Raychem Circuit Protection Products Catalog 2010

Tyco Electronics

Our commitment. Your advantage.

This catalog is intended to present application, product, and technical data to assist the user in selecting circuit protection products, including PolySwitch resettable devices, PolyZen devices, 2Pro devices, Silicon ESD protection devices, ESD protection devices, chip fuses and gas discharge tubes. All information, including illustrations, is believed to be accurate and reliable. However, users should independently evaluate the suitability of, and test each product for their application. Tyco Electronics Corporation makes no warranties as to the accuracy or completeness of the information in this catalog and disclaims any liability resulting from its use. Tyco Electronics 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. Tyco Electronics' only obligations are those in the Tyco Electronics Standard Terms and Conditions of Sale and in no case will Tyco Electronics be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of its products.

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Tyco Electronics
Our commitment. Your advantage.

Welcome to Tyco Electronics

Tyco Electronics Ltd. is a leading global provider of engineered electronic components, network solutions, specialty products and undersea telecommunication systems, with fiscal 2009 sales of US$10.3 billion to customers in more than 150 countries. We design, manufacture and market products for customers in a broad array of industries including automotive; data communication systems and consumer electronics; telecommunications; aerospace, defense and marine; medical; energy; and lighting. With approximately 7,000 engineers and worldwide manufacturing, sales and customer service capabilities, Tyco Electronics' commitment is our customers' advantage.

Our Product Advantage

We design, manufacture, and market nearly 500,000 products for more than 200,000 customer locations in industries ranging from automotive, appliance, and aerospace and defense to telecommunications, computers, and consumer electronics. We bring a performance advantage to every technology, product and service we provide, including connector systems, relays, fiber optics, circuit protection devices, wire and cable, touch systems, heat shrink tubing, racks and panels, network interface devices, and undersea telecommunication systems. We are continually honing our technological edge with the goal of delivering the best products – with the highest quality – every time.

Our Technology Advantage

We invest more than four percent of the company's sales revenue on research, development and engineering annually. These efforts are supported by over 7,000 engineers and 17 global design centers, working closely with our customers to develop highly engineered, application-specific products and systems to satisfy customers' needs. We apply for more than 750 patents annually and hold more than 15,000 patents and patent applications in total. Our innovation, early design involvement and materials expertise give customers a competitive advantage by delivering new functionality, and by helping them to bring better performance to existing products, deliver new products to market faster, and realize greater efficiencies in their manufacturing processes.

Our Global Advantage

We have an established manufacturing presence in over 25 countries, we operate in approximately 50 countries, and we serve customers in more than 150 countries. Our global coverage positions us near our customers and allows us to assist them in consolidating their supply base and lowering their production costs. In addition, our Global Account Management programs allow us to maintain close working relationships with the key customers in the markets we serve. With sales of US$10.3 billion in fiscal 2009, we are significantly larger than many of our competitors – giving us scale and reach that generate direct dividends for our customers everywhere.

Our Employee Advantage

We have approximately 75,000 dedicated employees who are based throughout the world, with approximately 26,000 employees in China alone. By maximizing the commitment of our 7,000-plus engineers, and the reach of our 5,000-plus member sales force serving customers in more than 150 countries, we can collaborate with customers to provide highly engineered products and innovative solutions to meet their needs. Our diverse and capable management team is equally dedicated to creating and sustaining those powerful customer alliances – and to earning their business every day.

Circuit Protection Products

Our circuit protection products are a part of your everyday life. From your phone battery to your car's steering wheel, we are helping to make your world safer and your electronics more reliable.

For over 25 years we have pioneered the field of polymeric positive temperature coefficient (PPTC) resettable technology with our PolySwitch product line. We developed the first patents for the use of a PPTC device as a variable resistor in circuit protection applications in the 70's and 80's. Since then, we have continued to expand our family of PolySwitch PPTC devices to include wider voltage, current, and temperature ranges in a variety of form factors.

Established as a leader in resettable circuit protection solutions, we continue to expand our product portfolio to include overcurrent, overvoltage and hybrid circuit protection product lines.

Our overvoltage circuit protection products include gas discharge tubes (GDT), electrostatic discharge protectors (ESD) and Silicon ESD (SESD) protection devices. When used along with PolySwitch devices, these overvoltage devices can help provide a coordinated and resettable solution to assist OEMs in meeting stringent regulatory requirements and in improving equipment reliability.

Single-use fuses – such as slow-blow chip fuses, fast-acting chip fuses, telecom fuses, and high-current-rated chip fuses – are suitable for use in applications that need to disable the circuit rather than isolate it.

Our two hybrid protection product lines – PolyZen devices and 2Pro devices – integrate overcurrent and overvoltage protection functions in a single device. This effectively reduces component count and, when appropriately applied, can expand performance attributes and help improve system reliability.

Billions of our Raychem 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 and HVAC, and telecommunication markets. In addition, our leading-edge solutions continue to add value in transient overvoltage protection for telecommunications applications.

We are recognized as a leader in operational excellence and customer service. And, our products are in compliance with globally recognized ISO9000/TS16949 standards.

We offer a dedicated engineering sales force, world-wide manufacturing and design centers, and local engineering support devoted to our circuit protection business. This helps us to think, manage, and share globally, yet act locally to meet our customer needs.

Application Summaries

Navigation and Infotainment System

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

- AHRF, AGRF, AHEF
- AHS, ASMD, miniSMD, microSMD, nanoSMD
- ESD
- SESD
- SFF, SFS
- ZEN

Driver-Side Console

The switch console on the driver-side door allows the driver to control multiple functions, including power windows, side mirrors and power door lock. Small surface-mount PolySwitch devices help protect PCB traces against damage caused by overheating and smoking in the event of a short circuit. A variety of designs include PolySwitch devices to help protect PCB traces leading to power window motors, delicate carbon membrane in microswitches, transistors in LED backlighting circuits and small traces of the side mirror contol circuit.

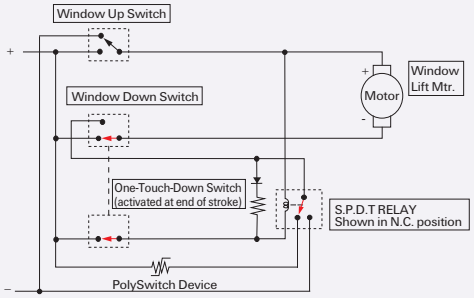
- miniSMD, microSMD, nanoSMD
- SFF, SFS

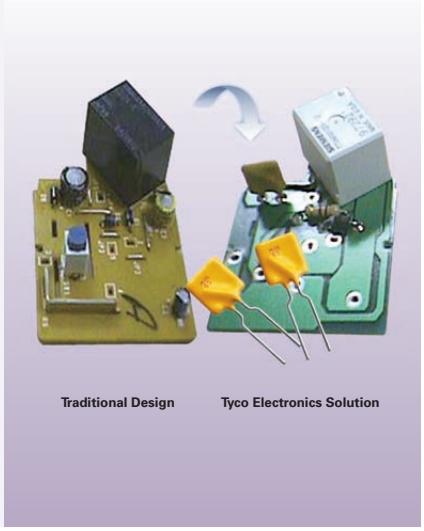
One-Touch-Down Circuit for Power Windows and Power Sunroofs

This lower cost one-touch-down circuit employs a PolySwitch PPTC device to function as both 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 achieve net cost savings through reduced component count and reduction in wire size.

- AHRF, AGRF, AHEF
- AHS, ASMD

PolySwitch Device Employed in One-Touch-Down Circuit

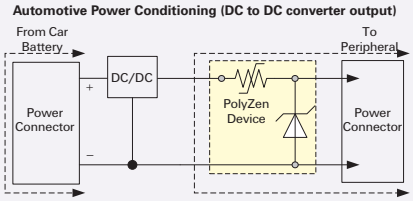




Automotive Electronics

PolyZen devices help protect automotive peripherals and portable electronics that can be charged in the vehicle from damage caused by inductive voltage spikes, voltage transients, and reverse bias. The PolyZen device provides coordinated protection with a component that protects like a Zener diode, but is capable of withstanding the high-power fault conditions that can occur in automotive applications.

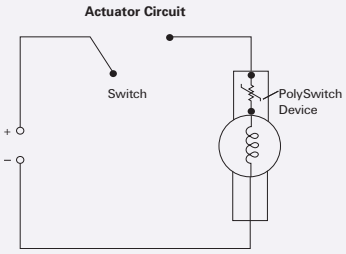
- ZEN



Automotive Actuators and Medium-Size DC Motors

Automotive electric motors can overheat and cause damage to temperature sensitive components. To help protect these components, custom made PolySwitch devices can be designed for specific customer applications. Installing a PolySwitch device in close proximity to the motor or solenoid offers the added benefit of limiting current due to excessive heat.

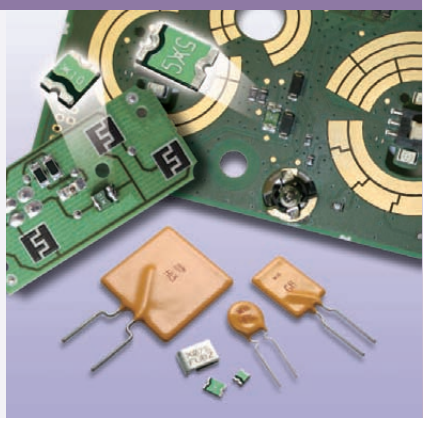
- AGRF, AHRF, AHEF
- SFF, SFS, SFH



Printed Circuit Board Trace

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.

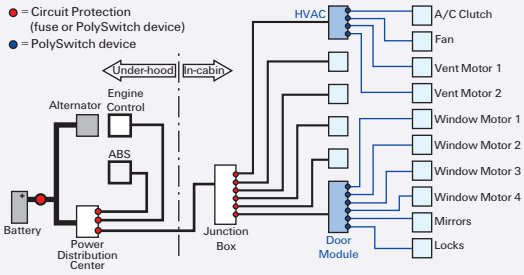
- AHRF, AGRF, AHEF
- AHS, ASMD, miniSMD, microSMD, nanoSMD
- SFF, SFS



Automobile Harness

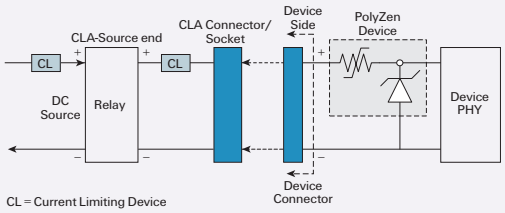
The wiring harness architectures of light and heavy vehicles have undergone considerable change due to increased electrical and electronic content. Resettable circuit protection that does not need to be driver accessible, such as PolySwitch PPTC devices, offers a number of solutions that may be used separately or in combination. Overvoltage protection devices (MOVs) are also recommended.

