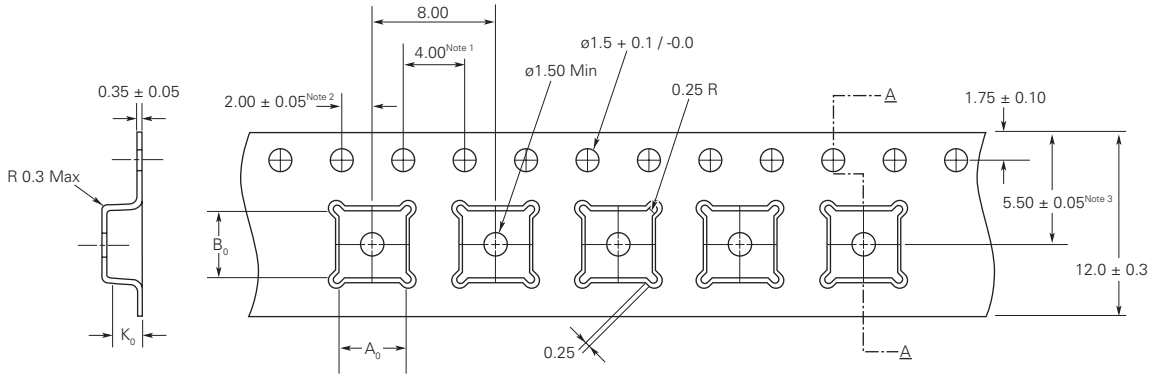
Figure PZ38



Tape and Reel Specifications for PolyZen Devices in Millimeters

Figure PZ39 EIA Referenced Taped Component Dimensions for PolyZen Devices in Millimeters (mm)

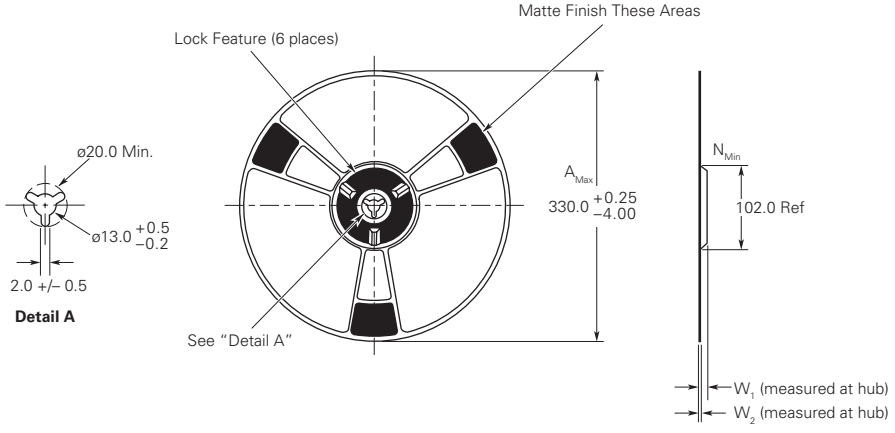
Description	ZENxxxVyyyAzzLS Devices	ZENxxxVyyyAzzCE Devices
A_0	4.35	4.35
B_0	4.35	5.35
K_0	2.30	1.35



Notes:
1. 10 sprocket hole pitch cumulative tolerance ±0.2
2. Camber in compliance with EIA 481
3. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole

Figure PZ40 Reel Dimensions for PolyZen Devices in Millimeters (mm)

Description	Dimension (mm)
A_{Max}	330
N_{Min}	102
W_1	8.4
W_2	11.1



Part Numbering System for PolyZen Devices

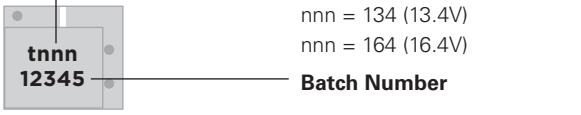
ZEN 056V 130A 24 LS & CE

- **Special Labeling**
  LS = Module Height of 1.7mm typical
  CE = Module Height of 1.0mm typical
- **V_{INT} Max Rating (24 = 24V)**
- **PPTC Hold Current Group (130 = 1.3A)**
- **Zener Voltage Group (056 = 5.6V)**
- **PolyZen Series**

RoHS Compliant, ELV Compliant

Part Marking System for PolyZen Devices

ZENxxxVyyyAzzLS Devices

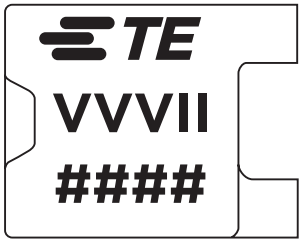


Zener Diode Voltage Rating
nnn = 056 (5.6V)
nnn = 059 (5.9V)
nnn = 065 (6.5V)
nnn = 098 (9.8V)
nnn = 134 (13.4V)
nnn = 164 (16.4V)

Batch Number

ZENxxxVyyyAzzCE Devices

Markings	V_z	Hold Current	Batch Number
05613	5.6V	1.3A	
#####			Last 4 digits of batch number



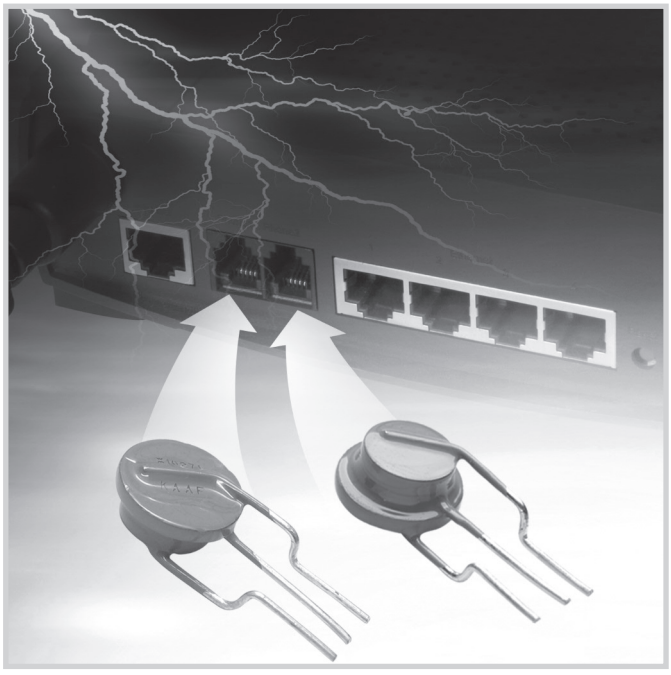
Notice :

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2Pro Devices

The 2Pro product is an integrated overcurrent/overvoltage protection device. The RoHS-compliant component incorporates PolySwitch PPTC (Polymeric Positive Temperature Coefficient) technology and MOV (Metal Oxide Varistor) technology in a single device to help reduce board space requirements and component count.



Damage to telephony communications equipment can be caused by various sources including lightning, electrostatic discharge (ESD), power contact and induction with AC lines. The 2Pro TM2P-10271 devices help provide current limiting during overcurrent events and voltage clamping during overvoltage events. After a fault condition is removed and power is cycled, 2Pro devices will reset so that the equipment remains operational.

The 2Pro device helps address the need for resettable circuit protection devices for use in cost-sensitive PSTN (Public Switched Telephone Network) and VoIP (Voice over Internet Protocol) telephony equipment. The widespread use of VoIP gateways in homes and enterprise environments as the primary means of voice delivery requires the utmost safety and reliability in equipment. 2Pro circuit protection devices help manufacturers comply with global safety standards, including UL 60950, TIA-968-A, IEC 60950 and ITU-T K.20/K.21. The UL 497A listed protector also helps provide ESD protection.

Benefits

- Single device helps reduce component count and footprint
- Helps reduce warranty returns
- Helps equipment comply with surge tests per: TIA-968-A, IEC 60950, ITU-T K.20/K.21
- Helps simplify UL 60950 testing
- Helps equipment comply with UL 60950

Features

- RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Single overcurrent, overvoltage and ESD protection device
- Resettable overcurrent protection
- UL 497A listed protector (#E258475)

Applications

- Cordless telephones
- VoIP gateways
- Fax machines
- Data modems
- Set-top boxes
- Security systems
- MDF modules
- Analog and ISDN linecards

Table 2P1 Electrical Characteristics for 2Pro Devices

Overcurrent (terminals 1 – 2) — Performance ratings @ 20°C

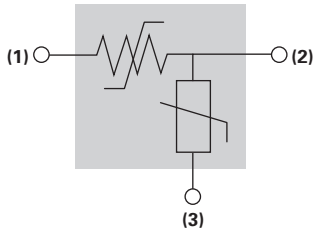
	Part Number	I_{HOLD} (A)	I_{TRIP} (A)	Resistance† (Ω) R_{MIN}	R_{MAX}	$R_{1\ MAX}$*	Time-to-Trip (s)† Typ	Max	
	TM2P-10271	0.15	0.30	6.50	14.00	16.00	0.90	3.00	(@1A)
	LVM2P-015R10431	0.15	0.30	6.50	14.00	16.00	0.90	3.00	(@1A)
NEW	LVM2P-035R14431	0.35	0.75	1.40	2.20	2.80	0.50	2.00	(@3A)
NEW	LVM2P-075R14431	0.75	1.50	0.37	0.80	1.00	0.90	1.20	(@7A)

Overvoltage (Terminals 2 – 3)

	Part Number	Varistor Voltage V @ 1mA DC (V)	Tolerance	DC Resistance @ 100V (MΩ)	Maximum Clamping (V)	Rated Wattage (W)
	TM2P-10271	260	+14% -7%	>10	455 (@25A)	0.25
	LVM2P-015R10431	430	+10% -10%	>10	710 (@ 25A)	0.25
NEW	LVM2P-035R14431	430	+10% -10%	>10	710 (@ 50A)	0.60
NEW	LVM2P-075R14431	430	+10% -10%	>10	710 (@ 50A)	1.00

* Maximum device resistance at 20°C measured 1 hour post trip.
† Corresponds to operation below varistor voltages.

Electrical Schematic



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Table 2P2 Dimensions for 2Pro Devices in Millimeters and (Inches*)

	Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Nom	F Min	F Max	Figure
	TM2P-10271												
	mm	—	12.0	—	15.0	—	6.6	6.0	—	2.5	—	12.0	2P1
	in*	—	(0.47)	—	(0.59)	—	(0.26)	(0.24)	—	(0.10)	—	(0.47)	
	LVM2P-015R10431												
	mm	—	12.0	—	17.0	—	7.4	8.5	11.5	5.1			2P2
	in*	—	(0.47)	—	(0.67)	—	(0.29)	(0.34)	(0.45)	(0.20)			
NEW	**LVM2P-035R14431**												
	mm	—	16.0	—	21.0	—	7.4	3.0	5.0	5.1			2P2
	in*	—	(0.63)	—	(0.83)	—	(0.29)	(0.12)	(0.20)	(0.20)			
NEW	**LVM2P-075R14431**												
	mm	—	16.0	—	21.0	—	7.4	3.0	5.0	2.5			2P3
	in*	—	(0.63)	—	(0.83)	—	(0.29)	(0.12)	(0.20)	(0.10)			

* The dimensions in inches are rounded approximations.

Figure 2P1-2P3 Dimension Figures for 2Pro Devices

Figure 2P1

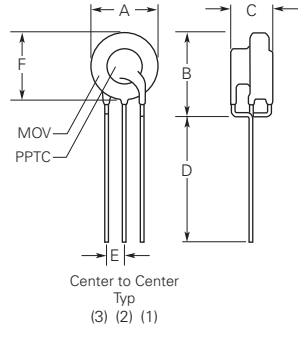


Figure 2P2

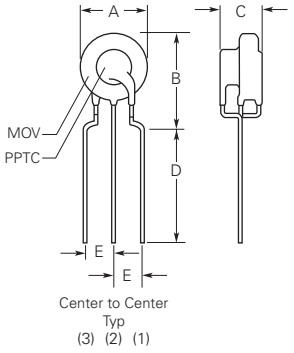
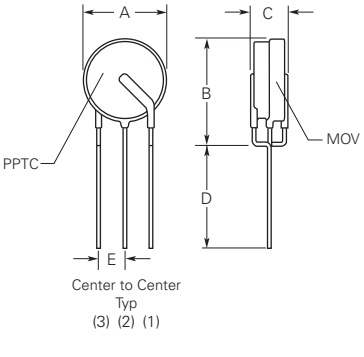


Figure 2P3



RoHS Compliant, ELV Compliant HF Halogen Free

Figure 2P4 Typical Time-to-Trip at 25°C for 2Pro Devices

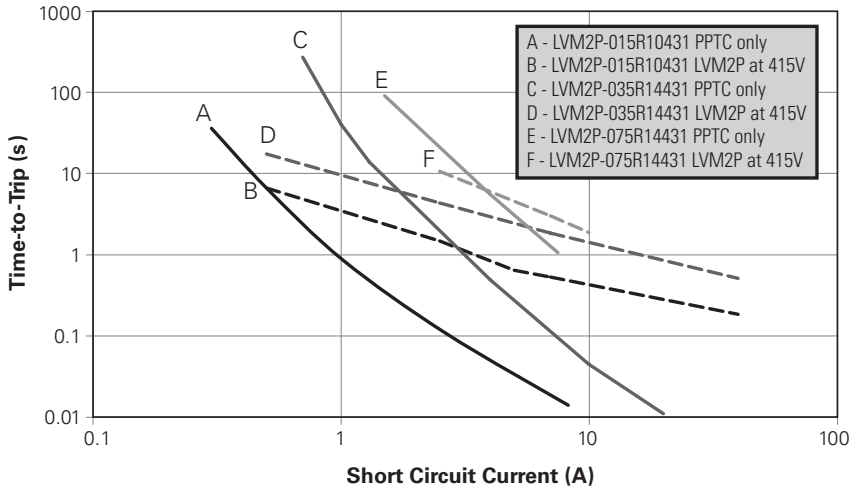


Table 2P3 Physical Characteristics and Environmental Specifications for 2Pro Devices

Physical Characteristics

Lead Material	Tin-plated Copper, 0.33mm^2 (22AWG), 0.64mm (0.025in)
Flammability	IEC 695-2-2 Needle Flame Test for 20s
Soldering Characteristics	ANSI Approved IPC/EIA/JEDEC J-STD-002, Category 3
Solder Heat Withstand	per IEC-STD 68-2-20, Test Tb, Method1A, Condition B, can withstand 10 Seconds at 260°C ± 5°C

Environmental Specifications

Test	Conditions
Passive Aging	60°C, 1000 Hours / 85°C, 1000 Hours
Humidity Aging	85°C, 85% RH, 500 Hours
Active Aging	60°C, 90% RH, 60VDC Bias,1000 Hours
Thermal Shock	125°C, -55°C (10 Times)
Solvent Resistance	MIL-STD-202, Method 215K

Note: Storage conditions: 40°C max, 70% RH max, devices should remain in original sealed bag prior to use.
Devices may not meet specified values if these storage conditions are exceeded.

Table 2P4 Packaging and Marking Information for 2Pro Devices

	Part Number	Bag Quantity	Tape and Reel Quantity	Standard Package	Part Marking	Agency Recognition
	TM2P-10271	500	-	10,000	1027 & Batch #	UL 497A/File No. E258475
	TM2P-10271-2	-	1,000	5,000	1027 & Batch #	UL 497A/File No. E258475
	LVM2P-015R10431	500	-	10,000	C431 & Batch #	MOV UL 1449/File No. E332226 PPTC UL 1434/File No. E74889
NEW	LVM2P-035R14431	250	-	5, 000	A431 & Batch #	
NEW	LVM2P-075R14431	250	-	5, 000	B431 & Batch #	

Table 2P5 Ordering Information for 2Pro Devices

Bulk	250/500	pieces/bag
	5,000/10,000	pieces/box
Tape & Reel	1,000	pieces/reel
	5,000	pieces/box

6

Wave Soldering and Rework Recommendations for 2Pro Devices

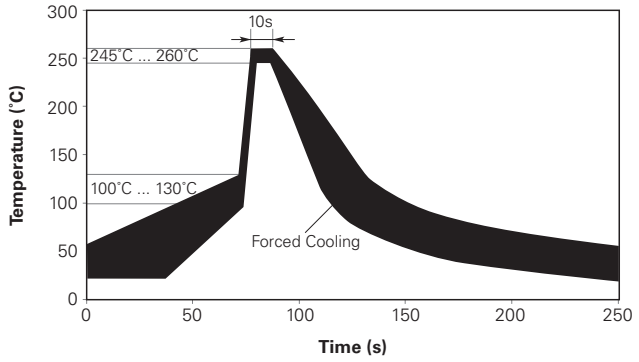
Recommended Wave Soldering for Radial-leaded Devices

- Soldering temperature profile
  (Temperature characteristic at component terminal with dual wave soldering)

Rework

- If a device is removed from the board, it should be discarded and replaced with a new device

Figure 2P5



RoHS Compliant, ELV Compliant HF Halogen Free

Table 2P6 Tape and Reel Specifications for 2Pro Devices in Millimeters (mm)

2Pro devices are available in tape and reel packaging per EIA 468-B standard. See Figures 2P6 and 2P7 for details.

Description	EIA Mark	IEC Mark	Dimension (mm)	Tolerance
Carrier Tape Width	W	W	18	-0.5/ +1.0
Hold Down Tape Width	W_4	W_0	5	Min
Top Distance Between Tape Edges	W_6	W_2	3	Max
Sprocket Hole Position	W_5	W_1	9	-0.5/ +0.75
Sprocket Hole Diameter	D_0	D_0	4	±0.2
Abcissa to Plane (Kinked Lead)*	H_0	H_0	16	-0.5/0.6
Abcissa to Top	H_1	H_1	32.2	Max
Overall Width with Lead Protrusion	-	C_1	43.2	Max
Overall Width Without Lead Protrusion	-	C_2	42.5	Max
Lead Protrusion	L_1	I_1	1.0	Max
Protrusion of Cut-out	L	L	11	Max
Protrusion Beyond Hold Down Tape	I_2	I_2	Not Specified	-
Sprocket Hole Pitch	P_0	P_0	12.7	±0.3
Pitch Tolerance	-	-	20 Consecutive	±1
Tape Thickness	t	t	0.9	Max
Tape Thickness with Splice*	t_1	-	2.0	Max
Splice Sprocket Hole Alignment	-	-	0	±0.3
Body Lateral Deviation	Δh	Δh	0	±0.1
Body Tape Plane Deviation	Δp	Δp	0	±1.3
Ordinate to Component Center Lead	P_2	P_2	6.35	±0.7
Lead Spacing*	F_1, F_2	F_1, F_2	2.54	-0.1/+0.4
Reel Width	w_2	w	56	Max
Reel Diameter	a	d	370	Max
Space Between Flanges	w_1	-	51.2	Max
Arbor Hole Diameter	c	f	26	±12.0
Core Diameter	n	h	80	Max
Box	-	-	56/372/372	Max
Consecutive Missing Pieces*	-	-	3 Max	-
Empty Places Per Reel*	-	-	Not Specified	-

Note: *Differs from EIA specification.

Figure 2P6 EIA Referenced Taped Component Dimensions for 2Pro Devices

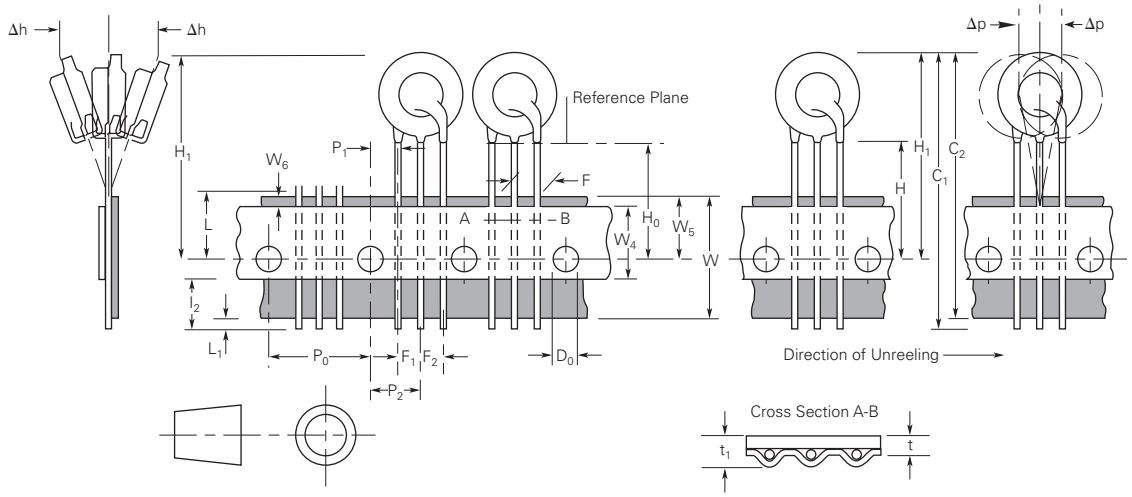
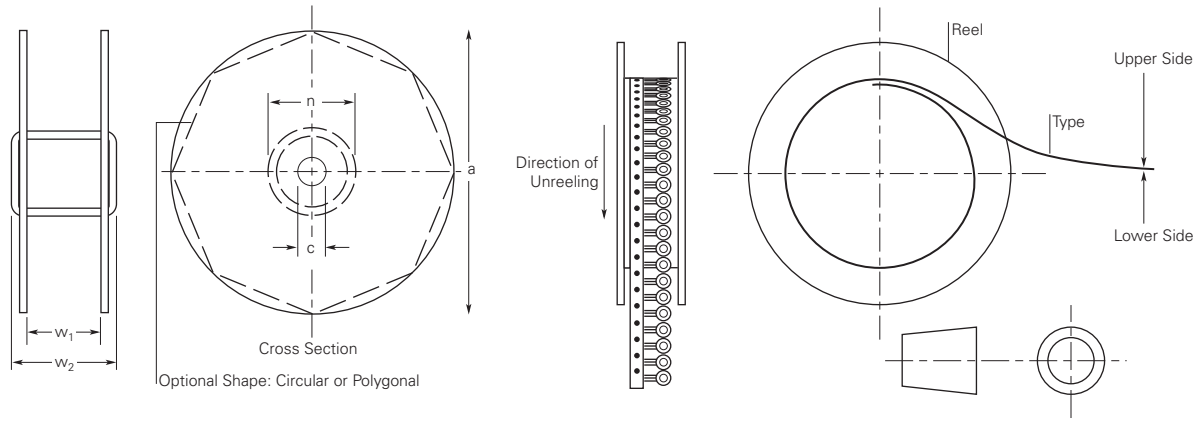


Figure 2P7 EIA Referenced Reel Dimensions for 2Pro Devices



Part Numbering System for 2Pro Devices

6

TM 2P - 10 271 -2

Packaging
Blank : Bulk
-2 : Tape and Reel

Varistor Voltage Indicator
The first two digits indicate voltage
The third digit signifies the power of ten
For example : 220 : 22 x 10^0 = 22V
221 : 22 x 10^1 = 220V
112 : 11 x 10^2 = 1100V

Typical PPTC Resistance (ohms)

2Pro Series

Telecom Module

LVM 2P - 015 R 10 431

MOV Breakover Voltage at 1mA Expressed as:
431: 43 x 10^1

MOV Diameter in mm

Radial Leaded

PPTC Hold Current

2Pro Series

Line Voltage Module

Notice:

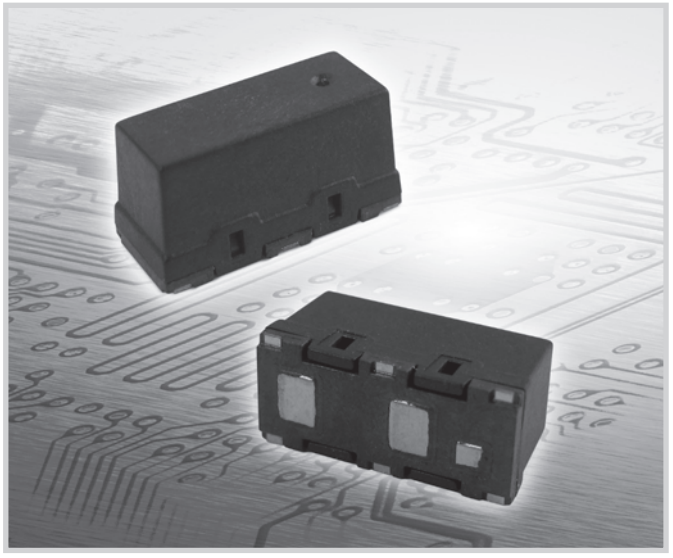
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RoHS Compliant, ELV Compliant HF Halogen Free



Reflowable Thermal Protection (RTP) Devices

The RTP device described in this overview can withstand the demanding environmental, life and reliability requirements of automotive and industrial applications, including shock, vibration, temperature cycling and humidity exposures. In the field, the RTP device opens if its internal junction exceeds the device's specified open temperature. Temperature increases can have multiple sources, one of which is component failure (e.g., when using power components such as a power FET, capacitor, resistor, triac, etc.). The RTP device's open temperature is selected so that the device does not open within normal component operating windows, but it does open in a thermal runaway event and before the melt temperature of typical lead-free solders.



To simplify installation, improve reliability and optimize thermal coupling with the PCB, the RTP device is surface mountable. No special SMD installation is required. Instead, after installation, the RTP device utilizes a one-time electronic arming process to become thermally sensitive. Before the arming procedure, the device can go through installation temperatures up to 260°C without going open. After arming, the device will open when the critical junction exceeds the open temperature. Arming can occur during test or in the field.

RTP200R060SA
200ºC Open temp DC rated.
Automotive Grade

RTP140R060S
140ºC Open temp AC rated.
Industrial Applications

RTP140R060SD
140ºC Open temp DC rated.
Info available upon request

Benefits

- Helps protect the system from thermal runaway damage due to failed power components
- Allows use of standard surface-mount production methods with no special assembly costs
- Low power dissipation and voltage drop
- Supports both DC and AC electronic circuits
- Can be installed on double-sided PCBs

Features

- Compatible with up to 3 Pb-free solder reflow processes with peak temperatures up to 260°C
- Low series resistance
- Robust design for harsh environment tested per stringent qualification specification
- RoHS compliant, lead and halogen free

Features RTP200R060SA

- Opens at temperature below critical thermal threshold
- DC interrupt voltage capable

Features RTP140R060S

- Opens at temperature open (Topen) of 140°C
- AC interrupt voltage capable

Applications RTP200R060SA

Helps provide protection against thermal runaway for power FETs and other components if failure occurs in applications such as automotive HVAC, ABS, power steering, DC/DC converters, PTC heaters, etc., or IT servers, telecom power, converters, etc.

- Other DC thermal protection

Applications RTP140R060S

Helps provide protection against thermal runaway for electronic components if failure occurs in low-temperature AC applications such as lighting dimmers

- Other AC thermal protection

RoHS Compliant, ELV Compliant HF Halogen Free

Figure RTP1 Typical Application Block Diagram for RTP200RO60SA Devices

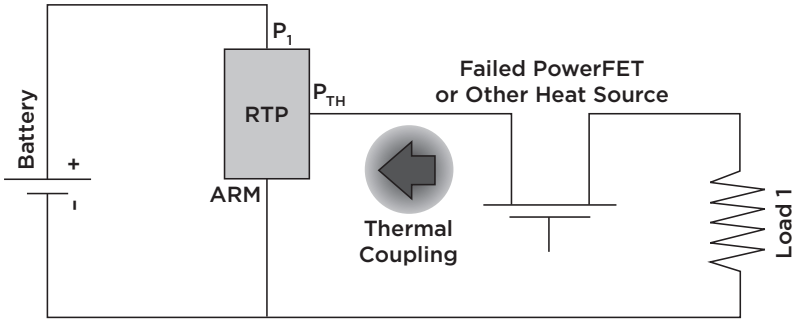
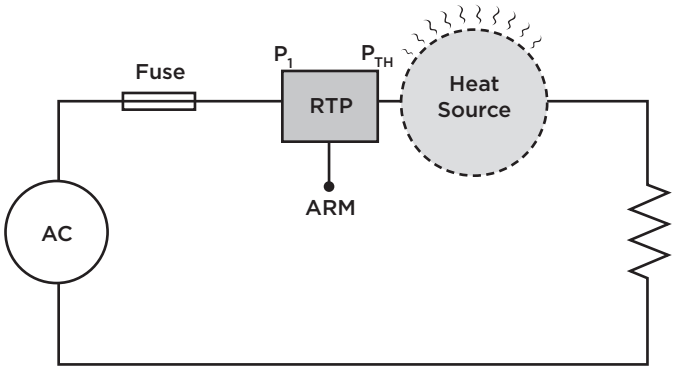


Figure RTP2 Typical Application Block Diagram for RTP140R060S Devices



Definition of Terms / Device Block Diagram

Term	Definition
Junction	The internal interface which must achieve the "Open Temperature" for the RTP device to open thermally after arming. This interface (thermal element) is located directly above the P_{TH} pad.
Open Temp	The device will open when the junction temperature achieves this value.
I_{ARM} and R_{ARM}	Current and resistance levels measured between the ARM pin and either the P_1 or P_{TH} pin. These values are relevant only pre device arming.
R_{PP} and I_{PP}	Current and resistance levels measured between the P_1 and P_{TH} pins.

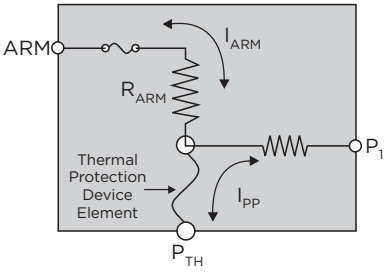


Table RTP1 Absolute Max Ratings of RTP200RO60SA Devices

Absolute Max Ratings		Max	Units
Max DC Open Voltage [1]	-	32	V_{DC}
Max DC Interrupt Current [1]	@ 16 V_{DC}	200	A
	@ 24 V_{DC}	130	A
	@ 32 V_{DC}	100	A
ESD Rating (Human Body Model)	-	25	KV
Max Reflow Temperature (Pre-Arming)	-	260	°C
Operating Temperature Limits, Post-Arming, Non-Opening	-	-55	°C
	-	+175	°C

(1) Performance capability at these conditions can be influenced by board design. Performance should be verified in the user's system.

RoHS Compliant, ELV Compliant HF Halogen Free

Table RTP2 Absolute Max Ratings of RTP140R060S Devices

Absolute Max Ratings		Max	Units
Max AC Open Voltage (V_r) [1]	-	250	V_{AC}
Rated Hold Current (I_r) [1,2,3]	@ 23+/-3°C	25	A
	@ 105+/-3°C	12	A
Max Interrupt Current (Ib) [1,2]	@ 250 VAC	37.5	A
ESD Rating (Human Body Model)	-	25	kV
Dielectric Strength Between Contacts (Post-Operation)	-	1	kV_{AC}
Maximum Reflow Temperature (Pre-Arming)	-	260	°C
Holding Temperature Limits (T_h, Post-Arming, Non-Opening)	-	-40	°C
	-	105	°C
Rated Functioning Temperature (T_f)	-	145	°C
Maximum Temperature Limit (T_m)	-	210	°C

(1) Performance capability at these conditions can be influenced by board design. Performance should be verified in the user's system.
(2) Hold current ratings apply to power factors of 1.0 and 0.6.
(3) Interrupt current ratings apply to a power factor of 1.0.

Figure RTP3-RTP4 Typical Time-to-Open Vs Fault Current (I_{PP} Open)

Figure RTP3

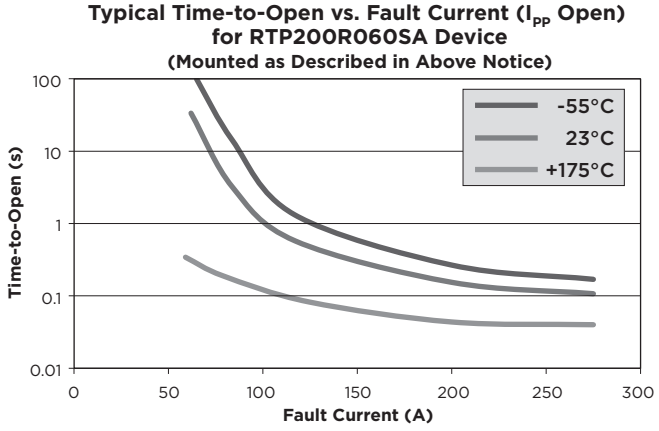


Figure RTP4

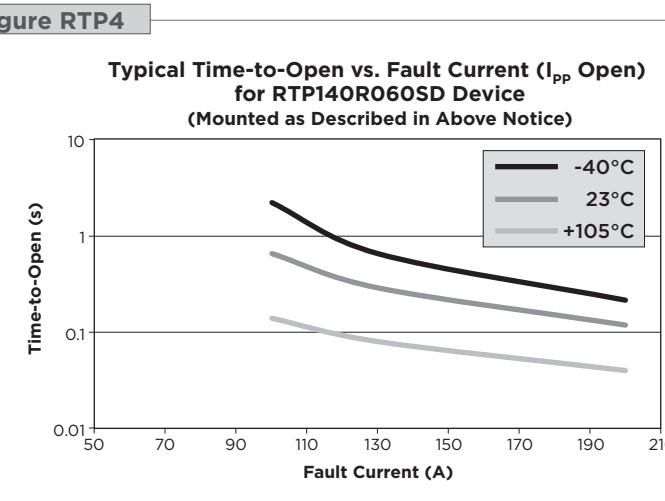


Table RTP3 Dimensions for RTP Devices in Millimeters and (Inches*)

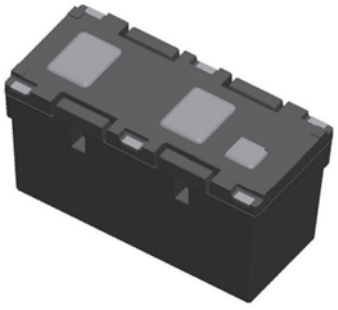
	A		B		C	
Part Number	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
RTP200R060SA						
mm	11.60	12.0	6.0	6.35	5.25	5.50
in*	(0.46)	(0.47)	(0.24)	(0.25)	(0.21)	(0.22)
RTP140R060S						
mm	11.60	12.0	6.0	6.35	5.25	5.50
in*	(0.46)	(0.47)	(0.24)	(0.25)	(0.21)	(0.22)

* The dimensions in inches are rounded approximations.

Figures RTP5-RTP6 Dimension Figures for RTP200R060SA Devices

Figure RTP5

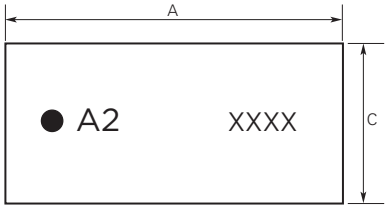
Pin Configuration
(Bottom View of the Device)



Note:
A2 is product code
XXXX is Batch Code
P_1 indicated by inmolded mark

Figure RTP6

Pin Configuration
(Top View of Device)



Pin Configuration
(Side View of Device)

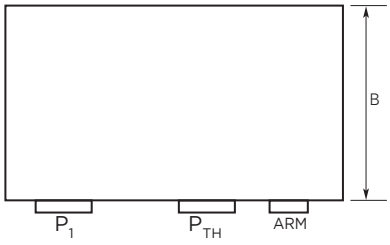
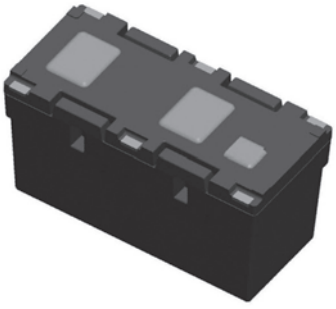


Figure RTP7-RTP8 Dimension Figures for RTP140R060S Devices

Figure RTP7

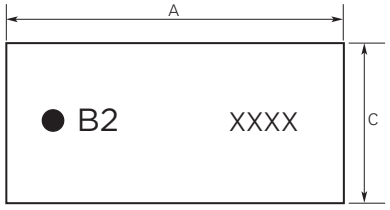
Pin Configuration
(Bottom View of the Device)



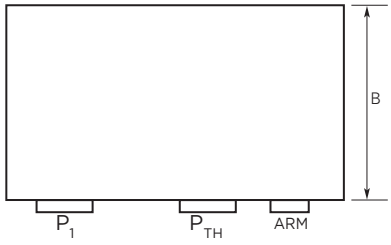
Note:
B2 is product code
XXXX is Batch Code
P_1 indicated by inmolded mark

Figure RTP8

Pin Configuration
(Top View of Device)



Pin Configuration
(Side View of Device)



RoHS Compliant, ELV Compliant HF Halogen Free

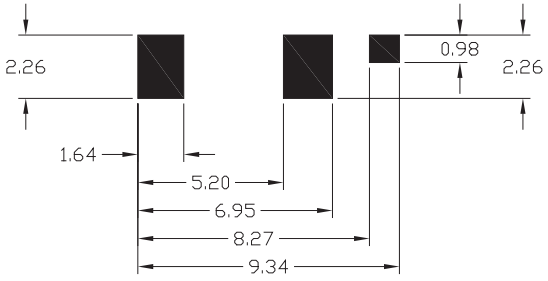
Figure RTP9 Pin Configuration and Pad Layout Recommendations

Pin Number	Pin Name	Pin Function
1	P_1	Power I/O pin (Main power current path)
2	P_{TH}	Thermally sensitive power I/O pin - Intended to share protected component heat sink
3	ARM	Electronic arming pin

Pin Configuration



Pad Dimensions in mm



Method of Operation - Electronic Arming

The RTP device is a unique thermal protector. It can be reflowed at temperatures up to 260°C without opening, yet in operation it will open at temperatures well below 260°C. To achieve this functionality, the RTP device uses an electronic arming mechanism.

Electronic arming must be done after reflow, and can be done during final test.

The device is armed by sending a specified arming current through the ARM pin of the device. Arming is a time- and current-dependent event. Arming times vs. current are provided in the "Arming Characteristics" section of this overview. Current can flow in either direction through the ARM pin.

Prior to arming, R_{ARM} should have typical resistance as specified in the "Arming Characteristics" section. Once armed, the ARM pin will be electrically open relative to the P_1 or P_{TH} pins.

Arming has been successful once R_{ARM} exceeds the post-arming minimum resistance specified in the "Arming Characteristics" section. RTP devices must be armed individually and cannot be armed simultaneously in series.

Once "armed," the RTP device will permanently open when the device junction achieves its specified opening temperature.

Although multiple options exist, below is one simple arming option.

Sample Arming Options

ARM pin connected between two test points

In this case, pin P_1 is left "floating," and arming can occur during test, at a user defined time, by connecting to the Test Points and applying sufficient current (I_{ARM}) between Test Point 1 and Test Point 2 until the device is armed.

Current Flow

P_{TH} ⟷ ARM = Arming

During Test

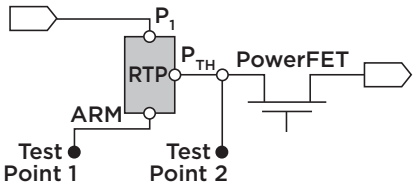


Table RTP4 Performance Characteristics RTP200R060SA

Resistance and Open Characteristics P_1 to P_{TH}		Min	Typ	Max	Units
RPP (Resistance from P_1 to P_{TH})	@ 23+/-3°C	-	0.6	0.8	mΩ
	@ 175+/-3°C	-	0.8	1.2	mΩ
Operating Voltage	-	-	32	-	V_{DC}
Open Temperature, Post-Arming	IPP = 0	196	205	213	°C
Thermal Resistance: Junction to Case	Case = P_{TH} pad	-	0.5	-	°C/W
Installation Dependent Operating Current, Post-Arming [1, 2]	@ 23+/-3°C	32	34	-	A
	@ 100+/-3°C	27	28	-	A
	@ 175+/-3°C	-	10	-	A
Moisture Sensitivity Level Rating [3]			1		

(1) Results were obtained on 44.5 x 57.2 x 1.6 mm single layer FR4 boards with 70µm (2oz) Cu heat spreader connected to the P_{TH} pad of the RTP device (See RTP device test board drawing). Results will vary based on user's configuration and should be validated by the user in the end system.
(2) Operating current is measured on the RTP test boards at the specified temperature. It is a highly installation dependent value.
(3) As per JEDEC J-STD-020C.

Table RTP5 Performance Characteristics RTP140R060S

Resistance and Open Characteristics P_1 to P_{TH}		Min	Typ	Max	Units
RPP (Resistance from P_1 to P_{TH})	@ -40+/-3°C	-	0.6	1	mΩ
	@ 23+/-3°C	-	0.7	1.1	mΩ
	@ 105+/-3°C	-	0.9	1.2	mΩ
Operating Voltage	-	-	250	-	V_{AC}
Open Temperature, Post-Arming	IPP = 0	135	140	145	°C
Thermal Resistance: Junction to Case	Case = P_{TH} pad	-	0.5	-	°C/W
Moisture Sensitivity Level Rating [1]			1		

(1) As per JEDEC J-STD-020C.

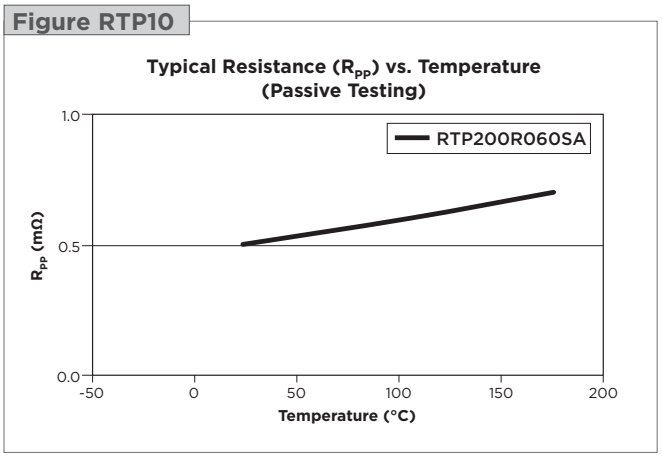
Table RTP6 Arming Characteristics

Arming Characteristics ARM		Min	Typ	Max	Units
Arming Type			Electronically Armed		
R_{ARM} (Resistance from ARM to P_1 or P_{TH})	Pre-Arming	-	300	-	mΩ
	Post-Arming	10	-	-	KΩ
Arming Current (I_{ARM}) [1]	@ 23 +/-3°C	2	-	5	A
Arming Time (@23 +/-3°C) [1]	@ 2A	-	0.1	-	s
	@ 5A	-	0.01	-	s

(1) Results were obtained on 44.5 x 57.2 x 1.6 mm single layer FR4 boards with 70µm (2oz) Cu heat spreader connected to the P_{TH} pad of the RTP device. (See RTP device test board drawing). Results will vary based on user's configuration and should be validated by the user in the end system.

Figures RTP10-RTP14 Typical Electrical Performance Characteristics RTP200R060SA

Figure RTP10



RoHS Compliant, ELV Compliant HF Halogen Free

Figures RTP10-RTP14 Typical Electrical Performance Characteristics RTP200R060SA (Cont)

INSTALLATION DEPENDENT PERFORMANCE CHARACTERISTICS

Note: Results were obtained on 44.5 x 57.2 x 1.6 mm single layer FR4 boards with 70µm (2oz) Cu traces, and a 645mm^2, 70µm (2oz) Cu heat spreader connected to the P_{TH} pad of the RTP device. (See RTP device test board drawing.) Results will vary based on user's configuration and should be validated by the user in the end system.

Figure RTP11

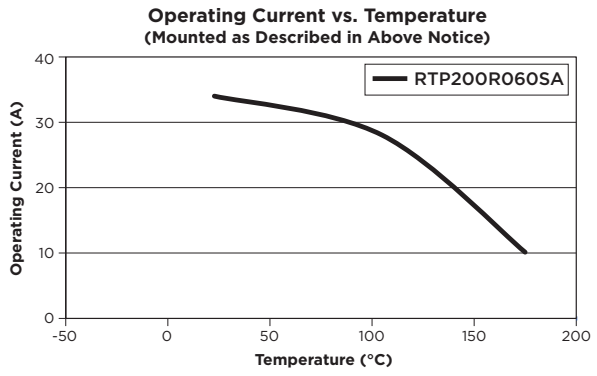


Figure RTP12

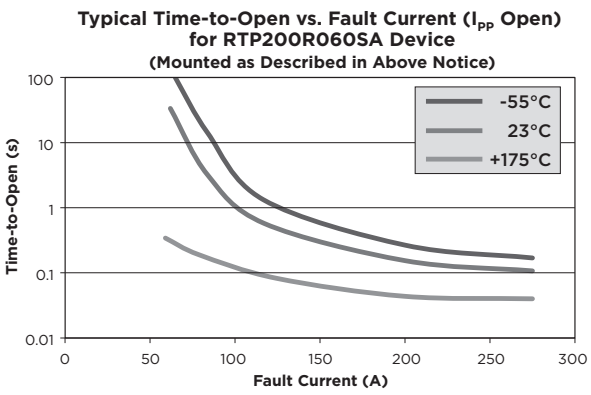


Figure RTP13

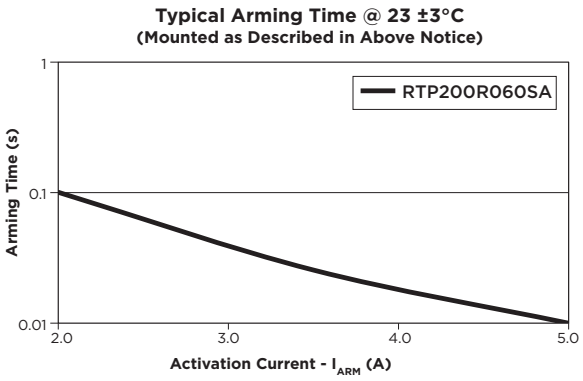
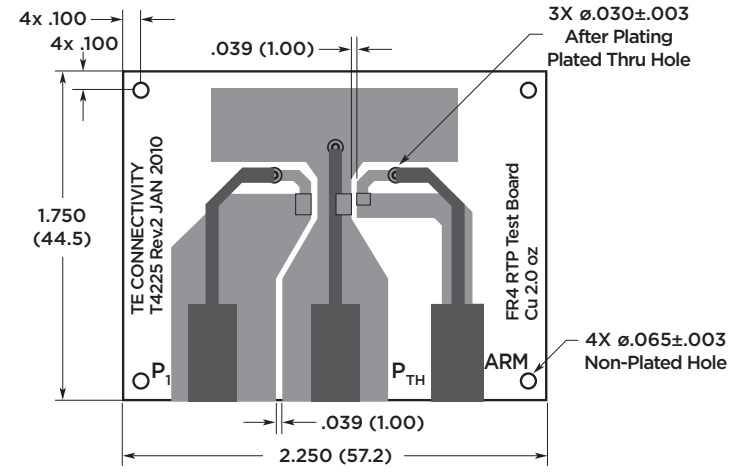


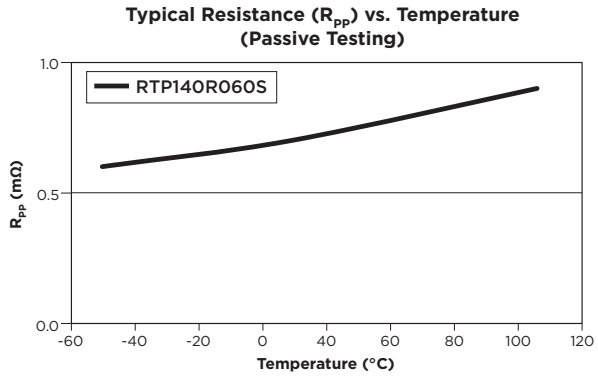
Figure RTP14



P_{TH} pad area = 661mm^2, P1 pad area = 393mm^2, ARM pad area = 169mm^2

Figures RTP15-RTP19 Typical Electrical Performance Characteristics RTP140R060S

Figure RTP15



INSTALLATION DEPENDENT PERFORMANCE CHARACTERISTICS

Note: Results were obtained on 44.5 x 57.2 x 1.6 mm single layer FR4 boards with 70µm (2oz) Cu traces, and a 645mm^2, 70µm (2oz) Cu heat spreader connected to the P_{TH} pad of the RTP device. (See RTP device test board drawing.) Results will vary based on user's configuration and should be validated by the user in the end system.

Figure RTP16

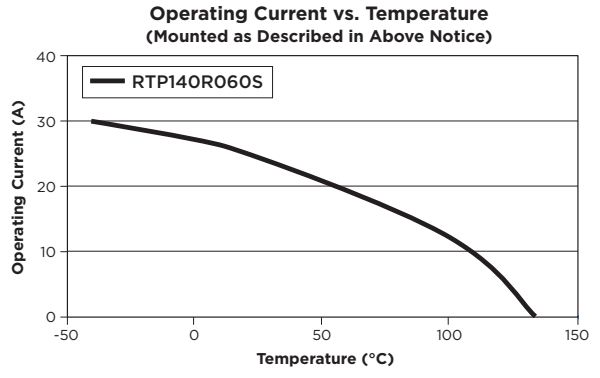


Figure RTP17

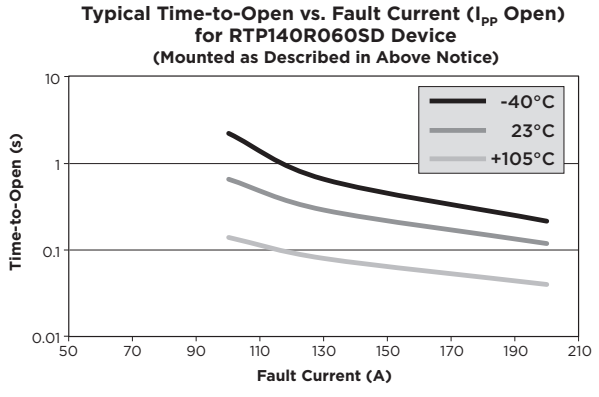
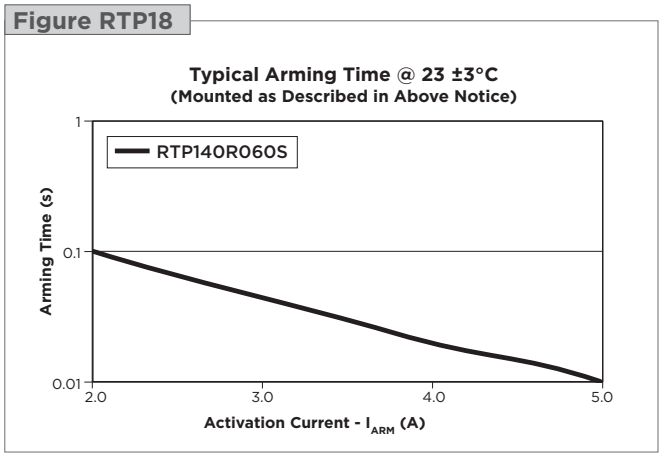


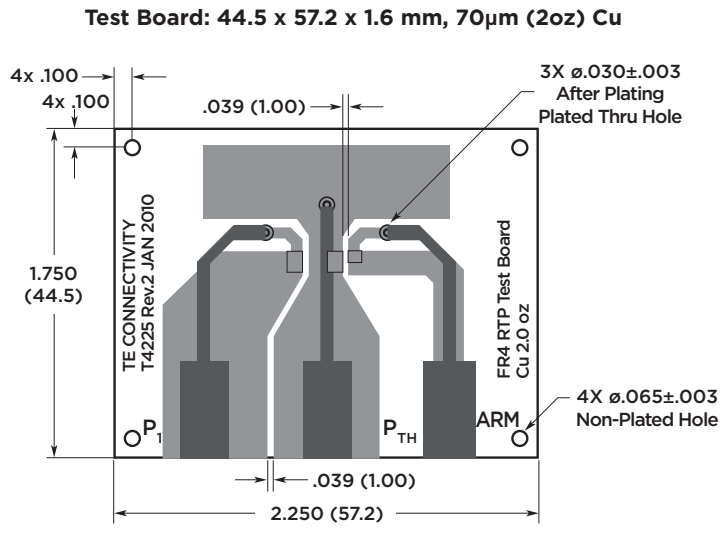
Figure RTP18



RoHS Compliant, ELV Compliant HF Halogen Free

Figures RTP15-RTP19 Typical Electrical Performance Characteristics RTP140R060S (Cont)

Figure RTP19



P_{TH} pad area = 661mm^2, P1 pad area = 393mm^2, ARM pad area = 169mm^2

Table RTP7 Physical Characteristics and Environmental Specifications for RTP Devices

Physical Characteristics RTP200R060SA & RTP140R060S

Lead Material	Nickel/gold Plated Copper
Flammability Rating	UL94 V0 Resin
Marking	Laser Marked
Soldering Characteristics	Solderability per JEDEC Standard No. 22-B102E, Method 2 in Section 5.3
Solder Heat Withstand	Up to 3 Reflows per Recommended Pb-free Reflow Profile

Environmental Specifications for Automotive RTP200R060SA

Test	Conditions
Passive Thermal Aging	175°C, 1000 Hours
Active Thermal Aging	175°C, 3A Bias, 1000 Hours
Passive Humidity Aging	85°C, 85% RH, 1000 Hours
Active Humidity Aging	85°C, 85% RH, 5A Bias,1000 Hours
Storage Humidity	Per IPC/JEDEC J-STD020A Level 1 (MSL1)
Thermal Shock	125°C, -55°C (300 Times)

Environmental Specifications Industrial AC application RTP140R060S

Test	Conditions
Passive Aging	105°C, 1000 Hours
Humidity Aging	85°C, 85% RH, 1000 Hours
Storage Humidity	Per IPC/JEDEC J-STD020A Level 1 (MSL1)
Thermal Shock	105°C, -40°C (300 Times)

Table RTP8 Physical Characteristics and Environmental Specifications for RTP Devices

Part Number	Bag Quantity	Tape and Reel Quantity	Standard Package	Part Marking	Agency Recognition
RTP200R060SA	-	750	3,000	A2 & Batch #	Per AECQ Standards
RTP140R060S	-	750	3,000	B2 & Batch #	UL Recognized File No. E348213

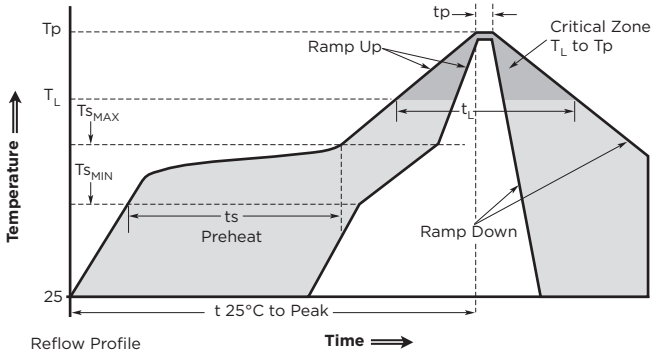
Table RTP9 Ordering Information for RTP Devices

Tape and Reel	750 Pieces/Reel	3,000 Pieces/Box

Wave Soldering and Reflow Recommendations for RTP Devices

RECOMMENDED REFLOW PROFILE

Profile Feature	Pb-Free Assembly
Average Ramp-Up Rate (TsMAX to Tp)	3°C/ s Max
Preheat	
• Temperature Min (TsMIN)	150°C
• Temperature Max (TsMAX)	200°C
• Time (tsMIN to tsMAX)	60-180 s
Time Maintained Above:	
• Temperature (TL)	217°C
• Time (tL)	60-150 s
Peak/Classification Temperature (Tp)	260°C
Time within 5°C of Actual Peak Temperature	
Time (tp)	20-40 s
Ramp-Down Rate	6°C/ s Max
Time 25°C to Peak Temperature	8 Minutes Min

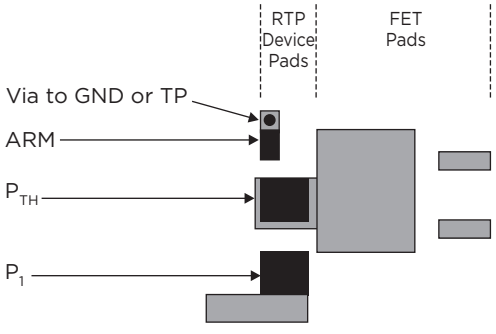


Layout Recommendations

Intimate thermal contact with the potential heat source is important to achieve the desired protection performance. The RTP device should be used so that the P_{TH} pin shares a copper mounting pad with the primary thermal pin or heat sink of the FET or protected component. Board layout recommendations for appropriate thermal coupling are provided below.

1. The RTP device P_{TH} pad must be placed as close to the FET heat sink as practical.
2. Connect the P_{TH} pad to the FET heat sink with as thick and wide a copper trace as practical.
3. Additional copper layers should NOT be placed directly underneath the P_{TH} pad and, if possible, pull additional copper layers away from the RTP device P_{TH} pad. These additional copper layers work to pull heat away from the RTP device and decrease its thermal sensitivity.
4. Pull top layer "cooling" traces as far away from RTP device P_{TH} pad as practical.

Figure RTP20



Note: Thermal conductivity between the RTP device and the heat source is highly dependent on board layout, heat sink structures and relative placement and design of co-located components. It is the responsibility of the user to verify that the RTP device provides sufficient protection in the user's specific final device implementation.

RoHS Compliant, ELV Compliant HF Halogen Free

Qualification Testing for RTP200R060SA

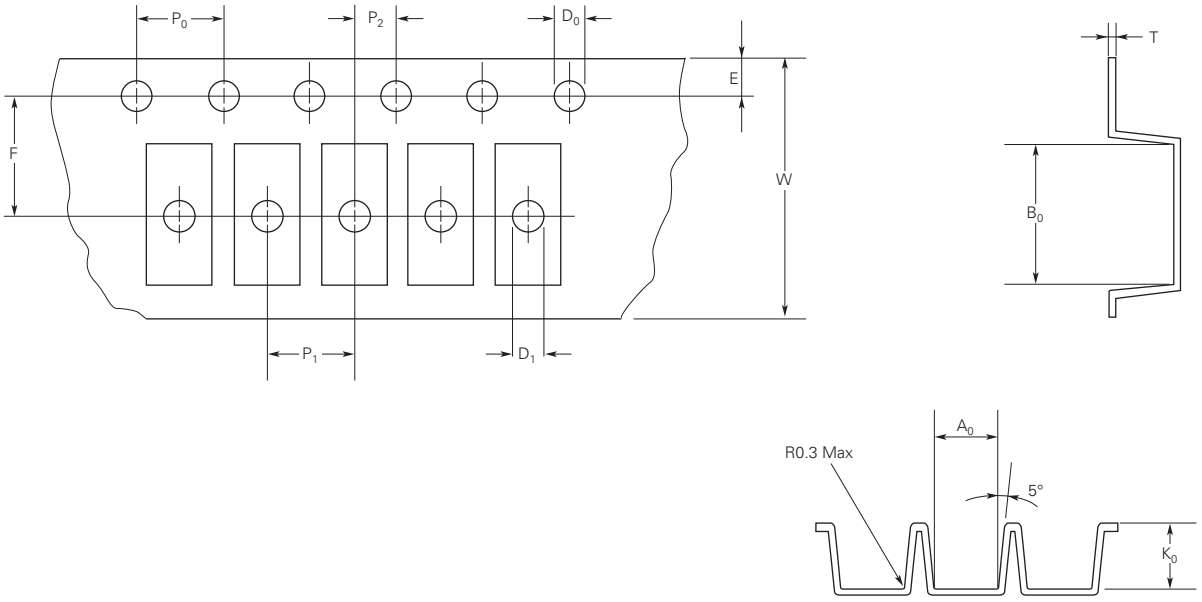
Qualification Testing

The Qualification Testing plan for this series of RTP devices is built upon AEC automotive grade testing for ICs (AEC-Q100), discrete semiconductors (AEC-Q101) and passive components (AEC-Q200), with the intent to demonstrate survivability to the most stringent of the relevant requirements.*

Contact TE Circuit Protection for updated qualification status and detailed procedures.

*A specific list of tests and conditions is available upon request.

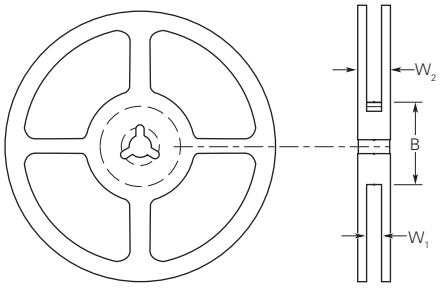
Figure RTP21 EIA Referenced Taped Component Dimensions for RTP Devices



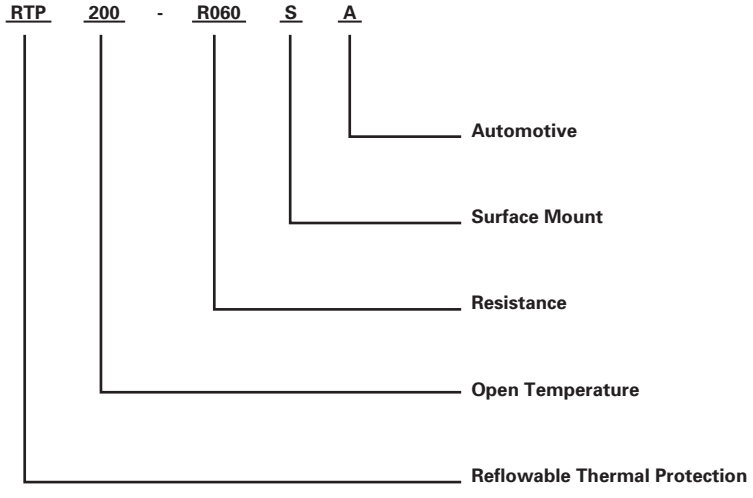
	E	F	W	P1	P0	P2
mm	1.75±0.10	11.50±0.10	24.00±0.30	12.00±0.10	4.00±0.10	2.00±0.10
(in)	(0.069±0.004)	(0.453±0.004)	(0.945±0.012)	(0.472±0.004)	(0.157±0.004)	(0.079±0.004)
	D0	**D1**	**T**	**A0**	**B0**	**K0**
mm	1.50+0.10/-0.00	1.50±0.10	0.46±0.046	5.70±0.18	12.40±0.18	6.50±0.18
(in)	(0.059+0.004/-0.000)	(0.059±0.004)	(0.018±0.002)	(0.224±0.007)	(0.488±0.007)	(0.256±0.007)

Figure RTP22 Referenced Reel Dimensions for RTP Devices

	B	W_1	W_2 Max
mm	102.0 ± 2.0	24	29
in	(4.0 ± 0.079)	(-0.945)	(-1.14)



Part Numbering System for RTP Devices



7

Notice :

Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability and test each product selected for their own applications. Tyco Electronics Corporation and its affiliates in the TE Connectivity Ltd. Group of companies ("TE") reserves the right to change or update, without notice, any information contained in this publication; to change, without notice, the design, construction, processing, or specification of any product; and to discontinue or limit production or distribution of any product. This publication supersedes and replaces all information previously supplied. Without express written consent by an officer of TE, TE does not authorize the use of any of its products as components in nuclear facility applications, aerospace, or in critical life support devices or systems. TE expressly disclaims all implied warranties regarding the information contained herein, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. TE's only obligations are those in the TE Standard Terms and Conditions of Sale and in no case will TE be liable for an incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of its products.

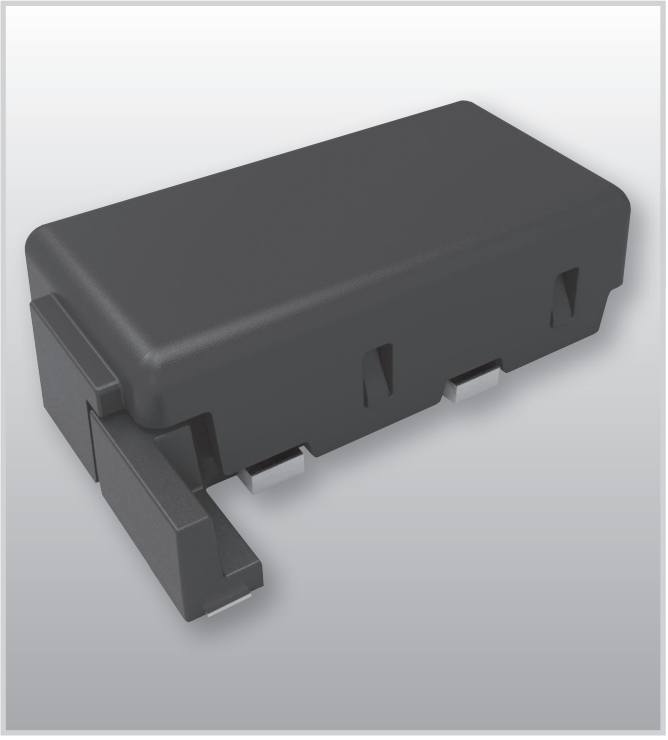


High-Current Reflowable Thermal Protection (HCRTP) Devices

Coming Soon

TE's High-Current Reflowable Thermal Protection (HCRTP) device is a low-resistance, robust surface mountable thermal protector. It has a set open temperature and can be installed using reliable, lead-free, Surface Mount Device (SMD) assembly and reflow processes.

The new HCRTP device, recently added to the RTP family, can help withstand the demanding environmental, life and reliability requirements of automotive and industrial applications, including shock, vibration, temperature cycling and humidity exposures. In the field, the HCRTP device opens if its internal junction exceeds the device's specified open temperature. Temperature increases can have multiple sources, one of which is component failure (e.g., when using power components such as a powerFET, capacitor, resistor, triac, etc.) The HCRTP device open temperature is selected so that the device does not open within normal component operating windows, but it does open in a thermal runaway event and before the melt temperature of typical lead free solders.



To help simplify installation, improve reliability and optimize thermal coupling with the PCB, the HCRTP device is surface mountable. No special SMD installation is required. Instead, after installation, the HCRTP device utilizes a one-time electronic arming process to become thermally sensitive. Before the arming procedure, the device can go through installation temperatures up to 260°C without going open. After arming, the device will open when the critical junction exceeds the open temperature. Arming can occur during test, or in the field.

Benefits

- Helps prevent failed components from smoking and/or desoldering in case of a thermal event
- Allows use of standard surface-mount production methods with no special assembly costs
- Low power dissipation and voltage drop
- Supports DC electronic circuits
- Suitable for rugged environment applications (automotive and industrial)

Features

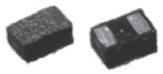
- Capable of high hold current
- Opens at temperature below critical thermal threshold
- Compatible with up to 3 Pb-free solder reflow processes with peak temperatures up to 260°C
- Low series resistance
- DC interrupt voltage capable
- Robust design for harsh environment tested per stringent qualification specification
- RoHS compliant, lead and halogen free
- Low profile

Applications

- Helps provide protection against thermal runaway for powerFETs and other components if failure occurs in applications such as automotive HVAC, ABS, power steering, DC/DC converters, diesel heaters, engine cooling fans, body control modules, PTC heaters, etc., or IT servers, telecom power converters, etc.
- Other DC thermal protection

RoHS Compliant, ELV Compliant HF Halogen Free

RoHS Compliant, ELV Compliant HF Halogen Free



Single-Channel Silicon ESD Protection Devices

NEW



Silicon ESD (SESD) devices help provide protection and improve reliability for applications including consumer, portable and mobile electronics. The 0402- and 0201-sized devices have low capacitance of 0.10pF for bi-directional devices and 0.20pF for uni-directional devices with low insertion loss. This helps provide protection for high-speed data signals. The single-channel SESD devices provide robust ESD protection with industry-leading 20kV contacts and air discharge ratings per IEC61000-4-2 standard. The ultra-low capacitance enables signal integrity for today's highest-speed interfaces including USB 3.0/2.0, HDMI, eSATA, DisplayPort and Thunderbolt.

TE offers the single-channel devices in uni-directional and bi-directional configurations. Bi-directional devices offer the lowest capacitance and insertion loss, allow placement on the PCB without orientation constraint and do not clip signals that swing below ground. Uni-directional devices offer a low negative breakover voltage and help provide protection for high-speed digital interfaces. The 0201-sized XDFN small footprint — measuring a mere 0.6mm x 0.3mm x 0.31mm — offers designers placement flexibility in space-constrained applications.

Benefits

- Low capacitance provides low insertion loss for high speed data signals
- Provides ESD protection up to 20kV contact and air discharge per IEC61000-4-2
- Small size ESD protection diodes for high-speed data signals (0402- and 0201-size devices)
- Helps protect electronic circuits against damage from Electrostatic Discharge (ESD), lightning and cable discharge events
- Assists equipment to pass IEC61000-4-2, level 4 testing

Features

- Low capacitance: at 0.10pF (typ, bi-di) and at 0.20 pF (typ, uni-di)
- Low leakage current: 50nA @ 5V (max)
- Low clamping voltage: +10.0 / - 10.V (typ, bi-di) +9.20 / -0.8V (typ, uni-di) @ (tp=8x20µs, Ipp=2A)
- ESD: 20kV contact / air discharge per IEC61000-4-2
- Surge: 2A (max) @ (tp=8x20µs) per IEC61000-4-5
- Small size and low profile: XDFN packages
- RoHS compliant, Pb and halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br + Cl≤1500ppm)

Applications

- Consumer, mobile and portable electronics
- Tablet PC and external storage with high-speed interfaces
- High-speed data lines
- USB 3.0/2.0, HDMI 1.3/1.4, DisplayPort interface, Thunderbolt interface (Light Peak), V-by-One HS, and LVDS interface
- Applications requiring high ESD performance in small packages

RoHS Compliant, ELV Compliant HF Halogen Free

Table SE1 Device Maximum Ratings

Part Number	ESD Withstand* (IEC 61000-4-2, level 4) Contact (kV)	ESD Withstand* (IEC 61000-4-2, level 4) Air (kV)	Temperature Operating (°C)	Temperature Storage (°C)	Peak Current (tp=8x20μs) Ipp (A)
SESD0201X1UN-0020-090	± 20	± 20	-55 to +125	-55 to +150	2.0
SESD0402X1UN-0020-090	± 20	± 20	-55 to +125	-55 to +150	2.0
SESD0201X1BN-0010-098	± 20	± 20	-55 to +125	-55 to +150	2.0
SESD0402X1BN-0010-098	± 20	± 20	-55 to +125	-55 to +150	2.0

* 20kV @ 1 pulse; 10kV @ 100 pulses; 8kV @ 1,000 pulses (under IEC6100-4-2)
- Maximum leakage current post 15kV & 20kV pulses is less than 1μA
- Device maximum rating @ T = 25°C, unless otherwise specified
- Caution: Stress exceeding Device Maximum Ratings may damage the device
- Prolonged exposure to stresses above the recommended operating conditions may affect device reliability

Table SE2 Device Electrical Characteristics @ T = 25°C

Part Number	Input Capacitance* Typical (pF)	Input Capacitance* Maximum (pF)	Breakdown Voltage (Typ) V_{BR} @ I_T=1mA (V)	Reverse Working Voltage (V) Min	Reverse Working Voltage (V) Max	Reverse Leakage Current (Typ) I_L @ V_{RWM}=5.0V (nA)	Clamping Voltage (Typ) V_{CL} @ Ipp=2.0A (V)
SESD0201X1UN-0020-090	0.20	0.25	+9.00 / -0.80	0	+7.00	25.0	+9.20 / -0.80
SESD0402X1UN-0020-090	0.20	0.25	+9.00 / -0.80	0	+7.00	25.0	+9.20 / -0.80
SESD0201X1BN-0010-098	0.10	0.13	+9.80 / -9.80	-7.00	+7.00	25.0	+10.0 / -10.0
SESD0402X1BN-0010-098	0.10	0.13	+9.80 / -9.80	-7.00	+7.00	25.0	+10.0 / -10.0

* @ V_R = OV, f = 3GHz

8

Figures SE1-SE2 Device IV Characteristics

Figure SE1

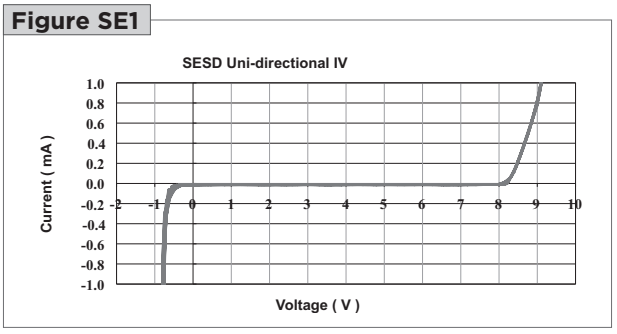
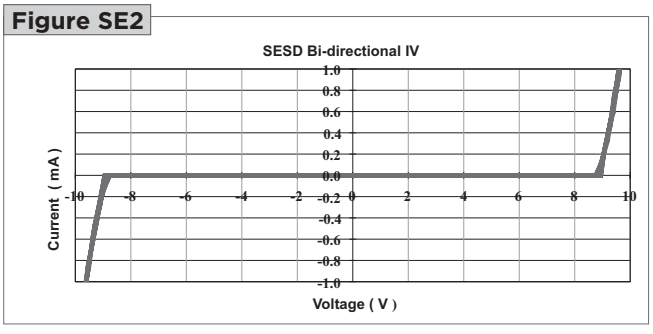


Figure SE2



Figures SE3-SE4 Insertion Loss Diagrams

Application / Protocols	Bit Rate (Gbps)	@Freq (GHz)	Ins. Loss (dB)
HDMI 1.4 (1080P)	2.25	1.13	-0.23
DisplayPort	2.70	1.35	-0.26
HDMI 1.4 (4K / QuadHD)*	3.40	1.70	-0.30
USB 3.0	5.00	2.50	-0.38
eSATA	6.00	3.00	-0.44
Thunderbolt	10.0	5.00	-0.69

* HDMI 4K / QuadHD resolutions (4096 x 2160) ready

RoHS Compliant, ELV Compliant HF Halogen Free

Figures SE3-SE4 Insertion Loss Diagrams

Cont'd

Figure SE3

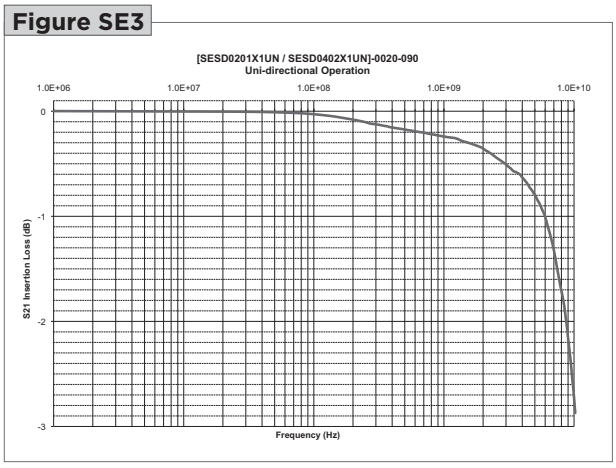
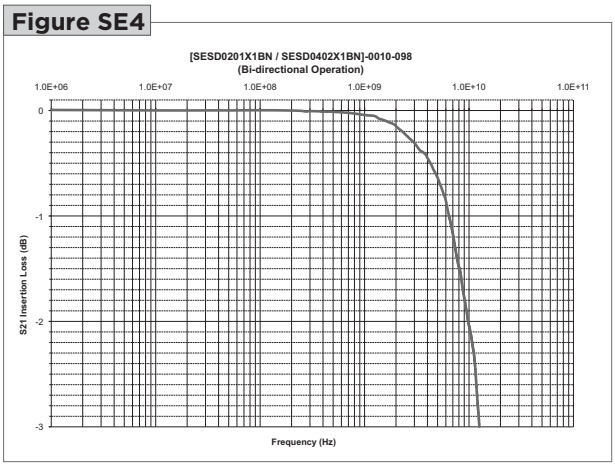


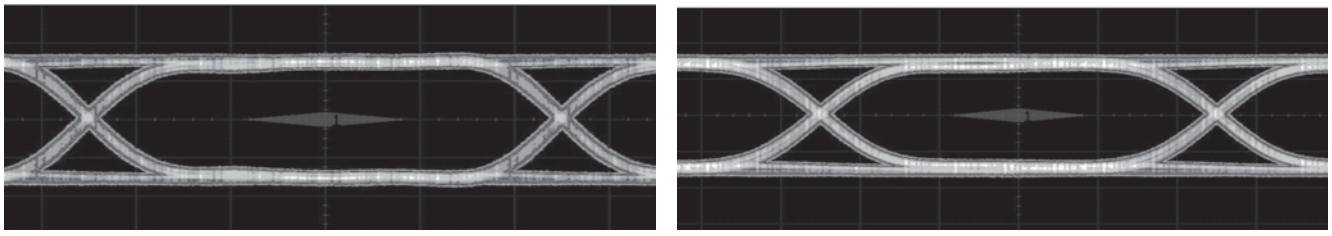
Figure SE4



Figures SE5-SE7 Eye Diagrams

Figure SE5

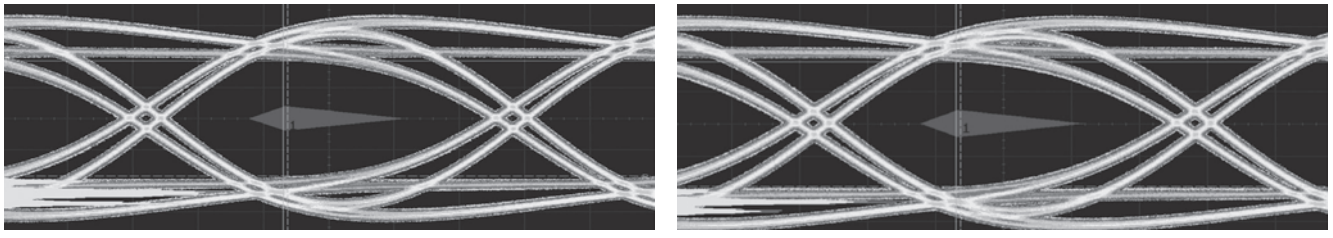
USB 3.0 Eye Diagrams
5.0 Gb/s, 1000mV differential, CPO Compliant Test Pattern



Without SESD Device **With SESD Device**

Figure SE6

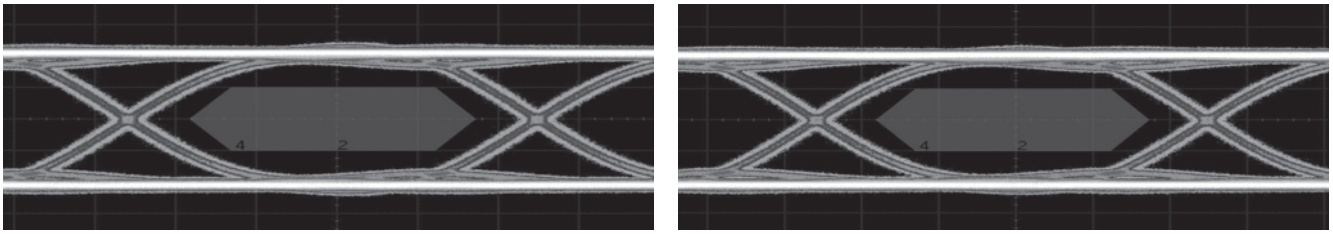
DisplayPort Eye Diagrams
5.4 Gb/s, 800mV differential, PRBS7 Compliant Test Pattern, SSC Enabled



Without SESD Device **With SESD Device**

Figure SE7

HDMI Eye Diagrams
3.4 Gb/s, 990 mV differential, TMDS Data



Without SESD Device **With SESD Device**

Table SE3 Dimensions for SESD Devices in Millimeters and (Inches)

Part Number
SESD0201X1UN-0020-090

A			A_1			A_3			D			E		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.28	0.30	0.32	0	–	0.05	–	0.102 ref.	–	0.25	0.30	0.35	0.55	0.60	0.65
(0.011)	(0.012)	(0.013)	(0)	–	(0.002)	–	(0.004 ref.)	–	(0.010)	(0.012)	(0.014)	(0.022)	(0.024)	(0.026)

K			b			L_1			L_2			e			
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Figure
0.11	0.17	0.22	0.20	0.25	0.30	0.13	0.18	0.23	0.14	0.19	0.24	–	0.356 BSC*	–	SE8
(0.004)	(0.007)	(0.009)	(0.008)	(0.010)	(0.012)	(0.005)	(0.008)	(0.009)	(0.006)	(0.007)	(0.009)	–	(0.014 BSC*)	–	

* BSC — Basic Spacing between Centers

Part Number
SESD0201X1BN-0010-098

A			A_1			A_3			D			E		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.28	0.30	0.32	0	–	0.05	–	0.102 ref.	–	0.25	0.30	0.35	0.55	0.60	0.65
(0.011)	(0.012)	(0.013)	(0)	–	(0.002)	–	(0.004 ref.)	–	(0.010)	(0.012)	(0.014)	(0.022)	(0.024)	(0.026)

K			b			L_1			L_2			e			
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Figure
0.11	0.17	0.22	0.20	0.25	0.30	0.13	0.18	0.23	0.14	0.19	0.24	–	0.356 BSC*	–	SE9
(0.004)	(0.007)	(0.009)	(0.008)	(0.010)	(0.012)	(0.005)	(0.008)	(0.009)	(0.006)	(0.007)	(0.009)	–	(0.014 BSC*)	–	

* BSC — Basic Spacing between Centers

8

Figure SE8

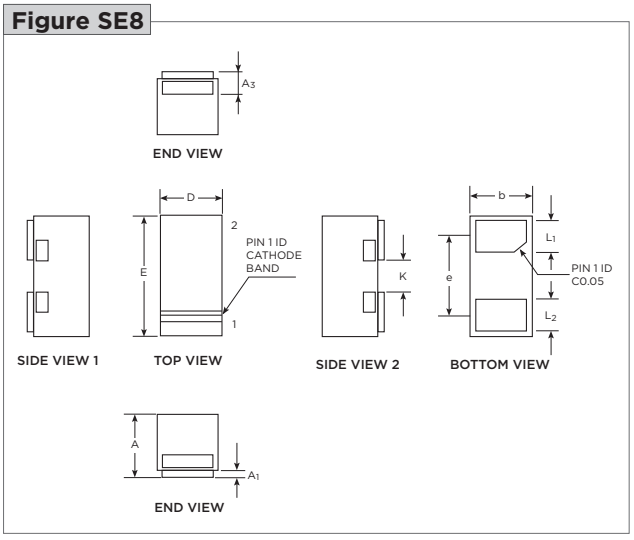
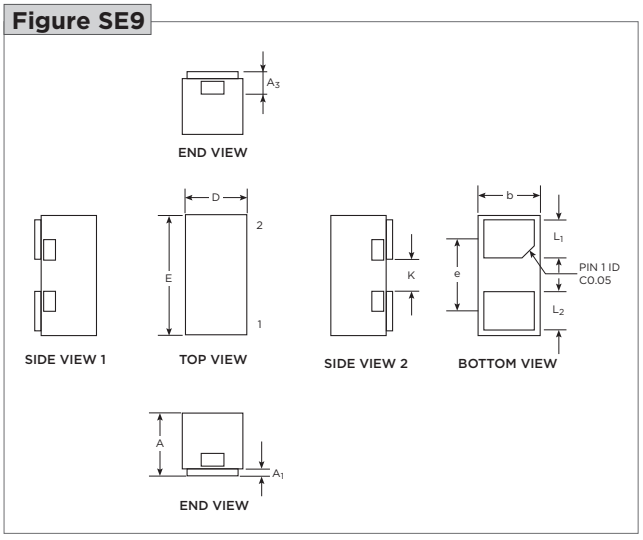


Figure SE9



RoHS Compliant, ELV Compliant HF Halogen Free

Table SE4 Dimensions for SESD Devices in Millimeters and (Inches)

Part Number
SESD0402X1UN-0020-090

A			A_1			A_3			D			E		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.33	0.38	0.43	0	–	0.05	–	0.13 ref.	–	0.55	0.60	0.65	0.95	1.00	1.05
(0.013)	(0.015)	(0.017)	(0)	–	(0.002)	–	(0.005 ref.)	–	(0.022)	(0.024)	(0.026)	(0.037)	(0.039)	(0.041)

K			b			L			e			
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Figure
0.35	0.40	0.45	0.45	0.50	0.55	0.20	0.25	0.30	–	0.65 BSC*	–	SE10
(0.014)	(0.016)	(0.018)	(0.018)	(0.020)	(0.022)	(0.008)	(0.010)	(0.012)	–	(0.026 BSC*)	–	

* BSC — Basic Spacing between Centers

Part Number
SESD0402X1BN-0010-098

A			A_1			A_3			D			E		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.33	0.38	0.43	0	–	0.05	–	0.13 ref.	–	0.55	0.60	0.65	0.95	1.00	1.05
(0.013)	(0.015)	(0.017)	(0)	–	(0.002)	–	(0.005 ref.)	–	(0.022)	(0.024)	(0.026)	(0.037)	(0.039)	(0.041)

K			b			L			e			
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Figure
0.35	0.40	0.45	0.45	0.50	0.55	0.20	0.25	0.30	–	0.65 BSC*	–	SE11
(0.0014)	(0.016)	(0.018)	(0.018)	(0.020)	(0.022)	(0.008)	(0.010)	(0.012)	–	(0.014 BSC*)	–	

* BSC — Basic Spacing between Centers

Figure SE10

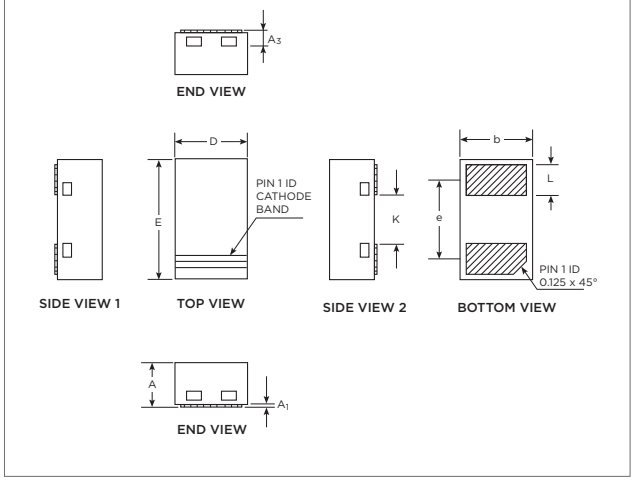


Figure SE11

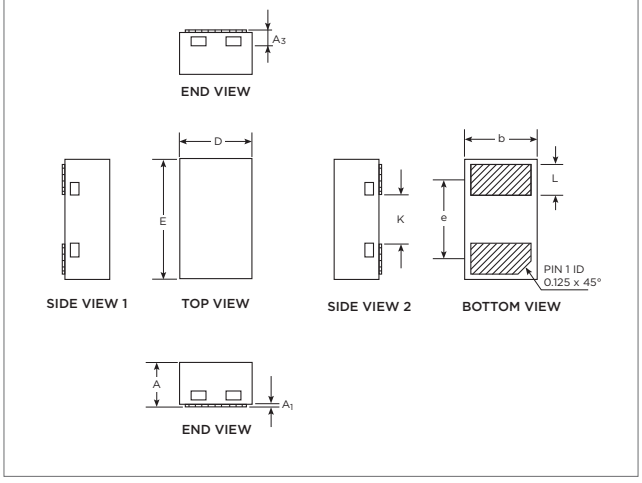


Table SE5 SESD Landing Pad Layout for 0201 Package

Symbol	Millimeters (mm)	Inches (in)
A	0.32	0.013
B	0.62	0.024
D	0.24	0.009
F	0.14	0.006

Figure SE12

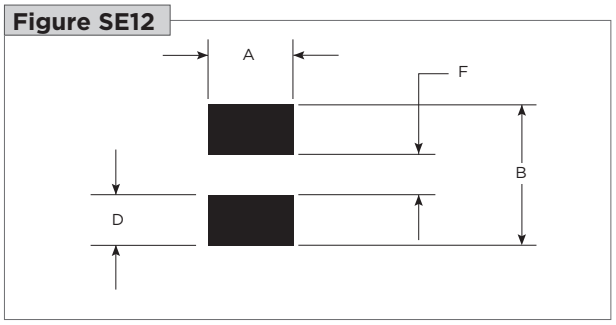
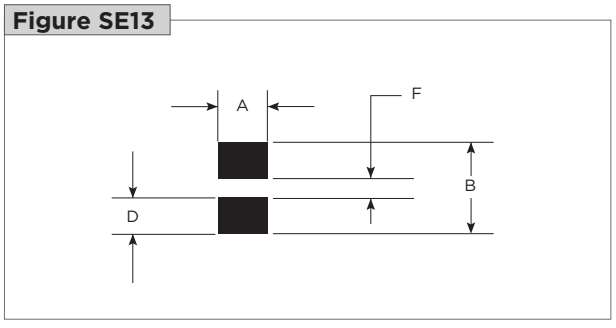


Table SE6 SESD Landing Pad Layout for 0402 Package

Symbol	Millimeters (mm)	Inches (in)
A	0.60	0.024
B	1.00	0.039
D	0.35	0.014
F	0.30	0.012

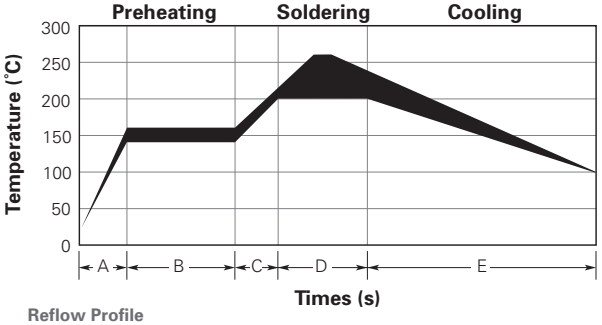
Figure SE13



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Table SE7 Solder Reflow Recommendations for SESD Devices

A	Temperature Ramp-up 1	From Ambient to Preheating Temperature	30s to 60s
B	Preheating	140°C - 160°C	60s to 120s
C	Temperature Ramp-up 2	From Preheating to Main Heating Temperature	20s to 40s
D	Main Heating	at 200°C at 220°C at 240°C at 260°C	60s to 70s 50s to 60s 30s to 40s 5s to 10s
E	Cooling	From Main Heating Temperature to 100°C	4°C/s max



Reflow Profile

RoHS Compliant, ELV Compliant HF Halogen Free

Table SE8 Carrier Tape Specifications

Tape Dimension EIA Mark	SESD0201 Dimension (mm)	SESD0201 Tolerance	SESD0402 Dimension (mm)	SESD0402 Tolerance
W	8.00	±0.10	8.00	±0.10
P_0	4.00	±0.10	4.00	±0.10
P_1	2.00	±0.10	2.00	±0.10
P_2	2.00	±0.05	2.00	±0.05
A_0	0.36	±0.03	0.70	±0.05
B_0	0.66	±0.03	1.15	±0.05
D_0	Ø1.50	-0.00 / +0.10	Ø1.55	±0.05
D_1	Ø0.20	±0.05	Ø0.40	±0.05
E_1	1.75	±0.10	1.75	±0.10
F	3.50	±0.05	3.50	±0.05
K_0	0.33	±0.03	0.47	±0.05
T	0.23	±0.02	0.20	±0.05
Detail A	-	2° (max)	-	3° (max)

Note 1. All dimensions in mm
Note 2. Measured from centerline of pocket to centerline of sprocket hole
Note 3. Cumulative tolerance of 10 sprocket holes is ±0.20
Note 4. Tolerances unless noted ±0.20

Figure SE14

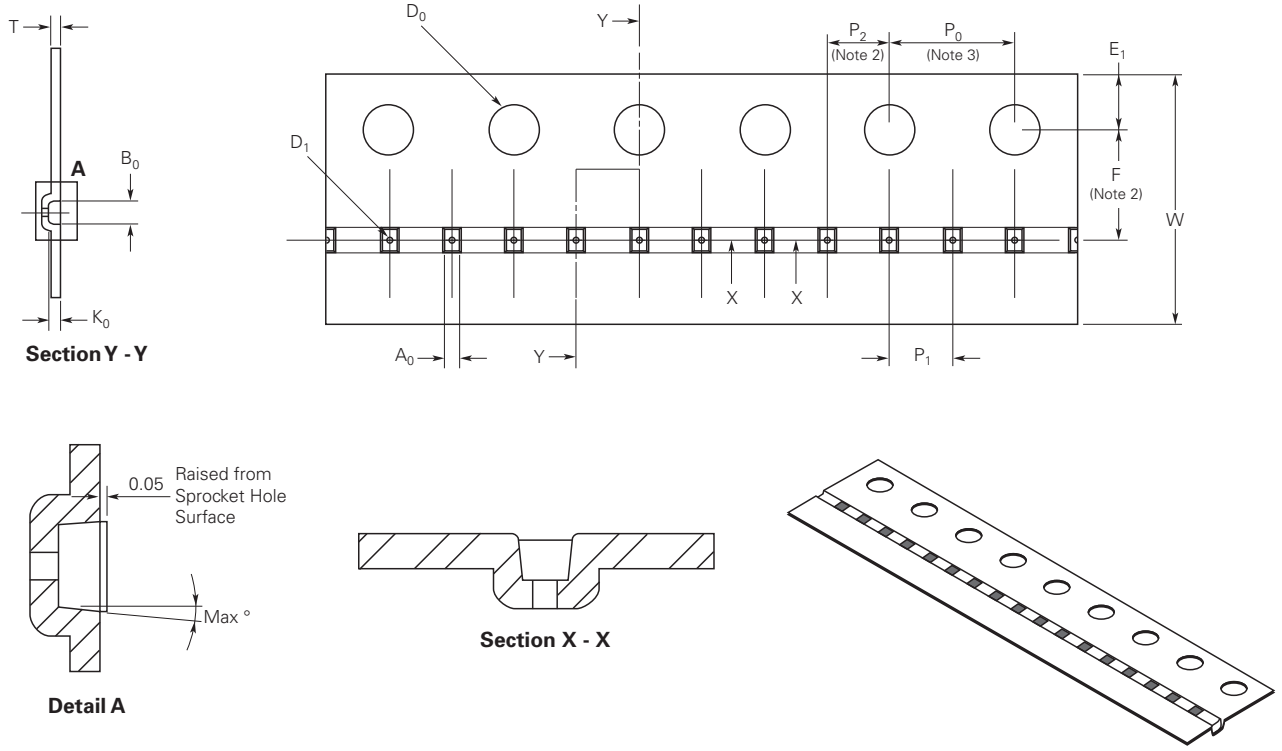
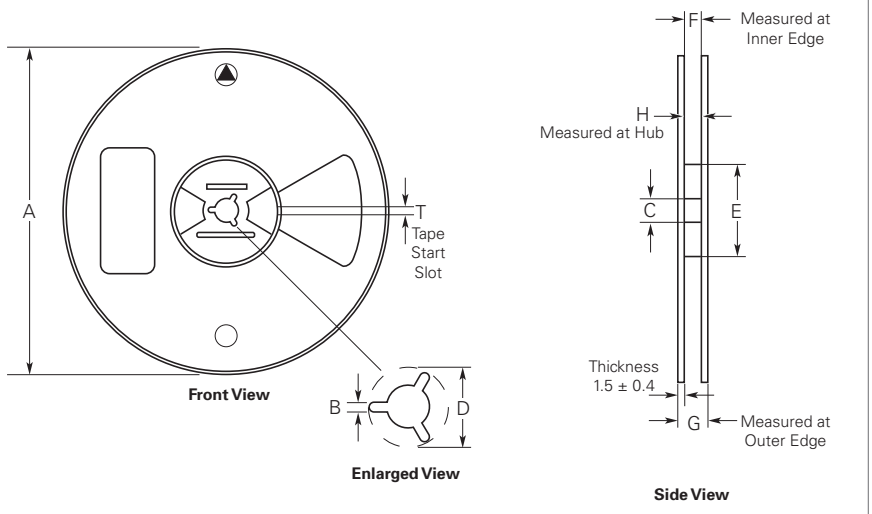


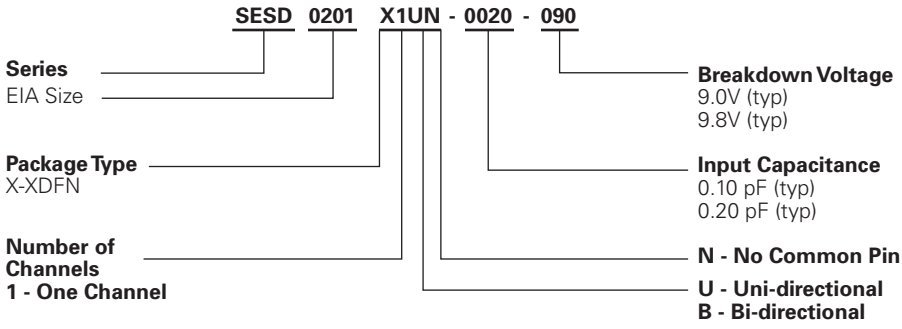
Table SE9 Reel Specifications

Reel Dimension EIA Mark	Dimension (mm)
A	180 ± 2.00
B	1.50 (min)
C	13.10 ± 0.20
D	20.20 (min)
E	60 ± 1.00
F	8.75 ± 1.00
G	11.6 ± 1.00
H	9.4 (max)

Figure SE15



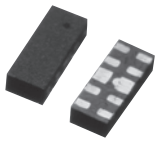
Part Numbering System for Single-Channel Silicon ESD Devices



Part Marking

Part Number	Part Marking
SESD0201X1UN-0020-090	C
SESD0402X1UN-0020-090	C
SESD0201X1BN-0010-098	C
SESD0402X1BN-0010-098	C

RoHS Compliant, ELV Compliant HF Halogen Free

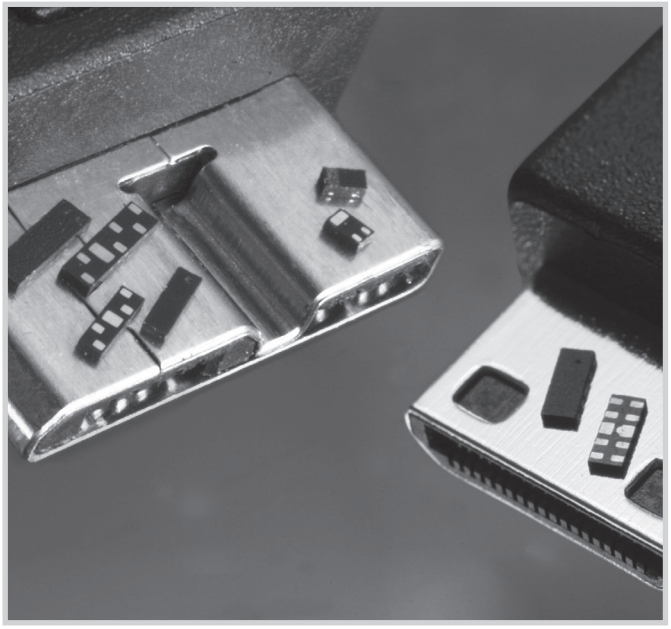


Multi-Channel Silicon ESD Flow-Through Arrays

NEW

The Silicon ESD (SESD) arrays can help provide protection and improve reliability of electronics in applications including but not limited to consumer, portable and mobile electronics. The multi-channel SESD flow-through arrays have low capacitance of 0.20pF with low insertion loss, which help protect high-speed data signals. The SESD arrays provide robust ESD protection with 20kV contact and air discharge rating per the IEC61000-4-2 standard. The low capacitance SESD arrays enable signal integrity for today's highest-speed interfaces including USB 3.0/2.0, HDMI, eSATA, DisplayPort and Thunderbolt.

TE offers four- and six-channel miniature arrays which are up to 85% smaller than common multi-channel arrays for space-constrained applications. TE's ultra-small packages have lower parasitic impedance which reduces insertion loss at high frequencies compared to larger-packaged devices. All of TE's SESD arrays are in flow-through design packages which allow for matched impedance PCB trace routing essential for high-speed signal integrity.