- AHRF, AGRF, AHEF
- VLP, VLR, VTP, LTP, SRP
- ASMD
- BD280
- SFF, SFS



DC Cigarette Lighters and Power Plug Adapters

Charger circuits for mobile phones, iPods, after-market hands-free devices, or other 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 a harsh automotive environment.
Typically, overcurrent protection, such as a PolySwitch PPTC device, and overvoltage protection are coordinated at the input to the charger to help meet the stringent electrical requirement.
A single PolyZen device can be used to help protect against damage caused by overcurrent and overvoltage faults.

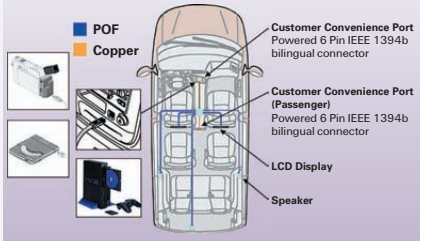


- AHRF, AGRF, AHEF
- AHS, ASMD
- SFF, SFS, SFH
- ZEN

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 but also for after-market electronic equipment such as Portable Navigation Devices (PNDs), iPods, 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.

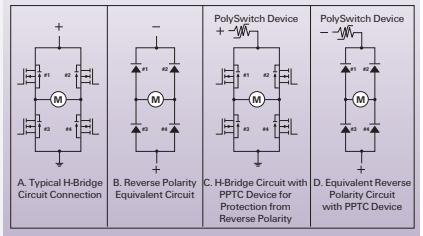
- AHS, ASMD, miniSMD, nanoSMD
- SFF, SFS
- ESD, SESD (Data Busses only)



H-Bridges

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.

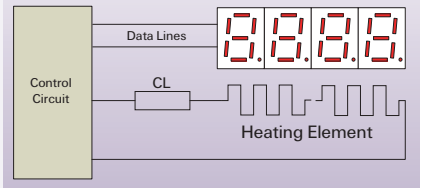
- AHRF, AGRF, AHEF
- AHS, ASMD



Liquid Crystal Display Backlight Heaters

There are an increased number of displays being designed into automobiles such as navigation systems, instrumentation displays, video and TV screens. A current limiting device should 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 (ie: when the ignition is turned off). In this case a resettable PPTC protection device may be desired. In other cases a single-use fuse may be preferred.

- AHRF, AGRF, AHEF
- miniSMD, microSMD, nanoSMD



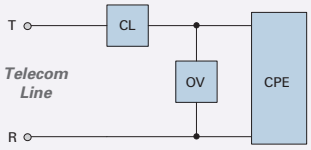
CL = Current Limiting Device

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

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

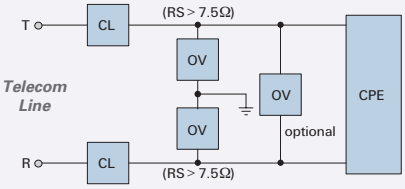
- TRF600, TS600, TSM600
- TM2P
- FT600

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



CL = Current Limiting Device
OV = Overvoltage Device

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



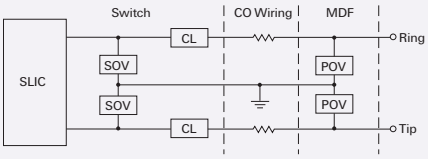
GR-1089 : Public Switched Telephone Network Equipment

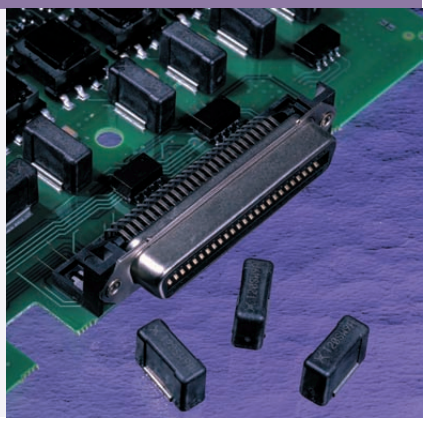
GR-1089 describes the electrical hazards which public switched telephone network (PSTN) equipment in North America should be protected against. The figure below shows several recommended resettable circuit protection solutions for a simplified model of a central office end of subscriber loop system.

- TRF600, TS600, TSM600
- FT600
- GTC

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

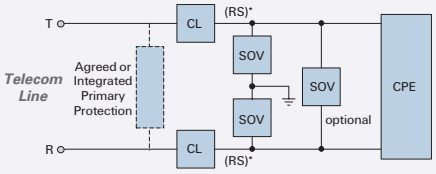




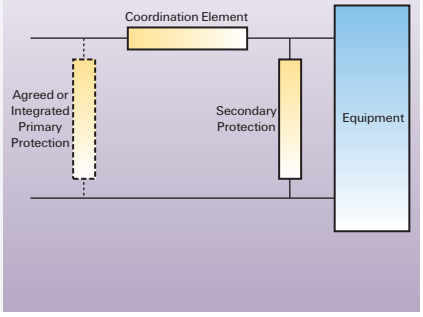
GR-1089-CORE, Issue 4

To help prevent damage to telecom equipment, circuits connected to outside lines generally need protection from lightning and power fault events. Protection may be primary. However, 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. Tyco Electronics offers a broad line of overcurrent and overvoltage devices that can help Public Switched Telephone Network conserve valuable board space and meet emerging safety and performance standards.

- TRF600, TS600, TSM600
- FT600
- GTC



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

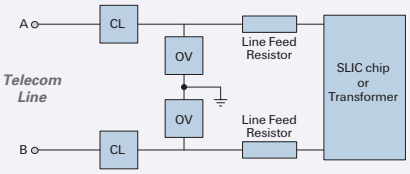


ITU-T Recommendations

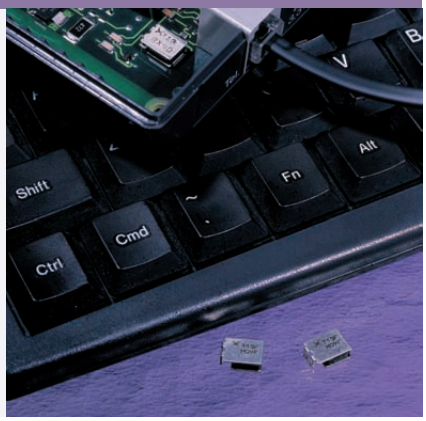
ITU-T provides the figure below shows several recommendations for central office (K.20), customer premise (K.21) and access network (K.45) equipment. Below is an overview of our recommendations and resettable circuit protection solutions.

- TCF250, TRF250, TS250, TSV250
- FT600
- GTC

Typical Protection System for Network Equipment



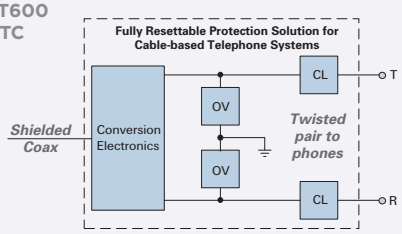
CL = Current Limiting Device
OV = Overvoltage Device

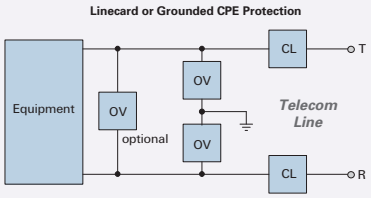


Short-haul/Intrabuilding Protection Requirements

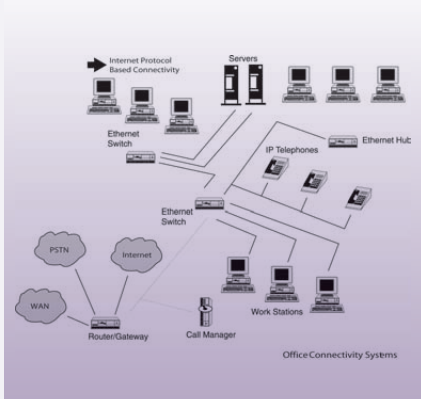
Communications equipment that is not directly connected to the PSTN is subjected to lower level hazards. Here are a few circuit protection recommendations for LAN, WLL, VoIP and other intrabuilding applications.

- TRF250, TS250, TSL250, TSV250
- FT600
- GTC





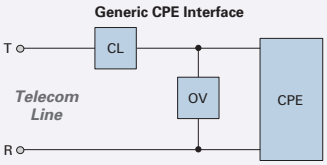
CL = Current Limiting Device
OV = Overvoltage Device

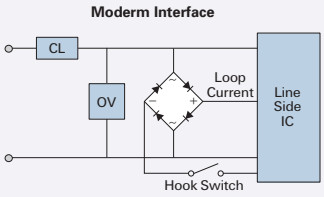


Customer Premise Equipment

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 protection solutions based on regional requirements.

- RXEF
- SMD
- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- FT600
- GTC



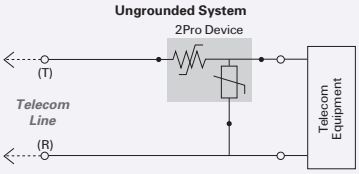


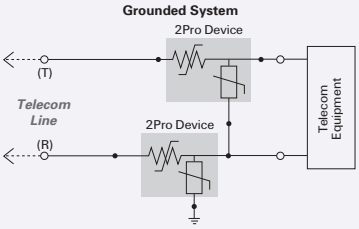
CL = Current Limiting Device
OV = Overvoltage Device

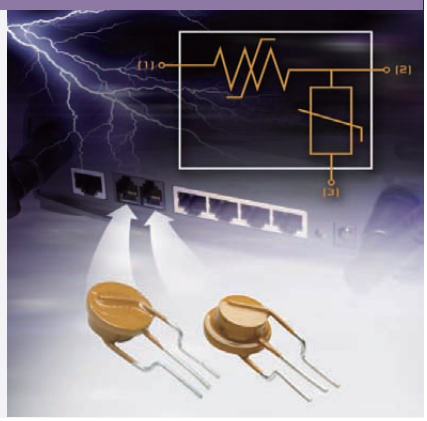
Customer Premise Equipment using 2Pro Devices

2Pro devices help protect cost-sensitive PSTN and voice over internet protocol (VoIP) telephony equipment from damage caused by lightning and ESD surges, power contact and induction with AC lines. If left unprotected from these hazards, CPE may fail or may pose a safety risk for subscribers and maintenance personnel.

- TM2P
- FT600
- GTC



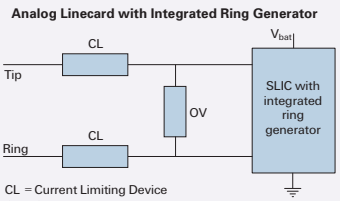


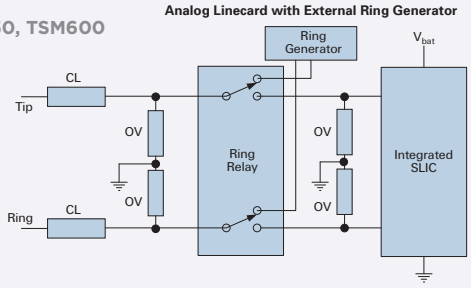


Analog Linecards

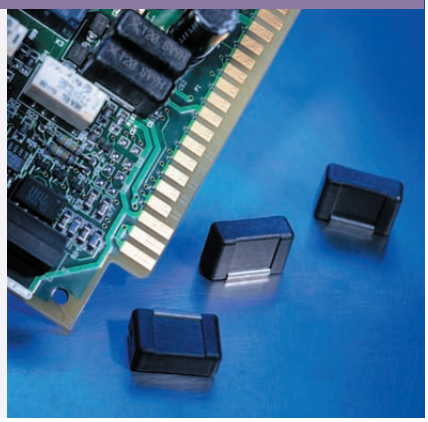
Central office linecards are subject to transient overcurrent and overvoltage faults, which may be generated from nearby power cross, power induction, and lightning events. Circuit protection recommendations based on regional agency specifications are provided below.

- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- FT600
- GTC





CL = Current Limiting Device
OV = Overvoltage Device

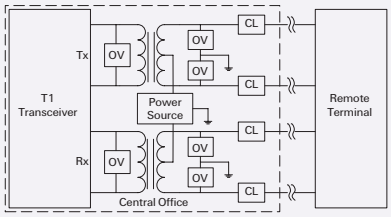


T1/E1 Equipment

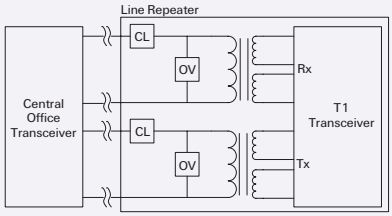
T1/E1 transmission equipment must be protected against damage caused by transient power cross and lightning faults which may enter on outside plant wiring. Here are our circuit protection recommendations based on regional agency specifications.

- **TRF250, TRF600, TS250, TS600, TSV250, TSM600**
- **FT600**
- **GTC**

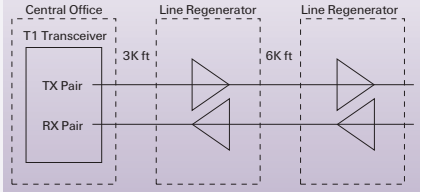
T1/E1 Central Office Transceiver Protection



T1/E1 Line Repeater Protection



CL = Current Limiting Device OV = Overvoltage Device

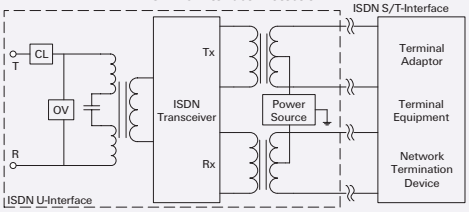


ISDN Equipment

ISDN central office (CO) and CPE equipment must be protected against damage caused by transient power cross and lightning faults which may also enter via outside plant wiring. Circuit protection recommendations based on regional agency specifications are provided here.

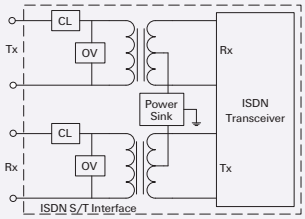
- **TRF250, TRF600, TS250, TS600, TSV250, TSM600**
- **FT600**
- **GTC**

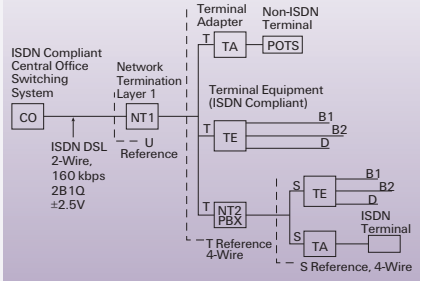
ISDN U Interface Protection



CL = Current Limiting Device OV = Overvoltage Device

ISDN S/T Interface Protection

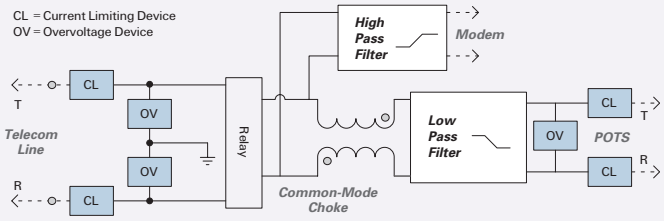


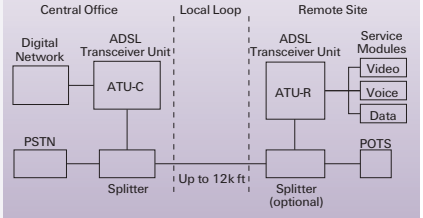


ADSL Equipment

ADSL equipment, like splitters, must be protected against damage caused by both external and intrabuilding faults. Resettable protection solutions are provided here, based on regional requirements.

- **TRF250, TRF600, TS250, TS600, TSV250, TSM600**
- **FT600**
- **GTC**



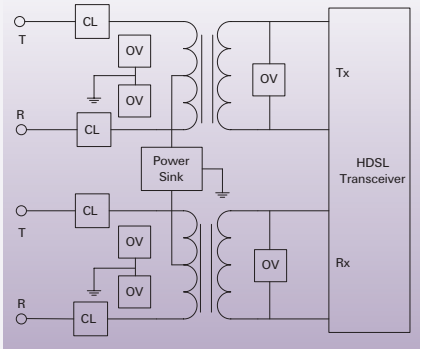


HDSL Equipment

HDSL equipment must be protected against damage caused by transient power cross and lightning faults which may enter on outside plant wiring. The following is our circuit protection recommendation, based on regional agency specifications.

- **TRF250, TRF600, TS250, TS600, TSV250, TSM600**
- **FT600**
- **GTC**

HDSL Central Office/Remote Terminal



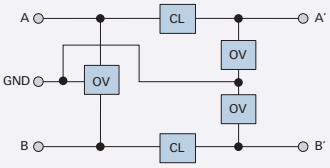
CL = Current Limiting Device OV = Overvoltage Device

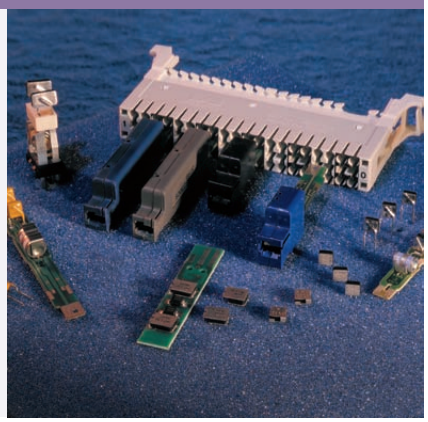
Main Distribution Frame (MDF) Modules

Telecom system, 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.

Primary:
- TCF250, TRF250, TS250, TSV250
- FT600

Secondary:
- GTC



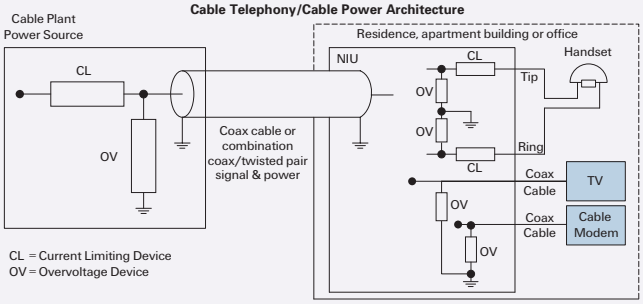


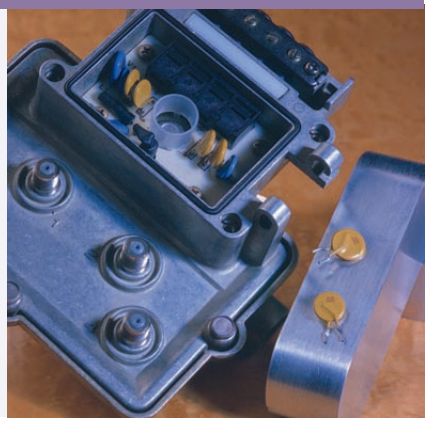
Cable Telephony/Cable Power Passing Tap

Cable telephony electronics that are powered via twisted pair or coaxial cable are susceptible to power faults passed through the cable plant. Protection in the power passing taps decreases the risk of these faults.