Benefits

- Low capacitance; provides low insertion loss for high-speed data signals
- Provides ESD protection up to 20kV contact and air discharge per IEC61000-4-2
- Industry's smallest footprint and lowest profile multi-channel ESD arrays helps to optimize board space
- Flow-through and single connection design helps routing PCB matched impedance high-speed data lines
- Helps protect electronic circuits against damage from Electrostatic Discharge (ESD), lightning and cable discharge events
- Helps assist equipment to pass IEC61000-4-2, level 4 testing

Features

- Low Capacitance: at 0.20pF (typ, 200pF)
- Low leakage current : 25nA @ 5V (typ)
- Low clamping voltage: +9.20 / - 0.8V (typ) (tp=8x20μs, Ipp-2A)
- ESD 20kV Contact and air discharge maximum rating per IEC61000-4-2
- Surge: 2A (max) @ (tp=8x20μs) per IEC61000-4-5
- Small size and low profile: XDFN array package 0.38mm height
- RoHS Compliant, Pb and Halogen Free (refers to: Br≤900ppm, Cl≤900ppm, Br + Cl≤1500ppm)

Applications

- Consumer, mobile and portable electronics
- Tablet PC and external storage with high-speed; also below: ultra-high-speed interfaces
- Ultra-high-speed data lines
- USB 3.0/2.0, HDMI 1.3/1.4, DisplayPort interface, Thunderbolt interface (Light Peak), V-by-One HS, and LVDS interface
- Applications requiring high ESD performance in small DFN packages

RoHS Compliant, ELV Compliant HF Halogen Free

Table ME1 Device Maximum Ratings

	ESD Withstand* (IEC 61000-4-2, level 4)		Temperature		Peak Current (tp=8x20μs)
Part Number	Contact (kV)	Air (kV)	Operating (ºC)	Storage (ºC)	Ipp (A)
SESD0402Q2UG-0020-090 (2-ch)	±20	±20	-55 to +125	-55 to +150	2.0
SESD0802Q4UG-0020-090 (4-ch)	±20	±20	-55 to +125	-55 to +150	2.0
SESD1004Q4UG-0020-090 (4-ch)	±20	±20	-55 to +125	-55 to +150	2.0
SESD1103Q6UG-0020-090 (6-ch)	±20	±20	-55 to +125	-55 to +150	2.0

* 20kV @ 1 pulse; 10kV @ 100 pulses; 8kV @ 1,000 pulses (under IEC6100-4-2)
- Maximum leakage current post 15kV and 20kV pulses is less than 1μA
- Device maximum rating @T=25ºC, unless otherwise specified
- Caution: Stress exceeding Device Maximum Ratings may damage the device
- Prolonged exposure to stresses above the recommended operating conditions may affect device reliability

Table ME2 Device Electrical Characteristics @T = 25ºC

	Input Capacitance*		Breakdown Voltage (Typ)	Reverse Working Voltage (V)		Reverse Leakage Current (Typ)	Clamping Voltage (Typ)
Part Number	Typ (pF)	Max (pF)	V_{BR} @ I_T=1mA (V)	Min	Max	I_L @ V_{RWM}=5.0V (nA)	V_{CL} @ Ipp=2.0V (V)
SESD0402Q2UG-0020-090 (2-ch)	0.20	0.25	+9.00 / -0.80	0	+7.00	25.0	+9.20 / -0.80
SESD0802Q4UG-0020-090 (4-ch)	0.20	0.25	+9.00 / -0.80	0	+7.00	25.0	+9.20 / -0.80
SESD1004Q4UG-0020-090 (4-ch)	0.20	0.25	+9.00 / -0.80	0	+7.00	25.0	+9.20 / -0.80
SESD1103Q6UG-0020-090 (6-ch)	0.20	0.25	+9.00 / -0.80	0	+7.00	25.0	+9.20 / -0.80

* @V_R=OV, f=3GHz

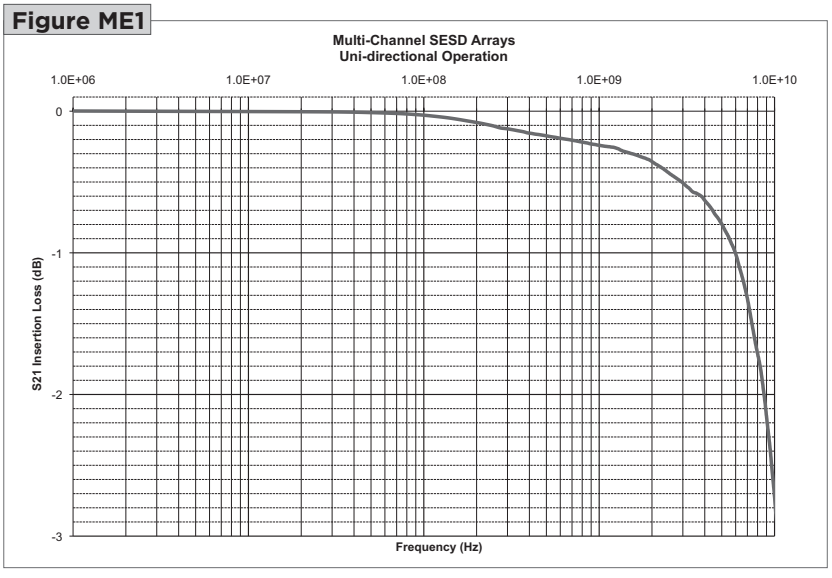
8

Table ME3 Insertion Loss Diagrams

Application / Protocol	Bit Rate (Gbps)	@Freq (GHz)	Ins. Loss (dB)
HDMI 1.4 (1080P)	2.25	1.13	-0.23
DisplayPort	2.70	1.35	-0.26
HDMI 1.4 (4K / QuadHD)*	3.40	1.70	-0.30
USB 3.0	5.00	2.50	-0.38
eSATA	6.00	3.00	-0.44
Thunderbolt	10.0	5.00	-0.69

* HDMI 4K / QuadHD resolutions (4096 x 2160) ready

Figure ME1

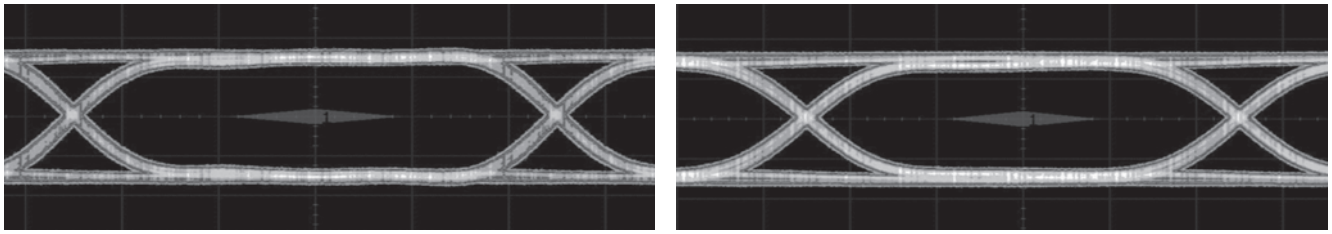


RoHS Compliant, ELV Compliant HF Halogen Free

Figures ME2-ME4 Eye Diagrams

Figure ME2

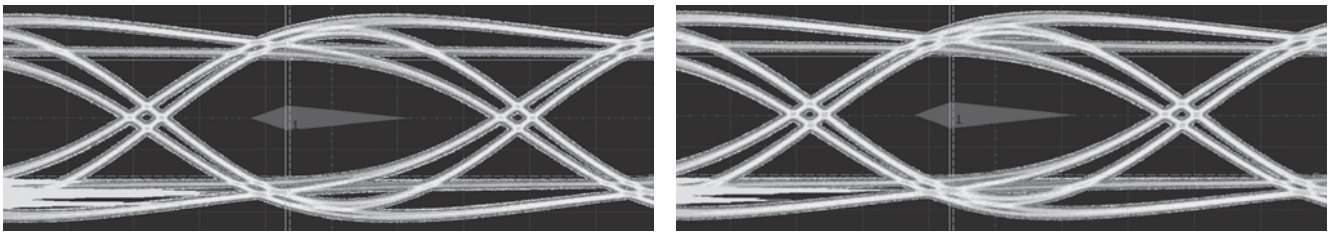
USB 3.0 Eye Diagrams
5.0Gb/s, 1000mV Differential, CPO Compliant Test Pattern



Without SESD Device **With SESD Device**

Figure ME3

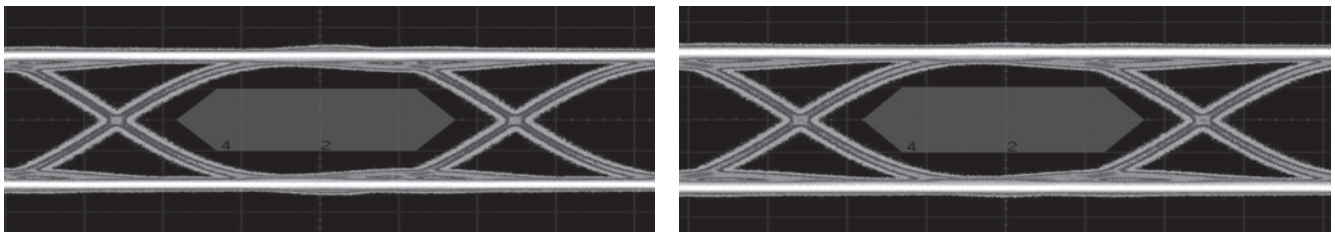
DisplayPort Eye Diagrams
5.4Gb/s, 800mV Differential, PRBS7 Compliant Test Pattern, SSC Enabled



Without SESD Device **With SESD Device**

Figure ME4

HDMI Eye Diagrams
3.4Gb/s, 990 mV Differential, TMDS Data



Without SESD Device **With SESD Device**

Table ME4 Device Dimensions for SESD Devices in Millimeters and (Inches)

Part Number
SESD0402Q4UG-0020-090

A			A_1			A_3			D			E			K		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.33	0.38	0.43	0	–	0.05	–	0.13 ref.	–	0.55	0.60	0.65	0.95	1.00	1.05	0.35	0.40	0.45
(0.013)	(0.015)	(0.017)	(0)	–	(0.002)	–	(0.005 ref.)	–	(0.022)	(0.024)	(0.026)	(0.037)	(0.039)	(0.041)	(0.014)	(0.016)	(0.018)

L_1			L_2			b			e_1			e_2			
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Figure
0.45	0.50	0.55	0.20	0.25	0.30	0.10	0.15	0.20	–	0.35 BSC*	–	–	0.65 BSC*	–	ME5
(0.018)	(0.020)	(0.022)	(0.008)	(0.010)	(0.012)	(0.004)	(0.006)	(0.008)	–	(0.014 BSC*)	–	–	(0.026 BSC*)	–	

* BSC — Basic Spacing between Centers

Figure ME5

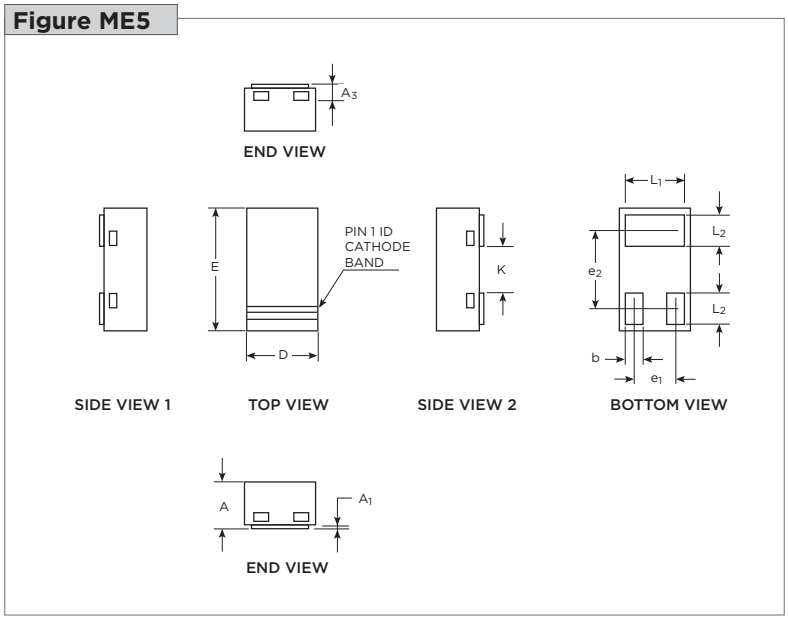
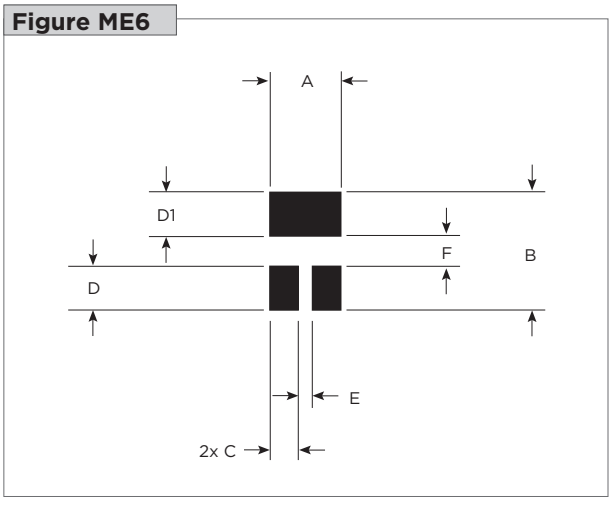


Table ME5 SESD Landing Pad Layout 3 Pin 2-ch 0402 Size Array

Symbol	Millimeters (mm)	Inches (in)
A	0.60	0.024
B	1.00	0.039
C	0.23	0.009
D	0.35	0.014
D_1	0.35	0.014
E	0.15	0.006
F	0.30	0.012

Figure ME6



RoHS Compliant, ELV Compliant HF Halogen Free

Table ME6 Device Dimensions for SESD Devices in Millimeters and (Inches)

Part Number
SESD0802Q4UG-0020-090

A			A_1			A_3			D			E			b			b_1		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.33	0.38	0.43	0	0.02	0.05	–	0.127 ref.	–	0.50	0.60	0.70	1.90	2.00	2.10	0.15	0.20	0.25	0.25	0.30	0.36
(0.013)	(0.015)	(0.017)	(0)	–	(0.002)	–	(0.005 ref.)	–	(0.020)	(0.024)	(0.028)	(0.075)	(0.079)	(0.083)	(0.006)	(0.008)	(0.010)	(0.010)	(0.012)	(0.014)

L			L_1			L_2			e			e_1			e_2			N			Figure
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	
0.25	0.30	0.36	0.35	0.40	0.45	–	0.05 BSC*	–	–	0.40 BSC*	–	–	0.45 BSC*	–	–	0.25 BSC*	–	–	4	–	ME7
(0.010)	(0.012)	(0.014)	(0.014)	(0.016)	(0.018)	–	(0.002 BSC*)	–	–	(0.016 BSC*)	–	–	(0.018 BSC*)	–	–	(0.010 BSC*)	–	–	4	–	

* BSC — Basic Spacing between Centers

Figure ME7

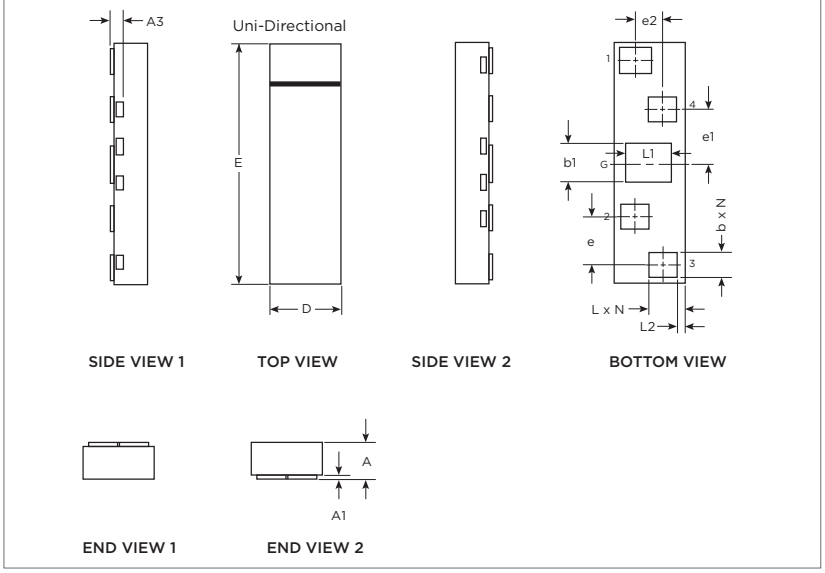


Table ME7 SESD Landing Pad Layout 5 Pin 4-ch Miniature FT Array

Symbol	Millimeters (mm)	Inches (in)
A	0.60	0.024
B	2.00	0.079
C	0.30	0.012
D	0.30	0.012
E	0.30	0.012
F	0.10	0.004
F_1	0.15	0.006
G	0.40 BSC*	0.016 BSC*
G_1	0.45 BSC*	0.018 BSC*

* BSC — Basic Spacing between Centers

Figure ME8

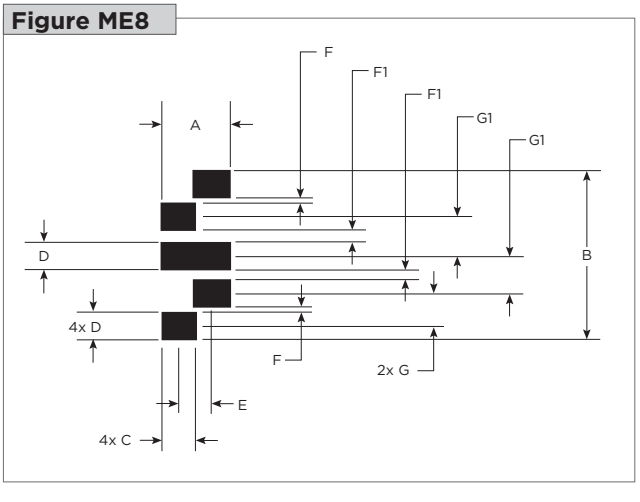


Table ME8 Device Dimensions for SESD Devices in Millimeters and (Inches)

Part Number
SESD1004Q4UG-0020-090

A			A_1			A_3			D			E			b			b_1		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.33	0.38	0.43	0	0.02	0.05	–	0.127 ref.	–	0.90	1.00	1.10	2.40	2.50	2.60	0.15	0.20	0.25	0.35	0.40	0.45
(0.013)	(0.015)	(0.017)	(0)	–	(0.002)	–	(0.005 ref.)	–	(0.035)	(0.039)	(0.043)	(0.094)	(0.098)	(0.102)	(0.006)	(0.008)	(0.010)	(0.014)	(0.016)	(0.018)

L			L_1			e			e_1			N			R			R_1			Figure
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	
0.33	0.38	0.43	0.00	0.10	0.15	–	0.50 BSC*	–	–	0.50 BSC*	–	–	10	–	–	0.075 BSC*	–	–	0.125 BSC*	–	ME9
(0.013)	(0.015)	(0.017)	(0.000)	(0.004)	(0.006)	–	(0.020 BSC*)	–	–	(0.020 BSC*)	–	–	10	–	–	(0.003 BSC*)	–	–	(0.005 BSC*)	–	

* BSC — Basic Spacing between Centers

Figure ME9

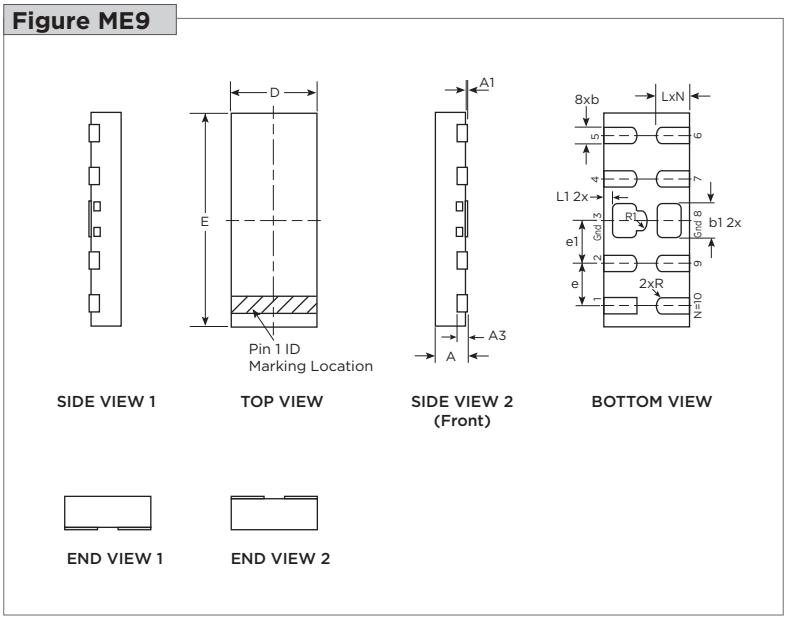
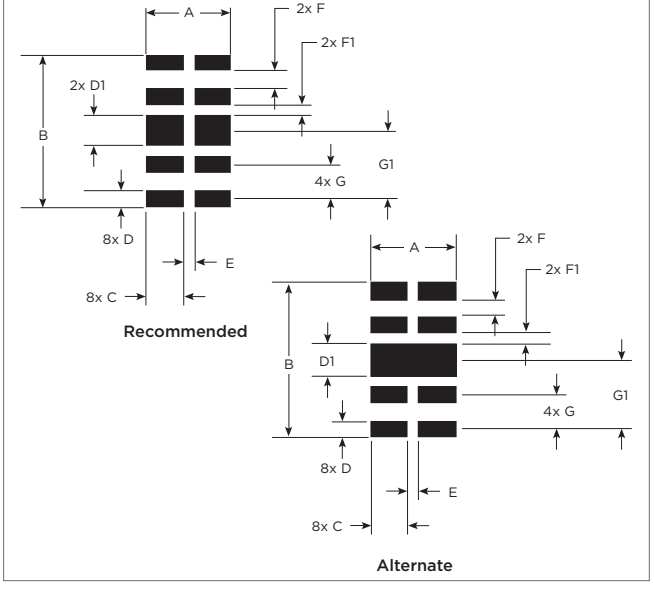


Table ME9 SESD Landing Pad Layout 3 Pin 2-ch 0402 Size Array

Symbol	Millimeters (mm)	Inches (in)
A	1.20	0.047
B	2.20	0.087
C	0.50	0.020
D	0.20	0.008
D_1	0.40	0.016
E	0.20	0.008
F	0.30	0.012
F_1	0.20	0.008
G	0.50 BSC*	0.020 BSC*
G_1	1.00 BSC*	0.039 BSC*

* BSC — Basic Spacing between Centers

Figure ME10



RoHS Compliant, ELV Compliant HF Halogen Free

Table ME10 Device Dimensions for SESD Devices in Millimeters and (Inches)

Part Number
SESD1103Q6UG-0020-090

A			A_1			A_3			D			E			b			b_1		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.33	0.38	0.43	0	0.02	0.05	–	0.127 ref.	–	0.70	0.80	0.90	2.70	2.80	2.90	0.15	0.20	0.25	0.25	0.30	0.35
(0.013)	(0.015)	(0.017)	(0)	–	(0.002)	–	(0.005 ref.)	–	(0.027)	(0.031)	(0.035)	(0.106)	(0.110)	(0.114)	(0.006)	(0.008)	(0.010)	(0.010)	(0.012)	(0.014)

L			L_1			L_2			e			e_1			e_2			N			
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Figure
0.30	0.35	0.40	0.50	0.55	0.60	–	0.05 BSC*	–	–	0.40 BSC*	–	–	0.45 BSC*	–	–	0.40 BSC*	–	–	6	–	ME11
(0.012)	(0.014)	(0.016)	(0.019)	(0.021)	(0.024)	–	(0.002 BSC*)	–	–	(0.016 BSC*)	–	–	(0.018 BSC*)	–	–	(0.016 BSC*)	–	–	6	–	

* BSC — Basic Spacing between Centers

Figure ME11

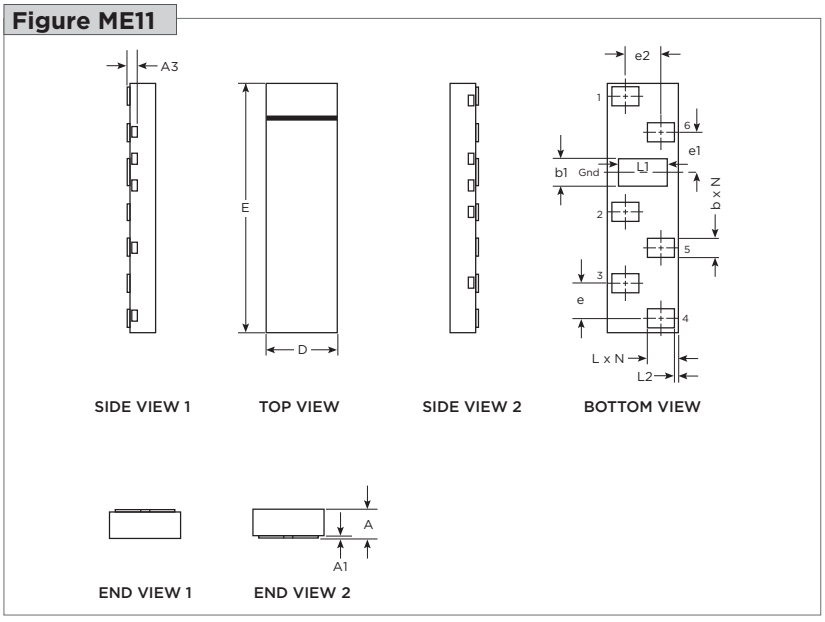


Table ME11 SESD Landing Pad Layout 5 Pin 4-ch Miniature FT Array

Symbol	Millimeters (mm)	Inches (in)
A	0.80	0.031
B	2.80	0.110
C	0.35	0.014
D	0.30	0.012
E	0.45	0.018
F	0.10	0.004
F_1	0.15	0.006
G	0.40 BSC*	0.016 BSC*
G_1	0.45 BSC*	0.018 BSC*

* BSC — Basic Spacing between Centers

Figure ME12

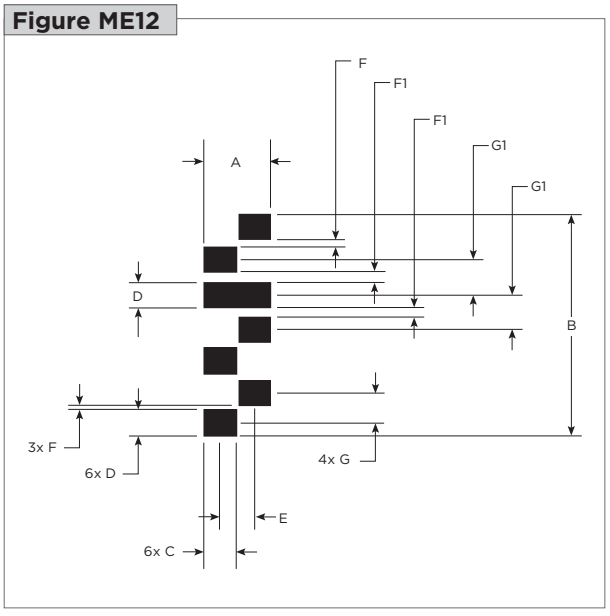
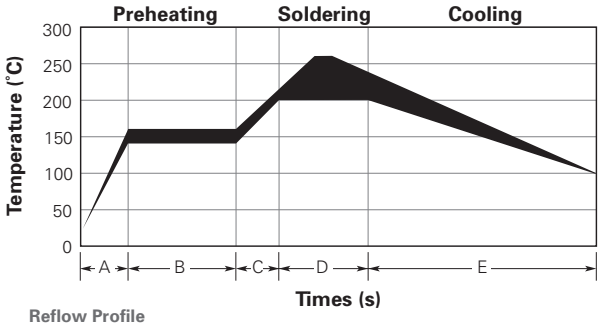


Table ME12 Solder Reflow Recommendations for ESD Devices

A	Temperature Ramp-up 1	From Ambient to Preheating Temperature	30s to 60s
B	Preheating	140°C - 160°C	60s to 120s
C	Temperature Ramp-up 2	From Preheating to Main Heating Temperature	20s to 40s
D	Main Heating	at 200°C at 220°C at 240°C at 260°C	60s to 70s 50s to 60s 30s to 40s 5s to 10s
E	Cooling	From Main Heating Temperature to 100°C	4°C/s max



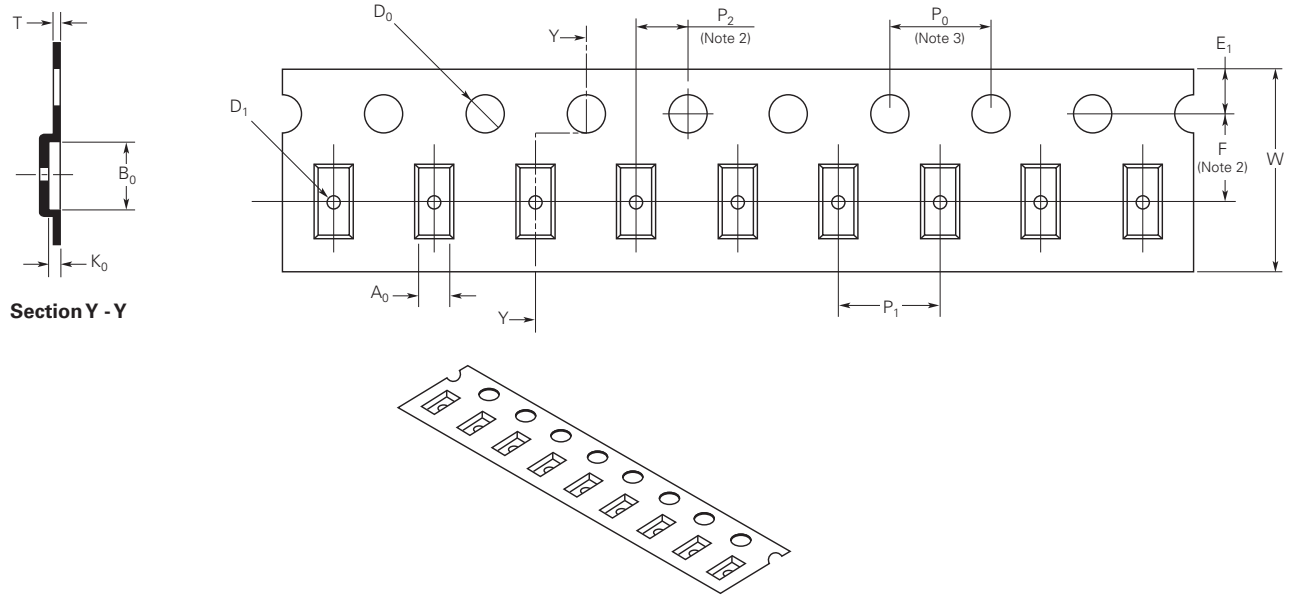
Reflow Profile

Table ME13 Carrier Tape Specifications

Tape Dimension	SESD00402Q		SESD0802Q		SESD1004Q		SESD1103Q	
EIA Mark	Dimension (mm)	Tolerance	Dimension (mm)	Tolerance	Dimension (mm)	Tolerance	Dimension (mm)	Tolerance
W	8.00	± 0.05	8.00	+0.30 / -0.10	8.00	+0.30 / -0.10	8.00	+0.30 / -0.10
zP_0	4.00	±0.10	4.00	±0.10	4.00	±0.10	4.00	±0.10
P_1	2.00	±0.05	2.00	±0.10	4.00	±0.10	4.00	±0.10
P_2	2.00	±0.05	2.00	±0.05	2.00	±0.05	2.00	±0.05
A_0	0.70	±0.05	0.81	±0.05	1.20	±0.05	1.00	±0.05
B_0	1.15	±0.05	2.21	±0.05	2.70	±0.05	3.00	±0.05
D_0	Ø1.55	±0.05	Ø1.50	+0.10 / -0.00	Ø1.50	+0.10 / -0.00	Ø1.50	+0.10 / -0.00
D_1	Ø0.40	±0.05	Ø0.40 (min)	–	Ø0.50 (min)	–	Ø0.50 (min)	–
E_1	1.75	±0.10	1.75	±0.10	1.75	±0.10	1.75	±0.10
F	3.50	±0.05	3.50	±0.05	3.50	±0.05	3.50	±0.05
K_0	0.47	±0.05	0.46	±0.05	0.51	±0.05	0.51	±0.05
T	0.20	±0.05	0.25	±0.20	0.25	±0.05	0.25	±0.05
Detail A	–	3° (max)	–	–	–	–	–	–

Note 1. All dimensions in mm
Note 2. Measured from centerline of pocket to centerline of sprocket hole
Note 3. Cumulative tolerance of 10 sprocket holes is ±0.20
Note 4. Tolerances unless noted ±0.20

Figure ME13

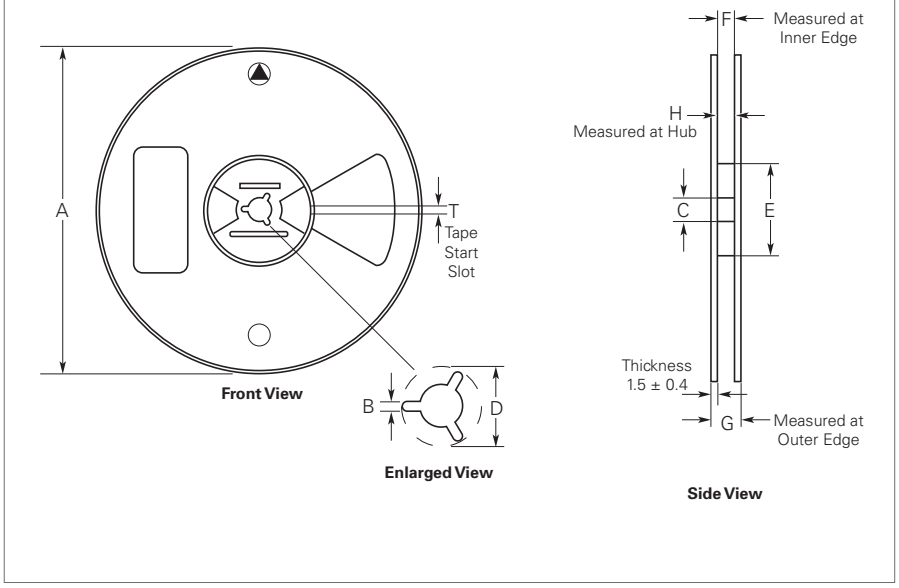


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Table ME14 Reel Specifications

Reel Dimension EIA Mark	Dimension (mm)
A	180 ± 2.00
B	1.50 (min)
C	13.10 ± 0.20
D	20.20 (min)
E	60 ± 1.00
F	8.75 ± 1.00
G	11.6 ± 1.00
H	9.4 (max)

Figure ME13



Part Numbering System for Multi-Channel Silicon ESD Devices

SESD 1004 Q4UG - 0020 - 090

Series
EIA Size

Package Type
Q - Array

Number of Channels
1 - One Channel
2 - Two Channels
4 - Four Channels
6 - Six Channels

Breakdown Voltage
9.0V (typ)
9.8V (typ)

Input Capacitance
0.10 pF (typ)
0.20 pF (typ)

N - No Common Pin
G - Common GND Pin

U - Uni-directional
B - Bi-directional

Part Marking

Part Number	Part Marking
SESD0402Q2UG-0020-090 (2-ch)	C
SESD0802Q4UG-0020-090 (4-ch)	MC
SESD1004Q4UG-0020-090 (4-ch)	4C
SESD1103Q6UG-0020-090 (6-ch)	6C

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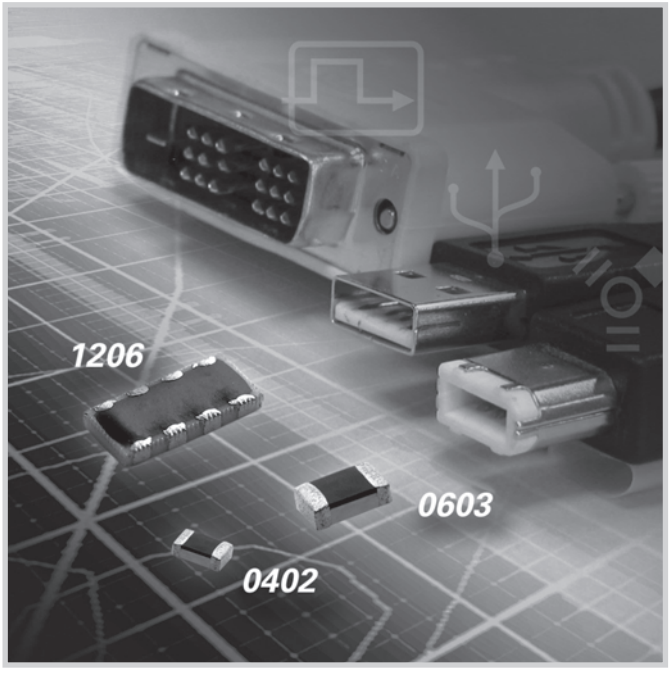


PESD Protection Devices

TE's Polymer ESD (PESD) line of devices helps protect I/O ports on HDMI 1.3, portable video players, LCD and plasma TVs, USB 2.0, digital visual interface (DVI) and antenna switches. PESD devices shunt electrostatic discharge away from sensitive circuitry in HDTV equipment, printers, laptops, cellular phones and other portable devices.

PESD devices offer many advantages over traditional protection devices, such as multi layer varistors (MLVs), which may degrade or distort the signal in high data rate circuits. Compared to transient voltage suppression (TVS) diodes and miniature gas discharge tubes (GDTs), PESD devices provide a more compact form factor and an economical solution for the shrinking profiles of today's compact information appliances.

Available in a range of form factors, our PESD protection devices provide low capacitance and meet transmission line pulse (TLP) testing, as well as IEC61000-4-2 testing.



Benefits

- ESD protection for high-frequency applications (HDMI 1.3)
- Smaller form factor for board space savings
- Helps protect sensitive electronic circuits against damage caused by electrostatic discharge (ESD) events
- Assists equipment to pass IEC 61000-4-2, level 4 testing

Features

- RoHS compliant
- Lead free
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- 0.25 pF (typ) capacitance
- Low-leakage current
- Low-clamping voltage
- Fast response time (< 1ns)
- Capable of withstanding numerous ESD strikes
- Compatible with standard reflow installation procedures
- Thick film technology
- Bi-directional protection

Applications

- HDMI 1.3 interfaces
- LCD and plasma TVs
- Cellular phones
- Antennas
- Portable video players
- Portable devices (PDA, DSC, BlueTooth)
- Printer ports
- Satellite radios
- USB 2.0 and IEEE 1394 interfaces
- DVI
- GPS systems

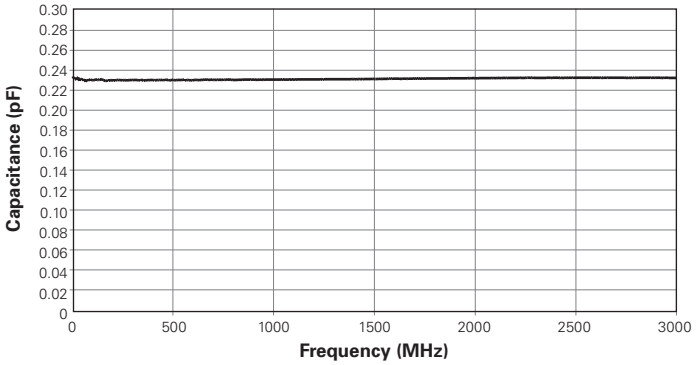
RoHS Compliant, ELV Compliant HF Halogen Free

Table E1 Electrical Characteristics for PESD Devices

	Continuous Max Operating Voltage	Typ Trigger Voltage*	Typ Clamping Voltage†	Typ Capacitance @1 MHz, $1V_{RMS}$	Typ Leakage Current	Max Leakage Current @ Max V_{DC}
Symbol	V_{DC}	$V_{T(TLP)}$	$V_{C(TLP)}$	C_P	$I_{L(TYP)}$	$I_{L(MAX)}$
Unit	V	V	V	pF	µA	µA
PESD0402-140	14	250	40	0.25	< 0.01	10.0
PESD0603-240	24	215	45	0.25	< 0.01	10.0
PESD1206Q-240	24	250	45	0.25	< 0.01	10.0

Notes : * TLP test method at 1kV.
† Measured 30ns after pulse initiation.
Typical capacitance value is at 0V and max operating voltage bias.

Figure E1 Capacitance vs. Frequency for PESD Devices



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Figure E2 Eye Diagram Performance at 3.4 GHz for PESD Devices

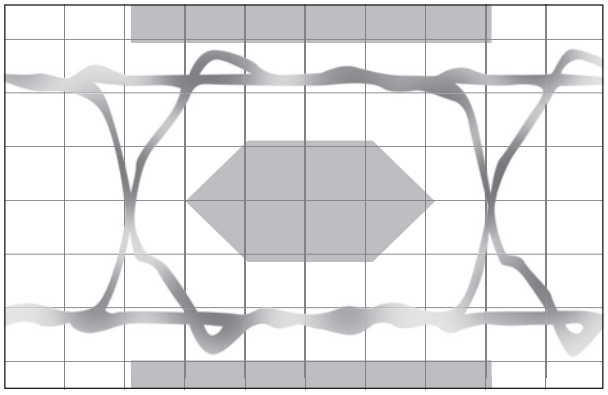
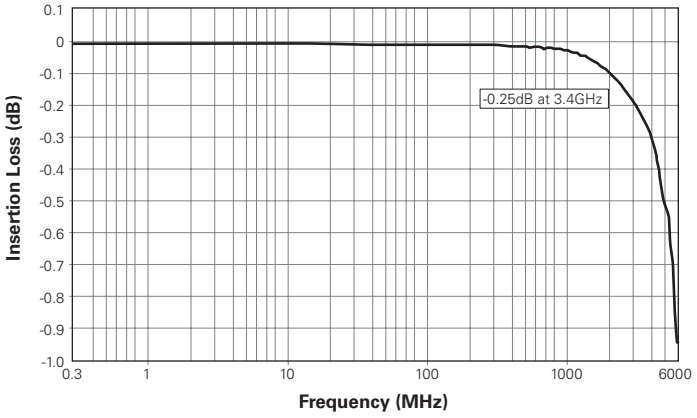


Figure E3 Insertion Loss Diagram for PESD Devices



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Figures E4-E5 PESD Device Protection for HDMI (PESD devices provide electrostatic discharge protection)

Figure E4

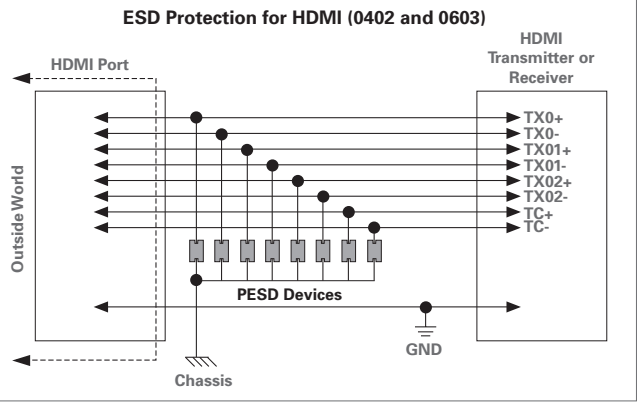


Figure E5

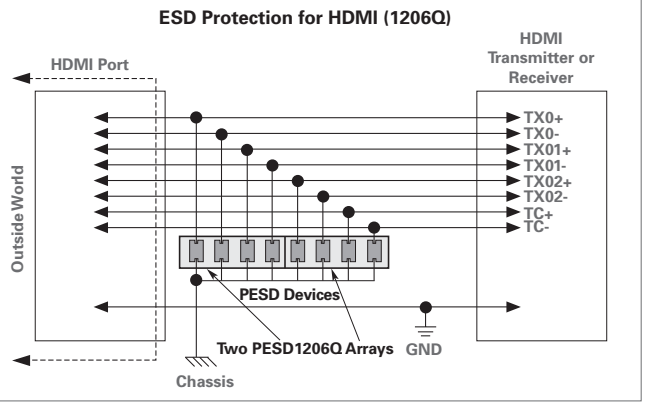


Table E2 Dimensions for PESD Devices in Millimeters and (Inches*)

	A		B		C		D		E		F		
Part Number	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Figure**
PESD0402-140	0.90	1.10	0.23	0.43	0.10	0.30	0.40	0.60	—	—	—	—	E6
	(0.035)	(0.043)	(0.009)	(0.017)	(0.004)	(0.012)	(0.016)	(0.024)					
PESD0603-240	1.50	1.70	0.45	0.55	0.10	0.50	0.70	0.95	—	—	—	—	E6
	(0.059)	(0.067)	(0.018)	(0.022)	(0.004)	(0.020)	(0.028)	(0.037)					
PESD1206Q-240	3.10	3.30	0.40	0.60	0.10	0.30	1.50	1.70	0.20	0.60	0.20	0.60	E7
	(0.122)	(0.130)	(0.016)	(0.024)	(0.004)	(0.012)	(0.059)	(0.067)	(0.008)	(0.024)	(0.008)	(0.024)	

*The dimensions in inches are rounded approximations.

Figure E6

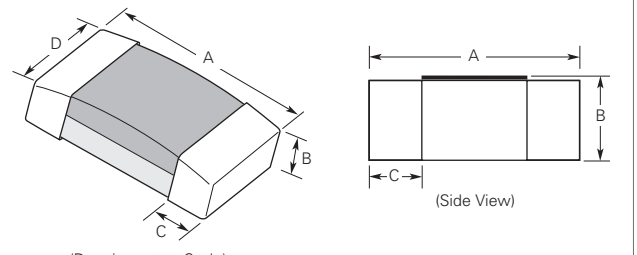


Figure E7

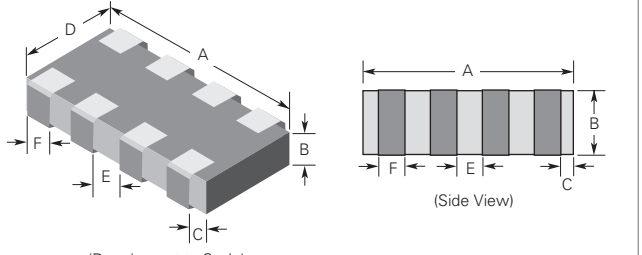


Table E3 Environmental Specifications for PESD Devices

	Test Conditions	**Pass / Fail Criteria**
Bias Humidity Test	85°C, 85% RH, $V_{DC\ (max)}$, 1000 hrs	$I_L \leqq 10$ µA
Thermal Shock	-55°C to 125°C, 30 min Dwell, 1000 Cycles	$I_L \leqq 10$ µA
Bias Heat Test	125°C, $V_{DC\ (max)}$, 1000 hrs	$I_L \leqq 10$ µA
Bias Low Temp Test	-55°C, $V_{DC\ (max)}$, 1000 hrs	$I_L \leqq 10$ µA
Solderability	250°C ± 5°C, 3 ±1s	95% Coverage
Solder Heat	260°C, 10s	90% Coverage
Vibration	10 to 50Hz, 60s Cycle, 2 hrs Each in X-Y-Z-Direction	No Physical Damage
Solvent Resistance	IPA Ultrasonic 300s	No Physical Damage
Shock	1500G, 0.5ms Each, X-Y-Z Axis 3 Times Each Axis	No Physical Damage

Table E4 General Characteristics for PESD Devices

Storage Temperature	-40°C to +85°C
Operating Temperature	-55°C to +125°C
ESD Voltage Capability (Tested per IEC 61000-4-2)	Contact Discharge Mode: 8kV (Typ), 15kV (max) Air Discharge Mode : 15kV (Typ), 25kV (max) [1 Pulse: per Customer Request]
ESD Pulse Withstand	100 Pulses (Tested per IEC 61000-4-2, Level 4, Contact Method)

Table E5 Materials Information for PESD Devices

RoHS Compliant	Directive 2002/95/EC Compliant
RoHS 2.0	Directive 2011/65/EU Compliant
ELV Compliant	Directive 2000/53/EC Compliant
Halogen Free	Halogen Free Refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm

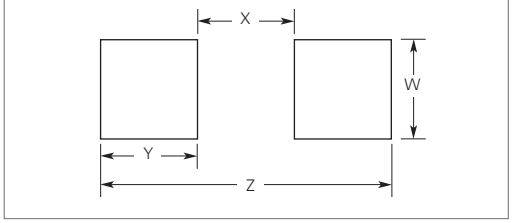
Table E6 Recommended Pad Layout for PESD Devices in Millimeters and (Inches*)

	V		W		X		Y		Z		
Part Number	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Figure**
PESD0402-140	—	—	0.60	0.70	0.30	0.40	0.80	0.90	2.10	2.20	E8
			(0.024)	(0.028)	(0.012)	(0.016)	(0.031)	(0.035)	(0.083)	(0.087)	
PESD0603-240	—	—	0.90	1.00	0.50	0.60	1.00	1.10	2.70	2.80	E8
			(0.035)	(0.039)	(0.020)	(0.024)	(0.039)	(0.043)	(0.106)	(0.110)	

	V	W	X	Y	Z	
Part Number	**Typ**	**Typ**	**Typ**	**Typ**	**Typ**	**Figure**
PESD1206Q-240	3.20	2.20	0.50	0.80	1.00	E9
	(0.126)	(0.087)	(0.020)	(0.031)	(0.039)	

*The dimensions in inches are rounded approximations.

Figure E8



Note: Solder thickness 0.15 to 0.2mm.

Figure E9

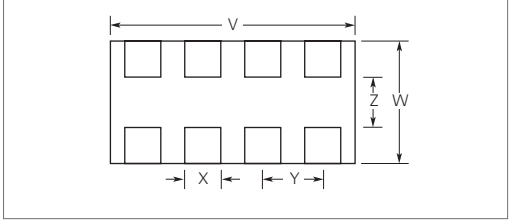
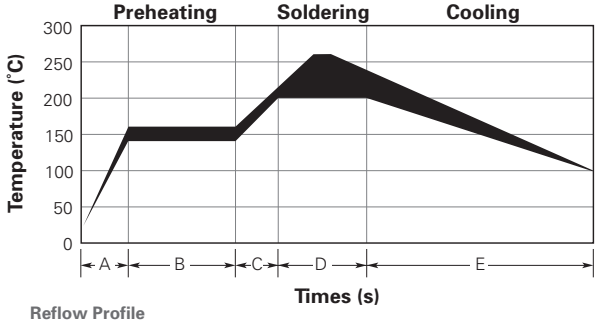


Table E7 Solder Reflow Recommendations for PESD Devices

A	Temperature Ramp-up 1	From Ambient to Preheating Temperature	30s to 60s
B	Preheating	140°C - 160°C	60s to 120s
C	Temperature Ramp-up 2	From Preheating to Main Heating Temperature	20s to 40s
D	Main Heating	at 200°C at 220°C at 240°C at 260°C	60s to 70s 50s to 60s 30s to 40s 5s to 10s
E	Cooling	From Main Heating Temperature to 100°C	4°C/s max



Reflow Profile

RoHS Compliant, ELV Compliant HF Halogen Free

Table E8 Tape Specifications for PESD Devices

Tape Dimension EIA Mark	0402		0603		1206Q	
	Dimension (mm)	Tolerance	Dimension (mm)	Tolerance	Dimension (mm)	Tolerance
W	8.00	±0.30	8.00	±0.30	8.00	±0.30
P_0	4.00	±0.10	4.00	±0.10	4.00	±0.10
P_1	2.00	±0.05	4.00	±0.05	4.00	±0.05
P_2	2.00	±0.05	2.00	±0.05	2.00	±0.05
A_0	0.69	±0.05	1.27	±0.15	2.02	±0.20
B_0	1.19	±0.05	2.02	±0.20	3.62	±0.20
D_0	1.50	±0.10	1.50	±0.10	1.50	±0.10
F	3.50	±0.05	3.50	±0.05	3.50	±0.05
E_1	1.75	±0.10	1.75	±0.10	1.75	±0.10
T	0.48	±0.03	0.60	±0.03	0.75	±0.03

Figure E10

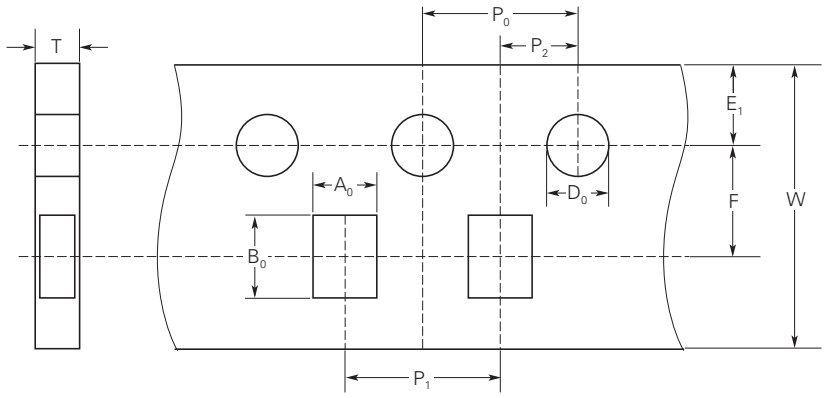
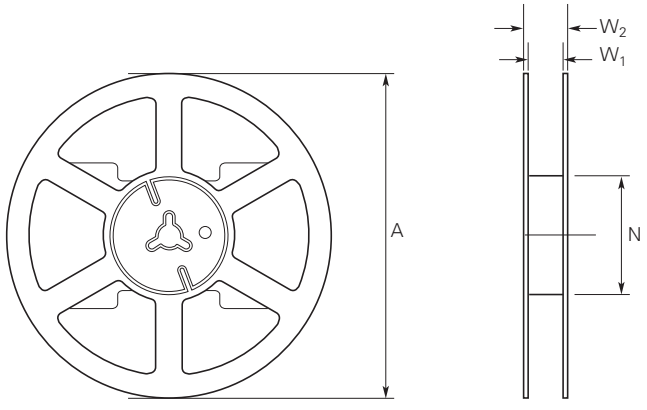


Table E9 Reel Specifications for PESD Devices

Reel Dimensions (0402, 0603 & 1206Q) EIA Mark	Dimension (mm)
A max	180.0
N min	60.5
W_1 max	9.5
W_2 max	14.0

Figure E11



Parameter Definitions for PESD Devices

Operation Voltage (V_{DC})

Defined as DC voltage, under which device is in OFF state and leakage current below certain threshold.

Leakage Current (I_L)

Current through device under Operation Voltage V_{DC}.

Trigger Voltage (V_T)

Voltage at which the device switches from the OFF to the ON state, during the IEC waveform or the TLP system.

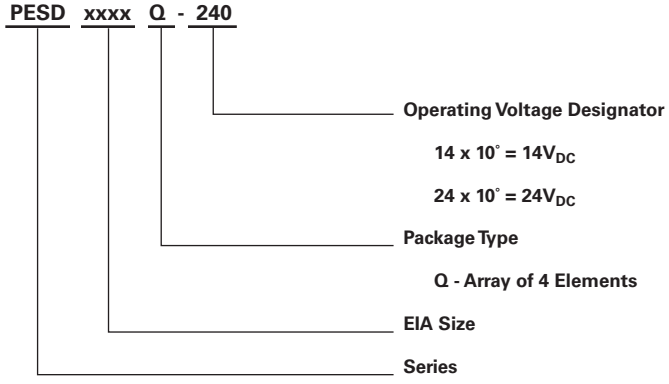
Clamping Voltage (V_C)

Voltage cross device under 8kV per IEC or measured by TLP system. Typically measured 30ns after initiation of the ESD pulse (for TLP, both 30ns and 60ns are sometimes used).

Capacitance (C_P)

Capacitance of the device measured at 1MHz with 0V and max operating voltage bias.

Part Numbering System for Polymer ESD (PESD) Devices



8

⚠ Warning :

Application Limitations for PESD0402-140, PESD0603-240 and PESD1206Q-240: These parts are not intended to be used on power lines or for power bus applications. Users should independently evaluate the suitability of and test each product selected for their own application.

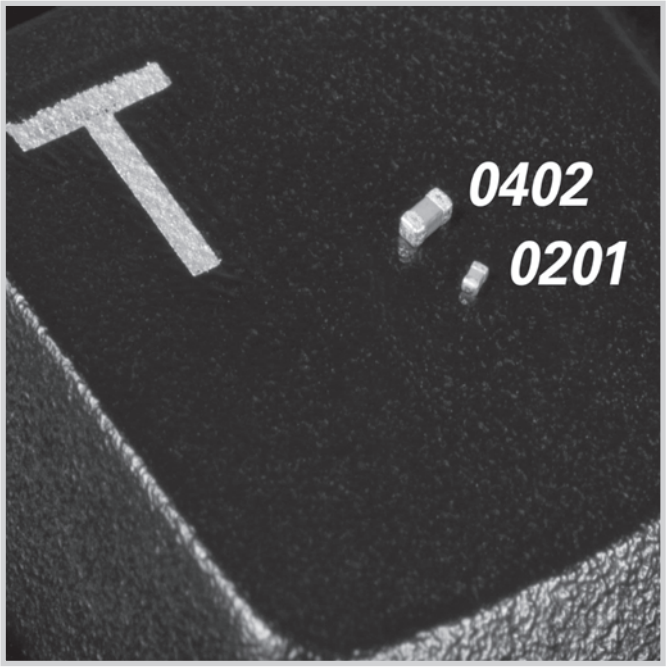
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RoHS Compliant, ELV Compliant HF Halogen Free



ChipSESD Devices



TE Circuit Protection's ChipSESD family of Silicon ESD devices, available in EIA-0201 and EIA-0602 sized rectangular SMT passive component packages, can help protect electronic circuits against damage from electrostatic discharge (ESD) events.

The SESD0201P1BN-0400-090, 0201-sized ChipSESD device's miniature footprint (0.6mm x 0.3mm x 0.3mm) is approximately 70% smaller than prior-generation devices. This offers designers flexibility in space-constrained applications.

The ChipSESD devices are high-capacitance, bi-directional devices that can be used for low-speed generic interfaces such as keypads, power buttons, speakers and microphone ports in a portable electronics. The bi-directional operation eliminates orientation constraints and the need for polarity inspections. The surface mount technology (SMT) passive component package allows the devices to be easily installed onto the printed circuit board using the standard PCB assembly process. Once soldered onto the boards, the ChipSESD's solder fillets at the end terminals can easily be visually inspected.

The ChipSESD devices offer 10kV contact and 16kV air discharge protection per the IEC61000-4-2, level 4 standard with a surge rating of 2A under 8x20μs pulse.

Benefits

- Silicon ESD devices in an EIA-0201 and EIA-0402 sized rectangular SMT passive component package
- Bi-directional operation eliminates orientation constraints
- Standard PCB assembly and rework process
- ESD protection in space-constrained portable electronics and mobile handsets
- Helps protect electronic circuits against damage from ESD
- Assists equipment to pass IEC61000-4-2, level 4 testing

Features

- Input capacitance - 4.5pF (typ)
- Low leakage current – 1.0μA (max)
- Low working reverse voltage - 6.0V (max)
- Capable of withstanding numerous ESD strikes
- RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)

Applications

- Mobile phones and portable electronics
- Digital cameras and camcorders
- Notebooks, set top boxes, motherboards
- USB 2.0 and computer I/O ports
- Applications requiring high ESD performance in a small package

RoHS Compliant, ELV Compliant HF Halogen Free

Table CE1 Maximum Ratings for ChipSESD Devices

Part Number	IEC61000-4-2, level 4 (ESD Withstand) Contact (kV)	Air (kV)	Temperature Operating (°C)	Storage (°C)
SESD0201P1BN-0400-090	±10*	±16	-40 to +125	-40 to +125
SESD0402P1BN-0450-090	±10*	±16	-40 to +125	-40 to +125

*10kV @ 50 ± pulses under IEC61000-4-2; 8kV @ 1,000 pulses under IEC61000-4-2

Table CE2 Electrical Characteristics @T=25°C for ChipSESD Devices

Part Number	Input Capacitance* Typ (pF)	Max (pF)	Leakage Current (max) I_L @ V_{RWM} = 6.0V (µA)	Breakdown Voltage (min) V_{br} @ I_T† = 1mA (V)	Working Reverse Voltage V_{RWM} @ peak (V)	Clamping Voltage (typ) V_{CL} @ Ipp=2A, tp=(8/20µs) (V)*
SESD0201P1BN-0400-090	4.0	5.0	1.0	9.0	6.0	+10.0
SESD0402P1BN-0450-090	4.5	5.5	1.0	9.0	6.0	+10.0

* @ Vr=0V, f=1MHz
† V_{br} is measured at test current I_T

Figure CE1 ESD Clamping Voltage — 8kV Contact for ChipSESD Devices

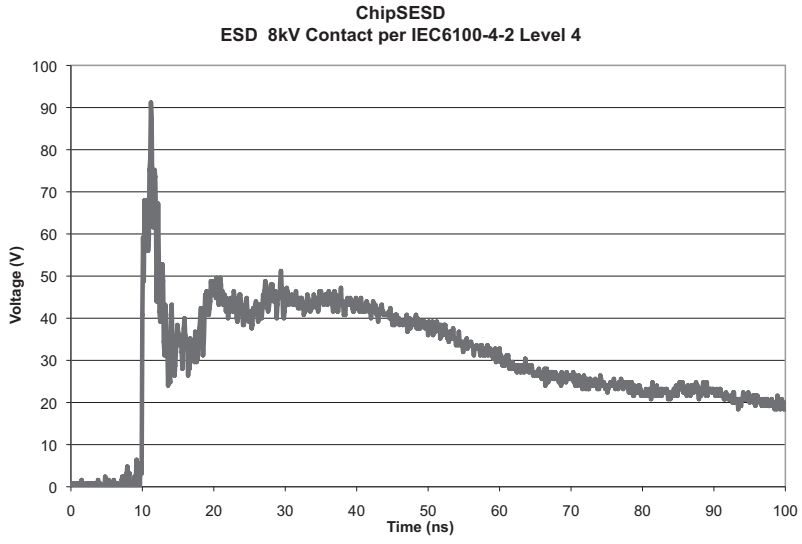
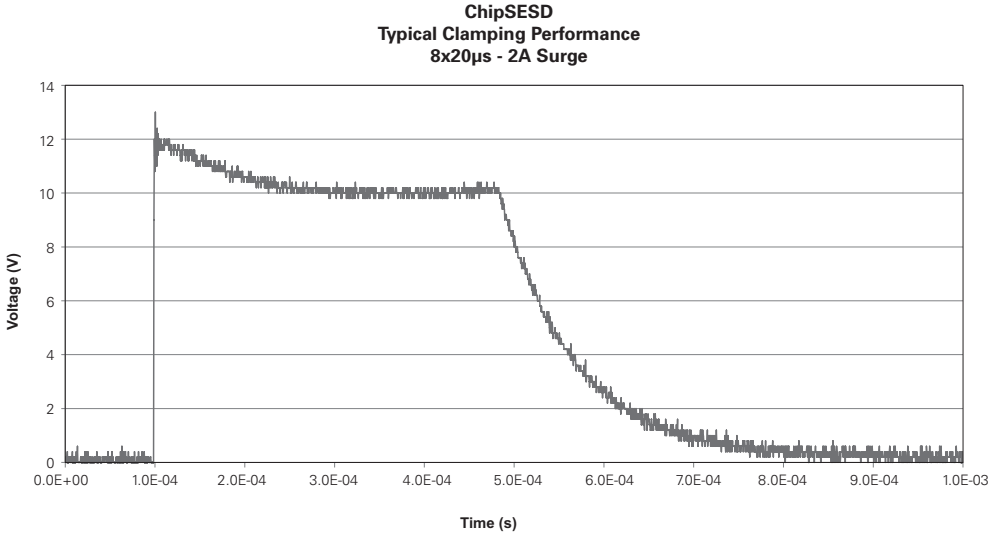


Figure CE2 ESD Clamping Voltage — 8x20µs, 2A Surge for ChipSESD Devices



RoHS Compliant, ELV Compliant HF Halogen Free

Table CE3 Dimensions for ChipSESD Devices in Millimeters and (Mils)*

Part Number	A	B	C	D	Figure
SESD0201P	0.60 ± 0.05	0.30 ± 0.05	0.30 ± 0.05	0.21 ± 0.07	CE3
	(23.62 ± 2.00)	(11.81 ± 2.00)	(11.81 ± 2.00)	(8.27 ± 2.80)	
SESD0402P	1.10 ± 0.10	0.50 ± 0.10	0.50 ± 0.10	0.25 ± 0.15	CE3
	(43.31 ± 0.40)	(19.69 ± 4.00)	(19.69 ± 4.00)	(9.84 ± 6.00)	

* Round off approximation

Figure CE3

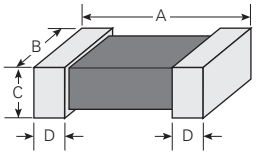


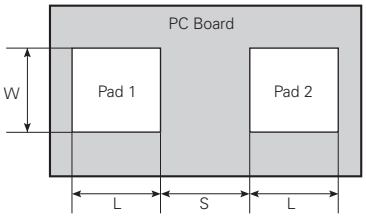
Table CE4 PCB Pad Layout for ChipSESD Devices in Millimeters and (Mils)*

Part Number	L	S	W	Figure
SESD0201P	0.28 ± 0.01	0.19 ± 0.01	0.30 ± 0.01	CE4
	(11.00 ± 0.40)	(7.50 ± 0.40)	(11.80 ± 0.40)	
SESD0402P	0.61 ± 0.05	0.52 ± 0.05	0.50 ± 0.05	CE4
	(24.00 ± 2.00)	(21.00 ± 2.00)	(20.00 ± 2.00)	

* Round off approximation

Figure CE4

Recommended Landing Pattern



ChipSESD Devices Can be Oriented Either Direction

Table CE5 Tape Specifications for ChipSESD Devices

Tape Dimension	SESD0201P1BN-0400-090	SESD0402P1BN-0450-090
EIA Mark	Dimension (mm)	Dimension (mm)
A	0.35 ± 0.02	0.58 ± 0.03
B	0.67 ± 0.02	1.20 ± 0.03
D	1.55 ± 0.05	1.55 ± 0.05
E	1.75 ± 0.05	1.75 ± 0.05
F	3.50 ± 0.05	3.50 ± 0.05
W	8.00 ± 0.10	8.00 ± 0.10
P_0	4.00 ± 0.10	4.00 ± 0.10
P_1	2.00 ± 0.05	2.00 ± 0.05
P_2	2.00 ± 0.05	2.00 ± 0.05
T	0.42 ± 0.03	0.60 ± 0.03

Figure CE5

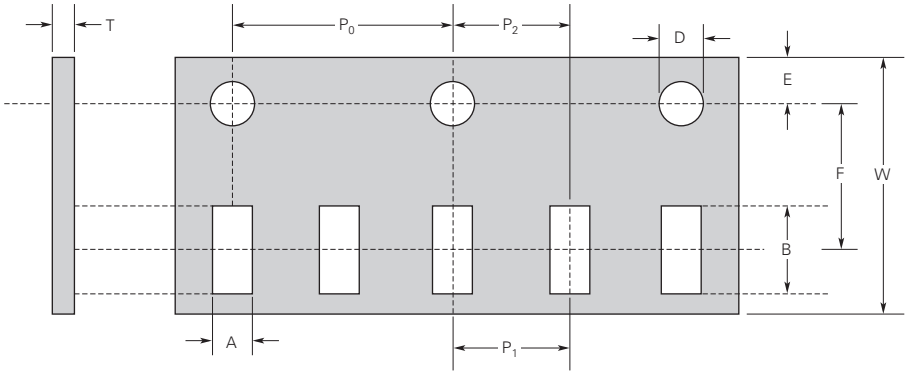
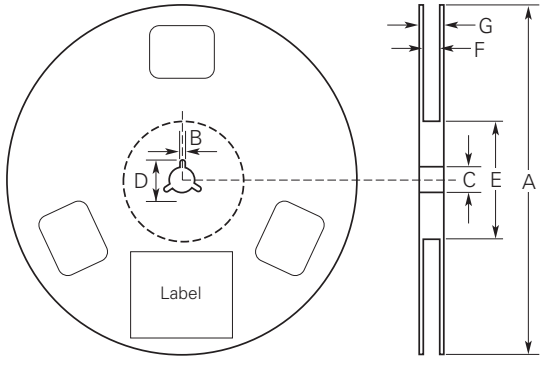


Table CE6 Reel Specifications for ChipSESD Devices

Reel Dimension	
EIA Mark	Dimension (mm)
A	178.0 ± 2.0
B	2.0 ± 0.5
C	13.0 ± 0.5
D	21.0 ± 0.8
E	62.0 ± 1.5
F	9.0 ± 0.5
G	13.0 ± 1.0

Figure CE6

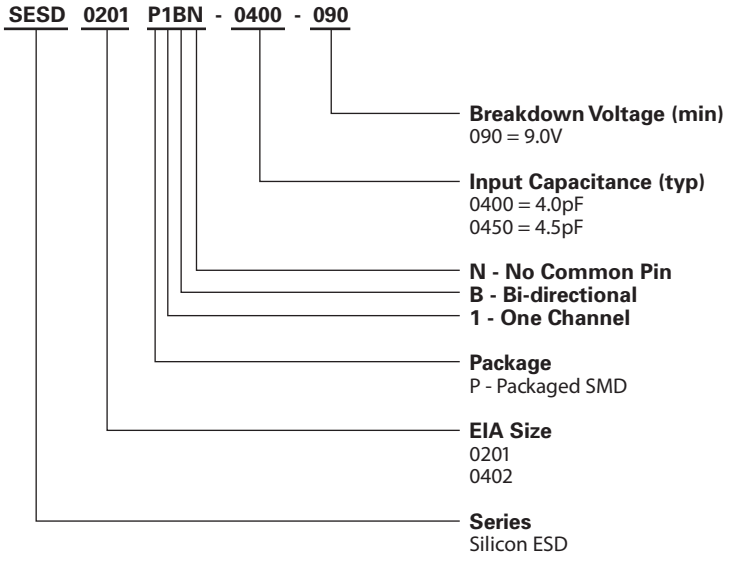


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Definition of Terms for ChipSESD Devices

I_L	Reverse Leakage Current @ V_{RWM}
V_{RWM}	Working Peak Reverse Voltage
V_{br}	Breakdown Voltage @ I_T
I_T	Test Current
V_{CL}	Clamping Voltage

Part Numbering System for ChipSESD Devices



Notice :

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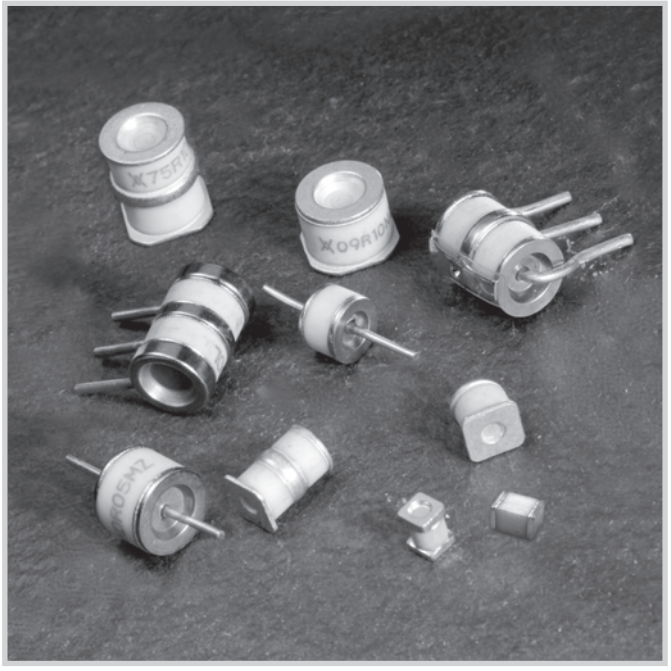
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Gas Discharge Tubes (GDTs)

TE Circuit Protection's GDTs (Gas Discharge Tubes) are placed in front of, and in parallel with, sensitive telecom equipment such as power lines, communication lines, signal lines and data transmission lines to help protect them from damage caused by transient surge voltages that may result from lightning strikes and equipment switching operations. These devices do not influence the signal in normal operation. However, in the event of an overvoltage surge, such as a lightning strike, the GDT switches to a low impedance state and diverts the energy away from the sensitive equipment.

Our GDTs offer a high level of surge protection, a broad voltage range, low capacitance and many form factors including new surface mount devices, which make them suitable for applications such as Main Distribution Frame (MDF) modules, high data-rate telecom applications (e.g., ADSL, VDSL) and surge protection on power lines. Their low capacitance also results in less signal distortion. When used in a coordinated circuit protection solution with PolySwitch devices, they can help equipment manufacturers meet stringent safety regulatory standards.



Benefits

- Helps provide overvoltage fault protection against damage caused by high energy surges
- Suitable for use in sensitive equipment due to impulse sparkover response
- Suitable for high-frequency applications
- Highly reliable performance
- New surface-mount devices for automated manufacturing

Features

- RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Wide range of voltages (75V-4000V)
- Wide range of form factors
  (3mm, 5mm, 6mm, 7mm, 8mm diameter devices)
- Low capacitance and insertion loss
- Crowbar device with low arc voltage
- High accuracy spark-over voltages for high precision designs
- Devices tested per ITU K.12 recommendations
- Various lead configurations and surface-mount options
- Optional fail-short mechanism
- Non radioactive materials
- Devices certified to UL497B and UL1449

Applications

- Telecommunications
  - MDF modules, xDSL equipment, RF systems, antenna, base stations
- Industrial and Consumer Electronics
  - Power supplies, surge protectors, alarm systems, irrigation systems

RoHS Compliant, ELV Compliant HF Halogen Free

Figures G1-G2 Typical Circuits for Gas Discharge Tubes (GDTs)

Figure G1

Two Electrode Devices for Ungrounded Circuits

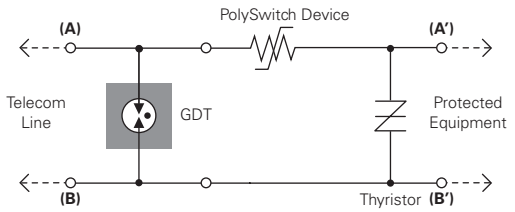


Figure G2

Three Electrode Devices for Grounded Circuits

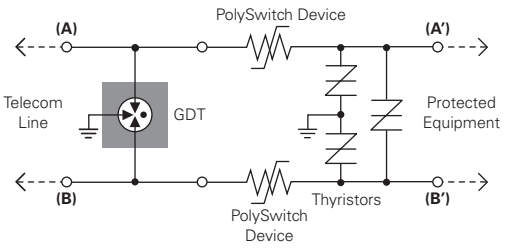


Table G1 Device Voltage Ratings, Surge Rating, Capacitance, Insulation Resistance and Agency Approval for Two-Electrode Gas Discharge Tubes (GDTs)

	DC Sparkover Voltage	Impulse Sparkover Voltage	Impulse Discharge Current		Impulse Withstanding Voltage	Capacitance	Insulation Resistance	UL Rating	
Part Number	@ 100V/s ± 20% Tolerance	@ 1kV/µs	8x20µs 10 Hits (5 Hits Each Polarity)	8x20µs 300 Hits (150 Hits Each Polarity)	10/700µs 10 Hits (5 Times Each Polarity)	@1MHz	@100V_{DC}†	UL497B	#E179610
GTCS23-XXXM-R01-2	75*	600	1kA	100A	4kV	<0.5pF	1,000 (MΩ)	All Devices	
	90	600							
	140	600							
	150	600							
GTCC23-XXXM-R01-2	200	700	1kA	100A	6kV‡	<0.5pF	1,000 (MΩ)	All Devices	
	230	700							
	300	900							
	350	1000							
	400	1000							

* DCSO 60~105
† Devices <=150V measured @ 50V_{DC}
‡ Effective output impedance: 40ohms

	DC Sparkover Voltage	Impulse Sparkover Voltage		DC Holdover Voltage	On-State Voltage	Impulse Discharge Current	Impulse Life	AC Discharge Current (1s duration; 10 hits)	Capacitance	Insulation Resistance	UL Rating	
Part Number	@ 100V/s ± 20% Tolerance	@ 100V/µs	@ 1kV/µs	Per ITU K.12	Nominal (@1A) (V)	8x20µs 10 Hits	10x1000µs 300 Hits	@ 50 Hz	@ 1MHz	@ 100V_{DC}	UL497B #E179610	
GTCX25-XXXM-R02	75	450	550	<52	20	2.5kA	100A	2.5Arms	<1pF	10,000 (MΩ)	All Devices	
	90	450	550	<52	20							
GTCX26-XXXM-R05	140	500	600	<80	20	5kA	100A	5Arms	<1pF	10,000 (MΩ)	All Devices	
	150	500	600	<80	20							
	200	600	700	<135	20							
GTCX28-XXXM-R05	230	600	700	<135	20	5kA	100A	5Arms	<1pF	10,000 (MΩ)	All Devices	
	250	600	700	<135	20							
	260	700	800	<135	20							
	300	800	900	<150	20							
GTCX28-XXXM-R10	350	900	1000	<150	20	10kA	100A	10Arms	<1pF††	10,000 (MΩ)	All Devices	
	400	900	1000	<150	20							
	420	900	1000	<150	20							
	470	1050	1150	<150	20							
	500	1100	1200	<150	20							
GTCX28-XXXM-R20**	550	1300	1400	<150	20	20kA	100A	20Arms	<1.5pF	10,000 (MΩ)	All Devices	
	600	1300	1400	<150	20							

** GTCX28-XXXM-R20 parts only up to 350V
†† <1.2pF for 75V and 90V devices.

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Table G2 Device Voltage Ratings, Surge Rating, Capacitance, Insulation Resistance and Agency Approval for Two Electrode High-Voltage Gas Discharge Tubes (GDTs)

Part Number	DC Sparkover Voltage @100V/s ± 20% Tolerance	Impulse Sparkover Voltage @ 100V/µs	Impulse Life 10/1000µs 100A	AC Discharge Current, 50Hz: Multiple Hits (1s Duration: 10 Hits)	AC Discharge Current, 50Hz: Single Hit, 9 Cycles	Impulse Discharge Current 8/20µs: 10 Hits (5 Hits Each Polarity)	Impulse Discharge Current 8/20µs: 1 Hit	Capacitance @ 1MHz	UL Rating UL1449 #E332226
GTCA28-801M-R05	800	1400	300 times	5A	N/A	5kA	N/A	<1pF	✓
GTCA28-102M-R03	1000	1700	N/A	1A	5A	3kA	10kA	<1pF	✓
GTCA28-122M-R03	1200	1900	N/A	1A	5A	3kA	10kA	<1pF	✓
GTCA28-152L-R03	1500 (± 15%)	2200	N/A	1A	5A	3kA	10kA	<1pF	✓
GTCA28-212M-R03	2100	2700	N/A	1A	5A	3kA	10kA	<1pF	✓
GTCA28-242M-R03	2400	3300	N/A	1A	5A	3kA	10kA	<1pF	✓
GTCA28-252M-R03	2500	3500	N/A	1A	5A	3kA	10kA	<1pF	✓
GTCA28-272L-R03	2700 (± 15%)*	3700	300 Times†	N/A	N/A	3kA	10kA	<1pF	✓
GTCA28-302M-R03	3000	4000	N/A	1A	5A	3kA	10kA	<1pF	✓
GTCA28-312L-R03	3100 (± 15%)*	3700‡	300 Times†	N/A	N/A	3kA	10kA	<1pF	✓
GTCA28-362M-R03	3600	4600	N/A	1A	5A	3kA	10kA	<1pF	✓
GTCA28-402M-R03	4000	5000	N/A	1A	5A	3kA	10kA	<1pF	✓

Note: Insulation resistance: ≥10,000MΩ (all parts measured @ 1000V_{DC}, except 800V/1000V/1200V @250V_{DC}; 1500V/2100V @ 500V_{DC})

* DC Sparkover Voltage measured at 5kV/s
† Measured with 8/20µs,100A impulse
‡ Measured at 1000V/µs

Table G3 Device Voltage Ratings, Surge Rating, Capacitance, Insulation Resistance and Agency Approval for Three-Electrode Gas Discharge Tubes (GDTs)

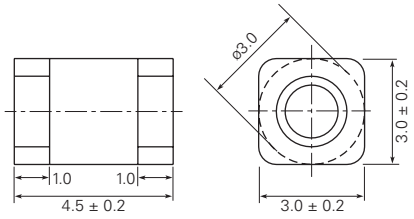
Part Number	DC Sparkover Voltage (A-E) (B-E) @ 100V/s ± 20% Tolerance	Impulse Sparkover Voltage (A-E) (B-E) @ 100V/µs	Impulse Sparkover Voltage (A-E) (B-E) @ 1kV/µs	DC Holdover Voltage Per ITU K.12	On-State Voltage Nominal (@1A) (V)	Impulse Discharge Current (A+B-E) 8x20µs 10 Hits	Impulse Life (A+B-E) 10x1000µs 300 Hits	AC Discharge Current (1s duration; 10 hits) (A+B-E) @ 50 Hz	Capacitance @ 1MHz	Insulation Resistance @ 100V_{DC}*	UL Rating UL497B #E179610
GTCX35-XXXM-R05	75	450	550	<52	20	5kA	100A	5Arms	<1pF	10,000 (MΩ)	All Devices
	90	450	550	<52	20						
GTCX36-XXXM-R05	140	500	600	<80	20	5kA	200A	5Arms	<1pF	10,000 (MΩ)	All Devices
	150	500	600	<80	20						
	200	600	700	<135	20						
GTCX36-XXXM-R10	230	600	700	<135	20	10kA	200A	10Arms	<1pF	10,000 (MΩ)	All Devices
	250	600	700	<135	20						
	260	700	800	<135	20						
	300	800	900	<150	20						
GTCX37-XXXM-R10	350	900	1000	<150	20	10kA	200A	10Arms	<1pF	10,000 (MΩ)	All Devices
	400	900	1000	<150	20						
	420	900	1000	<150	20						
	470	1050	1150	<150	20						
	500	1100	1200	<150	20						
GTCX38-XXXM-R10	550	1300	1400	<150	20	10kA	200A	10Arms	<1pF	10,000 (MΩ)	All Devices
	600	1300	1400	<150	20						

* Insulation resistance measured at 50V for devices less than 150V.
Insulation resistance measured at 250V for devices more than 500V.

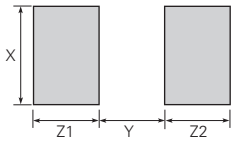
Figures G3-G11 Dimensions for Gas Discharge Tubes (GDTs)

Figure G3 Two Electrode 3mm Product Dimensions

Surface-mount (GTCS23-XXXM-R01)



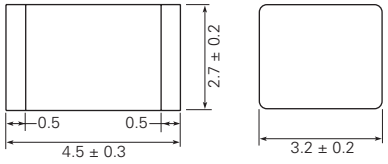
Pad Layout - Surface-mount Devices (GTCS23-XXXM-R01)



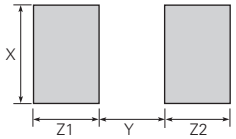
	X	Y	Z1	Z2
	Nom	Nom	Nom	Nom
mm	3.0	2.0	2.0	2.0
in*	0.118	0.079	0.079	0.079

* The dimensions in inches are rounded approximations.

Chip GDT (GTCC23-XXXM-R01)



Pad Layout - Chip GDT Devices (GTCC23-XXXM-R01)

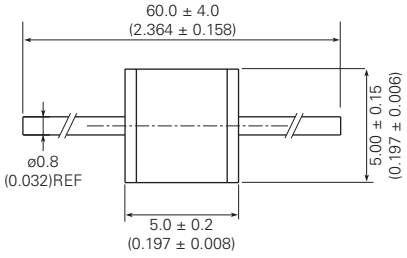


	X	Y	Z1	Z2
	Nom	Nom	Nom	Nom
mm	3.5	2.7	2.0	2.0
in*	0.138	0.106	0.079	0.079

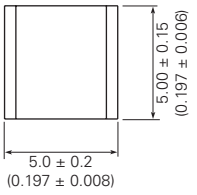
* The dimensions in inches are rounded approximations.

Figure G4 Two Electrode 5mm Product Dimensions

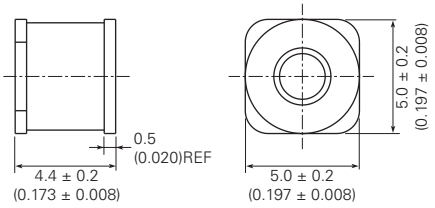
Axial Leads (GTCA25-XXXM-R02)



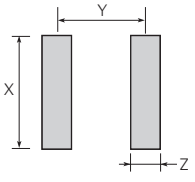
No Leads (GTCN25-XXXM-R02)†



Surface-mount (GTCS25-XXXM-R02)



Pad Layout - Surface-mount Devices (GTCS25-XXXM-R02)



	X	Y	Z
	Nom	Nom	Nom
mm	6.0	3.9	1.3
in*	0.197	0.154	0.051

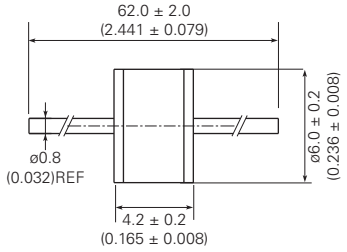
* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

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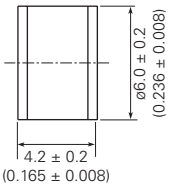
Figures G3-G11 Dimensions for Gas Discharge Tubes (GDTs) Cont'd

Figure G5 Two Electrode 6mm Product Dimensions

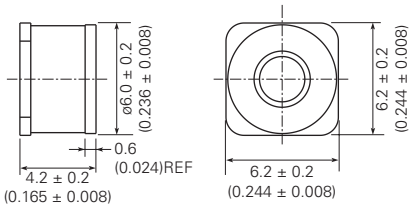
Axial Leads (GTCA26-XXXM-R05)



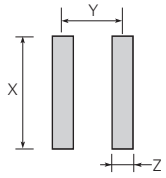
No Leads (GTCN26-XXXM-R05)†



Surface-mount (GTCS26-XXXM-R05)



Pad Layout - Surface-mount Devices (GTCS26-XXXM-R05)

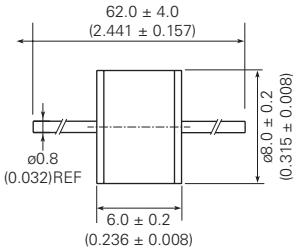


	X Nom	Y Nom	Z Nom
mm	7.0	3.7	1.3
in*	0.276	0.146	0.051

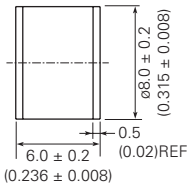
* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G6 Two Electrode 8mm Product Dimensions

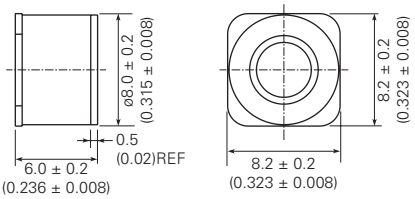
Axial Leads (GTCA28-XXXM-R05, R10 & R20)



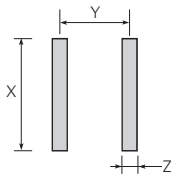
No Leads (GTCN28-XXXM-R05, R10 & R20)†



Surface-mount (GTCS28-XXXM-R05, R10 & R20)



Pad Layout - Surface-mount Devices (GTCS28-XXXM-R05, R10 & R20)



	X Nom	Y Nom	Z Nom
mm	9.0	5.6	1.2
in*	0.354	0.22	0.047

* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G7 Two Electrode 8mm High Voltage Product Dimensions

Axial Leads (GTCA28-XXXM-R0X)

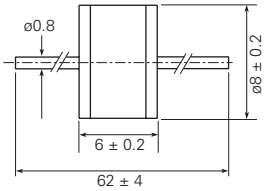
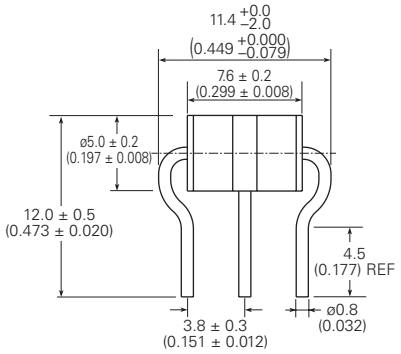
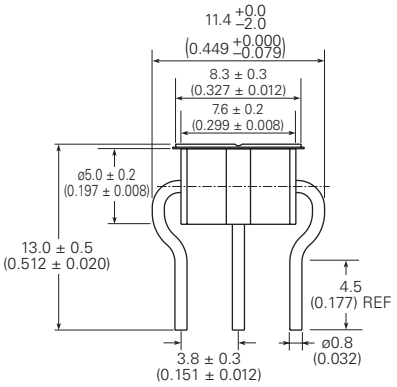


Figure G8 Three Electrode 5mm Product Dimensions

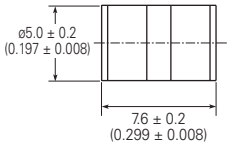
Axial Leaded (GTCA35-XXXM-R05)



Axial Leaded with-FT (GTCA35-XXXM-R05-FT)

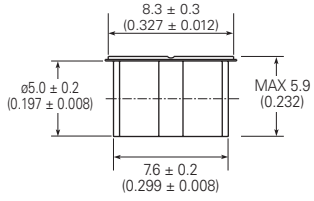


No Leads (GTCN35-XXXM-R05)†

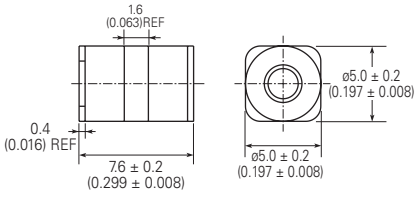


Dimensions in these drawings are in millimeters (inches)

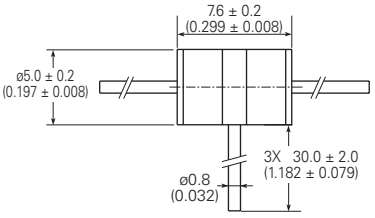
No Leads with-FT (GTCN35-XXXM-R05-FT)†



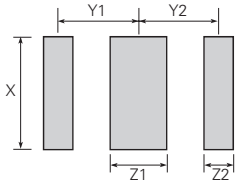
Surface-mount (GTCS35-XXXM-R05)



T Leaded (GTCT35-XXXM-R05)



Pad Layout - Surface-mount Devices (GTCS35-XXXM-R05)



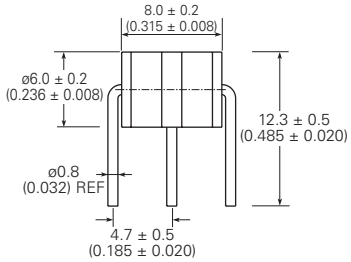
	X	Y1	Y2	Z1	Z2
	Nom	Nom	Nom	Nom	Nom
mm	6.0	3.6	3.6	2.5	1.3
in*	0.236	0.142	0.142	0.098	0.051

* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

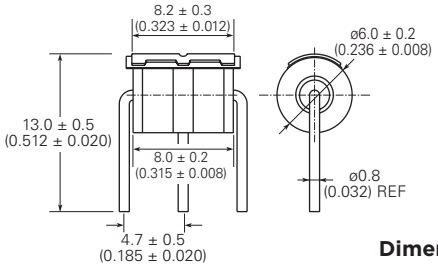
Figures G3-G11 Dimensions for Gas Discharge Tubes (GDTs) Cont'd

Figure G9 Three Electrode 6mm Product Dimensions

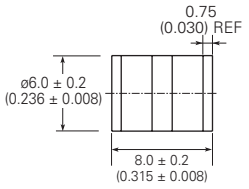
Axial Leaded (GTCA36-XXXM-R05 and R10)



Axial Leaded with-FT (GTCA36-XXXM-R05 and R10-FT)

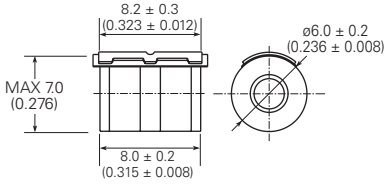


No Leads (GTCN36-XXXM-R05 and R10)†

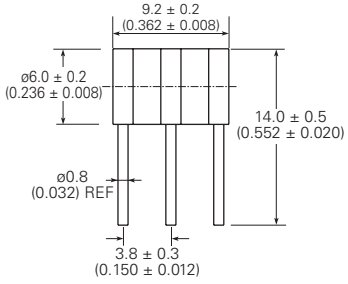


Dimensions in these drawings are in millimeters (inches)

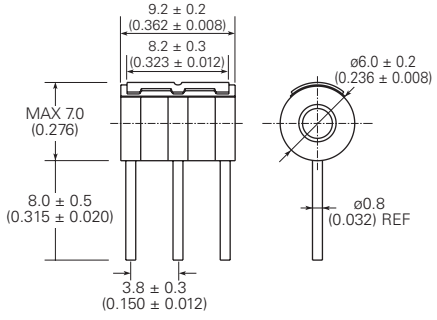
No Leads with-FT (GTCN36-XXXM-R05 and R10-FT)†



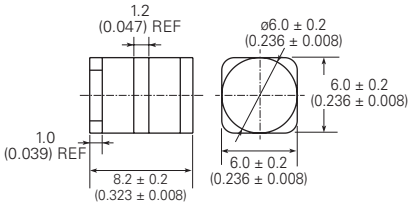
Radial Leaded (GTCR36-XXXM-R05 and R10)



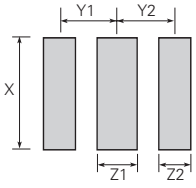
Radial Leaded with-FT (GTCR36-XXXM-R05 and R10-FT)



Surface-mount (GTCS36-XXXM-R05 and R10)



Pad Layout - Surface-mount Devices (GTCS36-XXXM-R05 and R10)

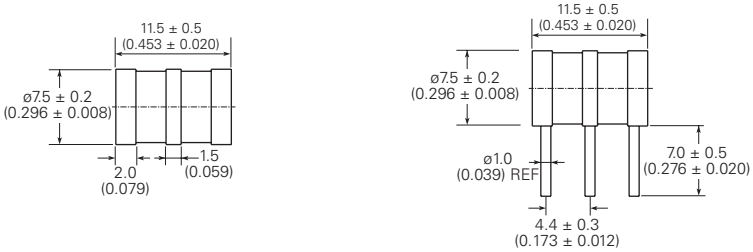


	X	Y1	Y2	Z1	Z2
	Nom	Nom	Nom	Nom	Nom
mm	7.0	3.6	3.6	2.5	2.0
in*	0.276	0.142	0.142	0.098	0.079

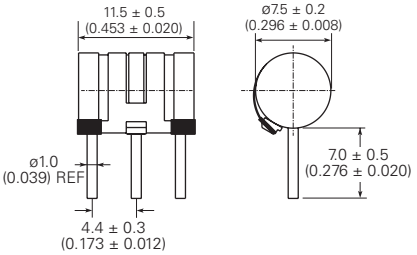
* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G10 Three Electrode 7mm Product Dimensions

Radial Leaded (GTCR37-XXXM-R10)



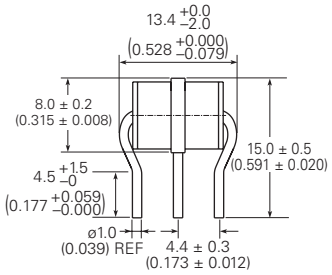
Radial Leaded with-FS (GTCR37-XXXM-R10-FS2)



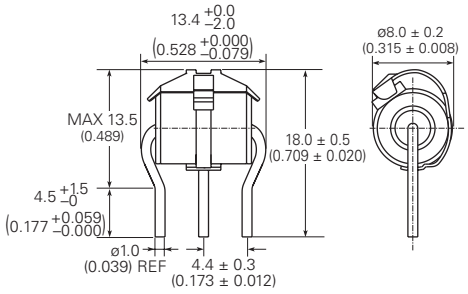
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G11 Three Electrode 8mm Product Dimensions

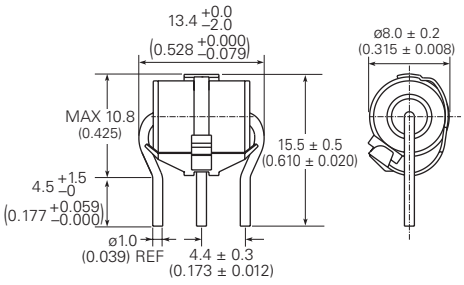
Axial Leaded (GTCA38-XXXM-R10)



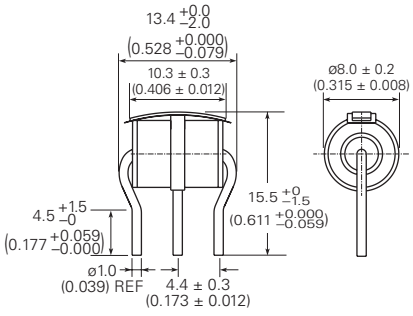
Axial Leaded with-FS (GTCA38-XXXM-R10-FS)



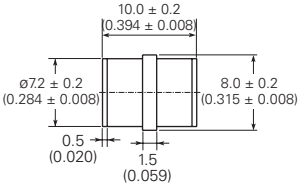
Axial Leaded with-FS (GTCA38-XXXM-R10-FS2)



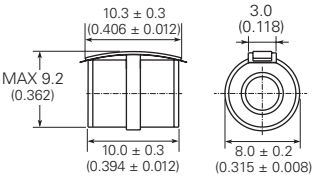
Axial Leaded with-FT (GTCA38-XXXM-R10-FT)



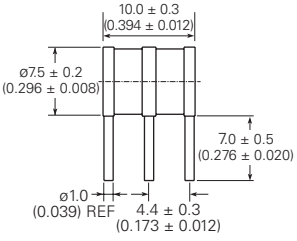
No Leads (GTCN38-XXXM-R10)†



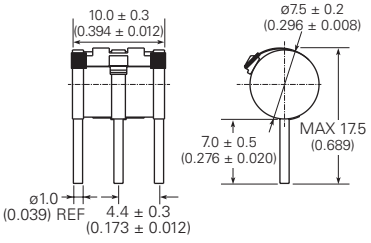
No Leads with-FT (GTCN38-XXXM-R10-FT)†



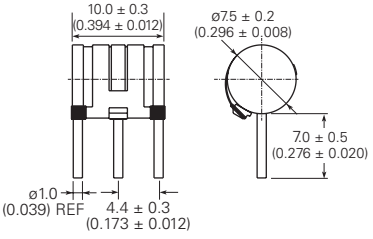
Radial Leaded (GTCR38-XXXM-R10)



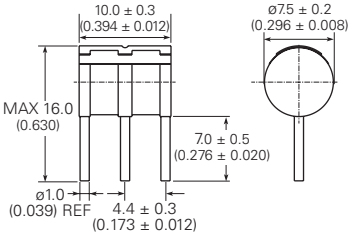
Radial Leaded with-FS (GTCR38-XXXM-R10-FS)



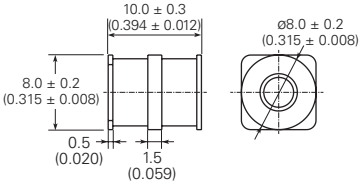
Radial Leaded with-FS (GTCR38-XXXM-R10-FS2)



Radial Leaded with-FT (GTCR38-XXXM-R10-FT)

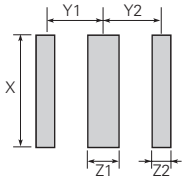


Surface-mount (GTCS38-XXXM-R10)



Dimensions in these drawings are in millimeters (inches)

Pad Layout - Surface-mount Devices (GTCS38-XXXM-R10)



	X Nom	Y1 Nom	Y2 Nom	Z1 Nom	Z2 Nom
mm	9.0	4.65	4.65	2.5	1.5
in*	0.354	0.183	0.183	0.098	0.059

* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

RoHS Compliant, ELV Compliant HF Halogen Free

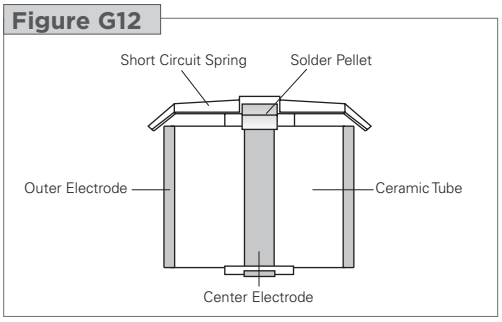
Fail-Short Mechanism for Gas Discharge Tubes (GDTs)

Fail-Short Mechanism - FS

The FS fail-short mechanism is a short circuit spring mounted onto a solder pellet located at the center electrode of the gas tube. Under normal operating conditions, the pellet is positioned to make the spring float above the outer electrodes, as shown in Figure G11 on the previous page..

When a prolonged discharge event causes the gas tube temperature to reach the melting point of the solder, the pellet softens allowing the short circuit spring to contact with both outer electrodes (Figure G12). This process results in a permanent short circuit between all three electrodes creating a low resistance path that conducts the fault current to ground without generating a significant amount of heat.

Figure G12

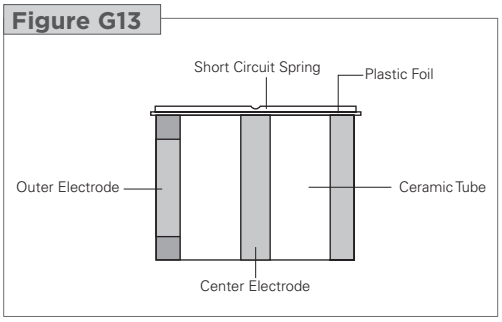


Fail-Short Mechanism - FT

The FT fail-short mechanism is a short circuit spring with a piece of plastic foil spot welded onto the center electrode. Under normal operating conditions, the plastic foil makes the spring insulated from the two outer electrodes.

When a prolonged discharge event causes the gas tube temperature to reach the melting point of the plastic foil, the plastic foil melts allowing the short circuit spring to contact both outer electrodes (Figure G13). This process results in a permanent short circuit between all three electrodes creating a low resistance path that conducts the fault current to ground without generating a significant amount of heat.