- BBRF, TRF250, TRF600, TS250, TS600, TSL250, TSV250, TSM600
- FT600
- GTC

Cable Telephony/Cable Power Architecture

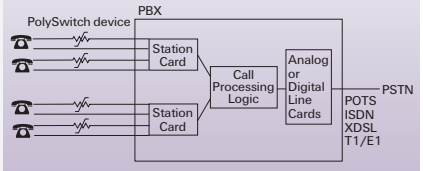




PBX and Key Telephone Systems

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

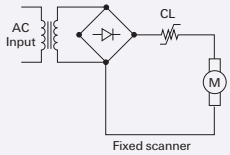
- TRF250, TRF600, TS250, TS600, TSM600
- FT600
- GTC

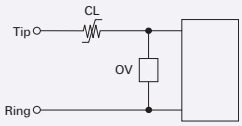


POS Equipment

Equipment connected to telephone lines can be subject to power cross, induction, and lightning surge hazards. Scanner motors and ditherers need protection against damage caused by jams and stalls.

- RUEF, RXEF
- miniSMD, SMD
- TRF, TS
- FT600
- SFF, SFS



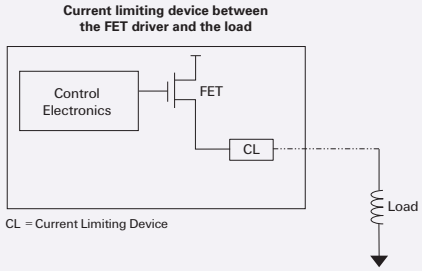


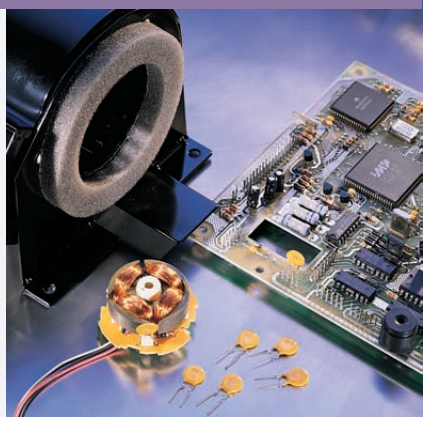
CL = Current Limiting Device
OV = Overvoltage Device

Electromagnetic Loads

Electromagnetic loads can be susceptible to many problems. Incorrect use of solenoids, valves, and motors can lead to device failure and circuit damage.

- RGEF, RUEF, RXEF
- miniSMD, SMD
- SFF, SFS

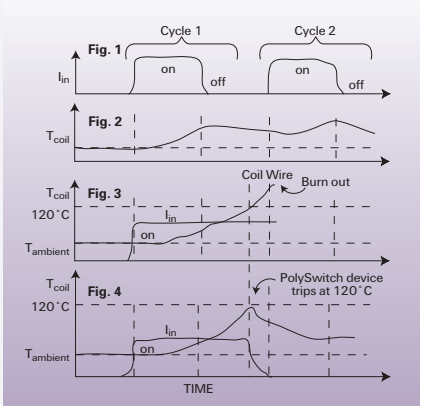




Solenoids

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.

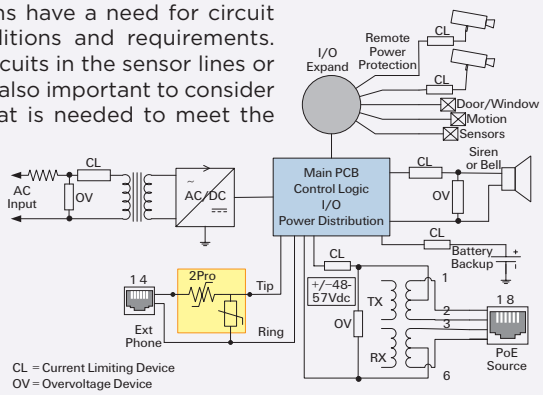
- RGEF, RHEF, RUEF, RXEF
- miniSMD, SMD
- SFF, SFS

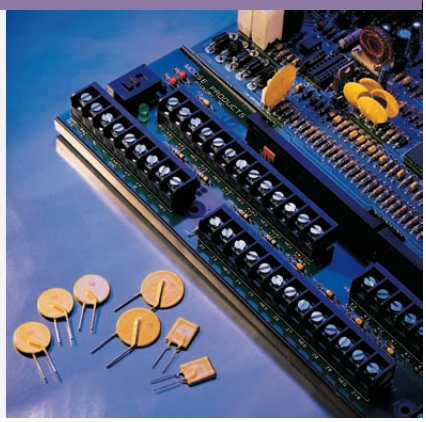


Security and Fire Alarm Systems

Security and fire alarm systems have a need for circuit protection, due to fault conditions and requirements. Possible faults include short circuits in the sensor lines or overheating of the battery. It is also important to consider the different currents and what is needed to meet the requirements of UL864.

- RGEF, RUEF, RXEF
- TRF
- GTC
- ESD, SESD
- TM2P

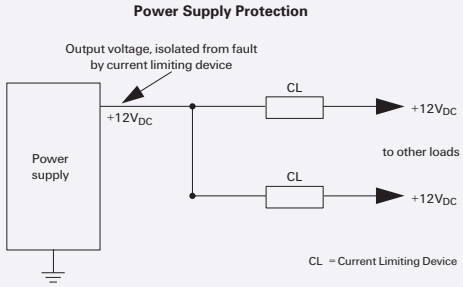




Test and Measurement Equipment

Power supplies, communication ports, test probes, and battery packs are all vulnerable to overcurrent faults because of incorrect connections or damaged cables.

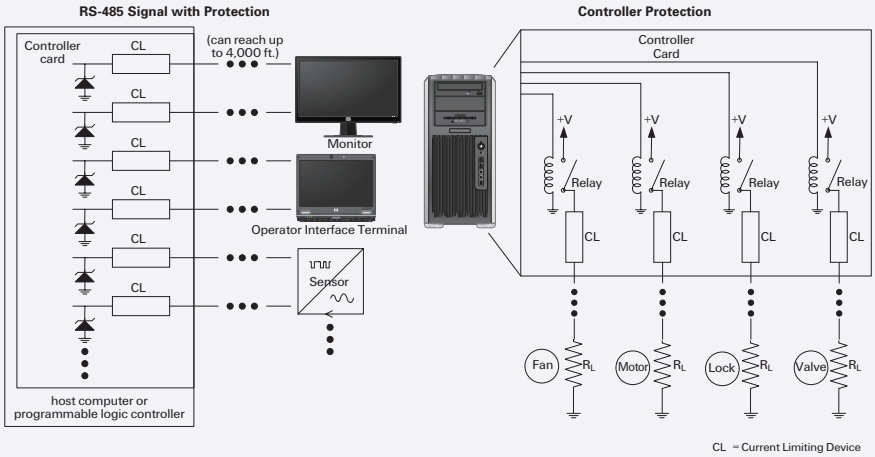
- RTEF, RUEF, RXEF
- miniSMD, SMD
- TRF
- ESD, SESD
- SFF, SFS

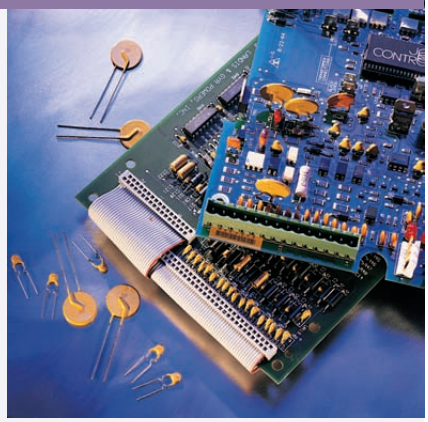


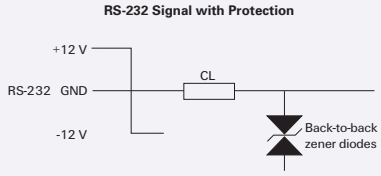
Process and Industrial Controls

Pinched cables and incorrectly installed/connected cables lead to shorts, overheating, component failures, and burned circuit board traces.

- RHEF, RTEF, RUEF, RXEF
- miniSMD, SMD
- SFF, SFS, SFH





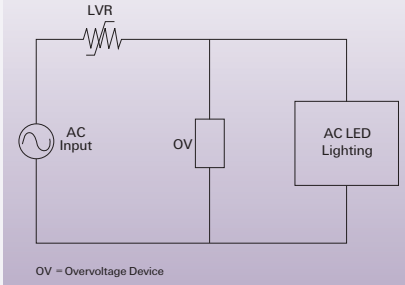


Power Input Protection for AC LED

Lighting fixtures powered by AC power can be put at risk from high voltage or power transients on the AC inputs due to lighting strikes, power station load switching transients, or from the resulting surge currents.

Overvoltage and overcurrent protection are often viewed as unrelated conditions. Tyco Electronics offers designers a complete solution that will help enhance product reliability and safety.

- LVR
- miniSMD, SMD

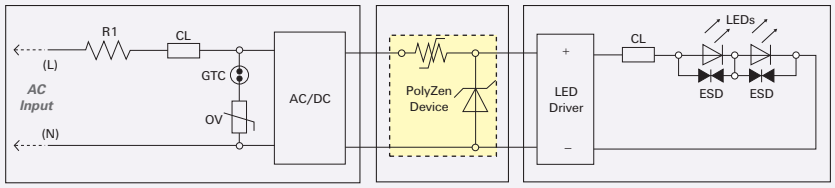


Circuit Protection Opportunities in Solid State Lighting (SSL)/LED Lighting

LED driver integrated circuits (ICs) used in many LED applications require a protected DC input to provide a regulated-current output to the LED.

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

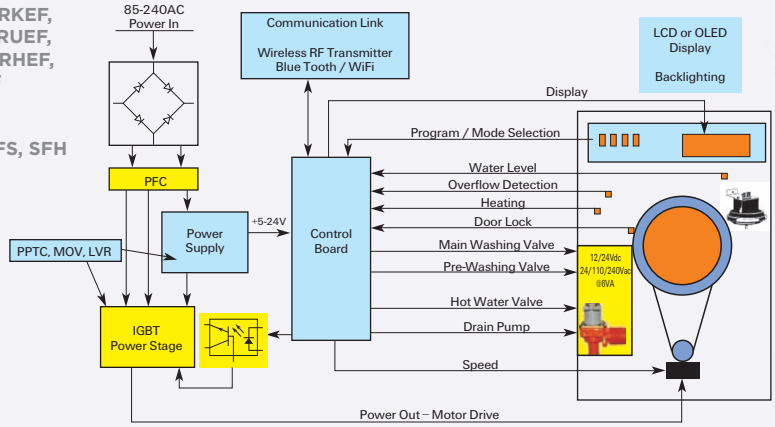
- LVR
- ZEN
- RGEF, RHEF, RUEF, RXEF
- GTC
- ESD
- SFF, SFS, SFH



Washing Machines

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

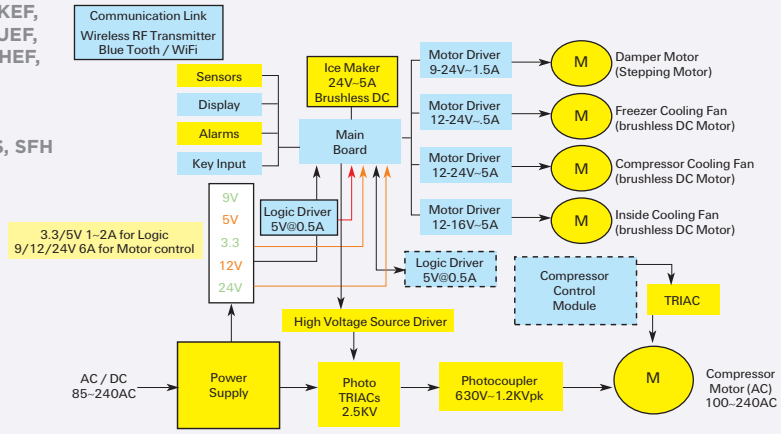
- LVR
- RXEF, RKEF, RTEF, RUEF, RGEF, RHEF, RUSBF
- SMD
- ESD
- SFF, SFS, SFH



Refrigerators / Freezers

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

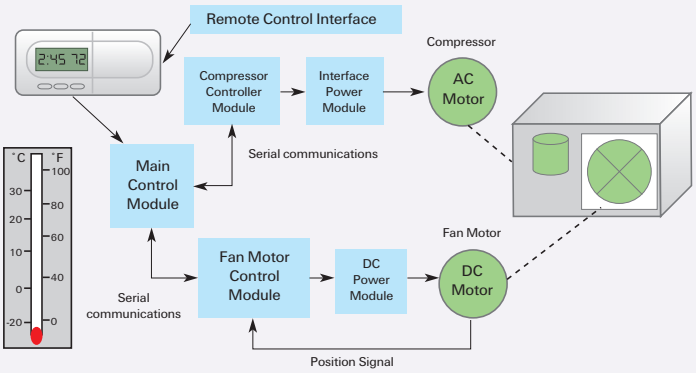
- LVR
- RXEF, RKEF, RTEF, RUEF, RGEF, RHEF, RUSBF
- SMD
- ESD
- SFF, SFS, SFH

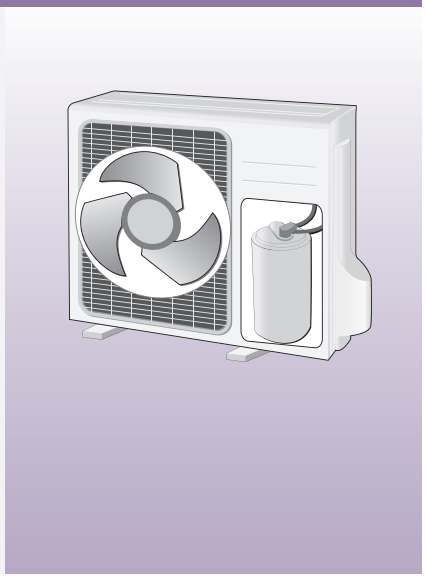


Air Conditioning Units

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

- LVR
- RXEF, RKEF, RTEF, RUEF, RGEF, RHEF, RUSBF
- SMD
- ESD
- SFF, SFS, SFH





Keypads / Buttons for Medical Applications

An electrostatic discharge (ESD) event can occur when the user presses the equipment buttons, which may result in damage to the internal circuitry of the device.

Extremely low capacitance ESD protection devices, such as our ESD and SESD devices, help shunt ESD away from sensitive circuitry in electronic devices without inducing signal distortion.

- ESD
- SESD

LCD Backlight for Glucose Monitors

If the control circuitry fails to turn off the element, the current flowing through the heating element can increase and lead to thermal runaway.

The PolySwitch resettable device is thermally linked to the liquid crystal display (LCD) glass. It will "trip" thus reducing the current flowing through the heating element.

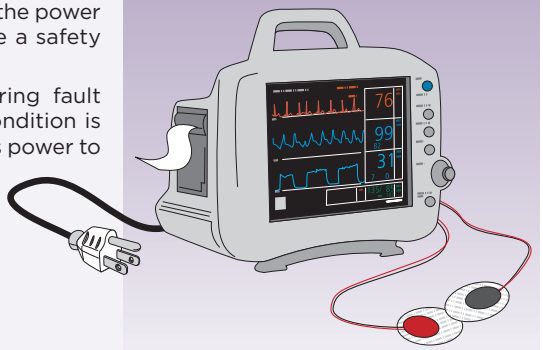
- miniSMD, SMD
- SFF, SFS
- ZEN

USB, AC Power, and Sensor Pad Protection for Medical Monitoring Systems

When an unsuitable or faulty USB cable is plugged into the USB port, the applied voltage, polarity and permitted current may exceed the specifications of the power regulation circuits. This can damage the equipment and could become a safety concern.

PolySwitch devices limit the flow of dangerously high currents during fault conditions and reset back to normal operating mode once the fault condition is removed; while PolyZen devices help clamp the voltage and shunt excess power to ground.

- RTEF, RUEF, RXEF, RUSBF
- miniSMD, SMD
- ESD
- SESD
- SFF, SFS
- ZEN



At the AC input, the equipment can be put at risk from high currents due to power station transients or application of the incorrect voltage.

- LVR

Sensor inputs, which monitor the patient's vital signs, can be damaged when the high voltage shock from a defibrillator is delivered.

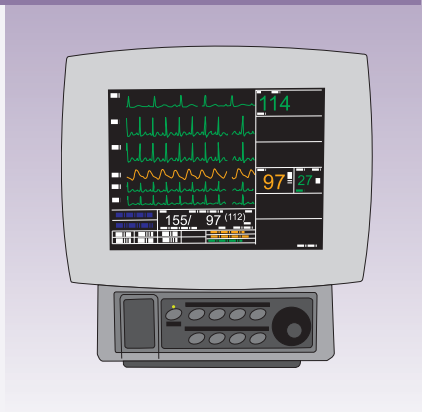
Gas discharge tubes help provide overvoltage fault protection against damage caused by high energy surges. They are suitable for sensitive equipment due to excellent impulse sparkover response.

- GTC

LCD Monitor Controller for Patient Monitoring Systems

Power for LCDs is supplied from the 5V and 12V busses. 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 during assembly or while in use can cause large overloads and short circuits in the system, damaging expensive components.

- **RUEF, RXEF**
- **nanoSMD, microSMD, miniSMD**
- **SFF, SFS**
- **ESD**
- **SESD**

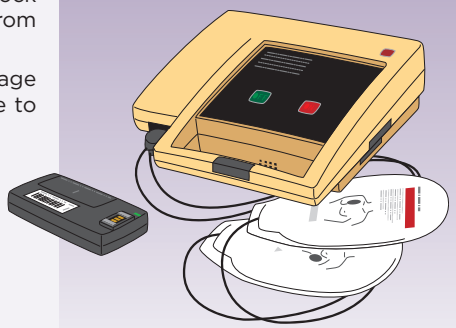


Automated External Defibrillator Electrodes

In most automated external defibrillators (AEDs), the pads that deliver the shock also contain the sensors for the patient's vital signs. The high voltage shock from the defibrillator can cause damage to the electrodes.

Gas discharge tubes help provide overvoltage fault protection against damage caused by high energy surges. They are suitable for sensitive equipment due to excellent impulse sparkover response.

- **GTC**

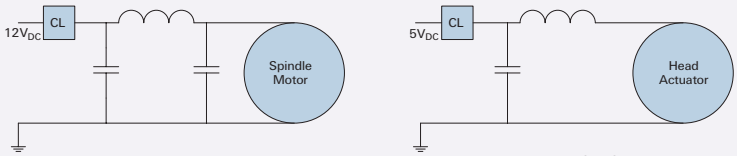


5V/12V Power Lines

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 that need this type of protection include hard disk drives, CD-ROM, CD-RW, DVD, and other storage devices.

- RUEF, RUSBF
- nanoSMD, microSMD, miniSMD
- SFF, SFS
- ZEN

Protection for Disk Drives

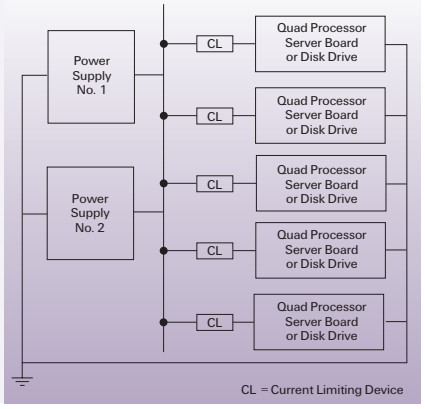


CL = Current Limiting Device

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. Circuit protection is employed to help minimize safety risks, comply with IEC60950 Safety Requirement Clause 1.2.8.7 – Hazardous Energy Levels, and help protect against damage caused by short circuits caused by incorrect insertion of cards.

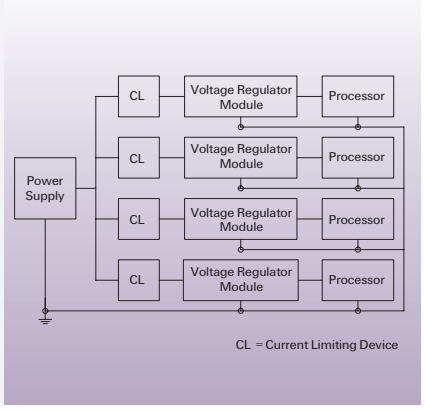
- RGEF, RXEF
- microSMD, miniSMD, SMD
- SFF, SFS, SFH



Central Processing Units (CPUs)

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 still change by as much as 7A as processor activity levels change. These high-current immediate demands can cause components to fail. Circuit protection helps prevent the VRM from damaging the processor in the event of a VRM failure.