Figure G13



Operation and Storage Temperatures for Gas Discharge Tubes (GDTs)

Operation Temperature Range

Models without Fail-Short Mechanism : -40°C/+90°C
Models with Fail-Short Mechanism : -20°C/+65°C

Storage Temperature Range

Models without Fail-Short Mechanism : -40°C/+90°C
Models with Fail-Short Mechanism : -20°C/+65°C

Packaging Information for Gas Discharge Tubes (GDTs)

	Parts in Bulk		Parts in Tape and Reel	
Part Description	**Min Order Quantity**	**Box Quantity**	**Tape and Reel Min Order Quantity**	**Box Quantity**
3mm 2Pole Surface-mount	-	-	2000	16000
5mm 2Pole No leads	5000	20000	-	-
5mm 2Pole Leads	1000	5000	-	-
5mm 2Pole Surface-mount	-	-	1500	12000
6mm 2Pole No leads	2000	10000	-	-
6mm 2Pole Leads	1000	5000	-	-
6mm 2Pole Surface-mount	-	-	750	6000
8mm 2pole No leads	2000	10000	-	-
8mm 2Pole Leads	1000	5000	-	-
8mm 2Pole Surface-mount	-	-	500	4000
5mm 3Pole No leads	2500	10000	-	-
5mm 3Pole Leads	1000	5000	-	-
5mm 3Pole Surface-mount	-	-	1000	8000
6mm 3Pole No leads	2500	10000	-	-
6mm 3Pole Leads	1000	5000	-	-
6mm 3Pole Surface-mount	-	-	750	4500
7mm 3Pole Leads	1000	5000	-	-
8mm 3Pole No leads	1000	5000	-	-
8mm 3Pole Leads	1000	5000	-	-
8mm 3Pole Surface-mount	-	-	500	2500

Installation for Gas Discharge Tubes (GDTs)

Care should be taken when installing GDTs equipped with fail-short mechanisms into arrester magazines, printed circuit boards, etc. Too much downward pressure may force the short circuit spring through the thin insulation tube creating a shorted condition.

Solder Reflow Recommendations for Surface-mount GDT Devices

Surface-mount GDTs can be soldered using standard Pb-free reflow profiles.

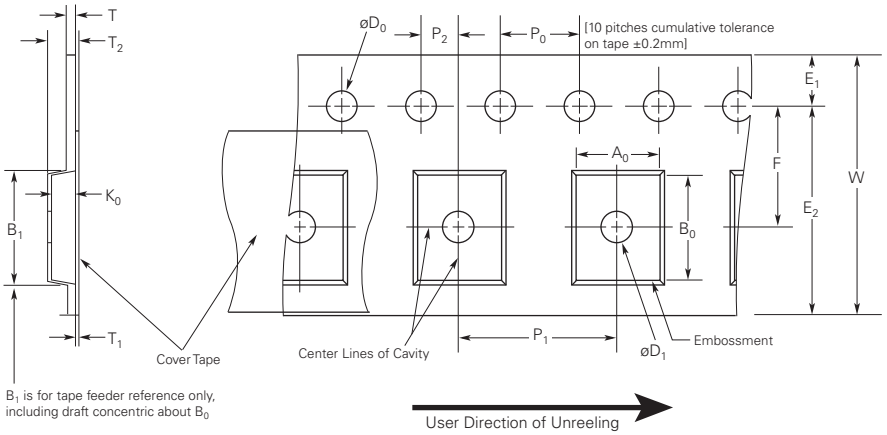
Table G4 Tape and Reel Specifications for GDT Devices

Tape Dimension EIA Mark	3mm devices (2 pole) Dimension (mm)	5mm devices (2 pole) Dimension (mm)	6mm devices (2 pole) Dimension (mm)	8mm devices (2 pole) Dimension (mm)
A_0	3.40±0.10	4.9±0.10	6.70±0.10	8.60±0.10
B_0	5.00±0.10	5.5±0.10	4.60±0.10	6.40±0.10
D_0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0
D_1	–	1.5 MIN	–	–
E_1	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10
E_2	14.25±0.30	14.25±0.30	14.25±0.30	14.25±0.30
F	7.50±0.10	7.50±0.10	7.50±0.10	7.50±0.10
P_0	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
P_1	8.00±0.10	8.00±0.10	12.00±0.10	12.00±0.10
P_2	2.00±0.10	2.00±0.10	2.00±0.10	2.00±0.10
W	16.00±0.30	16.00±0.30	16.00±0.30	16.00±0.30

TapeThickness EIA Mark	Dimension (mm)	Dimension (mm)	Dimension (mm)	Dimension (mm)
B_1	–	–	–	–
K_0	3.30±0.10	5.30±0.10	6.50±0.10	8.50±0.10
T	0.35±0.05	0.40±0.05	0.35±0.05	0.50±0.05
T_1	–	–	–	–
T_2	–	–	–	–

Reel Dimension EIA Mark	Dimension (mm)	Dimension (mm)	Dimension (mm)	Dimension (mm)
A	330	330	330	330
B	2.20±0.50	2.20±0.50	2.20±0.50	2.20±0.50
C	13.00±0.20	13.00±0.20	13.00±0.20	13.00±0.20
D	20.20±1.00	20.20±1.00	20.20±1.00	20.20±1.00
N	100.00±1.00	100.00±1.00	100.00±1.00	100.00±1.00
W_1	16.50±0.10	16.50±0.10	16.50±0.10	16.50±0.10
W_2	21.10±02.00	21.10±02.00	21.10±02.00	21.10±02.00

Figure G14 EIA Referenced Taped Component Dimensions for GDT Devices



RoHS Compliant, ELV Compliant HF Halogen Free

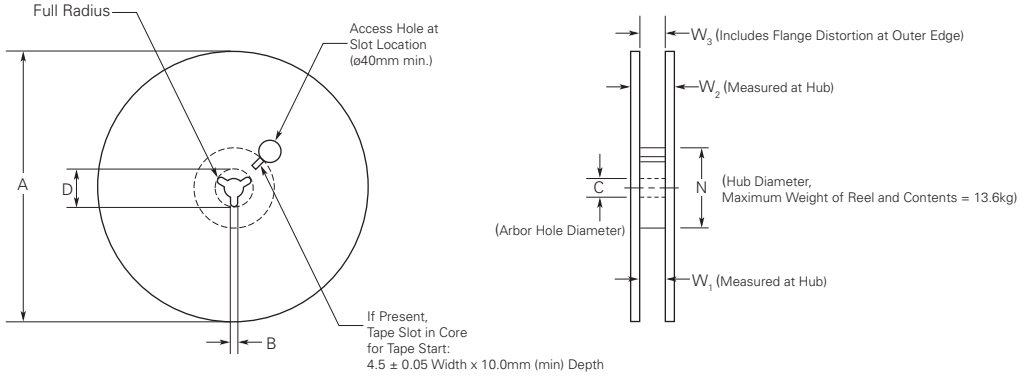
Table G5 Tape and Reel Specifications for GDT Devices (Cont'd)

Tape Dimension EIA Mark	5mm devices (3 pole) Dimension (mm)	6mm devices (3 pole) Dimension (mm)	8mm devices (3 pole) Dimension (mm)
A_0	5.40±0.10	6.50±0.10	8.50±0.10
B_0	8.00±0.10	8.60±0.10	10.60±0.10
D_0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0
D_1	1.50(min)	1.50(min)	–
E_1	1.75±0.10	1.75±0.10	1.75±0.10
E_2	14.25±0.30	22.25±0.30	22.25±0.30
F	7.50±0.10	11.50±0.10	11.50±0.10
P_0	4.00±0.10	4.00±0.10	4.00±0.10
P_1	8.00±0.10	12.00±0.10	16.00±0.10
P_2	2.00±0.10	2.00±0.10	2.00±0.10
W	16.00±0.30	24.00±0.30	24.00±0.30

TapeThickness EIA Mark	Dimension (mm)	Dimension (mm)	Dimension (mm)
B_1	–	–	–
K_0	5.70±0.10	6.30±0.10	8.40±0.10
T	0.50±0.05	0.50±0.05	0.50±0.05
T_1	–	–	–
T_2	–	–	–

Reel Dimension EIA Mark	Dimension (mm)	Dimension (mm)	Dimension (mm)
A	330	330	330
B	2.20±0.50	2.20±0.50	2.20±0.50
C	13.00±0.20	13.00±0.20	13.00±0.20
D	20.20±1.00	20.20±1.00	20.20±1.00
N	100.00±1.00	100.00±1.00	100.00±1.00
W_1	16.50±0.10	24.50±0.10	24.50±0.10
W_2	21.10±02.00	29.10±02.00	29.10±02.00
W_3	–	–	–

Figure G15 EIA Referenced Reel Dimensions for GDT Devices



Part Numbering System for Gas Discharge Tubes (GDTs) Cont'd

Example Part Number for GDTs

GT C S 2 3 - 231 M - R 01 - FS - 2

Packaging
2 = Tape and Reel
Nothing = Tray Packaging

FS = Solder Pellet Fail Short Mechanism on Top
FS2 = Solder Pellet Fail Short Mechanism on Bottom
FT = Plastic Fail Short Mechanism on Top

Surge Rating
01 = 8x20µs 1kA, 10 Hits
02 = 8x20µs 2.5kA, 10 Hits
05 = 8x20µs 5kA, 10 Hits
10 = 8x20µs 10kA, 10 Hits
20 = 8x20µs 20kA, 10 Hits

Product Family Designator
R = R Series

Tolerance of 20% on DC Switch Voltage

DC Switch Voltage of 230V
23 x 10***1** = 230V, **23** x 10***2** = 2300V

Diameter
3 = 3mm
5 = 5mm
6 = 6mm
8 = 8mm

Number of Electrodes (2, 3)

Lead Configuration
A = Axial Leads
C = Chip Type
N = No Leads
S = Surface-Mount
T = T-Shape Leads

Ceramic

Gas Tube

NOTE: GTCS23-XXXM-R01 and GTCC23-XXXM-R01 parts available only in surface-mount and tape and reel packaging.

Marking Reference Guide - Example

X 352 R 05 GN

Year and Week of Manufacture
G = First Half of 2004
N = Week 14
Per Manufacturer's Lot Number System

8x20µs 10 Hits Surge Current (05=5kA)

Product Family Designator
R = R Series

Voltage Designator (35 = 350V, 352=3500V)

Manufacturer's Mark

NOTES: GTCS23-XXXM-R01 and GTCC23-XXXM-R01 parts will have no marking. Devices with no leads (GTCNxx-xxxx-xx) are not able to be soldered as their electrodes are nickel plated. They should be installed by insertion into a magazine clip.

Notice :

Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability and test each product selected for their own applications. Tyco Electronics Corporation and its affiliates in the TE Connectivity Ltd. group of companies ("TE") reserves the right to change or update, without notice, any information contained in this publication; to change, without notice, the design, construction, processing, or specification of any product; and to discontinue or limit production or distribution of any product. This publication supersedes and replaces all information previously supplied. Without express written consent by an officer of TE, TE does not authorize the use of any of its products as components in nuclear facility applications, aerospace, or in critical life support devices or systems. TE expressly disclaims all implied warranties regarding the information contained herein, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. TE's only obligations are those in the TE Standard Terms and Conditions of Sale and in no case will TE be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of its products.

Surface-Mount Fuses
Fundamentals

Overview

TE Circuit Protection offers the widest selection of surface-mount fuses available for addressing a broad range of overcurrent protection applications. Helping to prevent costly damage and promote a safe environment for electronic and electrical equipment, our single-use chip fuses provide performance stability to support applications with current ratings from .5A up to 20A.

TE Circuit Protection also offers the telecom FT600 fuse for telecommunications applications. This telecom fuse helps comply with North American overcurrent protection requirements, including Telcordia, GR-1089, TIA-968-A (formerly FCC Part 68), and UL60950 3rd edition.



Multi-layer Design for Chip Fuses

The multi-layer design has the benefit of exposing more fuse element surface area to the glass-ceramic absorption material. When the fuse elements open, there is more material for the vaporizing fuse metals to absorb into, resulting in a very efficient and effective quenching of the fuse arc.

Figure SF1 compares the multi-layer design of our SFF fuses with standard glass coated designs. The glass coated designs rely on the coating on only one side of the fuse element to absorb the vaporizing fuse material when it opens. Therefore, there is much less absorption material available to absorb the fuse metals. The result can be prolonged arcing and possible coating breach.

Figure SF2 shows how the absorption characteristics of the two designs differ. The multi-layer design indicates a clean separation with the fuse element evenly diffusing into the surrounding ceramic substrate. In the glass coated design, the element diffusion takes place in a small portion of the device and is only absorbed by the glass material directly above the area of failure.

Figure SF1

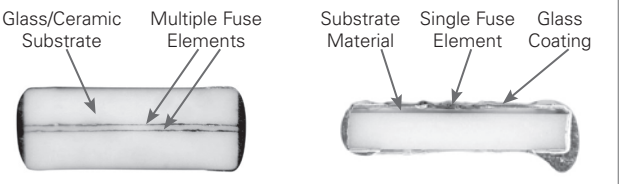
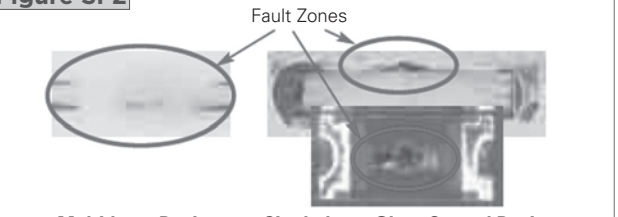


Figure SF2



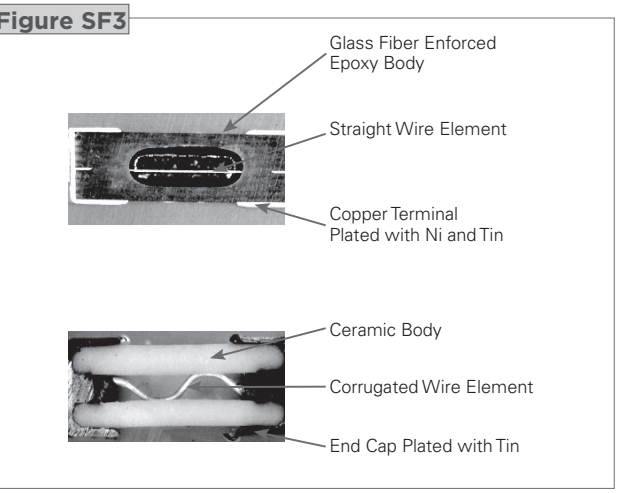
Wire-In-Air Design for 2410SFV Fuses

The 2410(6125) is a Wire-In-Air SMD fuse that is suitable for secondary level overcurrent protection applications.

Figure SF3 compares our straight wire element design 2410SFV fuses with normal corrugated wire design fuse. The straight wire element in air provides consistent fusing and cutting characteristics together with inrush current withstanding capability.

By introducing PCB assembly technology into the 2410SFV fuse design and manufacturing process, lead-free compliance has been achieved without the problems associated with end caps on traditional ceramic devices.

Figure SF3

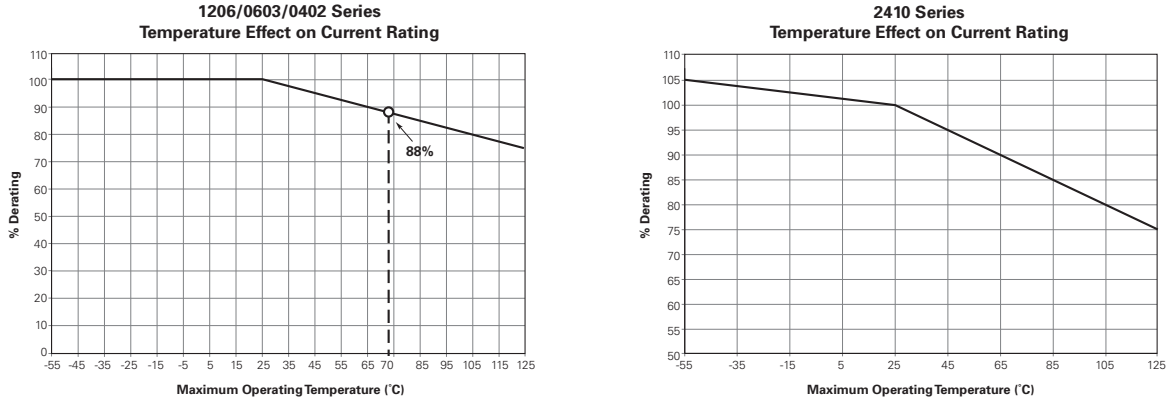


RoHS Compliant, ELV Compliant HF Halogen Free

Temperature Derating

A fuse is a temperature sensitive device. Therefore, operating temperature will have an effect on fuse performance and lifetime. Operating temperature should be taken into consideration when selecting the fuse current rating. The Thermal Derating Curve for surface-mount fuses is presented in Figure SF4. Use it to determine the derating percentage based on operating temperature and apply it to the derated system current.

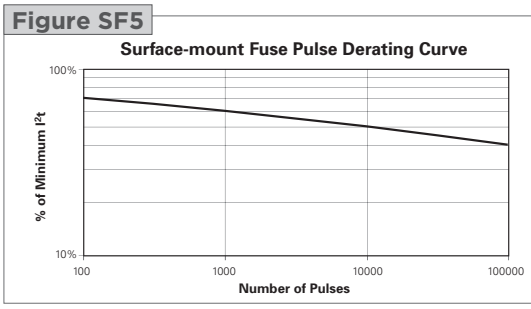
Figure SF4



Pulse Cycle Derating

Once the I^2t value for the application waveform has been determined, it must be derated based on the number of cycles expected over the system lifetime. Since the stress induced by the current pulse is mechanical in nature, the number of times the stress is applied has significant bearing on how much derating must be applied to the fuse rating. Figure SF5 presents the current pulse derating curve for our surface-mount chip fuses up to 100,000 cycles.

Figure SF5



Selecting Surface-mount Fuses

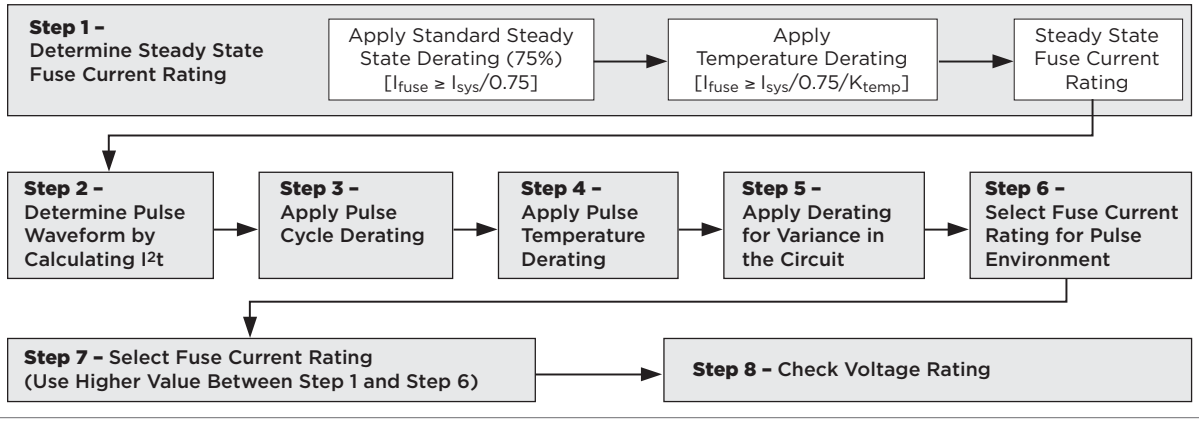
Fuse selection seems straightforward, in that you pick one which has a current rating just a bit higher than your worst case system operating current. Unfortunately, it is not that simple. There are derating considerations for operating current and application temperature. Turn-on and other system operations (like processor speed changes or motor start up) cause current surges or spikes that also require consideration when selecting a fuse. So selecting the right fuse for your application is not as simple as knowing the nominal current drawn by the system.

10

Fuse Selection Flowchart

However, the basic considerations for fuse selection are shown in the flow chart presented in Figure SF6. Following this flow chart will help you select a fuse best suited for your application conditions. For a detailed example of this process you can download our Fuse Selection Guide available on our website.

Figure SF6



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Surface-Mount Fuses
Pulse Tolerant Chip Fuses

NEW

Pulse Tolerant Chip Fuses have high inrush current withstand capability and provide overcurrent protection for DC power systems. These devices combine a silver fusing element and monolithic, multilayer design to provide strong arc suppression characteristics.

These RoHS-compliant surface-mount devices can help facilitate the development of more reliable, high-performance consumer electronics such as laptops, multimedia devices, cell phones and other portable electronics.



Benefits

- High inrush current withstand capability
- Ceramic monolithic structure
- Silver fusing element and silver termination with nickel and tin plating
- Temperature stability
- Strong arc suppression characteristics

Features

- Lead free materials and RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

Applications

- Laptops
- Digital cameras
- Cell phones
- Printers
- DVD players
- Portable electronics
- Game systems
- LCD monitors
- Scanners

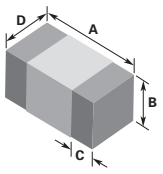
Table FP1 Clear Time Characteristics for Pulse Tolerant Chip Fuses

% of rated current	Clear time at 25°C	
100%	4 hrs (min)	
200%	1 s (min)	60 s (max)
1000%	0.0002 s (min)	0.02 s (max)

Table FP2 Typical Electrical Characteristics and Dimensions for Pulse Tolerant Chip Fuses

0603 (1608 mm) Pulse Tolerant Chip Fuses

Shape and Dimensions
mm (in)

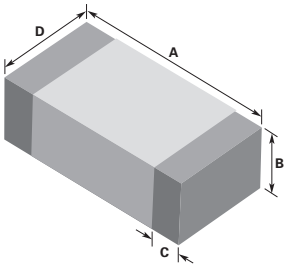


	A		B		C		D	
	Min	Max	Min	Max	Min	Max	Min	Max
mm	1.45	1.75	0.65	0.95	0.21	0.51	0.65	0.95
in	(0.057)	(0.069)	(0.026)	(0.037)	(0.008)	(0.020)	(0.026)	(0.037)

	Typical Electrical Characteristics			Max Interrupt Ratings	
Part Number	Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2s)†	Voltage (V_{DC})	Current (A)
0603SFP100F/32-2	1.0	0.210	0.08	32	50
0603SFP150F/32-2	1.5	0.101	0.11	32	50
0603SFP200F/32-2	2.0	0.057	0.24	32	50
0603SFP250F/32-2	2.5	0.042	0.56	32	50
0603SFP300F/32-2	3.0	0.030	0.72	32	50
0603SFP350F/32-2	3.5	0.022	1.10	32	50
0603SFP400F/32-2	4.0	0.018	2.08	32	50
0603SFP450F/32-2	4.5	0.014	2.63	32	50
0603SFP500F/32-2	5.0	0.013	3.25	32	50
0603SFP600F/32-2	6.0	0.010	4.00	32	70

1206 (3216 mm) Pulse Tolerant Chip Fuses

Shape and Dimensions
mm (in)



	A		B		C		D	
	Min	Max	Min	Max	Min	Max	Min	Max
mm	3.00	3.40	0.77	1.17	0.26	0.76	1.40	1.80
in	(0.118)	(0.134)	(0.030)	(0.046)	(0.010)	(0.030)	(0.055)	(0.071)

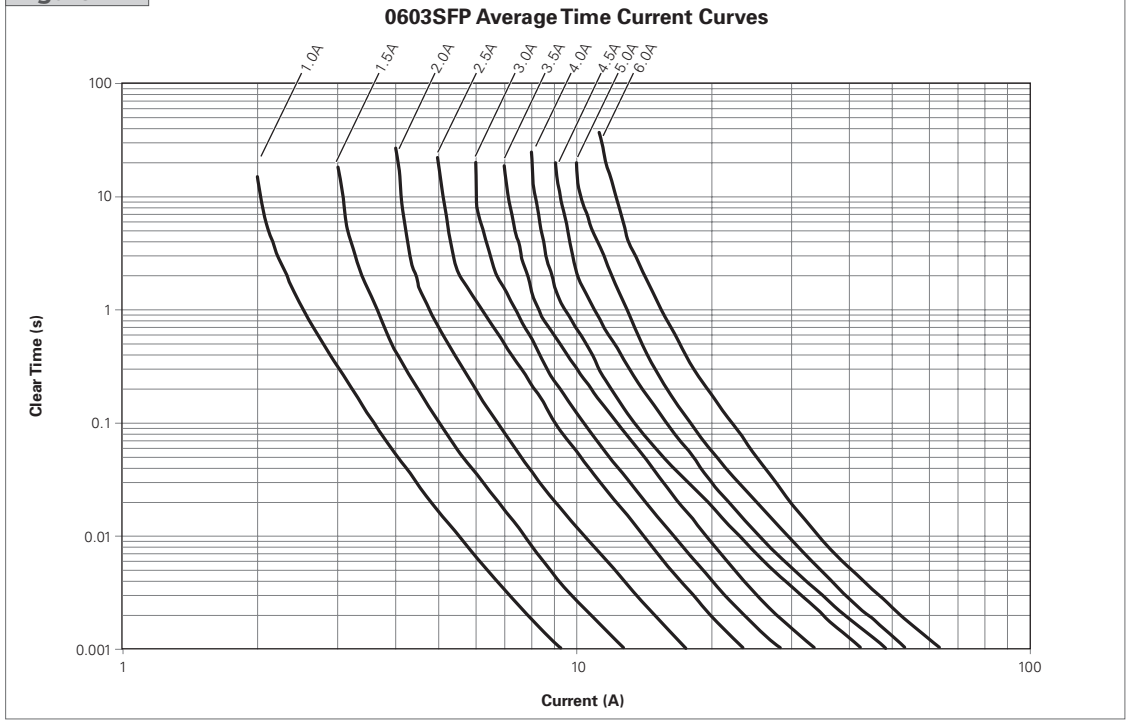
	Typical Electrical Characteristics			Max Interrupt Ratings	
Part Number	Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2sec)†	Voltage (V_{DC})	Current (A)
1206SFP100F/63-2	1.0	0.340	0.11	63	50
1206SFP150F/63-2	1.5	0.150	0.33	63	50
1206SFP200F/63-2	2.0	0.090	0.80	63	50
1206SFP250F/32-2	2.5	0.070	1.19	32	50
1206SFP300F/32-2	3.0	0.035	1.35	32	50
1206SFP350F/32-2	3.5	0.029	1.84	32	50
1206SFP400F/32-2	4.0	0.023	2.74	32	50
1206SFP450F/32-2	4.5	0.021	3.20	32	50
1206SFP500F/32-2	5.0	0.017	5.50	32	50
1206SFP600F/24-2	6.0	0.013	12.50	24	80
1206SFP700F/24-2	7.0	0.010	30.00	24	80
1206SFP800F/24-2	8.0	0.009	60.00	24	80

* Measured at ≤10% of rated current and 25°C ambient temperature.
† Melting I^2t at 0.001 sec clear time.

RoHS Compliant, ELV Compliant HF Halogen Free

Figures FP1-FP4 Family Performance Curves for Pulse Tolerant Chip Fuses

Figure FP1



Note: Curves are nominal.

Figure FP2

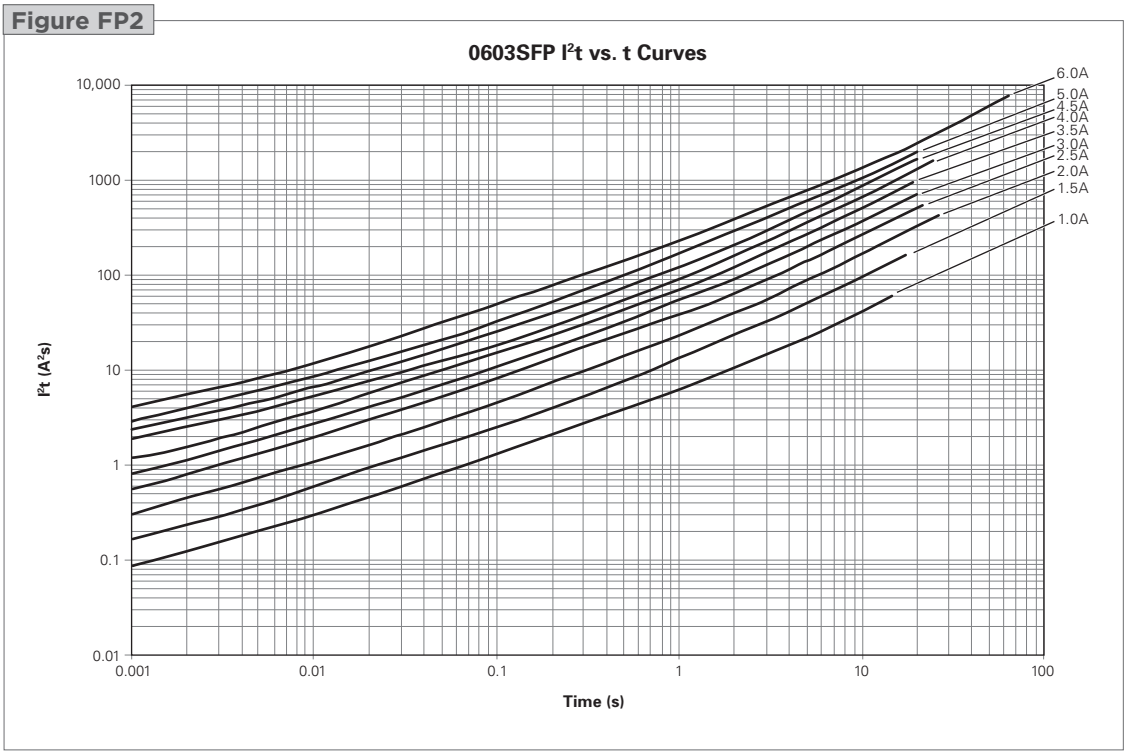


Figure FP3

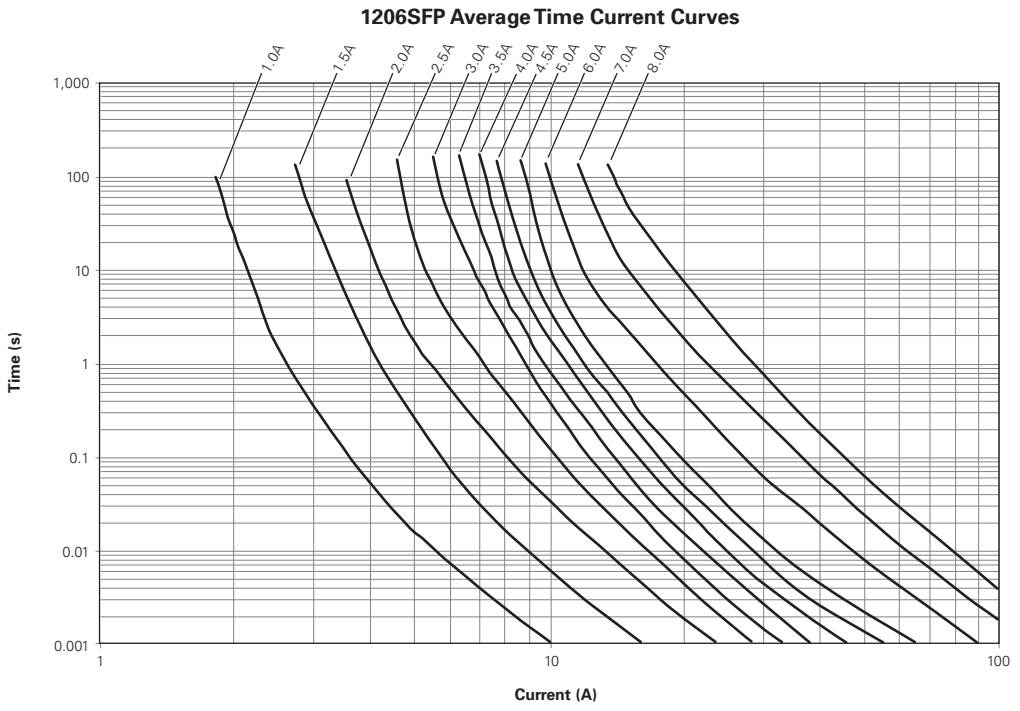
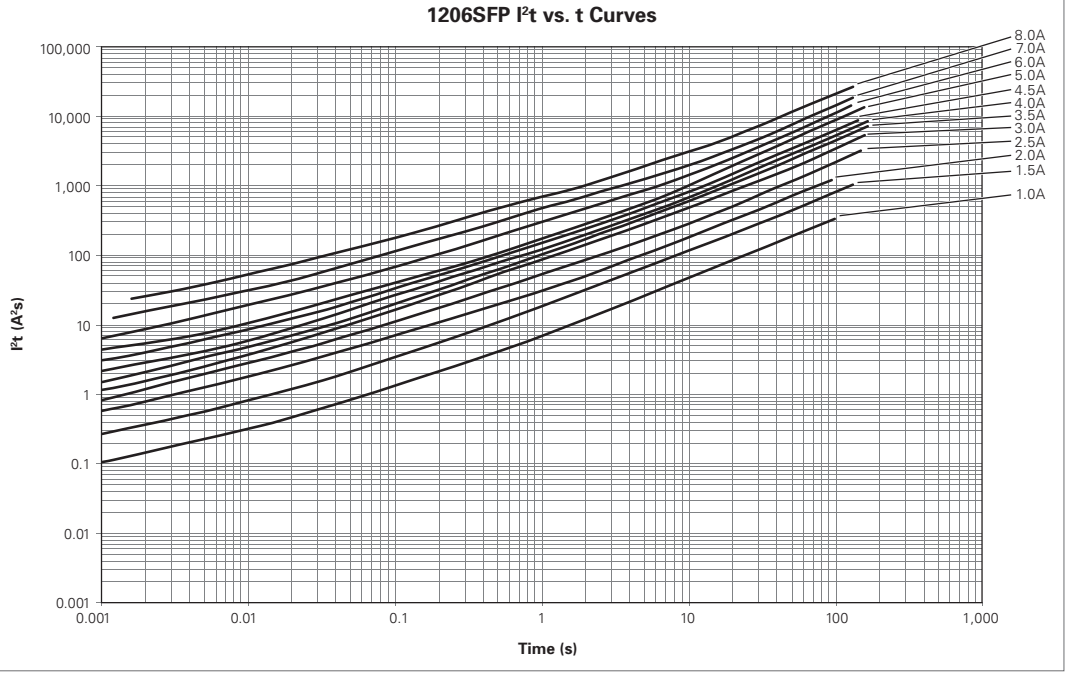


Figure FP4



Note: Curves are nominal.

➔ **Please go to page 129 for more information about Pulse Tolerant Chip Fuses.**



Surface-Mount Fuses
0603 Very Fast-Acting Chip Fuses

NEW

Very fast-acting chip fuses help provide overcurrent protection for systems using DC power sources up to $32V_{DC}$. The fuse's monolithic, multilayer design helps provide the highest hold current in the smallest footprint, reduce diffusion-related aging, improve product reliability and resilience, and enhance high-temperature performance in a wide range of circuit designs.

These RoHS-compliant surface-mount devices offer strong arc suppression characteristics and facilitate the development of more reliable, high-performance consumer electronics such as laptops, multimedia devices, cell phones and other portable electronics.



Benefits

- Very fast acting at 200% and 300% overloads
- Inrush current withstand capability at high overloads
- Thin body for space-limited applications
- Glass ceramic monolithic structure
- Silver fusing element and silver termination with nickel and tin plating
- RoHS compliant and lead-free materials
- Symmetrical design with marking on both sides (optional)

Features

- Lead-free materials and RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

Applications

- Laptops
- Digital cameras
- Cell phones
- Printers
- DVD players
- Portable electronics
- Game systems
- LCD monitors
- Scanners

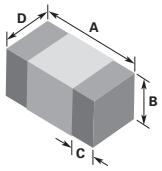
Table FV1 Clear Time Characteristics for Very Fast-Acting Chip Fuses

% of Rated Current	Clear Time at 25°C	
100%	4 hrs (min)	
200%	0.01 s (min)	5 s (max)
300%	0.001 s (min)	0.2 s (max)

Table FV2 Typical Electrical Characteristics and Dimensions for Very Fast-Acting Chip Fuses

0603 (1608mm) Very Fast-Acting Chip Fuses

Shape and Dimensions
mm (in)



	A		B		C		D	
	Min	Max	Min	Max	Min	Max	Min	Max
mm	1.45	1.75	0.22	0.48	0.21	0.51	0.65	0.95
in	(0.057)	(0.069)	(0.009)	(0.019)	(0.008)	(0.020)	(0.025)	(0.037)

	Typical Electrical Characteristics			Max Interrupt Ratings	
Part Number	Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2s)	Voltage (V_{DC})	Current (A)
0603SFV050F/32-2	0.5	0.860	0.0093	32	50
0603SFV075F/32-2	0.8	0.450	0.0191	32	50
0603SFV100F/32-2	1.0	0.280	0.0360	32	50
0603SFV125F/32-2	1.3	0.205	0.0630	32	35
0603SFV150F/32-2	1.5	0.143	0.0950	32	35
0603SFV175F/32-2	1.8	0.095	0.1400	32	35
0603SFV200F/32-2	2.0	0.073	0.2100	32	35
0603SFV250F/32-2	2.5	0.046	0.3000	32	35
0603SFV300F/32-2	3.0	0.039	0.4600	32	35
0603SFV350F/32-2	3.5	0.028	0.7300	32	35
0603SFV400F/32-2	4.0	0.023	1.1500	32	35
0603SFV450F/32-2	4.5	0.019	1.6800	32	35
0603SFV500F/32-2	5.0	0.015	2.6200	32	35

* Measured at 10% of rated current and 25°C.

Figures FV1-FV2 Family Performance Curves for Very Fast-Acting Chip Fuses

Figure FV1

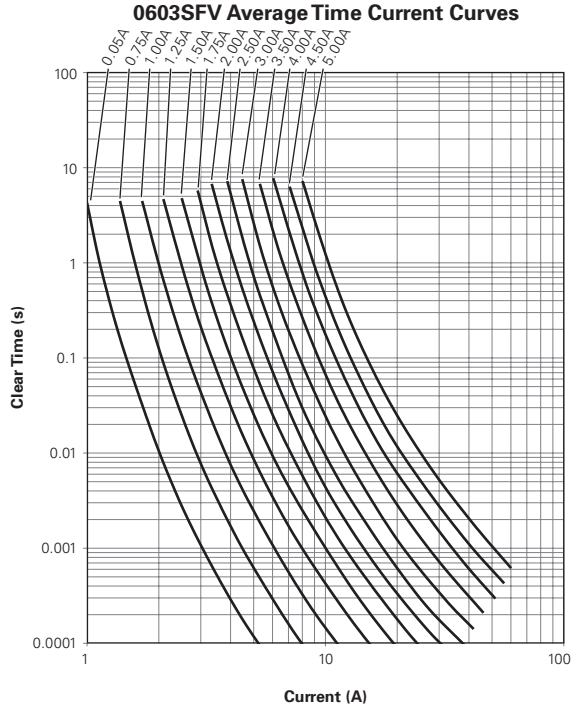
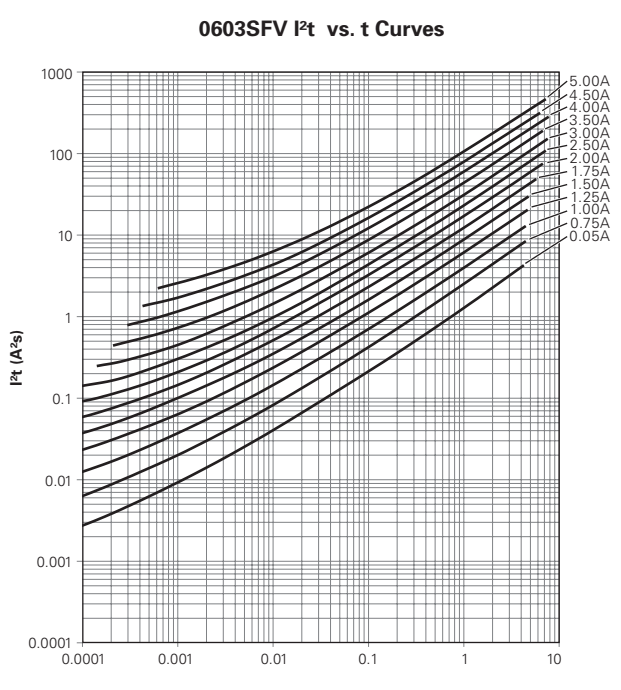


Figure FV2



Note: Curves are nominal.

➔ **Please go to page 129 for more information about Very Fast-Acting Chip Fuses.**

RoHS Compliant, ELV Compliant HF Halogen Free



Surface-Mount Fuses
Fast-Acting Chip Fuses

Fast-acting chip fuses help provide overcurrent protection for systems using DC power sources up to $63V_{DC}$. The fuse's monolithic, multilayer design helps provide the highest hold current in the smallest footprint, reduce diffusion-related aging, improve product reliability and resilience, and enhance high-temperature performance in a wide range of circuit designs.

These RoHS-compliant surface-mount devices offer strong arc suppression characteristics and help facilitate the development of more reliable, high-performance consumer electronics such as laptops, multimedia devices, cell phones and other portable electronics.



Benefits

- Small size with high-current ratings
- Temperature stability
- High reliability and resilience
- Strong arc suppression characteristics

Features

- Lead-free and RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

Applications

- Laptops
- Digital cameras
- Cell phones
- Printers
- DVD players
- Portable electronics
- Game systems
- LCD monitors
- Scanners

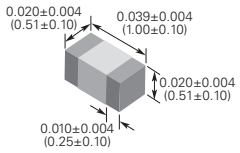
Table FF1 Clear Time Characteristics for Fast-Acting Chip Fuses

% of Rated Current	Clear Time at 25°C
100%	4 hrs min
250%	5 s max
400%	0.05 s max

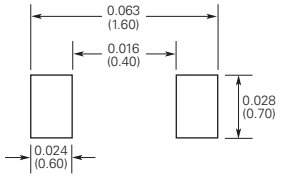
Table FF2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Fast-Acting Chip Fuses

0402 (1005mm) Fast-Acting Chip Fuses

Shape and Dimensions in (mm)



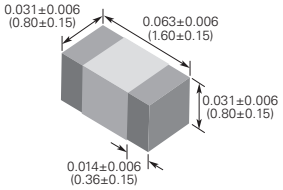
Recommended Pad Layout in (mm)



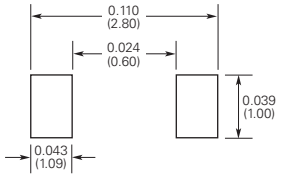
	Typical Electrical Characteristics			Max Interrupt Ratings	
Part Number	Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2s)†	Voltage (V_{DC})	Current (A)
0402SFF100F/24	1.00	0.120	0.0170	24	35
0402SFF150F/24	1.50	0.056	0.0490	24	35
0402SFF200F/24	2.00	0.035	0.0700	24	35
0402SFF300F/24	3.00	0.021	0.1250	24	35
0402SFF400F/24	4.00	0.014	0.2250	24	35

0603 (1608mm) Fast-Acting Chip Fuses

Shape and Dimensions in (mm)



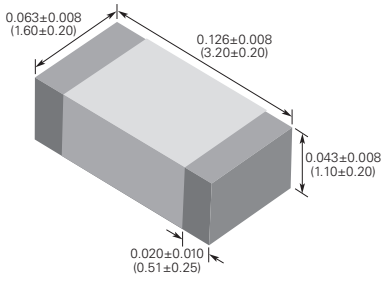
Recommended Pad Layout in (mm)



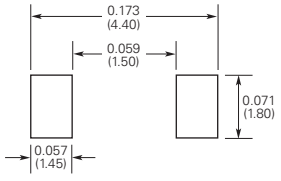
	Typical Electrical Characteristics			Max Interrupt Ratings	
Part Number	Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2s)†	Voltage (V_{DC})	Current (A)
0603SFF050F/32	0.50	0.485	0.0029	63	35
0603SFF075F/32	0.75	0.254	0.0064	63	35
0603SFF100F/32	1.00	0.147	0.0160	63	35
0603SFF150F/32	1.50	0.059	0.0300	63	35
0603SFF200F/32	2.00	0.044	0.0600	32	35
0603SFF250F/32	2.50	0.032	0.1150	32	35
0603SFF300F/32	3.00	0.025	0.1900	32	35
0603SFF350F/32	3.50	0.024	0.2950	32	35
0603SFF400F/32	4.00	0.018	0.4000	32	35
0603SFF500F/32	5.00	0.013	0.7000	32	35
0603SFF600F/24	6.00	0.010	1.1250	24	35

1206 (3216mm) Fast-Acting Chip Fuses

Shape and Dimensions in (mm)



Recommended Pad Layout in (mm)



	Typical Electrical Characteristics			Max Interrupt Ratings	
Part Number	Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2s)†	Voltage (V_{DC})	Current (A)
1206SFF050F/63	0.50	0.730	0.0021	63	50
1206SFF075F/63	0.75	0.513	0.0052	63	50
1206SFF100F/63	1.00	0.220	0.0120	63	50
1206SFF150F/63	1.50	0.120	0.0250	63	50
1206SFF175F/63	1.75	0.100	0.0450	63	50
1206SFF200F/63	2.00	0.050	0.0700	63	50
1206SFF250F/32	2.50	0.035	0.1400	32	50
1206SFF300F/32	3.00	0.031	0.2200	32	50
1206SFF400F/32	4.00	0.022	0.3800	32	45
1206SFF500F/32	5.00	0.015	0.6000	32	45
1206SFF600F/32	6.00	0.013	1.0000	32	50
1206SFF700F/32	7.00	0.011	1.7500	32	50
1206SFF800F/32	8.00	0.008	2.5000	32	50
1206SFF600F/24	6.00	0.013	1.0000	24	45
1206SFF700F/24	7.00	0.011	1.7500	24	45
1206SFF800F/24	8.00	0.008	2.5000	24	45

* Measured at ≤10% of rated current and 25°C ambient temperature.
† Melting I^2t at 0.001 sec clear time.

RoHS Compliant, ELV Compliant HF Halogen Free

Figures FF1-FF6 Family Performance Curves for Fast-Acting Chip Fuses

Figure FF1

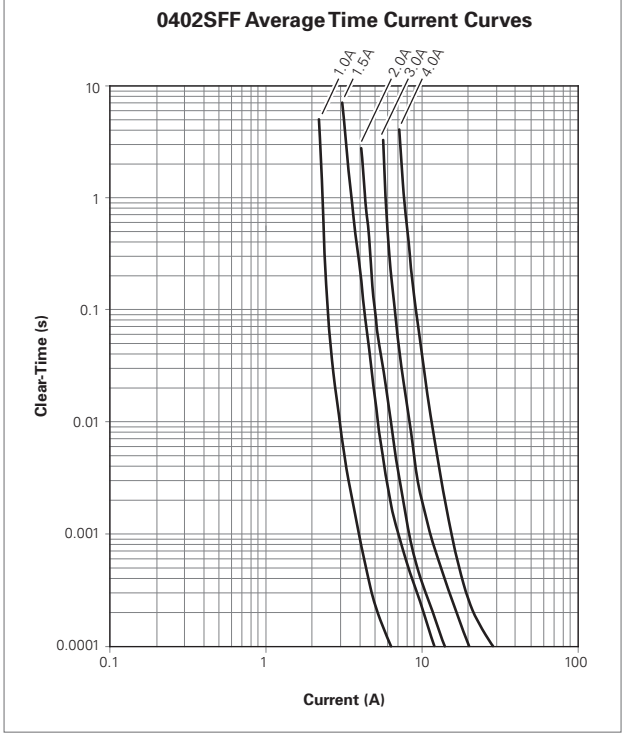
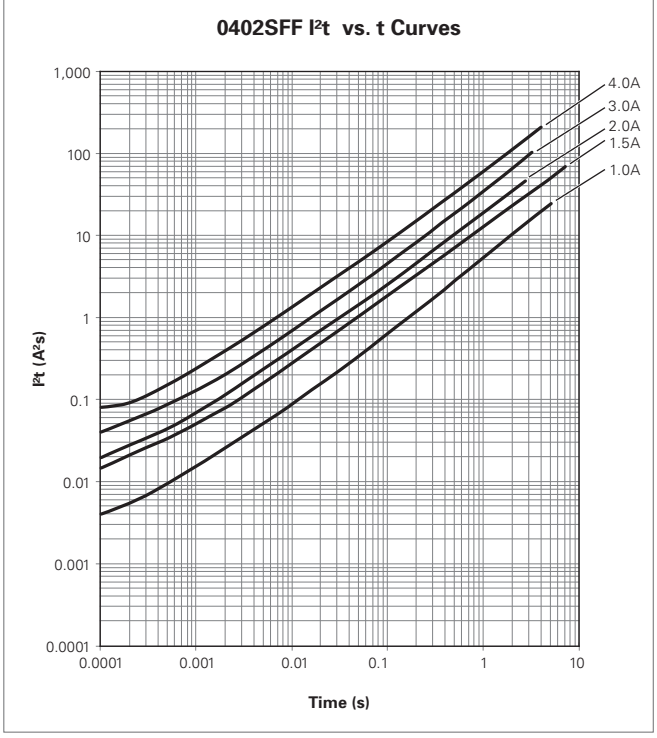


Figure FF2



Note: Curves are nominal

Figure FF3

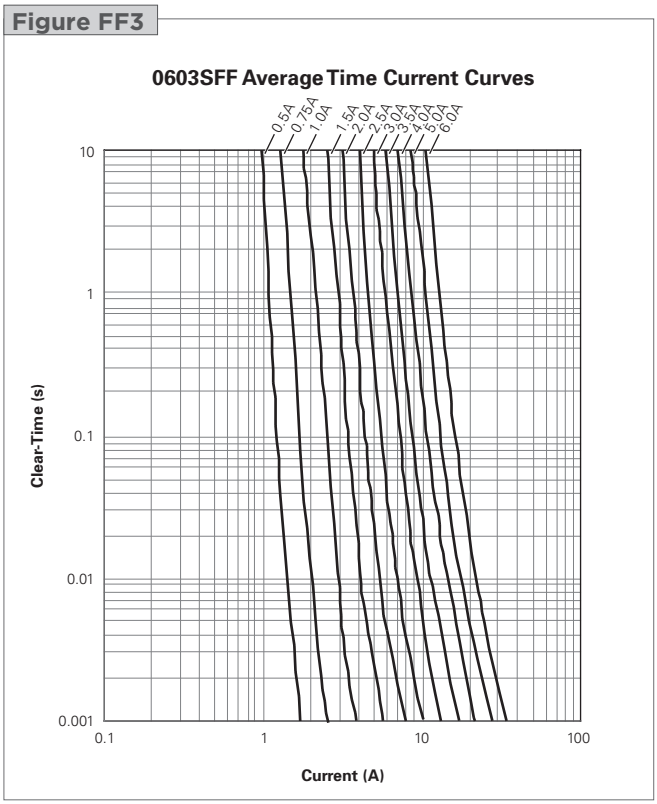
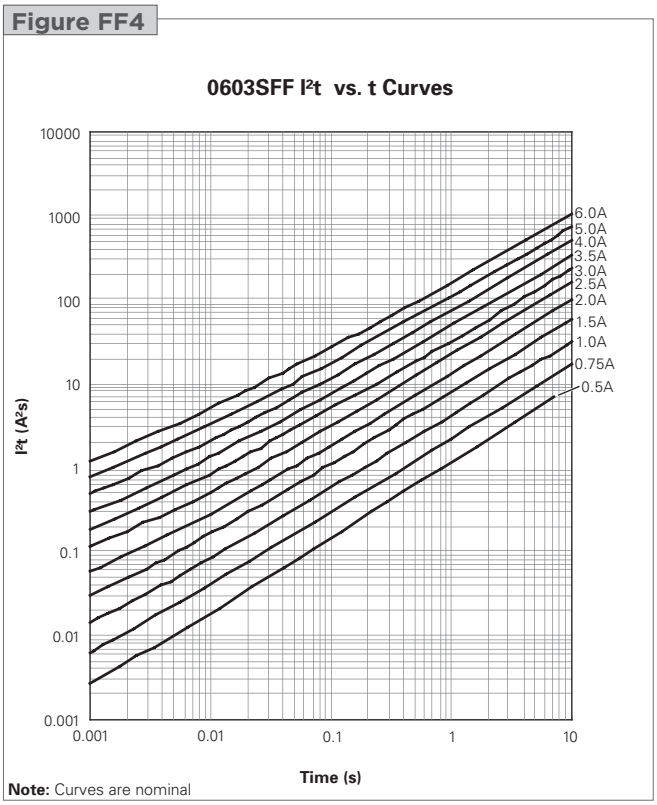


Figure FF4



Note: Curves are nominal

Figure FF5

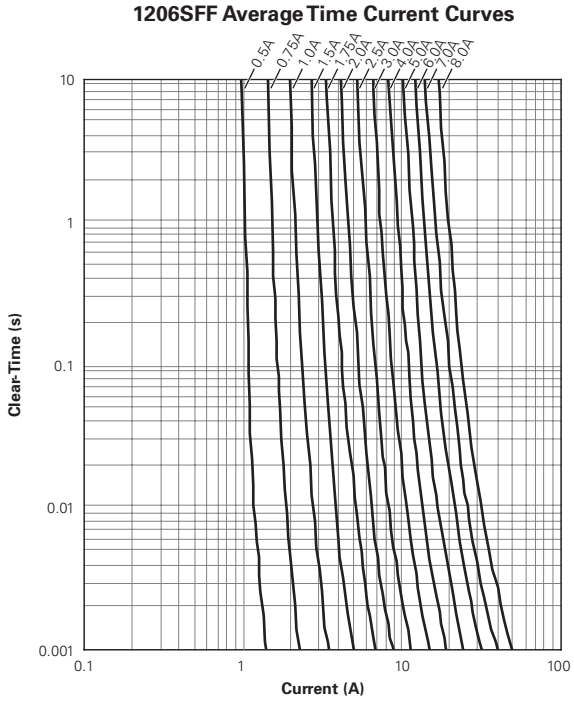
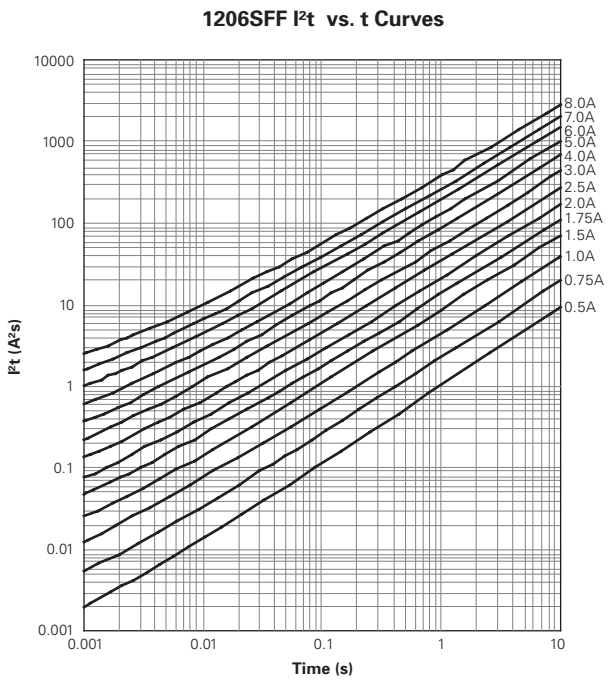


Figure FF6



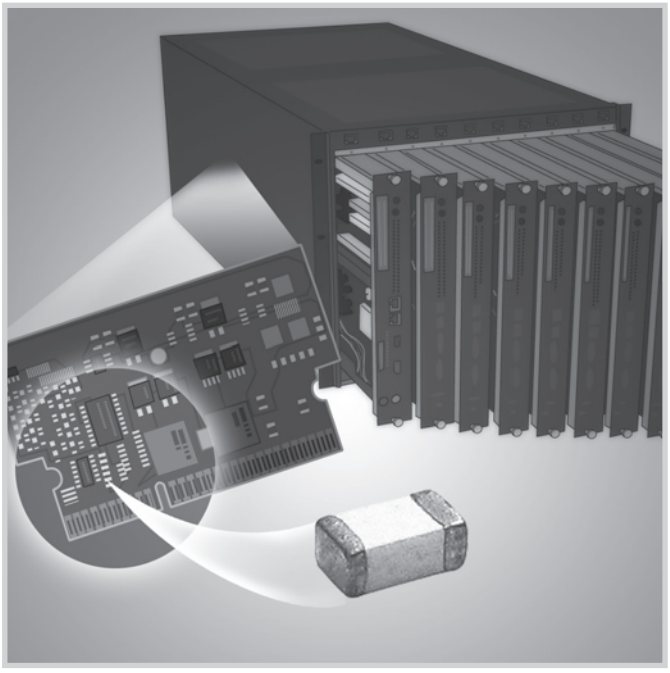
Note: Curves are nominal.

➔ **Please go to page 129 for more information about Fast-Acting Chip Fuses.**



Surface-Mount Fuses
High-Current-Rated Chip Fuses

The monolithic multilayer design of the TE Circuit Protection high-current-rated chip fuses helps to provide some of the highest current ratings available in the 1206 size and enhances high-temperature performance in a wide range of circuit protection designs. The devices' small size, high reliability and strong arc suppression characteristics make them suitable for overcurrent protection of power supplies, servers, communications equipment, voltage regulator modules, and other high-current, small size applications.



Benefits

- Glass ceramic monolithic structure provides stability in application cycling
- High-current rating in a small package allows more efficient use in system space
- Strong arc suppression in overcurrent conditions

Features

- Lead-free materials and RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

Applications

- Communications equipment
- Voltage regulator modules
- Power supplies
- Servers

Table FH1 Clear Time Characteristics for High-Current-Rated Chip Fuses

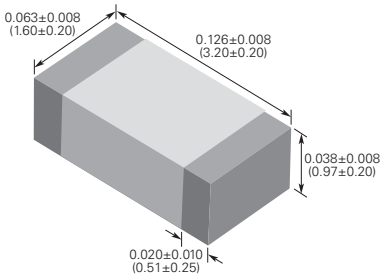
1206SFH Series

% of Rated Current	Clear Time at 25°C
100%	4 hrs (min)
250%	5 s (max)

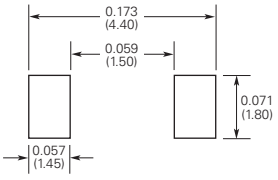
Table FH2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for High-Current-Rated Chip Fuses

1206 (3216mm) High-Current-Rated Chip Fuses

Shape and Dimensions
in (mm)



Recommended Pad Layout
in (mm)



Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2s)†	Max Interrupt Ratings: Voltage (V_{DC})	Current (A)
1206SFH100F/24	10	0.010	9	24	100
1206SFH120F/24	12	0.008	14	24	100
1206SFH150F/24	15	0.005	26	24	100
1206SFH200F/24	20	0.003	56	24	100

* Measured at ≤10% of rated current and 25°C ambient temperature.
† Melting I^2t at 0.001 sec clear time.

Figures FH1-FH2 Family Performance Curves for High-Current-Rated Chip Fuses

Figure FH1

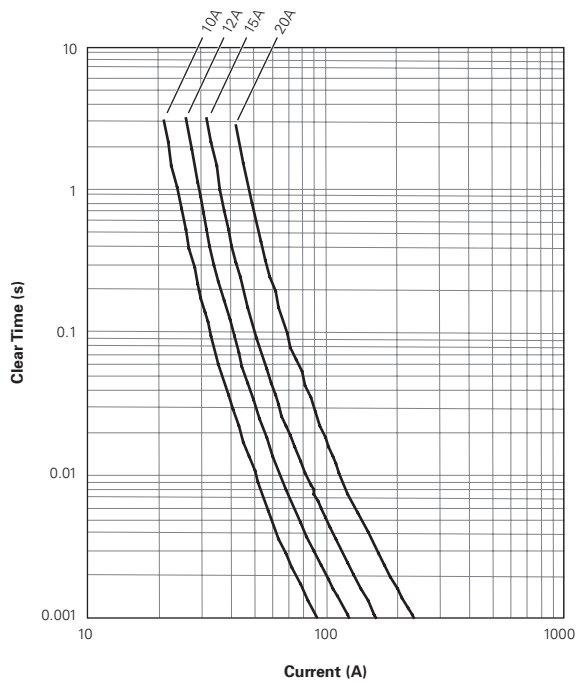
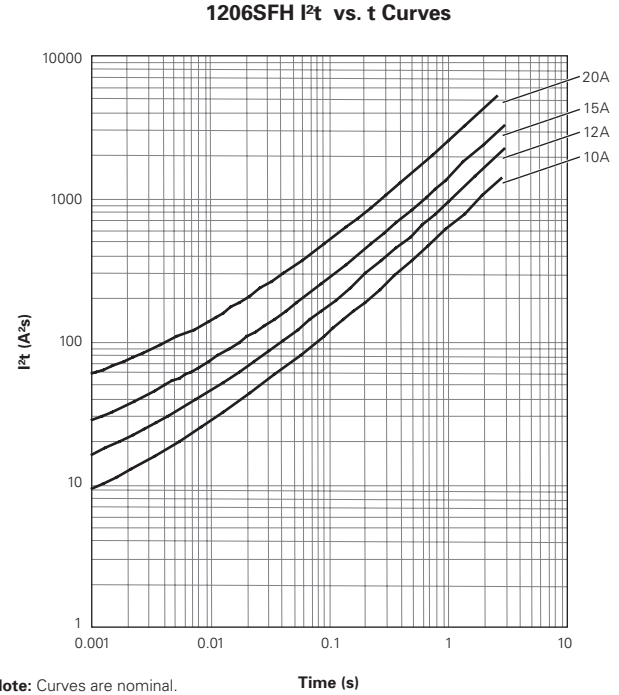


Figure FH2



Note: Curves are nominal.

➔ **Please go to page 129 for more information about High-Current-Rated Chip Fuses.**

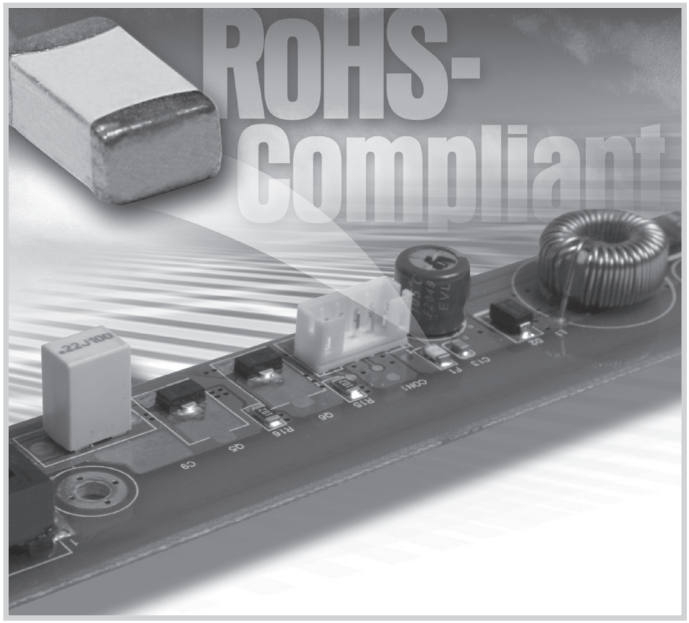
RoHS Compliant, ELV Compliant HF Halogen Free



Surface-Mount Fuses
Slow-Blow Chip Fuses

Available in industry standard 1206 and 0603 chip sizes, TE Circuit Protection's slow-blow chip fuses help provide overcurrent protection on systems that experience large and frequent current surges as part of their normal operation.

The slow-blow chip fuse's monolithic, multilayer design helps provide some of the highest current ratings available in the 1206 and 0603 footprints and enhances high-temperature performance in a wide range of circuit protection designs. The devices' small size, high reliability and strong arc suppression characteristics make them suitable for overcurrent protection of power supplies, capacitor filter banks, Liquid Crystal Display (LCD) backlight inverters, electric motors and portable electronics.



Benefits

- Time-delayed design help prevent nuisance openings in pulsed and high inrush current applications
- Small size with high-current ratings
- Strong arc suppression characteristics

Features

- Lead-free materials and RoHS compliant
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

Applications

- Small motor systems
- Portable electronics
- Input power ports
- Power over Ethernet (PoE)
- Test equipment
- POL converter protection
- Computer drives
- Displays
- Printers

Table FS1 Clear Time Characteristics for Slow-Blow Chip Fuses

0603SFS Series

% of Rated Current	Clear Time at 25°C	
100%	4 hrs (min)	
200%	1 s (min)	120 s (max)
300%	0.1 s (min)	3 s (max)
800%(1.0A-1.5A)	0.0005 s (min)	0.05 s (max)
800%(2.0A-5.0A)	0.001 s (min)	0.05 s (max)

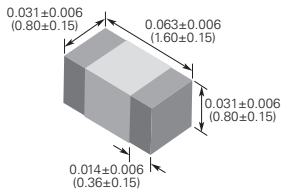
1206SFS Series

% of Rated Current	Clear Time at 25°C	
100%	4 hrs (min)	
200%	1 s (min)	120 s (max)
300%	0.1 s (min)	3 s (max)
800%(1.0A-1.5A)	0.0016 s (min)	0.05 s (max)
800%(2.0A-8.0A)	0.002 s (min)	0.05 s (max)

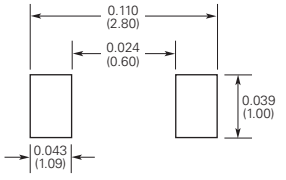
Table FS2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Slow-Blow Chip Fuses

0603 (1608mm) Slow-Blow Chip Fuses

Shape and Dimensions in (mm)



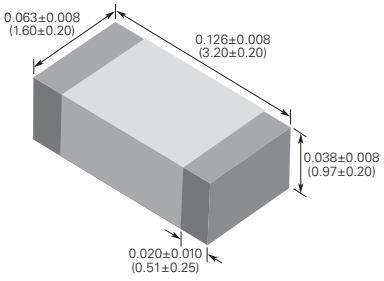
Recommended Pad Layout in (mm)



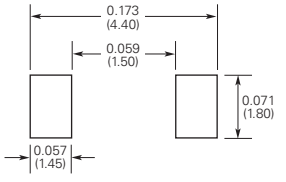
Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2s)†	Max Interrupt Ratings: Voltage (V_{DC})	Current (A)
0603SFS100F/32	1.0	0.200	0.093	32	50
0603SFS150F/32	1.5	0.100	0.18	32	50
0603SFS200F/32	2.0	0.052	0.32	32	50
0603SFS250F/32	2.5	0.041	0.63	32	50
0603SFS300F/32	3.0	0.031	0.87	32	50
0603SFS350F/32	3.5	0.021	1.20	32	50
0603SFS400F/32	4.0	0.017	2.30	32	50
0603SFS450F/32	4.5	0.015	2.70	32	50
0603SFS500F/32	5.0	0.013	3.20	32	50

1206 (3216mm) Slow-Blow Chip Fuses

Shape and Dimensions in (mm)



Recommended Pad Layout in (mm)



Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2s)†	Max Interrupt Ratings: Voltage (V_{DC})	Current (A)
1206SFS100F/63	1.0	0.360	0.11	63	50
1206SFS125F/63	1.25	0.200	0.22	63	50
1206SFS150F/63	1.5	0.150	0.23	63	50
1206SFS200F/63	2.0	0.088	0.63	63	50
1206SFS250F/32	2.5	0.065	0.90	32	50
1206SFS300F/32	3.0	0.034	1.20	32	50
1206SFS350F/32	3.5	0.028	1.60	32	50
1206SFS400F/32	4.0	0.024	2.20	32	50
1206SFS450F/32	4.5	0.020	3.60	32	50
1206SFS500F/32	5.0	0.016	5.30	32	50
1206SFS550F/24	5.5	0.014	6.40	24	50
1206SFS600F/24	6.0	0.011	8.50	24	60
1206SFS700F/24	7.0	0.010	10.00	24	60
1206SFS800F/24	8.0	0.009	16.90	24	60

* Measured at ≤10% of rated current and 25°C ambient temperature.
† Melting I^2t at 0.001 s clear time.

RoHS Compliant, ELV Compliant HF Halogen Free

Figures FS1-FS4 Family Performance Curves for Slow-Blow Chip Fuses

Figure FS1

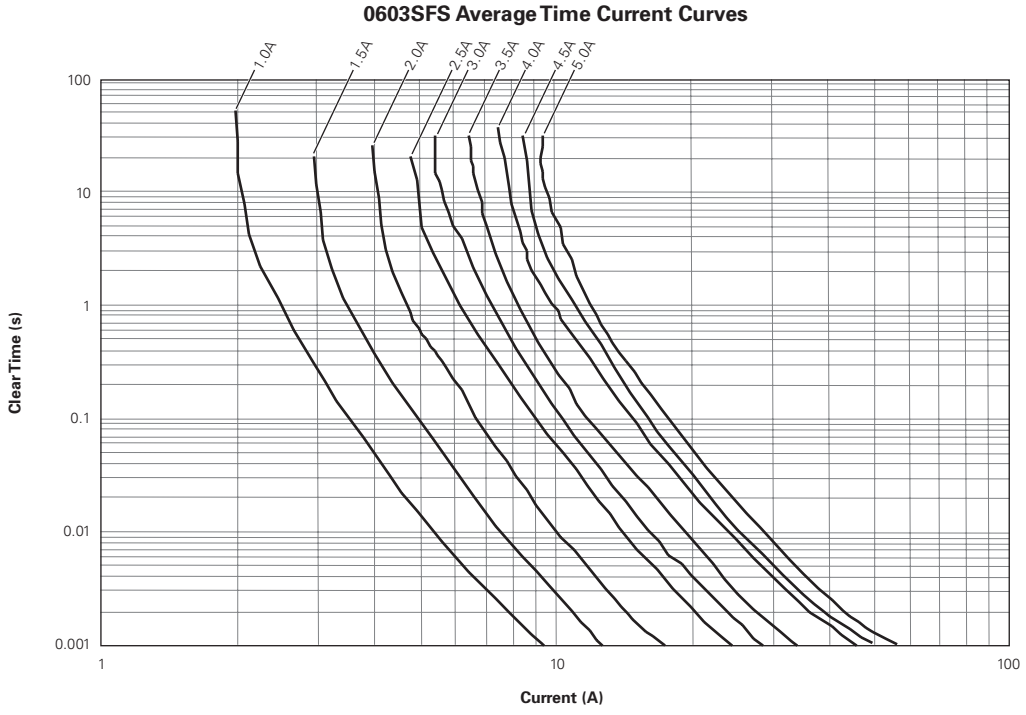
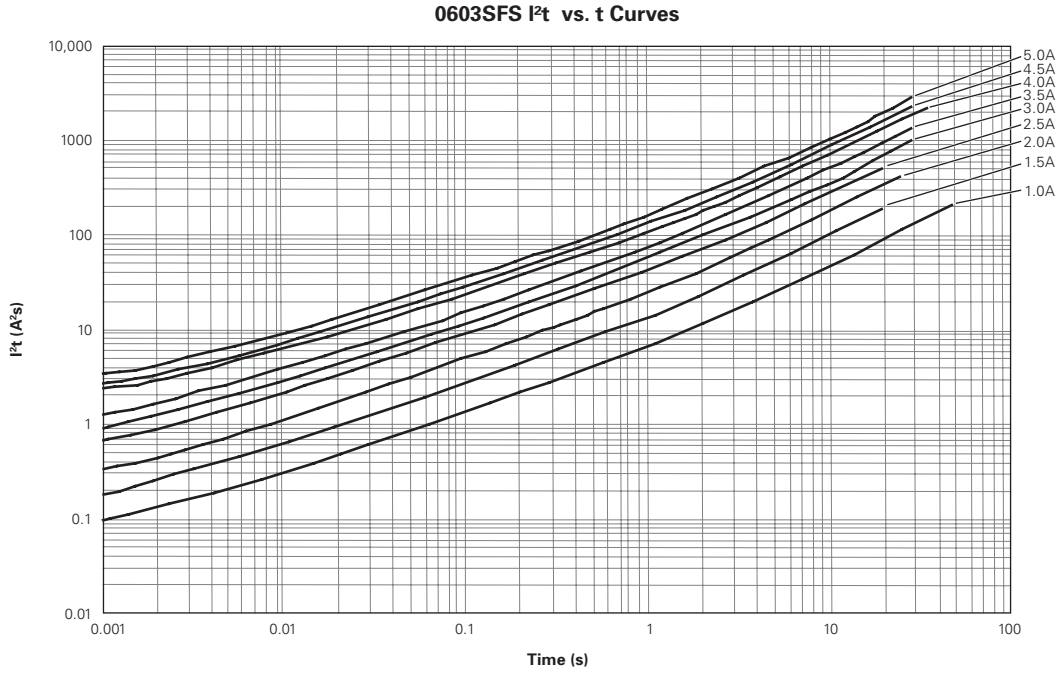


Figure FS2



Note: Curves are nominal.

Figure FS3

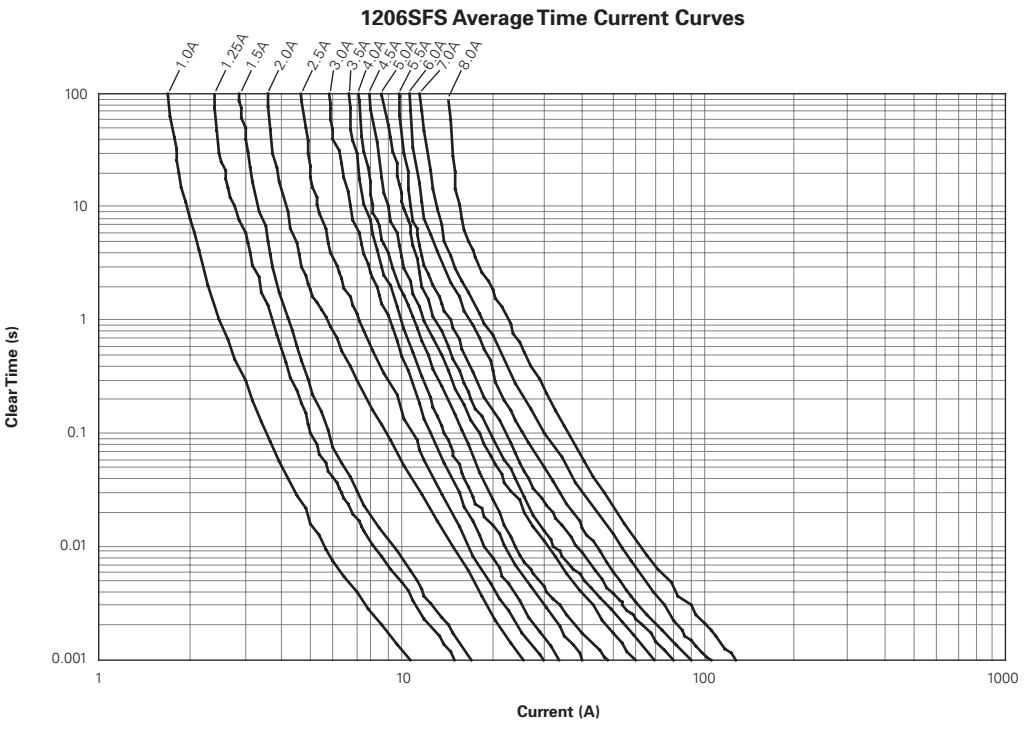
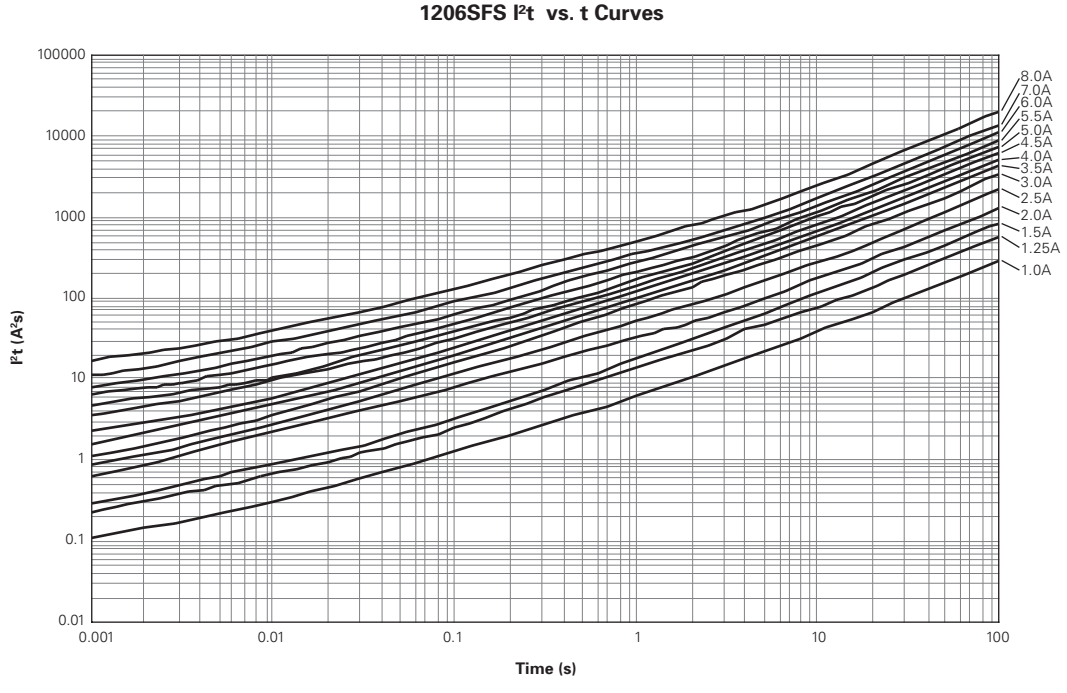


Figure FS4



Note: Curves are nominal

➔ **Please go to page 129 for more information about Slow-Blow Chip Fuses.**



Surface-Mount Fuses
2410 Very Fast-Acting Fuses

NEW

The 2410 (6125mm) Wire-in-Air (WIA) SMD Fuse is suitable for secondary-level overcurrent protection applications.

These lead-free surface-mount devices offer increased reliability and avoid the risk of end caps falling off. Their straight wire element in air performs consistent fusing and cutting characteristics.



Benefits

- Very fast acting at 200% overload current level
- Excellent inrush current withstand capability
- High reliability and resilience
- Strong arc suppression characteristics
- Copper terminal with nickel and tin plating

Features

- Halogen free, RoHS compliant and 100% lead free
- Copper or copper alloy composite fuse link
- Fiberglass enforced epoxy fuse body
- Wide range of current rating
- -55°C to +125°C operating temperature range (with de-rating)

Applications

- Industrial equipment
- LCD/PDP TV
- Backlight inverter
- Power supplier
- Telecom system
- Networking
- Game systems
- White goods
- Automotive

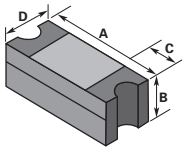
Table SFV1 Clear Time Characteristics for 2410 Very Fast-Acting Fuses

% of Rated Current	Clear Time at 25°C	
100%	4 hrs (min)	
200% (0.5A-10.0A)	0.01 s (min)	5 s (max)
200% (12.0A-20.0A)	0.01 s (min)	20 s (max)

Table SFV2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for 2410 Very Fast-Acting Fuses

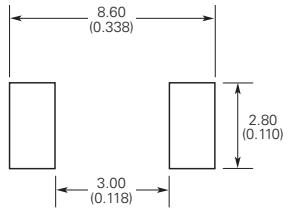
2410 (6125mm) Very Fast-Acting Fuse

Shape and Dimensions
mm (in)



	A		B		C		D	
	Min	Max	Min	Max	Min	Max	Min	Max
mm	5.95	6.25	1.96	2.36	0.97	1.73	2.34	2.64
in	(0.234)	(0.246)	(0.077)	(0.093)	(0.038)	(0.068)	(0.092)	(0.104)

Recommended Pad Layout
mm (Inch)



Part Number	Marking Code	Rated Current (A)	Interrupt Rating	Voltage Rating (V)		Nominal Cold DC Resistance (DCR) (Ω)*	Nominal I^2t (A^2s)
				AC	DC		
2410SFV0.50FM/125	C	0.5	**UL:** 0.5~2A 100A @ 250V_{AC} **2.5~8A** 50A @ 125V_{AC} **0.5~8A** 50A @ 125V_{DC} 300A @ 32V_{DC} **TUV:** **0.5~2A** 100A @ 250V_{AC} 50A @ 125V_{DC} **CQC:** **0.5A, 1A, 2A** 100A @ 250V_{AC} 50A @ 125V_{DC}	250	125	0.231	0.1
2410SFV0.63FM/125	S	0.63		250	125	0.174	0.16
2410SFV0.75FM/125	D	0.75		250	125	0.148	0.23
2410SFV1.00FM/125	E	1		250	125	0.093	0.59
2410SFV1.25FM/125	F	1.25		250	125	0.07	0.96
2410SFV1.50FM/125	G	1.5		250	125	0.062	1.19
2410SFV2.00FM/125	I	2		250	125	0.042	2.75
2410SFV2.50FM/125	J	2.5		125	125	0.031	1.21
2410SFV3.00FM/125	K	3		125	125	0.0249	1.73
2410SFV3.15FM/125	V	3.15		125	125	0.0232	2.2
2410SFV3.50FM/125	L	3.5		125	125	0.022	2.5
2410SFV4.00FM/125	M	4		125	125	0.0172	4.1
2410SFV5.00FM/125	N	5		125	125	0.0143	5.9
2410SFV6.30FM/125	O	6.3		125	125	0.01	12.5
2410SFV7.00FM/125	P	7		125	125	0.0094	14.2
2410SFV8.00FM/125	R	8		125	125	0.0086	20.3
2410SFV10.0FM/125	Q	10	**UL:** 35A @ 125V_{AC} 50A @ 125V_{DC} 300A @ 32V_{DC}	125	125	0.0066	29.2
2410SFV12.0FM/065	X	12	**UL:** 50A @ 65V_{AC} 50A @ 65V_{DC} 300A @ 32V_{DC}	65	65	0.0053	49.2
2410SFV15.0FM/065	Y	15		65	65	0.0038	102.5
2410SFV20.0FM/065	Z	20	**UL:** 50A @ 65V_{AC} 100A @ 65V_{DC} 300A @ 32V_{DC}	65	65	0.0034	126.2

* Measured at ≤10% of rated current and 25°C ambient

RoHS Compliant, ELV Compliant HF Halogen Free

Figures SFV1-SFV2 Family Performance Curves for 2410 Very Fast-Acting Fuses

Figure SFV1

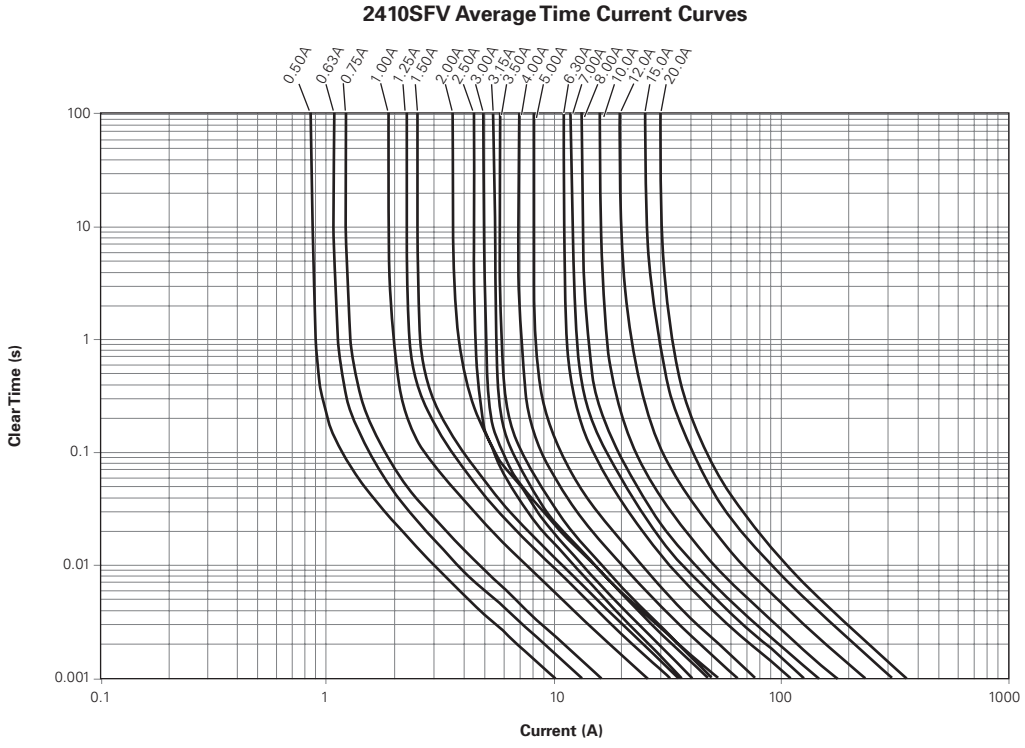
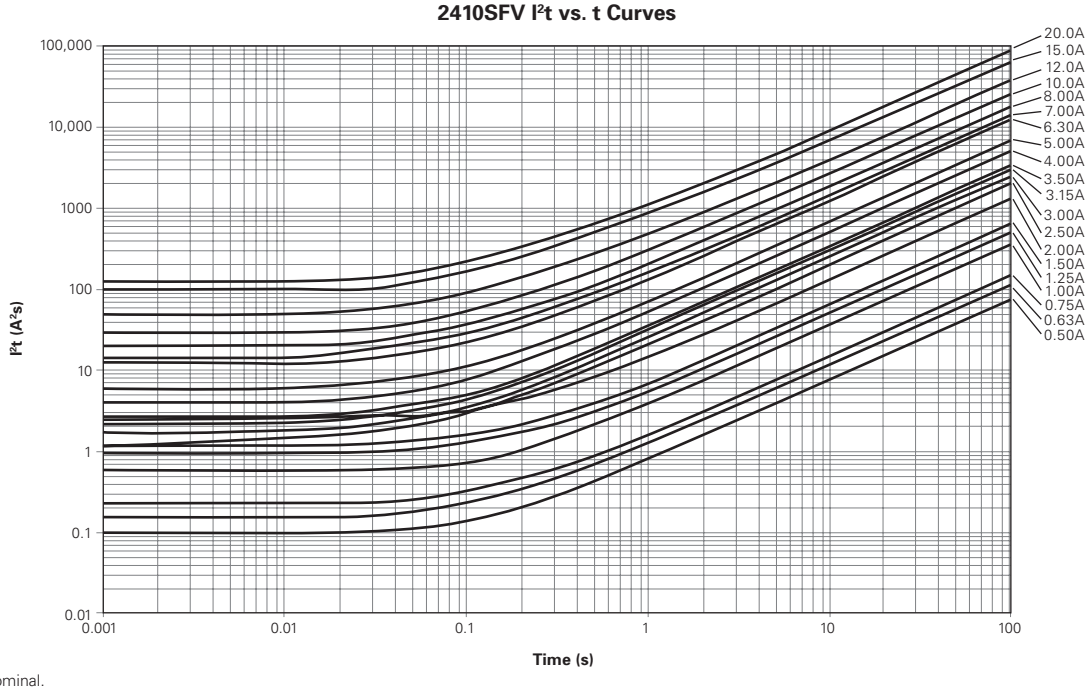


Figure SFV2



Note: Curves are nominal.

➔ **Please go to page 129 for more information about 2410 Fast-Acting Fuses.**

RoHS Compliant, ELV Compliant HF Halogen Free

RoHS Compliant, ELV Compliant HF Halogen Free

Specifications, Packaging Information, Agency Approvals and Part Numbering Systems for All Fuses

Table F1 Environmental Specifications for All Fuses

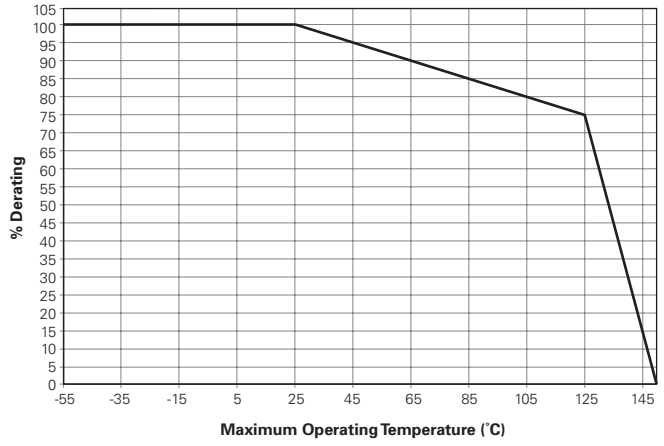
Operating Temperature	-55°C to +125°C
Mechanical Vibration	Withstands 5-3000 Hz at 30Gs when evaluated per Method 204 of MIL-STD-202
Mechanical Shock	Withstands 1500Gs, 0.5 millisecond half-sine pulses when evaluated per Method 213 of MIL-STD-202
Thermal Shock	Withstands 100 cycles from -65°C to +125°C when evaluated per Method 107 of MIL-STD-202
Resistance to Soldering Heat	Withstands 60 seconds at +260°C when evaluated per Method 210 of MIL-STD-202
Solderability	Meets 95% minimum coverage requirement when evaluated per Method 208 of MIL-STD-202
Moisture Resistance	Withstands 10 cycles when evaluated per Method 106 of MIL-STD-202
Salt Spray	Withstands 48-hour exposure when evaluated per Method 101 of MIL-STD-202
Storage Temperature	≤30°C/ 85% RH
Storage Humidity	Per MIL-STD-202F, Method 106F

Table F2 Material Specifications for All Fuses

Construction Body Material	Ceramic (1206/0603/0402); Fiberglass/Epoxy (2410)
Termination Material	Silver, Nickel, Tin
Fuse Element	Silver(1206/0603/0402); Copper/Copper Alloy (2410)

Figure F1 Thermal Derating Current for All Fuses

1206/0603/0402 Series
Temperature Effect on Current Rating



2410 Series
Temperature Effect on Current Rating

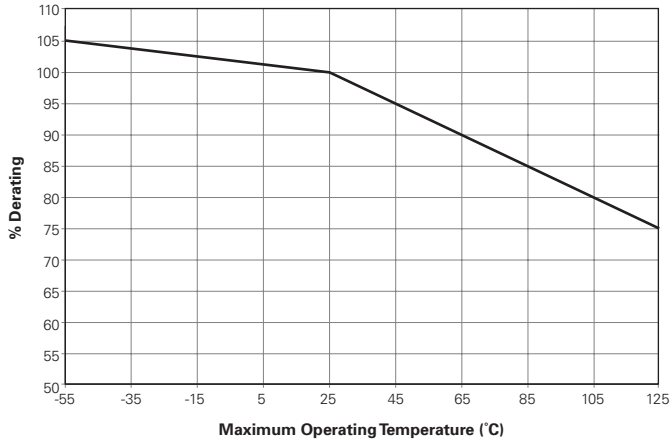


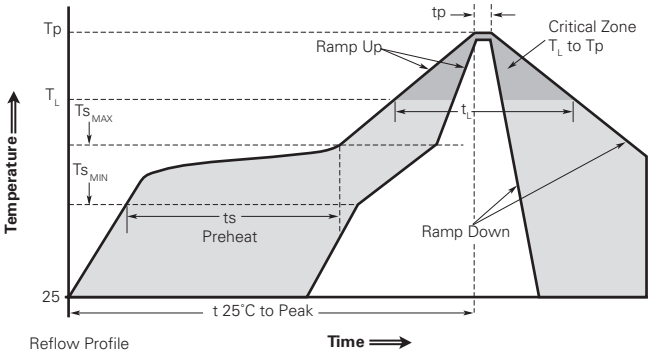
Table F3 Electrical Specifications for All Fuses

Insulation Resistance after Opening	20,000Ω minimum @ rated voltage. Fuse clearing under low-voltage conditions may result in lower post-clearing insulation values. Under normal fault conditions TE Circuit Protection fuses help provide sufficient insulation resistance for circuit protection.
Current Carrying Capacity	Withstands 100% rated current at +25°C ambient for 4 hours when evaluated per MIL-PRF-23419.

Table F4 Packaging Information for All Fuses

Size	Reel Quantity (pcs)	Reel Diameter	Reel Width	Carrier Tape Size	Tape Type	Reels per Outside Shipment Box	Outside Shipment Boxes per Overpack
0402 (1005)	10,000	178mm White Plastic	9.0 ± 0.5mm	8.00 ± 0.10mm	Paper	5	1 to 10
0603 (1608)	4,000	178mm White Plastic	9.0 ± 0.5mm	8.00 ± 0.10mm	Paper	5	1 to 10
0603SFV (1608)	6,000	178mm White Plastic	9.0 ± 0.5mm	8.00 ± 0.10mm	Paper	5	1 to 10
1206 (3216)	3,000	178mm White Plastic	9.0 ± 0.5mm	8.00 ± 0.10mm	Plastic	5	1 to 10
2410 (6125)	2,000	178mm White Plastic	13.4 ± 0.5mm	12.00 ± 0.10mm	Plastic	4	1 to 10

Figure F2 Recommended Soldering Temperature Profile for All Fuses



Classification Reflow Profiles

Profile Feature	1206/0603/0402	2410
Average Ramp Up Rate (Ts_{MAX} to Tp)	3°C/second max	3°C/second max
Preheat		
• Temperature min (Ts_{MIN})	150°C	150°C
• Temperature max (Ts_{MAX})	200°C	200°C
• Time (ts_{MIN} to ts_{MAX})	60-180 seconds	40-100 seconds
Time Maintained Above:		
• Temperature (T_L)	217°C	200°C
• Time (t_L)	60-150 seconds	30-90 seconds
Peak/Classification Temperature (Tp)	260°C max	250°C max
Time Within 5°C of Actual Peak Temperature		
Time (tp)	20-40 seconds	30-40 seconds
From 25°C to Preheating (150°C)	8 minutes max	40-100 seconds
Ramp Down Rate	4°C/seconds max	Natural Cooling

Recommended Conditions for Hand Soldering:

1. Using a hot air rework station that can reflow the solder on both terminations at the same time is strongly recommended; do not directly contact the chip termination with the tip of soldering iron.
2. Preheating: 150°C, 60s (min)
   Appropriate temperature (max) of soldering iron tip/soldering time (max): 280°C /10s or 350°C /3s.

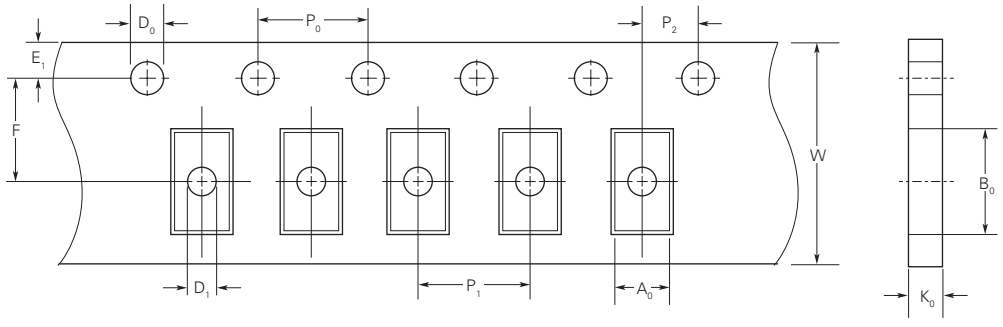
Table F4 Packaging Information for All Fuses (Cont'd)

Dimension in in (mm)

Mark	0402 (1005)	0603 (1608)	1206 (3216)	0603SFV (1608)	2410 (6125)
E_1	0.069 ± 0.004 (1.75 ± 0.10)	0.069 ± 0.004 (1.75 ± 0.10)	0.069 ± 0.004 (1.75 ± 0.10)	0.069 ± 0.004 (1.75 ± 0.10)	0.069 ± 0.004 (1.75 ± 0.10)
F	0.138 ± 0.002 (3.50 ± 0.05)	0.138 ± 0.002 (3.50 ± 0.05)	0.138 ± 0.002 (3.50 ± 0.05)	0.138 ± 0.002 (3.50 ± 0.05)	0.217 ± 0.004 (5.50 ± 0.10)
W	0.315 ± 0.004 (8.00 ± 0.10)	0.315 ± 0.004 (8.00 ± 0.10)	0.315 ± 0.004 (8.00 ± 0.10)	0.315 ± 0.004 (8.00 ± 0.10)	0.472 ± 0.004 (12.00 ± 0.10)
P_1	0.079 ± 0.004 (2.00 ± 0.10)	0.157 ± 0.004 (4.00 ± 0.10)	0.157 ± 0.004 (4.00 ± 0.10)	0.157 ± 0.004 (4.00 ± 0.10)	0.157 ± 0.004 (4.00 ± 0.10)
P_0	0.157 ± 0.004 (4.00 ± 0.10)	0.157 ± 0.004 (4.00 ± 0.10)	0.157 ± 0.004 (4.00 ± 0.10)	0.157 ± 0.004 (4.00 ± 0.10)	0.157 ± 0.004 (4.00 ± 0.10)
P_2	0.079 ± 0.002 (2.00 ± 0.05)	0.079 ± 0.002 (2.00 ± 0.05)	0.079 ± 0.002 (2.00 ± 0.05)	0.079 ± 0.002 (2.00 ± 0.05)	0.079 ± 0.004 (2.00 ± 0.10)
D_0	0.059 ± 0.004 (1.50+0.10/-0.00)	0.059 ± 0.004 (1.50+0.10/-0.00)	0.059 ± 0.004 (1.50+0.10/-0.00)	0.059 ± 0.004 (1.50+0.10/-0.00)	0.059 ± 0.004 (1.50+0.10/-0.00)
D_1	—	—	0.039 max (1.00 max)	—	0.61 ± 0.004 (1.55 ± 0.10)
t	—	—	0.009 ± 0.001 (0.23 ± 0.02)	—	0.010 ± 0.002 (0.25 ± 0.05)
A_0	0.026 ± 0.004 (0.67 ± 0.10)	0.039 ± 0.004 (0.98 ± 0.10)	0.071 ± 0.004 (1.80 ± 0.10)	0.039 ± 0.004 (0.98 ± 0.10)	0.112 ± 0.004 (2.85 ± 0.10)
B_0	0.046 ± 0.004 (1.17 ± 0.10)	0.071 ± 0.004 (1.80 ± 0.10)	0.138 ± 0.004 (3.50 ± 0.10)	0.071 ± 0.004 (1.80 ± 0.10)	0.252 ± 0.004 (6.40 ± 0.10)
K_0	0.025 ± 0.004 (0.63 ± 0.10)	0.037 ± 0.003 (0.95 ± 0.08)	0.050 ± 0.004 (1.27 ± 0.10)	0.024 ± 0.003 (0.60 ± 0.08)	0.093 ± 0.004 (2.35 ± 0.10)

Figure F3 Component Tape Dimensions for All Fuses

Paper Carrier Tape Specifications



Plastic Carrier Tape Specifications

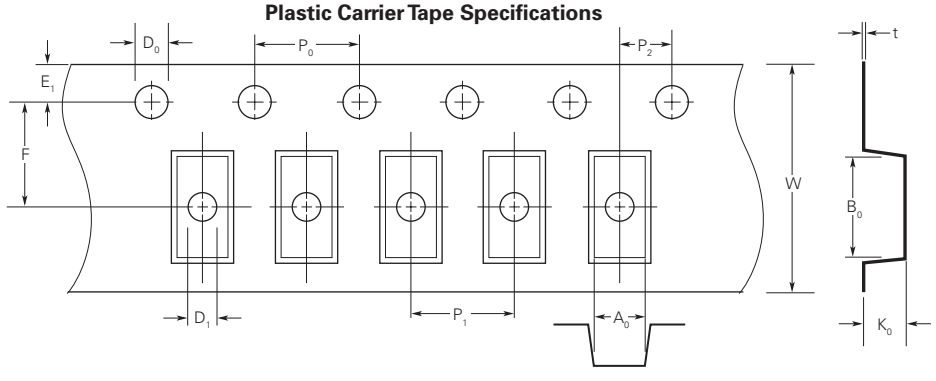
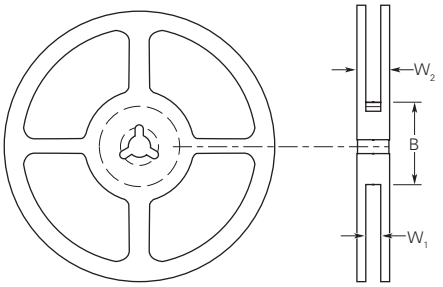


Figure F4 Reel Dimensions for All Fuses

Dimension Description	Mark	Dimension (mm) 1206/0603/0402	2410
Hub Outer Diameter	B	60	60.2
Reel Inside Width	W_1	9	13.4
Reel Outside Width	W_2	11.4	16
Tape Width		8	



Agency Approvals for All Fuses

UL: All fuses
CQC: File # 12012078873 (for 2410SFV 0.5A, 1A, 2A)
TUV: File # 50236400 (for 2410SFV 0.5A, 0.63A, 1A, 1.25A, 2A)

Part Numbering System for Fast-Acting, Slow-Blow and 0603 Very Fast-Acting Chip Fuses

1206 SF F 400 F / 24 -2

Packaging
-2 = Tape and Reel

Typical Voltage Rating
24 = $24V_{DC}$

Special Code
F = RoHS Compliant
FM = RoHS Compliant + Marked Part

Rated Current
050 = 0.50A
400 = 4A

Fuse Blow Type
F = Fast Acting
S = Slow Blow

SF = Surface-Mount Fuse

Size (1206, 0603, 0402)

10

Part Numbering System for High-Current-Rated Chip Fuses

1206 SF H 100 F / 24 -2

Packaging
-2 = Tape and Reel

Typical Voltage Rating
24 = $24V_{DC}$

Special Code
F = RoHS Compliant
FM = RoHS Compliant + Marked Part

Rated Current
100 = 10A

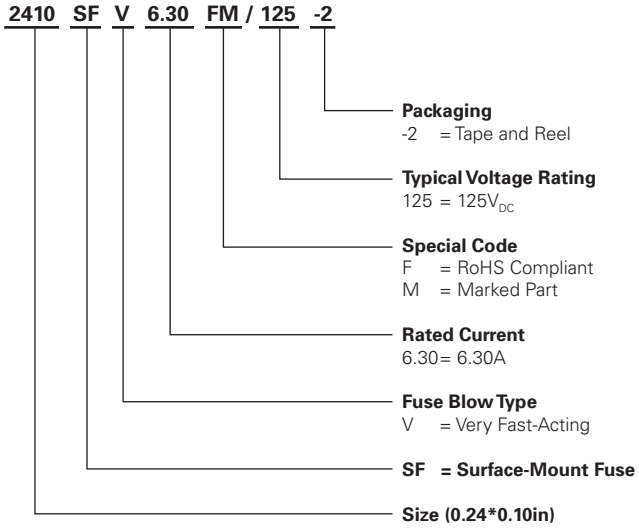
Fuse Blow Type
H = High Current

SF = Surface-Mount Fuse

Size (1206)

RoHS Compliant, ELV Compliant HF Halogen Free

Part Numbering System for 2410 Very Fast-Acting Fuses



Notice :

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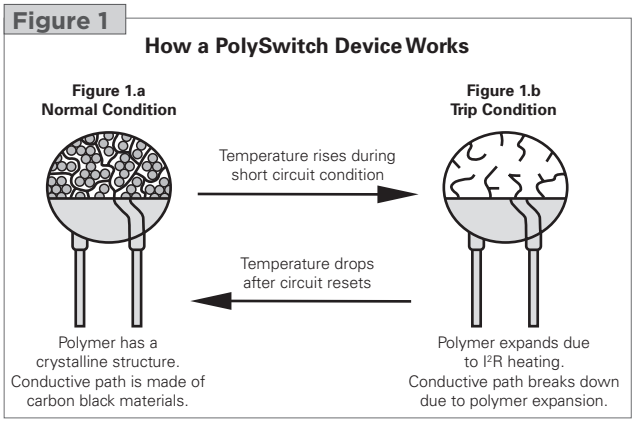
RoHS Compliant, ELV Compliant HF Halogen Free

PolySwitch Resettable Devices
Fundamentals

Overview

PolySwitch polymeric positive temperature coefficient (PPTC) devices help protect against damage caused by harmful overcurrent surges and overtemperature faults. Like traditional fuses, these devices limit the flow of dangerously high current during fault conditions. The PolySwitch device, however, resets after the fault is cleared and power to the circuit is removed, thereby helping to reduce warranty, service and repair costs.