- RGEF, RUEF
- SMD
- SFF, SFS, SFH

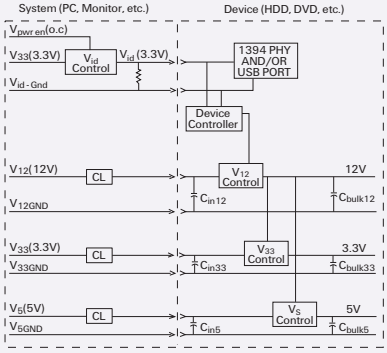


Device Bay

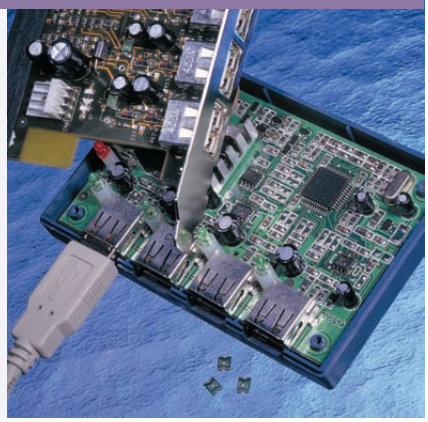
Due to hot-swappable bays, the device bay specification recommends overcurrent protection for high availability situations such as servers and industrial computers. An externally accessible port such as IEEE1394 or USB may also be used.

- RGEF, RUEF
- microSMD, miniSMD, SMD
- SFS, SFH

Typical Schematic



CL = Current Limiting Device

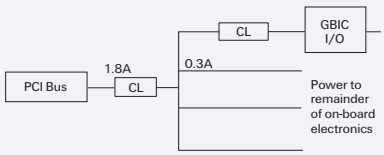


Fibre Channel

A fault, such as a short circuit, 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.

- **RUEF**
- **miniSMDC110F, miniSMDC260F**
- **SFS**

Typical Schematic



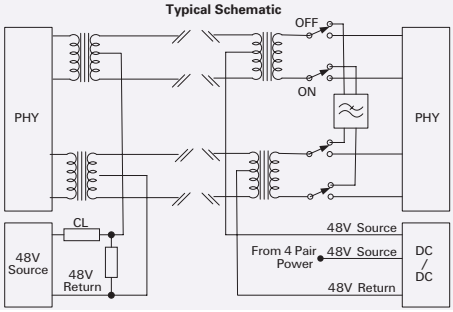
CL = Current Limiting Device

IEEE 802.3 Ethernet LAN (Powered Ethernet)

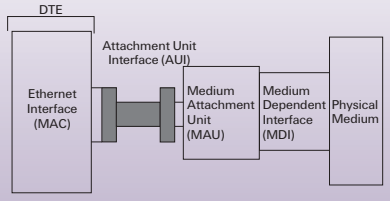
The auxiliary unit interface (AUI) consists of signal circuits, power, and ground. Per the IEEE 802.3 standard, the Voltage Plus circuit is capable of operating at 12-15V_{DC} for currents up to 500mA. In addition, per section 7.5.2.5, the source shall provide protection for this circuit against damage 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.

- **RUEF, RXEF**
- **miniSMDC100F/16, miniSMDC075F, SMD030F-2018**
- **SFF**

Typical Schematic



CL = Current Limiting Device

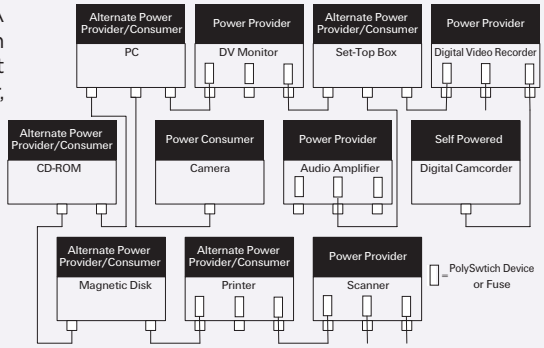


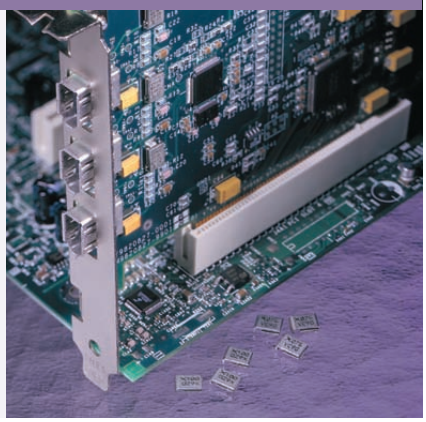
IEEE 1394 FireWire, i.Link

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.

- **RTEF**
- **SMD**
- **SFS**

Example of an IEEE 1394 Network

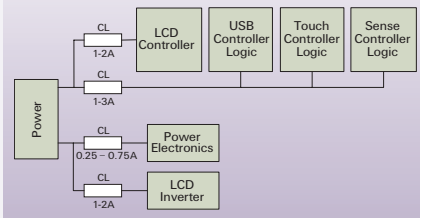




LCD Monitors

Power for LCD monitors is supplied from the 5V and 12V busses. 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 during assembly or while in use can cause large overloads and short circuits in the system, damaging expensive components.

- **RUEF, RXEF**
- **nanoSMD, microSMD, miniSMD**
- **SFF, SFS, SFH**
- **ESD, SESD (Data lines and user interface buttons)**

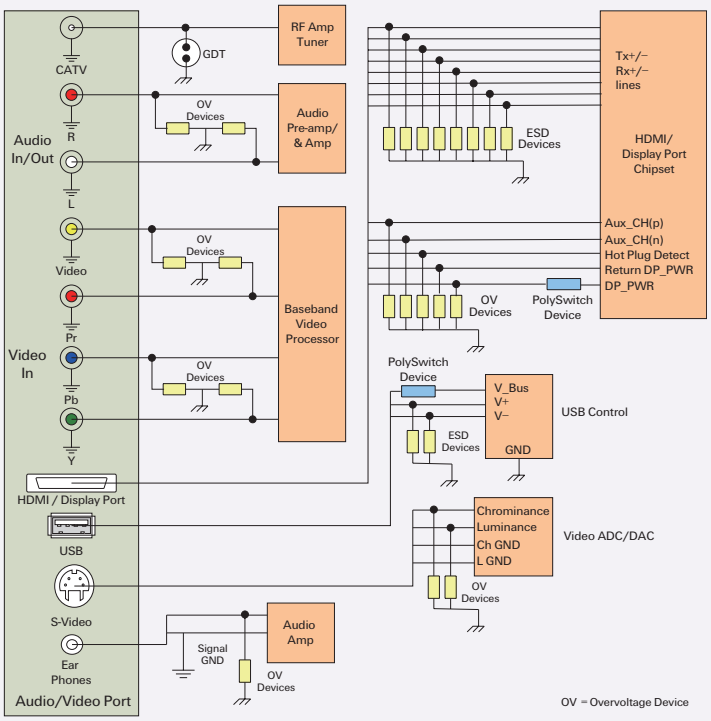


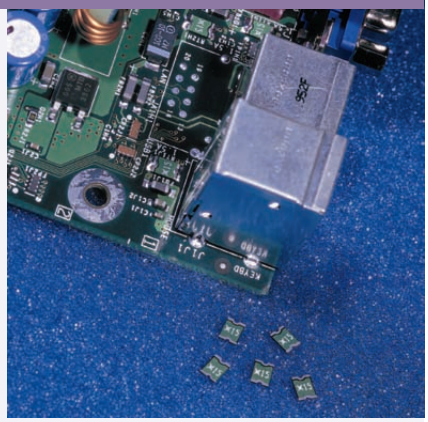
CL = Current Limiting Device

I/O Ports

To meet regulatory agency requirements (UL60950), these ports must have a way of interrupting or limiting the current in the event of an overload or short circuit.

- RUEF, RUSBF
- nanoSMD, microSMD, miniSMD, SMD
- SFF, SFS
- ZEN
- ESD, SESD
- GTC

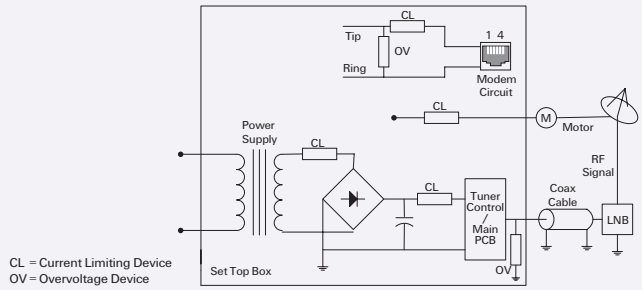


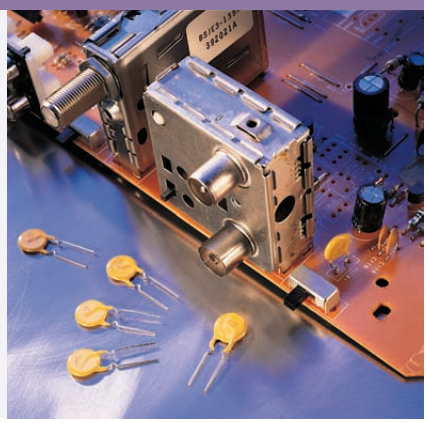


LNB Satellite Set-Top Boxes

A short-circuit overload to the power supply can occur if the central pin in the coaxial cable connection to the receiver is bent or crushed against the connector during installation. It can also occur any time the user disconnects the antenna from the receiver.