Figure 1



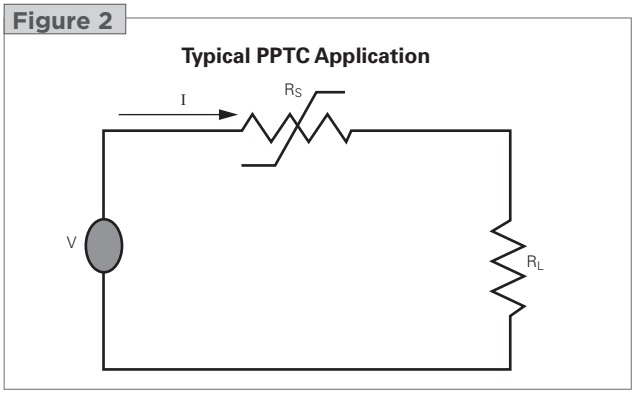
PolySwitch circuit protection devices are made from a composite of semi-crystalline polymer and conductive particles. At normal temperature, the conductive particles form low-resistance networks in the polymer (Figure 1.a). However, if the temperature rises above the device's switching temperature (Tsw), either from high current through the part or from an increase in the ambient temperature, the crystallites in the polymer melt and become amorphous. The increase in volume during melting of the crystalline phase separates the conductive particles, resulting in a large non-linear increase in the resistance of the device.

Overcurrent Protection Using a PPTC Device

The PPTC device is a series element in a circuit. The PPTC device helps protect the circuit by going from a low-resistance to a high-resistance state in response to an overcurrent condition, as shown in Figure 2. This is referred to as "tripping" the device.

In normal operation the device has a resistance that is much lower than that of the circuit. In response to an overcurrent condition, the device increases in resistance (trips), reducing the current in the circuit to a value that can be safely carried by any of the circuit elements. This change is the result of a rapid increase in the temperature of the device caused by I^2R heating.

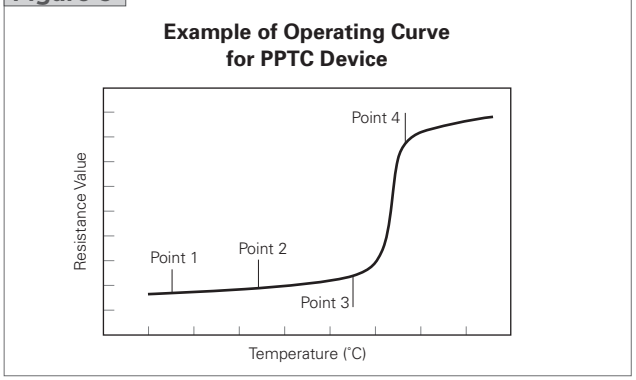
Figure 2



Principles of Operation

PolySwitch PPTC device's operation is based on an overall energy balance, as shown in Figure 3. Under normal operating conditions, the heat generated by the device and the heat lost by the device to the environment are in balance at a relatively low temperature, as shown between Points 1 and 2.

Figure 3



If the current through the device is increased while the ambient temperature is kept constant, the temperature of the device increases. Further increases in either current, ambient temperature, or both, will cause the device to reach a temperature where the resistance rapidly increases, as shown in Point 3.

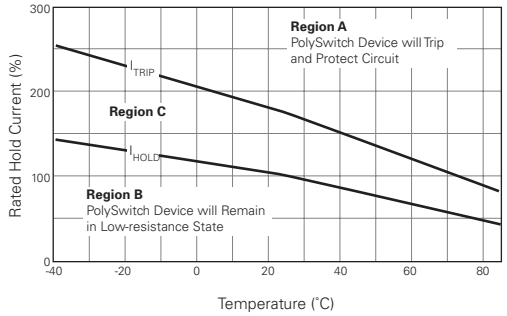
Any further increase in current or ambient temperature will cause the device to generate heat at a rate greater than the rate at which heat can be dissipated, thus causing the device to heat up rapidly. At this stage, a very large increase in resistance occurs for a very small change in temperature, between Points 3 and 4. This is the normal operating region for a device in the tripped state. This large change in resistance causes a corresponding decrease in the current flowing to the circuit. This relation holds until the device resistance reaches the upper knee of the curve (Point 4). As long as the applied voltage remains at this level, the device will remain in the tripped state (that is, the device will remain latched in its protective state). Once the voltage decreases, the power is removed and the device cools, the device will reset.

Example of Hold and Trip Current as a Function of Temperature

Figure 4 illustrates the hold- and trip-current behavior of a PolySwitch PPTC device as a function of temperature. One such curve can be defined for each available device. Region A describes the combinations of current and temperature at which the PolySwitch device will trip (go into the high-resistance state) and protect the circuit. Region B describes the combinations of current and temperature at which the PolySwitch device will allow for normal operation of the circuit. In Region C, it is possible for the device to either trip or remain in the low-resistance state (depending on individual device resistance).

Figure 4

Example of Hold and Trip Current as a Function of Temperature

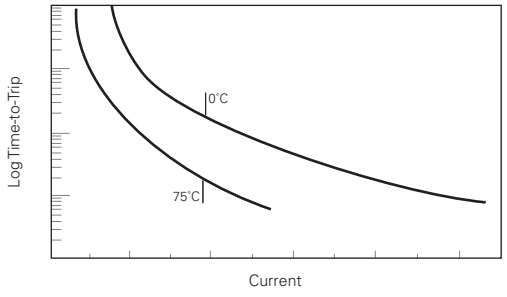


Operating Characteristics of a PolySwitch PPTC Device

Figure 5 shows a typical pair of operating curves for a PolySwitch device in still air at 0°C and 75°C. The curves are different because the heat required to trip the device comes both from electrical I^2R heating and from the device environment. At 75°C the heat input from the environment is substantially greater than it is at 0°C, so the additional I^2R needed to trip the device is correspondingly less. This results in a lower trip current at a given trip time (or a faster trip at given trip current).

Figure 5

Example of PolySwitch PPTC Device Operating Characteristics



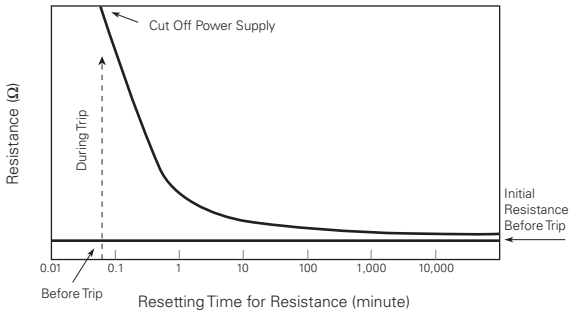
Typical Resistance Recovery After a Trip Event

Figure 6 shows typical behavior of a PolySwitch device that is tripped and then allowed to cool. This figure illustrates how, even after a number of hours, the device resistance is still greater than the initial resistance. Over an extended period of time, device resistance will continue to fall and will eventually approach initial resistance.

However, since this time can be measured in days, months, or years, it is not practical to expect that the device resistance will reach the original value for operational purposes. Therefore, when PolySwitch devices are chosen, R_{1MAX} should be taken into consideration when determining hold current. R_{1MAX} is the resistance of the device one hour after the thermal event.

Figure 6

Typical Resistance Recovery After a Trip Event



 RoHS Compliant, ELV Compliant

PolySwitch Resettable Devices
Product Selection Guide

Table 1 PolySwitch Device Characteristics

PolySwitch Device Family	V_{MAX} Operating (V_{DC})	V_{MAX} Interrupt (V_{RMS})	I_H	Temp. Range	Form Factor	Agency Spec.	Application
LVR	120V/240V	135V/265V	0.05 to 2A	-20 to 85°C	Radial-leaded	UL, CSA, TÜV	Line Voltage
LVB	240V	265V	1.25A	-40 to 85°C	Radial-leaded	UL	Line Voltage
RGEF	16V	-	2.5 to 14.0A	-40 to 85°C	Radial-leaded	UL, CSA, TÜV	General Electronics
RHEF	16 to 30V	-	0.5 to 15A	-40 to 125°C	Radial-leaded	UL, CSA, TÜV	General Electronics
RUEF	30V	-	0.9 to 9.0A	-40 to 85°C	Radial-leaded	UL, CSA, TÜV	General Electronics
RKEF	60V	-	0.50 to 5A	-40 to 85°C	Radial-leaded	UL, CSA, TÜV	General Electronics
RXEF	60 to 72V	-	0.05 to 3.75A	-40 to 85°C	Radial-leaded	UL, CSA, TÜV	General Electronics
RUSBF	6 to 16V	-	0.75 to 2.5A	-40 to 85°C	Radial-leaded	UL, CSA, TÜV	Computer/General Electronics
femtoSMDC	6 to 15V	-	0.05 to 0.35A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Computer/General Electronics
microSMD	6 to 30V	-	0.05 to 2.0A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Computer/General Electronics
midSMD	6 to 60V	-	0.3 to 2.0A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Computer/General Electronics
miniSMDC	6 to 60V	-	0.10 to 3A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Computer/General Electronics
nanoSMDC	6 to 48V	-	0.12 to 2.0A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Computer/General Electronics
picoSMDC	6 to 15V	-	0.10 to 1.1A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Computer/General Electronics
SMD	6 to 60V	-	0.3 to 3.0A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Computer/General Electronics
SMD2	15 to 33V	-	1.5 to 2.5A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Computer/General Electronics
BD	14V	-	8 to 21A	-40 to 125°C	Plug-in	-	Automotive
AGRF	16V	-	4.0 to 14.0A	-40 to 85°C	Radial-leaded	-	Automotive
AHRF	16 to 30V	-	0.50 to 15A	-40 to 125°C	Radial-leaded	-	Automotive
AHS	16V	-	0.80 to 3.0A	-40 to 125°C	Surface-mount	-	Automotive
ASMD	16 to 60V	-	0.23 to 1.97A	-40 to 85°C	Surface-mount	-	Automotive
AHEF	32V	-	0.50 to 10A	-40 to 125°C	Radial-leaded	-	Automotive
nanoASMDC	16 to 48V	-	0.12 to 0.35A	-40 to 85°C	Surface-mount	-	Automotive
microASMD	30V	-	0.05 to 0.1A	-40 to 85°C	Surface-mount	-	Automotive
miniASMDC	16 to 60V	-	0.1 to 2.6A	-40 to 85°C	Surface-mount	-	Automotive
TCF	60V	250V	0.10 to 0.18A	-40 to 85°C	Chip	-	Telecom & Networking
TRF250	60 to 100V	250V	0.055 to 0.184A	-40 to 85°C	Radial-leaded	UL, CSA, TÜV	Telecom & Networking
TRF600	60 to 250V	600V	0.15 to 0.40A	-40 to 85°C	Radial-leaded	UL, CSA, TÜV	Telecom & Networking
TS250/TSV250	60V	250V	0.13A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Telecom & Networking
TSL250	80V	250V	0.08A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Telecom & Networking
TS600/TSM600	60 to 250V	600V	0.17 to 0.40A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Telecom & Networking
MXP	6V	-	1.9 to 3.7A	-40 to 85°C	Axial-leaded	UL, CSA, TÜV	Battery
LR4	15 to 20V	-	1.9 to 13.0A	-40 to 85°C	Axial-leaded	UL, CSA, TÜV	Battery
SRP	15 to 30V	-	1.2 to 4.2A	-40 to 85°C	Axial-leaded	UL, CSA, TÜV	Battery
VLP	16V	-	1.2 to 2.7A	-40 to 85°C	Axial-leaded	UL, CSA, TÜV	Battery
VLR	12V	-	1.7 to 2.3A	-40 to 85°C	Axial-leaded	UL, CSA, TÜV	Battery
VTP	16V	-	1.1 to 2.1A	-40 to 85°C	Axial-leaded	UL, CSA, TÜV	Battery
low rho SMD	6V	-	1.75 to 5.0A	-40 to 85°C	Surface-mount	UL, CSA, TÜV	Battery

Table 2 Thermal Derating PPTC

PolySwitch Device Family	-40°C	-20°C	0°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	85°C	125°C
LVR005-055	-	1.48	1.24	1.00	0.99	0.93	0.82	0.72	0.60	0.51	0.35	-
LVR075-200	-	1.69	1.34	1.00	0.99	0.95	0.88	0.80	0.73	0.66	0.55	-
LVB	1.67	1.45	1.22	1.00	0.95	0.88	0.79	0.69	0.59	0.48	0.33	-
RGEF	1.54	1.37	1.21	1.04	1.00	0.96	0.88	0.79	0.71	0.63	0.50	-
RHEF	1.50	1.35	1.19	1.04	1.00	0.96	0.88	0.81	0.73	0.65	0.54	0.23
RUEF	1.48	1.32	1.16	1.00	0.96	0.92	0.84	0.76	0.68	0.60	0.48	-
RKEF	1.45	1.30	1.15	1.00	0.97	0.92	0.83	0.77	0.68	0.61	0.52	-
RXEF	1.56	1.37	1.19	1.00	0.95	0.91	0.82	0.72	0.63	0.54	0.40	-
RUSBF	1.41	1.27	1.14	1.00	0.97	0.93	0.87	0.80	0.73	0.66	0.56	-
femtoSMDC	1.59	1.39	1.18	1.05	1.00	0.86	0.78	0.66	0.61	0.47	0.41	-
microSMD	1.45	1.30	1.15	1.00	0.96	0.93	0.85	0.78	0.70	0.63	0.51	-
midSMD	1.41	1.27	1.14	1.00	0.97	0.93	0.87	0.80	0.73	0.66	0.56	-
miniSMD	1.45	1.30	1.15	1.00	0.96	0.93	0.85	0.78	0.70	0.63	0.51	-
nanoSMD	1.56	1.39	1.15	1.04	1.00	0.96	0.87	0.79	0.70	0.61	0.49	-
picoSMD	1.45	1.30	1.15	1.00	0.96	0.93	0.85	0.78	0.70	0.63	0.51	-
SMD	1.45	1.30	1.15	1.00	0.96	0.93	0.85	0.78	0.70	0.63	0.51	-
BD	1.50	1.35	1.19	1.04	1.00	0.96	0.88	0.81	0.73	0.65	0.54	0.23
AGRF	1.54	1.37	1.21	1.04	1.00	0.96	0.88	0.79	0.71	0.63	0.50	-
AHRF	1.50	1.35	1.19	1.04	1.00	0.96	0.88	0.81	0.73	0.65	0.54	0.23
AHS	1.41	1.28	1.16	1.03	1.00	0.97	0.91	0.84	0.78	0.72	0.62	0.37
ASMD	1.59	1.41	1.23	1.05	1.00	0.95	0.86	0.77	0.68	0.59	0.45	-
AHEF	1.36	1.25	1.14	1.03	1.00	0.96	0.89	0.81	0.74	0.66	0.55	0.20
nanoASMDC	1.56	1.39	1.15	1.04	1.00	0.96	0.87	0.79	0.70	0.61	0.49	-
microASMD	1.45	1.30	1.15	1.00	0.96	0.93	0.85	0.78	0.70	0.63	0.51	-
miniASMDC	1.45	1.30	1.15	1.00	0.96	0.93	0.85	0.78	0.70	0.63	0.51	-
TCF	1.54	1.36	1.18	1.00	0.96	0.91	0.82	0.73	0.64	0.55	0.42	-
TRF	1.54	1.36	1.18	1.00	0.96	0.91	0.82	0.73	0.64	0.55	0.42	-
TS	1.54	1.36	1.18	1.00	0.96	0.91	0.82	0.73	0.64	0.55	0.42	-
MXP	1.99	1.68	1.37	1.07	1.00	0.91	0.76	0.61	0.45	0.30	0.07	-
LR4	1.41	1.27	1.14	1.00	0.97	0.93	0.87	0.80	0.73	0.66	0.56	-
SRP	1.47	1.31	1.16	1.00	0.96	0.92	0.85	0.77	0.69	0.61	0.50	-
VLP	1.88	1.67	1.43	1.05	1.00	0.95	0.76	0.62	0.48	0.33	0.04	-
VLR	2.05	1.70	1.41	1.08	1.00	0.92	0.74	0.59	0.41	0.18	-	-
VTP	1.88	1.67	1.43	1.05	1.00	0.95	0.76	0.62	0.48	0.33	0.04	-
low rho SMD	5.80	5.20	4.60	4.00	3.90	3.40	3.10	2.82	2.52	2.23	2.10	-

PolySwitch Device Selection Guide

Step 1. Determine your circuit's parameters

You will need to determine the following parameters of your circuit:

- Maximum ambient operating temperature
- Normal operating current
- Maximum operating voltage
- Maximum interrupt current

Step 2. Select a PolySwitch device that will accommodate the circuit's maximum ambient temperature and normal operating current

Use the Thermal Derating [Hold Current (A) at Ambient Temperature (°C)] table on page 112 and choose the column with the temperature that most closely matches the circuit's maximum ambient temperature. Look down that column to find the value equal to or greater than the circuit's normal operating current. Now look to the far left of that row to find the part number that will best accommodate that current.

Step 3. Compare the selected device's maximum electrical ratings with the circuit's maximum operating voltage and interrupt current

Use the Electrical Characteristics table on page 111 to verify that the part you selected in Step 2 will handle your circuit's maximum operating voltage and interrupt current. Find the device's maximum operating voltage (V_{MAX}) and maximum interrupt current (I_{MAX}). Ensure that V_{MAX} and I_{MAX} are greater than or equal to the circuit's maximum operating voltage and maximum fault current.

Step 4. Determine time-to-trip

Time-to-trip is the amount of time it takes for a device to switch to a high-resistance state once a fault current has been applied through the device. Identifying the PolySwitch device's time-to-trip is important in order to provide the desired protection capabilities. If the chosen device trips too fast, undesired or nuisance tripping may occur. If the device trips too slowly, the components being protected may be damaged before the device can trip and limit the current.

Use the Typical Time-to-trip Curves at 20°C on page 110 Figure 5 to determine if the PolySwitch device's time-to-trip characteristics are acceptable at expected fault levels. If not, go back to Step 2 and choose an alternate device.

Step 5. Verify ambient operating temperature

Ensure that your application's minimum and maximum ambient temperatures are within the operating temperature of the PolySwitch device. Most PolySwitch devices have an operating temperature range from -40°C to 85°C with some exceptions to 125°C.

Step 6. Verify the PolySwitch device dimensions

Use the Dimensions table on pages 122-125 to compare the dimensions of the PolySwitch device you selected with the application's space considerations.

Definitions of terms

I_H	the maximum steady state current at 20°C that can be passed through a PolySwitch device without causing the device to trip
I_T	the minimum current that will cause the PolySwitch device to trip at 20°C
V_{MAX}	the maximum voltage that can safely be dropped across a PolySwitch device in its tripped state also called: Maximum Device Voltage, Maximum Voltage, Vmax, Max Interrupt Voltage
I_{MAX}	the maximum fault current that can safely be used to trip a PolySwitch device
P_D	the power (in Watts) dissipated by a PolySwitch device in its tripped state
R_{MAX}	the maximum resistance prior to the trip of a PolySwitch device
R_{MIN}	the minimum resistance prior to the trip of a PolySwitch device
R_{1MAX}	the maximum resistance of a PolySwitch device at 20°C 1 hour after being tripped and reset or after reflow soldering
$R_{Tripped\ Typ}$	the typical resistance of a PolySwitch device 1 hour after the initial trip and reset

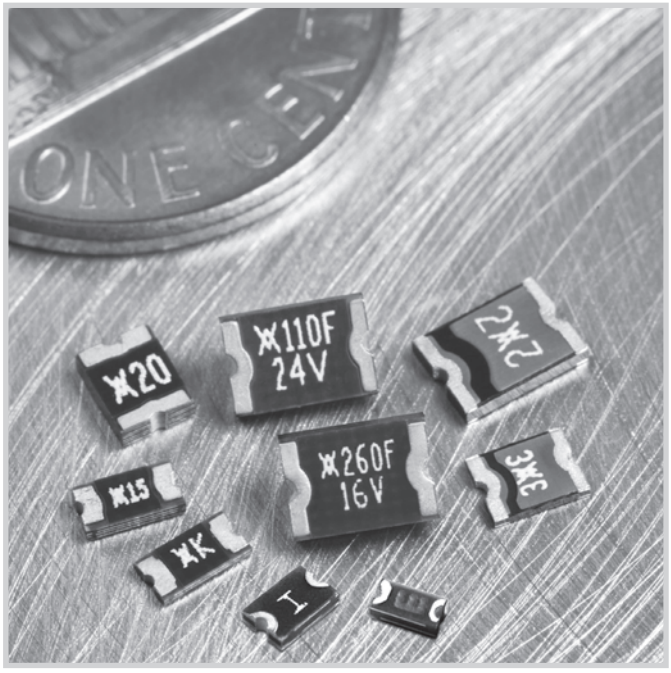


PolySwitch Resettable Devices
Surface-Mount Devices

PolySwitch surface-mount devices are an effective circuit protection method for computer, consumer, multimedia, portable and automotive electronics applications.

In an affort to reduce the size and cost of surface-mount devices, TE Circuit Protection introduced the miniSMD product series in 1995. Subsequently, we developed the microSMD, nanoSMD, picoSMD and femtoSMD family of products. The femtoSMD series reduced the device size to a 1608mm (0603 mils) footprint, which is one-twelfth the size of the popular miniSMD series.

Recent additions to the PolySwitch surface-mount series include 1.1A picoSMD 1210mm (0805 mils) and 0.35A femtoSMD 1608mm (0603 mils) devices.



Benefits

- Smaller size helps save board space and cost
- Many product choices optimizes design flexibility
- Compatible with high-volume electronics assembly
- Assists in meeting regulatory requirements
- Higher voltage ratings allow use in new applications

Features

- RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Broadest range of resettable devices available in the industry
- Current ratings from 0.05 to 3A
- Voltage ratings from 6V computer and electronic applications to 60V telecom applications
- Agency recognition: UL, CSA, TÜV
- Small footprint
- Fast time-to-trip
- Low resistance

Applications

- Computer
- Portable electronics
- Multimedia
- Game machines
- Telephony and broadband
- Mobile phones
- Automotive
- Industrial controls
- Battery

RoHS Compliant, ELV Compliant HF Halogen Free

Application Selection Table for PolySwitch Surface-Mount Devices

- The table below lists PolySwitch surface-mount devices recommended for use in typical applications
- Specifications for the suggested PolySwitch surface-mount device part numbers can be found in this table
- Once a part has been selected, the user should evaluate and test each product for the intended application

			PolySwitch Resettable Devices - Key Selection Criteria		
Protection Application	**Additional Comments**	**Overcurrent Overvoltage**	**Small Size**	**Low Resistance**	**Fast Time-to-trip (Temperature Protection)**
AC Adapter Input Power	Use w/ Zener and Triac		SMD250F	SMD250F	SMD200F
Battery Pack Protection			nanoSMDC150F	miniSMDC260F	miniSMDC200F/16
Charger Protection			nanoSMDC050F	miniSMDC110F/16	nanoSMDC075F
CPU/IC Protection			nanoSMDC110F	nanoSMDC150F	nanoSMDC075F
Data Acquisition/Sensor			microSMD005F	-	microSMD005F
DC Input/Output Power	≤6V		nanoSMDC075F	nanoSMDC150F	nanoSMDC050F/13.2
	≤12V		miniSMDC075F	miniSMDC110F/16	miniSMDC075F
DDC			nanoSMDC075F	nanoSMDC110F	nanoSMDC050F/13.2
Device Bay System	DB12, DB20		miniSMDC200F	miniSMDC260F	miniSMDC200F
	DB32		miniSMDC260F	SMD300F	miniSMDC200F
Ethernet/LAN			nanoSMDC050F/13.2	miniSMDC110F/16	nanoSMDC075F
Fan			microSMD035F	microSMD050F	microSMD035F
HDMI			picoSMDC035S	picoSMDC035S	picoSMDC035S
IEEE 802.3af	VoIP		decaSMDC050F/60	decaSMDC050F/60	decaSMDC050F/60
IEEE-1394	Power Provider		SMD100F/33	SMD185F	SMD100F/33
	Alt. Power Provider		SMD185F	SMD185F	SMD150F/33
	Self-Powered		SMD185F	SMD185F	SMD150F/33
LCD Inverter			nanoSMDC050F/13.2	miniSMDC110F/16	nanoSMDC075F
LCD Screen Power			nanoSMDC050F/13.2	nanoSMDC050F/13.2	microSMD035F
LNB (Low Noise Block)			SMD075F	SMD075F	SMD050F
Motor	≤6V		nanoSMDC110F	nanoSMDC150F	microSMD075F
	≤13.2V		miniSMDC075F	miniSMDC110F/16	miniSMDC075F
PS/2 Mouse/Keyboard			nanoSMDC075F	nanoSMDC110F	nanoSMDC050F/13.2
Signal - Data Communication	≤6V		nanoSMDC075F	nanoSMDC075F	nanoSMDC075F
	≤13.2V		miniSMDC050F	miniSMDC075F	miniSMDC020F
	≤30V		SMD030F-2018	SMD075F	SMD050F
SCSI			nanoSMDC110F	nanoSMDC150F	nanoSMDC075F
SIM/Smart Card Reader			femtoSMDC010F	femtoSMDC010F	femtoSMDC005F
Telecom - Modem	Digital Line	OC	miniSMDC014F	miniSMDC014F	miniSMDC014F
Telecom - PBX	Subscriber	OC	miniSMDC014F	miniSMDC014F	miniSMDC014F
Temperature Sensor	CPU		nanoSMDC050F/13.2	nanoSMDC075F	nanoSMDC050F/13.2
USB	Individual Port		nanoSMDC075F	nanoSMDC110F	nanoSMDC050F/13.2
	2 Port Ganged		nanoSMDC150F	miniSMDC150F	miniSMDC125F
	3 Port Ganged		miniSMDC200F	miniSMDC200F	miniSMDC200F

Note : This list is not exhaustive. TE Circuit Protection welcomes our customers' input for additional application ideas for PolySwitch resettable devices.

Table S1 Product Series: Size, Current Rating, Voltage Rating/Maximum Resistance for PolySwitch Surface-Mount Devices

	femtoSMD	picoSMD	nanoSMD	microSMD	miniSMD	midSMD	SMD	SMD2	decaSMD
Size mm (mils)	1608 (0603)	2012 (0805)	3216 (1206)	3225 (1210)	4532 (1812)	5050 (2018)	7555 (2920)	8763 (3425)	5050 (2018)
Hold Current (A)									
0.050	$15V_{DC}$/30.00Ω	—	—	$30V_{DC}$/50Ω	—	—	—	—	—
0.080	$12V_{DC}$/14.00Ω	—	—	—	—	—	—	—	—
0.100	$12V_{DC}$/8.00Ω	$15V_{DC}$/11.00Ω	—	$30V_{DC}$/15Ω	$60V_{DC}$/12.70Ω	—	—	—	—
0.120	$9V_{DC}$/5.80Ω	$15V_{DC}$/9.00Ω	$48V_{DC}$/6.50Ω	—	—	—	—	—	—
0.140	—	—	—	—	$60V_{DC}$/6.00Ω	—	—	—	—
0.160	$9V_{DC}$/4.20Ω	—	$48V_{DC}$/5.00Ω	—	—	—	—	—	—
0.200	$9V_{DC}$/3.00Ω	$9V_{DC}$/3.20Ω	$24V_{DC}$/3.10Ω	—	$30V_{DC}$/3.30Ω	—	—	—	—
0.250	—		$16V_{DC}$/2.30Ω	—	—	—	—	—	—
0.300	—	—	—	—	$30V_{DC}$/1.75Ω	$60V_{DC}$/2.30Ω	$60V_{DC}$/4.80Ω	—	—
0.350	$6V_{DC}$/1.40Ω	$6V_{DC}$/1.40Ω	$16V_{DC}$/1.35Ω	$6V_{DC}$/1.30Ω	—	—	—	—	—
0.500	—	$6V_{DC}$/0.80Ω	$13.2V_{DC}$/0.75Ω	$13.2V_{DC}$/0.90Ω	$24V_{DC}$/1.00Ω	—	$60V_{DC}$/1.40Ω	—	$60V_{DC}$/1.10Ω
0.750	—	$6V_{DC}$/0.35Ω	$6V_{DC}$/0.30Ω	$6V_{DC}$/0.40Ω	$13.2V_{DC}$/0.45Ω	—	$30V_{DC}$/1.00Ω	—	—
	—	—	—	—	$24V_{DC}$/0.29Ω	—	$60V_{DC}$/1.00Ω	—	—
	—	—	—	—	$33V_{DC}$ /0.39Ω	—	—	—	—
1.000	—	—	—	—	—	$15V_{DC}$/0.40Ω	$30V_{DC}$/0.48Ω	—	—
	—	—	—	—	—	—	$33V_{DC}$/0.41Ω	—	—
1.100	—	$6V_{DC}$/0.17Ω	$6V_{DC}$/0.20Ω	$6V_{DC}$/0.21Ω	$8V_{DC}$/0.21Ω	—	—	—	—
	—	—	—	—	$16V_{DC}$/0.18Ω	—	—	—	—
	—	—	—	—	$24V_{DC}$/0.18Ω	—	—	—	—
1.200	—	—	—	—	—	—	$16V_{DC}$/0.34Ω	—	—
1.250	—	—	—	—	$6V_{DC}$/0.14Ω	—	$15V_{DC}$/0.25Ω	—	—
	—	—	—	—	$16V_{DC}$/0.14Ω	—	—	—	—
1.500	—	—	$6V_{DC}$/0.11Ω	$6V_{DC}$/0.11Ω	$6V_{DC}$/0.11Ω	$15V_{DC}$/0.18Ω	$33V_{DC}$/0.23Ω	$15V_{DC}$/0.25Ω	—
	—	—	—	—	$12V_{DC}$/0.11Ω	—	—	$33V_{DC}$/0.23Ω	—
	—	—	—	—	$16V_{DC}$/0.11Ω	—	—	—	—
	—	—	—	—	$24V_{DC}$/0.12Ω	—	—	—	—
1.600	—	—	—	—	$9V_{DC}$/0.10Ω	—	—	$16V_{DC}$/0.15Ω	—
1.750	—	—	—	$6V_{DC}$/0.08Ω	—	—	—	—	—
1.850	—	—	—	—	—	—	—	$33V_{DC}$/0.165Ω	—
2.000	—	—	$6V_{DC}$/0.072Ω	$6V_{DC}$/0.06ΩΩ	$8V_{DC}$/0.07Ω	$6V_{DC}$/0.10Ω	$24V_{DC}$/0.125Ω	$15V_{DC}$/0.125Ω	—
	—	—	—	—	$16V_{DC}$/0.085Ω	—	—	—	—
2.500	—	—	—	—	—	—	$15V_{DC}$/0.085Ω	$15V_{DC}$/0.85Ω	—
2.600	—	—	—	—	$6V_{DC}$/0.043Ω	—	$6V_{DC}$/0.075Ω	—	—
	—	—	—	—	$12V_{DC}$/0.047Ω	—	—	—	—
	—	—	—	—	$13.2V_{DC}$/0.050Ω	—	—	—	—
	—	—	—	—	$16V_{DC}$/0.050Ω	—	—	—	—
3.000	—	—	—	—	$6V_{DC}$/0.036Ω	—	$6V_{DC}$/0.048Ω	—	—
	—	—	—	—	—	—	$15V_{DC}$/0.05Ω	—	—

Table S2 Thermal Derating for PolySwitch Surface-Mount Devices [Hold Current (A) at Ambient Temperature (°C)]

		Maximum Ambient Temperature											
	Part Number	-40°C	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	80°C	85°C	125°C
	femtoSMDC Series Size 1608mm/0603mils												
	femtoSMDC005F	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	—
	femtoSMDC008F	0.13	0.11	0.10	0.08	0.08	0.07	0.06	0.06	0.05	0.04	0.04	—
	femtoSMDC010F	0.16	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04	—
	femtoSMDC012F	0.18	0.16	0.14	0.12	0.12	0.11	0.10	0.08	0.08	0.07	0.06	—
	femtoSMDC016F	0.25	0.22	0.18	0.17	0.16	0.14	0.12	0.11	0.10	0.08	0.07	—
	femtoSMDC020F	0.30	0.27	0.24	0.20	0.20	0.17	0.16	0.14	0.12	0.11	0.10	—
	femtoSMDC035F	0.53	0.47	0.41	0.36	0.35	0.30	0.27	0.25	0.22	0.19	0.17	—
	picoSMDC Series Size 2012mm/0805mils												
	picoSMDC010S	0.17	0.15	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.05	—
	picoSMDC012S	0.20	0.17	0.15	0.13	0.12	0.10	0.09	0.08	0.07	0.06	0.05	—
	picoSMDC020S	0.30	0.27	0.24	0.21	0.20	0.18	0.16	0.15	0.13	0.12	0.11	—
	picoSMDC035S	0.55	0.49	0.44	0.37	0.35	0.31	0.28	0.26	0.23	0.20	0.18	—
	picoSMDC050S	0.70	0.62	0.55	0.55	0.50	0.43	0.38	0.33	0.30	0.28	0.26	—
NEW	picoSMDC075S	1.13	1.01	0.90	0.78	0.75	0.67	0.61	0.55	0.49	0.43	0.40	—
NEW	picoSMDC110S	1.64	1.47	1.30	1.14	1.10	0.97	0.89	0.80	0.72	0.64	0.59	—
	nanoSMDC Series Size 3216mm/1206mils												
	nanoSMDC012F	0.20	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.08	0.07	0.07	—
	nanoSMDC016F	0.21	0.20	0.18	0.16	0.16	0.14	0.13	0.12	0.11	0.10	0.09	—
	nanoSMDC020F	0.34	0.30	0.26	0.22	0.20	0.17	0.15	0.13	0.11	0.09	0.08	—
	nanoSMDC025F	0.38	0.33	0.30	0.26	0.25	0.22	0.20	0.19	0.16	0.13	0.11	—
	nanoSMDC035F	0.58	0.51	0.44	0.38	0.35	0.31	0.28	0.24	0.21	0.18	0.16	—
	nanoSMDC050F/13.2	0.78	0.69	0.61	0.52	0.50	0.44	0.39	0.35	0.30	0.25	0.24	—
	nanoSMDC075F	1.15	1.04	0.92	0.78	0.75	0.69	0.63	0.58	0.51	0.46	0.43	—
	nanoSMDC110F	1.64	1.46	1.30	1.10	1.06	0.92	0.83	0.80	0.65	0.56	0.52	—
	nanoSMDC150F	2.20	1.99	1.77	1.55	1.50	1.34	1.23	1.10	1.01	0.90	0.84	—
	nanoSMDC200F	2.92	2.64	2.35	2.07	2.00	1.79	1.64	1.50	1.36	1.22	1.15	—
	microSMD Series Size 3225mm/1210mils												
	microSMD005F	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	—
	microSMD010F	0.15	0.13	0.12	0.10	0.10	0.09	0.08	0.06	0.06	0.05	0.05	—
	microSMD035F	0.51	0.46	0.40	0.35	0.34	0.30	0.27	0.24	0.22	0.19	0.18	—
	microSMD050F	0.76	0.66	0.58	0.50	0.48	0.42	0.38	0.35	0.29	0.25	0.23	—
	microSMD075F	1.10	0.97	0.86	0.75	0.72	0.64	0.58	0.55	0.47	0.42	0.39	—
	microSMD110F	1.60	1.42	1.26	1.10	1.06	0.94	0.86	0.80	0.70	0.62	0.58	—
	microSMD150F	2.30	2.02	1.76	1.50	1.43	1.24	1.11	1.00	0.85	0.72	0.65	—
	microSMD175F	2.80	2.45	2.10	1.75	1.70	1.55	1.45	1.35	1.25	1.15	1.10	—
	microSMD200F	2.60	2.44	2.35	2.00	1.96	1.78	1.67	1.50	1.45	1.15	1.10	—
	miniSMDC Series Size 4532mm/1812mils												
	miniSMDC010F	0.17	0.15	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04	—
	miniSMDC014F	0.23	0.20	0.17	0.14	0.13	0.11	0.10	0.09	0.07	0.06	0.05	—
	miniSMDC020F	0.30	0.27	0.23	0.20	0.19	0.17	0.15	0.13	0.12	0.10	0.09	—
	miniSMDC030F	0.49	0.44	0.39	0.32	0.30	0.27	0.24	0.22	0.18	0.16	0.14	—
	miniSMDC050F	0.59	0.57	0.55	0.50	0.48	0.45	0.43	0.35	0.30	0.25	0.23	—
	miniSMDC075F	1.10	0.99	0.87	0.75	0.72	0.63	0.57	0.49	0.45	0.39	0.35	—
	miniSMDC075F/24	1.50	1.25	1.00	0.75	0.73	0.65	0.60	0.55	0.50	0.45	0.43	—
NEW	miniSMDC075F/33	1.09	0.98	0.87	0.77	0.75	0.66	0.61	0.55	0.50	0.45	0.42	—
	miniSMDC100F	1.60	1.45	1.28	1.10	1.07	0.92	0.83	0.71	0.66	0.57	0.52	—

RoHS Compliant, ELV Compliant HF Halogen Free

Table S2 Thermal Derating for PolySwitch Surface-Mount Devices [Hold Current (A) at Ambient Temperature (°C)] Cont'd

		Maximum Ambient Temperature											
	Part Number	-40°C	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	80°C	85°C	125°C
	miniSMDC Series												
	Size 4532mm/1812mils												
	miniSMDC110F	1.60	1.45	1.28	1.10	1.07	0.92	0.83	0.71	0.66	0.57	0.52	—
	miniSMDC110F/16	1.68	1.49	1.30	1.10	1.05	0.92	0.83	0.75	0.64	0.55	0.50	—
	miniSMDC110F/24	2.00	1.70	1.40	1.10	1.06	0.95	0.88	0.80	0.73	0.65	0.61	—
	miniSMDC125F	2.00	1.69	1.47	1.25	1.17	1.03	0.92	0.90	0.69	0.58	0.53	—
	miniSMDC125F/16	2.00	1.69	1.47	1.25	1.17	1.03	0.92	0.90	0.69	0.58	0.53	—
	miniSMDC150F	2.30	2.05	1.77	1.50	1.44	1.23	1.09	0.95	0.82	0.68	0.61	—
	miniSMDC150F/12	2.40	2.10	1.80	1.50	1.44	1.25	1.13	1.00	0.88	0.75	0.69	—
	miniSMDC150F/16	2.40	2.10	1.80	1.50	1.44	1.25	1.13	1.00	0.88	0.75	0.69	—
	miniSMDC150F/24	2.10	1.90	1.70	1.50	1.44	1.25	1.13	1.00	0.88	0.75	0.69	—
	miniSMDC160F	2.50	2.19	1.89	1.60	1.53	1.31	1.16	1.10	0.95	0.79	0.71	—
	miniSMDC200F	2.60	2.44	2.22	2.00	1.96	1.78	1.67	1.50	1.45	1.34	1.29	—
NEW	miniSMDC200F/16	3.07	2.74	2.40	2.07	2.00	1.74	1.57	1.40	1.24	1.07	0.99	—
	miniSMDC260F	3.40	3.16	2.80	2.60	2.54	2.32	2.18	2.00	1.90	1.76	1.69	—
	miniSMDC260F/12	3.40	3.16	3.00	2.60	2.54	2.32	2.18	2.00	1.90	1.76	1.69	—
	miniSMDC260F/13.2	3.40	3.16	3.00	2.60	2.54	2.32	2.18	2.00	1.90	1.76	1.69	—
	miniSMDC260F/16	3.50	3.20	3.00	2.60	2.53	2.30	2.15	2.00	1.85	1.70	1.63	—
	miniSMDC300F	4.13	3.75	3.33	3.02	3.00	2.70	2.54	2.35	2.22	2.06	1.98	—
	midSMD Series												
	Size 5050mm/2018mils												
	SMD030F-2018	0.48	0.42	0.35	0.30	0.28	0.24	0.21	0.17	0.15	0.12	0.10	—
	decaSMDC050F/60	1.00	0.85	0.70	0.55	0.53	0.45	0.40	0.35	0.30	0.25	0.23	—
	SMD100F-2018	1.59	1.43	1.20	1.10	1.03	0.94	0.85	0.72	0.69	0.61	0.57	—
	SMD150F-2018	2.21	1.97	1.70	1.50	1.43	1.26	1.15	1.00	0.91	0.79	0.73	—
	SMD200F-2018	2.81	2.54	2.27	2.00	1.93	1.73	1.59	1.46	1.32	1.19	1.12	—
	SMD Series												
	Size 7555mm/2920mils												
	SMD030F	0.44	0.39	0.32	0.30	0.28	0.26	0.23	0.19	0.18	0.17	0.15	—
	SMD050F	0.73	0.65	0.55	0.50	0.47	0.43	0.39	0.33	0.31	0.28	0.26	—
	SMD075F	1.11	0.99	0.84	0.75	0.71	0.63	0.57	0.49	0.45	0.39	0.36	—
	SMD075F/60	1.11	0.99	0.84	0.75	0.71	0.63	0.57	0.49	0.45	0.39	0.36	—
	SMD100F	1.59	1.43	1.20	1.10	1.03	0.94	0.85	0.72	0.69	0.61	0.57	—
	SMD100F/33	1.48	1.35	1.20	1.10	1.06	0.98	0.91	0.83	0.79	0.73	0.69	—
	SMDH120	2.34	1.96	1.58	1.20	1.15	1.02	0.92	0.83	0.74	0.65	0.60	0.26
	SMD125F	1.89	1.68	1.50	1.25	1.21	1.04	0.93	0.85	0.71	0.61	0.55	—
NEW	SMD150F/33-2920	2.27	2.01	1.76	1.50	1.44	1.25	1.12	0.99	0.86	0.74	0.67	—
NEW	SMD200F/24-2920	2.90	2.60	2.30	2.00	1.93	1.70	1.55	1.40	1.25	1.10	1.03	—
NEW	SMD250F/15-2920	3.65	3.25	2.80	2.50	2.33	2.02	1.82	1.60	1.41	1.20	1.11	—
	SMD260F	3.82	3.41	2.90	2.60	2.45	2.19	1.99	1.70	1.58	1.38	1.28	—
	SMD300F	4.13	3.75	3.30	3.00	2.87	2.62	2.43	2.25	2.00	1.87	1.78	—
	SMD300F/15	4.20	3.80	3.30	3.00	2.90	2.62	2.43	2.25	2.00	1.87	1.78	—
	SMD2 Series												
	Size 8763mm/3425mils												
	SMD150F	2.30	2.04	1.80	1.50	1.45	1.23	1.10	0.99	0.83	0.70	0.63	—
	SMD150F/33	2.30	2.04	1.80	1.50	1.45	1.23	1.10	0.99	0.83	0.70	0.63	—
	SMDH160	2.14	1.96	1.78	1.60	1.56	1.42	1.33	1.24	1.15	1.06	1.02	0.44
	SMD185F	2.54	2.29	2.20	1.85	1.80	1.55	1.43	1.31	1.19	1.06	1.00	—
	SMD200F	3.01	2.67	2.30	2.00	1.90	1.66	1.50	1.30	1.16	0.99	0.91	—
	SMD250F	3.72	3.31	2.80	2.50	2.35	2.09	1.89	1.60	1.48	1.28	1.18	—

Figure S1 Thermal Derating Curve for PolySwitch Surface-Mount Devices

A = femtoSMD / picoSMD / nanoSMD / microSMD / miniSMD / decaSMD and SMD

B = SMDH120 and SMDH160

Figure S1

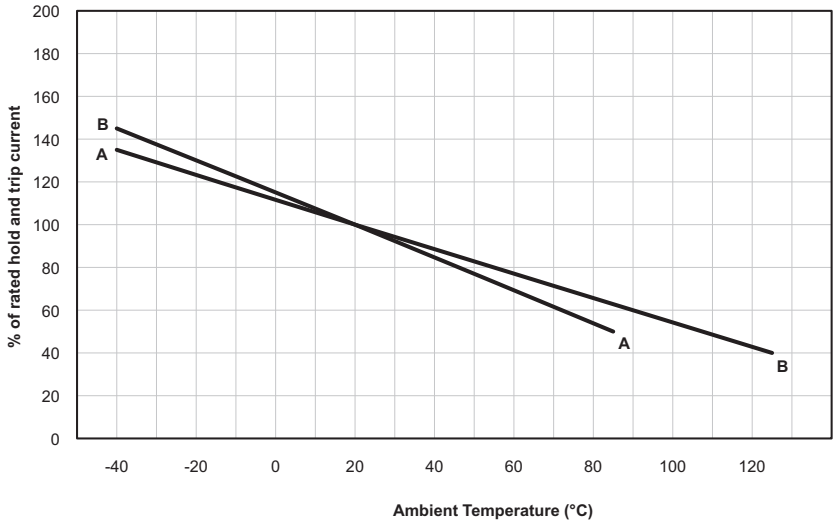


Table S3 Electrical Characteristics for PolySwitch Surface-Mount Devices at Room Temperature

Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\ MAX}$ (W)	Max Time-to-Trip (A)	Max Time-to-Trip (S)	R_{MIN} (Ω)	R_{1MAX} (Ω)	Figure for Dimensions
femtoSMDC Series Size 1608mm/0603mils										
femtoSMDC005F	0.05	0.15	15	40	0.50	0.50	0.10	3.80	30.00	S2
femtoSMDC008F	0.08	0.20	12	40	0.50	0.60	0.10	2.80	14.00	S2
femtoSMDC010F	0.10	0.25	12	40	0.50	0.70	0.10	1.70	8.00	S2
femtoSMDC012F	0.12	0.30	9	40	0.50	0.80	0.10	1.10	5.80	S2
femtoSMDC016F	0.16	0.40	9	40	0.50	1.00	0.10	1.00	4.20	S2
femtoSMDC020F	0.20	0.45	9	40	0.50	2.00	0.10	0.70	3.00	S2
femtoSMDC035F	0.35	0.70	6	40	0.50	3.50	0.10	0.20	1.40	S2
picoSMDC Series Size 2012mm/0805mils										
picoSMDC010S	0.10	0.30	15	100	0.50	0.50	0.60	1.50	11.00	S2
picoSMDC012S	0.12	0.30	15	100	0.50	1.00	0.10	1.50	9.00	S2
picoSMDC020S	0.20	0.47	9	100	0.50	2.00	0.10	0.75	3.20	S2
picoSMDC035S	0.35	0.75	6	100	0.50	1.75	0.20	0.35	1.40	S2
picoSMDC050S	0.50	1.00	6	100	0.50	8.00	0.10	0.15	0.80	S2
NEW picoSMDC075S	0.75	1.50	6	40	0.70	8.00	0.20	0.10	0.35	S2
NEW picoSMDC110S	1.10	2.20	6	40	0.80	8.00	0.20	0.05	0.17	S2
nanoSMDC Series Size 3216mm/1206mils										
nanoSMDC012F	0.12	0.39	48	10	0.50	1.00	0.20	1.40	6.50	S2
nanoSMDC016F	0.16	0.45	48	10	0.50	1.00	0.30	1.10	5.00	S2
nanoSMDC020F	0.20	0.42	24	100	0.60	8.00	0.10	0.65	3.10	S2
nanoSMDC025F	0.25	0.58	16	100	0.60	8.00	0.01	0.55	2.30	S2
nanoSMDC035F	0.35	0.75	16	20	0.60	3.50	0.10	0.45	1.35	S2
nanoSMDC050F/13.2	0.50	1.10	13.2	100	0.80	8.00	0.10	0.20	0.75	S2
nanoSMDC075F	0.75	1.50	6	100	0.80	8.00	0.10	0.09	0.30	S2
nanoSMDC110F	1.10	2.20	6	100	0.80	8.00	0.10	0.07	0.20	S2
nanoSMDC150F	1.50	3.00	6	100	0.80	8.00	0.30	0.04	0.11	S2
nanoSMDC200F	2.00	4.00	6	100	1.00	8.00	1.50	0.02	0.072	S2

RoHS Compliant, ELV Compliant HF Halogen Free

Table S3 Electrical Characteristics for PolySwitch Surface-Mount Devices at Room Temperature Cont'd

Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\ MAX}$ (W)	Max Time-to-Trip (A)	Max Time-to-Trip (S)	R_{MIN} (Ω)	R_{1MAX} (Ω)	Figure for Dimensions
microSMD Series Size 3225mm/1210mils										
microSMD005F	0.05	0.15	30	10	1.00	0.25	1.50	3.60	50.00	S2
microSMD010F	0.10	0.25	30	10	0.80	0.50	1.00	2.10	15.00	S2
microSMD035F	0.35	0.75	6	40	0.80	8.00	0.20	0.32	1.30	S2
microSMD050F	0.50	1.00	13.2	40	0.80	8.00	0.05	0.25	0.90	S2
microSMD075F	0.75	1.50	6	40	0.80	8.00	0.10	0.11	0.40	S2
microSMD110F	1.10	2.20	6	40	0.80	8.00	0.20	0.07	0.21	S2
microSMD150F	1.50	3.00	6	40	0.80	8.00	1.00	0.04	0.11	S2
microSMD175F	1.75	3.50	6	40	0.80	8.00	0.80	0.025	0.08	S2
microSMD200F	2.00	4.00	6	100	0.80	8.00	2.50	0.020	0.06	S2
miniSMDC Series Size 4532mm/1812mils										
miniSMDC010F	0.10	0.30	60	40	0.75	0.50	5.00	0.70	12.70	S2
miniSMDC014F	0.14	0.28	60	10	0.75	8.00	0.008	1.50	6.00	S2
miniSMDC020F	0.20	0.40	30	10	0.80	8.00	0.02	0.60	3.30	S2
miniSMDC030F	0.30	0.60	30	40	0.80	8.00	0.10	0.20	1.75	S2
miniSMDC050F	0.50	1.00	24	100	0.80	8.00	0.15	0.15	1.00	S2
miniSMDC075F	0.75	1.50	13.2	100	1.00	8.00	0.20	0.11	0.45	S2
miniSMDC075F/24	0.75	1.50	24	40	0.80	8.00	0.30	0.09	0.29	S2
NEW miniSMDC075F/33	0.75	1.60	33	100	1.00	8.00	1.00	0.11	0.39	S2
miniSMDC100F	1.10	2.20	8	100	1.20	8.00	0.30	0.04	0.21	S2
miniSMDC110F	1.10	2.20	8	100	1.20	8.00	0.30	0.04	0.21	S2
miniSMDC110F/16	1.10	2.20	16	100	0.80	8.00	0.30	0.06	0.18	S2
miniSMDC110F/24	1.10	2.20	24	20	0.80	8.00	0.50	0.06	0.18	S2
miniSMDC125F	1.25	2.50	6	100	0.80	8.00	0.40	0.05	0.14	S2
miniSMDC125F/16	1.25	2.50	16	100	0.80	8.00	0.40	0.05	0.14	S2
miniSMDC150F	1.50	3.00	6	100	0.80	8.00	0.50	0.04	0.11	S2
miniSMDC150F/12	1.50	2.80	12	100	0.80	8.00	0.50	0.04	0.11	S2
miniSMDC150F/16	1.50	2.80	16	100	0.80	8.00	0.50	0.04	0.11	S2
miniSMDC150F/24	1.50	3.00	24	20	1.00	8.00	1.50	0.04	0.12	S2
miniSMDC160F	1.60	3.20	9	100	0.80	8.00	1.00	0.03	0.10	S2
miniSMDC200F	2.00	4.00	8	100	1.00	8.00	5.00	0.020	0.070	S2
NEW miniSMDC200F/16	2.00	4.00	16	40	1.20	8.00	5.00	0.020	0.085	S2
miniSMDC260F	2.60	5.00	6	100	1.00	8.00	5.00	0.015	0.043	S2
miniSMDC260F/12	2.60	5.00	12	100	1.00	8.00	5.00	0.015	0.047	S2
miniSMDC260F/13.2	2.60	5.00	13.2	100	1.20	8.00	5.00	0.015	0.050	S2
miniSMDC260F/16	2.60	5.00	16	100	1.20	8.00	5.00	0.015	0.050	S2
miniSMDC300F	3.00	6.00	6	100	1.00	8.00	5.00	0.011	0.036	S2
midSMD Series Size 5050mm/2018mils										
SMD030F-2018	0.30	0.80	60	20	1.50	1.50	1.50	0.500	2.30	S3
decaSMDC050F/60	0.55	1.10	60	10	1.00	8.00	0.10	0.200	1.10	S2
SMD100F-2018	1.10	2.20	15	40	1.40	8.00	0.50	0.100	0.40	S3
SMD150F-2018	1.50	3.00	15	40	1.80	8.00	1.00	0.070	0.18	S3
SMD200F-2018	2.00	4.20	6	40	1.50	8.00	3.00	0.048	0.10	S3

Table S3 Electrical Characteristics for PolySwitch Surface-Mount Devices at Room Temperature

Cont'd

	Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\ MAX}$ (W)	Max Time-to-Trip (A)	Max Time-to-Trip (S)	R_{MIN} (Ω)	R_{1MAX} (Ω)	Figure for Dimensions
	SMD Series Size 7555mm/2920mils										
	SMD030F	0.30	0.60	60	10	1.70	1.50	3.00	1.200	4.800	S4
	SMD050F	0.50	1.00	60	10	1.70	2.50	4.00	0.350	1.400	S4
	SMD075F	0.75	1.50	30	40	1.70	8.00	0.30	0.350	1.000	S4
	SMD075F/60	0.75	1.50	60	10	1.70	8.00	0.30	0.350	1.000	S4
	SMD100F	1.10	2.20	30	40	1.70	8.00	0.50	0.120	0.480	S4
	SMD100F/33	1.10	2.20	33	40	1.70	8.00	0.50	0.120	0.410	S4
	SMDH120	1.20	2.30	16	50	2.00	8.00	2.00	0.150	0.340	S4
	SMD125F	1.25	2.50	15	40	1.70	8.00	2.00	0.070	0.250	S4
NEW	SMD150F/33-2920	1.50	3.00	33	40	1.50	8.00	5.00	0.080	0.230	S4
NEW	SMD200F/24-2920	2.00	4.00	24	40	1.50	8.00	5.00	0.050	0.125	S4
NEW	SMD250F/15-2920	2.50	5.00	15	40	1.50	8.00	10.00	0.035	0.085	S4
	SMD260F	2.60	5.20	6	40	1.70	8.00	20.00	0.025	0.075	S4
	SMD300F	3.00	6.00	6	40	1.50	8.00	35.00	0.015	0.048	S4
	SMD300F/15	3.00	6.00	15	40	1.50	8.00	35.00	0.015	0.050	S4
	SMD2 Devices Size 8763mm/3425mils										
	SMD150F	1.50	3.00	15	40	1.90	8.00	5.00	0.060	0.250	S4
	SMD150F/33	1.50	3.00	33	40	1.90	8.00	5.00	0.080	0.230	S4
	SMDH160	1.60	3.20	16	70	2.20	8.00	15.00	0.050	0.150	S4
	SMD185F	1.85	3.60	33	40	1.50	8.00	5.00	0.065	0.165	S4
	SMD200F	2.00	4.00	15	40	1.90	8.00	12.00	0.050	0.125	S4
	SMD250F	2.50	5.00	15	40	1.90	8.00	25.00	0.035	0.085	S4

Figures S2-S4 Dimension Figures for Surface-Mount Devices

Figure S2

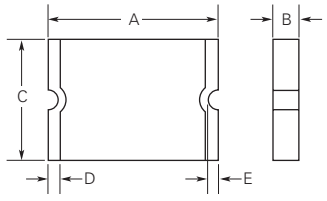


Figure S3

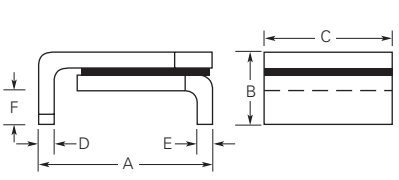


Figure S4

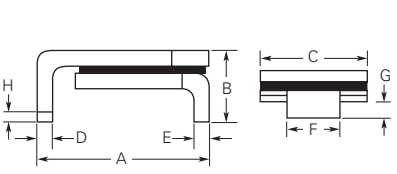


Table S4 Dimensions for PolySwitch Surface-Mount Devices in Millimeters (Inches)

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	H Min	Figure
femtoSMDC Series Size 1608mm/0603mils																
femtoSMDC005F	1.40	1.80	0.45	0.85	0.60	1.00	0.10	0.50	0.075	—	—	—	—	—	—	S2
	(0.055)	(0.071)	(0.017)	(0.033)	(0.023)	(0.039)	(0.004)	(0.020)	(0.003)	—	—	—	—	—	—	
femtoSMDC008F	1.40	1.80	0.45	0.85	0.60	1.00	0.10	0.50	0.075	—	—	—	—	—	—	S2
	(0.055)	(0.071)	(0.017)	(0.033)	(0.023)	(0.039)	(0.004)	(0.020)	(0.003)	—	—	—	—	—	—	
femtoSMDC010F	1.40	1.80	0.45	0.85	0.60	1.00	0.10	0.50	0.075	—	—	—	—	—	—	S2
	(0.055)	(0.071)	(0.017)	(0.033)	(0.023)	(0.039)	(0.004)	(0.020)	(0.003)	—	—	—	—	—	—	
femtoSMDC012F	1.40	1.80	0.35	0.75	0.60	1.00	0.10	0.50	0.075	—	—	—	—	—	—	S2
	(0.055)	(0.071)	(0.013)	(0.030)	(0.023)	(0.039)	(0.004)	(0.020)	(0.003)	—	—	—	—	—	—	
femtoSMDC016F	1.40	1.80	0.35	0.75	0.60	1.00	0.10	0.50	0.075	—	—	—	—	—	—	S2
	(0.055)	(0.071)	(0.013)	(0.030)	(0.023)	(0.039)	(0.004)	(0.020)	(0.003)	—	—	—	—	—	—	
femtoSMDC020F	1.40	1.80	0.35	0.75	0.60	1.00	0.10	0.50	0.075	—	—	—	—	—	—	S2
	(0.055)	(0.071)	(0.013)	(0.030)	(0.023)	(0.039)	(0.004)	(0.020)	(0.003)	—	—	—	—	—	—	
femtoSMDC035F	1.40	1.80	0.40	0.65	0.60	1.00	0.10	0.50	0.075	—	—	—	—	—	—	S2
	(0.055)	(0.071)	(0.016)	(0.026)	(0.023)	(0.039)	(0.004)	(0.020)	(0.003)	—	—	—	—	—	—	

RoHS Compliant, ELV Compliant HF Halogen Free

Table S4 Dimensions for PolySwitch Surface-Mount Devices in Millimeters (Inches) Cont'd

	Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	H Min	Figure
	picoSMDC Series Size 2012mm/0805mils																
	picoSMDC010S	2.00	2.20	0.60	1.00	1.30	1.50	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.079)	(0.087)	(0.023)	(0.040)	(0.051)	(0.059)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	picoSMDC012S	2.00	2.20	0.44	0.68	1.30	1.50	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.079)	(0.087)	(0.017)	(0.027)	(0.051)	(0.059)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	picoSMDC020S	2.00	2.20	0.44	0.68	1.30	1.50	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.079)	(0.087)	(0.017)	(0.027)	(0.051)	(0.059)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	picoSMDC035S	2.00	2.20	0.44	0.68	1.30	1.50	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.079)	(0.087)	(0.017)	(0.027)	(0.051)	(0.059)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	picoSMDC050S	2.00	2.20	0.63	0.93	1.30	1.50	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.079)	(0.087)	(0.025)	(0.036)	(0.051)	(0.059)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
NEW	picoSMDC075S	2.00	2.20	0.63	0.93	1.30	1.50	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.079)	(0.087)	(0.025)	(0.036)	(0.051)	(0.059)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
NEW	picoSMDC110S	2.00	2.20	0.80	1.20	1.30	1.50	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.079)	(0.087)	(0.031)	(0.047)	(0.051)	(0.059)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC Series Size 3216mm/1206mils																
	nanoSMDC012F	3.00	3.40	0.62	1.00	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.024)	(0.039)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC016F	3.00	3.40	0.62	1.00	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.024)	(0.039)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC020F	3.00	3.40	0.58	0.82	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.023)	(0.032)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC025F	3.00	3.40	0.58	0.82	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.023)	(0.032)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC035F	3.00	3.40	0.58	0.82	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.023)	(0.032)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC050F/13.2	3.00	3.40	0.50	0.74	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.019)	(0.029)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC075F	3.00	3.40	0.44	0.68	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.017)	(0.027)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC110F	3.00	3.40	0.28	0.67	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.011)	(0.026)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC150F	3.00	3.40	0.55	0.89	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.022)	(0.035)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC200F	3.00	3.40	0.83	1.10	1.37	1.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.134)	(0.033)	(0.043)	(0.054)	(0.071)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	microSMD Series Size 3225mm/1210mils																
	microSMD005F	3.0	3.43	0.50	0.85	2.35	2.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.135)	(0.019)	(0.034)	(0.092)	(0.110)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	microSMD010F	3.0	3.43	0.50	0.85	2.35	2.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.135)	(0.019)	(0.034)	(0.092)	(0.110)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	microSMD035F	3.0	3.43	0.38	0.62	2.35	2.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.135)	(0.015)	(0.025)	(0.092)	(0.110)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	microSMD050F	3.0	3.43	0.38	0.62	2.35	2.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.135)	(0.015)	(0.025)	(0.092)	(0.110)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	microSMD075F	3.0	3.43	0.38	0.62	2.35	2.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.135)	(0.015)	(0.025)	(0.092)	(0.110)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	microSMD110F	3.0	3.43	0.28	0.48	2.35	2.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.135)	(0.011)	(0.019)	(0.092)	(0.110)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	microSMD150F	3.0	3.43	0.51	1.22	2.35	2.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.135)	(0.020)	(0.048)	(0.092)	(0.110)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	microSMD175F	3.0	3.43	0.40	0.76	2.35	2.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.135)	(0.016)	(0.030)	(0.092)	(0.110)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	microSMD200F	3.0	3.43	0.79	1.17	2.35	2.80	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.118)	(0.135)	(0.031)	(0.046)	(0.092)	(0.110)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	

RoHS Compliant, ELV Compliant HF Halogen Free

Table S4 Dimensions for PolySwitch Surface-mount Devices in Millimeters (Inches) Cont'd

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	H Min	Figure
miniSMDC Series Size 4532mm/1812mils																
miniSMDC010F	4.37	4.73	0.635	0.89	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.025)	(0.035)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC014F	4.37	4.73	0.635	0.89	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.025)	(0.035)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC020F	4.37	4.73	0.635	0.89	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.025)	(0.035)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC030F	4.37	4.73	0.635	0.89	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.025)	(0.035)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC050F	4.37	4.73	0.38	0.62	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.015)	(0.025)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC075F	4.37	4.73	0.38	0.62	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.015)	(0.025)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC075F/24	4.37	4.83	0.81	1.46	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.032)	(0.057)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
NEW miniSMDC075F/33	4.37	4.83	0.94	1.46	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.037)	(0.057)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC100F	4.37	4.73	0.38	0.62	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.015)	(0.025)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC110F	4.37	4.73	0.38	0.62	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.015)	(0.025)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC110F/16	4.37	4.83	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC110F/24	4.37	4.83	0.81	1.46	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.032)	(0.057)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC125F	4.37	4.73	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC125F/16	4.37	4.83	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC150F	4.37	4.73	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC150F/12	4.37	4.83	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC150F/16	4.37	4.83	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC150F/24	4.37	4.83	1.00	1.94	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.040)	(0.077)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC160F	4.37	4.73	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC200F	4.37	4.73	0.51	1.22	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.020)	(0.048)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
NEW miniSMDC200F/16	4.37	4.73	0.51	1.22	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.020)	(0.048)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC260F	4.37	4.73	0.48	0.78	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.019)	(0.031)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC260F/12	4.37	4.83	1.02	1.52	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.042)	(0.060)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC260F/13.2	4.37	4.83	1.02	1.52	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.042)	(0.060)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC260F/16	4.37	4.83	1.02	1.52	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.190)	(0.042)	(0.060)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	
miniSMDC300F	4.37	4.73	0.45	0.76	3.07	3.41	0.25	0.95	0.20	—	—	—	—	—	—	S2
	(0.172)	(0.186)	(0.018)	(0.030)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	—	—	—	—	—	

RoHS Compliant, ELV Compliant HF Halogen Free

Table S4 Dimensions for PolySwitch Surface-Mount Devices in Millimeters (Inches) Cont'd

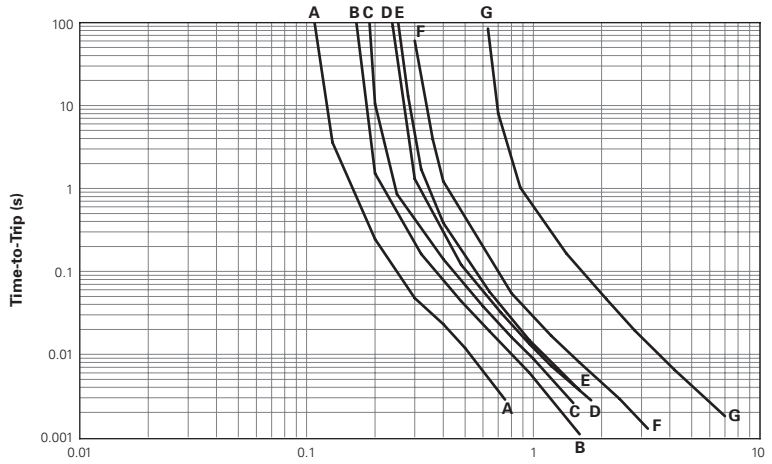
Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	H Min	Figure
midSMD Series Size 5050mm/2018mils																
SMD030F-2018	4.72	5.44	—	1.78	4.22	4.93	0.25	0.36	0.25	0.36	0.30	0.46	—	—	—	S3
	(0.186)	(0.214)	—	(0.070)	(0.166)	(0.194)	(0.010)	(0.014)	(0.010)	(0.014)	(0.012)	(0.018)	—	—	—	
decaSMDC050F/60	4.70	5.31	0.63	0.89	4.19	4.81	0.25	0.95	0.25	—	—	—	—	—	—	S2
	(0.185)	(0.209)	(0.025)	(0.035)	(0.165)	(0.189)	(0.010)	(0.040)	(0.010)	—	—	—	—	—	—	
SMD100F-2018	4.72	5.44	—	1.52	4.22	4.93	0.25	0.36	0.25	0.36	0.30	0.46	—	—	—	S3
	(0.186)	(0.214)	—	(0.060)	(0.166)	(0.194)	(0.010)	(0.014)	(0.010)	(0.014)	(0.012)	(0.018)	—	—	—	
SMD150F-2018	4.72	5.44	—	1.52	4.22	4.93	0.25	0.36	0.25	0.36	0.30	0.46	—	—	—	S3
	(0.186)	(0.214)	—	(0.060)	(0.166)	(0.194)	(0.010)	(0.014)	(0.010)	(0.014)	(0.012)	(0.018)	—	—	—	
SMD200F-2018	4.72	5.44	—	1.52	4.22	4.93	0.25	0.36	0.25	0.36	0.30	0.46	—	—	—	S3
	(0.186)	(0.214)	—	(0.060)	(0.166)	(0.194)	(0.010)	(0.014)	(0.010)	(0.014)	(0.012)	(0.018)	—	—	—	
SMD Series Size 7555mm/2920mils																
SMD030F	6.73	7.98	—	3.18	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.125)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD050F	6.73	7.98	—	3.18	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.125)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD075F	6.73	7.98	—	3.18	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.125)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD075F/60	6.73	7.98	—	3.18	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.125)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD100F	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD100F/33	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMDH120	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD125F	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
NEW SMD150F/33-2920	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
NEW SMD200F/24-2920	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
NEW SMD250F/15-2920	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD260F	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD300F	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD300F/15	6.73	7.98	—	3.00	4.80	5.44	0.56	0.71	0.56	0.71	2.16	2.41	0.66	1.37	0.43	S4
	(0.265)	(0.314)	—	(0.118)	(0.19)	(0.214)	(0.022)	(0.028)	(0.022)	(0.028)	(0.085)	(0.095)	(0.026)	(0.054)	(0.017)	
SMD2 Devices Size 8763mm/3425mils																
SMD150F	8.00	9.40	—	3.00	6.00	6.71	0.56	0.71	0.56	0.71	3.68	3.94	0.66	1.37	0.43	S4
	(0.315)	(0.370)	—	(0.118)	(0.236)	(0.264)	(0.022)	(0.028)	(0.022)	(0.028)	(0.145)	(0.155)	(0.026)	(0.054)	(0.017)	
SMD150F/33	8.00	9.40	—	3.00	6.00	6.71	0.56	0.71	0.56	0.71	3.68	3.94	0.66	1.37	0.43	S4
	(0.315)	(0.370)	—	(0.118)	(0.236)	(0.264)	(0.022)	(0.028)	(0.022)	(0.028)	(0.145)	(0.155)	(0.026)	(0.054)	(0.017)	
SMDH160	8.00	9.40	—	3.00	6.00	6.71	0.56	0.71	0.56	0.71	3.68	3.94	0.66	1.37	0.43	S4
	(0.315)	(0.370)	—	(0.118)	(0.236)	(0.264)	(0.022)	(0.028)	(0.022)	(0.028)	(0.145)	(0.155)	(0.026)	(0.054)	(0.017)	
SMD185F	8.00	9.40	—	3.00	6.00	6.71	0.56	0.71	0.56	0.71	3.68	3.94	0.66	1.37	0.43	S4
	(0.315)	(0.370)	—	(0.118)	(0.236)	(0.264)	(0.022)	(0.028)	(0.022)	(0.028)	(0.145)	(0.155)	(0.026)	(0.054)	(0.017)	
SMD200F	8.00	9.40	—	3.00	6.00	6.71	0.56	0.71	0.56	0.71	3.68	3.94	0.66	1.37	0.43	S4
	(0.315)	(0.370)	—	(0.118)	(0.236)	(0.264)	(0.022)	(0.028)	(0.022)	(0.028)	(0.145)	(0.155)	(0.026)	(0.054)	(0.017)	
SMD250F	8.00	9.40	—	3.00	6.00	6.71	0.56	0.71	0.56	0.71	3.68	3.94	0.66	1.37	0.43	S4
	(0.315)	(0.370)	—	(0.118)	(0.236)	(0.264)	(0.022)	(0.028)	(0.022)	(0.028)	(0.145)	(0.155)	(0.026)	(0.054)	(0.017)	

Figures S5-S12 Typical Time-to-Trip Curves at 20°C for Surface-Mount Devices

femtoSMDCxxxF

A = femtoSMDC005F
B = femtoSMDC008F
C = femtoSMDC010F
D = femtoSMDC012F
E = femtoSMDC016F
F = femtoSMDC020F
G = femtoSMDC035F

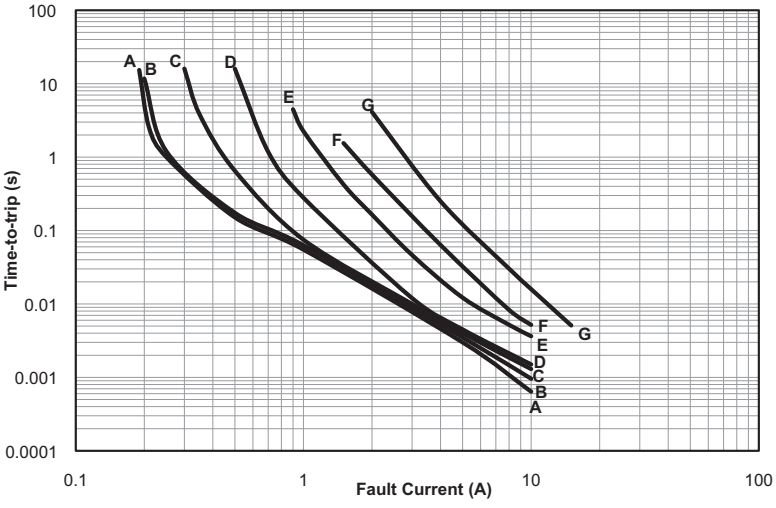
Figure S5



picoSMDCxxxS

A = picoSMDC010S
B = picoSMDC012S
C = picoSMDC020S
D = picoSMDC035S
E = picoSMDC050S
F = picoSMDC075S
G = picoSMDC110S

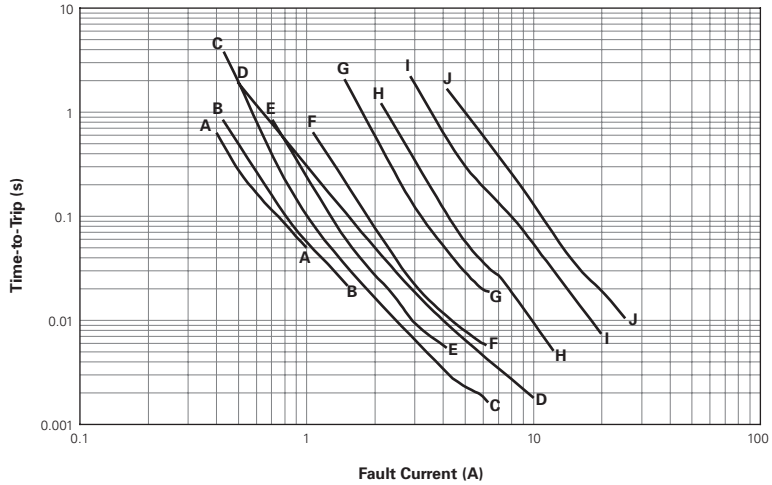
Figure S6



nanoSMDCxxxF

A = nanoSMDC012F
B = nanoSMDC016F
C = nanoSMDC020F
D = nanoSMDC025F
E = nanoSMDC035F
F = nanoSMDC050F/13.2
G = nanoSMDC075F
H = nanoSMDC110F
I = nanoSMDC150F
J = nanoSMDC200F

Figure S7



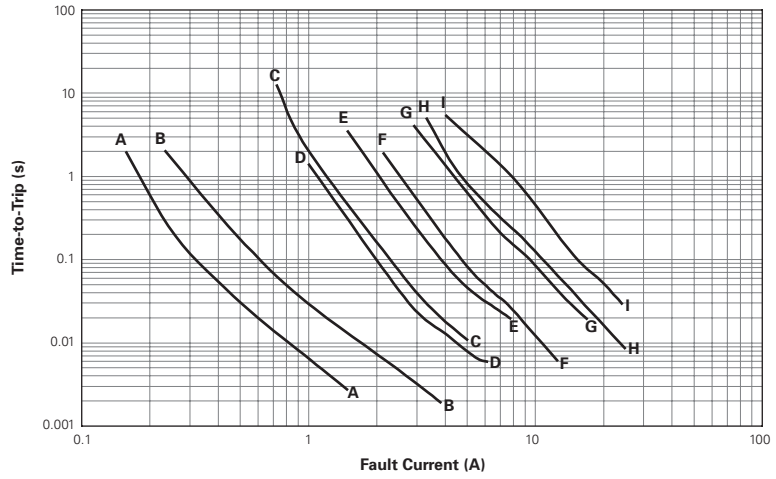
 RoHS Compliant, ELV Compliant HF Halogen Free

Figures S5-S12 Typical Time-to-Trip Curves at 20°C for PolySwitch Surface-Mount Devices Cont'd

microSMDxxxF

A = microSMD005F
B = microSMD010F
C = microSMD035F
D = microSMD050F
E = microSMD075F
F = microSMD110F
G = microSMD150F
H = microSMD175F
I = microSMD200F

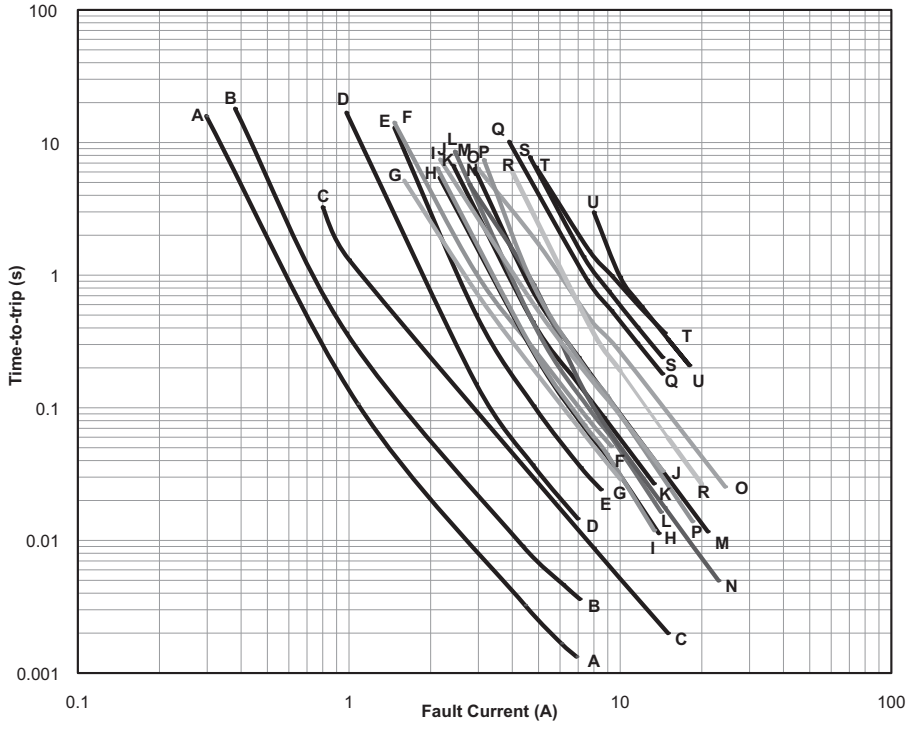
Figure S8



miniSMDCxxxF

A = miniSMDC010F, miniSMDC014F
B = miniSMDC020F
C = miniSMDC030F
D = miniSMDC050F
E = miniSMDC075F
F = miniSMDC075F/24
G = miniSMDC075F/33
H = miniSMDC100F, miniSMDC110F
I = miniSMDC110F/16
J = miniSMDC110F/24
K = miniSMDC125F
L = miniSMDC125F/16
M = miniSMDC150F, miniSMDC150F/12
N = miniSMDC150F/16
O = miniSMDC150F/24
P = miniSMDC160F
Q = miniSMDC200F
R = miniSMDC200F/16
S = miniSMDC260F
T = miniSMDC260F/12,miniSMDC260F/13.2 miniSMDC260F/16
U = miniSMDC300F

Figure S9



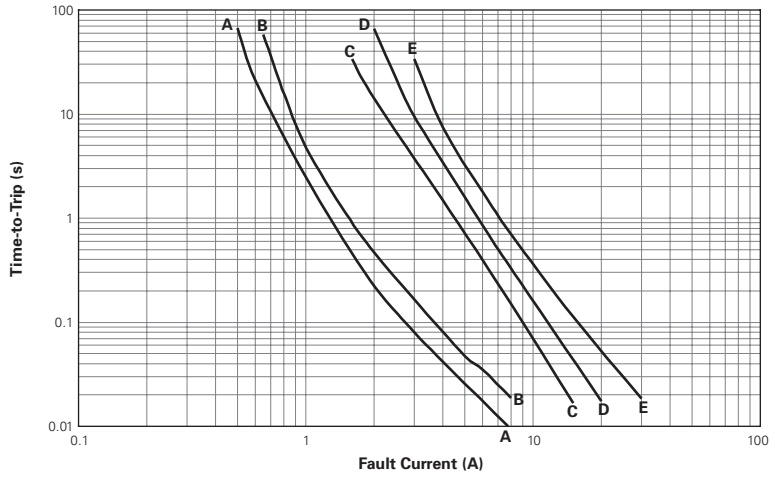
RoHS Compliant, ELV Compliant HF Halogen Free

Figures S5-S12 Typical Time-to-Trip Curves at 20°C for PolySwitch Surface-Mount Devices Cont'd

midSMD

A = SMD030F-2018
B = decaSMDC050F/60
C = SMD100F-2018
D = SMD150F-2018
E = SMD200F-2018

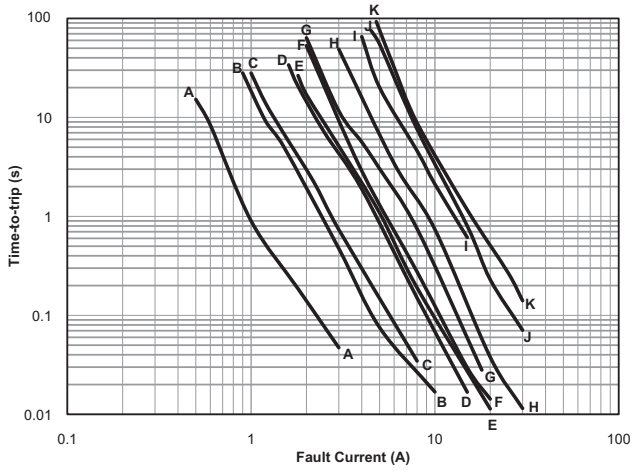
Figure S10



SMDxxxF

A = SMD030F
B = SMD050F
C = SMD075F, SMD075F/60
D = SMD100F, SMD100F/33
E = SMDH120
F = SMD150F/33-2920
G = SMD125F
H = SMD200F/24-2920
I = SMD250F/15-2920
J = SMD260F
K = SMD300F, SMD300F/15

Figure S11



SMD2xxxF

A = SMD150F, SMD150F/33
B = SMDH160
C = SMD185F
D = SMD200F
E = SMD250F

Figure S12

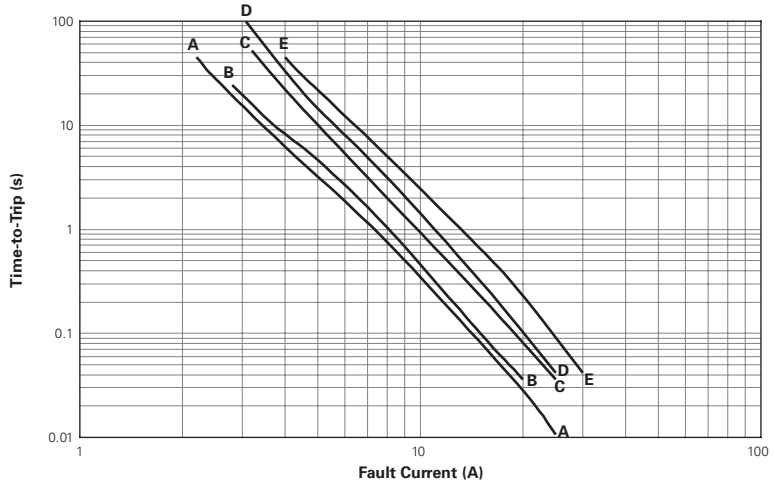


Table S5 Physical Characteristics and Environmental Specifications for PolySwitch Surface-Mount Devices Operating Temperature Range -40°C to 85°C, -40°C to 125°C for SMDH120 and SMDH160

Physical Characteristics

Terminal Pad Material	100% Matte Tin with Nickel Underplate
Soldering Characteristics	ANSI/J-STD-002 Category 3 for femtoSMD, picoSMD, nanoSMD, microSMD and miniSMD Series ANSI/J-STD-002 Category 1 for SMD Series
SolderHeat Withstand	per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A
Flammability Resistance	per IEC 695-2-2 Needle Flame Test for 20 seconds
Recommended Storage Conditions	40°C max, 70% R.H. max; Devices May Not Meet Specified Ratings if Storage Conditions Are Exceeded

Environmental Specifications

Test	Test Method	Conditions	Resistance Change
Storage Life	PS300, Section 5.3.2	60°C, 1000 hrs	±3% typ
		85°C, 1000 hrs	±5% typ
Humidity Aging	PS300, Section 5.3.1	85°C, 85% RH, 100 hrs	±1.2% typ
Thermal Shock	MIL-STD-202, Method 107G	85°C, -40°C (20 Times)	-33% typ
		125°C, -55°C (10 Times)	-33% typ
Vibration	MIL-STD-883C	per MIL-STD-883C	No Change
Solvent Resistance	PS300, Section 5.2.2	Freon	No Change
		Trichloroethane	No Change
		Hydrocarbons	No Change

Table S6 Packaging and Marking Information for PolySwitch Surface-Mount Devices

	Part Number	Tape and Reel Quantity	Standard Package	Part Marking	Recommended Pad Layout Figures [mm (in)] Dimension A (Nom)	Dimension B (Nom)	Dimension C (Nom)	Agency Recognition
	femtoSMDC Series Size 1608mm/0603mils							
	femtoSMDC005F	4,000	20,000	A	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	UL, CSA
	femtoSMDC008F	4,000	20,000	T	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	UL, CSA
	femtoSMDC010F	4,000	20,000	B	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	UL, CSA, TÜV
	femtoSMDC012F	5,000	25,000	C	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	UL, CSA
	femtoSMDC016F	5,000	25,000	E	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	UL, CSA
	femtoSMDC020F	5,000	25,000	F	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	UL, CSA, TÜV
	femtoSMDC035F	5,000	25,000	K	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	Pending
	picoSMDC Series Size 2012mm/0805mils							
	picoSMDC010S	3,000	15,000	C	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	UL, CSA, TÜV
	picoSMDC012S	4,000	20,000	F	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	UL, CSA, TÜV
	picoSMDC020S	4,000	20,000	H	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	UL, CSA, TÜV
	picoSMDC035S	4,000	20,000	I	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	UL, CSA, TÜV
	picoSMDC050S	3,000	15,000	K	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	UL, CSA, TÜV
NEW	picoSMDC075S	3,000	15,000	M	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	UL, CSA, TÜV
NEW	picoSMDC110S	3,000	15,000	S	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	UL, TÜV
	nanoSMDC Series Size 3216mm/1206mils							
	nanoSMDC012F	3,000	15,000	P	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMDC016F	3,000	15,000	N	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMDC020F	3,000	15,000	02	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMDC025F	3,000	15,000	C	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMDC035F	3,000	15,000	03	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMDC050F/13.2	3,000	15,000	M	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMDC075F	3,000	15,000	L	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMDC110F	3,000	15,000	K	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMDC150F	3,000	15,000	15	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMDC200F	3,000	15,000	T	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV

RoHS Compliant, ELV Compliant HF Halogen Free

Table S6 Packaging and Marking Information for PolySwitch Surface-Mount Devices Cont'd

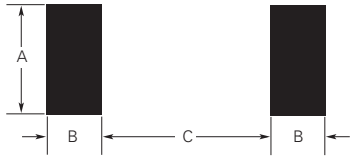
	Part Number	Tape and Reel Quantity	Standard Package	Part Marking	Recommended Pad Layout Figures [mm (in)] Dimension A (Nom)	Dimension B (Nom)	Dimension C (Nom)	Agency Recognition
	microSMD Series Size 3225mm/1210mils							
	microSMD005F	4,000	20,000	05	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	microSMD010F	4,000	20,000	10	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	microSMD035F	4,000	20,000	3	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	microSMD050F	4,000	20,000	50	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	microSMD075F	4,000	20,000	75	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	microSMD110F	4,000	20,000	11	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	microSMD150F	4,000	20,000	15	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	microSMD175F	4,000	20,000	17	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	microSMD200F	3,000	15,000	20	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	miniSMDC Series Size 4532mm/1812mils							
	miniSMDC010F	2,000	10,000	10	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC014F	2,000	10,000	14	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC020F	2,000	10,000	2	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC030F	2,000	10,000	3	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC050F	2,000	10,000	5	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC075F	2,000	10,000	7	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC075F/24	1,500	7,500	075F 24V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
NEW	miniSMDC075F/33	1,500	7,500	075F 33V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC100F	2,000	10,000	1	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC110F	2,000	10,000	1	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC110F/16	2,000	10,000	110F 16V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC110F/24	1,500	7,500	110F 24V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC125F	2,000	10,000	12	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC125F/16	2,000	10,000	125F 16V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC150F	2,000	10,000	15	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC150F/12	2,000	10,000	150F 12V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC150F/16	2,000	10,000	150 16V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC150F/24	1,000	5,000	150F 24V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC160F	2,000	10,000	16	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC200F	2,000	10,000	20	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
NEW	miniSMDC200F/16	2,000	10,000	200F 16V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL
	miniSMDC260F	2,000	10,000	260F	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC260F/12	1,500	7,500	260F 12V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC260F/13.2	1,500	7,500	260F 13V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC260F/16	1,500	7,500	260F 16V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC300F	2,000	10,000	30	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	midSMD Series Size 5050mm/2018mils							
	SMD030F-2018	4,000	20,000	A03F	4.60 (0.18)	1.50 (0.059)	3.40 (0.134)	UL, CSA, TÜV
	decaSMDC050F/60	1,000	5,000	050F 60V	4.32 (0.17)	1.40 (0.055)	3.61 (0.142)	UL, CSA, TÜV
	SMD100F-2018	4,000	20,000	A10F	4.60 (0.18)	1.50 (0.059)	3.40 (0.134)	UL, CSA, TÜV
	SMD150F-2018	4,000	20,000	A15F	4.60 (0.18)	1.50 (0.059)	3.40 (0.134)	UL, CSA, TÜV
	SMD200F-2018	4,000	20,000	A20F	4.60 (0.18)	1.50 (0.059)	3.40 (0.134)	UL, CSA, TÜV

RoHS Compliant, ELV Compliant HF Halogen Free

Table S6 Packaging and Marking Information for PolySwitch Surface-Mount Devices Cont'd

	Part Number	Tape and Reel Quantity	Standard Package	Part Marking	Recommended Pad Layout Figures [mm (in)] Dimension A (Nom)	Dimension B (Nom)	Dimension C (Nom)	Agency Recognition
	SMD Series Size 7555mm/2920mils							
	SMD030F	2,000	10,000	030F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD050F	2,000	10,000	050F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD075F	2,000	10,000	075F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD075F/60	2,000	10,000	756F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD100F	2,000	10,000	100F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD100F/33	2,000	10,000	103F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMDH120	2,000	10,000	H12	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD125F	2,000	10,000	125F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
NEW	SMD150F/33-2920	2,000	10,000	S15F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
NEW	SMD200F/24-2920	2,000	10,000	S20F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
NEW	SMD250F/15-2920	2,000	10,000	S25F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD260F	2,000	10,000	260F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD300F	2,000	10,000	300F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD300F/15	2,000	10,000	315F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA, TÜV
	SMD2 Devices Size 8763mm/3425mils							
	SMD150F	1,500	7,500	150F	4.60 (0.18)	2.30 (0.09)	6.10 (0.240)	UL, CSA, TÜV
	SMD150F/33	1,500	7,500	153F	4.60 (0.18)	2.30 (0.09)	6.10 (0.240)	UL, CSA, TÜV
	SMDH160	1,500	7,500	160F	4.60 (0.18)	2.30 (0.09)	6.10 (0.240)	UL, CSA, TÜV
	SMD185F	1,500	7,500	185F	4.60 (0.18)	2.30 (0.09)	6.10 (0.240)	UL, CSA, TÜV
	SMD200F	1,500	7,500	200F	4.60 (0.18)	2.30 (0.09)	6.10 (0.240)	UL, CSA, TÜV
	SMD250F	1,500	7,500	250F	4.60 (0.18)	2.30 (0.09)	6.10 (0.240)	UL, CSA, TÜV

Figure S13 Recommended Pad Layout for PolySwith Surface-Mount Devices



Agency Recognition for PolySwitch Surface-Mount Devices

UL	File # E74889 for all Surface-mount Devices
CSA	File # CA78165 for all Surface-mount Devices
TÜV	Certificate Number Available Upon Request (Certified to IEC 60730-1)

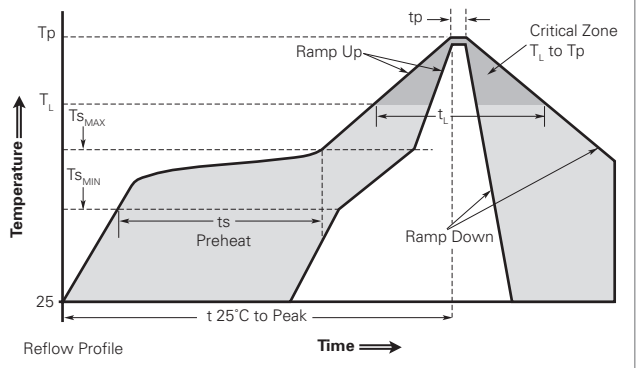
Solder Reflow and Rework Recommendation for PolySwitch Surface-Mount Devices

Classification Reflow Profiles

Profile Feature	Pb-Free Assembly
Average Ramp-up Rate (Ts_{MAX} to Tp)	3°C/s max
Preheat	
• Temperature min (Ts_{MIN})	150°C
• Temperature max (Ts_{MAX})	200°C
• Time (ts_{MIN} to ts_{MAX})	60-120s
Time Maintained Above:	
• Temperature (T_L)	217°C
• Time (t_L)	60-150s
Peak/Classification Temperature (Tp)	260°C
Time within 5°C of Actual Peak Temperature	
Time (tp)	30s max
Ramp-down Rate	3°C/s max
Time 25°C to Peak Temperature	8 mins max

Note: All temperatures refer to topside of the package measured on the package body surface.

Figure S14



Solder Reflow

- Recommended reflow methods:
  - IR
  - Hot air
  - Nitrogen
- Recommended maximum paste thickness: 0.25mm (0.010in)
- Devices can be cleaned using standard methods and aqueous solvents.
- Experience has shown the optimum conditions for forming acceptable solder fillets occur when a reasonable amount of solder paste is placed underneath each device's termination. As such, we request that customers comply with our recommended solder pad layouts.
- Customer should validate that the solder paste amount and reflow recommendations meet its application.
- We request that customer board layouts refrain from placing raised features (e.g., vias, nomenclature, traces, etc.) underneath PolySwitch devices. It is possible that raised features could negatively impact solderability performance of our devices.

Rework

- femtoSMD, picoSMD, nanoSMD, microSMD and miniSMD series: standard industry practices. (Please also avoid direct contact to the device.)
- SMD series: Rework should be confined to removal of the installed product and replacement with a fresh device.

Table S7 Tape and Reel Specifications for Surface-Mount Devices (Millimeters)

Description	femtoSMDC EIA 481-1	picoSMDC EIA 481-1	nanoSMDC EIA 481-1	microSMD EIA 481-1	miniSMDC and decaSMDC050F/60 EIA 481-1	midSMD except decaSMDC050F/60 EIA 481-2	SMD EIA 481-2	SMD2 EIA 481-2
W	8.0 ± 0.30	8.0 ± 0.30	8.0 ± 0.30	8.0 ± 0.30	12.0 ± 0.30	16.0 ± 0.30	16.0 ± 0.30	16.0 ± 0.30
P_0	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10
P_1	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	8.0 ± 0.10	8.0 ± 0.10	8.0 ± 0.10	12.0 ± 0.10
P_2	2.0 ± 0.05	2.0 ± 0.10	2.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.10	2.0 ± 0.10	2.0 ± 0.10
A_0	0.95 ± 0.05	1.70 ± 0.10	1.95 ± 0.10	2.9 ± 0.10	Table S8	5.11 ± 0.15	5.6 ± 0.23	6.9 ± 0.23
B_0	1.85± 0.05	2.45 ± 0.10	Table S8	Table S8	Table S8	5.6 ± 0.23	8.1 ± 0.15	9.6 ± 0.15
B_1 max	4.35	4.35	4.35	4.35	6.15	6.4	12.1	12.1
D_0	1.55 ± 0.05	1.55 ± 0.05	1.55 ± 0.05	1.55 ± 0.05	1.55 ± 0.05	1.5 + 0.10/ -.00	1.5 + 0.10/ -.00	1.5 + 0.10/ -.00
F	3.50 ± 0.05	3.50 ± 0.05	3.50 ± 0.05	3.50 ± 0.05	5.50 ± 0.10	7.50 ± 0.10	7.50 ± 0.10	7.50 ± 0.10
E_1	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10
E_2 min	6.25	6.25	6.25	6.25	10.25	14.25	14.25	14.25
T max	0.3	0.3	0.3	0.3	0.35	0.4	0.4	0.4
T_1 max	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
K_0	Table S8	Table S8	Table S8	Table S8	Table S8	1.8 ± 0.15	3.2 ± 0.15	3.4 ± 0.15

Table S8 Tape and Reel Specifications for PolySwitch Surface-Mount Devices (Millimeters)

	femtoSMDC005F femtoSMDC008F femtoSMDC010F	femtoSMDC012F femtoSMDC016F femtoSMDC020F femtoSMDC035F	picoSMDC012S picoSMDC020S picoSMDC035S	picoSMDC010S picoSMDC050S picoSMDC075S	picoSMDC110S	All nanoSMDC Series Except nanoSMDC012F nanoSMDC016F nanoSMDC200F
A_0	0.95 ± 0.05	0.95 ± 0.05	1.70 ± 0.1	1.70 ± 0.1	1.70 ± 0.1	1.95 ± 0.1
B_0	1.85 ± 0.05	1.85 ± 0.05	2.45 ± 0.1	2.45 ± 0.1	2.45 ± 0.1	3.50 +0.1/-0.08
K_0	0.90 ± 0.1	0.55 ± 0.05	0.86 ± 0.1	1.12 ± 0.1	1.35 ± 0.1	0.89 ± 0.1

	nanoSMDC012F nanoSMDC016F nanoSMDC200F	All microSMD series except microSMD200F	microSMD200F	miniSMDC010F miniSMDC014F~075F miniSMDC100F~110F/16 miniSMDC125F~150F/16 miniSMDC160F~260F miniSMDC300F	miniSMDC075F/24 miniSMDC075F/33 miniSMDC110F/24 miniSMDC260F/12 miniSMDC260F/13.2 miniSMDC260F/16	miniSMDC150F/24	decaSMDC050F/60
A_0	1.95 ± 0.1	2.9 ± 0.1	2.9 ± 0.1	3.5 ± 0.1	3.7 ± 0.1	3.7 ± 0.1	5.0 ± 0.1
B_0	3.5 ± 0.1	3.5 ± 0.1	3.55 ± 0.1	4.95 ± 0.1	4.9 ± 0.1	4.9 ± 0.1	5.4 ± 0.1
K_0	1.27 ± 0.1	0.9 ± 0.1	1.27 ± 0.1	0.9 ± 0.1	1.4 ± 0.1	1.78 ± 0.1	1.7 ± 0.1

Table S9 Reel Dimensions for PolySwitch Surface-Mount Devices (Millimeters)

	femto/pico/nano/microSMD	miniSMDC	midSMD	SMD	SMD2
A max	185	185	330	330	330
N min	50	50	50	50	50
W_1	8.4 + 1.5/-.00	12.4 + 2.0/-.00	16.4 + 2.0/-.00	16.4 + 2.0/-.00	16.4 + 2.0/-.00
W_2 max	14.4	18.4	22.4	22.4	22.4

Figure S15 EIA Referenced Taped Component Dimensions for PolySwitch Surface-Mount Devices

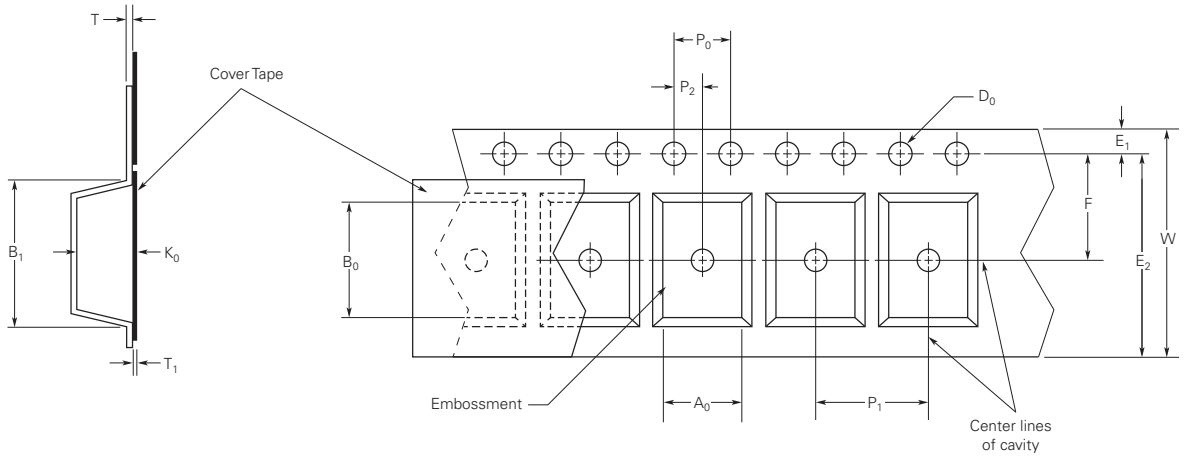
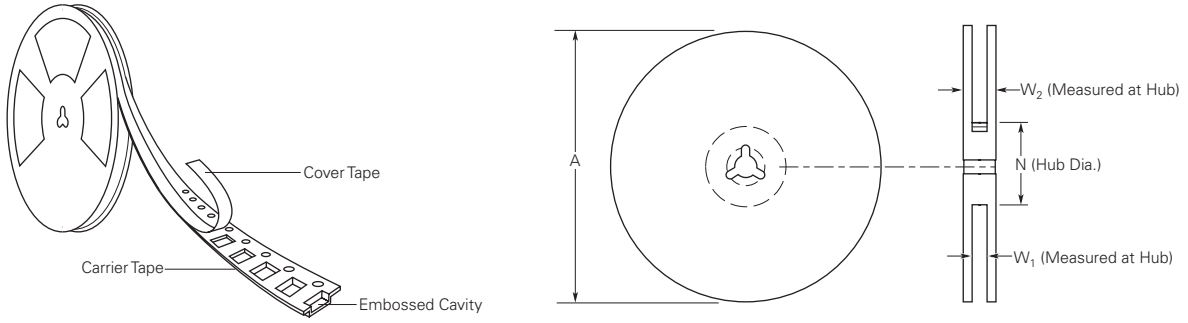
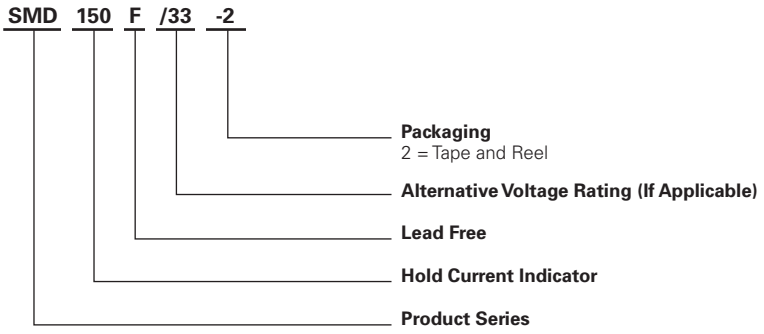


Figure S16 EIA Referenced Reel Dimensions for PolySwitch Surface-Mount Devices



Part Numbering System for PolySwitch Surface-Mount Devices



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⚠ Warning:

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage (Ldi/dt) above the rated voltage of the device.

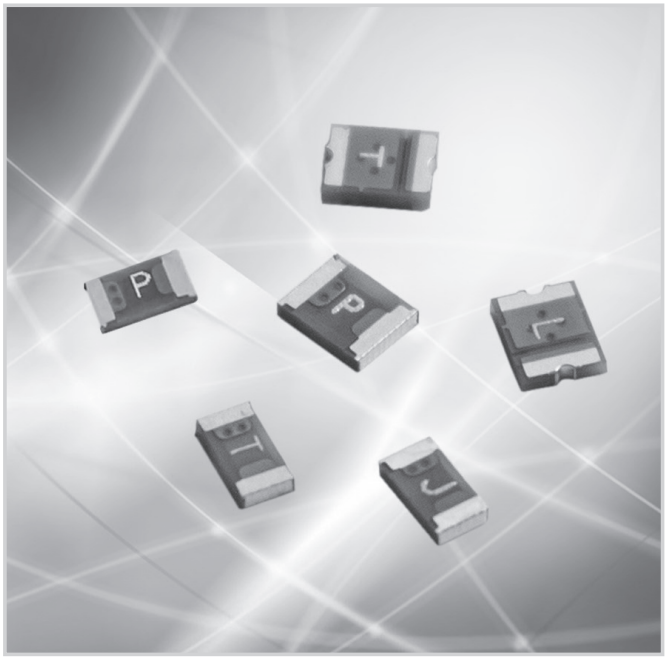
RoHS Compliant, ELV Compliant HF Halogen Free



PolySwitch Resettable Devices
Low rho SMD Devices

The low rho SMD (surface-mount device) series is well suited to space-constrained mobile applications. The devices can help provide both overcurrent and overtemperature protection for battery pack PCMs (protection circuit modules) used in compact consumer devices such as smartphones and MP3/MP4 media players. In particular, the low rho SMD series helps battery pack suppliers achieve their design goals and simplify their installation methods.

The low rho SMD series comprises eleven devices. In the model number descriptions, the “micro” prefix refers to the 1210 form factor and the “nano” prefix refers to the 1206 form factor.



Benefits

- Helps save board space and power consumption, and therefore costs, in space-constrained mobile electronics
- Are more compact in comparison with similiar offerings and are available in an industry-standard form factor
- Can be assembled with a reflowable soldering technique, as opposed to the spot welding process required by many other components
- Maximum electrical rating: Voltage $6V_{DC}$ and short circuit current 50A
- Industry-standard form factor of 1210 (3.0mmx2.54mm, or 0.12inx0.10in), or 1206 (3.0mmx1.52mm; or 0.12inx0.060in)
- Useful for an operating current of 2A and above
- Useful for and packaged for surface mounting on the PCB

Features

- RoHS compliant
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Current ratings from 1.75 to 5.0A
- Agency recognition: UL, CSA, TÜV
- Small footprint
- Fast time-to-trip

Applications

- Mobile and smart phones
- Media players (MP3/MP4)
- Digital still and video cameras
- Tablets
- Mini notebooks

RoHS Compliant, ELV Compliant HF Halogen Free

Table LR1 Thermal Derating for low rho SMD Devices [Hold Current (A) at Ambient Temperature (ºC)]

		Maximum Ambient Temperature										
	Part Number	-40ºC	-20ºC	0ºC	20ºC	25ºC	40ºC	50ºC	60ºC	70ºC	80ºC	85ºC
	nanoSMDLR series Size 3216mm/1206mils											
	nanoSMD175LR	3.00	2.60	2.20	1.75	1.70	1.40	1.20	1.00	0.80	0.60	0.50
	nanoSMD200LR	3.60	3.20	2.80	2.00	1.90	1.80	1.60	1.40	1.20	1.00	0.80
	nanoSMD270LR	4.00	3.50	3.00	2.70	2.60	2.20	2.00	1.60	1.40	1.20	1.10
	nanoSMD350LR	5.50	4.80	4.00	3.50	3.30	2.70	2.30	1.90	1.60	1.40	1.30
Coming Soon	nanoSMD400LR*	5.80	5.20	4.60	4.00	3.90	3.40	3.10	2.82	2.52	2.23	2.10
	nanoSMD500LR	7.40	6.60	6.00	5.00	4.90	4.60	4.20	3.70	3.30	3.00	2.80
	microSMDLR series Size 3225mm/1210mils											
	microSMD190LR	3.40	2.90	2.40	1.90	1.80	1.40	1.15	0.90	0.65	0.40	0.28
	microSMD200LR	3.50	3.00	2.50	2.00	1.90	1.50	1.25	1.00	0.75	0.50	0.38
	microSMD250LR	4.40	3.80	3.20	2.50	2.40	1.90	1.60	1.30	1.00	0.65	0.50
	microSMD350LR	5.40	4.75	4.00	3.50	3.20	2.70	2.40	2.00	1.70	1.35	1.20
Coming Soon	microSMD450LR*	7.00	6.20	5.50	4.50	4.40	3.80	3.50	3.20	2.75	2.35	2.16

***** Data is preliminary.

Figure LR1 Thermal Derating Curve for low rho SMD Devices

Figure LR1

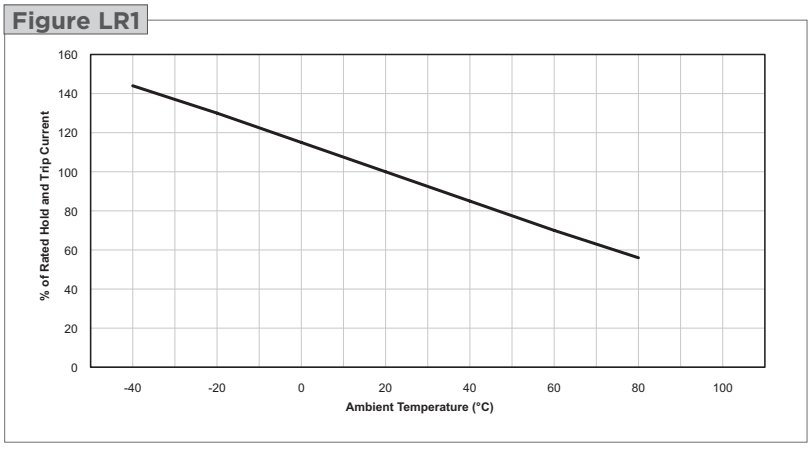


Table LR2 Electrical Characteristics for low rho SMD Devices at Room Temperature

	Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\ MAX}$ (W)	Max Time-to-Trip (A)	Max Time-to-Trip (s)	R_{MIN} Ω	$R_{1\ MAX}$ Ω	Figure for Dimensions
	nanoSMDLR series Size 3216mm/1206mils										
	nanoSMD175LR	1.75	5.00	6	50	1.00	9.50	1.00	0.008	0.034	LR2
	nanoSMD200LR	2.00	6.00	6	50	1.00	9.50	3.00	0.006	0.024	LR2
	nanoSMD270LR	2.70	6.30	6	50	1.00	8.00	5.00	0.005	0.018	LR2
	nanoSMD350LR	3.50	6.30	6	50	1.00	8.00	5.00	0.004	0.018	LR2
Coming Soon	nanoSMD400LR*	4.00	8.00	6	50	1.00	22.00	2.00	0.004	0.010	LR2
	nanoSMD500LR	5.00	10.00	6	50	1.00	25.00	2.00	0.002	0.008	LR2
	microSMDLR series Size 3225mm/1210mils										
	microSMD190LR	1.90	4.90	6	50	1.00	9.50	4.00	0.006	0.021	LR3
	microSMD200LR	2.00	5.00	6	50	1.00	9.50	4.00	0.006	0.021	LR3
	microSMD250LR	2.50	5.20	6	50	1.00	9.50	5.00	0.005	0.018	LR3
	microSMD350LR	3.50	9.00	6	50	1.00	9.50	10.00	0.0025	0.011	LR2
Coming Soon	microSMD450LR*	4.50	9.00	6	50	1.00	25.00	2.00	0.002	0.008	LR3

***** Data is preliminary.

RoHS Compliant, ELV Compliant HF Halogen Free

Figures LR2-LR3 Dimensions Figures for low rho SMD Devices

Figure LR2

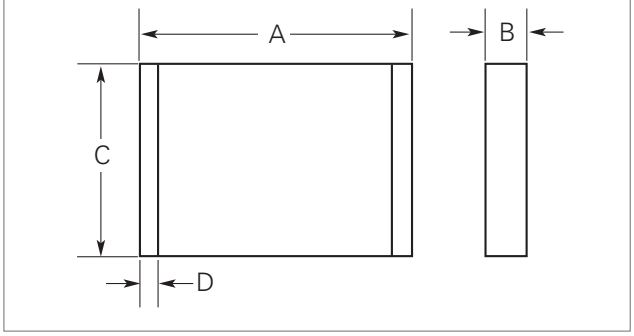


Figure LR3

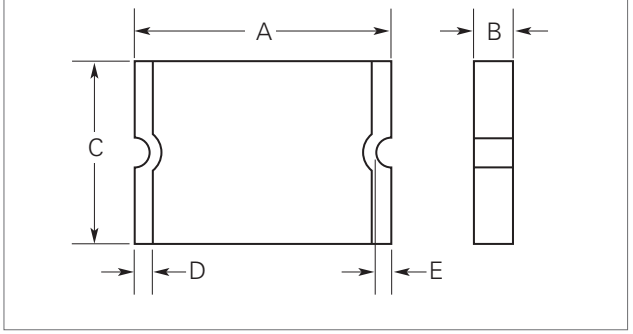


Table LR3 Dimensions for low rho SMD Devices in Millimeters (Inches)

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	Figure
nanoSMDLR Series Size 3216mm/1206mils										
nanoSMD175LR	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	1.37 (0.054)	1.85 (0.073)	0.25 (0.010)	0.75 (0.030)	—	LR2
nanoSMD200LR	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	1.37 (0.054)	1.85 (0.073)	0.25 (0.010)	0.75 (0.030)	—	LR2
nanoSMD270LR	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	1.37 (0.054)	1.85 (0.073)	0.25 (0.010)	0.75 (0.030)	—	LR2
nanoSMD350LR	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	1.37 (0.054)	1.85 (0.073)	0.25 (0.010)	0.75 (0.030)	—	LR2
Coming Soon nanoSMD400LR*	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	1.37 (0.054)	1.85 (0.073)	0.25 (0.010)	0.75 (0.030)	—	LR2
nanoSMD500LR	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	1.37 (0.054)	1.85 (0.073)	0.25 (0.010)	0.75 (0.030)	—	LR2
nanoSMDLR Series Size 3225mm/1210mils										
microSMD190LR	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	2.35 (0.092)	2.80 (0.110)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	LR3
microSMD200LR	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	2.35 (0.092)	2.80 (0.110)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	LR3
microSMD250LR	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	2.35 (0.092)	2.80 (0.110)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	LR3
microSMD350LR	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	2.35 (0.092)	2.80 (0.110)	0.25 (0.010)	0.75 (0.030)	—	LR2
Coming Soon microSMD450LR*	3.00 (0.118)	3.43 (0.135)	0.50 (0.019)	1.00 (0.039)	2.35 (0.092)	2.80 (0.110)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	LR3

***** Data is preliminary.

Table LR4 Physical Characteristics for low rho SMD Devices Operating Temperature Range -40ºC to 85ºC

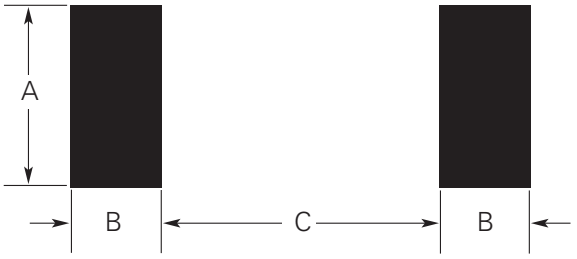
Physical Characteristics	
Terminal Pad Material	Gold with Nickel Underplate
Soldering Characteristics	ANSI/J-STD-002 Category 3
Solder Heat Withstand	per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A
Flammability Resistance	per IEC 695-2-2 Needle Flame Test for 20 sec.
Recommended Storage Conditions	40°C max, 70% R.H. max; Devices May Not Meet Specified Ratings if Storage Conditions Are Exceeded.

Table LR5 Packaging and Marking Information for low rho SMD Devices

	Part Number	Tape & Reel Quantity	Standard Package	Part Marking	Recommended Pad Layout Figures [mm (in)] Dimension A (Nom)	Dimension B (Nom)	Dimension C (Nom)	Agency Recognition
	nanoSMDLR Series Size 3216mm/1206mils							
	nanoSMD175LR	3,000	15,000	J	1.75 (0.069)	1.10 (0.043)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMD200LR	3,000	15,000	T	1.75 (0.069)	1.10 (0.043)	2.00 (0.079)	UL, CSA
	nanoSMD270LR	3,000	15,000	L	1.75 (0.069)	1.10 (0.043)	2.00 (0.079)	UL, CSA, TÜV
	nanoSMD350LR	3,000	15,000	P	1.75 (0.069)	1.10 (0.043)	2.00 (0.079)	UL, CSA, TÜV
Coming Soon	nanoSMD400LR*	3,000	15,000	S	1.75 (0.069)	1.10 (0.043)	2.00 (0.079)	Pending
	nanoSMD500LR	3,000	15,000	H	1.75 (0.069)	1.10 (0.043)	2.00 (0.079)	UL, CSA, TÜV
	microSMDLR Series Size 3225mm/1210mils							
	microSMD190LR	3,000	15,000	None	2.65 (0.104)	1.00 (0.039)	2.00 (0.079)	UL, CSA
	microSMD200LR	3,000	15,000	T	2.65 (0.104)	1.00 (0.039)	2.00 (0.079)	UL, CSA
	microSMD250LR	3,000	15,000	L	2.65 (0.104)	1.00 (0.039)	2.00 (0.079)	UL, CSA
	microSMD350LR	3,000	15,000	P	2.65 (0.104)	1.10 (0.043)	2.00 (0.079)	UL, CSA
Coming Soon	microSMD450LR*	3,000	15,000	H	2.65 (0.104)	1.00 (0.039)	2.00 (0.079)	Pending

***** Data is preliminary.

Figure LR4 Recommended Pad Layout for low rho SMD Devices



Agency Recognition for low rho SMD Devices

UL	File # E74889 for all low rho SMD Devices
CSA	File # CA78165 for all low rho SMD Devices
TÜV	Certificate Number Available Upon Request (Certified to IEC 60730-1)

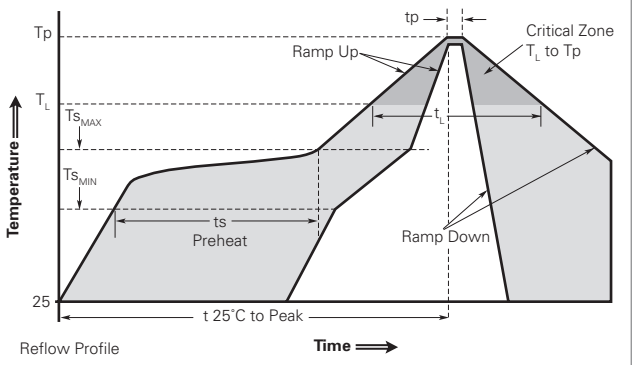
Solder Reflow Recommendation for low rho SMD Devices

Classification Reflow Profiles

Profile Feature	Pb-Free Assembly
Average Ramp-up Rate (Ts_{MAX} to Tp)	3°C/s max
Preheat	
• Temperature min (Ts_{MIN})	150°C
• Temperature max (Ts_{MAX})	200°C
• Time (ts_{MIN} to ts_{MAX})	60-120s
Time Maintained Above:	
• Temperature (T_L)	217°C
• Time (t_L)	60-150s
Peak/Classification Temperature (Tp)	260°C
Time within 5°C of Actual Peak Temperature	
Time (tp)	30s max
Ramp down rate	2°C/s max
Time 25°C to Peak Temperature	8 mins max

Note: All temperatures refer to topside of the package measured on the package body surface.

Figure LR5



Solder Reflow

- Recommended reflow methods:
  - IR
  - Hot air
  - Nitrogen
- Recommended maximum paste thickness: 0.25mm (0.010in).
- Devices can be cleaned using standard methods and aqueous solvents.
- Experience has shown the optimum conditions for forming acceptable solder fillets occur when a reasonable amount of solder paste is placed underneath each device's termination. As such, we request that customers comply with our recommended solder pad layouts.
- Customer should validate that the solder paste amount and reflow recommendations meet its application.
- We request that customer board layouts refrain from placing raised features (e.g., vias, nomenclature, traces, etc.) underneath PolySwitch devices. It is possible that raised features could negatively impact solderability performance of our devices.

Table LR6 Tape and Reel Specifications for low rho SMD Devices in Millimeters

Description	nanoSMDLR Series EIA 481-1	microSMDLR Series EIA 481-1
W	8.0 ± 0.30	8.0 ± 0.30
P_0	4.0 ± 0.10	4.0 ± 0.10
P_1	4.0 ± 0.10	4.0 ± 0.10
P_2	2.0 ± 0.05	2.0 ± 0.05
A_0	1.95 ± 0.10	2.9 ± 0.10
B_0	3.50 +0.1/-0.08	3.55 ± 0.10
B_1 MAX	4.35	4.35
D_0	1.55 ± 0.05	1.55 ± 0.05
F	3.50 ± 0.05	3.50 ± 0.05
E_1	1.75 ± 0.10	1.75 ± 0.10
E_2 MIN	6.25	6.25
T MAX	0.3	0.3
T_1 MAX	0.1	0.1
K_0	0.89 ± 0.10	1.27 ± 0.10
A MAX	179	179
N MIN	53.5	53.5
W_1	9.5 ± 0.5	9.5 ± 0.5
W_2 MAX	15	15

Figure LR6 EIA Referenced Taped Component Dimensions for low rho SMD Devices

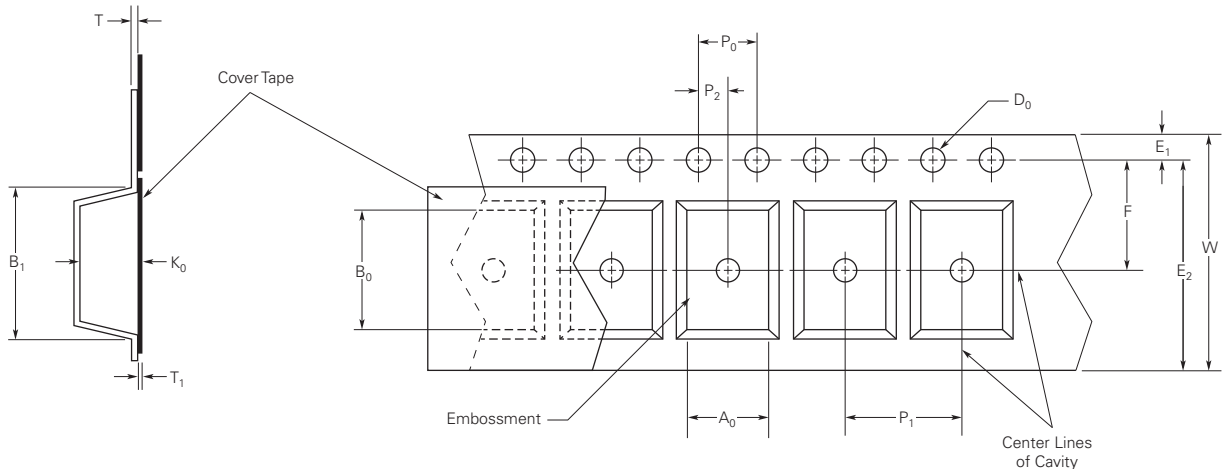
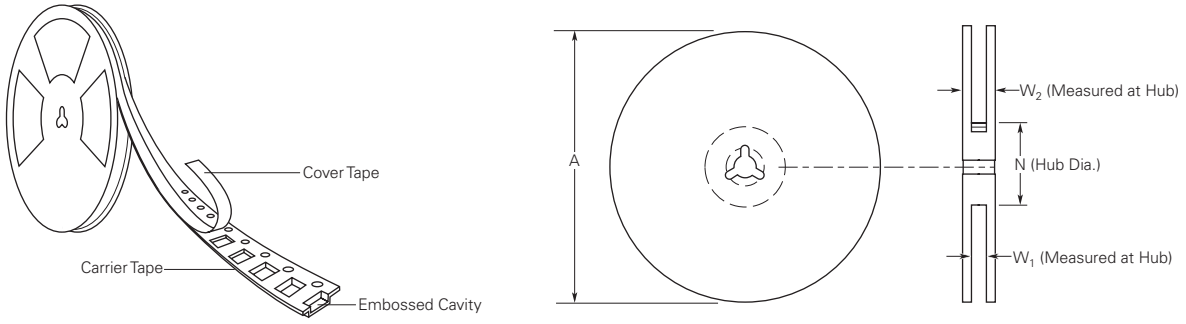
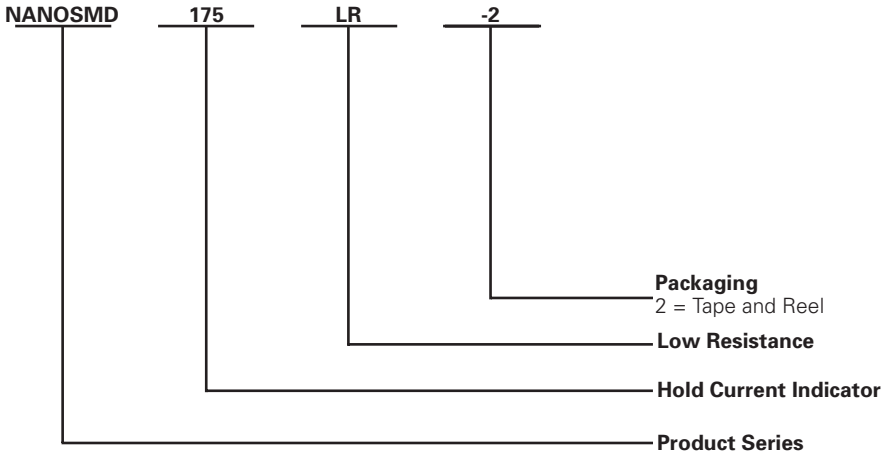


Figure LR7 EIA Referenced Reel Dimensions for low rho SMD Devices



Part Numbering System for low rho SMD Devices



⚠ Warning:

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage (Ldi/dt) above the rated voltage of the device.

RoHS Compliant, ELV Compliant HF Halogen Free

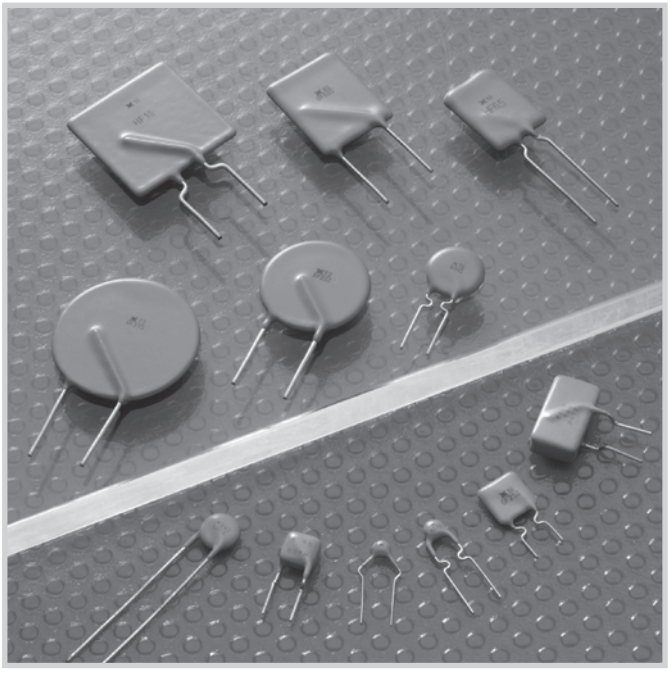
RoHS Compliant, ELV Compliant HF Halogen Free



PolySwitch Resettable Devices
Radial-Leaded Devices

TE Circuit Protection's PolySwitch radial-leaded products represent the most comprehensive and complete set of PPTC products available in the industry today:

- RGEF series for hold currents up to 14A
- RHEF series for flatter thermal derating and operating temperatures up to 125°C
- RUEF series for balance of voltage rating (30V) and hold current (up to 9A)
- RUSBF series for fast time-to-trip and low-resistance computer applications
- RXEF series for low hold currents (down to 50mA) and high voltage rating (up to 72V)
- RKEF series for balance of voltage rating (60V) and hold current (up to 5A)
- Now offering halogen a free versions of all products



Benefits

- Many product choices help provide engineers more design flexibility
- Compatible with high-volume electronics assembly
- Assists in meeting regulatory requirements
- Higher voltage ratings allow use in new applications

Features

- RoHS compliant
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Broadest range of radial-leaded resettable devices available in the industry
- Current ratings from 50mA to 15A
- Voltage ratings from 6V (computer and electronic applications) to 99V
- Agency recognition : UL, CSA, TÜV
- Fast time-to-trip
- Low resistance

Applications

- Satellite video receivers
- Industrial controls
- Transformers
- Computer motherboards
- Modems
- USB hubs, ports and peripherals
- IEEE 1394 ports
- CD-ROMs
- Game machines
- Battery packs
- Phones
- Fax machines
- Analog and digital line cards
- Printers

RoHS Compliant, ELV Compliant HF Halogen Free

Application Selection Guide for Radial-Leaded Devices

The guide below lists PolySwitch radial-leaded devices that are typically used in each of the applications described.
Specifications for the suggested device part numbers can be found in this section.
Once a part number has been selected, the user should evaluate and test each product for its intended application.

	PolySwitch Resettable Devices — Key Selection Criteria		
Protection Application	**Small Size**	**Flatter Derating**	**Lower Current Higher Voltage**
Electromagnetic Loads	RGEF (<16V), RUEF (<30V)	RHEF (<16V)	RXEF (<72V), RKEF(<60V)
Halogen Lighting	RGEF (<16V), RUEF (<30V)	RHEF (<16V)	RXEF (<72V), RKEF(<60V)
Lighting Ballast	RXEF (<72V), BBRF (<99V)		
Loudspeakers	RXEF (<72V)		RXEF (<72V), RKEF(<60V)
Medical Equipment	RGEF (<16V), RUEF (<30V)	RHEF (<16V)	RXEF (<72V), RKEF(<60V)
MOSFET Devices	RGEF (<16V), RUEF (<30V)	RHEF (<16V)	RXEF (<72V), RKEF(<60V)
Motors, Fans and Blowers	RXEF (<72V), RGEF (<16V)	RHEF (<16V)	
POS Equipment	RXEF (<72V), RUEF (<30V)		
Process and Industrial Controls	RXEF (<72V), RUEF (<30V)		
Satellite Video Receivers	RGEF (<16V), RUEF (<30V)	RHEF (<16V)	RXEF (<72V), RKEF(<60V)
Security and Fire Alarm Systems	RGEF (<16V), RUEF (<30V)	RHEF (<16V)	RXEF (<72V), RKEF(<60V)
Test and Measurement Equipment	RGEF (<16V), RUEF (<30V)	RHEF (<16V)	RXEF (<72V), RKEF(<60V)
Transformers	RGEF (<16V), RUEF (<30V)	RHEF (<16V)	RXEF (<72V), RKEF(<60V)
DDC Computer and Consumer Electronics	RUEF (<30V)		
Mouse and Keyboard	RUEF (<30V)		
SCSI	RUEF (<30V)		
USB	RUSBF (<16V)		
Traces and Printed Circuit Board Protection	RGEF (<16V), RUEF (<30V)	RHEF (<16V)	RXEF (<72V), RKEF(<60V)

Note : This list is not exhaustive. TE Circuit Protection welcomes customer input for additional application ideas for PolySwitch resettable devices.

Table R1 Product Series - Current Rating, Voltage Rating / Typical Resistance for Radial-Leaded Devices

Voltage Rating	**RXEF 72V**	**RKEF 60V**	**RXEF 60V**	**RUEF 30V**	**RGEF 16V**	**RHEF 16V**	**RHEF 30V**	**RUSBF 16V**	**RUSBF 6V**
Hold Current (A)									
0.050	—	—	9.20Ω	—	—	—	—	—	—
0.100	—	—	3.50Ω	—	—	—	—	—	—
0.170	—	—	4.30Ω	—	—	—	—	—	—
0.200	2.290Ω	—	—	—	—	—	—	—	—
0.250	1.600Ω	—	—	—	—	—	—	—	—
0.300	1.110Ω	—	—	—	—	—	—	—	—
0.400	0.710Ω	—	—	—	—	—	—	—	—
0.500	0.640Ω	0.425Ω	—	—	—	—	0.68Ω	—	—
0.550	—	—	—	—	—	—	—	—	—
0.650	0.400Ω	0.350Ω	—	—	—	—	—	—	—
0.700	—	—	—	—	—	—	0.42Ω	—	—
0.750	0.325Ω	0.295Ω	—	—	—	—	—	—	0.140Ω
0.900	0.255Ω	0.255Ω	—	0.095Ω	—	—	—	0.100Ω	—
1.000	—	—	—	—	—	—	0.24Ω	—	—
1.100	0.200Ω	0.225Ω	—	0.075Ω	—	—	—	0.075Ω	—
1.200	—	—	—	—	—	—	—	—	0.080Ω
1.350	0.155Ω	0.165Ω	—	0.060Ω	—	—	—	0.060Ω	—
1.550	—	—	—	—	—	—	—	—	0.058Ω
1.600	0.115Ω	0.150Ω	—	0.050Ω	—	—	—	0.050Ω	—
1.850	0.100Ω	0.106Ω	—	0.045Ω	—	—	—	0.045Ω	—
1.900	—	—	—	—	—	—	—	—	—

RoHS Compliant, ELV Compliant HF Halogen Free

Table R1 Product Series - Current Rating, Voltage Rating / Typical Resistance for Radial-Leaded Devices Cont'd

Voltage Rating	RXEF 72V	RKEF 60V	RXEF 60V	RUEF 30V	RGEF 16V	RHEF 16V	RHEF 30V	RUSBF 16V	RUSBF 6V
Hold Current (A)									
2.000	—	—	—	—	—	0.0610Ω	—	—	—
2.500	0.065Ω	0.063Ω	—	0.030Ω	0.0380Ω	—	—	0.030Ω	—
3.000	0.050Ω	0.040Ω	—	0.035Ω	0.0514Ω	0.0430Ω	—	—	—
3.750	0.040Ω	0.029Ω	—	—	—	—	—	—	—
4.000	—	0.026Ω	—	0.020Ω	0.0300Ω	0.0320Ω	—	—	—
4.500	—	—	—	—	—	0.0290Ω	—	—	—
5.000	—	0.021Ω	—	0.020Ω	0.0192Ω	—	—	—	—
5.500	—	—	—	—	—	0.0200Ω	—	—	—
6.000	—	—	—	0.013Ω	0.0145Ω	0.0175Ω	—	—	—
6.500	—	—	—	—	—	0.0144Ω	—	—	—
7.000	—	—	—	0.013Ω	0.0105Ω	0.0132Ω	—	—	—
7.500	—	—	—	—	—	0.0120Ω	—	—	—
8.000	—	—	—	0.013Ω	0.0086Ω	0.0110Ω	—	—	—
9.000	—	—	—	0.008Ω	0.0070Ω	0.0100Ω	—	—	—
10.00	—	—	—	—	0.0056Ω	0.0083Ω	—	—	—
11.00	—	—	—	—	0.0050Ω	0.0073Ω	—	—	—
12.00	—	—	—	—	0.0046Ω	—	—	—	—
13.00	—	—	—	—	—	0.0055Ω	—	—	—
14.00	—	—	—	—	0.0040Ω	0.0050Ω	—	—	—
15.00	—	—	—	—	—	0.0050Ω	—	—	—

HF Halogen Free

Table R2 Thermal Derating for Radial-Leaded Devices [Hold Current (A) at Ambient Temperature (°C)]

	Maximum Ambient Temperature										
Part Number	**-40°C**	**-20°C**	**0°C**	**20°C**	**25°C**	**40°C**	**50°C**	**60°C**	**70°C**	**85°C**	**125°C**
RXEF 60V											
RXEF005	0.078	0.068	0.06	0.05	0.048	0.04	0.035	0.032	0.027	0.02	—
RXEF010	0.160	0.140	0.11	0.10	0.096	0.08	0.072	0.067	0.050	0.04	—
RXEF017	0.260	0.230	0.21	0.17	0.160	0.14	0.120	0.110	0.090	0.07	—
RXEF 72V											
RXEF020	0.31	0.27	0.24	0.20	0.19	0.16	0.14	0.13	0.11	0.08	—
RXEF025	0.39	0.34	0.30	0.25	0.24	0.20	0.18	0.16	0.14	0.10	—
RXEF030	0.47	0.41	0.36	0.30	0.29	0.24	0.22	0.20	0.16	0.12	—
RXEF040	0.62	0.54	0.48	0.40	0.38	0.32	0.29	0.25	0.22	0.16	—
RXEF050	0.78	0.68	0.60	0.50	0.48	0.41	0.36	0.32	0.27	0.20	—
RXEF065	1.01	0.88	0.77	0.65	0.62	0.53	0.47	0.41	0.35	0.26	—
RXEF075	1.16	1.02	0.89	0.75	0.72	0.61	0.54	0.47	0.41	0.30	—
RXEF090	1.40	1.22	1.07	0.90	0.86	0.73	0.65	0.57	0.49	0.36	—
RXEF110	1.71	1.50	1.31	1.10	1.06	0.89	0.79	0.69	0.59	0.44	—
RXEF135	2.09	1.84	1.61	1.35	1.30	1.09	0.97	0.85	0.73	0.54	—
RXEF160	2.48	2.18	1.90	1.60	1.54	1.30	1.15	1.01	0.86	0.64	—
RXEF185	2.87	2.52	2.20	1.85	1.78	1.50	1.33	1.17	1.00	0.74	—
RXEF250	3.88	3.40	2.98	2.50	2.40	2.03	1.80	1.58	1.35	1.00	—
RXEF300	4.65	4.08	3.57	3.00	2.88	2.43	2.16	1.89	1.62	1.20	—
RXEF375	5.81	5.10	4.46	3.75	3.60	3.04	2.70	2.36	2.03	1.50	—

Table R2 Thermal Derating for Radial-Leaded Devices [Hold Current (A) at Ambient Temperature (°C)] Cont'd

Part Number	Maximum Ambient Temperature -40°C	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	85°C	125°C
RKEF 60V											
RKEF050	0.73	0.65	0.58	0.50	0.48	0.42	0.38	0.34	0.31	0.26	—
RKEF065	0.94	0.85	0.75	0.65	0.63	0.54	0.50	0.44	0.40	0.34	—
RKEF075	1.09	0.98	0.86	0.75	0.73	0.62	0.58	0.51	0.46	0.39	—
RKEF090	1.30	1.17	1.04	0.90	0.87	0.75	0.69	0.61	0.55	0.47	—
RKEF110	1.60	1.43	1.27	1.10	1.06	0.92	0.85	0.75	0.67	0.57	—
RKEF135	1.96	1.76	1.55	1.35	1.31	1.12	1.04	0.92	0.83	0.71	—
RKEF160	2.32	2.08	1.84	1.60	1.55	1.33	1.23	1.08	0.98	0.83	—
RKEF185	2.68	2.41	2.13	1.85	1.79	1.54	1.43	1.26	1.13	0.96	—
RKEF250	3.63	3.25	2.88	2.50	2.43	2.08	1.93	1.70	1.52	1.31	—
RKEF300	4.35	3.90	3.45	3.00	2.91	2.50	2.30	2.04	1.84	1.55	—
RKEF375	5.44	4.88	4.31	3.75	3.64	3.11	2.90	2.54	2.29	1.94	—
RKEF400	5.80	5.20	4.60	4.00	3.88	3.32	3.08	2.73	2.45	2.08	—
RKEF500	7.25	6.50	5.75	5.00	4.85	4.15	3.85	3.41	3.06	2.59	—
RUEF 30V											
RUEF090	1.31	1.17	1.04	0.90	0.87	0.75	0.69	0.61	0.55	0.47	—
RUEF110	1.60	1.43	1.27	1.10	1.07	0.91	0.85	0.75	0.67	0.57	—
RUEF135	1.96	1.76	1.55	1.35	1.31	1.12	1.04	0.92	0.82	0.70	—
RUEF160	2.32	2.08	1.84	1.60	1.55	1.33	1.23	1.09	0.98	0.83	—
RUEF185	2.68	2.41	2.13	1.85	1.79	1.54	1.42	1.26	1.13	0.96	—
RUEF250	3.63	3.25	2.88	2.50	2.43	2.08	1.93	1.70	1.53	1.30	—
RUEF300	4.35	3.90	3.45	3.00	2.91	2.49	2.31	2.04	1.83	1.56	—
RUEF400	5.80	5.20	4.60	4.00	3.88	3.32	3.08	2.72	2.44	2.08	—
RUEF500	7.25	6.50	5.75	5.00	4.85	4.15	3.85	3.40	3.05	2.60	—
RUEF600	8.70	7.80	6.90	6.00	5.82	4.98	4.62	4.08	3.66	3.12	—
RUEF700	10.15	9.10	8.05	7.00	6.79	5.81	5.39	4.76	4.27	3.64	—
RUEF800	11.60	10.40	9.20	8.00	7.76	6.64	6.16	5.44	4.88	4.16	—
RUEF900	13.05	11.70	10.35	9.00	8.73	7.47	6.93	6.12	5.49	4.68	—
RHEF 30V - High Temperature											
RHEF050	0.68	0.62	0.56	0.51	0.50	0.44	0.40	0.36	0.34	0.28	0.12
RHEF070	0.95	0.87	0.79	0.72	0.70	0.62	0.56	0.51	0.47	0.39	0.17
RHEF100	1.36	1.24	1.13	1.03	1.00	0.89	0.80	0.73	0.67	0.56	0.24
RUSBF 16V											
RUSBF090	1.31	1.17	1.04	0.90	0.87	0.75	0.69	0.61	0.55	0.47	—
RUSBF110	1.60	1.43	1.27	1.10	1.07	1.00	0.92	0.75	0.67	0.57	—
RUSBF135	1.96	1.76	1.55	1.35	1.31	1.12	1.04	0.92	0.82	0.70	—
RUSBF160	2.32	2.08	1.84	1.60	1.55	1.33	1.23	1.09	0.98	0.83	—
RUSBF185	2.68	2.41	2.13	1.85	1.79	1.54	1.42	1.26	1.13	0.96	—
RUSBF250	3.63	3.25	2.88	2.50	2.43	2.08	1.93	1.70	1.53	1.30	—
RGEF 16V											
RGEF250	3.7	3.3	3.0	2.6	2.50	2.2	2.0	1.8	1.6	1.2	—
RGEF300	4.4	4.0	3.6	3.1	3.00	2.6	2.4	2.1	1.9	1.4	—
RGEF400	5.9	5.3	4.8	4.1	4.00	3.5	3.2	2.8	2.5	1.9	—
RGEF500	7.3	6.6	6.0	5.2	5.00	4.4	4.0	3.6	3.1	2.4	—
RGEF600	8.8	8.0	7.2	6.2	6.00	5.2	4.8	4.2	3.8	2.8	—
RGEF700	10.3	9.3	8.4	7.3	7.00	6.2	5.6	5.0	4.4	3.3	—
RGEF800	11.7	10.7	9.6	8.3	8.00	6.9	6.4	5.6	5.1	3.7	—
RGEF900	13.2	11.9	10.7	9.4	9.00	7.9	7.2	6.4	5.6	4.2	—
RGEF1000	14.7	13.3	12.0	10.3	10.00	8.7	8.0	7.0	6.3	4.7	—
RGEF1100	16.1	14.6	13.1	11.5	11.00	9.7	8.8	7.8	6.9	5.2	—
RGEF1200	17.6	16.0	14.4	12.4	12.00	10.4	9.6	8.4	7.6	5.6	—
RGEF1400	20.5	18.7	16.8	14.5	14.00	12.1	11.2	9.8	8.9	6.5	—

RoHS Compliant, ELV Compliant HF Halogen Free

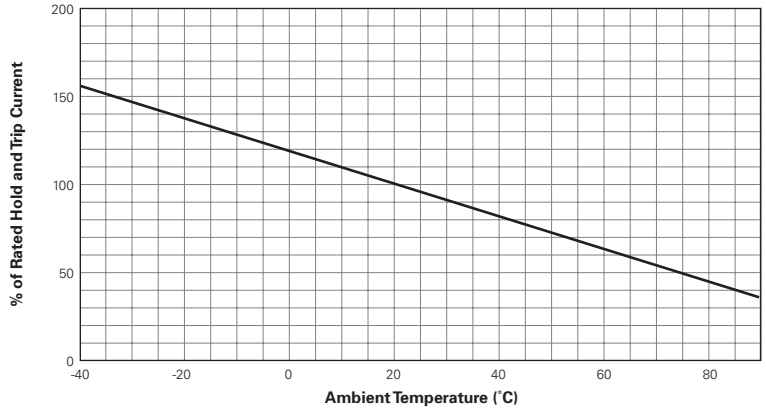
Table R2 Thermal Derating for Radial-Leaded Devices [Hold Current (A) at Ambient Temperature (°C)] Cont'd

	Maximum Ambient Temperature										
Part Number	**-40°C**	**-20°C**	**0°C**	**20°C**	**25°C**	**40°C**	**50°C**	**60°C**	**70°C**	**85°C**	**125°C**
RHEF 16V - High Temperature											
RHEF200	2.71	2.49	2.26	2.06	2.00	1.77	1.60	1.46	1.34	1.11	0.49
RHEF300	4.07	3.74	3.41	3.09	3.00	2.65	2.40	2.21	2.00	1.66	0.74
RHEF400	5.57	5.11	4.65	4.22	4.00	3.62	3.29	3.01	2.73	2.27	1.01
RHEF450	6.10	5.60	5.10	4.60	4.50	4.00	3.60	3.30	3.00	2.50	1.10
RHEF550	7.47	6.86	6.24	5.66	5.50	4.85	4.41	4.04	3.66	3.05	1.36
RHEF600	8.20	7.50	6.80	6.20	6.00	5.30	4.90	4.40	4.00	3.30	1.50
RHEF650	8.80	8.10	7.40	6.70	6.50	5.70	5.30	4.80	4.30	3.60	1.60
RHEF700	9.51	8.73	7.95	7.20	7.00	6.17	5.61	5.15	4.66	3.88	1.73
RHEF750	10.20	9.40	8.60	7.70	7.50	6.60	6.10	5.60	5.00	4.10	1.90
RHEF800	10.87	9.98	9.08	8.23	8.00	7.06	6.41	5.88	5.33	4.43	1.97
RHEF900	12.21	11.19	10.16	9.26	9.00	7.97	7.20	6.56	6.04	5.01	2.19
RHEF1000	13.60	12.50	11.40	10.30	10.00	8.80	8.10	7.40	6.60	5.50	2.50
RHEF1100	14.94	13.72	12.49	11.31	11.00	9.70	8.82	8.09	7.32	6.09	2.71
RHEF1300	17.70	16.30	14.80	13.40	13.00	11.40	10.50	9.60	8.60	7.20	3.30
RHEF1400	19.01	17.46	15.89	14.40	14.00	12.35	11.22	10.29	9.32	7.76	3.45
RHEF1500	20.40	18.80	17.10	15.50	15.00	13.20	12.10	11.10	9.90	8.30	3.80
RUSBF 6V											
RUSBF075	1.05	0.95	0.85	0.75	0.73	0.65	0.60	0.55	0.50	0.43	—
RUSBF120	1.69	1.52	1.36	1.20	1.16	1.04	0.96	0.88	0.80	0.68	—
RUSBF155	2.17	1.96	1.75	1.55	1.50	1.34	1.24	1.14	1.03	0.88	—

Figure R1-R5 Thermal Derating Curve for Radial-Leaded Devices

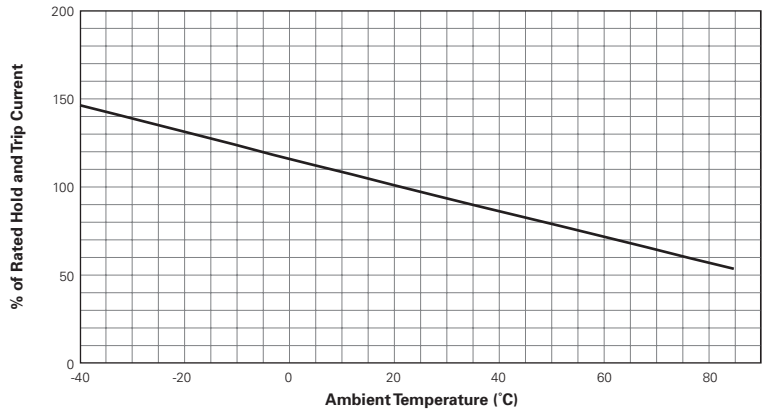
RXEF

Figure R1



RKEF

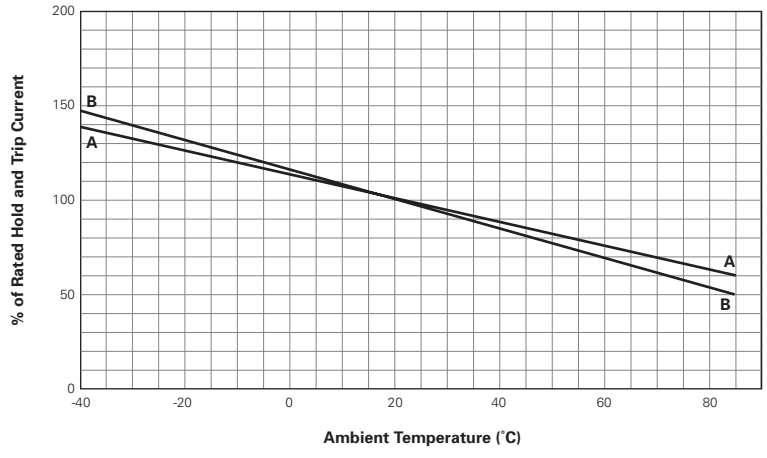
Figure R2



A = RUSBF075, RUSBF120, RUSBF155

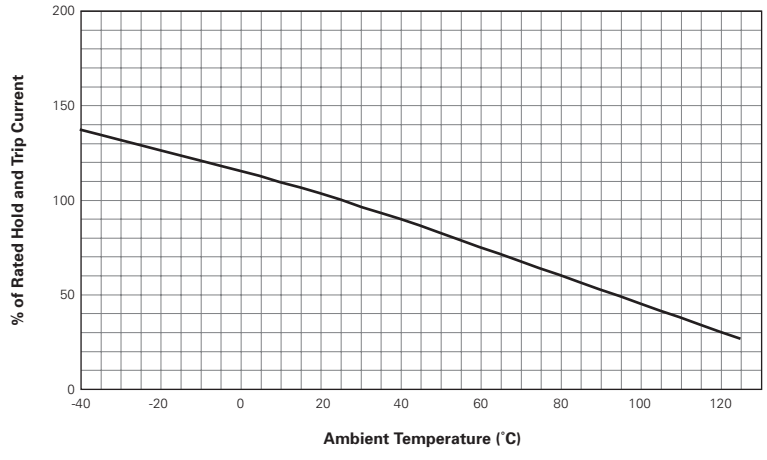
B = RUEF, and all other RUSBF

Figure R3



RHEF

Figure R4



Figures R1-R5 Thermal Derating Curve for Radial-Leaded Devices Cont'd

RGEF

Figure R5

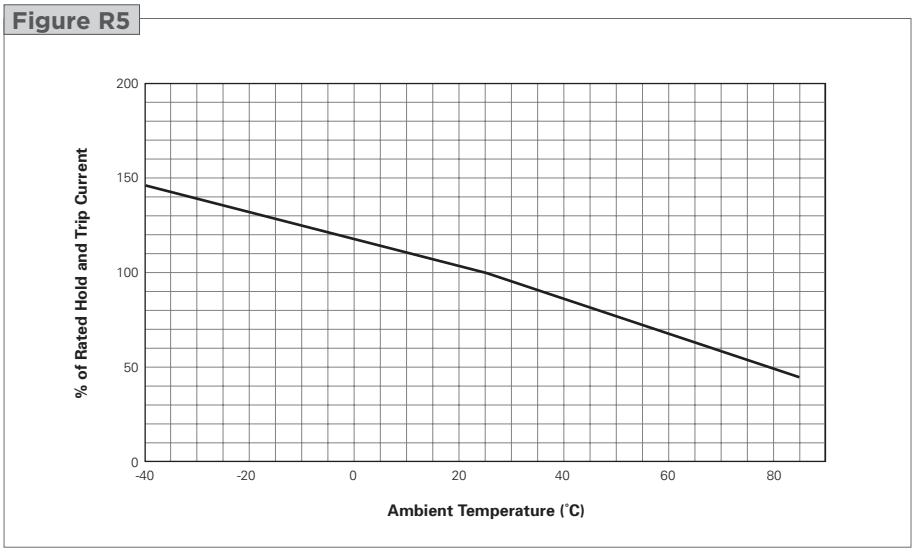


Table R3 Electrical Characteristics for Radial-Leaded Devices

Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	V_{MAX} ($V_{AC\ RMS}$)	I_{MAX} (DC_{ADC})	I_{MAX} (AC_{ARMS})	$P_{D\ Typ}$ (W)	Max Time-to-trip (A)	Max Time-to-trip (s)	R_{MIN} (Ω)	R_{MAX} (Ω)	R_{1MAX} (Ω)	Lead Size [mm^2 (AWG)]
RXEF 60V													
RXEF005	0.05	0.10	60	—	40	—	0.22	0.25	5.0	7.3	11.10	20.00	[0.128mm^2 (26)]
RXEF010	0.10	0.20	60	—	40	—	0.38	0.50	4.0	2.5	4.50	7.50	[0.205mm^2 (24)]
RXEF017	0.17	0.34	60	—	40	—	0.48	0.85	3.0	3.3	5.21	8.00	[0.205mm^2 (24)]
RXEF 72V													
RXEF020	0.20	0.40	72	72	40	40	0.41	1.00	2.2	1.83	2.75	4.40	[0.205mm^2 (24)]
RXEF025	0.25	0.50	72	72	40	40	0.45	1.25	2.5	1.25	1.95	3.00	[0.205mm^2 (24)]
RXEF030	0.30	0.60	72	72	40	40	0.49	1.50	3.0	0.88	1.33	2.10	[0.205mm^2 (24)]
RXEF040	0.40	0.80	72	72	40	40	0.56	2.00	3.8	0.55	0.86	1.29	[0.205mm^2 (24)]
RXEF050	0.50	1.00	72	72	40	40	0.77	2.50	4.0	0.50	0.77	1.17	[0.205mm^2 (24)]
RXEF065	0.65	1.30	72	72	40	40	0.88	3.25	5.3	0.31	0.48	0.72	[0.205mm^2 (24)]
RXEF075	0.75	1.50	72	72	40	40	0.92	3.75	6.3	0.25	0.40	0.60	[0.205mm^2 (24)]
RXEF090	0.90	1.80	72	72	40	40	0.99	4.50	7.2	0.20	0.31	0.47	[0.205mm^2 (24)]
RXEF110	1.10	2.20	72	72	40	40	1.50	5.50	8.2	0.15	0.25	0.38	[0.520mm^2 (20)]
RXEF135	1.35	2.70	72	72	40	40	1.70	6.75	9.6	0.12	0.19	0.30	[0.520mm^2 (20)]
RXEF160	1.60	3.20	72	72	40	40	1.90	8.00	11.4	0.09	0.14	0.22	[0.520mm^2 (20)]
RXEF185	1.85	3.70	72	72	40	40	2.10	9.25	12.6	0.08	0.12	0.19	[0.520mm^2 (20)]
RXEF250	2.50	5.00	72	72	40	40	2.50	12.50	15.6	0.05	0.08	0.13	[0.520mm^2 (20)]
RXEF300	3.00	6.00	72	72	40	40	2.80	15.00	19.8	0.04	0.06	0.10	[0.520mm^2 (20)]
RXEF375	3.75	7.50	72	72	40	40	3.20	18.75	24.0	0.03	0.05	0.08	[0.520mm^2 (20)]

Table R3 Electrical Characteristics for Radial-Leaded Devices Cont'd

Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	($V_{AC\ RMS}$)	I_{MAX} (DC_{ADC})	(AC_{ARMS})	$P_{D\ Typ}$ (W)	Max Time-to-trip (A)	(s)	R_{MIN} (Ω)	R_{MAX} (Ω)	R_{1MAX} (Ω)	Lead Size [mm² (AWG)]
RKEF 60V													
RKEF050	0.50	1.00	60	—	40	—	1.00	8.00	0.8	0.320	0.529	0.900	[0.205mm² (24)]
RKEF065	0.65	1.30	60	—	40	—	1.25	8.00	1.0	0.250	0.450	0.720	[0.205mm² (24)]
RKEF075	0.75	1.50	60	—	40	—	1.40	8.00	1.5	0.200	0.390	0.640	[0.205mm² (24)]
RKEF090	0.90	1.80	60	—	40	—	1.50	8.00	2.0	0.190	0.320	0.520	[0.205mm² (24)]
RKEF110	1.10	2.20	60	—	40	—	2.20	8.00	3.0	0.170	0.280	0.470	[0.520mm² (20)]
RKEF135	1.35	2.70	60	—	40	—	2.30	8.00	4.5	0.110	0.220	0.370	[0.520mm² (20)]
RKEF160	1.60	3.20	60	—	40	—	2.40	8.20	9.0	0.100	0.200	0.320	[0.520mm² (20)]
RKEF185	1.85	3.70	60	—	40	—	2.60	9.25	12.6	0.060	0.152	0.250	[0.520mm² (20)]
RKEF250	2.50	5.00	60	—	40	—	2.80	12.50	15.6	0.040	0.085	0.140	[0.520mm² (20)]
RKEF300	3.00	6.00	60	—	40	—	3.20	15.00	19.8	0.030	0.050	0.080	[0.520mm² (20)]
RKEF375	3.75	7.50	60	—	40	—	3.40	18.75	22.0	0.017	0.040	0.060	[0.520mm² (20)]
RKEF400	4.00	8.00	60	—	40	—	3.70	20.00	24.0	0.014	0.038	0.060	[0.520mm² (20)]
RKEF500	5.00	10.00	60	—	40	—	5.00	25.00	28.0	0.012	0.030	0.050	[0.520mm² (20)]
RUEF 30V													
RUEF090	0.90	1.80	30	30	100	70	0.60	4.50	5.9	0.070	0.120	0.22	[0.205mm² (24)]
RUEF110	1.10	2.20	30	30	100	70	0.70	5.50	6.6	0.070	0.100	0.17	[0.205mm² (24)]
RUEF135	1.35	2.70	30	30	100	70	0.80	6.75	7.3	0.040	0.080	0.13	[0.205mm² (24)]
RUEF160	1.60	3.20	30	30	100	70	0.90	8.00	8.0	0.030	0.070	0.11	[0.205mm² (24)]
RUEF185	1.85	3.70	30	30	100	70	1.00	9.25	8.7	0.030	0.060	0.09	[0.205mm² (24)]
RUEF250	2.50	5.00	30	30	100	70	1.20	12.50	10.3	0.020	0.040	0.07	[0.205mm² (24)]
RUEF300	3.00	6.00	30	30	100	70	2.00	15.00	10.8	0.020	0.050	0.08	[0.520mm² (20)]
RUEF400	4.00	8.00	30	30	100	70	2.50	20.00	12.7	0.010	0.030	0.05	[0.520mm² (20)]
RUEF500	5.00	10.00	30	30	100	70	3.00	25.00	14.5	0.010	0.030	0.05	[0.520mm² (20)]
RUEF600	6.00	12.00	30	30	100	70	3.50	30.00	16.0	0.005	0.020	0.04	[0.520mm² (20)]
RUEF700	7.00	14.00	30	30	100	70	3.80	35.00	17.5	0.005	0.020	0.03	[0.520mm² (20)]
RUEF800	8.00	16.00	30	30	100	70	4.00	40.00	18.8	0.005	0.013	0.02	[0.520mm² (20)]
RUEF900	9.00	18.00	30	30	100	70	4.20	45.00	20.0	0.005	0.010	0.02	[0.520mm² (20)]
RHEF* 30V - High Temperature													
RHEF050	0.5	0.9	30	—	40	—	0.9	2.5	2.5	0.480	0.780	1.10	[0.205mm² (24)]
RHEF070	0.7	1.4	30	—	40	—	1.4	3.5	3.2	0.300	0.540	0.80	[0.205mm² (24)]
RHEF100	1.0	1.8	30	—	40	—	1.4	5.0	5.2	0.180	0.300	0.43	[0.205mm² (24)]
RUSBF 16V													
RUSBF090	0.90	1.8	16	—	40	—	0.6	8.0	1.2	0.070	0.120	0.180	[0.205mm² (24)]
RUSBF110	1.10	2.2	16	—	40	—	0.7	8.0	2.3	0.050	0.095	0.140	[0.205mm² (24)]
RUSBF135	1.35	2.7	16	—	40	—	0.8	8.0	4.5	0.040	0.074	0.112	[0.205mm² (24)]
RUSBF160	1.60	3.2	16	—	40	—	0.9	8.0	9.0	0.030	0.061	0.110	[0.205mm² (24)]
RUSBF185	1.85	3.7	16	—	40	—	1.0	8.0	10.0	0.030	0.051	0.090	[0.205mm² (24)]
RUSBF250	2.50	5.0	16	—	40	—	1.2	8.0	40.0	0.020	0.036	0.060	[0.205mm² (24)]
RGEF* 16V													
RGEF250	2.5	4.7	16	—	100	—	1.0	12.5	5.0	0.0220	0.0350	0.0530	[0.205mm² (24)]
RGEF300	3.0	5.1	16	—	100	—	2.3	15.0	1.0	0.0380	0.0645	0.0975	[0.520mm² (20)]
RGEF400	4.0	6.8	16	—	100	—	2.4	20.0	1.7	0.0210	0.0390	0.0600	[0.520mm² (20)]
RGEF500	5.0	8.5	16	—	100	—	2.6	25.0	2.0	0.0150	0.0240	0.0340	[0.520mm² (20)]
RGEF600	6.0	10.2	16	—	100	—	2.8	30.0	3.3	0.0100	0.0190	0.0280	[0.520mm² (20)]
RGEF700	7.0	11.9	16	—	100	—	3.0	35.0	3.5	0.0077	0.0131	0.0200	[0.520mm² (20)]
RGEF800	8.0	13.6	16	—	100	—	3.0	40.0	5.0	0.0056	0.0110	0.0175	[0.520mm² (20)]
RGEF900	9.0	15.3	16	—	100	—	3.3	45.0	5.5	0.0047	0.0091	0.0135	[0.520mm² (20)]
RGEF1000	10.0	17.0	16	—	100	—	3.6	50.0	6.0	0.0040	0.0070	0.0102	[0.520mm² (20)]
RGEF1100	11.0	18.7	16	—	100	—	3.7	55.0	7.0	0.0037	0.0060	0.0089	[0.520mm² (20)]
RGEF1200	12.0	20.4	16	—	100	—	4.2	60.0	7.5	0.0033	0.0057	0.0086	[0.823mm² (18)]
RGEF1400	14.0	23.8	16	—	100	—	4.6	70.0	9.0	0.0026	0.0043	0.0064	[0.823mm² (18)]

Table R3 Electrical Characteristics for Radial-Leaded Devices Cont'd

Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	($V_{AC\ RMS}$)	I_{MAX} (DC_{ADC})	(AC_{ARMS})	$P_{D\ Typ}$ (W)	Max Time-to-trip (A)	(s)	R_{MIN} (Ω)	R_{MAX} (Ω)	R_{1MAX} (Ω)	Lead Size [mm^2 (AWG)]
RHEF* 16V - High Temperature													
RHEF200	2.0	3.8	16	—	100	—	1.4	10.0	4.3	0.0450	0.07400	0.1100	[0.205mm^2 (24)]
RHEF300	3.0	6.0	16	—	100	—	3.0	15.0	5.0	0.0330	0.05300	0.0790	[0.520mm^2 (20)]
RHEF400	4.0	7.5	16	—	100	—	3.3	20.0	5.0	0.0240	0.04000	0.0600	[0.520mm^2 (20)]
RHEF450	4.5	7.8	16	—	100	—	3.6	22.5	3.0	0.0220	0.03600	0.0540	[0.520mm^2 (20)]
RHEF550	5.5	10.0	16	—	100	—	3.5	27.5	6.0	0.0150	0.02500	0.0370	[0.520mm^2 (20)]
RHEF600	6.0	10.8	16	—	100	—	4.1	30.0	5.0	0.0130	0.02150	0.0320	[0.520mm^2 (20)]
RHEF650	6.5	12.0	16	—	100	—	4.1	32.5	5.5	0.0110	0.01750	0.0260	[0.520mm^2 (20)]
RHEF700	7.0	13.0	16	—	100	—	4.0	35.0	7.0	0.0100	0.01640	0.0250	[0.520mm^2 (20)]
RHEF750	7.5	13.1	16	—	100	—	4.5	37.5	7.0	0.0094	0.01530	0.0220	[0.520mm^2 (20)]
RHEF800	8.0	15.0	16	—	100	—	4.2	40.0	8.0	0.0080	0.01350	0.0200	[0.520mm^2 (20)]
RHEF900	9.0	16.5	16	—	100	—	5.0	45.0	10.0	0.0074	0.01200	0.0170	[0.520mm^2 (20)]
RHEF1000	10.0	18.5	16	—	100	—	5.3	50.0	9.0	0.0062	0.01050	0.0150	[0.520mm^2 (20)]
RHEF1100	11.0	20.0	16	—	100	—	5.5	55.0	11.0	0.0055	0.00900	0.0130	[0.520mm^2 (20)]
RHEF1300	13.0	24.0	16	—	100	—	6.9	65.0	13.0	0.0041	0.00690	0.0100	[0.823mm^2 (18)]
RHEF1400	14.0	27.0	16	—	100	—	6.9	70.0	13.0	0.0030	0.00600	0.0090	[0.823mm^2 (18)]
RHEF1500	15.0	28.0	16	—	100	—	7.0	75.0	20.0	0.0032	0.00613	0.0092	[0.823mm^2 (18)]
RUSBF 6V													
RUSBF075	0.75	1.30	6	—	40	—	0.3	8.0	0.4	0.110	0.1750	0.23	[0.205mm^2 (24)]
RUSBF120	1.20	2.00	6	—	40	—	0.6	8.0	0.5	0.070	0.0975	0.14	[0.205mm^2 (24)]
RUSBF155	1.55	2.65	6	—	40	—	0.6	7.8	2.2	0.040	0.0705	0.10	[0.205mm^2 (24)]

Notes:

I_H : Hold current: maximum current device will pass without interruption in 20°C still air.
I_T : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.
V_{MAX} : Maximum continuous voltage device can withstand without damage at rated current.
I_{MAX} : Maximum fault current device can withstand without damage at rated voltage.
P_D : Power dissipated from device when in the tripped state in 20°C still air.
R_{MIN} : Minimum resistance of device as supplied at 20°C unless otherwise specified.
R_{MAX} : Maximum resistance of device as supplied at 20°C unless otherwise specified.
R_{1MAX} : Maximum resistance of device when measured one hour post reflow (surface-mount device) or one hour post trip (radial-leaded device) at 20°C unless otherwise specified.
* Electrical characteristics determined at 25°C.

Figures R6-R14 Dimension Figures for Radial-Leaded Devices

Figure R6

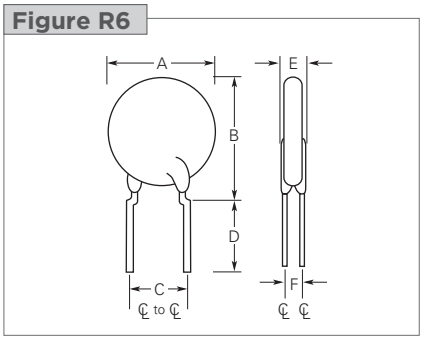


Figure R7

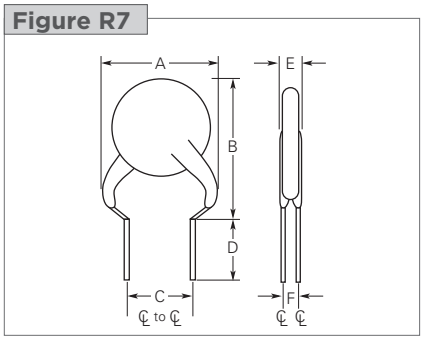


Figure R8

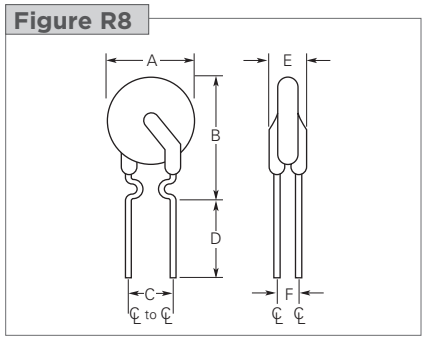


Figure R9

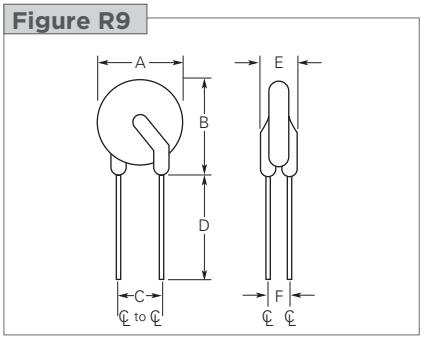


Figure R10

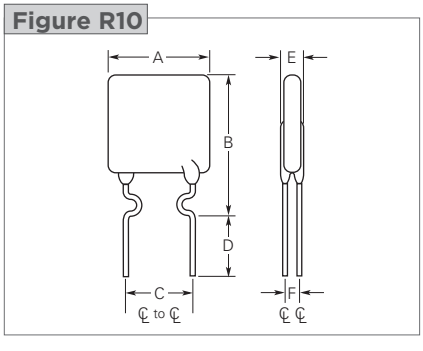
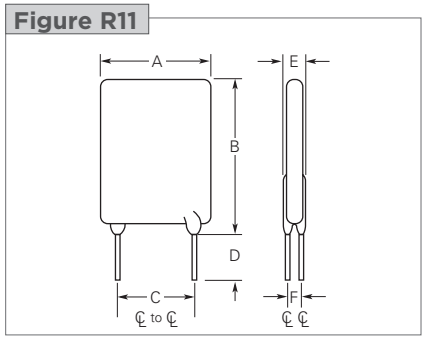


Figure R11



Figures R6-R14 Dimension Figures for Radial-Leaded Devices Cont'd

Figure R12

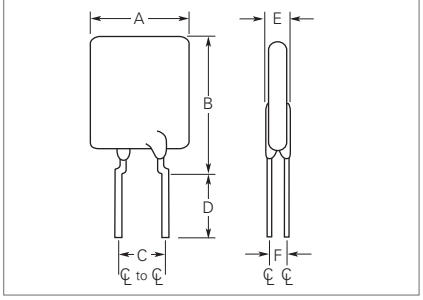


Figure R13

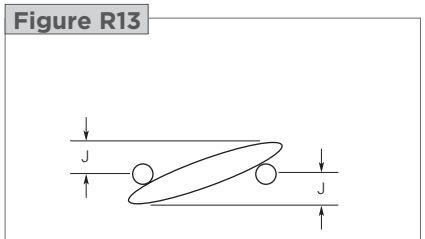


Figure R14

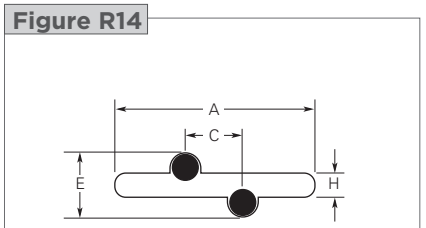


Table R4 Dimensions and Weights for Radial-Leaded Devices

	Dimensions in Millimeters (Inches)														
	A		B		C		D		E		F	H	J		Device Mass (g)
Part Number	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Typ	Typ	Typ	Figure	(Only for Reference)
RXEF 60V															
RXEF005	—	8.0 (0.32)	—	8.3 (0.33)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.07 (0.042)	1.0 (0.04)	R7, R13, R14	0.069
RXEF010	—	7.4 (0.29)	—	11.6 (0.46)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.07 (0.042)	1.0 (0.04)	R8, R13, R14	0.128
RXEF017	—	7.4 (0.29)	—	12.7 (0.50)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.68 (0.066)	1.7 (0.07)	R8, R13, R14	0.174
RXEF 72V															
RXEF020	—	7.4 (0.29)	—	11.7 (0.46)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.17 (0.046)	1.0 (0.04)	R8, R13, R14	0.119
RXEF025	—	7.4 (0.29)	—	12.7 (0.50)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.17 (0.046)	1.0 (0.04)	R8, R13, R14	0.130
RXEF030	—	7.4 (0.29)	—	12.7 (0.50)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.17 (0.046)	1.0 (0.04)	R8, R13, R14	0.143
RXEF040	—	7.6 (0.30)	—	13.5 (0.53)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.17 (0.046)	1.2 (0.05)	R8, R13, R14	0.202
RXEF050	—	7.9 (0.31)	—	13.7 (0.54)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.17 (0.046)	1.2 (0.05)	R8, R13, R14	0.210
RXEF065	—	9.4 (0.37)	—	14.5 (0.57)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.17 (0.046)	1.5 (0.06)	R8, R13, R14	0.277
RXEF075	—	10.2 (0.40)	—	15.2 (0.60)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.17 (0.046)	1.5 (0.06)	R8, R13, R14	0.310
RXEF090	—	11.2 (0.44)	—	15.8 (0.62)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.17 (0.046)	1.5 (0.06)	R8, R13, R14	0.365
RXEF110	—	12.8 (0.50)	—	17.5 (0.69)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.37 (0.054)	1.2 (0.05)	R9, R13, R14	0.546
RXEF135	—	14.5 (0.57)	—	19.1 (0.75)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.37 (0.054)	1.2 (0.05)	R9, R13, R14	0.653
RXEF160	—	16.3 (0.64)	—	20.8 (0.82)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.37 (0.054)	1.5 (0.06)	R9, R13, R14	0.684
RXEF185	—	17.5 (0.69)	—	22.4 (0.88)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.37 (0.054)	1.5 (0.06)	R9, R13, R14	0.808
RXEF250	—	20.8 (0.82)	—	25.4 (1.00)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.37 (0.054)	1.7 (0.07)	R9, R13, R14	1.139
RXEF300	—	23.9 (0.94)	—	28.6 (1.13)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.37 (0.054)	1.7 (0.07)	R9, R13, R14	1.379
RXEF375	—	27.2 (1.07)	—	31.8 (1.25)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.37 (0.054)	1.7 (0.07)	R9, R13, R14	1.708

Table R4 Dimensions and Weights for Radial-leaded Devices Cont'd

	Dimensions in Millimeters (Inches)														
	A		B		C		D		E		F	H	J		Device Mass (g)
Part Number	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Typ	Typ	Typ	Figure	(Only for Reference)
RKEF															
60V															
RKEF050	—	7.10 (0.28)	—	11.43 (0.45)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	3.56 (0.14)	—	—	—	R10, R13, R14	0.166
RKEF065	—	7.11 (0.28)	—	12.20 (0.48)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	3.56 (0.14)	—	—	—	R10, R13, R14	0.182
RKEF075	—	7.87 (0.31)	—	12.20 (0.48)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	3.56 (0.14)	—	—	—	R10, R13, R14	0.201
RKEF090	—	7.87 (0.31)	—	13.97 (0.55)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	3.56 (0.14)	—	—	—	R10, R13, R14	0.235
RKEF110	—	7.60 (0.30)	—	15.00 (0.59)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	4.10 (0.16)	—	—	—	R10, R13, R14	0.353
RKEF135	—	10.20 (0.40)	—	17.00 (0.67)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	3.81 (0.15)	—	—	—	R11, R13, R14	0.438
RKEF160	—	12.20 (0.48)	—	18.30 (0.72)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	3.81 (0.15)	—	—	—	R11, R13, R14	0.546
RKEF185	—	13.00 (0.51)	—	18.80 (0.74)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	3.81 (0.15)	—	—	—	R11, R13, R14	0.538
RKEF250	—	14.00 (0.55)	—	20.60 (0.81)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	3.00 (0.12)	—	—	—	R11, R13, R14	0.775
RKEF300	—	16.50 (0.65)	—	21.20 (0.83)	4.32 (0.17)	5.84 (0.23)	7.60 (0.30)	—	—	3.00 (0.12)	—	—	—	R11, R13, R14	0.971
RKEF375	—	16.50 (0.65)	—	25.20 (0.99)	9.40 (0.37)	10.90 (0.43)	7.60 (0.30)	—	—	3.00 (0.12)	—	—	—	R11, R13, R14	1.142
RKEF400	—	21.00 (0.83)	—	24.90 (0.98)	9.40 (0.37)	10.90 (0.43)	7.60 (0.30)	—	—	3.00 (0.12)	—	—	—	R11, R13, R14	1.391
RKEF500	—	24.10 (0.95)	—	29.00 (1.14)	9.40 (0.37)	10.90 (0.43)	7.60 (0.30)	—	—	3.00 (0.12)	—	—	—	R11, R13, R14	1.783
RUEF															
30V															
RUEF090	—	7.4 (0.29)	—	12.2 (0.48)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	0.8 (0.03)	R10, R13, R14	0.183
RUEF110	—	7.4 (0.29)	—	14.2 (0.56)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	0.8 (0.03)	R10, R13, R14	0.204
RUEF135	—	8.9 (0.35)	—	13.5 (0.53)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	1.0 (0.04)	R10, R13, R14	0.255
RUEF160	—	8.9 (0.35)	—	15.2 (0.60)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	1.0 (0.04)	R10, R13, R14	0.289
RUEF185	—	10.2 (0.40)	—	15.7 (0.62)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	1.0 (0.04)	R10, R13, R14	0.379
RUEF250	—	11.4 (0.45)	—	18.3 (0.72)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	1.2 (0.05)	R10, R13, R14	0.493
RUEF300	—	11.4 (0.45)	—	16.5 (0.65)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.19 (0.047)	1.5 (0.06)	R11, R13, R14	0.516
RUEF400	—	14.0 (0.55)	—	19.3 (0.76)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.19 (0.047)	1.7 (0.07)	R11, R13, R14	0.670
RUEF500	—	14.0 (0.55)	—	24.1 (0.95)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.19 (0.047)	1.0 (0.04)	R11, R13, R14	0.926
RUEF600	—	16.5 (0.65)	—	24.1 (0.95)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.19 (0.047)	1.0 (0.04)	R11, R13, R14	1.352
RUEF700	—	19.1 (0.75)	—	25.9 (1.02)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.19 (0.047)	1.2 (0.05)	R11, R13, R14	1.543
RUEF800	—	21.6 (0.85)	—	28.4 (1.12)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.19 (0.047)	1.5 (0.06)	R11, R13, R14	1.852
RUEF900	—	24.1 (0.95)	—	29.0 (1.14)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	—	1.19 (0.047)	1.5 (0.06)	R11, R13, R14	2.104
RHEF															
30V - High Temperature															
RHEF050	—	7.4 (0.29)	—	12.7 (0.50)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	R8, R13, R14	0.177
RHEF070	—	6.9 (0.27)	—	10.8 (0.43)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.2 (0.05)	R10, R13, R14	0.259
RHEF100	—	9.7 (0.38)	—	13.6 (0.54)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	—	—	R8, R13, R14	0.312

Table R4 Dimensions & Weights for Radial-Leaded Devices Cont'd

Part Number	Dimensions in Millimeters (Inches)														Device Mass (g) (Only for Reference)
	A		B		C		D		E		F	H	J	Figure	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Typ	Typ	Typ		
RUSBF 16V															
RUSBF090	—	7.4 (0.29)	—	12.2 (0.48)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.1 (0.12)	—	0.89 (0.035)	0.8 (0.03)	R10, R13, R14	0.183
RUSBF110	—	7.4 (0.29)	—	14.2 (0.56)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	0.8 (0.03)	R10, R13, R14	0.204
RUSBF135	—	8.9 (0.35)	—	13.5 (0.53)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	1.0 (0.04)	R10, R13, R14	0.240
RUSBF160	—	8.9 (0.35)	—	15.2 (0.60)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	1.0 (0.04)	R10, R13, R14	0.300
RUSBF185	—	10.2 (0.40)	—	15.7 (0.62)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	1.0 (0.04)	R10, R13, R14	0.368
RUSBF250	—	11.4 (0.45)	—	18.3 (0.72)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	0.89 (0.035)	1.2 (0.05)	R10, R13, R14	0.467
RGEF 16V															
RGEF250	—	8.9 (0.35)	—	12.8 (0.50)	4.3 (0.17)	5.8 (0.23)	3.18 (0.13)	6.18 (0.24)	—	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.2 (0.05)	R10, R13, R14	0.277
RGEF300	6.1 (0.24)	7.1 (0.28)	6.1 (0.24)	11.0 (0.43)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	2.0 (0.08)	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.2 (0.05)	R11, R13, R14	0.323
RGEF400	7.9 (0.31)	8.9 (0.35)	7.9 (0.31)	12.8 (0.50)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	2.0 (0.08)	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.4 (0.06)	R11, R13, R14	0.417
RGEF500	9.4 (0.37)	10.4 (0.41)	9.4 (0.37)	14.3 (0.56)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	2.0 (0.08)	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.6 (0.06)	R11, R13, R14	0.540
RGEF600	9.7 (0.38)	10.7 (0.42)	12.2 (0.48)	17.1 (0.67)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	2.0 (0.08)	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.6 (0.06)	R11, R13, R14	0.604
RGEF700	10.2 (0.40)	11.2 (0.44)	14.7 (0.58)	19.7 (0.78)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	2.0 (0.08)	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.7 (0.07)	R11, R13, R14	0.701
RGEF800	11.7 (0.46)	12.7 (0.50)	16.0 (0.63)	20.9 (0.82)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	2.0 (0.08)	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.8 (0.07)	R11, R13, R14	0.829
RGEF900	13.0 (0.51)	14.0 (0.55)	16.8 (0.66)	21.7 (0.85)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	2.0 (0.08)	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	2.0 (0.08)	R11, R13, R14	0.887
RGEF1000	—	16.5 (0.65)	21.1 (0.83)	25.2 (0.99)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	2.0 (0.08)	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	2.0 (0.08)	R11, R13, R14	1.219
RGEF1100	16.5 (0.65)	17.5 (0.69)	21.1 (0.83)	26.0 (1.02)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	2.0 (0.08)	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	2.4 (0.09)	R11, R13, R14	1.408
RGEF1200	16.4 (0.65)	17.5 (0.69)	22.6 (0.89)	28.0 (1.10)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	2.3 (0.09)	3.5 (0.14)	1.4 (0.06)	1.45 (0.057)	1.5 (0.06)	R11, R13, R14	1.650
RGEF1400	—	23.5 (0.925)	22.6 (0.89)	27.9 (1.10)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	2.3 (0.09)	3.5 (0.14)	1.4 (0.06)	1.45 (0.057)	1.9 (0.08)	R11, R13, R14	2.146
RHEF 16V - High Temperature															
RHEF200	—	9.4 (0.37)	—	14.4 (0.57)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.1 (0.12)	—	—	—	R8, R13, R14	0.278
RHEF300	—	8.8 (0.35)	—	13.8 (0.55)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	R12, R13, R14	0.433
RHEF400	—	10.0 (0.39)	—	15.0 (0.59)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.6 (0.06)	R12, R13, R14	0.509
RHEF450	—	10.4 (0.41)	—	15.6 (0.61)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.6 (0.06)	R12, R13, R14	0.605
RHEF550	—	11.2 (0.44)	—	18.9 (0.74)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	R12, R13, R14	0.704
RHEF600	—	11.2 (0.44)	—	21.0 (0.83)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.7 (0.067)	R12, R13, R14	0.792
RHEF650	—	12.7 (0.50)	—	22.2 (0.88)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.8 (0.07)	R12, R13, R14	0.952
RHEF700	—	14.0 (0.55)	—	21.9 (0.86)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	R12, R13, R14	0.850
RHEF750	—	14.0 (0.55)	—	23.5 (0.93)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	2.0 (0.08)	R12, R13, R14	1.054
RHEF800	—	16.5 (0.65)	—	22.5 (0.88)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	R12, R13, R14	1.073
RHEF900	—	16.5 (0.65)	—	25.7 (1.01)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	R12, R13, R14	1.516

RoHS Compliant, ELV Compliant HF Halogen Free

Table R4 Dimensions and Weights for Radial-Leaded Devices Cont'd

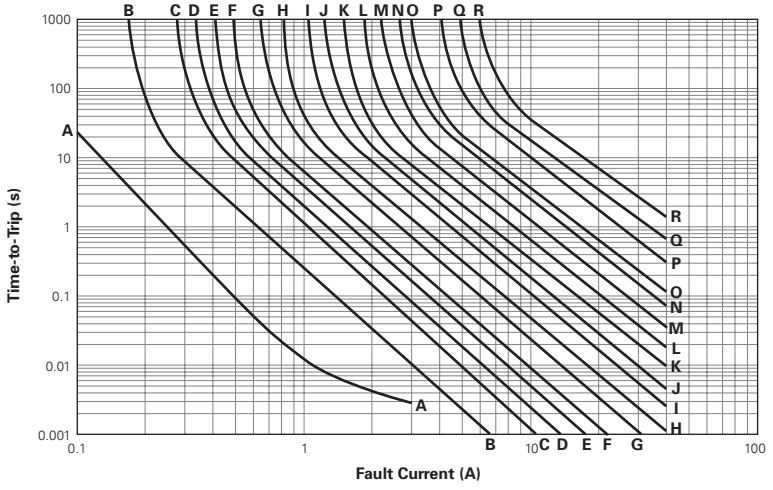
	Dimensions in Millimeters (Inches)														
	A		B		C		D		E		F	H	J		Device Mass (g)
Part Number	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Typ	Typ	Typ	Figure	(Only for Reference)
RHEF															
16V - High Temperature															
RHEF1000	—	17.5 (0.69)	—	26.5 (1.04)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	1.24 (0.049)	1.5 (0.06)	R12, R13, R14	1.791
RHEF1100	—	21.0 (0.83)	—	26.1 (1.03)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	R12, R13, R14	1.570
RHEF1300	—	23.5 (0.925)	—	28.7 (1.13)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.6 (0.14)	1.4 (0.06)	1.45 (0.057)	1.9 (0.084)	R12, R13, R14	2.257
RHEF1400	—	23.5 (0.925)	—	28.6 (1.13)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.6 (0.14)	1.4 (0.06)	—	—	R12, R13, R14	2.051
RHEF1500	—	23.5 (0.925)	—	28.7 (1.13)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.6 (0.14)	1.4 (0.06)	1.45 (0.057)	1.9 (0.084)	R12, R13, R14	2.257
RUSBF															
6V															
RUSBF075	—	6.9 (0.27)	—	11.4 (0.45)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	—	—	3.1 (0.12)	—	0.91 (0.036)	1.0 (0.04)	R8, R13, R14	0.123
RUSBF120	—	6.9 (0.27)	—	11.7 (0.46)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	—	—	3.1 (0.12)	—	0.91 (0.036)	1.0 (0.04)	R8, R13, R14	0.111
RUSBF155	—	6.9 (0.27)	—	11.7 (0.46)	4.3 (0.17)	5.9 (0.23)	7.6 (0.30)	—	—	3.1 (0.12)	—	0.91 (0.036)	1.0 (0.04)	R8, R13, R14	0.135

Figures R15-R20 Typical Time-to-Trip Curves at 20°C for Radial-Leaded Devices

RXEF

A	=	RXEF005	J	=	RXEF075
B	=	RXEF010	K	=	RXEF090
C	=	RXEF017	L	=	RXEF110
D	=	RXEF020	M	=	RXEF135
E	=	RXEF025	N	=	RXEF160
F	=	RXEF030	O	=	RXEF185
G	=	RXEF040	P	=	RXEF250
H	=	RXEF050	Q	=	RXEF300
I	=	RXEF065	R	=	RXEF375

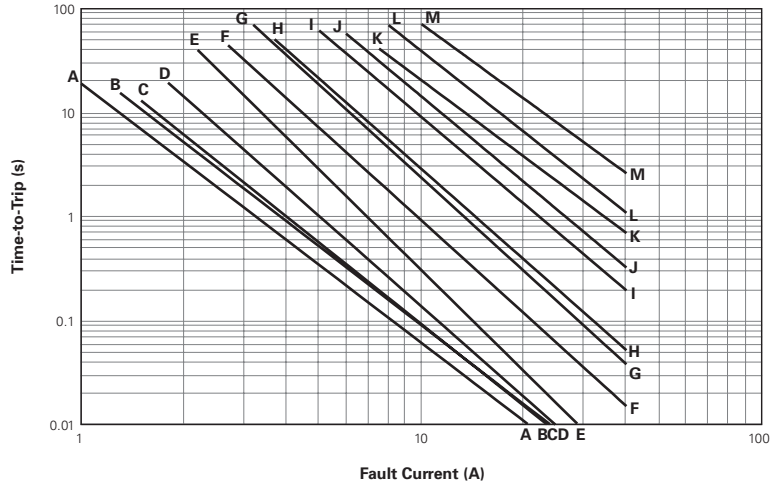
Figure R15



RKEF

A	=	RKEF050	J	=	RKEF300
B	=	RKEF065	K	=	RKEF375
C	=	RKEF075	L	=	RKEF400
D	=	RKEF090	M	=	RKEF500
E	=	RKEF110			
F	=	RKEF135			
G	=	RKEF160			
H	=	RKEF185			
I	=	RKEF250			

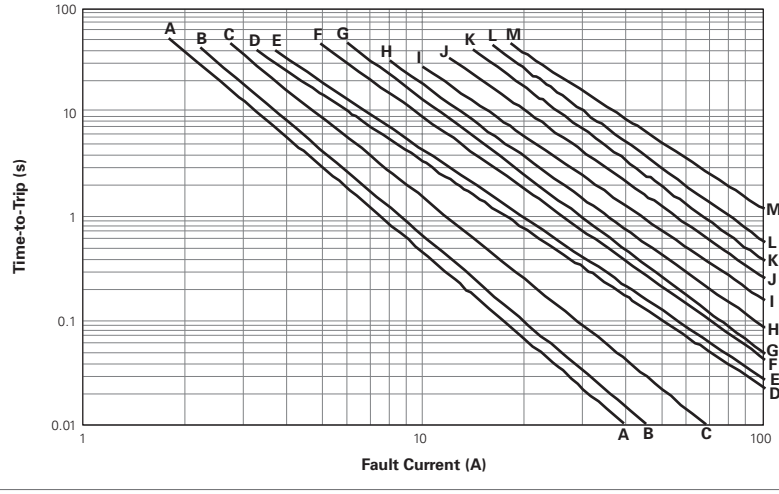
Figure R16



RUEF

A	=	RUEF090	H	=	RUEF400
B	=	RUEF110	I	=	RUEF500
C	=	RUEF135	J	=	RUEF600
D	=	RUEF160	K	=	RUEF700
E	=	RUEF185	L	=	RUEF800
F	=	RUEF250	M	=	RUEF900
G	=	RUEF300			

Figure R17



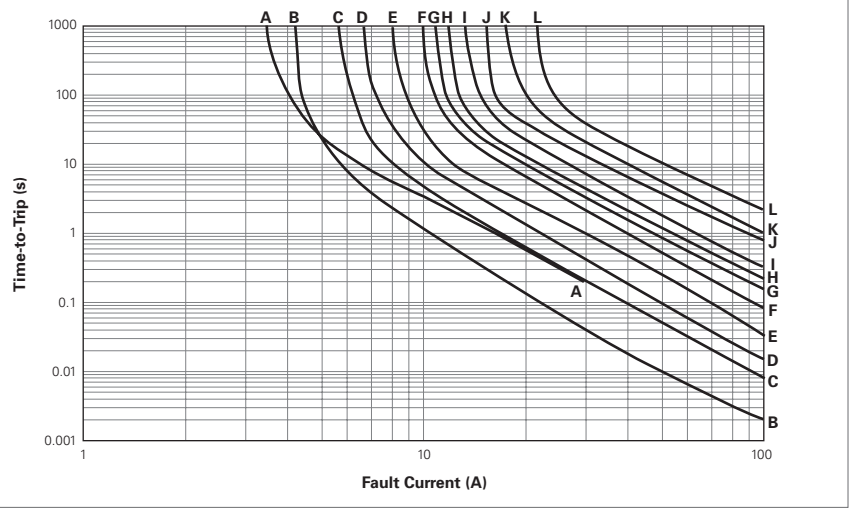
RoHS Compliant, ELV Compliant HF Halogen Free

Figure R15-R20 Typical Time-to-trip Curves at 20°C for Radial-Leaded Devices Cont'd

RGEF (data at 25°C)

A = RGEF250
B = RGEF300
C = RGEF400
D = RGEF500
E = RGEF600
F = RGEF700
G = RGEF800
H = RGEF900
I = RGEF1000
J = RGEF1100
K = RGEF1200
L = RGEF1400

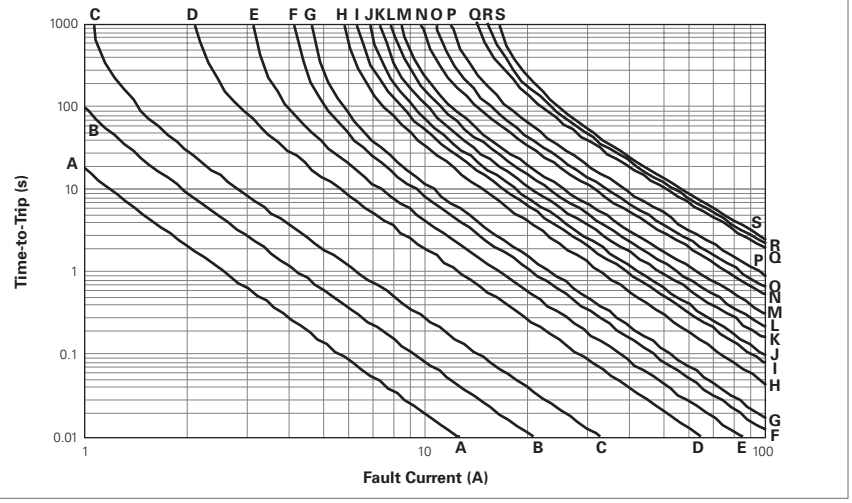
Figure R18



RHEF (data at 25°C)

A = RHEF050
B = RHEF070
C = RHEF100
D = RHEF200
E = RHEF300
F = RHEF400
G = RHEF450
H = RHEF550
I = RHEF600
J = RHEF650
K = RHEF700
L = RHEF750
M = RHEF800
N = RHEF900
O = RHEF1000
P = RHEF1100
Q = RHEF1300
R = RHEF1400
S = RHEF1500

Figure R19



RUSBF

A = RUSBF075
B = RUSBF090
C = RUSBF110
D = RUSBF120
E = RUSBF135
F = RUSBF155
G = RUSBF160
H = RUSBF185
I = RUSBF250

Figure R20

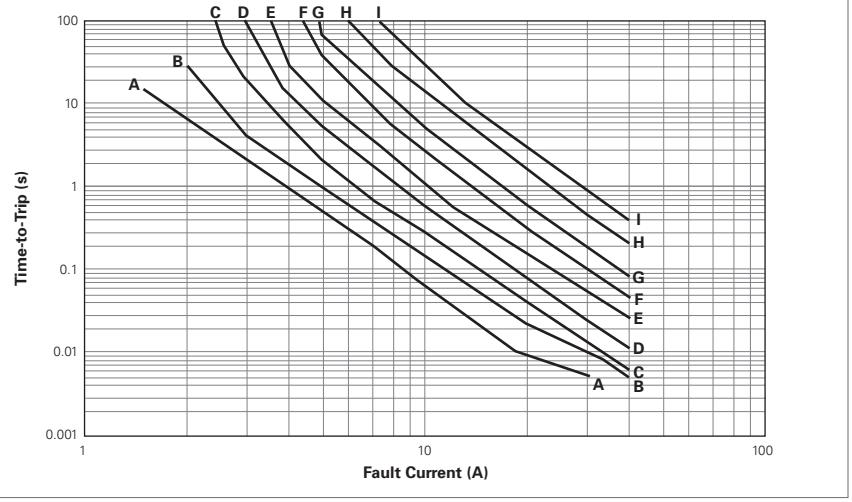


Table R5 Physical Characteristics and Environmental Specifications for Radial-Leaded Devices

RXEF
Physical Characteristics

Lead Material	RXEF005	: Tin-plated Nickel-copper Alloy, 0.128mm^2 (26AWG), ø0.40mm (0.016in)
	RXEF010	: Tin-plated Nickel-copper Alloy, 0.205mm^2 (24AWG), ø0.51mm (0.020in)
	RXEF017 to 040	: Tin-plated Copper-clad Steel, 0.205mm^2 (24AWG), ø0.51mm (0.020in)
	RXEF050 to 090	: Tin-plated Copper, 0.205mm^2 (24AWG), ø0.51mm (0.020in)
	RXEF110 to 375	: Tin-plated Copper, 0.52mm^2 (20AWG), ø0.81mm (0.032in)
Soldering Characteristics	Solderability per ANSI/J-STD-002 Category 3	
	RXEF005, RXEF010 Meet ANSI/J-STD-002 Category 1	
Solder Heat Withstand	RXEF005- RXEF025: per IEC-STD 68-2-20, Test Tb, Method 1a, Condition a; Can Withstand 5s at 260°C ±5°C	
	All Other Sizes: per IEC-STD 68-2-20, Test Tb, Method 1a, Condition b; Can Withstand 10s at 260°C ±5°C	
Insulating Material	Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0	
Operation Temperature	-40°C~85°C	

Note: Devices are not designed to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	-40°C, 1000 hrs	±5%
	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85%RH, 1000 hrs	±10%
Thermal Shock	85°C, -40°C (10 Times)	±10%
Solvent Resistance	MIL-STD-202, Method 215F	No Change

RKEF
Physical Characteristics

Lead Material	RKEF050 to 090	: Tin-plated Copper, 0.205mm^2 (24AWG), ø0.51mm (0.020in)
	RKEF110 to 500	: Tin-plated Copper, 0.52mm^2 (20AWG), ø0.81mm (0.032in)
Soldering Characteristics	Solderability per ANSI/J-STD-002 Category 3	
Solder Heat Withstand	RKEF050-RKEF185 : per IEC-STD 68-2-20, Test Tb, Method 1a, Condition a; Can Withstand 5s at 260°C ±5°C	
	All Other Sizes: per IEC-STD 68-2-20, Test Tb, Method 1a, Condition b; RKEF Can Withstand 10s at 260°C ±5°C	
Insulating Material	Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0	
Operation Temperature	-40°C~85°C	

Note: Devices are not designed to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	-40°C, 1000 hrs	±5%
	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85%RH, 1000 hrs	±10%
Thermal Shock	85°C, -40°C (10 Times)	±10%
Solvent Resistance	MIL-STD-202, Method 215F	No Change

Table R5 Physical Characteristics and Environmental Specifications for Radial-Leaded Devices Cont'd

RUEF

Physical Characteristics

Lead Material	RUEF090 to RUEF250: Tin-plated Copper-clad Steel, 0.205mm² (24AWG)
	RUEF300 to RUEF900: Tin-plated Copper, 0.52mm² (20AWG), ø0.81mm (0.032in)
Soldering Characteristics	Solderability per ANSI/J-STD-002 Category 3
Solder Heat Withstand	per IEC-STD 68-2-20, Test Tb, Method1A, Condition B, Can Withstand 10s at 260°C ±5°C
Insulating Material	Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0
Operation Temperature	-40°C~85°C

Note: Devices are not designed to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±5%
	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85%RH, 1000 hrs	±5%
Thermal Shock	85°C, -40°C (10 times)	±5%
Solvent Resistance	MIL-STD-202, Method 215F	No Change

RUSBF

Physical Characteristics

Lead Material	RUSBF075: Tin-plated Nickel-copper Alloy, 0.205mm² (24AWG), ø0.51mm/0.020in
	RUSBF090 to RUSBF250: Tin-plated Copper-clad Steel, 0.205mm² (24AWG), ø0.51mm/0.020in
Soldering Characteristics	Solderability per ANSI/J-STD-002 Category 3 Except
	RUSBF075 Meet ANSI/J-STD-002 Category 1
Solder Heat Withstand	RUSBF120: per IEC-STD 68-2-20, Test Tb, Method 1A, Condition A; Can Withstand 5s at 260°C ±5°C
	All Others: per IEC-STD 68-2-20, Test Tb, Method 1A, Condition B; Can Withstand 10s at 260°C ±5°C
Insulating Material	Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0
Operation Temperature	-40°C~85°C

Note: Devices are not designed to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±5%
	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85%RH, 1000 hrs	±5%
Thermal Shock	85°C, -40°C (10 Times)	±5%
Solvent Resistance	MIL-STD-202, Method 215F	No change

Table R5 Physical Characteristics and Environmental Specifications for Radial-Leaded Devices Cont'd

RGEF

Physical Characteristics

Lead Material	RGEF250: Tin-plated Copper-clad Steel, 0.205mm² (24AWG), ø0.51mm/0.020in
	RGEF300 to RGEF1100 : Tin-plated Copper, 0.52mm² (20AWG), ø0.81mm/0.032in
	RGEF1200 to RGEF1400 : Tin-plated Copper, 0.82mm² (18AWG), ø1.0mm/0.04in
Soldering Characteristics	Solderability per ANSI/J-STD-002 Category 3
Solder Heat Withstand	RGEF250 and RGEF400: per IEC 68-2-20, Test Tb, Method 1a, Condition a; can withstand 5s at 260°C ±5°C
	RGEF500 to RGEF1400: per IEC 68-2-20, Test Tb, Method 1a, Condition b; can withstand 10s at 260°C ±5°C
Insulating Material	Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0
Operation Temperature	-40°C~85°C

Note: Devices are not designed to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	-40°C, 1000 hrs	±5%
	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85%RH, 1000 hrs	±5%
Thermal Shock	85°C, -40°C (10 Times)	±5%
Solvent Resistance	MIL-STD-202, Method 215F	No Change

RHEF

Physical Characteristics

Lead Material	RHEF050 to RHEF200 : Tin-plated Copper-clad Steel, 0.205mm² (24AWG), ø0.51mm/0.020in
	RHEF300 to RHEF1100 : Tin-plated Copper, 0.52mm² (20AWG), ø0.81mm/0.032in
	RHEF1300 to RHEF1500 : Tin-plated Copper, 0.82mm² (18AWG), ø1.0mm/0.04in
Soldering Characteristics	Solderability per ANSI/J-STD-002 Category 3
Solder Heat Withstand	per IEC 68-2-20, Test Tb, Method 1A, Condition B; Can Wthstand 10s at 260°C ±5°C
Insulating Material	Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0
Operation Temperature	-40°C~125°C

Note: Devices are not designed to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±5%
	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85%RH, 1000 hrs	±5%
Thermal Shock	125°C, -40°C (10 Times)	±5%
Solvent Resistance	MIL-STD-202, Method 215F	No Change

Storage Conditions for Radial-Leaded Devices

Storage Conditions	40°C max, 70% RH max; devices should remain in original sealed bags prior to use. Devices may not meet specified values if these storage conditions are exceeded.