- miniSMD, SMD
- RXEF
- GTC
- SFF

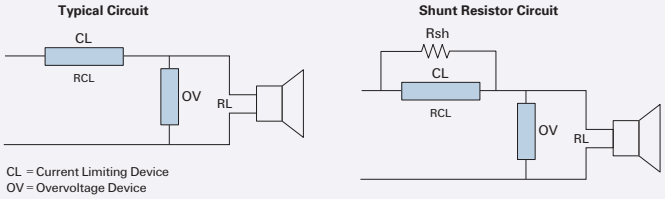


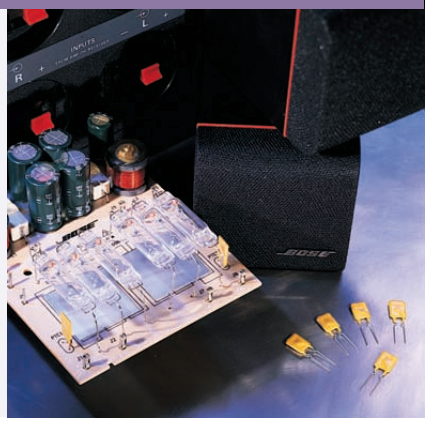


Loudspeakers

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, including compact discs, with their ability to reproduce high-frequency material, place extra strain on tweeters. PolySwitch devices can help the design engineer solve these problems.

- RXEF
- SFF, SFS



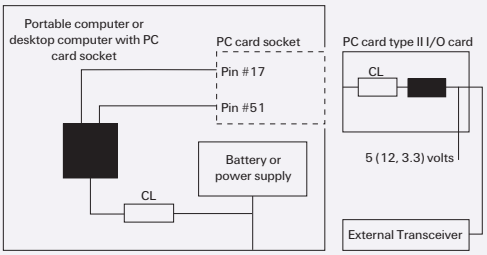


PC Cards and Sockets

Short circuits from external sources are the primary hazards for PC cards. The cards need protection from large current inrushes that can damage the PC card or the PC card bus.

- RUEF, RUSBF
- nanoSMD, microSMD, SMD
- SFF, SFS
- ESD, SESD (Data lines)
- ZEN

Type II PC Card and Socket



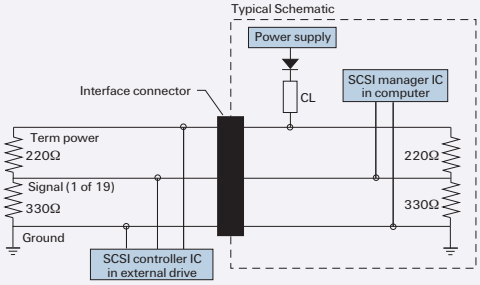
CL = Current Limiting Device

SCSI

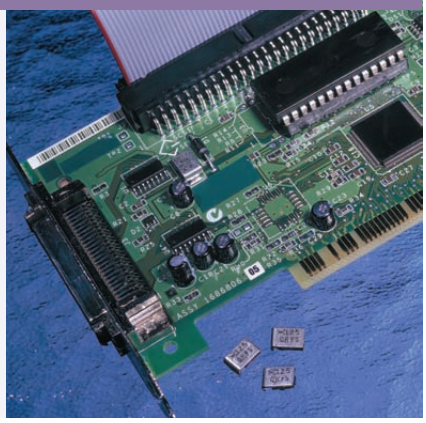
The SCSI bus TERMPWR line can draw significant amounts of current in a short circuit condition. A short circuit anywhere on the bus can cause the entire bus and host to crash. PolySwitch PPTC devices can be used on the SCSI controller circuit and on each connected peripheral to help protect against permanant damage.

- RUEF, RXEF
- microSMD, miniSMD, SMD
- SFF, SFS

Typical Schematic



CL = Current Limiting Device

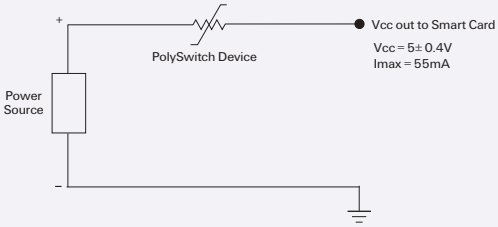


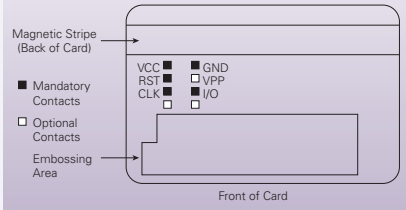
Smart Card Readers

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.

- microSMD010F

Smart Card Reader Schematic





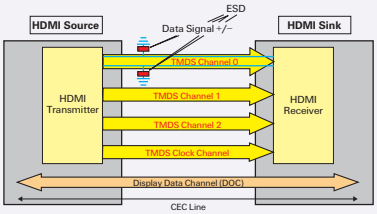
HDMI: LCD, plasma, HDTV, set-top box, DVD player

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). To help protect the high speed TMDS lines against damage caused by ESD hits, ESD or SESD devices are used 2 per line.

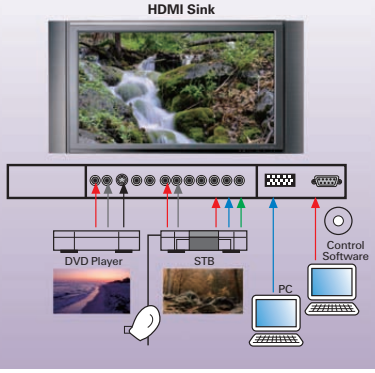
- nanoSMD, microSMD, miniSMD
- ESD
- SESD
- SFF
- ZEN

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

HDMI Source



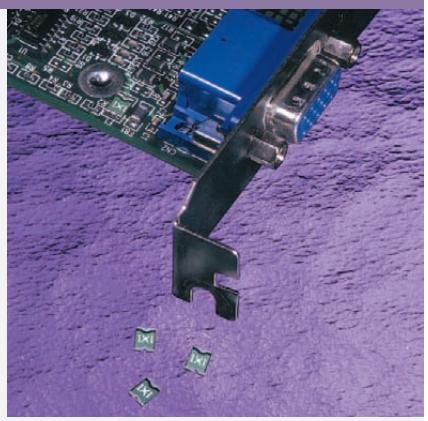
HDMI Sink

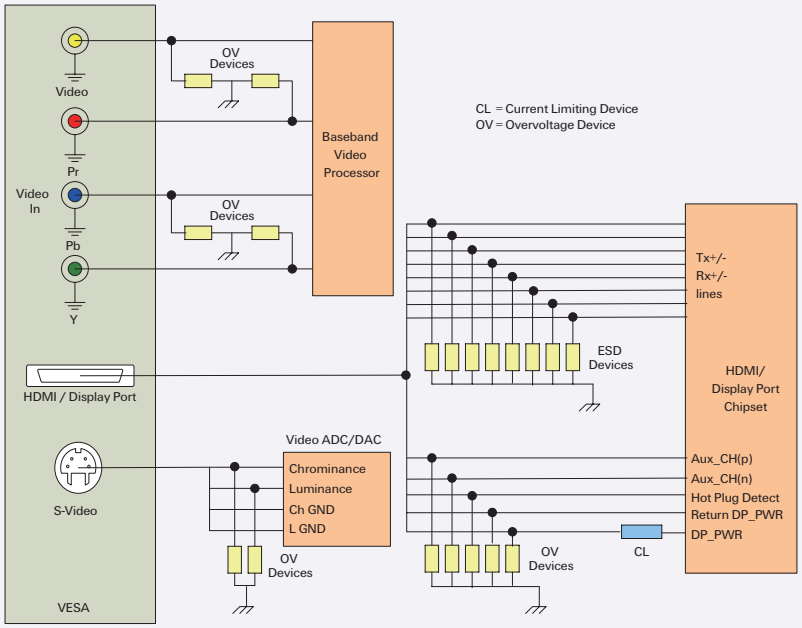


Video Ports (VESA, DDC, DVI, HDMI, DisplayPort)

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.

- RUEF, RUSBF
- nanoSMD, microSMD, miniSMD, SMD
- SFF, SFS
- ZEN
- ESD, SESD (Data lines)

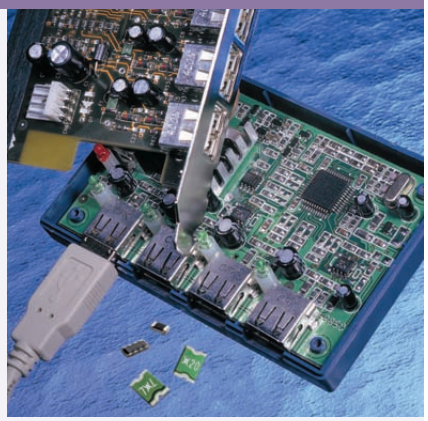




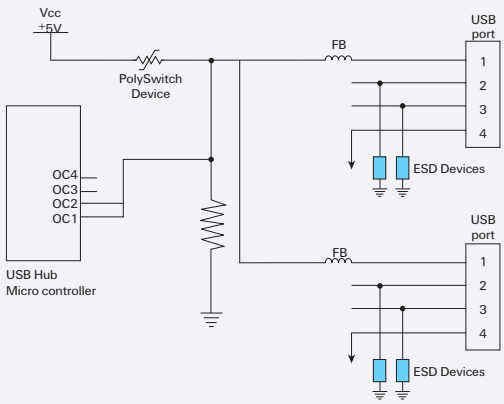
Universal Serial Bus (USB)

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

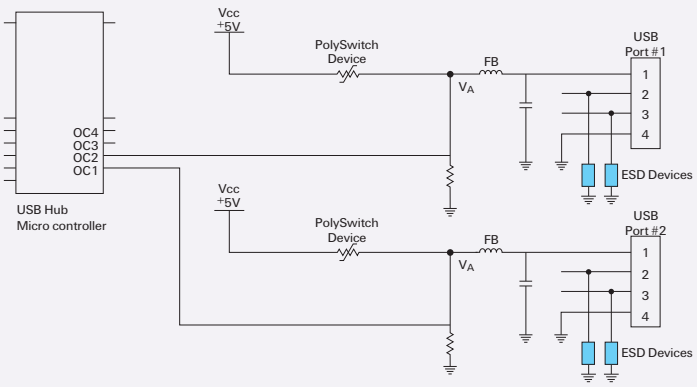
- ZEN
- RUEF, RUSBF
- nanoSMD, microSMD, miniSMD
- ESD
- SESD
- SFF, SFS



Ganged Port Protection (two-port example)



Low-active Overcurrent Pin Fault Reporting for Individual Port Protection

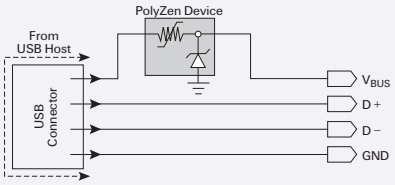


USB Peripherals

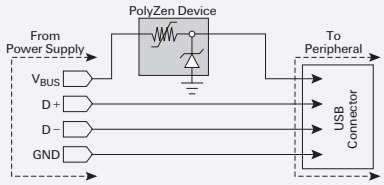
PolyZen devices help protect against damage caused by overvoltage on USB peripherals and devices on the 5V computer bus. The component helps protect sensitive follow-on electronics – such as flash memory and other 6V capable silicon – from inductive voltage spikes, incorrect power supplies, dirty power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

- **nanoSMD, microSMD, miniSMD**
- **ZEN**
- **ESD, SESD (on data lines)**

Typical Circuit – USB Peripherals



USB Power Conditioning (Host, Hub, Remote Charger)

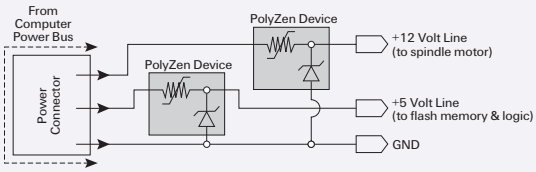


Hard Disk Drives

PolyZen micro-assemblies help protect devices on the 5V and 12V computer bus from overvoltage events and inductive voltage spikes resulting from 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 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.