Note: For the TR devices series, see the telecommunications and networking devices section.

Table R6 Packaging and Marking Information for Radial-Leaded Devices

Part Number	Bag Quantity	Tape and Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
RXEF 60V						
RXEF005	500	—	—	10,000	—	UL, CSA, TÜV
RXEF005-2	—	3,000	—	15,000	—	UL, CSA, TÜV
RXEF005-AP	—	—	2,000	10,000	—	UL, CSA, TÜV
RXEF010	500	—	—	10,000	X10	UL, CSA, TÜV
RXEF010-2	—	3,000	—	15,000	X10	UL, CSA, TÜV
RXEF010-AP	—	—	2,000	10,000	X10	UL, CSA, TÜV
RXEF017	500	—	—	10,000	X17	UL, CSA, TÜV
RXEF017-2	—	2,500	—	12,500	X17	UL, CSA, TÜV
RXEF017-AP	—	—	2,000	10,000	X17	UL, CSA, TÜV
RXEF 72V						
RXEF020	500	—	—	10,000	X20	UL, CSA, TÜV
RXEF020-2	—	3,000	—	15,000	X20	UL, CSA, TÜV
RXEF020-AP	—	—	2,000	10,000	X20	UL, CSA, TÜV
RXEF025	500	—	—	10,000	X25	UL, CSA, TÜV
RXEF025-2	—	3,000	—	15,000	X25	UL, CSA, TÜV
RXEF025-AP	—	—	2,000	10,000	X25	UL, CSA, TÜV
RXEF030	500	—	—	10,000	X30	UL, CSA, TÜV
RXEF030-2	—	3,000	—	15,000	X30	UL, CSA, TÜV
RXEF030-AP	—	—	2,000	10,000	X30	UL, CSA, TÜV
RXEF040	500	—	—	10,000	X40	UL, CSA, TÜV
RXEF040-2	—	3,000	—	15,000	X40	UL, CSA, TÜV
RXEF040-AP	—	—	2,000	10,000	X40	UL, CSA, TÜV
RXEF050	500	—	—	10,000	X50	UL, CSA, TÜV
RXEF050-2	—	3,000	—	15,000	X50	UL, CSA, TÜV
RXEF050-AP	—	—	2,000	10,000	X50	UL, CSA, TÜV
RXEF065	500	—	—	10,000	X65	UL, CSA, TÜV
RXEF065-2	—	3,000	—	15,000	X65	UL, CSA, TÜV
RXEF065-AP	—	—	2,000	10,000	X65	UL, CSA, TÜV
RXEF075	500	—	—	10,000	X75	UL, CSA, TÜV
RXEF075-2	—	3,000	—	15,000	X75	UL, CSA, TÜV
RXEF075-AP	—	—	2,000	10,000	X75	UL, CSA, TÜV
RXEF090	500	—	—	10,000	X90	UL, CSA, TÜV
RXEF090-2	—	3,000	—	15,000	X90	UL, CSA, TÜV
RXEF090-AP	—	—	2,000	10,000	X90	UL, CSA, TÜV
RXEF110	500	—	—	10,000	X110	UL, CSA, TÜV
RXEF110-2	—	1,500	—	7,500	X110	UL, CSA, TÜV
RXEF110-AP	—	—	1,000	5,000	X110	UL, CSA, TÜV
RXEF135	500	—	—	10,000	X135	UL, CSA, TÜV
RXEF135-2	—	1,500	—	7,500	X135	UL, CSA, TÜV
RXEF135-AP	—	—	1,000	5,000	X135	UL, CSA, TÜV
RXEF160	500	—	—	10,000	X160	UL, CSA, TÜV
RXEF160-2	—	1,500	—	7,500	X160	UL, CSA, TÜV
RXEF160-AP	—	—	1,000	5,000	X160	UL, CSA, TÜV
RXEF185	500	—	—	10,000	X185	UL, CSA, TÜV
RXEF185-2	—	1,500	—	7,500	X185	UL, CSA, TÜV
RXEF185-AP	—	—	1,000	5,000	X185	UL, CSA, TÜV

Table R6 Packaging and Marking Information for Radial-Leaded Devices Cont'd

Part Number	Bag Quantity	Tape and Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
RXEF 72V						
RXEF250	250	—	—	5,000	X250	UL, CSA, TÜV
RXEF250-2	—	1,000	—	5,000	X250	UL, CSA, TÜV
RXEF250-AP	—	—	1,000	5,000	X250	UL, CSA, TÜV
RXEF300	250	—	—	5,000	X300	UL, CSA, TÜV
RXEF300-2	—	1,000	—	5,000	X300	UL, CSA, TÜV
RXEF300-AP	—	—	1,000	5,000	X300	UL, CSA, TÜV
RXEF375	250	—	—	5,000	X375	UL, CSA, TÜV
RKEF 60V						
RKEF050	500	—	—	10,000	K50	UL, CSA, TÜV
RKEF065	500	—	—	10,000	K65	UL, CSA, TÜV
RKEF075	500	—	—	10,000	K75	UL, CSA, TÜV
RKEF090	500	—	—	10,000	K90	UL, CSA, TÜV
RKEF110	500	—	—	10,000	K110	UL, CSA, TÜV
RKEF135	500	—	—	10,000	K135	UL, CSA, TÜV
RKEF160	500	—	—	10,000	K160	UL, CSA, TÜV
RKEF185	500	—	—	10,000	K185	UL, CSA, TÜV
RKEF250	500	—	—	10,000	K250	UL, CSA, TÜV
RKEF300	250	—	—	5,000	K300	UL, CSA, TÜV
RKEF375	250	—	—	5,000	K375	UL, CSA, TÜV
RKEF400	250	—	—	5,000	K400	UL, CSA, TÜV
RKEF500	250	—	—	5,000	K500	UL, CSA, TÜV
RUEF 30V						
RUEF090	500	—	—	10,000	U90	UL, CSA, TÜV, CQC
RUEF090-2	—	3,000	—	15,000	U90	UL, CSA, TÜV, CQC
RUEF090-AP	—	—	2,000	10,000	U90	UL, CSA, TÜV, CQC
RUEF110	500	—	—	10,000	U110	UL, CSA, TÜV, CQC
RUEF110-2	—	3,000	—	15,000	U110	UL, CSA, TÜV, CQC
RUEF110-AP	—	—	2,000	10,000	U110	UL, CSA, TÜV, CQC
RUEF135	500	—	—	10,000	U135	UL, CSA, TÜV, CQC
RUEF135-2	—	3,000	—	15,000	U135	UL, CSA, TÜV, CQC
RUEF135-AP	—	—	2,000	10,000	U135	UL, CSA, TÜV, CQC
RUEF160	500	—	—	10,000	U160	UL, CSA, TÜV, CQC
RUEF160-2	—	3,000	—	15,000	U160	UL, CSA, TÜV, CQC
RUEF160-AP	—	—	2,000	10,000	U160	UL, CSA, TÜV, CQC
RUEF185	500	—	—	10,000	U185	UL, CSA, TÜV, CQC
RUEF185-2	—	3,000	—	15,000	U185	UL, CSA, TÜV, CQC
RUEF185-AP	—	—	2,000	10,000	U185	UL, CSA, TÜV, CQC
RUEF250	500	—	—	10,000	U250	UL, CSA, TÜV, CQC
RUEF250-2	—	3,000	—	15,000	U250	UL, CSA, TÜV, CQC
RUEF250-AP	—	—	2,000	10,000	U250	UL, CSA, TÜV, CQC
RUEF300	500	—	—	10,000	U300	UL, CSA, TÜV, CQC
RUEF300-2	—	2,500	—	12,500	U300	UL, CSA, TÜV, CQC
RUEF300-AP	—	—	1,000	5,000	U300	UL, CSA, TÜV, CQC
RUEF400	500	—	—	10,000	U400	UL, CSA, TÜV, CQC
RUEF400-2	—	1,500	—	7,500	U400	UL, CSA, TÜV, CQC
RUEF400-AP	—	—	1,000	5,000	U400	UL, CSA, TÜV, CQC
RUEF500	250	—	—	5,000	U500	UL, CSA, TÜV, CQC
RUEF500-2	—	1,500	—	7,500	U500	UL, CSA, TÜV, CQC
RUEF500-AP	—	—	1,000	5,000	U500	UL, CSA, TÜV, CQC
RUEF600	250	—	—	5,000	U600	UL, CSA, TÜV, CQC
RUEF600-2	—	1,000	—	5,000	U600	UL, CSA, TÜV, CQC
RUEF600-AP	—	—	1,000	5,000	U600	UL, CSA, TÜV, CQC

RoHS Compliant, ELV Compliant HF Halogen Free

Table R6 Packaging and Marking Information for Radial-Leaded Devices Cont'd

Part Number	Bag Quantity	Tape and Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
RUEF 30V						
RUEF700	250	—	—	5,000	U700	UL, CSA, TÜV, CQC
RUEF700-2	—	1,000	—	5,000	U700	UL, CSA, TÜV, CQC
RUEF700-AP	—	—	1,000	5,000	U700	UL, CSA, TÜV, CQC
RUEF800	250	—	—	5,000	U800	UL, CSA, TÜV, CQC
RUEF800-2	—	1,000	—	5,000	U800	UL, CSA, TÜV, CQC
RUEF800-AP	—	—	1,000	5,000	U800	UL, CSA, TÜV, CQC
RUEF900	250	—	—	5,000	U900	UL, CSA, TÜV, CQC
RUEF900-2	—	1,000	—	4,000	U900	UL, CSA, TÜV, CQC
RUEF900-AP	—	—	1,000	4,000	U900	UL, CSA, TÜV, CQC
RHEF 30V - High Temperature						
RHEF050	500	—	—	10,000	H0.5	UL, CSA, TÜV
RHEF050-2	—	2,500	—	12,500	H0.5	UL, CSA, TÜV
RHEF070	500	—	—	10,000	H0.7	UL, CSA, TÜV
RHEF070-2	—	2,500	—	12,500	H0.7	UL, CSA, TÜV
RHEF100	500	—	—	10,000	H1	UL, CSA, TÜV
RHEF100-2	—	2,500	—	12,500	H1	UL, CSA, TÜV
RUSBF 16V						
RUSBF090	500	—	—	10,000	R90	UL, CSA, TÜV
RUSBF090-2	—	3,000	—	15,000	R90	UL, CSA, TÜV
RUSBF090-AP	—	—	2,000	10,000	R90	UL, CSA, TÜV
RUSBF110	500	—	—	10,000	R110	UL, CSA, TÜV
RUSBF110-2	—	3,000	—	15,000	R110	UL, CSA, TÜV
RUSBF110-AP	—	—	2,000	10,000	R110	UL, CSA, TÜV
RUSBF135	500	—	—	10,000	R135	UL, CSA, TÜV
RUSBF135-2	—	3,000	—	15,000	R135	UL, CSA, TÜV
RUSBF135-AP	—	—	2,000	10,000	R135	UL, CSA, TÜV
RUSBF160	500	—	—	10,000	R160	UL, CSA, TÜV
RUSBF160-2	—	3,000	—	15,000	R160	UL, CSA, TÜV
RUSBF160-AP	—	—	2,000	10,000	R160	UL, CSA, TÜV
RUSBF185	500	—	—	10,000	R185	UL, CSA, TÜV
RUSBF185-2	—	3,000	—	15,000	R185	UL, CSA, TÜV
RUSBF185-AP	—	—	2,000	10,000	R185	UL, CSA, TÜV
RUSBF250	500	—	—	10,000	R250	UL, CSA, TÜV
RUSBF250-2	—	3,000	—	15,000	R250	UL, CSA, TÜV
RUSBF250-AP	—	—	2,000	10,000	R250	UL, CSA, TÜV
RGEF 16V						
RGEF250	500	—	—	10,000	G2.5	UL, CSA, TÜV
RGEF250-2	—	3,000	—	15,000	G2.5	UL, CSA, TÜV
RGEF250-AP	—	—	2,000	10,000	G2.5	UL, CSA, TÜV
RGEF300	500	—	—	10,000	G3	UL, CSA, TÜV
RGEF300-2	—	2,500	—	12,500	G3	UL, CSA, TÜV
RGEF300-AP	—	—	2,000	10,000	G3	UL, CSA, TÜV
RGEF400	500	—	—	10,000	G4	UL, CSA, TÜV
RGEF400-2	—	2,500	—	12,500	G4	UL, CSA, TÜV
RGEF400-AP	—	—	2,000	10,000	G4	UL, CSA, TÜV
RGEF500	500	—	—	10,000	G5	UL, CSA, TÜV
RGEF500-2	—	2,000	—	10,000	G5	UL, CSA, TÜV
RGEF500-AP	—	—	2,000	10,000	G5	UL, CSA, TÜV
RGEF600	500	—	—	10,000	G6	UL, CSA, TÜV
RGEF600-2	—	2,000	—	10,000	G6	UL, CSA, TÜV
RGEF600-AP	—	—	2,000	10,000	G6	UL, CSA, TÜV

RoHS Compliant, ELV Compliant HF Halogen Free

Table R6 Packaging and Marking Information for Radial-Leaded Devices Cont'd

Part Number	Bag Quantity	Tape and Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
RGEF 16V						
RGEF700	500	—	—	10,000	G7	UL, CSA, TÜV
RGEF700-2	—	1,500	—	7,500	G7	UL, CSA, TÜV
RGEF700-AP	—	—	1,500	7,500	G7	UL, CSA, TÜV
RGEF800	500	—	—	10,000	G8	UL, CSA, TÜV
RGEF800-2	—	1,000	—	5,000	G8	UL, CSA, TÜV
RGEF800-AP	—	—	1,000	5,000	G8	UL, CSA, TÜV
RGEF900	500	—	—	10,000	G9	UL, CSA, TÜV
RGEF900-2	—	1,000	—	5,000	G9	UL, CSA, TÜV
RGEF900-AP	—	—	1,000	5,000	G9	UL, CSA, TÜV
RGEF1000	250	—	—	5,000	G10	UL, CSA, TÜV
RGEF1000-2	—	1,000	—	5,000	G10	UL, CSA, TÜV
RGEF1000-AP	—	—	1,000	5,000	G10	UL, CSA, TÜV
RGEF1100	250	—	—	5,000	G11	UL, CSA, TÜV
RGEF1100-2	—	1,000	—	5,000	G11	UL, CSA, TÜV
RGEF1100-AP	—	—	1,000	5,000	G11	UL, CSA, TÜV
RGEF1200	250	—	—	5,000	G12	UL, CSA, TÜV
RGEF1200-2	—	1,000	—	5,000	G12	UL, CSA, TÜV
RGEF1200-AP	—	—	1,000	5,000	G12	UL, CSA, TÜV
RGEF1400	250	—	—	5,000	G14	UL, CSA, TÜV
RGEF1400-2	—	1,000	—	5,000	G14	UL, CSA, TÜV
RGEF1400-AP	—	—	1,000	5,000	G14	UL, CSA, TÜV
RHEF 16V - High Temperature						
RHEF200	500	—	—	10,000	H2	UL, CSA, TÜV
RHEF200-2	—	2,500	—	12,500	H2	UL, CSA, TÜV
RHEF200-AP	—	—	2,500	12,500	H2	UL, CSA, TÜV
RHEF300	500	—	—	10,000	H3	UL, CSA, TÜV
RHEF300-2	—	2,000	—	10,000	H3	UL, CSA, TÜV
RHEF300-AP	—	—	2,000	10,000	H3	UL, CSA, TÜV
RHEF400	500	—	—	10,000	H4	UL, CSA, TÜV
RHEF400-2	—	1,500	—	7,500	H4	UL, CSA, TÜV
RHEF400-AP	—	—	1,500	7,500	H4	UL, CSA, TÜV
RHEF450	500	—	—	10,000	H4.5	UL, CSA, TÜV
RHEF450-2	—	1,500	—	7,500	H4.5	UL, CSA, TÜV
RHEF450-AP	—	—	1,500	7,500	H4.5	UL, CSA, TÜV
RHEF550	500	—	—	10,000	H5.5	UL, CSA, TÜV
RHEF550-2	—	2,000	—	10,000	H5.5	UL, CSA, TÜV
RHEF550-AP	—	—	2,000	10,000	H5.5	UL, CSA, TÜV
RHEF600	500	—	—	10,000	H6	UL, CSA, TÜV
RHEF600-2	—	1,500	—	7,500	H6	UL, CSA, TÜV
RHEF600-AP	—	—	1,500	7,500	H6	UL, CSA, TÜV
RHEF650	500	—	—	10,000	H6.5	UL, CSA, TÜV
RHEF650-2	—	1,500	—	7,500	H6.5	UL, CSA, TÜV
RHEF650-AP	—	—	1,500	7,500	H6.5	UL, CSA, TÜV
RHEF700	500	—	—	10,000	H7	UL, CSA, TÜV
RHEF700-2	—	1,500	—	7,500	H7	UL, CSA, TÜV
RHEF700-AP	—	—	1,500	7,500	H7	UL, CSA, TÜV
RHEF750	500	—	—	10,000	H7.5	UL, CSA, TÜV
RHEF750-2	—	1,000	—	5,000	H7.5	UL, CSA, TÜV
RHEF750-AP	—	—	1,000	5,000	H7.5	UL, CSA, TÜV
RHEF800	500	—	—	10,000	H8	UL, CSA, TÜV
RHEF800-2	—	1,000	—	5,000	H8	UL, CSA, TÜV
RHEF800-AP	—	—	1,000	5,000	H8	UL, CSA, TÜV

RoHS Compliant, ELV Compliant HF Halogen Free

Table R6 Packaging and Marking Information for Radial-Leaded Devices Cont'd

Part Number	Bag Quantity	Tape and Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
RHEF 16V - High Temperature						
RHEF900	250	—	—	5,000	H9	UL, CSA, TÜV
RHEF900-2	—	1,000	—	5,000	H9	UL, CSA, TÜV
RHEF900-AP	—	—	1,000	5,000	H9	UL, CSA, TÜV
RHEF1000	250	—	—	5,000	H10	UL, CSA, TÜV
RHEF1000-2	—	1,000	—	5,000	H10	UL, CSA, TÜV
RHEF1000-AP	—	—	1,000	5,000	H10	UL, CSA, TÜV
RHEF1100	250	—	—	5,000	H11	UL, CSA, TÜV
RHEF1100-2	—	1,000	—	5,000	H11	UL, CSA, TÜV
RHEF1100-AP	—	—	1,000	5,000	H11	UL, CSA, TÜV
RHEF1300	250	—	—	5,000	H13	UL, CSA, TÜV
RHEF1300-2	—	1,000	—	5,000	H13	UL, CSA, TÜV
RHEF1300-AP	—	—	1,000	5,000	H13	UL, CSA, TÜV
RHEF1400	250	—	—	5,000	H14	UL, CSA, TÜV
RHEF1400-2	—	1,000	—	5,000	H14	UL, CSA, TÜV
RHEF1400-AP	—	—	1,000	5,000	H14	UL, CSA, TÜV
RHEF1500	250	—	—	5,000	H15	UL, CSA, TÜV
RHEF1500-2	—	1,000	—	5,000	H15	UL, CSA, TÜV
RHEF1500-AP	—	—	1,000	5,000	H15	UL, CSA, TÜV
RUSBF 6V						
RUSBF075	500	—	—	10,000	R75	UL, CSA, TÜV
RUSBF075-2	—	3,000	—	15,000	R75	UL, CSA, TÜV
RUSBF075-AP	—	—	2,000	10,000	R75	UL, CSA, TÜV
RUSBF120	500	—	—	10,000	R120	UL, CSA, TÜV
RUSBF120-2	—	3,000	—	15,000	R120	UL, CSA, TÜV
RUSBF120-AP	—	—	2,000	10,000	R120	UL, CSA, TÜV
RUSBF155	500	—	—	10,000	R155	UL, CSA, TÜV
RUSBF155-2	—	3,000	—	15,000	R155	UL, CSA, TÜV
RUSBF155-AP	—	—	2,000	10,000	R155	UL, CSA, TÜV

Agency Recognitions for Radial-Leaded Devices

UL	File # E74889
CSA	File # CA78165
TÜV	Certificate number available on request (per IEC 60730-1).

Table R7 Tape and Reel Specifications for Radial-Leaded Devices

RXEF and RKEF devices are available in tape and reel packaging per EIA468-B/IEC60286-2 standards.
See Figures R22 and R23 for details.

Description	EIA Mark	Dimension (mm)	Tolerance
Carrier Tape Width	W	18	-0.5/+1.0
Hold-Down Tape Width	W_4	11	Minimum
Top Distance between Tape Edges	W_6	3	Maximum
Sprocket Hole Position	W_5	9	-0.5/+0.75
Sprocket Hole Diameter	D_0	4	± 0.2
Abscissa to Plane (Straight Lead) (RXEF110 To RXEF300, RKEF135 To RKEF500)	H	18.5	± 2.5
Abscissa to Plane (Kinked Lead) (RXEF010 To RXEF090, RKEF050 To RKEF110)	H_0	16.0	± 0.5
Abscissa to Top (RXEF010 To RXEF090, RKEF050 To RKEF185)	H_1	32.2	Maximum
Abscissa to Top* (RXEF110 To RXEF300, RKEF250 To RKEF500)	H_1	47.5	Maximum
Overall Width with Lead Protrusion (RXEF010 To RXEF090, RKEF050 To RKEF185)	C_1	43.2	Maximum
Overall Width with Lead Protrusion* (RXEF110 To RXEF300, RKEF250 To RKEF500)	C_1	58	Maximum
Overall Width without Lead Protrusion (RXEF010 To RXEF090, RKEF050 To RKEF185)	C_2	42.5	Maximum
Overall Width without Lead Protrusion* (RXEF110 To RXEF300, RKEF250 To RKEF500)	C_2	57	Maximum
Lead Protrusion	L_1	1.0	Maximum
Protrusion of Cut-Out	L	11.0	Maximum
Protrusion beyond Hold-down Tape	I_2	Not Specified	—
Sprocket Hole Pitch	P_0	12.7	± 0.3
Device Pitch (RXEF010 To RXEF090, RKEF050 To RKEF185)	—	12.7	± 0.3
Device Pitch (RXEF110 To RXEF300, RKEF250 To RKEF500)	—	25.4	± 0.61
Pitch Tolerance	—	20 Consecutive	± 1
Tape Thickness	T	0.9	Maximum
Overall Tape and Lead Thickness (RXEF010 To RXEF090, RKEF050 To RKEF185)	T_1	1.5	Maximum
Overall Tape and Lead Thickness (RXEF110 To RXEF300, RKEF250 To RKEF500)	T_1	2.3	Maximum
Splice Sprocket Hole Alignment	—	0	± 0.3
Body Lateral Deviation	Δh	0	± 1.0
Body Tape Plane Deviation	Δp	0	± 1.3
Ordinate to Adjacent Component Lead (RXEF010 To RXEF185, RKEF050 To RKEF300)	P_1	3.81	± 0.7
Ordinate to Adjacent Component Lead (RXEF250 To RXEF300, RKEF375 To RKEF500)	P_1	7.62	± 0.7
Lead Spacing* (RXEF010 To RXEF185, RKEF050 To RKEF300)	F	5.05	± 0.75
Lead Spacing* (RXEF250 To RXEF300, RKEF375 To RKEF500)	F	10.15	± 0.75
Reel Width (RXEF010 To RXEF090, RKEF050 To RKEF185)	W_2	56.0	Maximum
Reel Width* (RXEF110 To RXEF300, RKEF250 To RKEF500)	W_2	63.5	Maximum
Reel Diameter	A	370.0	Maximum
Space between Flanges* (RXEF010 To RXEF090, RKEF050 To RKEF185)	W_1	48.00	Maximum
Space between Flanges* (RXEF110 To RXEF300, RKEF250 To RKEF500)	W_1	55.00	Maximum
Arbor Hold Diameter	C	26.0	± 12.0
Core Diameter*	N	91.0	Maximum
Box	—	64/372/362	Maximum
Consecutive Missing Places	—	None	—
Empty Places per Reel	—	0.1%	Maximum

*Differs from EIA specification.

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Table R7 Tape and Reel Specifications for Radial-Leaded Devices Cont'd

RUEF and RUSBF devices are available in tape and reel packaging per EIA468–B/IEC60286–2 standards.
See Figures R21 and R22 for details.

Description	EIA Mark	Dimension (mm)	Tolerance
Carrier Tape Width	W	18	-0.5/+1.0
Hold-down Tape Width	W_4	11	Minimum
Top Distance between Tape Edges	W_6	3	Maximum
Sprocket Hole Position	W_5	9	-0.5/+0.75
Sprocket Hole Diameter	D_0	4	± 0.2
Abscissa to Plane (Straight Lead)* (RUEF300 to RUEF900)	H	18.5	± 2.5
Abscissa to Plane (Kinked Lead) (RUSBF075 to RUSBF250, RUEF090 to RUEF250)	H_0	16.0	± 0.5
Abscissa to Top (RUSBF075 to RUSBF250, RUEF090 to RUEF300)	H_1	32.2	Maximum
Abscissa to Top* (RUEF400 to RUEF900)	H_1	45.0	Maximum
Overall Width with Lead Protrusion (RUSBF075 to RUSBF250, RUEF090 to RUEF300)	C_1	43.2	Maximum
Overall Width with Lead Protrusion (RUEF400 To RUEF900)	C_1	56	Maximum
Overall Width without Lead Protrusion (RUSBF075 to RUSBF250, RUEF090 to RUEF300)	C_2	42.5	Maximum
Overall Width without Lead Protrusion (RUEF400 to RUEF900)	C_2	56	Maximum
Lead Protrusion	L_1	1.0	Maximum
Protrusion of Cut-out	L	11	Maximum
Protrusion beyond Hold-down Tape	I_2	Not Specified	—
Sprocket Hole Pitch	P_0	12.7	± 0.3
Device Pitch (RUSBF075 to RUSBF250, RUEF090 to RUEF300)	—	12.7	± 0.3
Device Pitch (RUEF400 to RUEF900)	—	25.4	± 0.6
Pitch Tolerance	—	20 Consecutive	± 1
Tape Thickness	T	0.9	Maximum
Overall Tape and Lead Thickness (RUSBF075 to RUSBF250, RUEF090 to RUEF50)	T_1	1.5	Maximum
Overall Tape and Lead Thickness* (RUEF300 to RUEF900)	T_1	2.3	Maximum
Splice Sprocket Hole Alignment	—	0	± 0.3
Body Lateral Deviation	Δh	0	± 1.0
Body Tape Plane Deviation	Δp	0	± 1.3
Ordinate to Adjacent Component Lead (RUSBF075 to RUSBF250, RUEF090 to RUEF300)	P_1	3.81	± 0.7
Ordinate to Adjacent Component Lead (RUEF400 to RUEF900)	P_1	7.62	± 0.7
Lead Spacing* (RUSBF075 to RUSBF250, RUEF090 to RUEF400)	F	5.05	± 0.75
Lead Spacing* (RUEF500 to RUEF900)	F	10.15	± 0.75
Reel Width (RUEF090 to RUEF400, Rusbf075 to Rusbf250)	W_2	56.0	Maximum
Reel Width (RUEF500* to RUEF900)	W_2	63.5	Maximum
Reel Diameter	A	370.0	Maximum
Space between Flanges* (RUEF090 to RUEF400, RUSBF075 to RUSBF250)	W_1	48.0	Maximum
Space between Flanges* (RUEF500 to RUEF900)	W_1	55.0	Maximum
Arbor Hold Diameter	C	26.0	± 12.0
Core Diameter*	N	91.0	Maximum
Box	—	64/372/362	Maximum
Consecutive Missing Places	—	None	—
Empty Places per Reel	—	0.1%	Maximum

*Differs from EIA specification.

Table R7 Tape and Reel Specifications for Radial-Leaded Devices Cont'd

RGEF and RHEF devices are available in tape and reel packaging per EIA468–B/IEC60286–2 standards.
See Figures R21 and R22 for details.

Description	EIA Mark	Dimension (mm)	Tolerance
Carrier Tape Width	W	18	-0.5/+1.0
Hold-Down Tape Width	W_4	11	Minimum
Top Distance between Tape Edges	W_6	3	Maximum
Sprocket Hole Position	W_5	9	-0.5/+0.75
Sprocket Hole Diameter	D_0	4	± 0.2
Abscissa to Plane (Straight Lead) (RGEF250 to RGEF1400)	H	18.5	± 2.5
Abscissa to Plane (Kinked Lead) (Rhef050 to RGEF1500)	H_0	16.0	± 0.5
Abscissa to Top (RGEF250 to RGEF500, RGEF050 to RGEF450)	H_1	32.2	Maximum
Abscissa to Top* (RGEF600 to RGEF1400, RHEF550 to RHEF1500)	H_1	45.0	Maximum
Overall Width with Lead Protrusion (RGEF250 to RGEF600, RHEF050 to RHEF450)	C_1	43.2	Maximum
Overall Width with Lead Protrusion (RGEF700 to RGEF1400, RHEF550 to RHEF1500)	C_1	55	Maximum
Overall Width without Lead Protrusion (RGEF250 to RGEF600, RHEF050 to RHEF450)	C_2	42.5	Maximum
Overall Width without Lead Protrusion (RGEF700 to RGEF1400, RHEF550 to RHEF1500)	C_2	54	Maximum
Lead Protrusion	L_1	1.0	Maximum
Protrusion of Cut-out	L	11	Maximum
Protrusion beyond Hold-down Tape	I_2	Not Specified	—
Sprocket Hole Pitch	P_0	12.7	± 0.3
Device Pitch (RGEF250 to RGEF700, RHEF050 to RHEF600)	—	25.4	± 0.61
Device Pitch (RGEF800 to RGEF1400, RHEF650 to RHEF1500)	—	25.4	± 0.6
Pitch Tolerance	—	20 Consecutive	± 1
Tape Thickness	T	0.9	Maximum
Overall Tape and Lead Thickness* (RGEF250 to RGEF1100, RHEF050 to RHEF1100)	T_1	2.0	Maximum
Overall Tape and Lead Thickness* (RGEF1200 to RGEF1400, RHEF1300 to RHEF1500)	T_1	2.3	Maximum
Splice Sprocket Hole Alignment	—	0	± 0.3
Body Lateral Deviation	Δh	0	± 1.0
Body Tape Plane Deviation	Δp	0	± 1.3
Ordinate to Adjacent Component Lead (RGEF250 to RGEF1100, RHEF050 to RHEF900)	P_1	3.81	± 0.7
Ordinate to Adjacent Component Lead (RGEF1200 to RGEF1400, RHEF1000 to RHEF1500)	P_1	7.62	± 0.7
Lead Spacing* (RGEF250 to RGEF1100, RHEF050 to RHEF900)	F	5.05	± 0.75
Lead Spacing* (RGEF1200 to RGEF1400, RHEF1000 to RHEF1500)	F	10.15	± 0.75
Reel Width (RGEF250 to RGEF600, RHEF050 to RHEF450)	W_2	56.0	Maximum
Reel Width* (RGEF700 to RGEF1400 & RHEF550 to RHEF1500)	W_2	63.5	Maximum
Reel Diameter	A	370.0	Maximum
Space between Flanges* (RGEF250 to RGEF600, RHEF050 to RHEF450)	W_1	48.0	Maximum
Space between Flanges* (RGEF700 to RGEF400, RHEF550 to RHEF1500)	W_1	55.0	Maximum
Arbor Hold Diameter	C	26.0	± 12.0
Core Diameter*	N	91.0	Maximum
Box	—	64/372/362	Maximum
Consecutive Missing Places	—	None	—
Empty Places per Reel	—	0.1%	Maximum

*Differs from EIA specification.

Figure R21 EIA Referenced Taped Component Dimensions for Radial-Leaded Devices

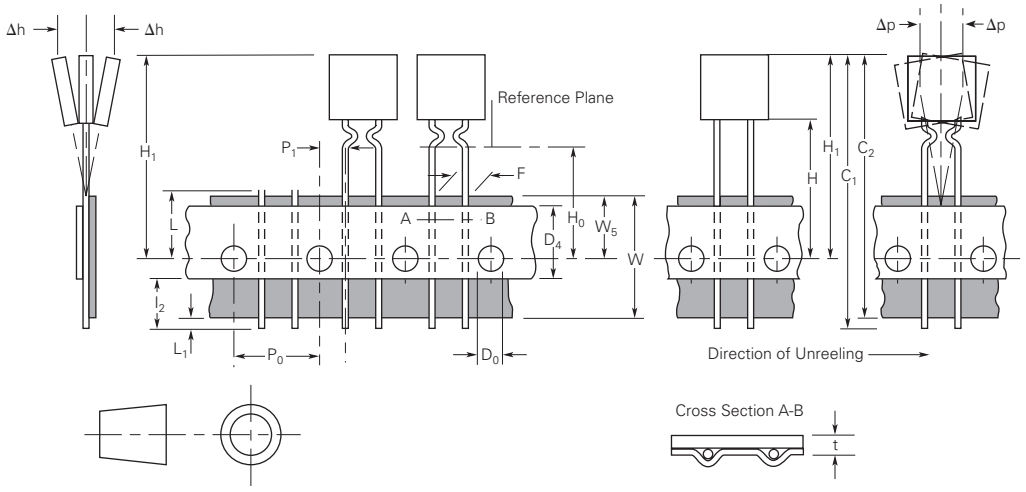
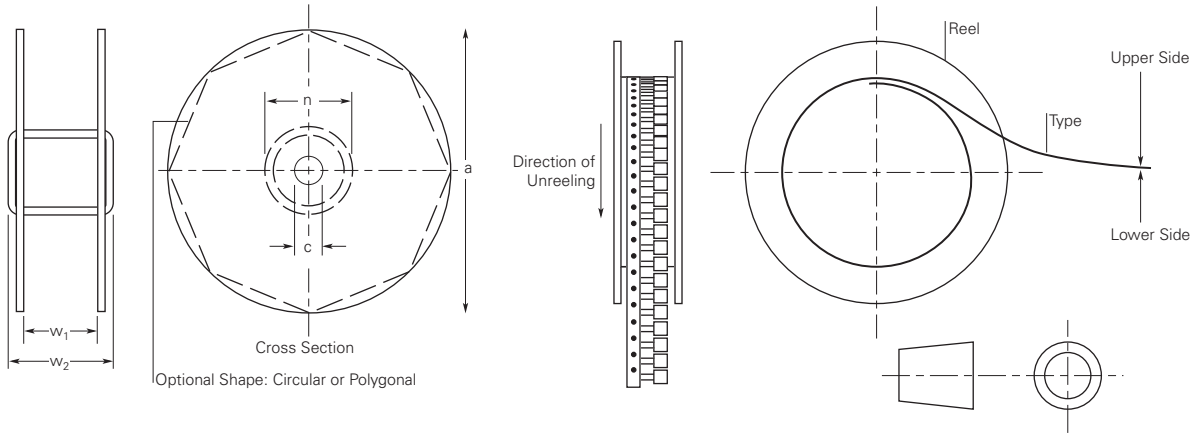
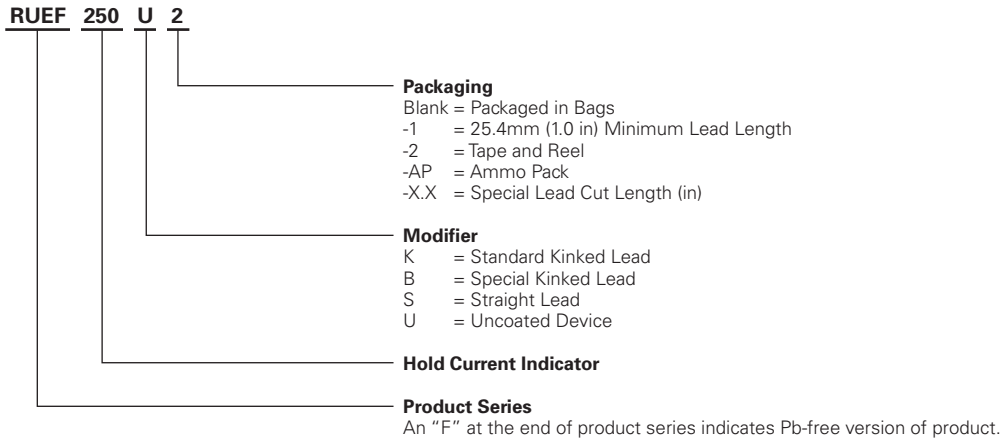


Figure R22 EIA Referenced Reel Dimensions for Radial-Leaded Devices



Part Numbering System for Radial-Leaded Devices



Note: Kinked parts are recommended to control the height of the part on the PCB in non-auto PCB applications.

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⚠ Warning :

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage (Ldi/dt) above the rated voltage of the device.

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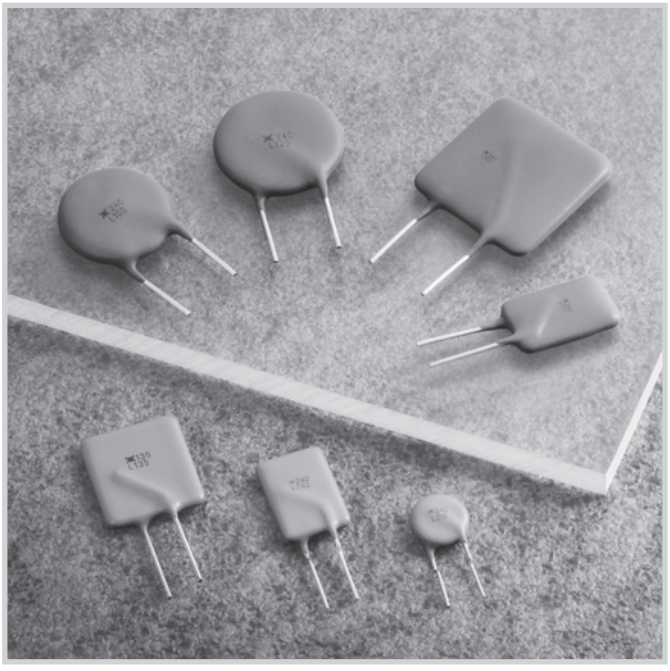


PolySwitch Resettable Devices
Line-Voltage-Rated Devices

PolySwitch line-voltage-rated (LVR) devices help protect electric motors and transformers used in commercial and home appliances from damage caused by mechanical overloads, overheating, stall, lost neutral and other potentially harmful conditions.

The LVR line-voltage product line of polymeric positive temperature coefficient (PPTC) devices includes components that are rated for line voltages of $120V_{AC}$ and $240V_{AC}$, for up to 2A of operating current at 20°C. They help protect against damage caused by both overcurrent surges and overtemperature faults. They also offer low resistance and are compatibly sized with fuse solutions.

Unlike traditional fuses, PolySwitch devices do not require replacement after a fault event. After power has been removed and the overcurrent condition eliminated, the circuit is restored to normal operating condition. Compared to bimetal breakers, they offer greater flexibility, longer lifespan and lower electromagnetic interference (EMI).



The PolySwitch LVR devices' resettable functionality and latching attributes make them a reliable, cost-effective circuit protection solution for both intermittent- and continuous-operation motor applications. Their low resistance, fast time-to-trip, and low profile help circuit designers provide a safe and dependable product, comply with regulatory agency requirements and reduce warranty repair costs.

LVR/LVB series are suitable for line-voltage applications up to a continuous operating voltage of $240V_{AC}/120V_{AC}$.

RoHS versions of all products are available.

Benefits

- Choice of many devices helps provide engineers with design flexibility
- Compatible with high-volume electronics assembly
- Assist in meeting regulatory requirements
- Higher voltage ratings allow use in new applications

Features

- RoHS compliant
- Broadest range of radial-leaded resettable devices available in the industry
- Current ratings from 50mA to 2A
- Line voltage rating of $120V_{AC}$ and $240V_{AC}$
- Agency recognition: UL, CSA, TÜV
- Fast time-to-trip
- Low resistance

Applications

- Electromagnetic loads
- Game machines
- Industrial controls
- Lighting ballasts
- Loudspeakers
- Medical equipment
- Motors, fans and blowers
- POS equipment
- Satellite video receivers
- Security and fire alarm systems
- Test and measurement equipment
- Transformers
- USB hubs, ports and peripherals

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Table L1 Product Series - Current Rating, Voltage Rating / Typical Resistance for LVR Devices

Voltage Rating	LVR 240V_{AC} / 120V_{AC}	LVB 240V_{AC}
Hold Current (A)		
0.050	25.00Ω	—
0.080	9.800Ω	—
0.120	4.800Ω	—
0.160	3.400Ω	—
0.250	1.700Ω	—
0.330	1.000Ω	—
0.400	0.800Ω	—
0.550	0.590Ω	—
0.750	0.400Ω	—
1.000	0.276Ω	—
1.250	0.209Ω	0.209Ω
1.350	—	—
2.000	0.110Ω	—

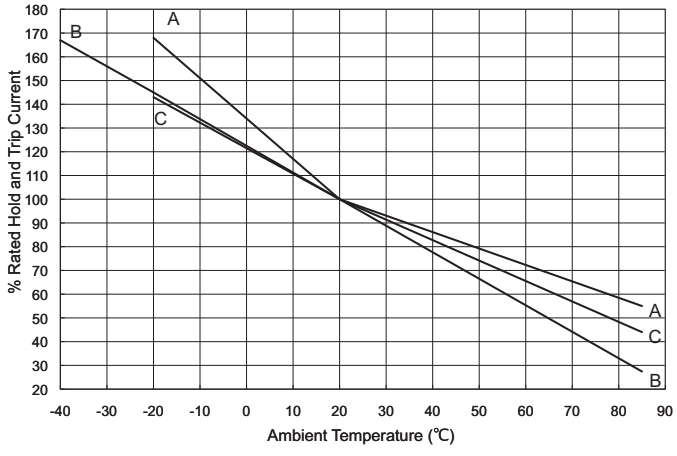
Table L2 Thermal Derating for LVR Devices [Hold Current (A) at Ambient Temperature (°C)]

	Maximum Ambient Temperature								
Part Number	**-20°C**	**0°C**	**20°C**	**25°C**	**40°C**	**50°C**	**60°C**	**70°C**	**85°C**
LVR									
LVR005N	0.08	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02
LVR008N	0.12	0.10	0.08	0.08	0.07	0.06	0.05	0.04	0.03
LVR012	0.18	0.15	0.12	0.12	0.10	0.09	0.07	0.06	0.04
LVR016	0.24	0.20	0.16	0.16	0.13	0.11	0.10	0.08	0.05
LVR025	0.38	0.32	0.25	0.25	0.21	0.18	0.15	0.13	0.09
LVR033	0.50	0.42	0.33	0.33	0.27	0.23	0.20	0.17	0.11
LVR040	0.61	0.51	0.40	0.40	0.33	0.28	0.24	0.20	0.14
LVR055	0.80	0.68	0.55	0.54	0.46	0.40	0.35	0.29	0.22
LVR075	1.23	0.98	0.75	0.74	0.60	0.56	0.49	0.45	0.41
LVR100	1.65	1.30	1.00	0.94	0.80	0.75	0.65	0.60	0.55
LVR125	2.06	1.63	1.25	1.20	1.00	0.94	0.81	0.75	0.69
LVR200	3.30	2.60	2.00	1.97	1.60	1.50	1.30	1.20	1.10
LVR075-240	1.23	0.98	0.75	0.74	0.60	0.56	0.49	0.45	0.41
LVR100-240	1.65	1.30	1.00	0.94	0.80	0.75	0.65	0.60	0.55
LVR125-240	2.06	1.63	1.25	1.20	1.00	0.94	0.81	0.75	0.69
LVR200-240	3.30	2.60	2.00	1.97	1.60	1.50	1.30	1.20	1.10

		Maximum Ambient Temperature								
Part Number	**-40°C**	**-20°C**	**0°C**	**20°C**	**25°C**	**40°C**	**50°C**	**60°C**	**70°C**	**85°C**
LVB										
LVB125	2.09	1.81	1.53	1.25	1.19	0.99	0.86	0.73	0.60	0.41

Figure L1 Thermal Derating Curve for LVR Devices

A = LVR075-LVR200
B = LVB125
C = LVR005N-LVR055



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Table L3 Electrical Characteristics for LVR Devices*

Part Number	I_H (A)	I_T (A)	V_{MAX}† Operating (V_{AC})	V_{MAX}† Interrupt (V_{AC})	I_{MAX}† Interrupt (A)	$P_{D\ Typ}$ (W)	Max. Time-to-trip (A)	Max. Time-to-trip (s)	R_{MIN} (Ω)	R_{MAX} (Ω)	R_{1MAX} (Ω)	Lead Size [mm (AWG)]
LVR												
LVR005NK	0.05	0.12	240 120	265 135	1.0 20.0	0.9	0.25	10.0	18.500	31.000	65.000	[0.51mm (24)]
LVR005NS	0.05	0.12	240 120	265 135	1.0 20.0	0.9	0.25	10.0	18.500	31.000	65.000	[0.51mm (24)]
LVR008NK	0.08	0.19	240 120	265 135	1.2 20.0	0.9	0.40	10.0	7.400	12.000	26.000	[0.51mm (24)]
LVR008NS	0.08	0.19	240 120	265 135	1.2 20.0	0.9	0.40	10.0	7.400	12.000	26.000	[0.51mm (24)]
LVR012K	0.12	0.30	240 120	265 135	1.2 20.0	1.0	0.60	15.0	3.000	6.500	12.000	[0.51mm (24)]
LVR012S	0.12	0.30	240 120	265 135	1.2 20.0	1.0	0.60	15.0	3.000	6.500	12.000	[0.51mm (24)]
LVR016K	0.16	0.37	240 120	265 135	2.0 20.0	1.4	0.80	15.0	2.500	4.100	7.800	[0.51mm (24)]
LVR016S	0.16	0.37	240 120	265 135	2.0 20.0	1.4	0.80	15.0	2.500	4.100	7.800	[0.51mm (24)]
LVR025K	0.25	0.56	240 120	265 135	3.5 20.0	1.5	1.25	18.5	1.300	2.100	3.800	[0.64mm (22)]
LVR025S	0.25	0.56	240 120	265 135	3.5 20.0	1.5	1.25	18.5	1.300	2.100	3.800	[0.64mm (22)]
LVR033K	0.33	0.74	240 120	265 135	4.5 20.0	1.7	1.65	21.0	0.770	1.240	2.600	[0.64mm (22)]
LVR033S	0.33	0.74	240 120	265 135	4.5 20.0	1.7	1.65	21.0	0.770	1.240	2.600	[0.64mm (22)]
LVR040K	0.40	0.90	240 120	265 135	5.5 20.0	2.0	2.00	24.0	0.600	0.970	1.900	[0.64mm (22)]
LVR040S	0.40	0.90	240 120	265 135	5.5 20.0	2.0	2.00	24.0	0.600	0.970	1.900	[0.64mm (22)]
LVR055K	0.55	1.25	240 120	265 135	7.0 20.0	3.4	2.75	26.0	0.450	0.730	1.450	[0.81mm (20)]
LVR055S	0.55	1.25	240 120	265 135	7.0 20.0	3.4	2.75	26.0	0.450	0.730	1.450	[0.81mm (20)]
LVR075S	0.75	1.50	240	265	7.5	2.6	3.75	18.0	0.316	0.483	0.839	[0.81mm (20)]
LVR100S	1.00	2.00	240	265	10.0	2.9	5.00	21.0	0.218	0.334	0.580	[0.81mm (20)]
LVR125S	1.25	2.50	240	265	12.5	3.3	6.25	23.0	0.165	0.253	0.440	[0.81mm (20)]
LVR200S	2.00	4.00	240	265	20.0	4.5	10.00	28.0	0.089	0.131	0.221	[0.81mm (20)]
LVR075S-240	0.75	1.50	240	265	7.5	2.6	3.75	18.0	0.316	0.483	0.839	[0.81mm (20)]
LVR100S-240	1.00	2.00	240	265	10.0	2.9	5.00	21.0	0.218	0.334	0.580	[0.81mm (20)]
LVR125S-240	1.25	2.50	240	265	12.5	3.3	6.25	23.0	0.165	0.253	0.440	[0.81mm (20)]
LVR200S-240	2.00	4.00	240	265	20.0	4.5	10.00	28.0	0.089	0.131	0.221	[0.81mm (20)]
LVB												
LVB125	1.25	2.50	240	265	12.5	4.0	8.00	5.0	0.152	0.292	0.482	[0.81mm (20)]

Notes:

I_H : Hold current: maximum current device will pass without interruption in 20°C still air.
I_T : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.
V_{MAX} Operating: Maximum continuous voltage device can withstand without damage at rated current.
V_{MAX} Interrupt : Under specified conditions this is the highest voltage that can be applied to the device at the maximum interrupt current.
I_{MAX} Interrupt : Maximum fault current device can withstand without damage at rated voltage.
P_D : Power dissipated from device when in the tripped state in 20°C still air.
R_{MIN} : Minimum resistance of device as supplied at 20°C unless otherwise specified.
R_{MAX} : Maximum resistance of device as supplied at 20°C unless otherwise specified.
R_{1MAX} : Maximum resistance of device when measured one hour post trip at 20°C unless otherwise specified.

* Electrical characteristics determined at 20°C.
† See Application Limitations on next page.

RoHS Compliant, ELV Compliant

Figures L2-L6 Dimension Figures for LVR Devices

Figure L2

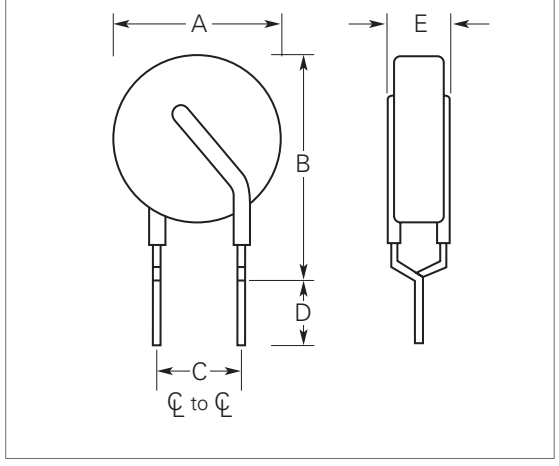


Figure L3

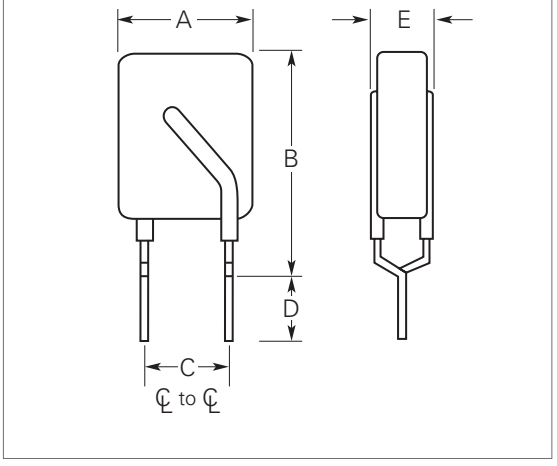


Figure L4

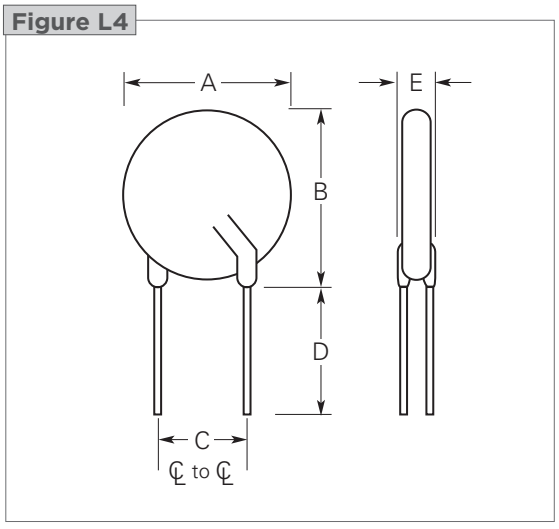


Figure L5

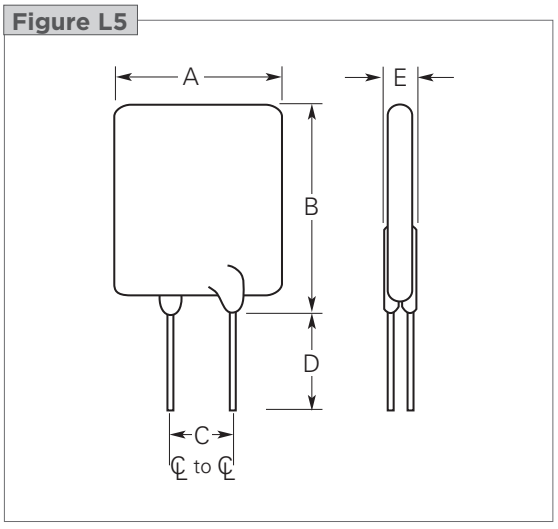
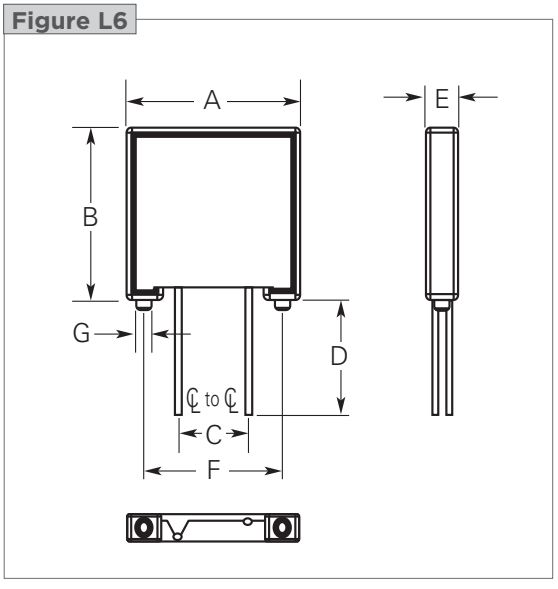


Figure L6



RoHS Compliant, ELV Compliant

Table L4 Dimensions and Weights for LVR Devices - Millimeters (Inches)

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	Figure	Device Mass(g) (Only for Reference)
LVR												
LVR005NK	—	6.9	—	12.1	4.3	5.8	7.6	—	—	4.6		
		(0.27)		(0.48)	(0.17)	(0.23)	(0.30)			(0.18)	L2	0.177
LVR005NS	—	6.9	—	9.9	4.3	5.8	7.6	—	—	4.6		
		(0.27)		(0.39)	(0.17)	(0.23)	(0.30)			(0.18)	L4	0.211
LVR008NK	—	7.2	—	12.4	4.3	5.8	7.6	—	—	4.6		
		(0.28)		(0.49)	(0.17)	(0.23)	(0.30)			(0.18)	L2	0.233
LVR008NS	—	7.2	—	10.2	4.3	5.8	7.6	—	—	4.6		
		(0.28)		(0.40)	(0.17)	(0.23)	(0.30)			(0.18)	L4	0.211
LVR012K	—	8.3	—	12.9	4.3	5.8	7.6	—	—	3.8		
		(0.33)		(0.51)	(0.17)	(0.23)	(0.30)			(0.15)	L2	0.231
LVR012S	—	8.3	—	10.7	4.3	5.8	7.6	—	—	3.8		
		(0.33)		(0.43)	(0.17)	(0.23)	(0.30)			(0.15)	L4	0.235
LVR016K	—	9.9	—	13.8	4.3	5.8	7.6	—	—	3.8		
		(0.39)		(0.54)	(0.17)	(0.23)	(0.30)			(0.15)	L2	0.253
LVR016S	—	9.9	—	12.5	4.3	5.8	7.6	—	—	3.8		
		(0.39)		(0.50)	(0.17)	(0.23)	(0.30)			(0.15)	L4	0.291
LVR025K	—	9.6	—	18.8	4.3	5.8	7.6	—	—	3.8		
		(0.38)		(0.74)	(0.17)	(0.23)	(0.30)			(0.15)	L3	0.508
LVR025S	—	9.6	—	17.4	4.3	5.8	7.6	—	—	3.8		
		(0.38)		(0.69)	(0.17)	(0.23)	(0.30)			(0.15)	L5	0.472
LVR033K	—	11.4	—	19.0	4.3	5.8	7.6	—	—	3.8		
		(0.45)		(0.75)	(0.17)	(0.23)	(0.30)			(0.15)	L3	0.628
LVR033S	—	11.4	—	16.5	4.3	5.8	7.6	—	—	3.8		
		(0.45)		(0.65)	(0.17)	(0.23)	(0.30)			(0.15)	L5	0.600
LVR040K	—	11.5	—	20.9	4.3	5.8	7.6	—	—	3.8		
		(0.46)		(0.82)	(0.17)	(0.23)	(0.30)			(0.15)	L3	0.698
LVR040S	—	11.5	—	19.5	4.3	5.8	7.6	—	—	3.8		
		(0.46)		(0.77)	(0.17)	(0.23)	(0.30)			(0.15)	L5	0.688
LVR055K	—	14.0	—	22.4	4.3	5.8	7.6	—	—	4.1		
		(0.55)		(0.88)	(0.17)	(0.23)	(0.30)			(0.16)	L3	1.100
LVR055S	—	14.0	—	21.7	4.3	5.8	7.6	—	—	4.1		
		(0.55)		(0.85)	(0.17)	(0.23)	(0.30)			(0.16)	L5	1.060
LVR075S	—	11.5	—	23.4	4.1	6.1	5.1	—	—	4.8		
		(0.45)		(0.92)	(0.16)	(0.24)	(0.20)			(0.19)	L5	1.088
LVR100S	—	18.7	—	24.4	8.9	11.4	5.1	—	—	5.1		
		(0.74)		(0.96)	(0.35)	(0.45)	(0.20)			(0.20)	L4	1.345
LVR125S	—	21.2	—	27.4	8.9	11.4	5.1	—	—	5.3		
		(0.84)		(1.08)	(0.35)	(0.45)	(0.20)			(0.21)	L4	1.800
LVR200S	—	24.9	—	33.8	8.9	11.4	5.1	—	—	6.1		
		(0.98)		(1.33)	(0.35)	(0.45)	(0.20)			(0.24)	L5	2.777
LVR075S-240	—	11.5	—	23.4	4.1	6.1	5.1	—	—	4.8		
		(0.45)		(0.92)	(0.16)	(0.24)	(0.20)			(0.19)	L5	1.088
LVR100S-240	—	18.7	—	24.4	8.9	11.4	5.1	—	—	5.1		
		(0.74)		(0.96)	(0.35)	(0.45)	(0.20)			(0.20)	L4	1.345
LVR125S-240	—	21.2	—	27.4	8.9	11.4	5.1	—	—	5.3		
		(0.84)		(1.08)	(0.35)	(0.45)	(0.20)			(0.21)	L4	1.800
LVR200S-240	—	24.9	—	33.8	8.9	11.4	5.1	—	—	6.1		
		(0.98)		(1.33)	(0.35)	(0.45)	(0.20)			(0.24)	L5	2.777

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	Figure	Device Mass(g) (Only for Reference)
LVB																
LVB125	24.8	25.2	26.8	27.2	8.9	11.4	5.1	—	4.2	4.6	20.0	20.3	—	2.5		
	(0.98)	(.099)	(1.06)	(1.07)	(0.35)	(0.45)	(0.20)	—	(0.17)	(0.18)	(0.79)	(0.80)	—	(0.80)	L6	1.653

Figure L7 Typical Time-to-Trip Curves at 20°C for LVR Devices

LVR/LVB

A = LVR005N
B = LVR008N
C = LVR012
D = LVR016
E = LVR025
F = LVR033
G = LVR040
H = LVR055
I = LVR075/LVR075-240
J = LVR0100/LVR100-240
K = LVR125/LVR125-240
L = LVB125
M = LVR200/LVR200-240

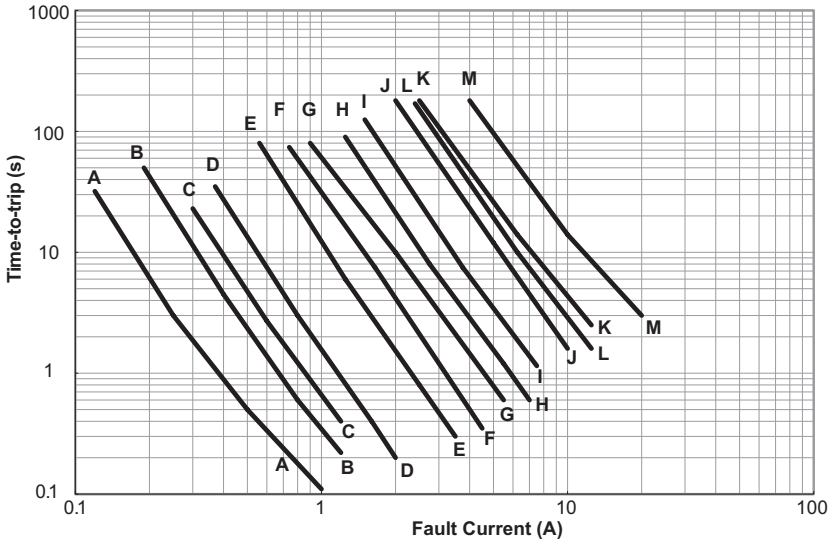


Table L5 Physical Characteristics and Environmental Specifications for LVR Devices

LVR/LVB
Physical Characteristics

Lead Material	LVR005N to LVR016:	Tin-plated Copper, (24AWG), ø0.51mm (0.020in)
	LVR025 to LVR040:	Tin-plated Copper, (22AWG), ø0.64mm (0.025in)
	LVR055 to LVR200:	Tin-plated Copper, (20AWG), ø0.81mm (0.032in)
	LVR075-240 to LVR200-240:	Tin-plated Copper, (20AWG), ø0.81mm (0.032in)
	LVB125:	Tin-plated Copper, (20AWG), ø0.81mm (0.032in)
Soldering Characteristics	Solderability per ANSI/J-STD-002 Category 3	
Solder Heat Withstand	Per IEC-STD 68-2-20, Test Tb, Method 1A, Condition B, Can Withstand 10 s at 260°C ±5°C	
Insulating Material	LVR005N to LVR055:	Cured, Flame-retardant Epoxy Polymer, Meets UL 94V-0
	LVR075 to LVR200:	Cured, Flame-retardant Modified Silicone, Meets UL 94V-0
	LVR075-240 to LVR200-240:	Cured, Flame-retardant Epoxy Polymer, Meets UL 94V-0
	LVB125:	Glass Reinforced PBT, Meets UL 94V-0

Note: Devices are not intended to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±10%
	85°C, 1000 hrs	±10%
Humidity Aging	85°C, 85%RH, 1000 hrs	±20%
Thermal Shock	85°C, -40°C (10 Times)	±15%
Solvent Resistance	MIL-STD-202, Method 215F	No Change

Agency Recognitions for LVR Devices

UL	File # E74889
CSA	File # CA78165
TÜV	Certificate Number Available on Request (per IEC 60730-1).

Table L6 Packaging and Marking Information for LVR Devices

Part Number	Bag Quantity	Tape and Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
LVR/LVB						
LVR005NK	500	—	—	10,000	L005	UL, CSA, TÜV
LVR005NK-2	—	1,500	—	7,500	L005	UL, CSA, TÜV
LVR005NS	500	—	—	10,000	L005	UL, CSA, TÜV
LVR005NS-2	—	1,500	—	7,500	L005	UL, CSA, TÜV
LVR008NK	500	—	—	10,000	L008	UL, CSA, TÜV
LVR008NK-2	—	1,500	—	7,500	L008	UL, CSA, TÜV
LVR008NS	500	—	—	10,000	L008	UL, CSA, TÜV
LVR008NS-2	—	1,500	—	7,500	L008	UL, CSA, TÜV
LVR012K	500	—	—	10,000	L012	UL, CSA, TÜV
LVR012K-2	—	2,000	—	10,000	L012	UL, CSA, TÜV
LVR012S	500	—	—	10,000	L012	UL, CSA, TÜV
LVR012S-2	—	2,000	—	10,000	L012	UL, CSA, TÜV
LVR016K	500	—	—	10,000	L016	UL, CSA, TÜV
LVR016K-2	—	2,000	—	10,000	L016	UL, CSA, TÜV
LVR016S	500	—	—	10,000	L016	UL, CSA, TÜV
LVR016S-2	—	2,000	—	10,000	L016	UL, CSA, TÜV
LVR025K	500	—	—	10,000	L025	UL, CSA, TÜV
LVR025K-2	—	2,000	—	10,000	L025	UL, CSA, TÜV
LVR025S	500	—	—	10,000	L025	UL, CSA, TÜV
LVR025S-2	—	2,000	—	10,000	L025	UL, CSA, TÜV
LVR033K	500	—	—	10,000	L033	UL, CSA, TÜV
LVR033K-2	—	2,000	—	10,000	L033	UL, CSA, TÜV
LVR033S	500	—	—	10,000	L033	UL, CSA, TÜV
LVR033S-2	—	2,000	—	10,000	L033	UL, CSA, TÜV
LVR040K	500	—	—	10,000	L040	UL, CSA, TÜV
LVR040K-2	—	2,000	—	10,000	L040	UL, CSA, TÜV
LVR040S	500	—	—	10,000	L040	UL, CSA, TÜV
LVR040S-2	—	2,000	—	10,000	L040	UL, CSA, TÜV
LVR055K	500	—	—	10,000	L055	UL, CSA, TÜV
LVR055S	500	—	—	10,000	L055	UL, CSA, TÜV
LVR055S-2	—	1,000	—	5,000	L055	UL, CSA, TÜV
LVR075S	500	—	—	10,000	L075	UL, CSA, TÜV
LVR100S	250	—	—	5,000	L100	UL, CSA, TÜV
LVR125S	250	—	—	5,000	L125	UL, CSA, TÜV
LVR200S	250	—	—	5,000	L200	UL, CSA, TÜV
LVR075S-240	500	—	—	10,000	L075	UL, CSA, TÜV
LVRO75S-240-2	—	1,000	—	5,000	L075	UL, CSA, TÜV
LVR075S-240-AP	—	—	1,000	5,000	L075	UL, CSA, TÜV
LVR100S-240	250	—	—	5,000	L100	UL, CSA, TÜV
LVR100S-240-2	—	1,000	—	5,000	L100	UL, CSA, TÜV
LVR100S-240-AP	—	—	1,000	5,000	L100	UL, CSA, TÜV
LVR125S-240	250	—	—	5,000	L125	UL, CSA, TÜV
LVR125S-240-2	—	1,000	—	5,000	L125	UL, CSA, TÜV
LVR125S-240-AP	—	—	1,000	5,000	L125	UL, CSA, TÜV
LVR200S-240	250	—	—	5,000	L200	UL, CSA, TÜV
LVR200S-240-2	—	1,000	—	5,000	L200	UL, CSA, TÜV
LVR200S-240-AP	—	—	1,000	5,000	L200	UL, CSA, TÜV
LVB125	250	—	—	5,000	B125	UL

RoHS Compliant, ELV Compliant

Table L7 Tape and Reel Specifications for LVR Devices

LVR devices are available in tape and reel packaging per EIA468-B/IEC60286-2 standards.
See Figures L8 and L9 for details.

Description	EIA Mark	Dimension (mm)	Tolerance
Carrier Tape Width	W	18	-0.5/+1.0
Hold-down Tape Width	W_4	11	Minimum
Top Distance between Tape Edges	W_6	3	Maximum
Sprocket Hole Position	W_5	9	-0.5/+0.75
Sprocket Hole Diameter	D_0	4	± 0.2
Abscissa to Plane (Straight Lead) (LVR005N to LVR200)	H	18.5	± 2.5
Abscissa to Plane (Kinked Lead) (LVR005N to LVR055)	H_0	16.0	± 0.5
Abscissa to Top (LVR005N to LVR016)	H_1	32.2	Maximum
Abscissa to Top* (LVR025 to LVR200)	H_1	45.0	Maximum
Overall Width with Lead Protrusion (LVR005N to LVR016)	C_1	43.2	Maximum
Overall Width with Lead Protrusion (LVR025 to LVR200)	C_1	56.0	Maximum
Overall Width without Lead Protrusion (LVR005N to LVR016)	C_2	42.5	Maximum
Overall Width without Lead Protrusion (LVR025 to LVR200)	C_2	56.0	Maximum
Lead Protrusion	L_1	1.0	Maximum
Protrusion of Cut-out	L	11.0	Maximum
Protrusion beyond Hold-down Tape	I_2	Not Specified	—
Sprocket Hole Pitch	P_0	12.7	± 0.3
Device Pitch (LVR005N to LVR040)	—	12.7	± 0.3
Device Pitch (LVR055 to LVR200)	—	25.4	± 0.6
Pitch Tolerance	—	20 Consecutive	± 1
Tape Thickness	t	0.9	Maximum
Overall Tape and Lead Thickness (LVR005N to LVR040)	t_1	1.5	Maximum
Overall Tape and Lead Thickness (LVR055 to LVR200)	t_1	2.3	Maximum
Splice Sprocket Hole Alignment	—	0	± 0.3
Body Lateral Deviation	Δh	0	± 1.0
Body Tape Plane Deviation	Δp	0	± 1.3
Ordinate to Adjacent Component Lead	P_1	3.81	± 0.7
Lead Spacing*	F	5.08	+0.75/-0.5
Reel Width (LVR005N to LVR040)	w_2	56.0	Maximum
Reel Width* (LVR055 to LVR200)	w_2	63.5	Maximum
Reel Diameter	a	370.0	Maximum
Space between Flanges* (LVR005N to LVR040)	w_1	48.0	Maximum
Space between Flanges* (LVR055 toLVR200)	w_1	55.0	Maximum
Arbor Hold Diameter	c	26.0	± 12.0
Core Diameter*	n	91.0	Maximum
Box	—	64/372/362	Maximum
Consecutive Missing Places	—	None	—
Empty Places per Reel	—	0.1%	Maximum

*Differs from EIA specification.

Figure L8 EIA Referenced Taped Component Dimensions for LVR Devices

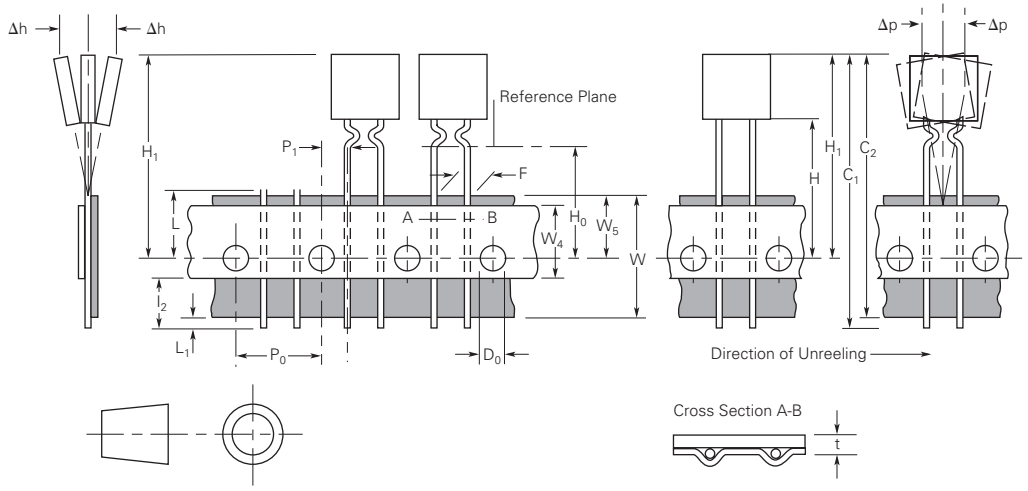
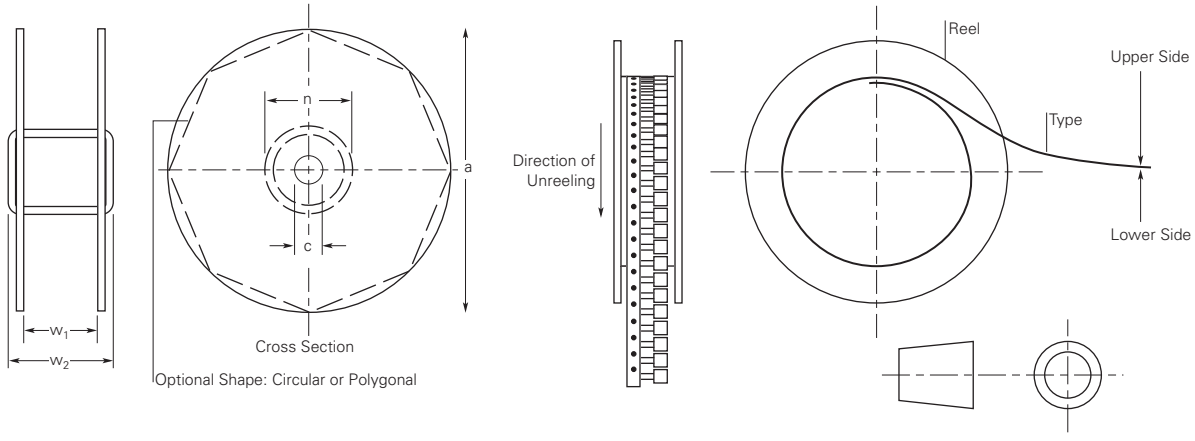
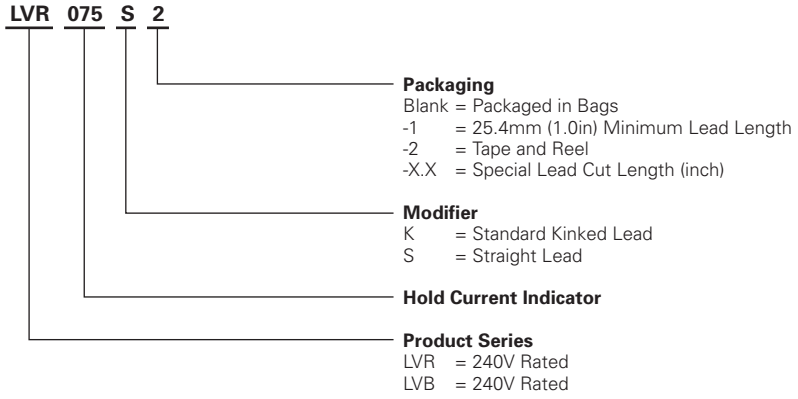


Figure L9 EIA Referenced Reel Dimensions for LVR Devices



Part Numbering System for LVR Devices



⚠ Warning: Application Limitations for the LVR Product Line

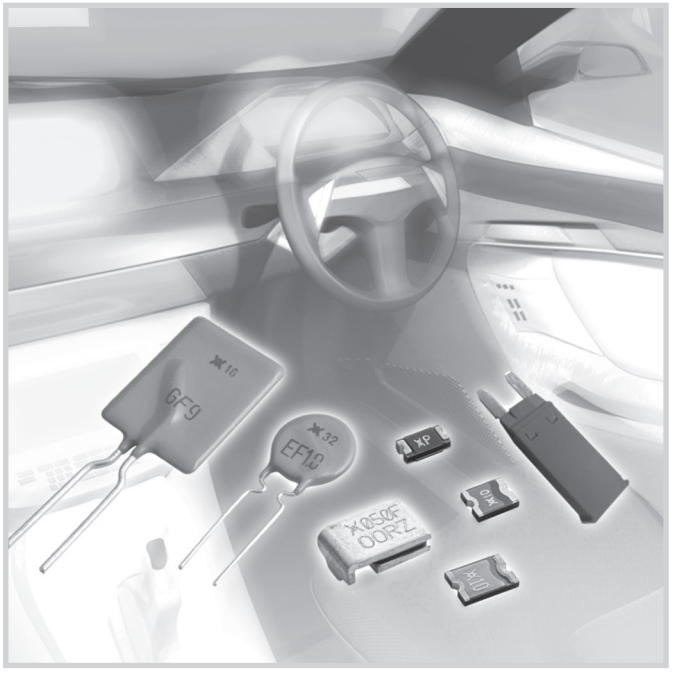
- Users should independently evaluate the suitability of and test each product selected for their own application.
- This product should not be used in an application where the maximum interrupt voltage or maximum interrupt current can be exceeded in a fault condition. Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- A PPTC device is not a fuse - it is a nonlinear thermistor that limits current. Under a fault condition all PPTC devices go into a high-resistance state but do not open circuit, so hazardous voltage may be present at PPTC locations.
- The devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- In most applications power must be removed and the fault condition cleared in order to reset a PPTC device; however under certain unusual conditions, a PPTC device may automatically reset. PPTC devices should not be used in an application where an automatic reset could create a safety hazard, such as garbage disposals and blenders. Appropriate qualification testing should be performed.
- It is the responsibility of the user to determine the need for back-up or failsafe protection to prevent damage that may occur in the event of abnormal function or failure of the PPTC device.
- Operation in circuits with a large inductance can generate a circuit voltage (Ldi/dt) above the rated voltage of a PPTC device. This product should not be used in an application where the maximum interrupt voltage or maximum interrupt current can be exceeded by inductive spikes.
- Devices are not recommended for reflow soldering.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, or mechanical procedures for electronic components.
- *PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- *Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.

*Does not apply for LVB devices.



PolySwitch Resettable Devices
Automotive Devices

We have provided PPTC resettable devices for the automotive industry for over 25 years. With the advent of TS16949 and our continued involvement in the automotive industry, TE Circuit Protection developed automotive-specific versions of our PolySwitch PPTC devices (the nanoASMDC, microASMD, miniASMDC, AHS, ASMD, AHRF, AHEF, AGRF and BD families). These products are qualified and sold under the PS400 specification which is derived from AEC-Q200, the standard for electronic components used in the automotive industry. The key difference between these product families and other protection devices in our circuit protection product portfolio is the qualification process that is followed that includes a series of rigorous tests related to the automotive environment. As a result, they are characterized by specific additional values determined following automotive-related testing.



Benefits

- Expertise from the world's leading resettable overcurrent protection manufacturer
- High-quality products from the world's largest passive component manufacturer
- Worldwide team dedicated to support automotive applications
- Wide range of dedicated automotive surface-mount and radial-leaded resettable overcurrent devices
- High-performance transient voltage protection devices

Features

- RoHS compliant
- Overcurrent and overvoltage circuit protection devices
- Resettable and single-use overcurrent devices
- Wide range of form factor and termination methods
- Products meet applicable automotive industry standards
- Devices compatible with high-volume electronics assembly

Applications

- Motor and motor circuit protection including power door-locks, mirrors, lumbar pumps, seats, sunroofs and windows
- Electronic Control Unit (ECU) I/O protection
- Heating, Ventilation and Cooling (HVAC) motor and I/O protection
- Telematics, infotainment and navigations systems
- Liquid Crystal Display (LCD) back-light heaters
- Power and cigarette lighter outlets, plugs and adapter/chargers
- Powered networks and buses
- Air-flow detection and overcurrent protection in HVAC and cooling fan systems
- Stall detection in express window and sunroof circuits
- Resettable overcurrent protection for power distribution, electrical centers and junction boxes
- Wire downsizing
- Motor electromagnetic interference (EMI) suppression
- Electrostatic discharge (ESD) damage protection
- Load dump and other transient voltage protection

Table A1 Product Series - Current Rating, Voltage Rating / Typical Resistance for PolySwitch Automotive Devices

Voltage Rating	AGRF 16V	AHRF 16V	AHRF 30V	AHEF 32V	AHS 16V	ASMD 16V	ASMD 30V	ASMD 60V	BD 14V
Hold Current (A)									
0.30	—	—	—	—	—	—	—	2.90Ω	—
0.50	—	—	0.565Ω	0.5650Ω	—	—	—	0.90Ω	—
0.70	—	—	0.385Ω	0.3850Ω	—	—	—	—	—
0.75	—	—	—	—	—	—	0.60Ω	—	—
0.80	—	—	—	—	0.250Ω	—	—	—	—
1.00	—	—	0.225Ω	0.2250Ω	—	—	0.30Ω	—	—
1.20	—	—	—	—	0.245Ω	—	—	—	—
1.25	—	—	—	—	—	0.160Ω	—	—	—
1.50	—	—	—	—	—	0.140Ω	—	—	—
1.60	—	—	—	—	0.100Ω	—	—	—	—
1.85	—	—	—	—	—	0.079Ω	—	—	—
2.00	—	0.0565Ω	—	—	0.070Ω	0.090Ω	—	—	—
2.50	—	—	—	—	—	0.060Ω	—	—	—
3.00	—	0.0410Ω	—	0.0520Ω	0.050Ω	—	—	—	—
4.00	0.0300Ω	0.0305Ω	—	—	—	—	—	—	—
4.50	—	0.0290Ω	—	—	—	—	—	—	—
5.00	0.0192Ω	—	—	0.0200Ω	—	—	—	—	—
5.50	—	0.0190Ω	—	—	—	—	—	—	—
6.00	0.0145Ω	0.0180Ω	—	—	—	—	—	—	—
6.50	—	0.0140Ω	—	—	—	—	—	—	—
7.00	0.0105Ω	0.0126Ω	—	—	—	—	—	—	—
7.50	—	0.0120Ω	—	0.0120Ω	—	—	—	—	—
8.00	0.0086Ω	0.0104Ω	—	—	—	—	—	—	0.01150Ω
9.00	0.0070Ω	0.0100Ω	—	—	—	—	—	—	—
10.00	0.0056Ω	0.0083Ω	—	0.0083Ω	—	—	—	—	—
11.00	0.0050Ω	0.0069Ω	—	—	—	—	—	—	—
12.00	0.0046Ω	—	—	—	—	—	—	—	0.00600Ω
13.00	—	0.0055Ω	—	—	—	—	—	—	—
14.00	0.0040Ω	0.0050Ω	—	—	—	—	—	—	—
15.00	—	0.0050Ω	—	—	—	—	—	—	—
16.00	—	—	—	—	—	—	—	—	0.00365Ω
20.00	—	—	—	—	—	—	—	—	0.00285Ω
21.00	—	—	—	—	—	—	—	—	0.00260Ω

Voltage Rating	nanoASMDC 48V	nanoASMDC 24V	nanoASMDC 16V	microASMD 30V	miniASMDC 60V	miniASMDC 30V	miniASMDC 24V	miniASMDC 16V
Hold Current (A)								
0.05	—	—	—	26.80Ω	—	—	—	—
0.10	—	—	—	8.55Ω	6.70Ω	—	—	—
0.12	3.95Ω	—	—	—	—	—	—	—
0.14	—	—	—	—	3.75Ω	—	—	—
0.16	3.05Ω	—	—	—	—	—	—	—
0.20	—	1.875Ω	—	—	—	1.950Ω	—	—
0.30	—	—	—	—	—	0.975Ω	—	—
0.35	—	—	0.90Ω	—	—	—	—	—
0.50	—	—	—	—	—	—	0.575Ω	—
0.75	—	—	—	—	—	—	0.190Ω	—
1.10	—	—	—	—	—	—	0.120Ω	0.1200Ω
1.25	—	—	—	—	—	—	—	0.0950Ω
1.50	—	—	—	—	—	—	0.080Ω	0.0750Ω
2.60	—	—	—	—	—	—	—	0.0325Ω

RoHS Compliant, ELV Compliant

Table A2 Thermal Derating for PolySwitch Automotive Devices [Hold Current (A) at Ambient Temperature (°C)]

	Maximum Ambient Temperature										
Part Number	**-40°C**	**-20°C**	**0°C**	**20°C**	**25°C**	**40°C**	**50°C**	**60°C**	**70°C**	**85°C**	**125°C**
AGRF 16V — Radial-leaded											
AGRF400	5.9	5.3	4.8	4.1	4.0	3.5	3.2	2.8	2.5	1.9	—
AGRF500	7.3	6.6	6.0	5.2	5.0	4.4	4.0	3.6	3.1	2.4	—
AGRF600	8.8	8.0	7.2	6.2	6.0	5.2	4.8	4.2	3.8	2.8	—
AGRF700	10.3	9.3	8.4	7.3	7.0	6.2	5.6	5.0	4.4	3.3	—
AGRF800	11.7	10.7	9.6	8.3	8.0	6.9	6.4	5.6	5.1	3.7	—
AGRF900	13.2	11.9	10.7	9.4	9.0	7.9	7.2	6.4	5.6	4.2	—
AGRF1000	14.7	13.3	12.0	10.3	10.0	8.7	8.0	7.0	6.3	4.7	—
AGRF1100	16.1	14.6	13.1	11.5	11.0	9.7	8.8	7.8	6.9	5.2	—
AGRF1200	17.6	16.0	14.4	12.4	12.0	10.4	9.6	8.4	7.6	5.6	—
AGRF1400	20.5	18.7	16.8	14.5	14.0	12.1	11.2	9.8	8.9	6.5	—
AHRF (High Temperature) 30V — Radial-leaded											
AHRF050	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.1
AHRF070	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.2
AHRF100	1.4	1.2	1.1	1.0	1.0	0.9	0.8	0.7	0.7	0.6	0.2
AHRF (High Temperature) 16V — Radial-leaded											
AHRF200	2.7	2.5	2.3	2.1	2.0	1.8	1.6	1.5	1.3	1.1	0.5
AHRF300	4.1	3.7	3.4	3.1	3.0	2.7	2.4	2.2	2.0	1.7	0.7
AHRF400	5.6	5.1	4.7	4.2	4.0	3.6	3.3	3.0	2.7	2.3	1.0
AHRF450	6.1	5.6	5.1	4.6	4.5	4.0	3.6	3.3	3.0	2.5	1.1
AHRF550	7.5	6.9	6.2	5.7	5.5	4.9	4.4	4.0	3.7	3.1	1.4
AHRF600	8.2	7.5	6.8	6.2	6.0	5.3	4.9	4.4	4.0	3.3	1.5
AHRF650	8.8	8.1	7.4	6.7	6.5	5.7	5.3	4.8	4.3	3.6	1.6
AHRF700	9.5	8.7	8.0	7.2	7.0	6.2	5.6	5.2	4.7	3.9	1.7
AHRF750	10.2	9.4	8.6	7.7	7.5	6.6	6.1	5.6	5.0	4.1	1.9
AHRF800	10.9	10.0	9.1	8.2	8.0	7.1	6.4	5.9	5.3	4.4	2.0
AHRF900	12.2	11.2	10.2	9.3	9.0	8.0	7.2	6.6	6.0	5.0	2.2
AHRF1000	13.6	12.5	11.4	10.3	10.0	8.8	8.1	7.4	6.6	5.5	2.5
AHRF1100	14.9	13.7	12.5	11.3	11.0	9.7	8.8	8.1	7.3	6.1	2.7
AHRF1300	17.7	16.3	14.8	13.4	13.0	11.4	10.5	9.6	8.6	7.2	3.3
AHRF1400	19.0	17.5	15.9	14.4	14.0	12.4	11.2	10.3	9.3	7.8	3.5
AHRF1500	20.4	18.8	17.1	15.5	15.0	13.2	12.1	11.1	9.9	8.3	3.8
AHEF (High Temperature) 32V — Radial-leaded											
AHEF050	0.7	0.6	0.60	0.5	0.5	0.4	0.400	0.40	0.30	0.300	0.1
AHEF070	1.0	0.9	0.80	0.7	0.7	0.6	0.600	0.50	0.50	0.400	0.2
AHEF100	1.4	1.2	1.10	1.0	1.0	0.9	0.800	0.70	0.70	0.600	0.2
AHEF300	4.1	3.8	3.42	3.1	3.0	2.7	2.430	2.22	1.98	1.650	0.6
AHEF500	6.8	6.3	5.70	5.2	5.0	4.5	4.050	3.70	3.30	2.750	1.0
AHEF750	10.2	9.4	8.55	7.7	7.5	6.7	6.075	5.55	4.95	4.125	1.5
AHEF1000	13.6	12.5	11.40	10.3	10.0	8.9	8.100	7.40	6.60	5.500	2.0
AHS (High Temperature) 16V — Surface-mount											
AHS080-2018	1.20	1.04	0.90	0.8	0.77	0.68	0.62	0.60	0.53	0.46	0.26
NEW AHS120	1.72	1.54	1.36	1.2	1.14	1.01	0.92	0.83	0.74	0.61	0.25
AHS160	2.15	1.96	1.78	1.6	1.55	1.42	1.33	1.24	1.15	1.01	0.64
AHS200	2.90	2.50	2.20	2.0	1.94	1.80	1.75	1.70	1.40	1.18	0.67
AHS300	4.20	3.80	3.70	3.0	2.92	2.63	2.44	2.10	2.00	1.76	1.00

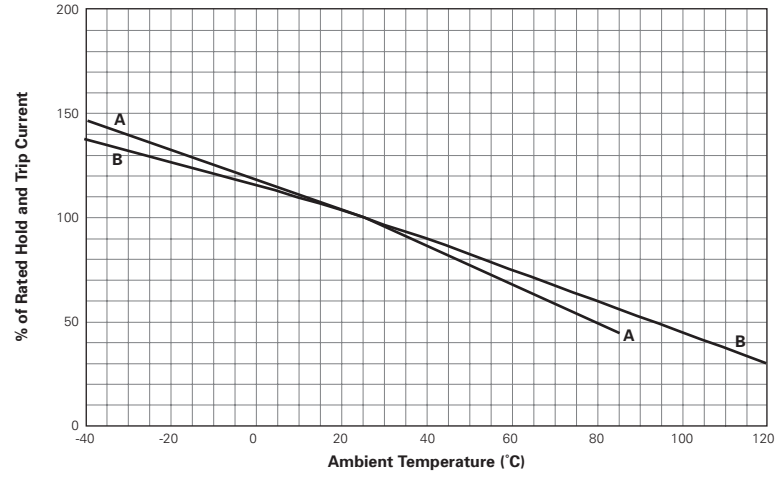
Table A2 Thermal Derating for PolySwitch Automotive Devices [Hold Current (A) at Ambient Temperature (°C)] Cont'd

	Maximum Ambient Temperature										
Part Number	**-40°C**	**-20°C**	**0°C**	**20°C**	**25°C**	**40°C**	**50°C**	**60°C**	**70°C**	**85°C**	**125°C**
ASMD 16-60V — Surface-mount											
ASMD030F	0.35	0.31	0.27	0.23	0.22	0.19	0.17	0.15	0.13	0.11	—
ASMD050F	0.59	0.53	0.46	0.39	0.37	0.33	0.29	0.26	0.23	0.18	—
ASMD075F	0.91	0.81	0.71	0.60	0.58	0.50	0.45	0.40	0.35	0.28	—
ASMD100F	1.37	1.22	1.06	0.90	0.86	0.76	0.68	0.60	0.52	0.41	—
ASMD125F	1.58	1.40	1.23	1.04	1.00	0.87	0.78	0.70	0.60	0.48	—
ASMD150F	1.93	1.70	1.50	1.27	1.22	1.07	0.95	0.85	0.74	0.58	—
ASMD185F	2.93	2.58	2.30	1.93	1.85	1.62	1.44	1.30	1.12	0.88	—
ASMD200F	2.63	2.34	2.04	1.73	1.66	1.45	1.30	1.16	1.00	0.80	—
ASMD250F	3.00	2.66	2.32	1.97	1.89	1.65	1.48	1.32	1.14	0.91	—
nanoASMDC 16-48V — Surface-mount											
nanoASMDC012F	0.20	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.08	0.07	—
nanoASMDC016F	0.21	0.20	0.18	0.16	0.16	0.14	0.13	0.12	0.11	0.09	—
nanoASMDC020F	0.34	0.30	0.26	0.22	0.20	0.17	0.15	0.13	0.11	0.08	—
nanoASMDC035F	0.58	0.51	0.44	0.38	0.35	0.31	0.28	0.24	0.21	0.16	—
microASMD 30V — Surface-mount											
microASMD005F	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02	—
microASMD010F	0.15	0.13	0.12	0.10	0.10	0.09	0.08	0.06	0.06	0.05	—
miniASMDC 16-60V — Surface-mount											
miniASMDC010F	0.17	0.15	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.04	—
miniASMDC014F	0.23	0.20	0.17	0.14	0.13	0.11	0.10	0.09	0.07	0.05	—
miniASMDC020F	0.30	0.27	0.23	0.20	0.19	0.17	0.15	0.13	0.12	0.09	—
miniASMDC030F	0.49	0.44	0.39	0.32	0.30	0.27	0.24	0.22	0.18	0.14	—
miniASMDC050F	0.59	0.57	0.55	0.50	0.48	0.45	0.43	0.35	0.30	0.23	—
miniASMDC075F/24	1.50	1.25	1.00	0.75	0.73	0.65	0.60	0.55	0.50	0.43	—
miniASMDC110F/16	1.68	1.49	1.30	1.10	1.05	0.92	0.83	0.75	0.64	0.50	—
miniASMDC110F/24	2.00	1.70	1.40	1.10	1.06	0.95	0.88	0.80	0.73	0.61	—
miniASMDC125F/16	2.00	1.69	1.47	1.25	1.17	1.03	0.92	0.90	0.69	0.53	—
miniASMDC150F/16	2.40	2.10	1.80	1.50	1.44	1.25	1.13	1.00	0.88	0.69	—
miniASMDC150F/24	2.10	1.90	1.70	1.50	1.44	1.25	1.13	1.00	0.88	0.69	—
miniASMDC260F/16	3.50	3.20	3.00	2.60	2.53	2.30	2.15	2.00	1.85	1.63	—
BD 14V— Bladed Device											
BD280-1130-10/16	12.4	11.0	9.7	8.3	8.0	7.0	6.3	5.6	5.0	4.0	—
BD280-1130-15/16	17.4	15.7	14.1	12.4	12.0	10.8	9.9	9.1	8.3	7.0	—
BD280-1130-20/16	24.0	21.6	19.1	16.6	16.0	14.1	12.9	11.7	10.4	8.6	—
BD280-1927-25/16-W	32.0	28.3	24.6	20.9	20.0	17.2	15.4	13.5	11.7	8.9	—
BD280-1927-30/16-W	34.1	30.1	26.0	22.0	21.0	18.0	16.0	14.0	11.9	9.1	—

Figures A1-A4 Thermal Derating Curves for PolySwitch Automotive Devices

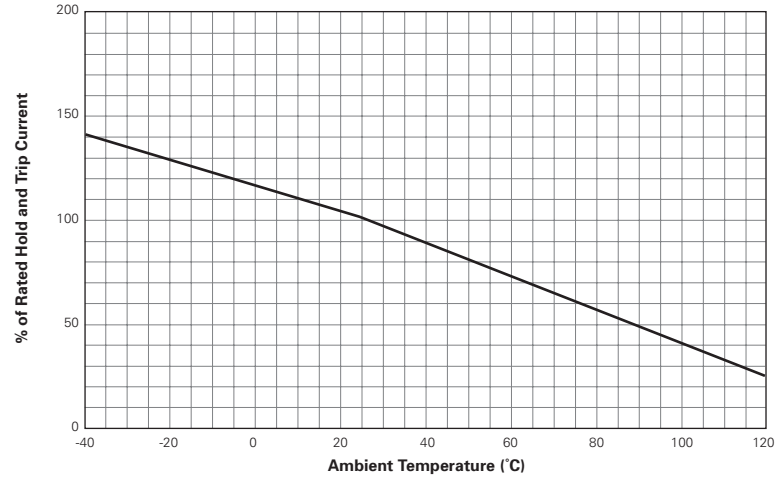
A = AGRF
B = AHRF

Figure A1



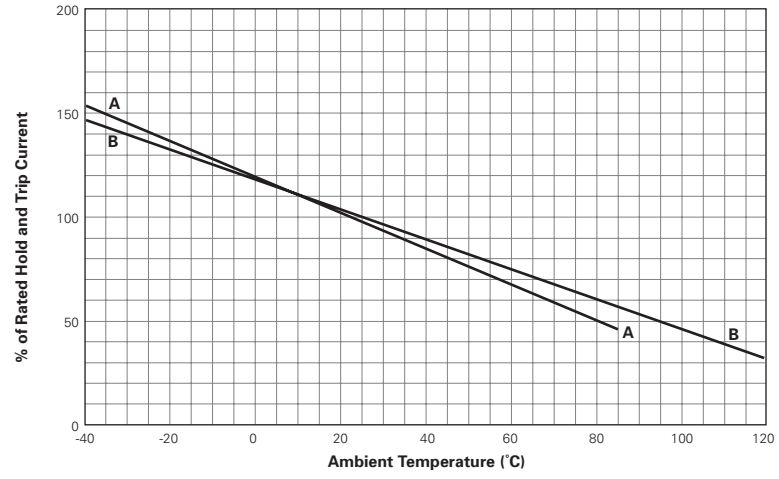
AHEF

Figure A2



A = ASMD, nanoASMDC, microASMD, miniASMDC
B = AHS

Figure A3



Figures A1-A4 Thermal Derating Curves for PolySwitch Automotive Devices Cont'd

BD

Figure A4

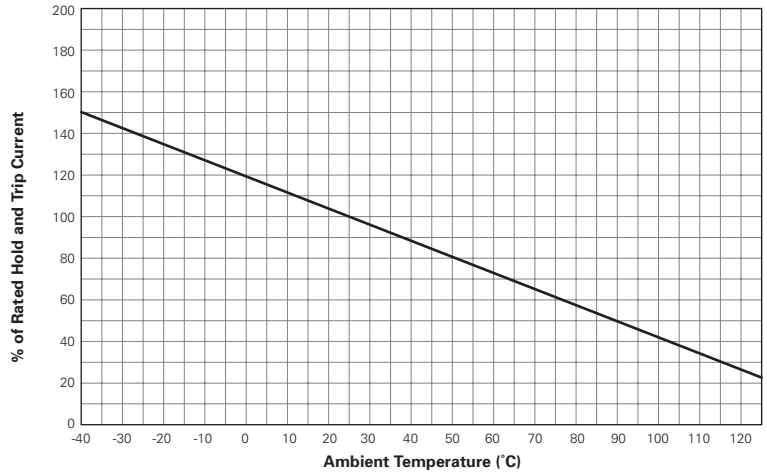


Table A3 Electrical Characteristics for PolySwitch Automotive Devices

Part Number	I_H(A)@ R_{1MAX}	I_H(A)@ R_{aMAX}	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\ Typ}$ (W)	Max. Time-to-trip (A)	Max. Time-to-trip (s)	R_{MIN} (Ω)	R_{1MAX} (Ω)	R_{aMAX} (Ω)	Figure for Dimensions
AGRF 16V — Radial-leaded												
AGRF400	4.0	3.0	7.6	16	100	2.5	20.0	2.0	0.0186	0.0610	0.0850	A5, A8, A9
AGRF500	5.0	4.3	9.4	16	100	2.7	25.0	2.5	0.0140	0.0340	0.0480	A5, A8, A9
AGRF600	6.0	5.3	10.7	16	100	2.8	30.0	3.5	0.0095	0.0280	0.0320	A5, A8, A9
AGRF700	7.0	6.5	13.2	16	100	3.0	35.0	4.0	0.0066	0.0200	0.0220	A5, A8, A9
AGRF800	8.0	7.6	15.0	16	100	3.2	40.0	5.5	0.0049	0.0175	0.0181	A5, A8, A9
AGRF900	9.0	8.6	16.5	16	100	3.4	45.0	6.0	0.0041	0.0135	0.0140	A5, A8, A9
AGRF1000	10.0	9.6	18.5	16	100	3.6	50.0	7.0	0.0034	0.0102	0.0106	A5, A8, A9
AGRF1100	11.0	10.5	20.3	16	100	3.7	55.0	7.5	0.0033	0.0089	0.0093	A5, A8, A9
AGRF1200	12.0	11.5	22.1	16	100	4.2	60.0	8.0	0.0030	0.0086	0.0091	A5, A8, A9
AGRF1400	14.0	13.0	27.3	16	100	4.6	70.0	9.0	0.0022	0.0064	0.0067	A5, A8, A9
AHRF (High Temperature) 30V — Radial-leaded												
AHRF050	0.5	0.5	1.0	30	40	0.9	2.5	3.0	0.3500	1.100	1.100	A8, A9, A11
AHRF070	0.7	0.7	1.4	30	40	1.4	3.5	3.2	0.2300	0.800	0.800	A5, A8, A9
AHRF100	1.0	1.0	1.9	30	40	1.4	5.0	6.2	0.1500	0.430	0.430	A8, A9, A10
AHRF (High Temperature) 16V — Radial-leaded												
AHRF200	2.0	2.0	3.8	16	100	1.4	10.0	4.8	0.0390	0.1100	0.1100	A8, A9, A10
AHRF300	3.0	3.0	6.5	16	100	3.0	15.0	5.0	0.0290	0.0790	0.0790	A5, A8, A9
AHRF400	4.0	4.0	7.4	16	100	3.3	20.0	5.0	0.0210	0.0600	0.0600	A5, A8, A9
AHRF450	4.5	4.5	8.7	16	100	3.6	22.5	4.0	0.0170	0.0540	0.0540	A5, A8, A9
AHRF550	5.5	5.5	10.0	16	100	3.5	27.5	6.0	0.0130	0.0370	0.0370	A5, A8, A9
AHRF600	6.0	6.0	12.0	16	100	4.1	30.0	6.5	0.0100	0.0320	0.0320	A5, A8, A9
AHRF650	6.5	6.5	13.7	16	100	4.3	32.5	7.0	0.0090	0.0260	0.0260	A5, A8, A9
AHRF700	7.0	7.0	13.1	16	100	4.0	35.0	7.0	0.0087	0.0250	0.0250	A5, A8, A9
AHRF750	7.5	7.5	14.8	16	100	4.5	37.5	8.0	0.0074	0.0220	0.0220	A5, A8, A9
AHRF800	8.0	8.0	15.0	16	100	4.2	40.0	8.0	0.0072	0.0200	0.0200	A5, A8, A9
AHRF900	9.0	9.0	18.5	16	100	5.0	45.0	11.5	0.0061	0.0170	0.0170	A5, A8, A9
AHRF1000	10.0	10.0	20.5	16	100	5.3	50.0	10.5	0.0051	0.0150	0.0150	A5, A8, A9
AHRF1100	11.0	11.0	21.2	16	100	5.5	55.0	11.0	0.0048	0.0130	0.0130	A5, A8, A9
AHRF1300	13.0	13.0	27.0	16	100	6.9	65.0	15.0	0.0034	0.0100	0.0100	A5, A8, A9
AHRF1400	14.0	14.0	28.3	16	100	6.9	70.0	15.5	0.0029	0.0090	0.0090	A5, A8, A9
AHRF1500	15.0	15.0	33.0	16	100	7.0	75.0	20.0	0.0027	0.0092	0.0092	A5, A8, A9

Table A3 Electrical Characteristics for PolySwitch Automotive Devices Cont'd

Part Number	I_H(A)@ R_{1MAX}	I_H(A)@ R_{aMAX}	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\ Typ}$ (W)	Max. Time-to-trip (A)	Max. Time-to-trip (s)	R_{MIN} (Ω)	R_{1MAX} (Ω)	R_{aMAX} (Ω)	Figure for Dimensions
AHEF (High Temperature) 32V — Radial-leaded												
AHEF050	0.5	0.5	1.0	32	100	0.9	2.5	3.0	0.3500	1.100	1.100	A8, A9, A10
AHEF070	0.7	0.7	1.4	32	100	0.9	3.5	3.2	0.2300	0.800	0.800	A8, A9, A11
AHEF100	1.0	1.0	1.9	32	100	1.4	5.0	6.2	0.1500	0.430	0.430	A8, A9, A10
AHEF300	3.0	3.0	6.0	32	100	3.2	15.0	5.0	0.0350	0.110	0.110	A8, A9, A12
AHEF500	5.0	5.0	10.0	32	100	5.3	25.0	9.0	0.0150	0.040	0.040	A8, A9, A12
AHEF750	7.5	7.5	15.0	32	100	6.5	37.5	13.0	0.0074	0.023	0.023	A8, A9, A12
AHEF1000	10.0	10.0	20.0	32	100	7.0	50.0	15.0	0.0060	0.016	0.016	A8, A9, A12
AHS (High Temperature) 16V — Surface-mount												
AHS080-2018	0.80	0.80	2.00	16	70	1.5	8.0	9.0	0.130	0.550	0.550	A6
NEW AHS120	1.20	1.20	2.30	16	50	2.2	8.0	2.0	0.150	0.340	0.340	A7
AHS160	1.60	1.60	3.20	16	70	2.2	8.0	15.0	0.050	0.150	0.150	A7
AHS200	2.00	2.00	4.00	16	70	2.3	8.0	13.4	0.050	0.140	0.140	A7
AHS300	3.00	3.00	6.00	16	70	3.0	15.0	8.0	0.024	0.083	0.083	A7
ASMD 16-60V — Surface-mount												
ASMD030F	0.23	0.23	0.59	60	10	1.1	1.15	12.0	0.980	4.800	4.800	A7
ASMD050F	0.37	0.37	0.98	60	10	1.7	1.95	20.0	0.290	1.400	1.400	A7
ASMD075F	0.60	0.60	1.48	30	40	1.1	3.00	20.0	0.290	1.000	1.000	A7
ASMD100F	0.90	0.90	2.16	30	40	1.1	4.50	20.0	0.098	0.480	0.480	A7
ASMD125F	1.04	1.04	2.46	16	40	1.1	5.20	20.0	0.057	0.250	0.250	A7
ASMD150F	1.27	1.27	2.95	16	40	1.2	6.35	25.0	0.049	0.250	0.250	A7
ASMD185F	1.85	1.85	3.70	16	40	1.5	9.25	11.3	0.032	0.126	0.126	A7
ASMD200F	1.73	1.73	3.93	16	40	1.2	8.65	30.0	0.050	0.120	0.120	A7
ASMD250F	1.97	1.97	5.00	16	40	1.2	9.85	30.0	0.035	0.085	0.085	A7
nanoASMDC 16-48V — Surface-mount												
nanoASMDC012F	0.12	0.12	0.39	48	10	0.5	1.0	0.2	1.40	6.50	6.50	A15
nanoASMDC016F	0.16	0.16	0.45	48	10	0.5	1.0	0.3	1.10	5.00	5.00	A15
nanoASMDC020F	0.20	0.20	0.42	24	100	0.6	8.0	0.1	0.65	3.10	3.10	A15
nanoASMDC035F	0.35	0.75	0.75	16	20	0.6	3.5	0.1	0.45	1.35	1.35	A15
microASMD 30V — Surface-mount												
microASMD005F	0.05	0.05	0.15	30	10	1.0	0.25	1.5	3.6	50.0	50.0	A15
microASMD010F	0.10	0.10	0.25	30	10	0.8	0.50	1.0	2.1	15.0	15.0	A15
miniASMDC 16-60V — Surface-mount												
miniASMDC010F	0.10	0.10	0.30	60	40	0.75	0.5	5.000	0.700	12.70	12.70	A15
miniASMDC014F	0.14	0.14	0.28	60	10	0.75	8.0	0.008	1.500	6.00	6.00	A15
miniASMDC020F	0.20	0.20	0.40	30	10	0.80	8.0	0.020	0.600	3.30	3.30	A15
miniASMDC030F	0.30	0.30	0.60	30	40	0.80	8.0	0.100	0.200	1.75	1.75	A15
miniASMDC050F	0.50	0.50	1.00	24	100	0.80	8.0	0.150	0.150	1.00	1.00	A15
miniASMDC075F/24	0.75	0.75	1.50	24	40	0.80	8.0	0.300	0.090	0.29	0.29	A15
miniASMDC110F/16	1.10	1.10	2.20	16	100	0.80	8.0	0.300	0.060	0.18	0.18	A15
miniASMDC110F/24	1.10	1.10	2.20	24	20	0.80	8.0	0.500	0.060	0.18	0.18	A15
miniASMDC125F/16	1.25	1.25	2.50	16	100	0.80	8.0	0.400	0.050	0.14	0.14	A15
miniASMDC150F/16	1.50	1.50	2.80	16	100	0.80	8.0	0.500	0.040	0.11	0.11	A15
miniASMDC150F/24	1.50	1.50	3.00	24	20	1.00	8.0	1.500	0.040	0.12	0.12	A15
miniASMDC260F/16	2.60	2.60	5.00	16	100	1.20	8.0	5.000	0.015	0.05	0.05	A15

Table A3 Electrical Characteristics for PolySwitch Automotive Devices Cont'd

Part Number	I_H(A)@ R_{1MAX}	I_H(A)@ R_{aMAX}	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\ Typ}$ (W)	Max. Time-to-trip (A)	(s)	R_{MIN} (Ω)	R_{1MAX} (Ω)	R_{aMAX} (Ω)	Figure for Dimensions
BD 14V — Bladed Device												
BD280-1130-10/16	8	8	13	14	100	4.4	40	8	0.0095	0.0185	0.0185	A13
BD280-1130-15/16	12	12	20	14	100	4.5	60	8	0.0050	0.0070	0.0070	A13
BD280-1130-20/16	16	16	26	14	100	5.2	80	10	0.0028	0.0064	0.0064	A13
BD280-1927-25/16-W	20	20	32	14	100	6.0	100	13	0.0024	0.0042	0.0042	A14
BD280-1927-30/16-W	21	21	38	14	100	6.2	120	13	0.0021	0.0043	0.0043	A14

Notes:

I_H : Hold current: maximum current device will pass without interruption in 25°C, unless otherwise specified (20°C for ASMD).
I_T : Trip current: minimum current that will switch the device from low-resistance to high-resistance in 25°C still air, unless otherwise specified.
V_{MAX} : Maximum voltage device can withstand without damage at rated current.
I_{MAX} : Maximum fault current device can withstand without damage at rated voltage.
P_D : Power dissipated from device when in the tripped state in 25°C still air, unless otherwise specified.
R_{MIN} : Minimum resistance of device as supplied at 25°C, unless otherwise specified.
R_{1MAX} : Maximum resistance of device when measured one hour post reflow (surface-mount device) or one hour post trip (radial-leaded device) at 25°C unless otherwise specified.
R_{aMAX} : Maximum functional resistance of device after being subjected to the stresses described in PS400 at 25°C, unless otherwise specified.
R_{aMIN} : Minimum functional resistance of device after being subjected to the stresses described in PS400 at 25°C, unless otherwise specified.

Figures A5-A15 Dimension Figures for PolySwitch Automotive Devices

Figure A5

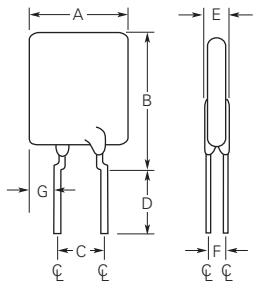


Figure A6

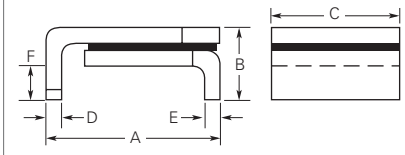


Figure A7

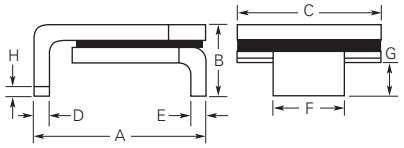


Figure A8

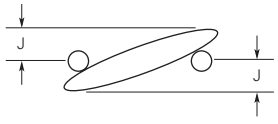


Figure A9

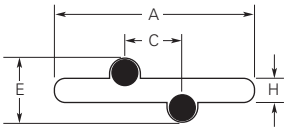


Figure A10

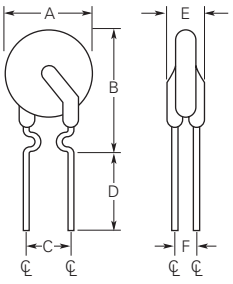


Figure A11

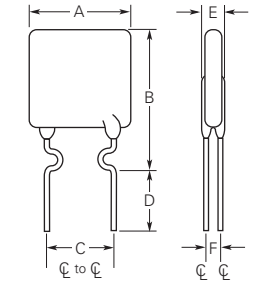


Figure A12

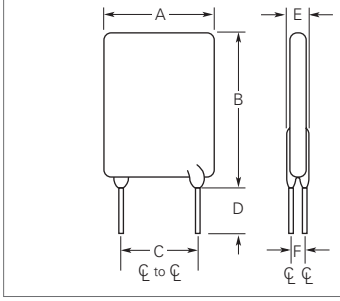
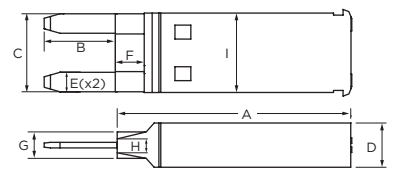


Figure A13



RoHS Compliant, ELV Compliant

Figures A5-A15 Dimension Figures for PolySwitch Automotive Devices Cont'd

Figure A14

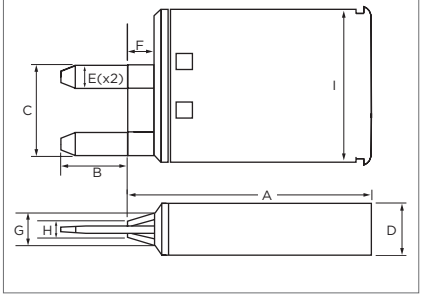


Figure A15

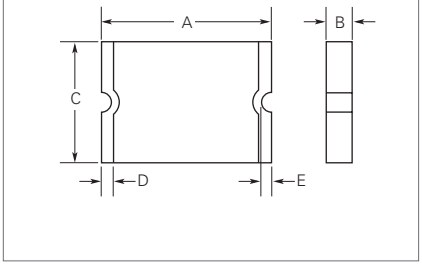


Table A4 Dimensions for PolySwitch Automotive Devices in Millimeters and (Inches)

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	H Typ	J Max	Figure
AGRF 16V — Radial-leaded																	
AGRF400	—	8.9 (0.350)	—	14.1 (0.56)	4.3 (0.17)	5.8 (0.20)	7.6 (0.3)	—	—	3.0 (0.12)	1.2 (0.15)	—	—	3.10 (0.120)	1.24 (0.049)	1.4 (0.06)	A5, A8, A9
AGRF500	—	10.4 (0.410)	—	15.6 (0.61)	4.3 (0.17)	5.8 (0.20)	7.6 (0.3)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	3.94 (0.155)	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AGRF600	—	10.7 (0.420)	—	18.4 (0.73)	4.3 (0.17)	5.8 (0.20)	7.6 (0.3)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	4.07 (0.160)	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AGRF700	—	11.2 (0.440)	—	21.0 (0.73)	4.3 (0.17)	5.8 (0.20)	7.6 (0.3)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	4.49 (0.177)	1.24 (0.049)	1.7 (0.07)	A5, A8, A9
AGRF800	—	12.7 (0.500)	—	22.2 (0.88)	4.3 (0.17)	5.8 (0.20)	7.6 (0.3)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	5.08 (0.200)	1.24 (0.049)	1.8 (0.07)	A5, A8, A9
AGRF900	—	14.0 (0.550)	—	23.0 (0.91)	4.3 (0.17)	5.8 (0.20)	7.6 (0.3)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	5.69 (0.224)	1.24 (0.049)	2.0 (0.08)	A5, A8, A9
AGRF1000	—	16.51 (0.650)	—	25.7 (1.01)	4.3 (0.17)	5.8 (0.20)	7.6 (0.3)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	6.96 (0.274)	1.24 (0.049)	2.0 (0.08)	A5, A8, A9
AGRF1100	—	17.5 (0.690)	—	26.5 (1.04)	4.3 (0.17)	5.8 (0.20)	7.6 (0.3)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	7.47 (0.294)	1.24 (0.049)	2.4 (0.09)	A5, A8, A9
AGRF1200	—	17.5 (0.690)	—	28.8 (1.14)	9.4 (0.37)	10.9 (0.43)	7.6 (0.3)	—	—	3.5 (0.14)	1.4 (0.06)	—	—	4.83 (0.190)	1.45 (0.057)	1.5 (0.06)	A5, A8, A9
AGRF1400	—	23.5 (0.925)	—	28.7 (1.13)	9.4 (0.37)	10.9 (0.43)	7.6 (0.3)	—	—	3.5 (0.14)	1.4 (0.06)	—	—	7.82 (0.308)	1.45 (0.057)	1.9 (0.07)	A5, A8, A9
AHRF (High Temperature) 30V — Radial-leaded																	
AHRF050	—	7.4 (0.29)	—	12.7 (0.50)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.3 (0.13)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A8, A9, A10
AHRF070	—	6.9 (0.27)	—	10.8 (0.43)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.3 (0.13)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A8, A9, A11
AHRF100	—	9.7 (0.38)	—	13.6 (0.54)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A8, A9, A10

Table A4 Dimensions for PolySwitch Automotive Devices in Millimeters and (Inches) Cont'd

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	H Typ	J Max	Figure
AHRF (High Temperature) 16V — Radial-leaded																	
AHRF200	—	9.4 (0.37)	—	14.4 (0.57)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A8, A9, A10
AHRF300	—	8.8 (0.35)	—	13.8 (0.55)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF400	—	10.0 (0.39)	—	15.0 (0.59)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF450	—	10.4 (0.41)	—	15.6 (0.61)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	3.94 (0.155)	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF550	—	11.2 (0.44)	—	18.9 (0.74)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF600	—	11.2 (0.44)	—	21.0 (0.73)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	4.49 (0.177)	1.24 (0.049)	1.7 (0.07)	A5, A8, A9
AHRF650	—	12.7 (0.50)	—	22.2 (0.88)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	5.08 (0.200)	1.24 (0.049)	1.8 (0.07)	A5, A8, A9
AHRF700	—	14.0 (0.55)	—	21.9 (0.86)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF750	—	14.0 (0.55)	—	23.5 (0.93)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	5.69 (0.224)	1.24 (0.049)	2.0 (0.08)	A5, A8, A9
AHRF800	—	16.5 (0.65)	—	22.5 (0.88)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF900	—	16,5 (0.65)	—	25.7 (1.01)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	—	—	—	A5, A8, A9
AHRF1000	—	17.5 (0.69)	—	26.5 (1.04)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	7.47 (0.294)	1.24 (0.049)	1.5 (0.06)	A5, A8, A9
AHRF1100	—	21.0 (0.83)	—	26.1 (1.03)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.0 (0.12)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF1300	—	23.5 (0.925)	—	28.7 (1.13)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.5 (0.14)	1.4 (0.06)	—	—	7.82 (0.308)	1.45 (0.057)	1.9 (0.08)	A5, A8, A9
AHRF1400	—	23.5 (0.93)	—	28.7 (1.13)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.6 (0.14)	1.4 (0.06)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF1500	—	23.5 (0.93)	—	28.7 (1.13)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.5 (0.14)	1.4 (0.06)	—	—	7.82 (0.308)	—	—	A5, A8, A9
AHEF (High Temperature) 32V — Radial-leaded																	
AHEF050	—	7.4 (0.29)	—	12.7 (0.50)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.3 (0.13)	—	—	—	—	—	—	A8, A9, A10
AHEF070	—	6.9 (0.27)	—	10.8 (0.43)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	—	—	—	—	—	A8, A9, A11
AHEF100	—	9.7 (0.38)	—	13.6 (0.54)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.0 (0.12)	—	—	—	—	—	—	A8, A9, A10
AHEF300	—	10.2 (0.40)	—	15.5 (0.61)	4.32 (0.17)	5.84 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	—	—	—	—	—	—	A8, A9, A12
AHEF500	—	14.0 (0.55)	—	24.1 (0.95)	4.3 (0.17)	5.8 (0.23)	11.5 (0.45)	—	—	3.8 (0.15)	—	—	—	—	—	—	A8, A9, A12
AHEF750	—	21.1 (0.83)	—	24.9 (0.98)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	3.8 (0.15)	—	—	—	—	—	—	A8, A9, A12
AHEF1000	—	23.5 (0.93)	—	27.9 (1.10)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	4.0 (0.16)	—	—	—	—	—	—	A8, A9, A12

Table A4 Dimensions for PolySwitch Automotive Devices in Millimeters and (Inches) Cont'd

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	H Min	H Max	Figure
AHS (High Temperature) 16V — Surface-mount																	
AHS080-2018	4.72 (0.186)	5.44 (0.214)	—	1.52 (0.060)	4.22 (0.166)	4.93 (0.194)	0.25 (0.010)	0.36 (0.014)	0.25 (0.010)	0.36 (0.014)	0.30 (0.012)	0.46 (0.018)	—	—	—	—	A6
NEW AHS120	6.73 (0.265)	7.98 (0.314)	—	3.00 (0.118)	4.8 (0.19)	5.44 (0.214)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	2.16 (0.085)	2.41 (0.095)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
AHS160	8.00 (0.315)	9.40 (0.370)	—	3.00 (0.118)	6.0 (0.24)	6.71 (0.264)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	3.68 (0.145)	3.94 (0.155)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
AHS200	8.00 (0.315)	9.40 (0.370)	—	3.00 (0.118)	6.0 (0.240)	6.71 (0.264)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	3.68 (0.145)	3.94 (0.155)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
AHS300	8.00 (0.315)	9.40 (0.370)	—	3.00 (0.118)	6.0 (0.240)	6.71 (0.264)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	3.68 (0.145)	3.94 (0.155)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
ASMD 16-60V — Surface-mount																	
ASMD030F	6.73 (0.265)	7.98 (0.314)	—	3.18 (0.125)	4.8 (0.19)	5.44 (0.214)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	2.16 (0.085)	2.41 (0.095)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
ASMD050F	6.73 (0.265)	7.98 (0.314)	—	3.18 (0.125)	4.8 (0.19)	5.44 (0.214)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	2.16 (0.085)	2.41 (0.095)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
ASMD075F	6.73 (0.265)	7.98 (0.314)	—	3.18 (0.125)	4.8 (0.19)	5.44 (0.214)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	2.16 (0.085)	2.41 (0.095)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
ASMD100F	6.73 (0.265)	7.98 (0.314)	—	3.00 (0.118)	4.8 (0.19)	5.44 (0.214)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	2.16 (0.085)	2.41 (0.095)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
ASMD125F	6.73 (0.265)	7.98 (0.314)	—	3.00 (0.118)	4.8 (0.19)	5.44 (0.214)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	2.16 (0.085)	2.41 (0.095)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
ASMD150F	8.00 (0.315)	9.40 (0.370)	—	3.00 (0.118)	6.0 (0.24)	6.71 (0.264)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	3.68 (0.145)	3.94 (0.155)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
ASMD185F	8.00 (0.315)	9.40 (0.370)	—	3.00 (0.118)	6.0 (0.24)	6.71 (0.264)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	3.68 (0.145)	3.94 (0.155)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
ASMD200F	8.00 (0.315)	9.40 (0.370)	—	3.00 (0.118)	6.0 (0.24)	6.71 (0.264)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	3.68 (0.145)	3.94 (0.155)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7
ASMD250F	8.00 (0.315)	9.40 (0.370)	—	3.00 (0.118)	6.0 (0.24)	6.71 (0.264)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	3.68 (0.145)	3.94 (0.155)	0.66 (0.026)	1.37 (0.054)	0.43 (0.017)	—	A7

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	Figure
nanoASMDC 30V — Surface-mount											
nanoASMDC012F	3.00 (0.118)	3.40 (0.134)	0.62 (0.024)	1.00 (0.039)	1.37 (0.054)	1.80 (0.071)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	— —	A15
nanoASMDC016F	3.00 (0.118)	3.40 (0.134)	0.62 (0.024)	1.00 (0.039)	1.37 (0.054)	1.80 (0.071)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	— —	A15
nanoASMDC020F	3.00 (0.118)	3.40 (0.134)	0.58 (0.023)	0.82 (0.032)	1.37 (0.054)	1.80 (0.071)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	— —	A15
nanoASMDC035F	3.00 (0.118)	3.40 (0.134)	0.58 (0.023)	0.82 (0.032)	1.37 (0.054)	1.80 (0.071)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	— —	A15
microASMD 30V — Surface-mount											
microASMD005F	3.0 (0.118)	3.43 (0.135)	0.50 (0.019)	0.85 (0.034)	2.35 (0.092)	2.80 (0.110)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	— —	A15
microASMD010F	3.0 (0.118)	3.43 (0.135)	0.50 (0.019)	0.85 (0.034)	2.35 (0.092)	2.80 (0.110)	0.25 (0.010)	0.75 (0.030)	0.076 (0.003)	— —	A15

Table A4 Dimensions for PolySwitch Automotive Devices in Millimeters and (Inches) Cont'd

Part Number	A		B		C		D		E		Figure
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
miniASMDC **16-60V — Surface-mount**											
miniASMDC010F	4.37	4.73	0.635	0.89	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.186)	(0.025)	(0.035)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC014F	4.37	4.73	0.635	0.89	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.186)	(0.025)	(0.035)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC020F	4.37	4.73	0.635	0.89	3.07	3.41	0.25	0.95	0.20		A15
	(0.172)	(0.186)	(0.025)	(0.035)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC030F	4.37	4.73	0.635	0.89	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.186)	(0.025)	(0.035)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC050F	4.37	4.73	0.38	0.62	3.07	3.41	0.25	0.95	0.20		A15
	(0.172)	(0.186)	(0.015)	(0.025)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC075F/24	4.37	4.83	0.81	1.46	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.190)	(0.032)	(0.057)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC110F/16	4.37	4.83	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.190)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC110F/24	4.37	4.83	0.81	1.46	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.190)	(0.032)	(0.057)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC125F/16	4.37	4.83	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.190)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC150F/16	4.37	4.83	0.28	0.48	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.190)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC150F/24	4.37	4.83	1.00	1.94	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.190)	(0.040)	(0.077)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	
miniASMDC260F/16	4.37	4.83	1.02	1.52	3.07	3.41	0.25	0.95	0.20	—	A15
	(0.172)	(0.190)	(0.042)	(0.060)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	—	

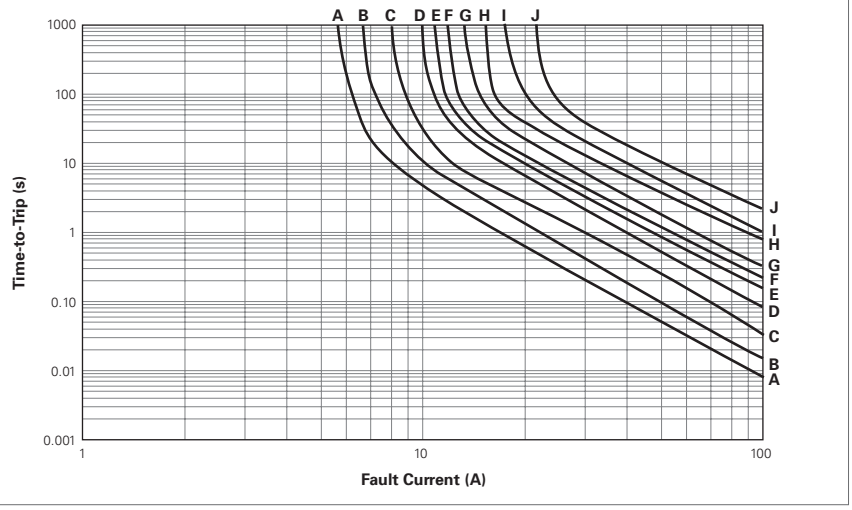
Part Number	A		B		C		D		E(x2)		F		G		H		I		Figure
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
BD **14V — Bladed Device**																			
BD280-1130-10/16	29.50	30.10	8.70	9.30	10.75	11.25	6.05	6.65	2.55	3.05	3.30	3.90	3.40	4.00	1.70	2.30	10.90	11.50	A13
	(1.173)	(1.185)	(0.343)	(0.366)	(0.423)	(0.443)	(0.238)	(0.262)	(0.100)	(0.120)	(0.130)	(0.154)	(0.134)	(0.157)	(0.067)	(0.091)	(0.429)	(0.453)	
BD280-1130-15/16	29.50	30.10	8.70	9.30	10.75	11.25	6.05	6.65	2.55	3.05	3.30	3.90	3.40	4.00	1.70	2.30	10.90	11.50	A13
	(1.173)	(1.185)	(0.343)	(0.366)	(0.423)	(0.443)	(0.238)	(0.262)	(0.100)	(0.120)	(0.130)	(0.154)	(0.134)	(0.157)	(0.067)	(0.091)	(0.429)	(0.453)	
BD280-1130-20/16	29.50	30.10	8.70	9.30	10.75	11.25	6.05	6.65	2.55	3.05	3.30	3.90	3.40	4.00	1.70	2.30	10.90	11.50	A13
	(1.173)	(1.185)	(0.343)	(0.366)	(0.423)	(0.443)	(0.238)	(0.262)	(0.100)	(0.120)	(0.130)	(0.154)	(0.134)	(0.157)	(0.067)	(0.091)	(0.429)	(0.453)	
BD280-1927-25/16-W	26.65	27.35	8.60	9.20	10.75	11.25	6.05	6.65	2.55	3.05	1.80	2.20	3.50	3.90	1.70	2.30	19.00	19.40	A14
	(1.049)	(1.077)	(0.339)	(0.362)	(0.423)	(0.443)	(0.238)	(0.262)	(0.100)	(0.120)	(0.071)	(0.087)	(0.138)	(0.154)	(0.067)	(0.091)	(0.748)	(0.764)	
BD280-1927-30/16-W	26.65	27.35	8.60	9.20	10.75	11.25	6.05	6.65	2.55	3.05	1.80	2.20	3.50	3.90	1.70	2.30	19.00	19.40	A14
	(1.049)	(1.077)	(0.339)	(0.362)	(0.423)	(0.443)	(0.238)	(0.262)	(0.100)	(0.120)	(0.071)	(0.087)	(0.138)	(0.154)	(0.067)	(0.091)	(0.748)	(0.764)	

Figures A16-A24 Typical Time-to-Trip at 25°C for PolySwitch Automotive Devices

AGRF

A = AGRF400
B = AGRF500
C = AGRF600
D = AGRF700
E = AGRF800
F = AGRF900
G = AGRF1000
H = AGRF1100
I = AGRF1200
J = AGRF1400

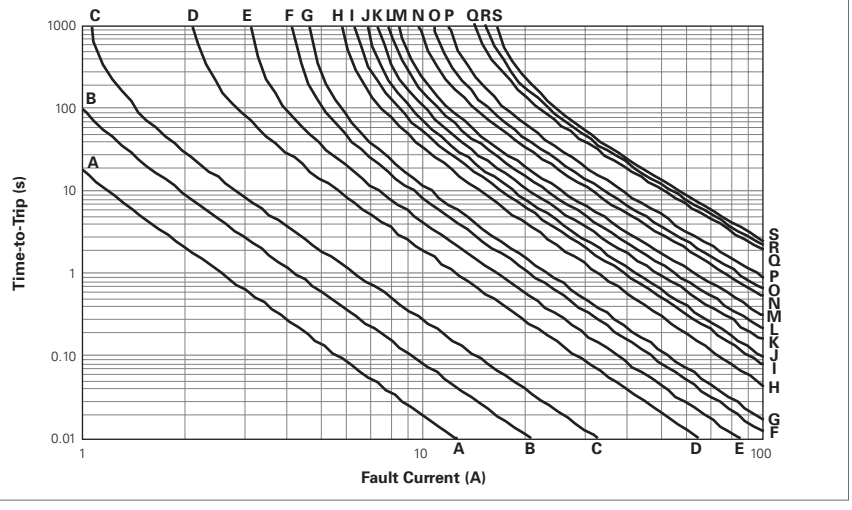
Figure A16



AHRF

A = AHRF050
B = AHRF070
C = AHRF100
D = AHRF200
E = AHRF300
F = AHRF400
G = AHRF450
H = AHRF550
I = AHRF600
J = AHRF650
K = AHRF700
L = AHRF750
M = AHRF800
N = AHRF900
O = AHRF1000
P = AHRF1100
Q = AHRF1300
R = AHRF1400
S = AHRF1500

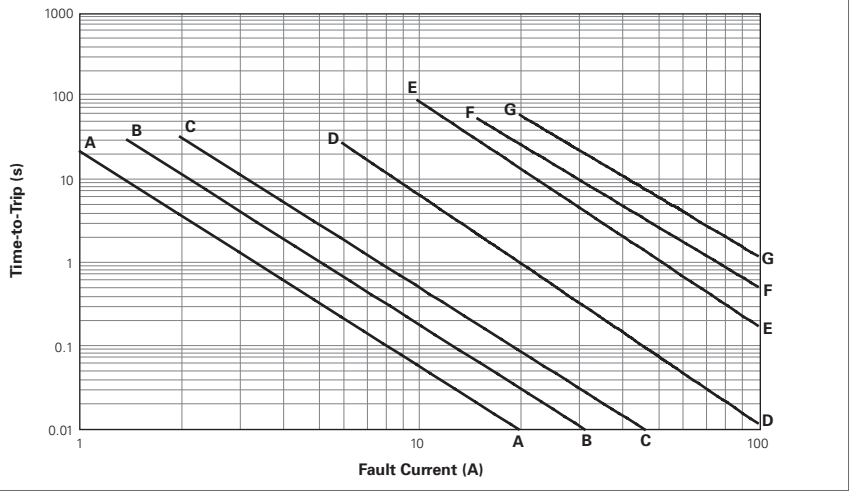
Figure A17



AHEF

A = AHEF050
B = AHEF070
C = AHEF100
D = AHEF300
E = AHEF500
F = AHEF750
G = AHEF1000

Figure A18



RoHS Compliant, ELV Compliant

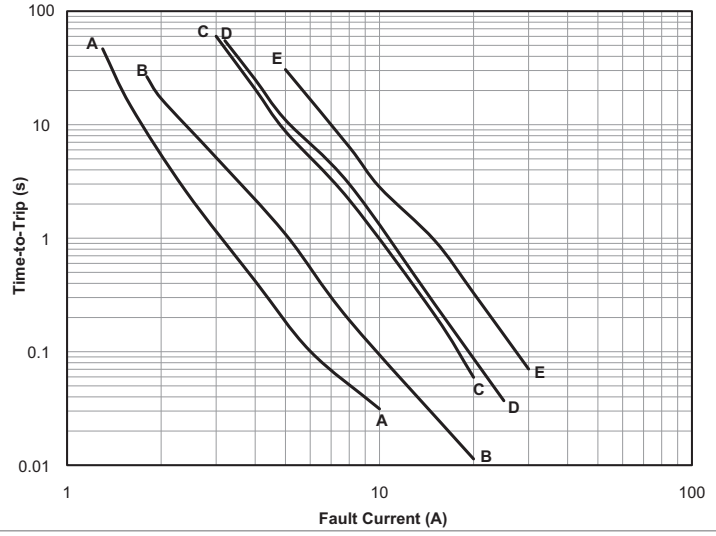
Figures A16-A24 Typical Time-to-Trip at 25°C for PolySwitch Automotive Devices

Cont'd

AHS

A = AHS080-2018
B = AHS120
C = AHS160
D = AHS200
E = AHS300

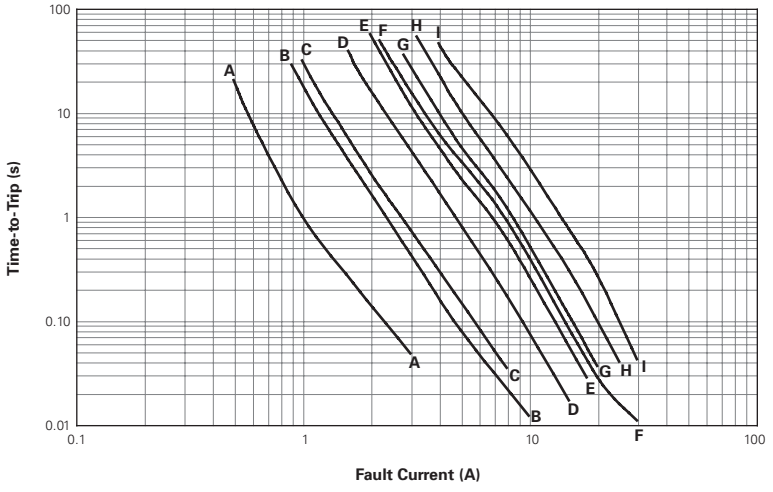
Figure A19



ASMD

A = ASMD030F
B = ASMD050F
C = ASMD075F
D = ASMD100F
E = ASMD125F
F = ASMD150F
G = ASMD185F
H = ASMD200F
I = ASMD250F

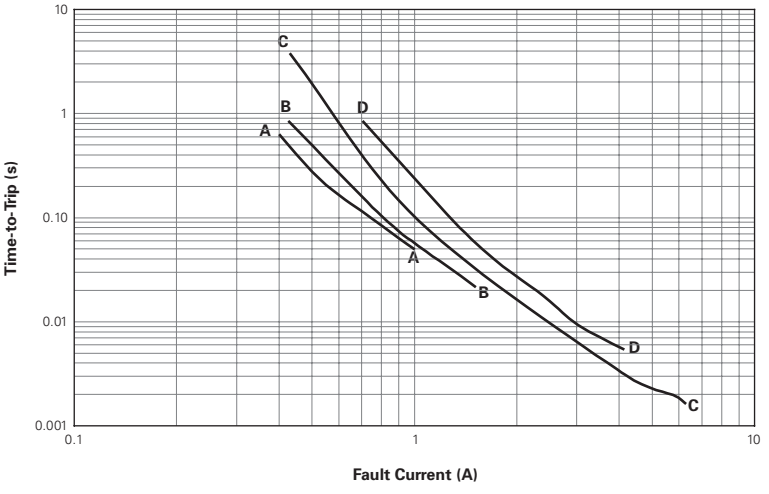
Figure A20



nanoASMDC

A = nanoASMDC012F
B = nanoASMDC016F
C = nanoASMDC020F
D = nanoASMDC035F

Figure A21



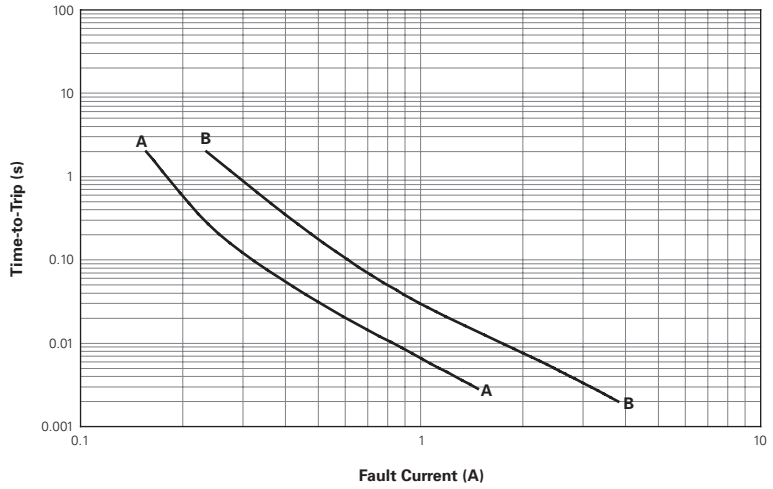
RoHS Compliant, ELV Compliant

Figures A16-A24 Typical Time-to-Trip at 25°C for PolySwitch Automotive Devices Cont'd

microASMD

A = microASMD005F
B = microASMD010F

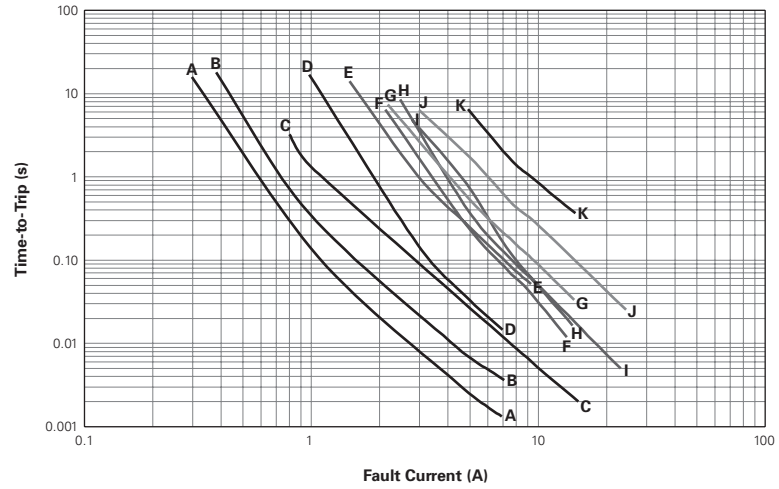
Figure A22



miniASMDC

A = miniASMDC010F, miniASMDC014F
B = miniASMDC020F
C = miniASMDC030F
D = miniASMDC050F
E = miniASMDC075F/24
F = miniASMDC110F/16
G = miniASMDC110F/24
H = miniASMDC125F/16
I = miniASMDC150F/16
J = miniASMDC150F/24
K = miniASMDC260F/16

Figure A23



BD

A = BD30A
B = BD25A
C = BD20A
D = BD15A
E = BD10A

Figure A24

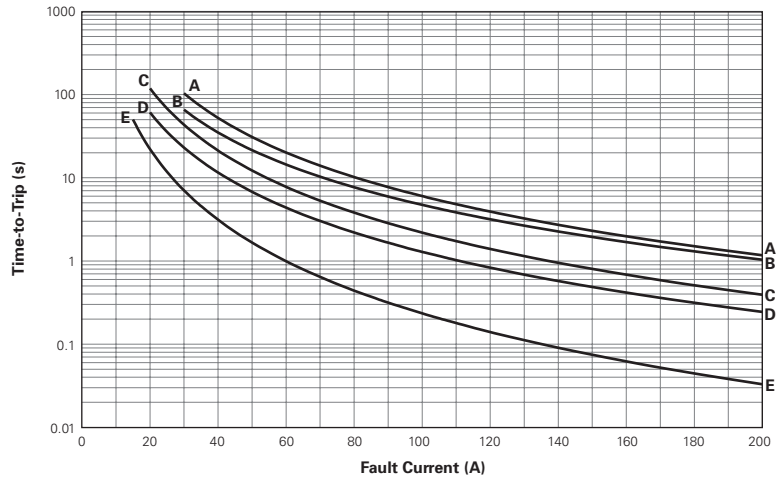


Table A5 Physical Characteristics and Environmental Specifications for PolySwitch Automotive Devices

AGRF

Physical Characteristics

Lead Material	AGRF400 to AGRF1100 : Tin-plated Copper, 0.52mm^2 (20AWG) ø 0.8 mm/0.032in AGRF1200 to AGRF1400 : Tin-plated Copper, 0.82mm^2 (18AWG) ø 1.0mm/0.040in
Soldering Characteristics	Solderability per ANSI/J-STD-002 Category 3
Solder Heat Withstand	AGRF400: per IEC68-2-20 Test Tb, Method 1A, Condition A: Can Withstand 5 s at 260°C ± 5°C AGRF500-AGRF1400: per IEC68-2-20 Test Tb, Method 1A, Condition B: Can Withstand 10 s at 260°C ± 5°C
Insulating Material	Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0
Operation Temperature	-40°C~85°C

Note: See PS400 for other physical characteristics.
Devices are not intended to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±5%
	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85% RH, 1000 hrs	±5%
Thermal Shock	85°C, -40°C (10 Times)	±5%
Solvent Resistance	MIL-STD-202, Method 215F	No Change

Note: See PS400 for other environmental specifications.

AHRF

Physical Characteristics

Lead material	AHRF050 to AHRF200 : Tin-plated Copper-clad Steel, 0.205mm^2 (24 AWG), ø 0.51mm/0.020in AHRF300 to AHRF1100 : Tin-plated Copper 0.52mm^2 (20 AWG), ø 0.81mm/0.032in AHRF1300 to AHRF1500 : Tin-plated Copper 0.82mm^2 (18 AWG), ø 1.0mm/0.04in
Soldering Characteristics	Solderability per ANSI/J-STD 002 Category 3
Solder Heat Withstand	Per IEC 68-2-20, Test Tb, Method 1A, Condition B; Can Withstand 10 s at 260°C ± 5°C
Insulating Material	Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0 Requirements
Operation Temperature	-40°C~125°C

Note: See PS400 for other physical characteristics.
Devices are not intended to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±5%
	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85% RH, 1000 hrs	±5%
Thermal Shock	125°C, -40°C (10 Times)	±5%
Solvent Resistance	MIL-STD-202, Method 215F	No Change

Note: See PS400 for other environmental specifications.

AHEF

Physical Characteristics

Lead Material	AHEF050 to AHEF100 : Tin-plated Copper-clad Steel, 0.205mm^2 (24 AWG), ø 0.51mm/0.020in. AHEF300 to AHEF750 : Tin-plated Copper 0.52mm^2 (20 AWG), ø 0.81mm/0.032in AHEF1000 : Tin-plated Copper 0.82mm^2 (18 AWG), ø 1.0mm/0.04in
Soldering Characteristics	Solderability per ANSI/J-STD 002 Category 3
Solder Heat Withstand	Per IEC 68-2-20, Test Tb, Method 1A, Condition B; Can Withstand 10 s at 260°C ± 5°C
Insulating Material	Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0 Requirements
Operation Temperature	-40°C~125°C

Note: See PS400 for other physical characteristics.
Devices are not intended to be placed through a reflow process.

Table A5 Physical Characteristics and Environmental Specifications for PolySwitch Automotive Devices Cont'd

AHEF

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±5%
	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85% RH, 1000 hrs	±5%
Thermal Shock	125°C, -40°C (10 Times)	±5%
Solvent Resistance	MIL-STD-202, Method 215F	No Change

Note: See PS400 for other environmental specifications.

AHS

Physical Characteristics

Lead Material	Tin-plated Brass to MIL-T-10727B
Soldering Characteristics	Solderability per ANSI-J-STD-002 Category 1
Solder Heat Withstand	Per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A
Flammability	Per IEC 695-2-2 Needle Flame Test for 20 s
Operation Temperature	-40°C~125°C

Note: See PS400 for other physical characteristics.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±3% Typical
	85°C, 1000 hrs	±5% Typical
Humidity Aging	85°C, 85% RH, 1000 hrs	±1.2% Typical
Thermal Shock	125°C, -40°C (20 Times)	-33% Typical
Solvent Resistance	Freon	No Change
	Trichloroethane	No Change
	Hydrocarbons	No Change

Note: See PS400 for other environmental specifications.

ASMD

Physical Characteristics

Terminal Pad Material	98%+ Tin-plated Brass
Soldering Characteristics	Solderability per ANSI-J-STD-002 Category 1
Solder Heat Withstand	Per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A
Flammability Resistance	Per IEC 695-2-2 Needle Flame Test for 20 s
Recommended Storage Conditions	40°C max, 70% RH max; Devices May Not Meet Specified Ratings if Storage Conditions are Exceeded
Operation Temperature	-40°C~85°C

Note: See PS400 for other physical characteristics.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	60°C, 1000 hrs	±3% Typical
	85°C, 1000 hrs	±5% Typical
Humidity Aging	85°C, 85% RH, 100 hrs	±1.2% Typical
Thermal Shock	85°C, -40°C (20 Times)	-33% Typical
	125°C, -55°C (10 Times)	-33% Typical
Solvent Resistance	Freon	No Change
	Trichloroethane	No Change
	Hydrocarbons	No Change

Note: See PS400 for other environmental specifications.

Table A5 Physical Characteristics and Environmental Specifications for PolySwitch Automotive Devices Cont'd

nanoASMDC/microASMD/miniASMDC

Physical Characteristics

Terminal Pad Material	100% Matte Tin with Nickel Underplate
Soldering Characteristics	Solderability per ANSI-J-STD-002 Category 3
Solder Heat Withstand	Per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A
Flammability Resistance	Per IEC 695-2-2 Needle Flame Test for 20 s
Recommended Storage Conditions	40°C max, 70% RH max; Devices May Not Meet Specified Ratings if Storage Conditions are Exceeded
Operation Temperature	-40°C~85°C

Note: See PS400 for other physical characteristics.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	60°C, 1000 hrs	±3% Typical
	85°C, 1000 hrs	±5% Typical
Humidity Aging	85°C, 85% RH, 100 hrs	±1.2% Typical
Thermal Shock	85°C, -40°C (20 Times)	-33% Typical
	125°C, -55°C (10 Times)	-33% Typical
Solvent Resistance	Freon	No Change
	Trichloroethane	No Change
	Hydrocarbons	No Change

Note: See PS400 for other environmental specifications.

BD

Physical Characteristics

Lead Material	Brass H65, Thickness: 0.8mm, Tin Plating Thickness: 5μm
Soldering Characteristics	NA
Solder Heat Withstand	NA
Insulating Material	Colored PBT, Meets UL94V-0 Requirements
Operation Temperature	-40°C~125°C

Note: See PS400 for other physical characteristics.

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	85°C, 1000 hrs	±5%
Humidity Aging	85°C, 85% RH,1000 hrs	±5%
	85°C, 85% RH (with 10% I_{HOLD}), 500 hrs	±5%
Thermal Shock	85°C to -40°C (5 Times)	Meet SCD
Solvent Resistance	MIL-STD-202, Method 215F	No Change

Note: See PS400 for other environmental specifications.

Table A6 Packaging and Marking Information for PolySwitch Automotive Devices

Part Number	Bag Quantity	Tape and Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
AGRF Radial-leaded						
AGRF400	500	—	—	10,000	G4	*
AGRF400-2	—	2,500	—	12,500	G4	*
AGRF400-AP	—	—	2,000	10,000	G4	*
AGRF500	500	—	—	10,000	G5	*
AGRF500-2	—	2,000	—	10,000	G5	*
AGRF500-AP	—	—	2,000	10,000	G5	*
AGRF600	500	—	—	10,000	G6	*
AGRF600-2	—	2,000	—	10,000	G6	*
AGRF600-AP	—	—	2,000	10,000	G6	*
AGRF700	500	—	—	10,000	G7	*
AGRF700-2	—	1,500	—	7,500	G7	*
AGRF700-AP	—	—	1,500	7,500	G7	*
AGRF800	500	—	—	10,000	G8	*
AGRF800-2	—	1,000	—	5,000	G8	*
AGRF800-AP	—	—	1,000	5,000	G8	*
AGRF900	500	—	—	10,000	G9	*
AGRF900-2	—	1,000	—	5,000	G9	*
AGRF900-AP	—	—	1,000	5,000	G9	*
AGRF1000	250	—	—	5,000	G10	*
AGRF1000-2	—	1,000	—	5,000	G10	*
AGRF1000-AP	—	—	1,000	5,000	G10	*
AGRF1100	250	—	—	5,000	G11	*
AGRF1100-2	—	1,000	—	5,000	G11	*
AGRF1100-AP	—	—	1,000	5,000	G11	*
AGRF1200	250	—	—	5,000	G12	*
AGRF1200-2	—	1,000	—	5,000	G12	*
AGRF1200-AP	—	—	1,000	5,000	G12	*
AGRF1400	250	—	—	5,000	G14	*
AGRF1400-2	—	1,000	—	5,000	G14	*
AGRF1400-AP	—	—	1,000	5,000	G14	*
AHRF (High Temperature) Radial-leaded						
AHRF050	500	—	—	10,000	H0.5	*
AHRF050-2	—	2,500	—	12,500	H0.5	*
AHRF050-AP	—	—	2,500	12,500	H0.5	*
AHRF070	500	—	—	10,000	H0.7	*
AHRF070-2	—	2,500	—	12,500	H0.7	*
AHRF070-AP	—	—	2,500	12,500	H0.7	*
AHRF100	500	—	—	10,000	H1	*
AHRF100-2	—	2,500	—	12,500	H1	*
AHRF100-AP	—	—	2,500	12,500	H1	*
AHRF200	500	—	—	10,000	H2	*
AHRF200-2	—	2,500	—	12,500	H2	*
AHRF200-AP	—	—	2,500	12,500	H2	*
AHRF300	500	—	—	10,000	H3	*
AHRF300-2	—	2,000	—	10,000	H3	*
AHRF300-AP	—	—	2,000	10,000	H3	*
AHRF400	500	—	—	10,000	H4	*
AHRF400-2	—	1,500	—	7,500	H4	*
AHRF400-AP	—	—	1,500	7,500	H4	*

* These devices are intended for use in automotive applications.
For commercial alternatives to these products please see the radial-leaded devices section or surface-mount devices section.

Table A6 Packaging and Marking Information for PolySwitch Automotive Devices Cont'd

Part Number	Bag Quantity	Tape and Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
AHRF (High Temperature) Radial-leaded						
AHRF450	500	—	—	10,000	H4.5	*
AHRF450-2	—	1,500	—	7,500	H4.5	*
AHRF450-AP	—	—	1,500	7,500	H4.5	*
AHRF550	500	—	—	10,000	H5.5	*
AHRF550-2	—	2,000	—	10,000	H5.5	*
AHRF550-AP	—	—	2,000	10,000	H5.5	*
AHRF600	500	—	—	10,000	H6	*
AHRF600-2	—	2,000	—	10,000	H6	*
AHRF600-AP	—	—	2,000	10,000	H6	*
AHRF650	500	—	—	10,000	H6.5	*
AHRF650-2	—	1,500	—	7,500	H6.5	*
AHRF650-AP	—	—	1,500	7,500	H6.5	*
AHRF700	500	—	—	10,000	H7	*
AHRF700-2	—	1,500	—	7,500	H7	*
AHRF700-AP	—	—	1,500	7,500	H7	*
AHRF750	500	—	—	10,000	H7.5	*
AHRF750-2	—	1,000	—	5,000	H7.5	*
AHRF750-AP	—	—	1,000	5,000	H7.5	*
AHRF800	500	—	—	10,000	H8	*
AHRF800-2	—	1,000	—	5,000	H8	*
AHRF800-AP	—	—	1,000	5,000	H8	*
AHRF900	250	—	—	5,000	H9	*
AHRF900-2	—	1,000	—	5,000	H9	*
AHRF900-AP	—	—	1,000	5,000	H9	*
AHRF1000	250	—	—	5,000	H10	*
AHRF1000-2	—	1,000	—	5,000	H10	*
AHRF1000-AP	—	—	1,000	5,000	H10	*
AHRF1100	250	—	—	5,000	H11	*
AHRF1100-2	—	1,000	—	5,000	H11	*
AHRF1100-AP	—	—	1,000	5,000	H11	*
AHRF1300	250	—	—	5,000	H13	*
AHRF1300-2	—	1,000	—	5,000	H13	*
AHRF1300-AP	—	—	1,000	5,000	H13	*
AHRF1400	250	—	—	5,000	H14	*
AHRF1400-2	—	1,000	—	5,000	H14	*
AHRF1400-AP	—	—	1,000	5,000	H14	*
AHRF1500	250	—	—	5,000	H15	*
AHRF1500-2	—	1,000	—	5,000	H15	*
AHRF1500-AP	—	—	1,000	5,000	H15	*
AHEF (High Temperature) Radial-leaded						
AHEF050	500	—	—	10,000	E0.5	*
AHEF070	500	—	—	10,000	E0.7	*
AHEF100	500	—	—	10,000	E1	*
AHEF300	500	—	—	10,000	E3	*
AHEF500	250	—	—	5,000	E5	*
AHEF750	250	—	—	5,000	E7.5	*
AHEF1000	250	—	—	5,000	E10	*

* These devices are intended for use in automotive applications.
For commercial alternatives to these products please see the radial-leaded devices section or surface-mount devices section.

Table A6 Packaging and Marking Information for PolySwitch Automotive Devices Cont'd

Part Number	Tape and Reel Quantity	Standard Package Quantity	Part Marking	Recommended Pad Layouts [mm(in) See Figure A25] Dimension A (Min*/Nom)	Dimension B (Nom)	Dimension C (Nom)	Agency Recognition
AHS (High Temperature) Surface-mount							
AHS080-2018	4,000	20,000	H08	4.6 (0.18)	1.5 (0.06)	3.4 (0.134)	*
NEW AHS120	2,000	10,000	H12	3.1 (0.12)	2.3 (0.09)	5.1 (0.201)	*
AHS160	1,500	7,500	160	4.6 (0.18)	2.3 (0.09)	6.1 (0.240)	*
AHS200	1,500	7,500	H200	4.6 (0.18)	2.3 (0.09)	6.1 (0.240)	*
AHS300	1,500	7,500	H300	4.6 (0.18)	2.3 (0.09)	6.1 (0.240)	*
ASMD Surface-mount							
ASMD030F	2,000	10,000	030F	3.1 (0.12)	2.3 (0.09)	5.1 (0.201)	*
ASMD050F	2,000	10,000	050F	3.1 (0.12)	2.3 (0.09)	5.1 (0.201)	*
ASMD075F	2,000	10,000	075F	3.1 (0.12)	2.3 (0.09)	5.1 (0.201)	*
ASMD100F	2,000	10,000	100F	3.1 (0.12)	2.3 (0.09)	5.1 (0.201)	*
ASMD125F	2,000	10,000	125F	3.1 (0.12)	2.3 (0.09)	5.1 (0.201)	*
ASMD150F	1,500	7,500	150F	4.6 (0.18)	2.3 (0.09)	6.1 (0.240)	*
ASMD185F	1,500	7,500	185A	4.6 (0.18)	2.3 (0.09)	6.1 (0.240)	*
ASMD200F	1,500	7,500	200F	4.6 (0.18)	2.3 (0.09)	6.1 (0.240)	*
ASMD250F	1,500	7,500	250F	4.6 (0.18)	2.3 (0.09)	6.1 (0.240)	*
nanoASMDC Surface-mount							
nanoASMDC012F	3,000	15,000	P	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	*
nanoASMDC016F	3,000	15,000	N	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	*
nanoASMDC020F	3,000	15,000	02	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	*
nanoASMDC035F	3,000	15,000	03	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	*
microASMD Surface-mount							
microASMD005F	4,000	20,000	05	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	*
microASMD010F	4,000	20,000	10	2.50 (0.098)	1.00 (0.039)	2.00 (0.079)	*
miniASMDC Surface-mount							
miniASMDC010F	2,000	10,000	10	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC014F	2,000	10,000	14	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC020F	2,000	10,000	2	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC030F	2,000	10,000	3	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC050F	2,000	10,000	5	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC075F/24	1,500	7,500	075F 24V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC110F/16	2,000	10,000	110F 16V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC110F/24	1,500	7,500	110F 24V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC125F/16	2,000	10,000	125F 16V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC150F/16	2,000	10,000	150 16V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC150F/24	1,000	5,000	150F 24V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*
miniASMDC260F/16	1,500	7,500	260F 16V	3.15 (0.124)	1.68 (0.066)	3.10 (0.122)	*

* These devices are intended for use in automotive applications.
For commercial alternatives to these products please see the radial-leaded devices section or surface-mount devices section.

Part Number	Bag Quantity	Standard Package Quantity	Part Marking	Agency Recognition
BD Bladed Device				
BD280-1130-10/16	200	1600	BD280-1130-10	*
BD280-1130-15/16	200	1600	BD280-1130-15	*
BD280-1130-20/16	200	1600	BD280-1130-20	*
BD280-1927-25/16-W	200	1600	BD280-1927-25	*
BD280-1927-30/16-W	200	1600	BD280-1927-30	*

* These devices are intended for use in automotive applications.
For commercial alternatives to these products please see the radial-leaded devices section or surface-mount devices section.

Figure A25 Recommended Pad Layout for PolySwitch Automotive Devices

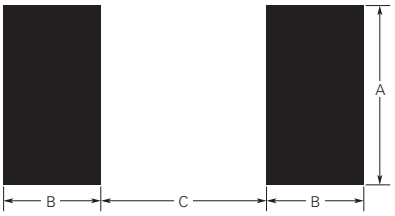


Table A7 Tape and Reel Specifications for AGRF/AHRF/AHEF PolySwitch Automotive Devices

AGRF, AHRF and AHEF devices are available in tape and reel packaging per EIA468-B/IEC286-2 and EIA 481-2 standards. See Figures A26 and A27 for details.

Description	EIA Mark	Dimension (mm)	Tolerance
Carrier Tape Width	W	18.0	-0.5/+1.0
Hold Down Tape Width	W_4	11.0	Minimum
Top Distance between Tape Edges	W_6	3.0	Maximum
Sprocket Hole Position	W_5	9.0	-0.5/+0.75
Sprocket Hole Diameter	D_0	4.0	±0.2
Abscissa to Plane (Straight Lead) (AHEF300 to AHEF1000)	H	20.3	±0.5
Abscissa to Plane (Kinked Lead) (AGRF400 to AGRF1400, AHRF050 to AHRF1500, AHEF050 to AHEF100)	H_0	16.0	±0.5
Abscissa to Top (AGRF400 to AGRF600, AHRF050 to AHRF450, AHEF050 to AHEF300)	H_1	32.2	Maximum
Abscissa to Top (AGRF700 to AGRF1400, AHRF550 to AHRF1500*, AHEF500 to AHEF1000)	H_1	45.0	Maximum
Overall Width with Lead Protrusion (AGRF400 to AGRF600 & AHRF050 to AHRF450, AHEF050 to AHEF300)	C_1	43.2	Maximum
Overall Width with Lead Protrusion (AGRF700 to AGRF1400, AHRF550 to AHRF1500, AHEF500 to AHEF1000)	C_1	55.0	Maximum
Overall Width without Lead Protrusion (AGRF400 to AGRF600, AHRF050 to AHRF450, AHEF050 to AHEF300)	C_2	42.5	Maximum
Overall Width without Lead Protrusion (AGRF700 to AGRF1400, AHRF550 to AHRF1500, AHEF500 to AHEF1000)	C_2	54.0	Maximum
Lead Protrusion	L_1	1.0	Maximum
Protrusion of Cut-out	L	11.0	Maximum
Protrusion Beyond Hold-Down Tape	l_2	Not specified	—
Sprocket Hole Pitch	P_0	12.7	± 0.3
Device Pitch (AGRF400 to AGRF700, AHRF050 to AHRF600, AHEF050 to AHEF300)	—	12.7	± 0.3
Device Pitch (AGRF800 to AGRF1400, AHRF650 to AHRF1500, AHEF500 to AHEF1000)	—	25.4	± 0.6
Pitch Tolerance	—	20 consec.	± 0.1
Tape Thickness	t	0.9	Maximum
Overall Tape and Lead Thickness (AGRF400 to AGRF1100, AHRF050 to AHRF1100*, AHEF050 to AHEF750)	t_1	2.0	Maximum
Overall Tape and Lead Thickness (AGRF1200 to AGRF1400, AHRF1300 to AHRF1500*, AHEF1000)	t_1	2.3	Maximum
Splice Sprocket Hole Alignment	—	0	± 0.3
Body Lateral Deviation	Δh	0	± 1.0
Body Tape Plane Deviation	Δp	0	± 1.3
Ordinate to Adjacent Component Lead (AGRF400 to AGRF1100, AHRF050 to AHRF900, AHEF050 to AHEF500	P_1	3.81	± 0.7
Ordinate to Adjacent Component Lead (AGRF1200 to AGRF1400, AHRF1000 to AHRF1500, AHEF750 to AHEF1000)	P_1	7.62	± 0.7
Lead Spacing (AGRF400 to AGRF1100, AHRF050 to AHRF900*, AHEF050 to AHEF500)	F	5.05	± 0.75
Lead Spacing (AGRF1200 to AGRF1400, AHRF1000 to AHRF1500*, AHEF750 to AHEF1000)	F	10.15	± 0.75
Reel Width (AGRF400 to AGRF600 & AHRF050 to AHRF450, AHEF050 to AHEF300)	w_2	56.0	Maximum
Reel Width (AGRF700 to AGRF1400, AHRF550 to AHRF1500*, AHEF500 to AHEF1000)	w_2	63.5	Maximum
Reel Diameter	a	370.0	Maximum
Space between Flanges* (AHEF050 to AHEF300)	w_1	48.0	Maximum
Space between Flanges* (AHEF500 to AHEF1000)	w_1	55.0	Maximum
Arbor Hold Diameter	c	26.0	±12.0
Core Diameter*	n	91.0	Maximum
Box	—	64/372/362	Maximum
Consecutive Missing Places	—	None	—
Empty Places per Reel	—	0.1%	Maximum

*Differs from EIA specification.

Figure A26 EIA Referenced Taped Component Dimensions for AGRF/AHRF/AHEF PolySwitch Automotive Devices

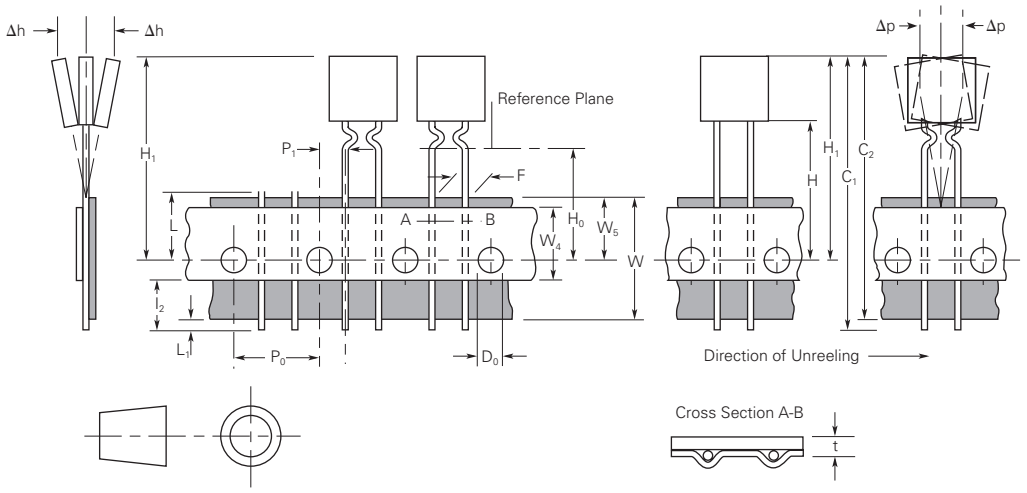


Figure A27 EIA Referenced Reel Dimensions for AGRF/AHRF/AHEF PolySwitch Automotive Devices

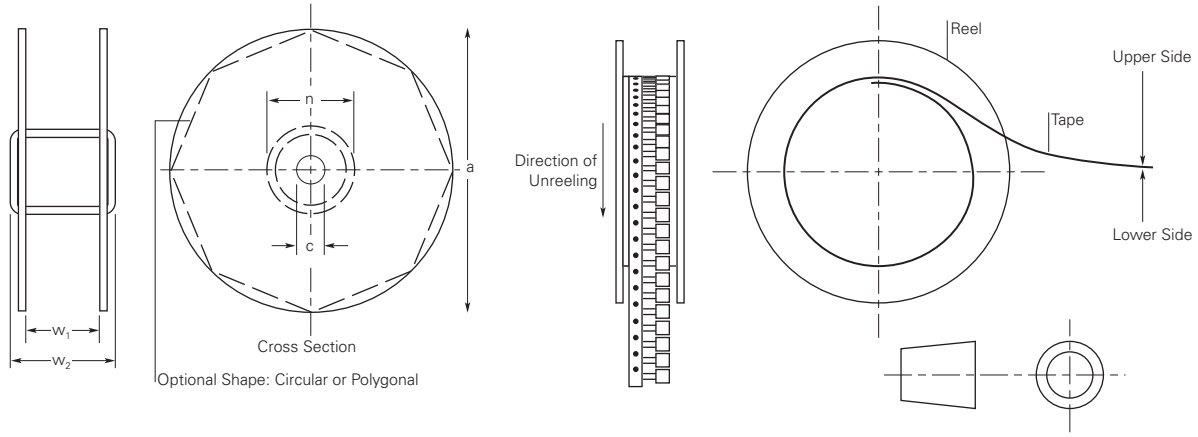


Table A8 Tape and Reel Specifications for AHS/ASMD/nanoASMDC/microASMD/miniASMDC PolySwitch Automotive Devices (in Millimeters)

Description	nanoASMDC EIA 481-1	microASMD EIA 481-1	miniASMDC EIA 481-1	AHS080-2018 EIA 481-2	AHS120 ASMD030F~ASMD125F EIA 481-2	AHS160~AHS300 ASMD150F~ASMD250F EIA 481-2
W	8.0 ± 0.30	8.0 ± 0.30	12.0 ± 0.30	16.0 ± 0.30	16.0 ± 0.30	16.0 ± 0.30
P_0	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10	4.0 ± 0.10
P_1	4.0 ± 0.10	4.0 ± 0.10	8.0 ± 0.10	8.0 ± 0.10	8.0 ± 0.10	12.0 ± 0.10
P_2	2.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.10	2.0 ± 0.10	2.0 ± 0.10
A_0	1.95 ± 0.10	2.9 ± 0.10	Table A9	5.11 ± 0.15	5.6 ± 0.23	6.9 ± 0.23
B_0	Table A9	3.50 ± 0.10	Table A9	5.6 ± 0.23	8.1 ± 0.15	9.6 ± 0.15
B_1 max	4.35	4.35	6.15	12.1	12.1	12.1
D_0	1.55 ± .05	1.55 ± .05	1.5 + 0.10/ -.00	1.5 + 0.10/ -.00	1.5 + 0.10/ -.00	1.5 + 0.10/ -.00
F	3.50 ± 0.05	3.50 ± 0.05	5.50 ± 0.05	7.50 ± 0.10	7.50 ± 0.10	7.50 ± 0.10
E_1	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10
E_2 min	6.25	6.25	10.25	14.25	14.25	14.25
T max	0.3	0.3	0.35	0.4	0.4	0.4
T_1 max	0.1	0.1	0.1	0.1	0.1	0.1
K_0	Table A9	0.9 ± 0.1	Table A9	1.8 ± 0.15	3.2 ± 0.15	3.4 ± 0.15
Leader min	390	390	390	400	400	400
Trailer min	160	160	160	160	160	160

Table A9 Tape and Reel Specifications for nanoASMDC/miniASMDC PolySwitch Automotive Devices (in Millimeters)

Description	nanoASMDC020F nanoASMDC035F	nanoASMDC012F nanoASMDC016F	miniASMDC010F~050F miniASMDC110F/16 miniASMDC125F/16 miniASMDC150F/16	miniASMDC075F/24 miniASMDC110F/24 miniASMDC260F/16	miniASMDC150F/24
A_0	1.95 ± 0.1	1.95 ± 0.1	3.5 ± 0.1	3.7 ± 0.1	3.7 ± 0.1
B_0	3.50 +0.1/-0.08	3.5 ± 0.1	4.95 ± 0.1	4.9 ± 0.1	4.9 ± 0.1
K_0	0.89 ± 0.1	1.27 ± 0.1	0.9 ± 0.1	1.4 ± 0.1	1.78 ± 0.1

Table A10 Reel Dimensions for AHS/ASMD/nanoASMDC/microASMD/miniASMDC PolySwitch Automotive Devices (in Millimeters)

Description	nanoASMDC microASMD	miniASMDC	AHS ASMD
A max	185	185	330
N min	50	50	50
W_1	8.4 + 1.5/-.00	12.4 + 2.0/-.00	16.4 + 2.0/-.00
W_2 max	14.4	18.4	22.4

Figure A28 EIA Referenced Taped Component Dimensions for AHS/ASMD/nanoASMDC/microASMD/miniASMDC PolySwitch Automotive Devices

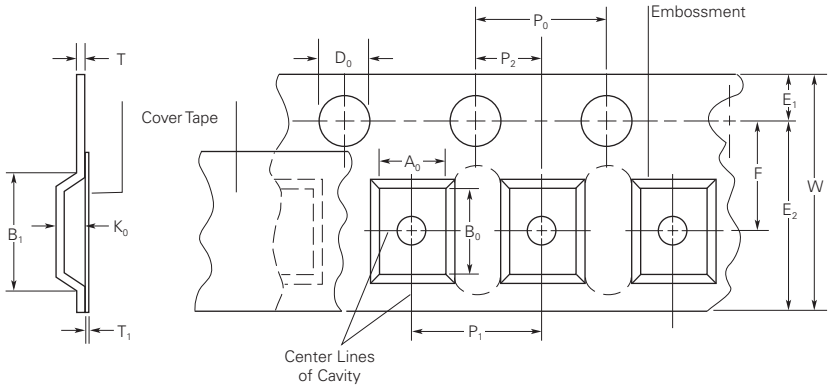
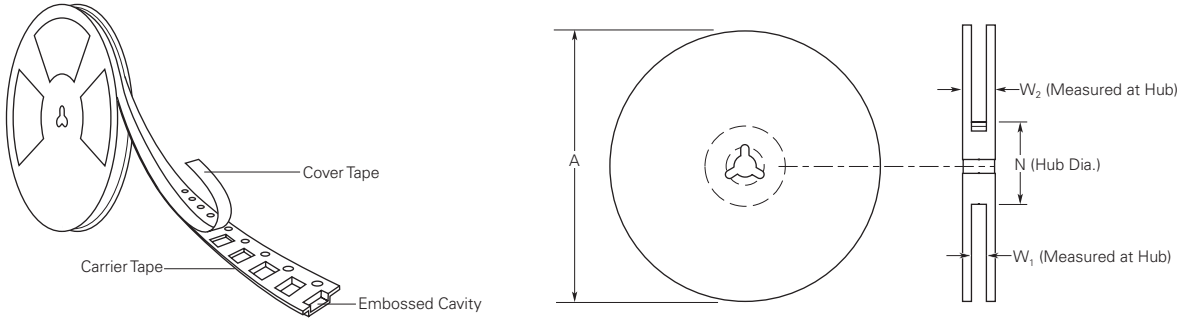
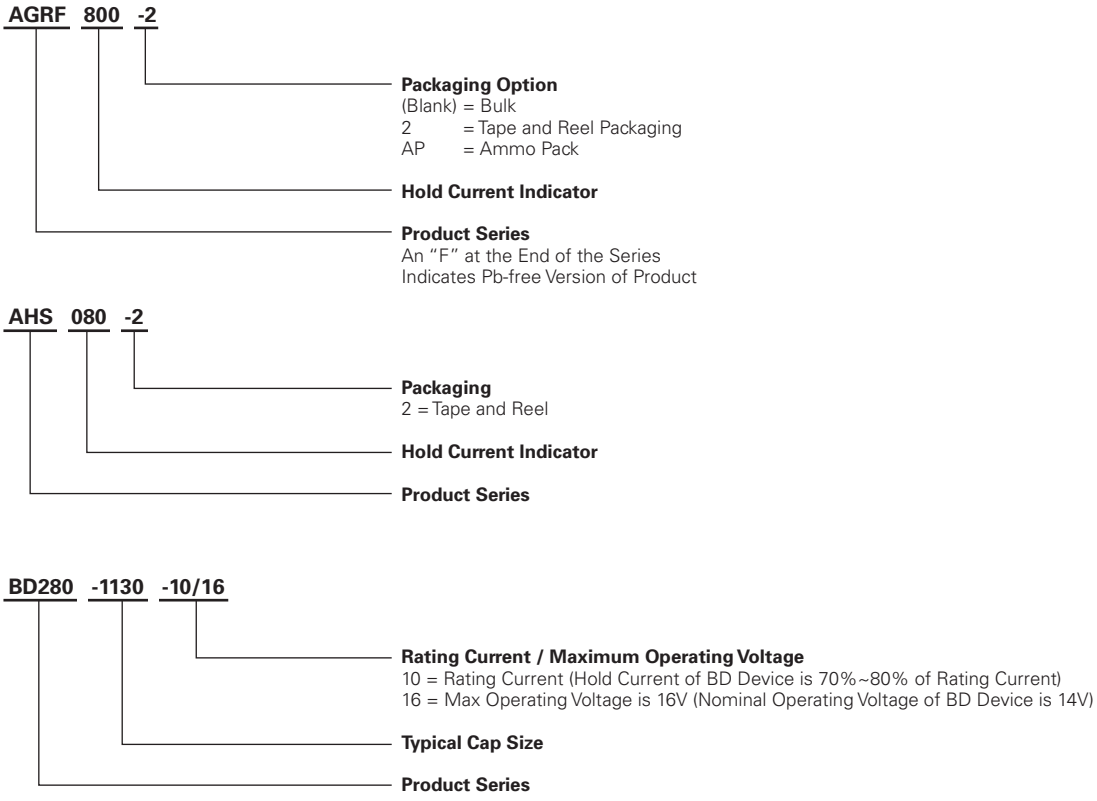


Figure A29 EIA Referenced Reel Dimensions for AHS/ASMD/nanoASMDC/microASMD/miniASMDC PolySwitch Automotive Devices



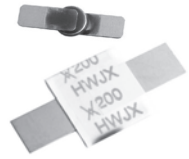
RoHS Compliant, ELV Compliant

Part Numbering System for PolySwitch Automotive Devices



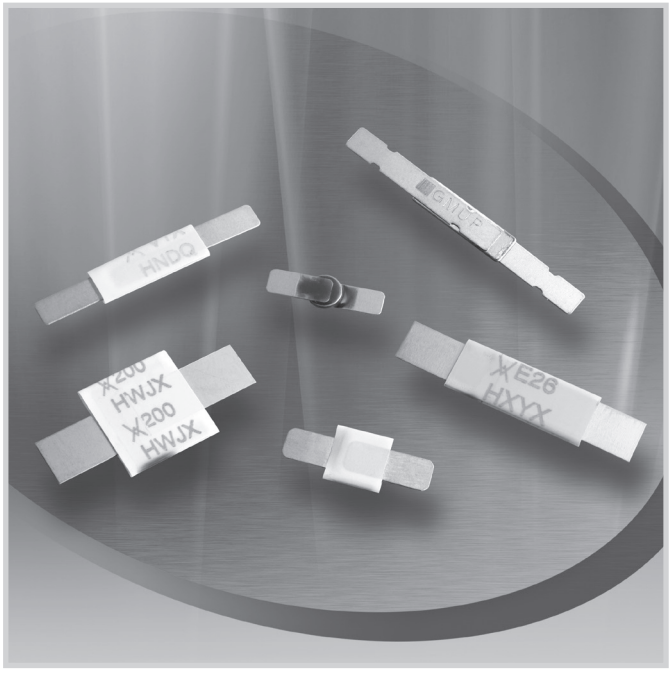
⚠ Warning :

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage (Ldi/dt) above the rated voltage of the device.



PolySwitch Resettable Devices
Strap Battery Devices

TE Circuit Protection, a pioneer of polymeric positive temperature coefficient (PPTC) resettable devices, offers several material platforms to help protect battery applications. Each of these material platforms offers different performance characteristics that allow the engineer greater design flexibility. PolySwitch devices for battery protection include SRP, LR4, VTP, VLP, VLR and MXP series, disc and special application strap devices.



Benefits

- Many material platforms and device form factors help provide engineers more design flexibility
- Compatible with high-volume electronics assembly
- Assists in meeting regulatory requirements
- Low-resistance devices increase battery operating time

Features

- RoHS compliant
- Lead-free versions of all devices are available
- Broad range of resettable devices available
- Current ratings from 1.1A to 13A
- Voltage ratings from 6V to 30V
- Agency recognition: UL, CSA, TÜV
- Fast time-to-trip
- Low resistance

Applications

- Mobile phone and smart phone battery packs
- Tablet PC battery packs
- Mobile radio battery packs
- Computer battery packs
- Digital camera battery packs
- Portable media player battery packs
- Power tools (charge line)

Application Selection Guide for Strap Battery Devices

The guide below lists PolySwitch strap battery devices which are typically used in applications.
The following pages contain the specifications for the part numbers recommended below.
Once a device is selected, the user should evaluate and test each product for its intended application.

		PolySwitch Resettable Devices — Key Device Selection Criteria		
Protection Application	**Additional Comments**	**Installation Method**	**Lowest Resistance**	**Lowest Thermal Cut-off**
Mobile Phone Battery Packs	Li-ion	Surface-mount	Refer to Surface-mount Section of this Catalog	
		Prismatic	MXP370BD	VLR175F
Cordless Phone Battery Packs	NiMH	Cylindrical	VLP210F	—
			SRP175F	
Mobile Radio Battery Packs	NiMH	Cylindrical	LR4-380F	—
			SRP350F	
Computer Battery Packs	NiMH	Cylindrical	LR4-900F	—
	Li-ion	Cylindrical	LR4-1300SSF	—
		Prismatic	Consult Local Rep	Consult Local Rep
Camcorder Battery Packs	NiMH or Li-ion	Prismatic	VLP270F	VTP210GF
			LR4-380F	—
PDA Battery Packs	Li-ion	Prismatic	VLP220F	VLR175F
Power Tools (Charge Line)	NiCd, NiMH or Li-ion	Cylindrical	Custom LR4	Custom VTP

Table B1 Product Series: Current Rating, Voltage Rating / Typical Resistance for Strap Battery Devices

	VLR	VLP	VTP	MXP	SRP	LR4
	Typical Activation Temperature					
Hold Current (A)	**85°C**	**90°C**	**90°C**	**120°C**	**125°C**	**125°C**
1.10	—	—	16V/0.054Ω	—	—	—
1.20	—	16V/0.053Ω	—	—	15V/0.123Ω	—
1.70	12V/0.025Ω	—	16V/0.041Ω	—	—	—
1.75	12V/0.024Ω	16V/0.032Ω	16V/0.040Ω	—	15V/0.070Ω	—
1.80	—	—	—	6V/0.0105Ω	—	—
1.90	—	—	—	6V/0.011Ω	—	15V/0.056Ω
2.00	—	—	—	—	30V/0.045Ω	—
2.10	—	16V/0.024Ω	16V/0.024Ω	—	—	—
2.20	—	16V/0.023Ω	—	—	—	—
2.30	12V/0.015Ω	—	—	—	—	—
2.50	—	—	—	6V/0.011Ω	—	—
2.60	—	—	—	—	—	15V/0.031Ω
2.70	—	16V/0.015Ω	—	6V/0.0105Ω	—	—
3.10	—	—	—	6V/0.0075Ω	—	—
3.50	—	—	—	—	30V/0.024Ω	—
3.70	—	—	—	6V/0.007Ω	—	—
3.80	—	—	—	—	—	15V/0.020Ω
4.20	—	—	—	—	30V/0.018Ω	—
4.50	—	—	—	—	—	20V/0.016Ω
5.50	—	—	—	—	—	20V/0.013Ω
6.00	—	—	—	—	—	20V/0.011Ω
7.30	—	—	—	—	—	20V/0.009Ω
9.00	—	—	—	—	—	20V/0.008Ω
13.00	—	—	—	—	—	20V/0.006Ω

RoHS Compliant, ELV Compliant

Table B2 Thermal Derating for Strap Battery Devices [Hold Current (A) at Ambient Temperature (°C)]

Part Number	Maximum Ambient Temperature -40°C A	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	80°C	85°C
85°C Typical Activation VLR*											
VLR170F	3.5	2.9	2.4	1.84	1.70	1.2	1.0	0.7	0.3	—	—
VLR175F	3.5	2.9	2.4	1.87	1.75	1.3	1.0	0.8	0.3	—	—
VLR175LF	3.5	2.9	2.4	1.87	1.75	1.3	1.0	0.8	0.3	—	—
VLR230F	5.0	4.2	3.4	2.52	2.30	1.7	1.3	0.9	0.4	—	—
90°C Typical Activation VLP*											
VLP120UF	2.4	2.1	1.8	1.30	1.20	1.0	0.7	0.6	0.3	0.2	0.1
VLP175UAF	3.2	2.7	2.3	1.70	1.75	1.2	1.0	0.9	0.5	0.2	0.1
VLP210F	4.3	3.6	2.9	2.31	2.10	1.6	1.3	1.0	0.6	0.3	0.1
VLP220F	4.5	3.8	3.0	2.45	2.20	1.7	1.4	1.1	0.7	0.3	0.1
VLP270F	5.6	4.7	4.0	3.05	2.70	2.2	1.7	1.4	0.9	0.4	0.1
VTP*											
VTP110F	2.0	1.7	1.4	1.12	1.10	0.85	0.75	0.7	0.4	0.2	0.1
VTP170F	3.2	2.7	2.2	1.80	1.70	1.3	1.0	0.8	0.5	0.3	0.1
VTP170XSF	3.2	2.7	2.2	1.80	1.70	1.3	1.0	0.8	0.5	0.3	0.1
VTP175F	3.2	2.7	2.2	1.84	1.75	1.3	1.0	0.8	0.5	0.3	0.1
VTP175LF	3.2	2.7	2.2	1.84	1.75	1.3	1.0	0.8	0.5	0.3	0.1
VTP210GF	4.1	3.5	2.9	2.26	2.10	1.6	1.3	1.0	0.7	0.4	0.1
VTP210SF	4.1	3.5	2.9	2.26	2.10	1.6	1.3	1.0	0.7	0.4	0.1

Part Number	Maximum Ambient Temperature -40°C A	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	75°C	80°C	85°C	90°C
120°C Typical Activation MXP*													
MXP180	-	-	2.45	-	1.8	-	-	0.80	-	-	-	-	-
MXP190BB	-	-	2.6	-	1.9	-	-	0.85	-	-	-	-	-
MXP250K	-	-	3.6	-	2.5	-	-	1.3	-	-	-	-	-
MXP270	-	-	3.8	-	2.7	-	-	1.4	-	-	-	-	0.3
MXP310	-	-	5.0	-	3.1	-	-	1.9	-	1.0	-	-	-
MXP370BD	-	-	5.0	-	3.7	-	-	1.9	-	-	-	-	-

Part Number	Maximum Ambient Temperature -40°C A	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	80°C	85°C
125°C Typical Activation SRP											
SRP120F	1.9	1.7	1.5	1.20	1.17	1.0	0.9	0.8	0.6	0.5	0.4
SRP175F	2.5	2.2	2.0	1.75	1.68	1.4	1.3	1.2	1.0	0.9	0.8
SRP200F	3.1	2.8	2.5	2.00	1.97	1.7	1.5	1.4	1.2	1.0	0.9
SRP350F	5.3	4.8	4.3	3.50	3.44	3.0	2.7	2.5	2.1	1.8	1.7
SRP420F	6.3	5.7	5.1	4.20	4.11	3.6	3.3	3.0	2.6	2.2	2.1
LR4											
LR4-190F	2.8	2.5	2.3	1.9	1.86	1.6	1.5	1.4	1.2	1.1	1.0
LR4-260F	3.8	3.4	3.1	2.6	2.54	2.2	2.0	1.9	1.7	1.4	1.3
LR4-380F	5.4	4.9	4.4	3.8	3.64	3.3	3.0	2.8	2.5	2.3	2.1
LR4-380XF	5.4	4.9	4.4	3.8	3.64	3.3	3.0	2.8	2.5	2.3	2.1
LR4-450F	6.5	5.8	5.3	4.5	4.38	3.9	3.6	3.3	2.9	2.6	2.4
LR4-550F	7.6	6.9	6.2	5.5	5.32	4.7	4.3	4.0	3.6	3.2	3.0
LR4-600F	8.7	7.8	7.1	6.0	5.86	5.2	4.7	4.4	3.9	3.4	3.2
LR4-600XF	8.7	7.8	7.1	6.0	5.86	5.2	4.7	4.4	3.9	3.4	3.2
LR4-730F	10.5	9.5	8.6	7.3	7.13	6.3	5.7	5.4	4.7	4.2	4.0
LR4-900F	12.7	11.4	10.0	9.0	8.50	7.5	6.8	6.2	5.5	4.9	4.5
LR4-1300SSF	17.9	16.2	14.5	13.0	12.40	11.1	10.3	9.5	8.6	7.7	7.2

* Product electrical characteristics determined at 25°C.

Figure B1 Thermal Derating Curve for Strap Battery Devices

A = LR4
B = SRP
C = VTP, VLP, MXP
D = VLR

Figure B1

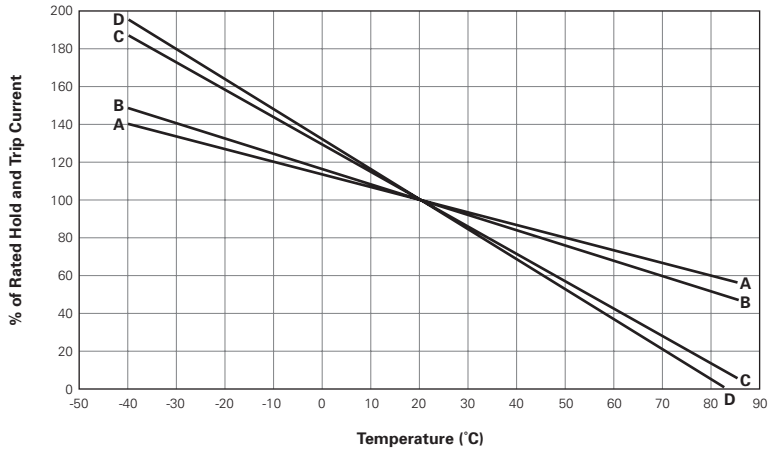


Table B3 Electrical Characteristics for Strap Battery Devices

Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\ MAX}$ (W)	Max Time-to-trip (A)	Max Time-to-trip (s)	R_{MIN} (Ω)	R_{MAX} (Ω)	R_{1MAX} (Ω)	Figure for Dimension
85°C Typical Activation VLR*											
VLR170F	1.70	4.1	12	100	1.4	8.50	5.0	0.018	0.032	0.064	B3
VLR175F	1.75	4.2	12	100	1.4	8.75	5.0	0.017	0.031	0.062	B3
VLR175LF	1.75	4.2	12	100	1.4	8.75	5.0	0.017	0.031	0.062	B3
VLR230F	2.30	5.0	12	100	2.5	10.00	5.0	0.012	0.018	0.036	B3
90°C Typical Activation VLP*											
VLP120UF	1.20	3.6	16	60	1.6	7.00	5.0	0.039	0.067	0.134	B5
VLP175UAF	1.75	3.9	16	60	1.8	8.75	5.0	0.023	0.041	0.082	B5
VLP210F	2.10	5.0	16	60	1.8	10.50	5.0	0.018	0.030	0.060	B2
VLP220F	2.20	5.3	16	60	1.8	11.00	5.0	0.017	0.029	0.058	B3
VLP270F	2.70	6.5	16	60	2.5	13.50	5.0	0.012	0.018	0.036	B3
VTP*											
VTP110F	1.10	2.7	16	100	1.3	5.50	5.0	0.038	0.070	0.140	B5
VTP170F	1.70	3.4	16	100	1.4	8.50	5.0	0.030	0.052	0.105	B2
VTP170XSF	1.70	3.4	16	100	1.4	8.50	5.0	0.030	0.052	0.105	B4
VTP175F	1.75	3.6	16	100	1.4	8.75	5.0	0.029	0.051	0.102	B3
VTP175LF	1.75	3.6	16	100	1.4	8.75	5.0	0.029	0.051	0.102	B3
VTP210GF	2.10	4.7	16	100	1.5	10.00	5.0	0.018	0.030	0.060	B3
VTP210SF	2.10	4.7	16	100	1.5	10.00	5.0	0.018	0.030	0.060	B4
120°C Typical Activation MXP*											
MXP180	1.80	5.2	6	50	1.0	9.00	5.0	0.007	0.014	0.024	B10
MXP190BB	1.90	4.9	6	50	1.0	9.50	2.0	0.007	0.015	0.024	B9
MXP250K	2.50	6.2	6	50	1.0	13.50	2.0	0.006	0.016	0.028	B10
MXP270	2.70	6.2	6	50	1.0	13.50	2.0	0.006	0.015	0.026	B10
MXP310	3.10	9.0	6	50	1.3	17.50	5.0	0.003	0.012	0.018	B10
MXP370BD	3.70	9.0	6	50	1.3	18.50	5.0	0.004	0.010	0.016	B10

* Product electrical characteristics determined at 25°C.

Table B3 Electrical Characteristics for Strap Battery Devices Cont'd

Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\ MAX}$ (W)	Max Time-to-trip (A)	Max Time-to-trip (s)	R_{MIN} (Ω)	R_{MAX} (Ω)	R_{1MAX} (Ω)	Figure for Dimensions
125°C Typical Activation SRP											
SRP120F	1.20	2.7	15	100	1.2	6.00	5.0	0.085	0.160	0.220	B6
SRP175F	1.75	3.8	15	100	1.5	8.75	5.0	0.050	0.090	0.120	B6
SRP200F	2.00	4.4	30	100	1.9	10.00	4.0	0.030	0.060	0.100	B6
SRP350F	3.50	6.3	30	100	2.5	20.00	3.0	0.017	0.031	0.050	B6
SRP420F	4.20	7.6	30	100	2.9	20.00	6.0	0.012	0.024	0.040	B6
LR4											
LR4-190F	1.90	3.9	15	100	1.2	9.5	5.0	0.0390	0.0720	0.102	B7
LR4-260F	2.60	5.8	15	100	2.5	13.0	5.0	0.0200	0.0420	0.063	B7
LR4-380F	3.80	8.3	15	100	2.5	19.0	5.0	0.0130	0.0260	0.037	B7
LR4-380XF	3.80	8.3	15	100	2.5	19.0	5.0	0.0130	0.0260	0.037	B7
LR4-450F	4.50	8.9	20	100	2.3	22.5	5.0	0.0110	0.0200	0.028	B7
LR4-550F	5.50	10.5	20	100	2.8	27.5	5.0	0.0090	0.0160	0.022	B7
LR4-600F	6.00	11.7	20	100	2.8	30.0	5.0	0.0070	0.0140	0.019	B7
LR4-600XF	6.00	11.7	20	100	2.8	30.0	5.0	0.0075	0.0140	0.019	B7
LR4-730F	7.30	14.1	20	100	3.3	30.0	5.0	0.0060	0.0120	0.015	B7
LR4-900F	9.00	16.7	20	100	3.8	45.0	5.0	0.0060	0.0100	0.014	B7
LR4-1300SSF	13.00	21.2	20	100	4.5	50.0	10.0	0.0035	0.0065	0.009	B8

* Product electrical characteristics determined at 25°C.

Notes:

I_H : Hold current: maximum current device will pass without interruption in 20°C still air unless otherwise specified.
I_T : Trip current: minimum current that will switch the device from low-resistance to high-resistance in 20°C still air unless otherwise specified.
V_{MAX} : Maximum voltage device can withstand without damage at rated current.
I_{MAX} : Maximum fault current device can withstand without damage at rated voltage.
P_D : Power dissipated from device when in the tripped state in 20°C still air unless otherwise specified.
R_{MIN} : Minimum resistance of device as supplied at 20°C unless otherwise specified.
R_{MAX} : Maximum resistance of device as supplied at 20°C unless otherwise specified.
R_{1MAX} : Maximum resistance, measured at 20°C unless otherwise specified, of device one hour after being tripped the first time.

Figures B2-B10 Dimension Figures for Strap Battery Devices

Figure B2

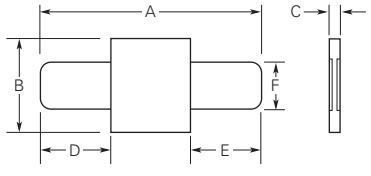


Figure B3

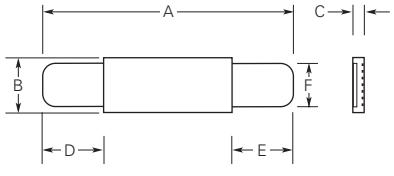
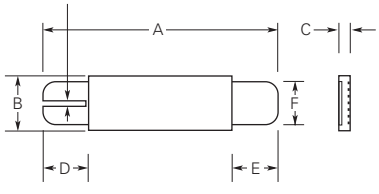


Figure B4



Figures B2-B10 Dimension Figures for Strap Battery Devices Cont'd

Figure B5

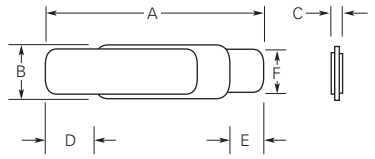


Figure B6

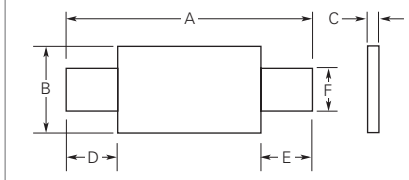


Figure B7

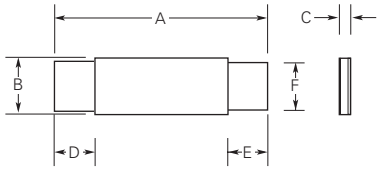


Figure B8

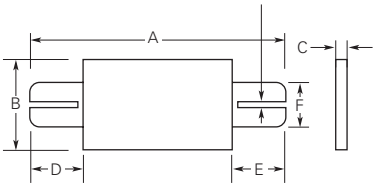


Figure B9

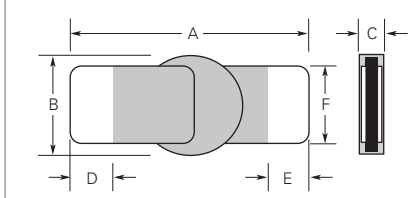


Figure B10

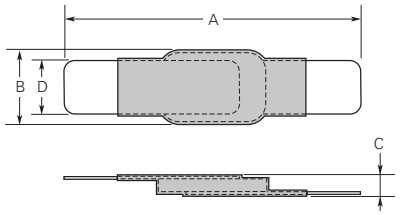


Table B4 Dimensions for Strap Battery Devices in Millimeters (Inches)

Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	Figure
85°C Typical Activation VLR													
VLR170F	20.8 (0.832)	23.2 (0.928)	3.5 (0.140)	3.9 (0.156)	— (—)	0.8 (0.032)	4.5 (0.180)	6.5 (0.260)	4.5 (0.180)	6.5 (0.260)	2.4 (0.096)	2.6 (0.104)	B3
VLR175F	23.0 (0.920)	24.5 (0.980)	2.9 (0.116)	3.3 (0.132)	0.5 (0.020)	0.8 (0.032)	4.7 (0.188)	7.2 (0.288)	3.8 (0.152)	5.4 (0.216)	2.4 (0.096)	2.6 (0.104)	B3
VLR175LF	29.3 (1.172)	31.7 (1.268)	2.9 (0.116)	3.3 (0.132)	— (—)	0.8 (0.032)	5.2 (0.208)	6.8 (0.272)	10 (0.400)	12.5 (0.500)	2.4 (0.096)	2.6 (0.104)	B3
VLR230F	20.9 (0.836)	23.1 (0.924)	4.9 (0.196)	5.3 (0.212)	— (—)	0.8 (0.032)	4.1 (0.164)	5.8 (0.232)	4.1 (0.164)	5.8 (0.232)	3.9 (0.156)	4.1 (0.164)	B3
90°C Typical Activation VLP													
VLP120UF	10.9 (0.430)	11.8 (0.460)	4.4 (0.170)	4.6 (0.180)	— (—)	0.7 (0.028)	5.5 (0.220)	6.5 (0.260)	1.65 (0.065)	1.9 (0.075)	2.3 (0.091)	2.5 (0.098)	B5
VLP175UAF	23.6 (0.944)	25.6 (1.024)	2.7 (0.108)	2.9 (0.116)	— (—)	0.7 (0.028)	7.0 (0.280)	8.0 (0.320)	7.0 (0.280)	8.0 (0.320)	2.3 (0.092)	2.5 (0.100)	B5
VLP210F	15.4 (0.616)	17.5 (0.700)	6.9 (0.276)	7.3 (0.292)	0.6 (0.024)	0.8 (0.032)	4.0 (0.160)	6.2 (0.248)	4.0 (0.160)	6.2 (0.248)	3.9 (0.156)	4.1 (0.164)	B2
VLP220F	21.1 (0.844)	23.3 (0.932)	3.5 (0.140)	3.9 (0.156)	0.6 (0.024)	0.8 (0.032)	5.1 (0.204)	6.8 (0.272)	5.1 (0.204)	6.8 (0.272)	2.9 (0.116)	3.1 (0.124)	B3
VLP270F	20.9 (0.836)	23.1 (0.924)	4.9 (0.196)	5.3 (0.212)	0.6 (0.024)	0.8 (0.032)	4.1 (0.164)	5.8 (0.232)	4.1 (0.164)	5.8 (0.232)	3.9 (0.156)	4.1 (0.164)	B3

Table B4 Dimensions for Strap Battery Devices in Millimeters (Inches) Cont'd

Part Number	A		B		C		D		E		F		Figure
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
VTP													
VTP110F	23.6	25.6	2.7	2.9	—	0.7	7.0	8.0	7.0	8.0	2.3	2.5	B5
	(0.944)	(1.024)	(0.108)	(0.116)	—	(0.028)	(0.280)	(0.320)	(0.280)	(0.320)	(0.092)	(0.100)	
VTP170F	15.4	17.5	7.0	7.4	0.5	0.8	4.0	6.2	4.0	6.2	3.9	4.1	B2
	(0.616)	(0.700)	(0.280)	(0.296)	(0.020)	(0.032)	(0.160)	(0.248)	(0.160)	(0.248)	(0.156)	(0.164)	
VTP170XSF	20.9	22.9	4.9	5.3	0.5	0.8	6.0	8.6	6.0	8.6	3.9	4.1	B4
	(0.836)	(0.916)	(0.196)	(0.212)	(0.020)	(0.032)	(0.240)	(0.344)	(0.240)	(0.344)	(0.156)	(0.164)	
VTP175F	21.2	23.2	3.5	3.9	—	0.8	4.6	6.6	4.6	6.6	2.9	3.1	B3
	(0.848)	(0.928)	(0.140)	(0.156)	—	(0.032)	(0.184)	(0.264)	(0.184)	(0.264)	(0.116)	(0.124)	
VTP175LF	25.8	28.2	3.5	3.9	—	0.8	5.7	7.3	8.7	10.3	2.4	2.6	B3
	(1.032)	(1.128)	(0.140)	(0.156)	—	(0.032)	(0.228)	(0.292)	(0.348)	(0.412)	(0.096)	(0.104)	
VTP210GF	20.9	23.1	4.9	5.3	—	0.8	4.1	5.8	4.1	5.8	3.9	4.1	B3
	(0.836)	(0.924)	(0.196)	(0.212)	—	(0.032)	(0.164)	(0.232)	(0.164)	(0.232)	(0.156)	(0.164)	
VTP210SF	20.9	23.1	4.9	5.3	0.6	0.8	4.1	5.8	4.1	5.8	3.9	4.1	B4
	(0.836)	(0.924)	(0.196)	(0.212)	(0.024)	(0.032)	(0.164)	(0.232)	(0.164)	(0.232)	(0.156)	(0.164)	
120°C Typical Activation MXP													
MXP180	9.4	10.0	2.3	2.6	0.7	1.1	1.9	2.1	—	—	—	—	B10
	(0.37)	(0.39)	(0.09)	(0.10)	(0.02)	(0.04)	(0.07)	(0.08)	—	—	—	—	
MXP190BB	9.2	10.8	2.96	3.26	0.7	1.1	1.6	3.1	1.6	3.1	2.2	2.4	B9
	(0.36)	(0.43)	(0.12)	(0.13)	(0.03)	(0.04)	(0.06)	(0.12)	(0.06)	(0.12)	(0.09)	(0.10)	
MXP250K	11.75	12.35	2.3	2.7	0.7	1.1	2.4	2.6	—	—	—	—	B10
	(0.46)	(0.49)	(0.09)	(0.11)	(0.03)	(0.04)	(0.09)	(0.10)	—	—	—	—	
MXP270	10.3	11.5	2.3	2.7	0.7	1.1	2.1	—	2.1	—	1.9	2.1	B9
	(0.40)	(0.45)	(0.09)	(0.10)	(0.02)	(0.04)	(0.08)	—	(0.08)	—	(0.07)	(0.08)	
MXP310	14.5	16.5	2.96	3.26	0.65	0.95	4.6	—	4.6	—	2.2	2.4	B9
	(0.57)	(0.65)	(0.11)	(0.13)	(0.03)	(0.04)	(0.18)	—	(0.18)	—	(0.09)	(0.10)	
MXP370BD	10.5	11.3	2.96	3.26	0.7	1.1	2.0	—	2.0	—	2.2	2.4	B9
	(0.41)	(0.44)	(0.11)	(0.12)	(0.02)	(0.04)	(0.07)	—	(0.07)	—	(0.08)	0.09)	
125°C Typical Activation SRP													
SRP120F	19.9	22.1	4.9	5.2	0.6	1.0	5.5	7.5	5.5	7.5	3.9	4.1	B6
	(0.796)	(0.884)	(0.196)	(0.208)	(0.024)	(0.040)	(0.220)	(0.300)	(0.220)	(0.300)	(0.156)	(0.164)	
SRP175F	20.9	23.1	4.9	5.2	0.6	1.0	4.1	5.5	4.1	5.5	3.9	4.1	B6
	(0.836)	(0.924)	(0.196)	(0.208)	(0.024)	(0.040)	(0.164)	(0.220)	(0.164)	(0.220)	(0.156)	(0.164)	
SRP200F	21.3	23.4	10.2	11.0	0.5	1.1	5.0	7.6	5.0	7.6	4.8	5.4	B6
	(0.852)	(0.936)	(0.408)	(0.440)	(0.020)	(0.044)	(0.200)	(0.304)	(0.200)	(0.304)	(0.192)	(0.216)	
SRP350F	28.4	31.8	13.0	13.5	0.5	1.1	6.3	8.9	6.3	8.9	6.0	6.6	B6
	(1.136)	(1.272)	(0.520)	(0.540)	(0.020)	(0.044)	(0.252)	(0.356)	(0.252)	(0.356)	(0.240)	(0.264)	
SRP420F	30.6	32.4	12.9	13.6	0.5	1.1	5.0	7.5	5.0	7.5	6.0	6.7	B6
	(1.224)	(1.296)	(0.516)	(0.544)	(0.020)	(0.044)	(0.200)	(0.300)	(0.200)	(0.300)	(0.240)	(0.268)	

Table B4 Dimensions for Strap Battery Devices in Millimeters (Inches) Cont'd

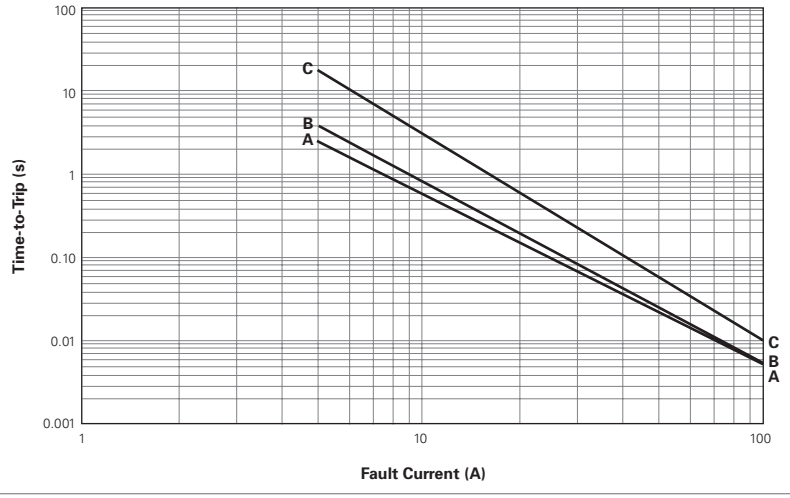
Part Number	A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	Figure
LR4													
LR4-190F	19.9 (0.796)	22.1 (0.884)	4.9 (0.196)	5.5 (0.220)	0.6 (0.024)	1.0 (0.040)	5.5 (0.220)	7.5 (0.300)	5.5 (0.220)	7.5 (0.300)	3.9 (0.156)	4.1 (0.164)	B7
LR4-260F	20.9 (0.836)	23.1 (0.924)	4.9 (0.196)	5.5 (0.220)	0.6 (0.024)	1.0 (0.040)	4.1 (0.164)	5.5 (0.220)	4.1 (0.164)	5.5 (0.220)	3.9 (0.156)	4.1 (0.164)	B7
LR4-380F	24.0 (0.960)	26.0 (1.040)	6.9 (0.276)	7.5 (0.300)	0.6 (0.024)	1.0 (0.040)	4.1 (0.164)	5.5 (0.220)	4.1 (0.164)	5.5 (0.220)	4.9 (0.196)	5.1 (0.204)	B7
LR4-380XF	32.2 (1.288)	35.8 (1.432)	4.9 (0.196)	5.5 (0.220)	0.6 (0.024)	1.0 (0.040)	5.5 (0.220)	7.5 (0.300)	5.5 (0.220)	7.5 (0.300)	3.9 (0.156)	4.1 (0.164)	B7
LR4-450F	24.0 (0.960)	26 (1.040)	9.9 (0.396)	10.5 (0.420)	0.6 (0.024)	1.0 (0.040)	5.3 (0.212)	6.7 (0.268)	5.3 (0.212)	6.7 (0.268)	5.9 (0.236)	6.1 (0.244)	B7
LR4-550F	35.0 (1.400)	37.0 (1.480)	6.9 (0.276)	7.5 (0.300)	0.6 (0.024)	1.0 (0.040)	5.3 (0.212)	6.7 (0.268)	5.3 (0.212)	6.7 (0.268)	4.9 (0.196)	5.1 (0.204)	B7
LR4-600F	24.0 (0.960)	26.0 (1.040)	13.9 (0.556)	14.5 (0.580)	0.6 (0.024)	1.0 (0.040)	4.1 (0.164)	5.5 (0.220)	4.1 (0.164)	5.5 (0.220)	5.9 (0.236)	6.1 (0.244)	B7
LR4-600XF	40.5 (1.620)	42.7 (1.708)	6.9 (0.276)	7.5 (0.300)	0.6 (0.024)	1.0 (0.040)	5.2 (0.208)	6.8 (0.272)	5.2 (0.208)	6.8 (0.272)	4.9 (0.196)	5.1 (0.204)	B7
LR4-730F	27.1 (1.084)	29.1 (1.164)	13.9 (0.556)	14.5 (0.580)	0.6 (0.024)	1.0 (0.040)	4.1 (0.164)	5.5 (0.220)	4.1 (0.164)	5.5 (0.220)	5.9 (0.236)	6.1 (0.244)	B7
LR4-900F	45.4 (1.816)	47.6 (1.904)	7.9 (0.316)	8.5 (0.340)	0.9 (0.036)	1.3 (0.052)	4.6 (0.184)	6.2 (0.248)	4.6 (0.184)	6.2 (0.248)	5.9 (0.236)	6.1 (0.244)	B7
LR4-1300SSF	61.5 (2.460)	66.5 (2.660)	9.4 (0.376)	10.0 (0.400)	0.9 (0.036)	1.3 (0.052)	5.0 (0.200)	7.5 (0.300)	5.0 (0.200)	7.5 (0.300)	5.9 (0.236)	6.1 (0.244)	B8

Figures B11-B16 Typical Time-to-Trip Curves at 20°C for Strap Battery Devices

VLR (data at 25°C)

A = VLR170F
B = VLR175F
C = VLR230F

Figure B11



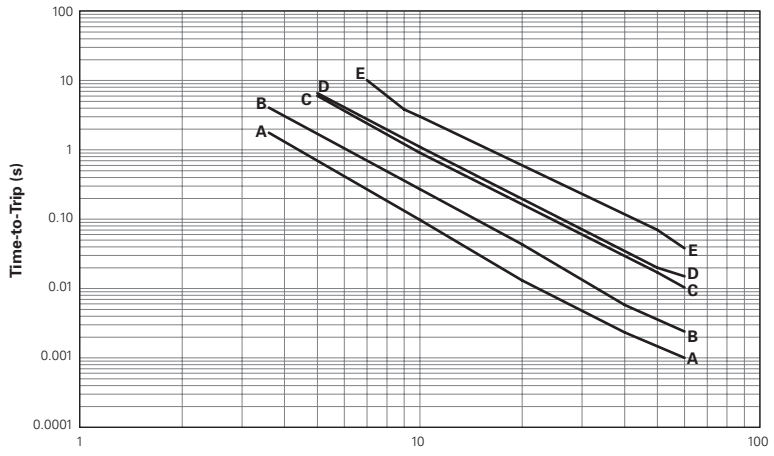
RoHS Compliant, ELV Compliant

Figures B11-B16 Typical Time-to-Trip Curves at 20°C for Strap Battery Devices Cont'd

VLP (data at 25°C)

A = VLP120UF
B = VLP175UAF
C = VLP210F
D = VLP220F
E = VLP270F

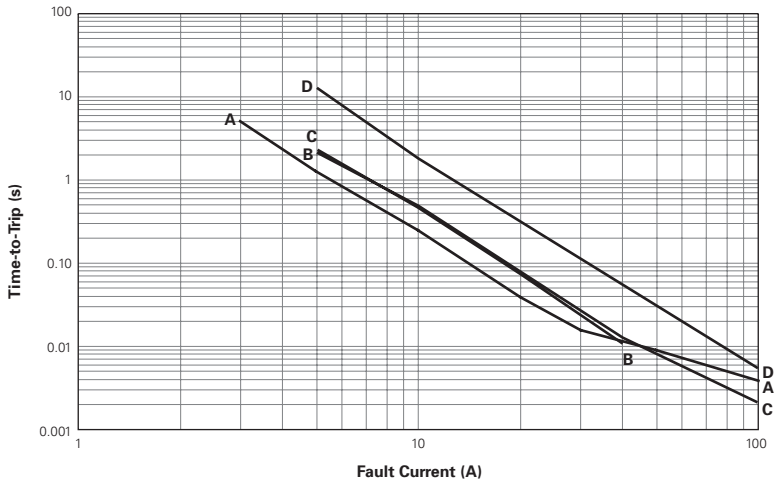
Figure B12



VTP (data at 25°C)

A = VTP110F
B = VTP170F
C = VTP175F
D = VTP210GF

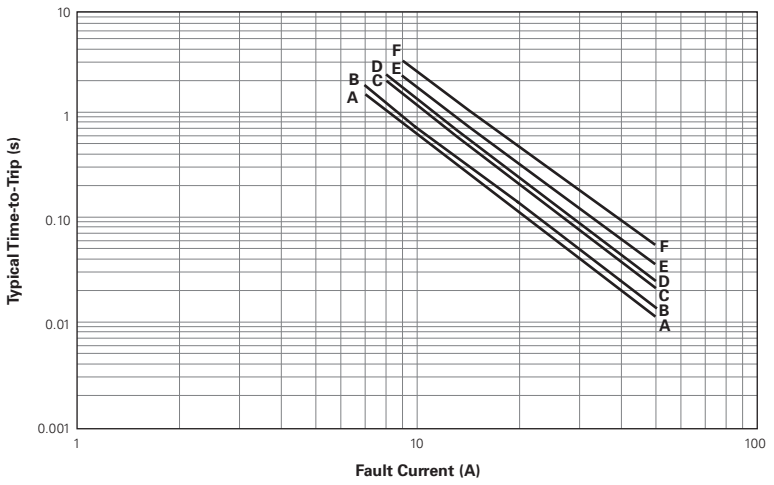
Figure B13



MXP (data at 25°C)

A = MXP180
B = MXP190BB
C = MXP250K
D = MXP270
E = MXP310
F = MXP370BD

Figure B14

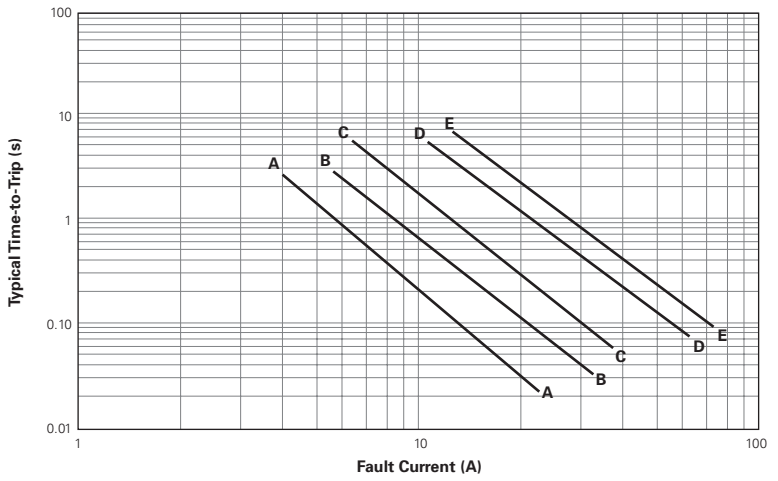


Figures B11-B16 Typical Time-to-Trip Curves at 20°C for Strap Battery Devices Cont'd

SRP

A = SRP120F
B = SRP175F
C = SRP200F
D = SRP350F
E = SRP420F

Figure B15



LR4

A = LR4-190F
B = LR4-260F
C = LR4-380F
D = LR4-450F
E = LR4-550F
F = LR4-600F
G = LR4-730F
H = LR4-900F
I = LR4-1300SSF

Figure B16

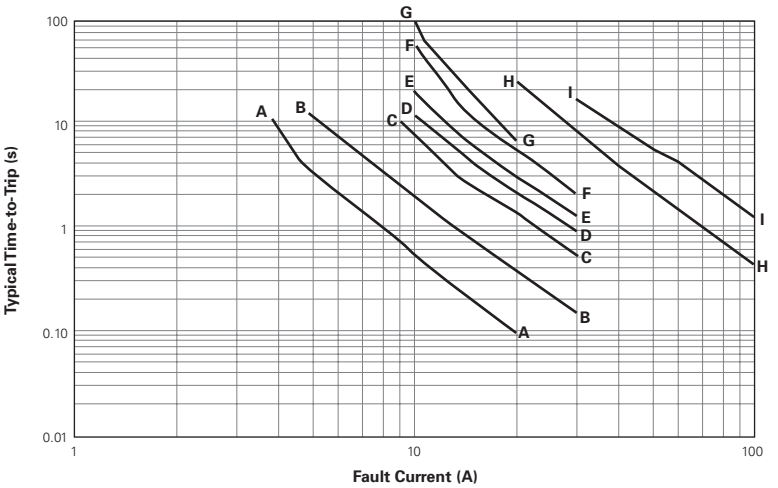


Table B5 Physical Characteristics and Environmental Specifications for Strap Battery Devices

VLR

Physical Characteristics

Lead Material	0.125mm Nominal Thickness, Quarter-hard Nickel
Tape Material	Polyester

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	-40°C, 1000 hrs	±5% typ
	60°C, 1000 hrs	±20% typ
Humidity Aging	60°C/95% RH, 1000 hrs	±30% typ
Thermal Shock	85°C, -40°C (10 Times)	±5% typ
Vibration	MIL-STD-883D, Method 2026	No Change

RoHS Compliant, ELV Compliant

Table B5 Physical Characteristics and Environmental Specifications for Strap Battery Devices Cont'd

VLP and VTP

Physical Characteristics

Lead Material	0.125mm Nominal Thickness, Quarter-hard Nickel
Tape Material	Polyester

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	-40°C, 1000 hrs	±5% typ
	60°C, 1000 hrs	±10% typ
Humidity Aging	60°C/95% RH, 1000 hrs	±10% typ
Thermal Shock	85°C, -40°C (10 Times)	±5% typ
Vibration	MIL-STD-883D, Method 2026	No Change

MXP

Physical Characteristics

Lead Material	0.1mm Nominal Thickness,Half-hard Nickel
Coating Material	Epoxy

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	-40°C, 1000 hrs	±5% typ
	60°C, 1000 hrs	±20% typ
Humidity Aging	60°C/95% RH, 1000 hrs	±30% typ
Thermal Shock	85°C, -40°C (10 Times)	±5% typ
Vibration	MIL-STD-883D, Method 2026	No Change

SRP

Physical Characteristics

Lead Material	0.125mm Nominal Thickness, Quarter-hard Nickel
Tape Material	Polyester

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±10% typ
Humidity Aging	85°C/85% RH, 7 Days	±5% typ
Vibration	MIL-STD-883C, Test Condition A	No Change

LR4

Physical Characteristics

Lead Material	0.125mm Nominal Thickness, Quarter-hard Nickel
Tape Material	Polyester

Environmental Specifications

Test	Conditions	Resistance Change
Passive Aging	70°C, 1000 hrs	±10% typ
Humidity Aging	85°C/85% RH, 7 Days	±5% typ
Vibration	MIL-STD-883D, Method 2026	No Change

Note: Storage conditions: 40°C max., 70% RH max.; devices should remain in original sealed bags prior to use. Devices may not meet specified values if these storage conditions are exceeded.

Table B6 Packaging and Marking Information/Agency Recognition for Strap Battery Devices

Part Number	Bag Quantity	Tape and Reel Quantity	Standard Package Quantity	Part Marking	Agency Recognition
85°C Typical Activation VLR					
VLR170F	1,000	—	10,000	R17	UL, CSA,TÜV
VLR175F	1,000	—	10,000	R1X	UL, CSA,TÜV
VLR175LF	1,000	—	10,000	R1X	UL, CSA,TÜV
VLR230F	1,000	—	10,000	R23	UL, CSA,TÜV
90°C Typical Activation VLP					
VLP120UF	1,000	—	10,000	—	UL, CSA, TÜV
VLP175UAF	1,000	—	10,000	—	UL, CSA, TÜV
VLP210F	1,000	—	10,000	W21	UL, CSA, TÜV
VLP220F	1,000	—	10,000	W22	UL, CSA, TÜV
VLP270F	1,000	—	10,000	W27	UL, CSA, TÜV
VTP					
VTP110F	1,000	—	10,000	—	UL, CSA, TÜV
VTP170F	1,000	—	10,000	V17	UL, CSA, TÜV
VTP170XSF	1,000	—	10,000	V17	UL, CSA, TÜV
VTP175F	1,000	—	10,000	V1X	UL, CSA, TÜV
VTP175LF	1,000	—	10,000	V1X	UL, CSA, TÜV
VTP210GF	1,000	—	10,000	V21	UL, CSA, TÜV
VTP210SF	1,000	—	10,000	V21	UL, CSA, TÜV
120°C Typical Activation MXP					
MXP180	2,000	—	4,000	—	UL, CSA, TÜV
MXP190BB	4,000	—	8,000	—	UL, CSA, TÜV
MXP250K	2,000	—	4,000	—	UL, CSA, TÜV
MXP270	2,000	—	4,000	—	UL
MXP310	2,000	—	4,000	—	UL
MXP370BD	2,000	—	4,000	—	UL, CSA, TÜV
125°C Typical Activation SRP					
SRP120F	1,000	—	10,000	120	UL, CSA, TÜV
SRP175F	2,000	—	10,000	175	UL, CSA, TÜV
SRP200F	1,000	—	10,000	200	UL, CSA, TÜV
SRP350F	500	—	10,000	350	UL, CSA, TÜV
SRP420F	500	—	10,000	420	UL, CSA, TÜV
LR4					
LR4-190F	2,000	—	10,000	E19	UL, CSA, TÜV
LR4-260F	1,000	—	10,000	E26	UL, CSA, TÜV
LR4-380F	1,000	—	10,000	E38	UL, CSA, TÜV
LR4-380XF	1,000	—	10,000	E38	UL, CSA, TÜV
LR4-450F	1,000	—	10,000	E45	UL, CSA, TÜV
LR4-550F	1,000	—	10,000	E55	UL, CSA, TÜV
LR4-600F	1,000	—	10,000	E60	UL, CSA, TÜV
LR4-600XF	1,000	—	10,000	E60	UL, CSA, TÜV
LR4-730F	1,000	—	10,000	E73	UL, CSA, TÜV
LR4-900F	500	—	10,000	E90	UL, CSA, TÜV
LR4-1300SSF	250	—	10,000	EX3	UL, CSA, TÜV

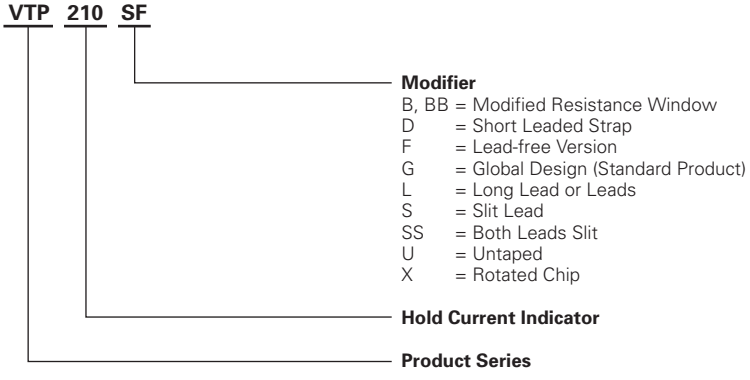
Agency Recognition for Strap Battery Devices

UL	File # E74889
CSA	File # 78165C
TÜV	Certificate Number Available on Request

Installation Guidelines for the Strap Family

- PPTC devices operate by thermal expansion of the conductive polymer. If devices are placed under pressure or installed in spaces that would prevent thermal expansion, they may not properly protect against damage caused by fault conditions. Designs must be selected in such a manner that adequate space is maintained over the life of the product.
- Twisting, bending, or placing the PPTC device in tension will decrease the ability of the device to protect against damage caused by electrical faults. No residual force should remain on device after installation. Mechanical damage to the PPTC device may affect device performance and should be avoided.
- Chemical contamination of PPTC devices should be avoided. Certain greases, solvents, hydraulic fluids, fuels, industrial cleaning agents, volatile components of adhesives, silicones, and electrolytes can have an adverse effect on device performance.
- PPTC strap devices are intended to be resistance welded to battery cells or to pack interconnect straps, yet some precautions must be taken when doing so. In order for the PPTC device to exhibit its specified performance, weld placement should be a minimum of 2mm from the edge of the PPTC device, weld splatter must not touch the PPTC device, and welding conditions must not heat the PPTC device above its maximum operating temperature.
- PPTC strap devices are not intended for applications where reflow onto flex circuits or rigid circuit boards is required.
- The polyester tape on PPTC strap devices is intended for marking and identification purposes only, not for electrical insulation.
- The coating on MXP devices is intended to prevent oxidization/aging of the devices. Damaging the coating or causing the coating to delaminate can have negative effects on device performance and should be avoided.
- MXP devices have a small PPTC chip size and therefore have weaker peel strength between the polymer and Ni-foil of the chip. Excessive mechanical force to the device may cause delamination of Ni-foil from the polymer.

Part Numbering System for Strap Battery Devices



⚠ Warning :

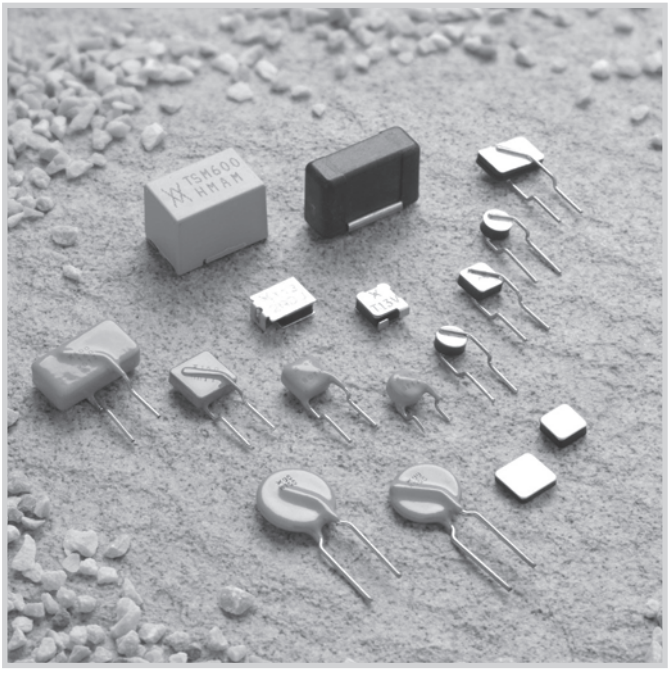
- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage (Ldi/dt) above the rated voltage of the device.

RoHS Compliant, ELV Compliant



PolySwitch Resettable Devices
Telecommunications and Networking Devices

The PolySwitch families of telecommunications and networking devices help meet the growing demand for resettable overcurrent protection. These product families help provide protection against damage caused by power cross and power induction surges as defined in ITU, Telcordia GR1089 and UL60950. Available in chip, surface-mount and radial-leaded configurations, TE's PolySwitch devices help improve the reliability of customer premise and network equipment worldwide.



Benefits

- Many product choices give engineers help increase design flexibility
- Compatible with high-volume electronics assembly
- Assist in meeting regulatory equipment requirements
- Help improve line balance
- Applicable for legacy POTS and modern digital communications equipment

Features

- RoHS compliant
- Resettable overcurrent protection
- Surface-mount, radial-leaded and chip form factors
- Fast time-to-trip
- Agency recognition: UL, CSA, TÜV
- Resistance-sorted and matched devices available
- Low parasitic capacitance/flat impedance with frequency

Applications

- Modems
- Phone sets
- Fax machines
- Phone wall outlets
- Alarm systems
- PBX systems
- MDF modules
- Analog and digital line cards
- T1/E1 equipment
- xDSL modems and splitters
- Powered ethernet systems
- VoIP (Voice over Internet Protocol) equipment
- LAN, WAN equipment
- Customer premise equipment
- Access network hardware

Application Guide for PolySwitch Telecommunications and Networking Devices*

To use this guide, follow the steps below:
1. Select your equipment type from the guide below.
2. Select the type of protection depending on the agency and regional specifications in the second column.
3. Select the form factor for your application.
4. Use the Agency Specification/ PolySwitch Device Selection Guide on the next page to select a specific part number for each application based on the agency requirements.
5. Parts with fast time-to-trip or low resistance are available. Please consult a TE Circuit Protection representative.

		Overcurrent Protection		
		Form Factor		
Application	**Region/ Specification**	**Radial-leaded**	**Surface-mount**	**Chip**
Customer Premise equipment IT equipment Analog Modems, V.90 Modems, ISDN Modems, xDSL Modems, ADSL Splitters, Phone Sets, Fax Machines, Answering Machines, Caller ID, Internet Appliances, PBX Systems, POS Terminals, Wall Plugs	**North America** TIA-968-A, UL 60950, GR1089 Port Type 3‡	TRF600-150 TR600-150F-EX TRF600-160 TRF600-250 TRF-600-400	TS600-170F TS600-200F TSM600-250F TSM600-400F	
	Europe/Asia/ South America ITU K.21	TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TS250-130F TSV250-130F TSV250-184F	
Access network equipment (†) Remote Terminals, Line Repeaters, Multiplexers, Cross-Connects, WAN Equipment	**North America** GR1089 Port Type 5‡	TRF600-160 TRF600-250 TRF600-400	TS600-170F TS600-200F TS600-400F TSM600-250F TSM600-400F FT600-1250**	
	Europe/Asia/ South America ITU K.45	TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TS250-130F TSV250-130F TSV250-184F	
Central office switching equipment (†) Analog/POTS Linecards, ISDN Linecards, xDSL Modems, ADSL/VDSL Splitters, T1/E1 Linecards, Multiplexers, CSU/DSU, Servers	**North America** GR1089 Port Type 1‡	TRF600-160 TRF600-250 TRF600-400	TS600-170F TS600-200F TS600-400F TSM600-250F TSM600-400F FT600-1250**	
	Europe/Asia/ South America ITU K.20	TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TS250-130F TSV250-130F TSV250-184F	TCF250-180
Primary protection modules (†) MDF modules, Network Interface Devices (NID)	**North America** Telcordia GR-974	TRF250-183 TRF250-184	TSV250-184F	
	Europe/Asia/ South America ITU K.20	TRF250-055UT TRF250-080U TRF250-110U TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TSL250-080F TS250-130F TSV250-130F TSV250-184F	TCF250-100T TCF250-120T TCF250-145T TCF250-180
Short-haul/intrabuilding communications equipment (†) LAN Equipment, VoIP Cards, Cable Telephony NIUs, Wireless Local Loop Handsets	**North America** GR1089 Port Type 2‡ GR1089 Port Type 4‡	TRF250-080U TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TSL250-080F TS250-130F TSV250-130F TSV250-184F	
	Europe/Asia/ South America ITU K.21	TRF250-120 TRF250-120T TRF250-145 TRF250-183 TSV250-184	TS250-130F TSV250-130F TSV250-184F	

* Applies to all products which share the same prefix. † Tested with 230V gas discharge tube primary protector.

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Protection Application Guide for PolySwitch Telecommunications and Networking Devices* Cont'd

Application	Region/ Specification	Overcurrent Protection – Form Factor: Radial-leaded	Surface-mount	Chip
LAN Intrabuilding Power Cross Protection LAN Equipment, VoIP Cards, IP Phones	**North America** GR1089 Port Type 4‡	TSL250-080U TRF250-120 TRF250-120T TRF250-145 TRF250-183 TRF250-184	TSL250-080F TS250-130F TSV250-130F TSV250-184F	
IEEE 802.3AF/AT Power over Ethernet protection Powered Ethernet Switches and Terminals, IP phones, Wireless LAN Base Stations, Microcellular Base Stations, VoIP Cards			decaSMDC050F/60-2††	

* This list is not exhaustive. TE Circuit Protection welcomes our customers' input for additional application ideas for PolySwitch resettable devices.
† For improved line balance in these applications, resistance-matched parts are recommended.
‡ May require additional impedance or coordination with primary protector.
** FT600-1250 are surface-mount telecom fuse devices. FT600-0500 and FT600-2000 reference also available. See telecom fuses section.
†† For details on decaSMDC050F/60-2, see surface-mount devices section.

Agency Specification/Selection Guide for Telecommunications and Networking Devices

Use the guide below to select the PolySwitch devices that are typically used in your application. The following pages contain the specifications for the part numbers recommended below. PolySwitch devices assist telecommunication equipment in meeting the applicable protection requirements of these industry specifications. Refer to individual agency specifications for test procedures and circuit schematics. Users should independently evaluate the suitability of and test each product for their application.

Family	Product*	Lightning	Power Cross/Contact/Induction
TCF250	**TCF250-100T**	ITU K.20 – 1.0kV 10/700µs	PRC YD/T694
		GR-1089 Port Types 2 and 4 – 1st Level	ITU K.20/21/45 – 0.2A^2s
			ITU K.20/21/45 – 1A^2s†
			GR-1089 Port Type 4 – 120V_{AC}, 25Asc
	TCF250-120T	ITU K.20/21/45 – 1.5kV 10/700µs	ITU K.20/21/45 – 230V_{AC}, 10Ω
	TCF250-145T	ITU K.20/21/45 – 4.0kV 10/700µs†	ITU K.20/21/45 – 0.2A^2s
	TCF250-180	GR-1089 Port Types 2 and 4 – 1st Level	ITU K.20/21/45 – 1A^2s†
			ITU K.20/21/45 – 10A^2s†
			GR-1089 Port Type 4 – 120V_{AC}, 25Asc

* Applies to all products which share the same prefix.
† Tested with 230V gas discharge tube primary protector.

Agency Specification/Selection Guide for PolySwitch Telecommunications and Networking Devices
Cont'd

Family	Product*	Lightning	Power Cross/Contact/Induction
TRF250	**TRF250-055UT** **TRF250-080U**	ITU K.20 – 1.0kV 10/700µs ITU K.20 – 1.0kV 10/700µs GR-1089 Port Types 2 and 4 – 1st Level	ITU K.20 – 230V_{AC}, 10Ω ITU K.20 – 230V_{AC}, 10Ω ITU K.20 – 0.2A^2s ITU K.20 – 1A^2s† GR-1089 Port Type 4 – 120V_{AC}, 25Asc
	TRF250-110U **TRF250-120** **TRF250-120T** **TRF250-120U** **TRF250-120UT** **TRF250-145** **TRF250-145U** **TRF250-183**	ITU K.20/21/45 – 1.5kV 10/700µs ITU K.20/21/45 – 4.0kV 10/700µs† GR-1089 Port Types 2 and 4 – 1st Level	ITU K.20/21/45 – 230V_{AC}, 10Ω ITU K.20/21/45 – 0.2A^2s ITU K.20/21/45 – 1A^2s† ITU K.20/21/45 – 10A^2s† GR-1089 Port Type 4 – 120V_{AC}, 25Asc
	TRF250-184	ITU K.20/21/45 – 1.5kV 10/700µs ITU K.20/21/45 – 4.0kV 10/700µs‡ GR-1089 Port Types 2 and 4 – 1st Level	ITU K.20/21/45 – 230V_{AC}, 10Ω** ITU K.20/21/45 – 0.2A^2s ITU K.20/21/45 – 1A^2s‡ ITU K.20/21/45 – 10A^2s‡ GR-1089 Port Type 4 – 120V_{AC}, 25Asc
TS250/TSV250	**TSV250-130F** **TS250-130F**	ITU K.20/21/45 – 1.5kV 10/700µs ITU K.20/21/45 – 4.0kV 10/700µs† GR-1089 Port Types 2 and 4 – 1st Level	ITU K.20/21/45 – 230V_{AC}, 10Ω ITU K.20/21/45 – 0.2A^2s ITU K.20/21/45 – 1A^2s† ITU K.20/21/45 – 10A^2s† GR-1089 Port Type 4 – 120V_{AC}, 25Asc
	TS250-130F-RB	ITU K.20/21/45 – 1.5kV 10/700µs ITU K.20/21/45 – 4.0kV 10/700µs‡ GR-1089 Port Types 2 and 4 – 1st Level	ITU K.20/21/45 – 230V_{AC}, 10Ω ITU K.20/21/45 – 0.2A^2s ITU K.20/21/45 – 1A^2s‡ ITU K.20/21/45 – 10A^2s‡ GR-1089 Port Type 4 – 120V_{AC}, 25Asc
	TSV250-184F	ITU K.20/21/45 – 1.5kV 10/700µs ITU K.20/21/45 – 4.0kV 10/700µs‡ GR-1089 Port Types 2 and 4 – 1st Level	ITU K.20/21/45 – 230V_{AC}, 10Ω** ITU K.20/21/45 – 0.2A^2s ITU K.20/21/45 – 1A^2s‡ ITU K.20/21/45 – 10A^2s‡ GR-1089 Port Type 4 – 120V_{AC}, 25Asc
TSL250	**TSL250-080F**	GR-1089 Port Types 2 and 4 – 1st Level ITU K.20 – 1.0kV 10/700µs	GR-1089 Port Type 4 – 120V_{AC}, 25Asc ITU K.20/21/45 – 230V_{AC}, 10Ω ITU K.20/21/45 – 0.2A^2s ITU K.20/21/45 – 1A^2s†
TRF600	**TRF600-150** **TR600-150F-EX** **TR600-150F-EX-RA-B-0.5** **TRF600-160** **TRF600-250** **TRF600-400**	TIA-968-A Types A & B GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level	UL60950 – 600V_{AC}, 40Asc UL60950 – 600V_{AC}, 40Asc UL60950 – 600V_{AC}, 40Asc Telcordia GR-1089 – 600V_{AC}, 60Asc Telcordia GR-1089 – 600V_{AC}, 60Asc Telcordia GR-1089 – 600V_{AC}, 60Asc
TS600	**TS600-170F** **TS600-200F-RA** **TS600-400F**	TIA-968-A Types A & B GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level††	UL60950 – 600V_{AC}, 40Asc Telcordia GR-1089 – 600V_{AC}, 60Asc
TSM600	**TSM600-250F** **TSM600-250F-RA** **TSM600-400F**	TIA-968-A Types A & B GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† TIA-968-A Types A & B GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level	UL60950 – 600V_{AC}, 40Asc Telcordia GR-1089 – 600V_{AC}, 60Asc UL60950 – 600V_{AC}, 40Asc Telcordia GR-1089 – 600V_{AC}, 60Asc
FT600‡‡	**FT600-0500** **FT600-1250** **FT600-2000**	TIA-968-A - Types A & B GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level	UL60950 - 600V_{AC}, 40Asc Telcordia GR-1089 – 600V_{AC}, 60Asc

* Applies to all products that share the same prefix.
† Tested with 230V gas discharge tube primary protector.
‡ Tested with 350V gas discharge tube primary protector.
** See SCD for additional application fault ratings.
†† May require additional series resistor to help telecommunication equipment pass Surge 3 (1kV, 10/1000µs).
‡‡ See telecom fuses section.

Table T1 Product Series: Size, Current Rating, Voltage Rating, Typical Resistance for PolySwitch Telecommunications and Networking Devices

	TCF250	TRF250	TS250	TSV250	TSL250	TS600 TSM600	TRF600
V_{MAX} Interrupt (V_{AC})*	250	250	250	250	250	600	600
Specification	ITU GR-1089 Ports 2 and 4	ITU GR-1089 Ports 2 and 4	ITU GR-1089 Ports 2 and 4	ITU GR-1089 Ports 2 and 4	GR-1089 Ports 2 and 4	UL60950 GR-1089 Ports 1, 3 and 5	UL60950 GR-1089 Ports 1, 3 and 5
Hold Current (A)							
0.055	—	20.0Ω	—	—	—	—	—
0.080	—	17.0Ω	—	—	8.0Ω	—	—
0.100	11.0Ω	—	—	—	—	—	—
0.110	—	7.0Ω	—	—	—	—	—
0.120	10.5Ω	8.0Ω	—	—	—	—	—
0.130	—	—	9.0Ω	5.5Ω	—	—	—
0.145	7.0Ω	4.5Ω	—	—	—	—	—
0.150	—	—	—	—	—	—	8.0Ω
0.160	—	—	—	—	—	—	6.0Ω
0.170	—	—	—	—	—	11.0Ω	—
0.183	—	1.3Ω	—	—	—	—	—
0.184	—	1.9Ω	—	1.6Ω	—	—	—
0.200	—	—	—	—	—	8.5Ω	—
0.250	—	—	—	—	—	3.5Ω	3.0Ω
0.400	—	—	—	—	—	1.2Ω	1.2Ω

Voltage Ratings for Telecommunications and Networking Devices

For circuit protection telecommunications devices there are two applicable voltage ratings. These are V_{MAX} Operating and V_{MAX} Interrupt. To help understand the nature of these two different voltage ratings, the following definitions are provided:

V_{MAX} Operating: For telecommunications devices, this is the voltage used to obtain component recognition under UL1434. Most circuit protection devices are certified at 60V but can withstand higher V_{MAX} Interrupt conditions. See Table T3 for its V_{MAX} Operating.

***V_{MAX} Interrupt**: Under specified conditions, this is the highest voltage that can be applied to the device at the maximum current. Devices may trip safely under higher power level cross conditions, as listed above, to assist equipment in meeting the appropriate industry conditions.

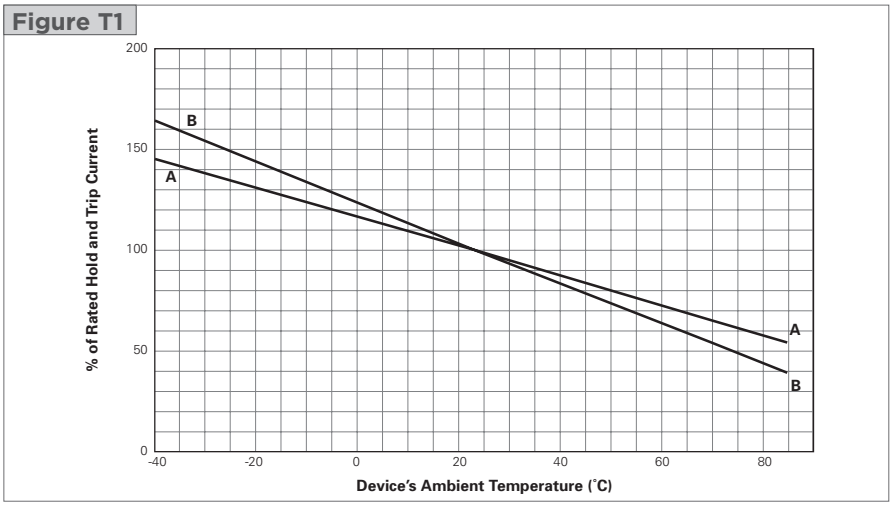
Table T2 Thermal Derating for PolySwitch Telecommunications and Networking Devices [Hold Current (A) at Ambient Temperature (°C)]

	Maximum Ambient Temperature								
Part Number	**-40°C**	**-20°C**	**0°C**	**20°C**	**40°C**	**50°C**	**60°C**	**70°C**	**85°C**
Chip* — 250V_{AC} TCF250									
TCF250-100T	0.155	0.138	0.119	0.100	0.083	0.073	0.064	0.055	0.042
TCF250-120T	0.186	0.165	0.143	0.120	0.099	0.088	0.077	0.066	0.050
TCF250-145T	0.225	0.199	0.172	0.145	0.119	0.106	0.093	0.080	0.060
TCF250-180‡	0.269	0.240	0.211	0.180	0.153	0.138	0.123	0.109	0.087
Radial-leaded* — 250V_{AC} TRF250									
TRF250-055UT	0.085	0.076	0.065	0.055	0.045	0.041	0.035	0.030	0.023
TRF250-080U	0.124	0.110	0.095	0.080	0.066	0.059	0.051	0.044	0.033
TRF250-110U	0.171	0.151	0.131	0.110	0.091	0.081	0.071	0.061	0.046
TRF250-120	0.186	0.165	0.143	0.120	0.099	0.088	0.077	0.066	0.050
TRF250-145	0.225	0.199	0.172	0.145	0.119	0.106	0.093	0.080	0.060
TRF250-183‡	0.284	0.251	0.217	0.183	0.149	0.133	0.117	0.101	0.075
TRF250-184‡	0.286	0.252	0.218	0.184	0.150	0.134	0.118	0.102	0.075
Surface-mount* — 250V_{AC} TS250/TSL250/TSV250									
TSL250-080F	0.124	0.110	0.095	0.080	0.066	0.059	0.051	0.044	0.033
TS250-130F	0.208	0.182	0.156	0.130	0.104	0.091	0.078	0.065	0.045
TSV250-130F	0.208	0.182	0.156	0.130	0.104	0.091	0.078	0.065	0.045
TSV250-184F	0.286	0.252	0.218	0.184	0.150	0.134	0.118	0.102	0.075
Radial-leaded† — 600V_{AC} TRF600									
TRF600-150	0.239	0.209	0.180	0.150	0.121	0.107	0.093	0.079	0.057
TR600-150F-EX	0.239	0.209	0.180	0.150	0.121	0.107	0.093	0.079	0.057
TR600-150F-EX-RA	0.239	0.209	0.180	0.150	0.121	0.107	0.093	0.079	0.057
TRF600-160	0.255	0.223	0.192	0.160	0.129	0.114	0.099	0.084	0.061
TRF600-250	0.400	0.350	0.300	0.250	0.198	0.170	0.140	0.117	0.083
TRF600-400	0.640	0.560	0.480	0.400	0.320	0.270	0.230	0.190	0.130
Surface-mount† — 600V_{AC} TS600/TSM600									
TS600-170F	0.264	0.230	0.200	0.170	0.140	0.125	0.109	0.094	0.070
TS600-200F-RA-B-0.5	0.310	0.275	0.238	0.200	0.165	0.147	0.128	0.110	0.083
TS600-400F	0.640	0.560	0.480	0.400	0.320	0.270	0.230	0.190	0.130
TSM600-250F	0.400	0.350	0.300	0.250	0.198	0.170	0.140	0.117	0.083
TSM600-250F-RA	0.400	0.350	0.300	0.250	0.198	0.170	0.140	0.117	0.083
TSM600-400F	0.640	0.560	0.480	0.400	0.320	0.270	0.230	0.190	0.130

* 250V_{AC} interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.
† 600V_{AC} interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.
‡ Product is not currently available in a resistance matched or sorted option.

Figure T1 Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]

A = TCF250-180
B = All other TCF, TRF, TSM Series Devices



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Table T3 Electrical Characteristics for PolySwitch Telecommunications and Networking Devices

Part Number	I_H (A)	I_T (A)	V_{MAX} Operating (V_{DC})	V_{MAX} Interrupt (V_{RMS})	I_{MAX}*† Interrupt (A)	$P_{D\ Typ}$ (W)	Typical Time-to-trip (A)	Typical Time-to-trip (s)	R_{MIN} (Ω)	R_{MAX} (Ω)	R_{1MAX} (Ω)
Chip* — 250V_{AC} TCF250											
TCF250-100T	0.100	0.150	60	250	3.0	0.6	1.0	0.2	14.0	18.0	24.0
TCF250-120T	0.120	0.240	60	250	3.0	1.0	1.0	0.6	6.3	12.0	18.0
TCF250-145T	0.145	0.290	60	250	3.0	1.0	1.0	1.5	5.0	9.0	14.0
TCF250-180‡	0.180	0.650	60	250	3.0	0.9	1.0	15.5	1.0	2.2	4.0
Radial-leaded* — 250V_{AC} TRF250											
TRF250-055UT	0.055	0.170	60	250	3.0	0.6	0.28	3.0	15.0	25.0	35.0
TRF250-080T	0.080	0.160	60	250	3.0	0.6	0.35	2.5	15.0	22.0	33.0
TRF250-080U	0.080	0.160	60	250	3.0	0.6	0.35	2.5	14.0	20.0	33.0
TRF250-110U	0.110	0.220	60	250	3.0	1.0	1.00	0.8	5.0	9.0	16.0
TRF250-120	0.120	0.240	60	250	3.0	1.0	1.00	1.5	4.0	8.0	16.0
TRF250-120T	0.120	0.240	60	250	3.0	1.0	0.35	0.7	7.0	12.0	16.0
TRF250-120T-RA	0.120	0.240	60	250	3.0	1.0	1.00	1.2	7.0	9.0	16.0
TRF250-120T-RC	0.130	0.260	60	250	3.0	1.0	1.00	1.5	5.4	7.5	14.0
TRF250-120T-RF	0.120	0.240	60	250	3.0	1.0	1.00	0.9	6.0	10.5	16.0
TRF250-120T-R1	0.120	0.240	60	250	3.0	1.0	1.00	1.0	6.0	9.0	16.0
TRF250-120T-R2	0.120	0.240	60	250	3.0	1.0	1.00	0.8	8.0	10.5	16.0
TRF250-120U	0.120	0.240	60	250	3.0	1.0	1.00	1.0	6.0	10.0	16.0
TRF250-120UT	0.120	0.240	60	250	3.0	1.0	1.00	0.7	7.0	12.0	16.0
TRF250-145	0.145	0.290	60	250	3.0	1.0	1.00	2.5	3.0	6.0	14.0
TRF250-145-RA	0.145	0.290	60	250	3.0	1.0	1.00	2.5	3.0	5.5	12.0
TRF250-145-RB	0.145	0.290	60	250	3.0	1.0	1.00	2.0	4.5	6.0	14.0
TRF250-145T	0.145	0.290	60	250	3.0	1.0	1.00	1.5	5.4	7.5	14.0
TRF250-145U	0.145	0.290	60	250	3.0	1.0	1.00	2.0	3.5	6.5	14.0
TRF250-183‡	0.183	0.685	100	250	10.0	0.9	3.00	0.6	0.8	2.2	3.4
TRF250-184‡	0.184	1.000	100	250	10.0	0.9	3.00	0.5	1.2	2.4	3.1
Surface-mount* — 250V_{AC} TS250/TSL250/TSV250											
TSL250-080F	0.080	0.240	80	250	3.0	1.2	1.0	0.8	5.0	11.0	20.0**
TS250-130F	0.130	0.260	60	250	3.0	1.1	1.0	0.9	6.5	12.0	20.0**
	—	—	60	600	1.0	—	—	—	—	—	—
TS250-130F-RA	0.130	0.260	60	250	3.0	1.1	1.0	1.4	6.5	9.0	15.0**
	—	—	60	600	1.0	—	—	—	—	—	—
TS250-130F-RB	0.130	0.260	60	250	3.0	1.1	1.0	0.7	9.0	12.0	20.0**
	—	—	60	600	1.0	—	—	—	—	—	—
TS250-130F-RC	0.130	0.260	60	250	3.0	1.1	1.0	1.1	7.0	10.0	17.0**
	—	—	60	600	1.0	—	—	—	—	—	—
TSV250-130F	0.130	0.260	60	250	3.0	1.5	1.0	2.0	4.0	7.0	12.0**
TSV250-184F	0.184	0.690	100	250	10.0	0.9	3.0	0.5	1.2	3.0	4.0**
Radial-leaded† — 600V_{AC} TRF600											
TRF600-150	0.150	0.300	250	600	3.0	1.4	1.0	1.4	6.0	10.0	17.0
TRF600-150-RB	0.130	0.260	250	600	3.0	1.0	1.0	1.0	9.0	12.0	22.0
TR600-150F-EX	0.150	0.300	250	600	3.0	1.4	1.0	5.0	6.0	12.0	22.0
TR600-150F-EX-RA-B-0.5	0.150	0.300	250	600	3.0	1.4	1.0	5.0	7.0	10.0	20.0
TRF600-160	0.160	0.320	250	600	3.0	1.7	1.0	7.5	4.0	10.0	18.0
TRF600-160-RA	0.160	0.320	250	600	3.0	1.7	1.0	9.5	4.0	7.0	16.0
TRF600-160-R1	0.160	0.320	250	600	3.0	1.7	1.0	9.0	4.0	8.0	17.0
TRF600-250	0.250	0.850	250	600	3.0	2.0	3.0	1.0	1.0	4.3	7.0
TRF600-400	0.400	1.000	60	600	3.0	2.4	3.0	4.0	0.95	1.45	1.90

* 250V_{AC} interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.
† 600V_{AC} interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.
‡ Product is not currently available in a resistance matched or sorted option.
** R_{1MAX} measured 1 hour post-trip or 24 hours post-reflow at 20°C.

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Table T3 Electrical Characteristics for PolySwitch Telecommunications and Networking Devices Cont'd

Part Number	I_H (A)	I_T (A)	V_{MAX} Operating (V_{DC})	V_{MAX} Interrupt (V_{RMS})	I_{MAX}*† Interrupt (A)	$P_{D\ Typ}$ (W)	Typical Time-to-trip (A)	Typical Time-to-trip (s)	R_{MIN} (Ω)	R_{MAX} (Ω)	R_{1MAX} (Ω)
Surface-mount† — 600V_{AC} TS600/TSM600											
TS600-170F	0.170	0.400	60	600	3.0	2.5	1.0	10.0	4.0	9.0	18.0
TS600-200F-RA-B-0.5	0.200	0.400	60	600	3.0	2.5	1.0	12.0	4.0	7.5	13.5
TS600-400F	0.400	1.000	60	600	3.0	2.0	3.0	5.0	0.5	1.5	2.0
TSM600-250F	0.250	0.860	250	600	3.0	2.0	3.0	0.8	1.0	3.5	7.0
TSM600-250F-RA	0.250	0.860	250	600	3.0	2.0	3.0	1.0	1.0	3.0	5.0
TSM600-400F	0.400	1.000	250	600	3.0	2.0	3.0	5.0	0.5	1.5	2.0

Notes:

I_H : Hold current: maximum current device will pass without interruption in 20°C still air.
I_T : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.
V_{MAX} Operating : Maximum continuous voltage device can withstand without damage at rated current. This voltage is used for component recognition under UL1434.
V_{MAX} Interrupt : Maximum voltage that can be safely placed across a device in its tripped state. Devices may trip safely under higher level power cross conditions to assist equipment in meeting the appropriate ITU, UL60950 or GR1089 industry requirements.
I_{MAX} Interrupt : Maximum fault current device can withstand without damage at rated operating voltage. This current is used for component recognition under UL1434. Devices may trip safely under higher level power cross conditions to assist equipment in meeting the appropriate ITU, UL60950 or GR1089 industry requirements.
P_D : Power dissipated from device when in the tripped state in 20°C still air.
R_{MIN} : Minimum resistance of device as supplied at 20°C unless otherwise specified.
R_{MAX} : Maximum resistance of device as supplied at 20°C unless otherwise specified.
R_{1MAX} : Maximum resistance measured one hour post-trip or post-reflow at 20°C.

* 250V_{AC} interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.
† 600V_{AC} interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

Figures T2-T13 Dimension Figures for PolySwitch Telecommunications and Networking Devices

Figure T2

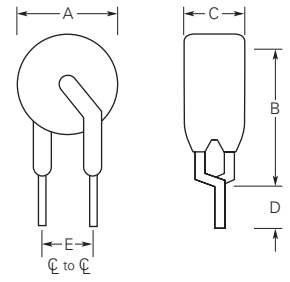


Figure T3

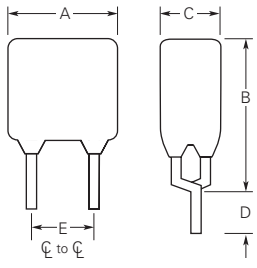


Figure T4

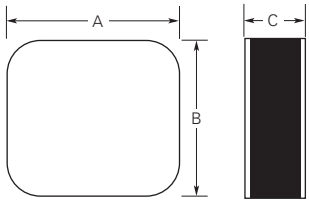


Figure T5

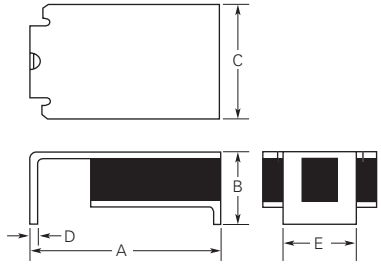


Figure T6

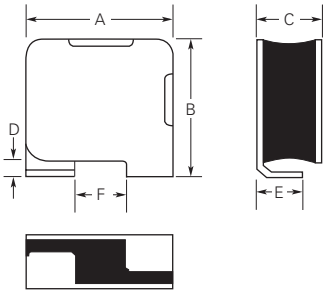
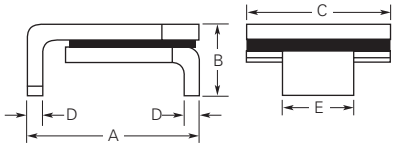


Figure T7



RoHS Compliant, ELV Compliant

Figures T2-T13 Dimension Figures for PolySwitch Telecommunications and Networking Devices Cont'd

Figure T8

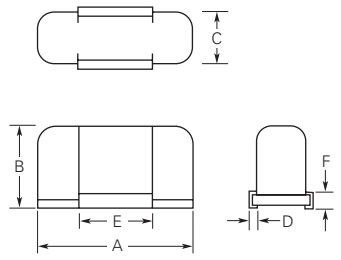


Figure T9

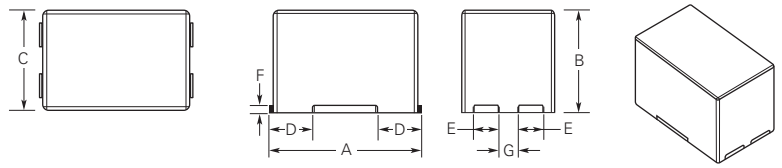


Figure T10

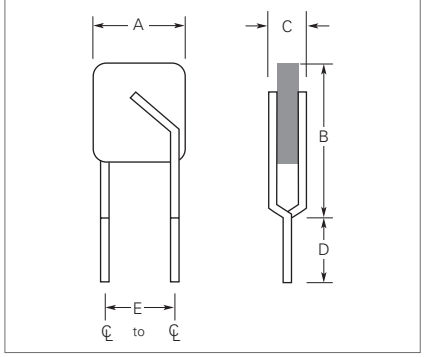


Figure T11

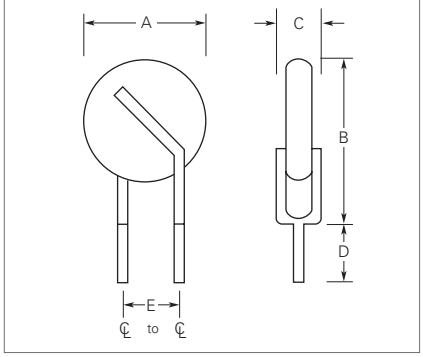


Figure T12

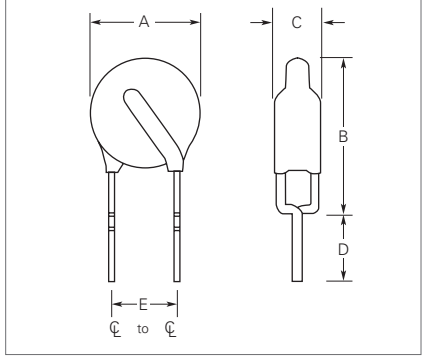


Figure T13

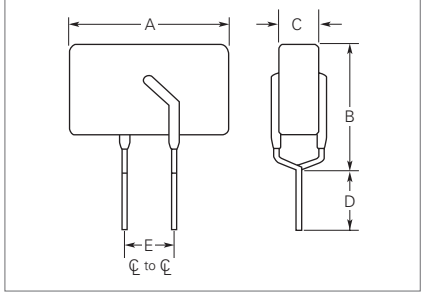


Table T4 Dimensions & Weights for PolySwitch Telecommunications and Networking Devices

Part Number	Dimensions in Millimeters (Inches) A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	Figure	Device Mass (g) (Only for Reference)
TCF-250V*																
TCF250-100T	4.6 (0.18)	4.9 (0.19)	4.6 (0.18)	4.9 (0.19)	2.0 (0.08)	2.3 (0.09)	—	—	—	—	—	—	—	—	T4	0.24
TCF250-120T	5.4 (0.21)	5.6 (0.22)	5.4 (0.21)	5.6 (0.22)	2.0 (0.08)	2.3 (0.09)	—	—	—	—	—	—	—	—	T4	0.28
TCF250-145T	5.4 (0.21)	5.6 (0.22)	5.4 (0.21)	5.6 (0.22)	2.0 (0.08)	2.5 (0.10)	—	—	—	—	—	—	—	—	T4	0.28
TCF250-180	6.9 (0.27)	7.1 (0.28)	6.9 (0.27)	7.1 (0.28)	1.3 (0.05)	1.6 (0.06)	—	—	—	—	—	—	—	—	T4	0.35
TRF250-250V*																
TRF250-055UT	—	4.8 (0.19)	—	9.3 (0.37)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T2	0.13
TRF250-080T	—	5.8 (0.23)	—	9.9 (0.39)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T2	0.28
TRF250-080U	—	4.8 (0.19)	—	9.3 (0.37)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T11	0.13
TRF250-110U	—	5.3 (0.21)	—	9.4 (0.37)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T11	0.13
TRF250-120	—	6.5 (0.26)	—	11.0 (0.43)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T3	0.38
TRF250-120U	—	6.0 (0.24)	—	10.0 (0.39)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T10	0.19
TRF250-145	—	6.5 (0.26)	—	11.0 (0.43)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T3	0.38
TRF250-145U	—	6.0 (0.24)	—	10.0 (0.39)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T10	0.19
TRF250-183	—	7.5 (0.29)	—	10.5 (0.41)	—	4.1 (0.16)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T2	0.30
TRF250-184	—	7.7 (0.30)	—	10.5 (0.41)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T12	0.32
TS250/TSL250/TSV250-250V*																
TSL250-080F	6.7 (0.27)	7.9 (0.31)	2.7 (0.11)	3.7 (0.15)	4.8 (0.19)	5.3 (0.21)	0.2 (0.01)	0.4 (0.02)	2.5 (0.10)	3.1 (0.12)	—	—	—	—	T7	2.80
TS250-130F	8.5 (0.34)	9.4 (0.37)	—	3.4 (0.14)	—	7.4 (0.29)	0.3‡ (0.01)	—	3.8‡ (0.15)	—	—	—	—	—	T5	3.60
TSV250-130F	—	6.10 (0.24)	—	6.90 (0.27)	—	3.20 (0.13)	0.56 (0.02)	—	—	1.90 (0.08)	1.60 (0.07)	2.30 (0.09)	—	—	T6	2.80
TSV250-184F	—	6.10 (0.24)	—	6.90 (0.27)	—	3.20 (0.13)	0.56 (0.02)	—	—	1.90 (0.08)	1.60 (0.07)	2.30 (0.09)	—	—	T6	2.80
TRF600-600V†																
TRF600-150	—	9.0 (0.35)	—	12.5 (0.49)	—	4.6 (0.18)	4.7 (0.19)	—	5.0 (0.20)	—	—	9.0 (0.35)	—	—	T3	0.37
TR600-150F-EX	—	13.5 (0.53)	—	12.6 (0.50)	—	6.0 (0.18)	4.7 (0.19)	—	5.0 (0.20)	—	—	—	—	—	T3	0.80
TR600-150F-EX-RA-B-0.5	—	13.5 (0.53)	—	12.6 (0.50)	—	6.0 (0.18)	4.7 (0.19)	—	5.0 (0.20)	—	—	—	—	—	T3	0.80
TRF600-160	—	16.0 (0.63)	—	12.6 (0.50)	—	6.0 (0.24)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	10.0 (0.39)	—	—	T13	0.90
TRF600-250	—	15.0 (0.59)		14.5 (0.57)		4.6 (0.18)	4.7 (0.19)		5.0‡ (0.20)	—		10.0 (0.39)		—	T3	0.87
TRF600-400	—	14.8 (0.58)	—	13.1 (0.52)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T13	0.85

* $250V_{AC}$ interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.
† $600V_{AC}$ interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.
‡ Indicates dimension is typical, not minimum.

Table T4 Dimensions & Weights for PolySwitch Telecommunications and Networking Devices Cont'd

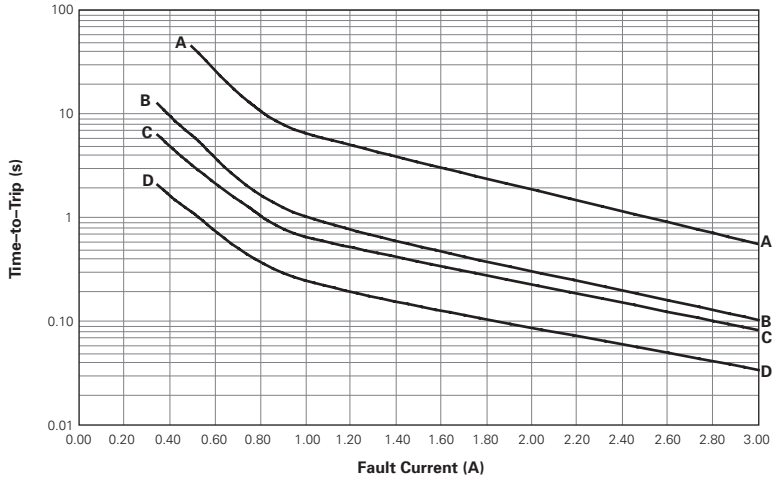
Part Number	Dimensions in Millimeters (Inches) A Min	A Max	B Min	B Max	C Min	C Max	D Min	D Max	E Min	E Max	F Min	F Max	G Min	G Max	Figure	Device Mass (g) (Only for Reference)
TS600/TSM600-600V†																
TS600-170F	18.3	19.4	11.6	12.3	7.2	8.3	1.7	2.4	9.9	10.4	1.5	2.3	—	—	T8	23.6
	(0.72)	(0.77)	(0.46)	(0.49)	(0.29)	(0.33)	(0.07)	(0.10)	(0.39)	(0.41)	(0.06)	(0.09)				
TS600-200F-RA	18.3	19.4	11.6	12.3	7.2	8.3	1.7	2.4	9.9	10.4	1.5	2.3	—	—	T8	23.6
	(0.72)	(0.77)	(0.46)	(0.49)	(0.29)	(0.33)	(0.07)	(0.10)	(0.39)	(0.41)	(0.06)	(0.09)				
TS600-400F	18.3	19.4	11.6	12.3	7.2	8.3	1.7	2.4	9.9	10.4	1.5	2.3	—	—	T8	19.8
	(0.72)	(0.77)	(0.46)	(0.49)	(0.29)	(0.33)	(0.07)	(0.10)	(0.39)	(0.41)	(0.06)	(0.09)				
TSM600-250F	17.0	17.60	11.20	11.70	10.40	11.20	4.80	5.20	2.50	2.80	0.60	1.0	2.2	3.1	T9	31.2
	(0.67)	(0.69)	(0.44)	(0.46)	(0.41)	(0.44)	(0.19)	(0.20)	(0.10)	(0.11)	(0.02)	(0.04)	(0.09)	(0.12)		
TSM600-250F-RA	17.0	17.60	11.20	11.70	10.40	11.20	4.80	5.20	2.50	2.80	0.60	1.0	2.2	3.1	T9	31.2
	(0.67)	(0.69)	(0.44)	(0.46)	(0.41)	(0.44)	(0.19)	(0.20)	(0.10)	(0.11)	(0.02)	(0.04)	(0.09)	(0.12)		
TSM600-400F	17.0	17.60	11.20	11.70	10.40	11.20	4.80	5.20	2.50	2.80	0.60	1.0	2.2	3.1	T9	31.2
	(0.67)	(0.69)	(0.44)	(0.46)	(0.41)	(0.44)	(0.19)	(0.20)	(0.10)	(0.11)	(0.02)	(0.04)	(0.09)	(0.12)		

† $600V_{AC}$ interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

TCF250

A = TCF250-180
B = TCF250-145T
C = TCF250-120T
D = TCF250-100T

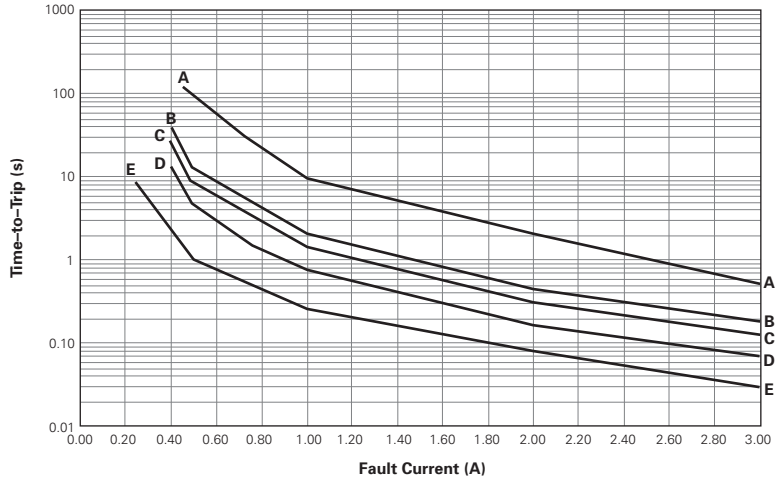
Figure T14



TRF250

A = TRF250-180/183/184
B = TRF250-145/145U
C = TRF250-120/120U
D = TRF250-110U/120UT/120T
E = TRF250-080T/080U/080US

Figure T15

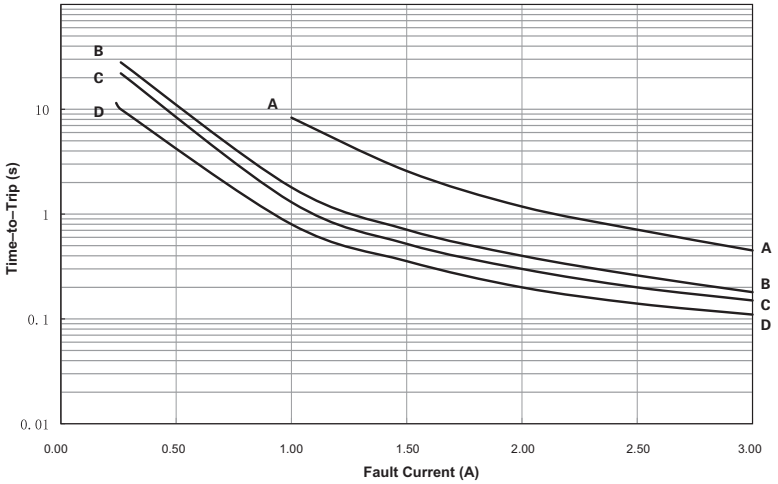


RoHS Compliant, ELV Compliant

TS250/TSV250/TSL250

A = TSV250-184F
B = TSV250-130F
C = TS250-130F
D = TSL250-080F

Figure T16



TRF600/TS600/TSM600

A = TRF600-400/TS600-400/TSM600-400F
B = TRF600-250/TSM600-250F/TS600-170F/200F
C = TRF600-160
D = TR600-150F-EX
E = TRF600-150

Figure T17

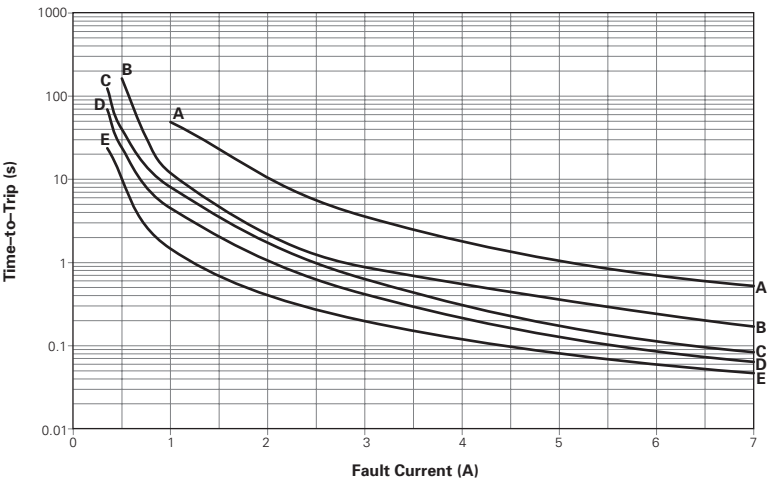


Table T5 Physical Characteristics and Environmental Specifications for PolySwitch Telecommunications and Networking Devices

Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)

TCF250*

Physical Characteristics

Terminal Material	Nickel-plated Copper Foil

Environmental Specifications

Test	Conditions
Passive Aging	60°C, 1000 hrs
	85°C, 1000 hrs
Humidity Aging	85°C, 85% RH, 1000 hrs
Thermal Shock	125°C, -55°C (10 Times)
Solvent Resistance	MIL-STD-202, Method 215F

Note: Storage conditions: 40°C (max), 70% RH (max), devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

Table T5 Physical Characteristics and Environmental Specifications for PolySwitch Telecommunications and Networking Devices Cont'd

Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)

TRF250*

Physical Characteristics

Lead Material	Tin-plated Copper, 22AWG
Insulating Material	Cured Epoxy Polymer
Flammability	Per IEC 695-2-2 Needle Flame Test for 20 s
Soldering Characteristics	ANSI/J-STD-002, Category 3
Solder Heat Withstand	IEC-STD 68-2-20, Test Tb, Section 5 Method 1A, Condition B: Can Withstand 10s at 260°C±5°C

Note: Devices are not intended to be placed through a reflow process.

Environmental Specifications

Test	Conditions
Passive Aging	60°C, 1000 hrs
	85°C, 1000 hrs
Humidity Aging	85°C, 85% RH, 1000 hrs
Thermal Shock	125°C, -55°C (10 Times)
Solvent Resistance	MIL-STD-202, Method 215F

Note: Storage conditions: 40°C (max), 70% RH (max), devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

TS250/TSV250/TSL250*

Physical Characteristics

Terminal Material	Tin-plated Brass, Nickel Under-plating
Soldering Characteristics	EIC 60008-2-58

Environmental Specifications

Test	Conditions
Passive Aging	60°C, 1000 hrs
	85°C, 1000 hrs
Humidity Aging	85°C, 85% RH, 500 hrs
Thermal Shock	125°C, -55°C (10 Times)
Solvent Resistance	MIL-STD-202, Method 215F

Note: Storage conditions: 40°C (max), 70% RH (max), devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

TRF600†

Physical Characteristics

Lead Material	Tin-plated Copper, 22AWG
Insulating Material	Cured Epoxy Polymer‡
Flammability	Per IEC 695-2-2 Needle Flame Test for 20s
Soldering Characteristics	ANSI/J-STD-002, Category 3
Solder Heat Withstand	IEC-STD 68-2-20, Test Tb, Section 5 Method 1A, Condition B: Can Withstand 10 s at 260°C±5°C

Note: Devices are not intended to be placed through a reflow process.

Environmental Specifications

Test	Conditions
Passive Aging	60°C, 1000 hrs
	85°C, 1000 hrs
Humidity Aging	85°C, 85% RH, 1000 hrs‡
Thermal Shock	125°C, -55°C (10 Times)
Solvent Resistance	MIL-STD-202, Method 215F

Note: Storage conditions: 40°C (max), 70% RH (max) devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

* $250V_{AC}$ interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.
† $600V_{AC}$ interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.
‡ Excluding TRF600-150 and TRF600-400, which have a coating that is not rated for dielectric withstand and can withstand 500h at 85°C/85% RH or 1000h at 60°C/90% RH.

Table T5 Physical Characteristics and Environmental Specifications for PolySwitch Telecommunications and Networking Devices Cont'd

Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)

TS600†

Physical Characteristics

Terminal Material	Tin-plated Brass
Insulating Material	Nylon Resin (UL94V-0), 1000V Dielectric Rating
Flammability	IEC 695-2-2 Needle Flame Test for 20 s
Soldering Characteristics	ANSI/J-STD-002, Category 3
Solder Heat Withstand	IEC-STD 68-2-20, Test Tb, Section 5 Method 1A

Environmental Specifications

Test	Conditions
Passive Aging	60°C, 1000 hrs
	85°C, 1000 hrs
Humidity Aging	85°C, 85% RH, 1000 hrs
Thermal Shock	125°C, -55°C (10 Times)
Solvent Resistance	MIL-STD-202, Method 215F

Note: Storage conditions: 40°C (max), 70% RH (max), devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

TSM600†

Physical Characteristics

Terminal Material	Tin-plated Brass
Insulating Material	Nylon Resin (UL94V-0), 1000V Dielectric Rating
Flammability	IEC 695-2-2 Needle Flame Test for 20 s
Soldering Characteristics	EIC60068-2-58, Method 7
Solder Heat Withstand	IEC-STD 68-2-20, Test Tb, Section 5 Method 1A

Environmental Specifications

Test	Conditions
Passive Aging	60°C, 1000 hrs
	85°C, 1000 hrs
Humidity Aging	85°C, 85% RH, 1000 hrs
Storage Humidity	Per IPC/JEDEC J-STD-020A Level 2a
Thermal Shock	125°C, -55°C (10 Times)
Solvent Resistance	MIL-STD-202, Method 215J

Note: Storage conditions: 40°C (max), 70% RH (max) devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

† $600V_{AC}$ interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

Table T6 Packaging and Marking Information for PolySwitch Telecommunications and Networking Devices

Part Number	Bag Quantity	Tape and Reel Quantity	Standard Package Quantity	Part Marking	Agency Recognition
Chip* — 250V_{AC} TCF250					
TCF250-100T	2,500	—	10,000	—	—
TCF250-120T	2,500	—	10,000	—	—
TCF250-145T	2,500	—	10,000	—	—
TCF250-180	2,500	—	10,000	—	UL
Radial-leaded* — 250V_{AC} TRF250					
TRF250-055UT	500	—	10,000	—	—
TRF250-080U	500	—	10,000	—	UL, CSA, TÜV
TRF250-080U-2	—	1,500	7,500	—	UL, CSA, TÜV
TRF250-080T	500	—	10,000	08F	UL, CSA, TÜV
TRF250-110U	500	—	10,000	—	UL, CSA, TÜV
TRF250-120	500	—	10,000	20F	UL, CSA, TÜV
TRF250-120-2	—	1,500	7,500	20F	UL, CSA, TÜV
TRF250-120T	500	—	10,000	20F	UL, CSA, TÜV
TRF250-120T-2	—	1,500	7,500	20F	UL, CSA, TÜV
TRF250-120U	500	—	10,000	20F	UL, CSA, TÜV
TRF250-120U-2	—	1,500	7,500	20F	UL, CSA, TÜV
TRF250-120UT	500	—	10,000	20F	UL, CSA, TÜV
TRF250-145	500	—	10,000	45F	UL, CSA, TÜV
TRF250-145-2	—	1,500	7,500	45F	UL, CSA, TÜV
TRF250-145-RA	500	—	10,000	45F	UL, CSA, TÜV
TRF250-145U	500	—	10,000	45F	UL, CSA, TÜV
TRF250-145U-2	—	1,500	7,500	45F	UL, CSA, TÜV
TRF250-183	500	—	10,000	83F	UL, CSA, TÜV
TRF250-183-2	—	1,500	7,500	83F	UL, CSA, TÜV
TRF250-184	500	—	10,000	84F	UL, CSA, TÜV
Surface-mount* — 250V_{AC} TS250/TSL250/TSV250					
TSL250-080F-2	—	1,500	7,500	T08	UL, CSA,TÜV
TS250-130F-2	—	1,500	7,500	T13	UL, CSA, TÜV
TSV250-130F-2	—	1,200	6,000	T13V	UL, CSA, TÜV
TSV250-184F	2500	—	10,000	T18V	UL
Radial-leaded† — 600V_{AC} TRF600					
TRF600-150	500	—	10,000	150F	UL, CSA, TÜV
TRF600-150-2	—	1,500	7,500	150F	UL, CSA, TÜV
TR600-150F-EX	500	—	10,000	150F	UL, CSA
TR600-150F-EX-2	—	600	3,000	150F	UL, CSA
TR600-150F-EX-RA-B-0.5	500	—	10,000	150F	UL, CSA
TRF600-160	500	—	10,000	160F	UL, CSA, TÜV
TRF600-160-2	—	600	3,000	160F	UL, CSA, TÜV
TRF600-250	500	—	10,000	250F	UL, CSA, TÜV
TRF600-400	500	—	10,000	400F	UL, CSA
Surface-mount† — 600V_{AC} TS600/TSM600					
TS600-170F-2	—	300	900	T20	UL, CSA
TS600-200F-RA-2	—	300	900	T20	UL, CSA
TS600-400F-2	—	300	900	T40	UL, CSA
TSM600-250F-2	—	200	1,000	TSM600	UL, CSA
TSM600-250F-RA-2	—	200	1,000	TSM600	UL, CSA
TSM600-400F-2	—	200	1,000	TSM600	UL

* 250V_{AC} interrupt products are designed to help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.
† 600V_{AC} interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

RoHS Compliant, ELV Compliant

Agency Recognition for PolySwitch Telecommunications and Networking Devices

UL	File # E74889	
CSA	File # 78165C	
TÜV	Per IEC60730-1	Certificate # for individual products available upon request.

Table T7 Recommended Pad Layouts for Surface-mount PolySwitch Telecommunications and Networking Devices in Millimeters (Inches) Nominal

Device	A	B	C	D	E	F	G	Figure
TS250 (All)	4.60	1.80	6.10	—	—	—	—	T18
	(0.180)	(0.070)	(0.240)	—	—	—	—	
TSV250 (All)	2.29	2.41	6.35	3.43	—	—	—	T19
	(0.090)	(0.095)	(0.250)	(0.135)	—	—	—	
TSL250 (All)	3.60	1.80	5.50	—	—	—	—	T18
	(0.140)	(0.070)	(0.220)	—	—	—	—	
TS600 (All)	10.42	3.30	3.35	—	—	—	—	T18
	(0.410)	(0.130)	(0.132)	—	—	—	—	
TSM600 (All)	5.20	17.80	5.54	6.75	2.08	3.12	8.39	T20
	(0.205)	(0.701)	(0.218)	(0.266)	(0.082)	(0.123)	(0.331)	

Figure T18

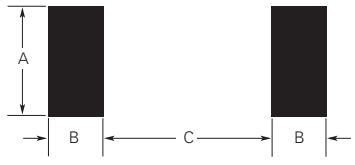


Figure T19

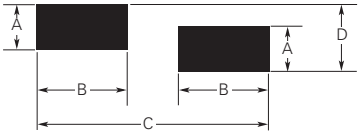
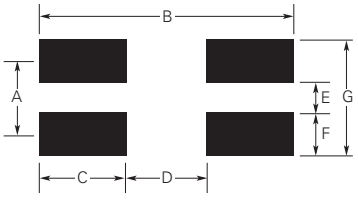


Figure T20

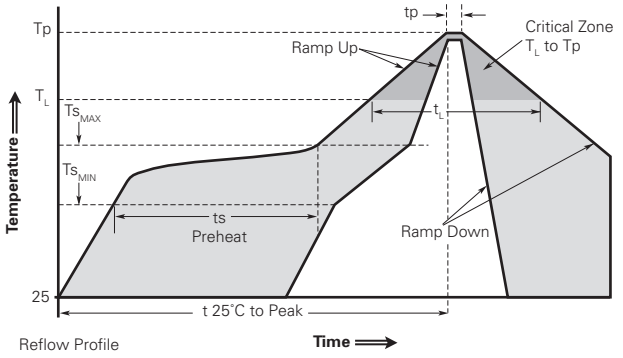


Solder Reflow and Rework Recommendations for PolySwitch Telecommunications Surface-Mount Devices

Profile Feature	Pb-Free Assembly
Average ramp up rate (Ts_{MAX} to Tp)	3°C/s max
Preheat	
• Temperature min (Ts_{MIN})	150°C
• Temperature max (Ts_{MAX})	200°C
• Time (ts_{MIN} to ts_{MAX})	60-180 s
Time maintained above:	
• Temperature (T_L)	217°C
• Time (t_L)	60-150 s
Peak/Classification temperature (Tp)	260°C
Time within 5°C of actual peak temperature	
Time (tp)	20-40 s
Ramp down rate	6°C/s max
Time 25°C to peak temperature	8min max

Note: All temperatures refer to topside of the package, measured on the package body surface.

Figure T21



Solder Reflow

- Recommended reflow method: IR, vapor phase oven, hot air oven.
- Surface-mount devices are not intended to be wave soldered to the bottom side of the board.
- Recommended maximum paste thickness of 0.25mm (0.010in).
- Devices can be cleaned using standard industry methods and solvents.

Rework

- If a device is removed from the board, it should be discarded and replaced with a new device.

RoHS Compliant, ELV Compliant

Wave Soldering and Rework Recommendations for PolySwitch Telecommunications Radial-Leaded Devices

Recommended Wave Soldering

- Soldering temperature profile
  Temperature characteristic at component terminal with dual wave soldering

Rework

- If a device is removed from the board, it should be discarded and replaced with a new device

Figure T22

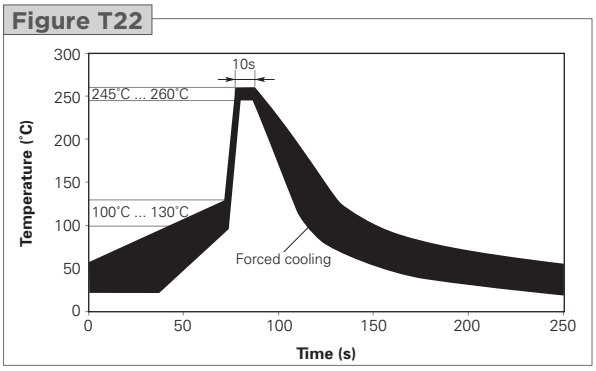


Table T8 TRF250/TRF600 Tape and Reel Specifications for PolySwitch Telecommunications and Networking Device

TRF250/TRF600 devices are available in tape and reel packaging per EIA 468-B standard. See Figures T23 and T24 for details.

Dimension Description	EIA Mark	IEC Mark	Dimension (mm)	Tolerance
Carrier Tape Width	W	W	18	-0.5/+1.0
Hold Down Tape Width	W_4	W_0	5	Min
Top Distance between Tape Edges	W_6	W_2	3	Max
Sprocket Hole Position	W_5	W_1	9	-0.5/+0.75
Sprocket Hole Diameter	D_0	D_0	4	±0.2
Abcissa to Plane (Straight Lead)	H	H	18.5	±3.0
Abcissa to Plane (Kinked Lead)*	H_0	H_0	16	-0.5/+0.6
Abcissa to Top	H_1	H_1	32.2	Max
Overall Width with Lead Protrusion	—	C_1	43.2	Max
Overall Width without Lead Protrusion	—	C_2	42.5	Max
Lead Protrusion	L_1	I_1	1.0	Max
Protrusion of Cut-out	L	L	11	Max
Protrusion beyond Hold Down Tape	I_2	I_2	Not Specified	—
Sprocket Hole Pitch	P_0	P_0	12.7	±0.3
Device Pitch (TRF250 and TRF600-150)	—	—	12.7	—
Device Pitch (TRF600-160 - TRF600-400)	—	—	25.4	—
Pitch Tolerance	—	—	20 Consecutive	±1
Tape Thickness	t	t	0.9	Max
Tape Thickness with Splice*	t_1	—	2.0	Max
Splice Sprocket Hole Alignment	—	—	0	±0.3
Body Lateral Deviation	Δh	Δh	0	±1.0
Body Tape Plane Deviation	Δp	Δp	0	±1.3
Lead Spacing Plane Deviation	ΔP_1	P_1	0	±0.7
Lead Spacing*	F	F	5.08	±0.6
Reel Width	w_2	w	56	Max
Reel Diameter	a	d	370	Max
Space between Flanges Less Device	w_1	—	4.75	±3.25
Arbor Hole Diameter	c	f	26	±12.0
Core Diameter	n	h	80	Max
Box	—	—	56/372/372	Max
Consecutive Missing Pieces*	—	—	3 Max	—
Empty Places per Reel*	—	—	Not Specified	—

* Differs from EIA specification.

Figure T23 EIA Referenced Taped Component Dimensions for PolySwitch Telecommunications Radial-Leaded Devices

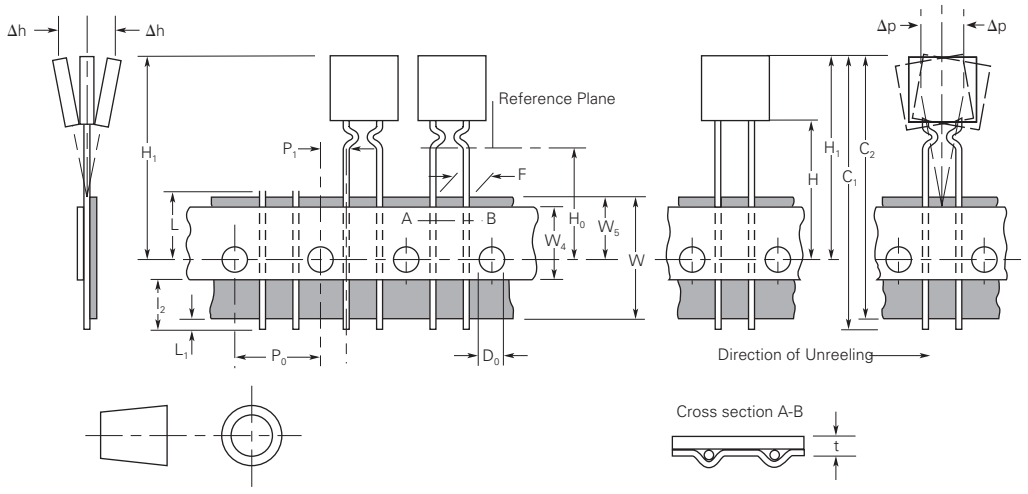


Figure T24 Reel Dimensions for PolySwitch Telecommunications Radial-Leaded Devices

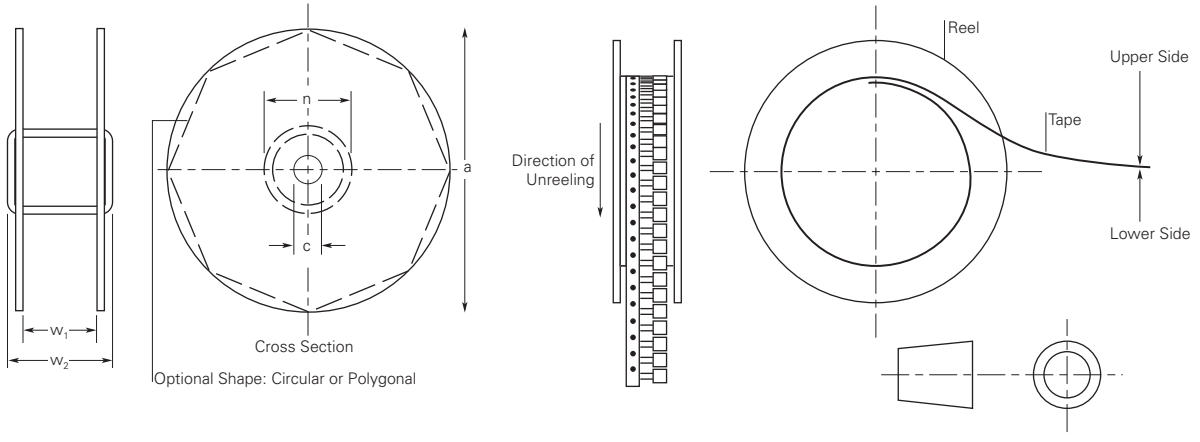


Table T9 TS Tape and Reel Specifications for PolySwitchTelecommunications and Networking Devices

TS devices are packaged per EIA 481 and EIA 481-2 standards. See Figures T25 and T26 for details.

TS250/TSL250/TSV250

Dimension Description	EIA Mark	TS250		TSV250		TSL250	
		Dimension (mm)	Tolerance (mm)	Dimension (mm)	Tolerance (mm)	Dimension (mm)	Tolerance (mm)
Carrier Tape Width	W	16	±0.30	16.0	±0.30	16	±0.30
Sprocket Hole Pitch	P_0	4.0	±0.10	4.0	±0.10	4.0	±0.10
	P_1	12.0	±0.10	8.0	±0.10	8.0	±0.10
	P_2	2.0	±0.10	2.0	±0.10	2.0	±0.10
	A_0	6.9	±0.23	5.5	±0.10	5.5	±0.10
	B_0	9.6	±0.15	6.2	±0.10	7.9	±0.10
	B_1 max	12.1	—	8.0	—	9.2	—
Sprocket Hole Diameter	D_0	1.5	-0/+0.1	1.55	±0.05	1.55	±0.05
	F	7.5	±0.10	7.5	±0.10	7.5	±0.10
	E_1	1.75	±0.10	1.75	±0.10	1.75	±0.10
	E_2 min	14.25	—	—	—	—	—
Tape Thickness	T max	0.4	—	0.45	—	0.35	—
Tape Thickness With	T_1 max	0.1	—	0.1	—	0.1	—
Splice Cover Tape Thickness	K_0	3.4	±0.15	7.0	±0.10	3.70	±0.10
	Leader min	300	—	390	—	390	—
	Trailer min	300	—	160	—	160	—
Reel Dimensions							
Reel Diameter	A max	340	—	340	—	340	—
Core Diameter	N min	50	—	50	—	50	—
Space between Flanges-less Device	W_1	16.4	-0/+2.0	16.4	-0/+2.0	16.4	-0/+2.0
Reel Width	W_2 max	22.4	—	22.4	—	22.4	—

TS600

Dimension Description	EIA Mark	Dimension (mm)	Tolerance
Carrier Tape Width	W	32	±0.3
Sprocket Hole Pitch	P_0	4.0	±0.1
	P_1	16	±0.1
	P_2	2.0	±0.1
	A_0	10	±0.1
	B_0	19.2	±0.1
	B_1 max	21.6	
Sprocket Hole Diameter	D_0	1.5	-0/+1.0
	F	14.2	±0.1
	E_1	1.75	±0.1
	E_2 min	28.4	±0.1
Tape Thickness	T max	0.50	±0.5
Tape Thickness with Splice	T_1 max	0.1	
	K_0	13.2	±0.1
	Leader min	390	
	Trailer min	160	
Reel Dimensions			
Reel Diameter	A max	360	
Core Diameter	N min	50	
Space between Flanges-less Device	W_1	32.4	-0/+2.0
Reel Width	W_2 max	40	

Table T9 TS Tape and Reel Specifications for PolySwitch Telecommunications and Networking Devices Cont'd

TS devices are packaged per EIA 481 and EIA 481-2 standards. See Figures T25 and T26 for details.

TSM600

Dimension Description	EIA Mark	Dimension (mm)	Tolerance
Carrier Tape Width	W	32	±0.3
Sprocket Hole Pitch	P_0	4.0	±0.1
	P_1	24	±0.1
	P_2	2.0	±0.1
	A_0	11.2	±0.1
	B_0	17.8	±0.1
	B_1 max	23.45	
Sprocket Hole Diameter	D	1.5	-0/+1.0
	F	14.2	±0.1
	E_1	1.74	±0.1
	E_2 max	28.4	±0.1
Tape Thickness	T max	0.5	±0.5
Tape Thickness with Splice	T_1 max	0.1	
	K_0	11.9	±0.1
	Leader min	390	
	Trailer min	160	

Reel Dimensions			
Reel Diameter	A max	360	
Core Diameter	N min	50	
Space between Flanges-less Device	W_1	32.4	-0/+2.0
Reel Width	W_2 max	40	

Figure T25 EIA Referenced Taped Component Dimensions for PolySwitch Telecommunications and Networking Devices

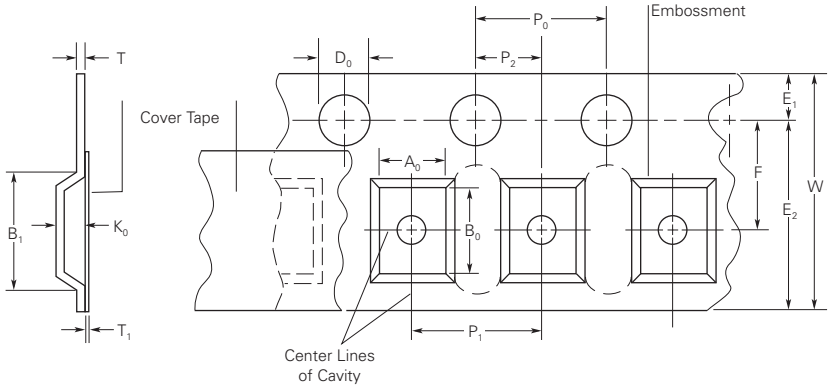
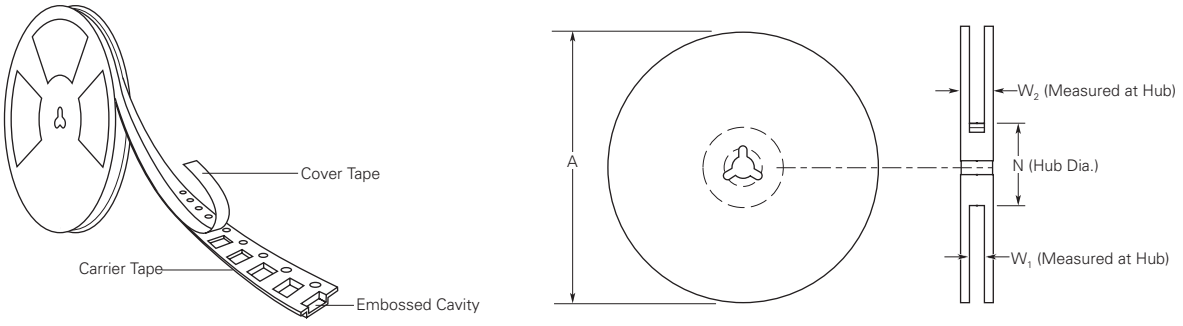


Figure T26 EIA Referenced Reel Dimensions for PolySwitch Telecommunications and Networking Devices



RoHS Compliant, ELV Compliant

PolySwitch Telecommunications and Networking Resistance-Sorted and Resistance-Matched Devices

Most TCF, TRF and TS devices are available in resistance-sorted and/or resistance-matched versions.

Resistance-sorted Devices

Resistance-sorted devices (part number suffix "Rx", where x = 1, 2, A, B, C, F, etc.) are supplied with resistance values that are within specified segments of the device's full range of resistance.

Feature

- Narrow resistance range.

Benefits

- Can help provide greater flexibility for design engineers.
- Lower resistance devices can help provide increased loop length on line card designs.
- Higher resistance devices may help provide greater protection by offering faster time-to-trip.

Resistance-matched Devices

Resistance-matched devices are supplied such that all parts in one particular package (or reel) are within 0.5Ω of each other (1.0Ω for TRF250-080T devices). Individual matched packages are supplied from the full resistance range of the specified device.

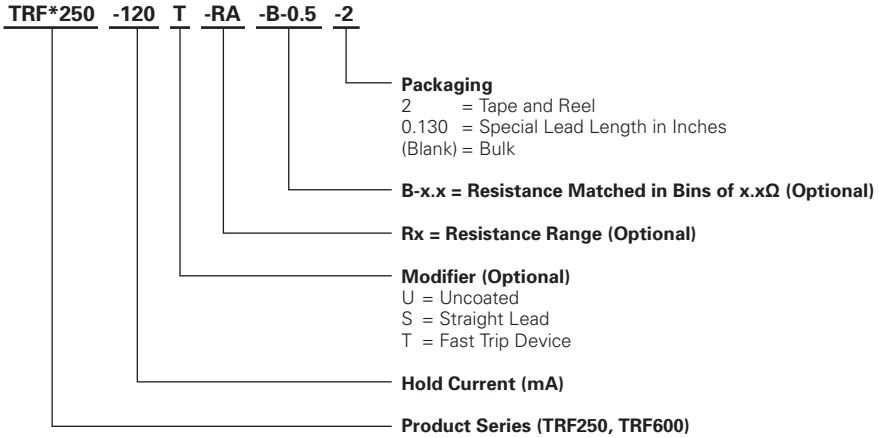
Feature

- Tighter resistance balance between any two parts in a package.

Benefits

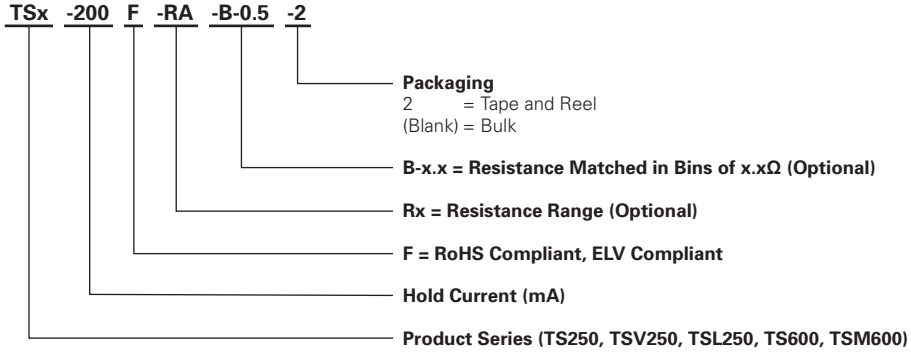
- Resistance-matched devices may help reduce the tip-ring resistance differential, reducing the possibility of line imbalance.

Part Numbering System for PolySwitch Radial-Leaded Telecommunications and Networking Devices

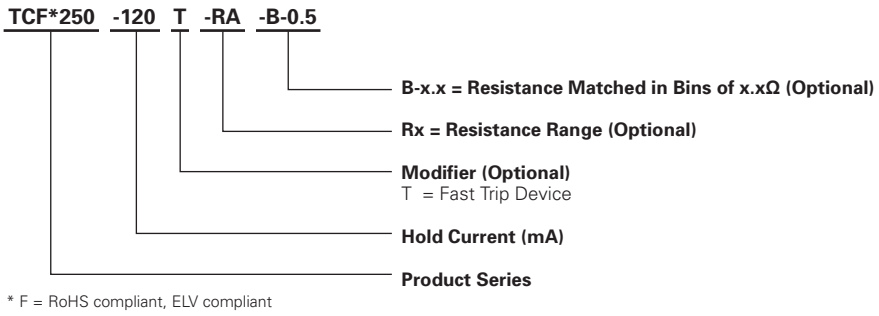


* F = RoHS compliant, ELV compliant

Part Numbering System for PolySwitch Surface-mount Telecommunications and Networking Devices



Part Numbering System for Chip PolySwitch Telecommunications and Networking Devices



* F = RoHS compliant, ELV compliant

⚠ Warning :

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage (Ldi/dt) above the rated voltage of the device.

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