- **nanoSMD, microSMD, miniSMD**
- **ZEN**
- **SFF**
- **ESD (on data lines)**

Typical Circuit – Hard Disc Drive

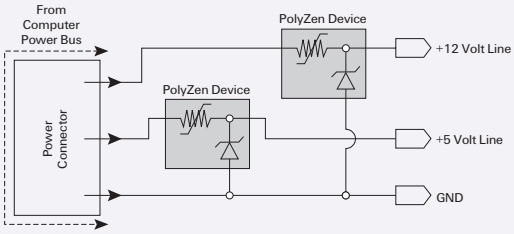


Computer Subsystems and Peripherals

Computer electronics can be exposed to voltages well in excess of the bus voltage, and require protection for power sensitive electronics like flash memory. Voltage spikes can result from a hot disconnect of a peripheral, an internal system shutdown, or other internal power fluctuations. The PolyZen device provides coordinated protection with a component that protects like a Zener diode, but is capable of withstanding the high power fault conditions that can occur in computer electronics.

- **nanoSMD, microSMD, miniSMD**
- **ZEN**
- **SFF**
- **ESD (on data lines)**

Typical Circuit – Computer Peripherals

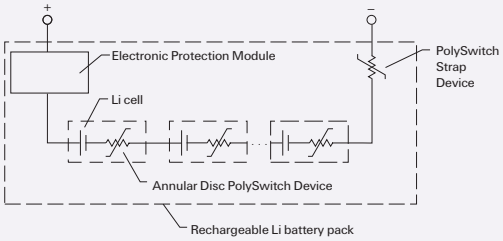


Lithium Cells and Battery Packs

External shorts, runaway charging conditions, or abusive charging can cause considerable damage to primary and secondary lithium cells. Rechargeable lithium batteries are used in notebook computers and cellular phones, as well as other portable electronic applications.

- LR4, LTP, SRP, VLR, VLP, VTP, MXP
- Custom Annular Disc Devices

Typical Rechargeable Lithium Battery Pack Circuit

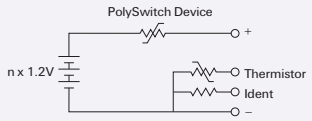


Rechargeable Battery Packs

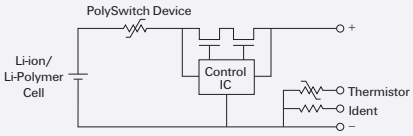
Due to external shorts, runaway charging conditions, or abusive charging, considerable damage can be sustained in both battery cells and pack surroundings. The most common applications are for lithium-ion (Li-ion) battery packs used in cellular phones, digital cameras and laptop/notebook computers or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

- LR4, LTP, SRP, VLR, VLP, VTP, MXP
- SFF, SFS

NiMH/NiCd Battery Pack Circuit Diagram



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

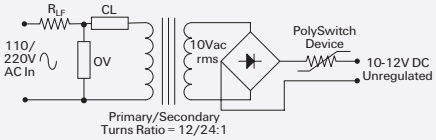


Linear AC/DC Adapters

Linear AC/DC adapters, or "wall warts", can be used in both battery charging applications and in low-cost DC power supplies for a variety of consumer equipment. Short circuits or excessive current draw can result in transformer winding overtemperature. PolySwitch devices can help end products meet UL requirements.

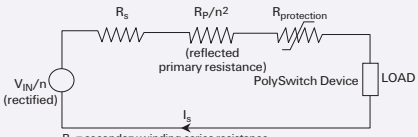
- RTEF, RUEF, RXEF
- nanoSMD, microSMD, miniSMD, SMD
- SFS, SFH

Example of an Unregulated Linear Adapter Protected by a PolySwitch Device

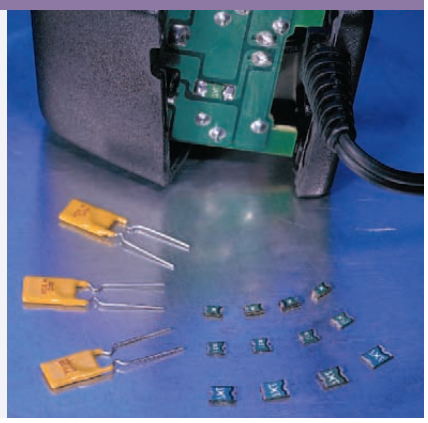


CL = Current Limiting Device
OV = Overvoltage Device

Transformer Equivalent Circuit



R_s = secondary winding series resistance
R_P = primary winding reflected resistance
n = turns ratio

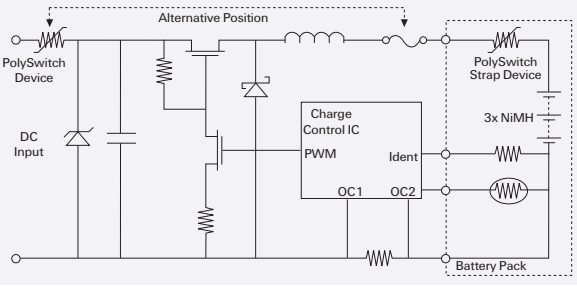


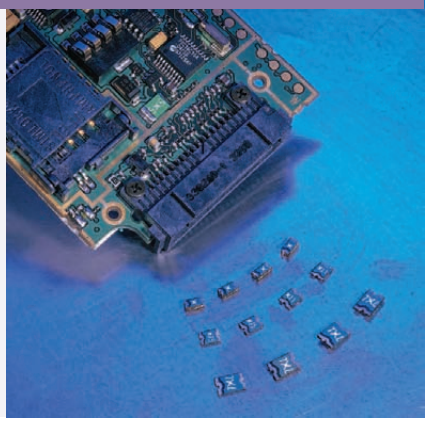
Portable Electronics Input Ports

The use of an incorrect or faulty adapter/charger can irreparably damage unprotected portable electronics equipment. Typical applications include cellular phones, PDAs, and digital cameras.

- nanoSMD, microSMD, miniSMD
- SFS, SFH
- ZEN

Typical Portable Electronics Charging Circuit with Protection

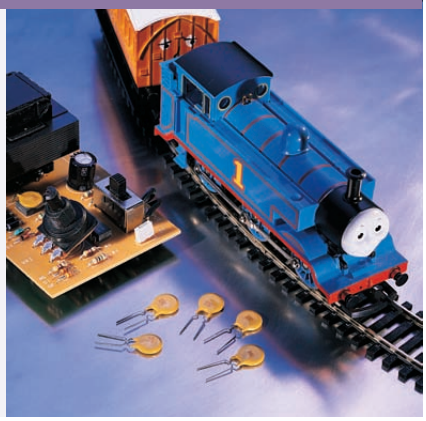




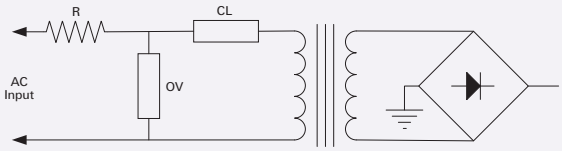
Transformers

A short circuit can cause high currents, which produce high temperatures and can damage the power supply.

- RGEF, RHEF, RUEF, RXEF
- LVR
- SMD
- SFS, SFF



Transformer Circuit



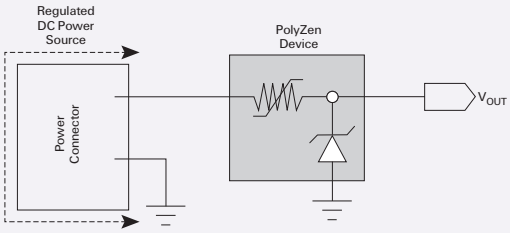
CL = Current Limiting Device
OV = Overvoltage Device

Portable Electronics using PolyZen Devices

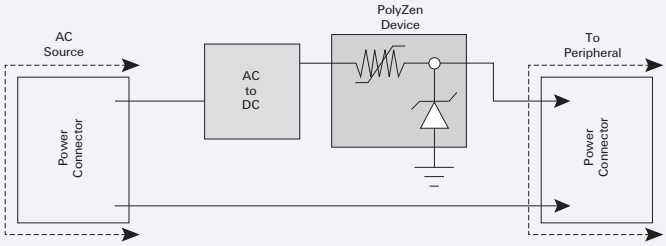
The PolyZen device's unique ability to withstand high inrush currents make it suitable to protect portable electronics and other low-power DC devices such as cell phones, PDAs, MP3 players, digital cameras and USB hubs. Transient protection is particularly important for peripherals that can be powered off computer and automotive power busses. PolyZen devices are designed to help lock out inappropriate power supplies and are especially effective at clamping and smoothing inductive voltage spikes.

- ZEN

Typical Circuit – "On Board" Protection



Power Conditioning (AC to DC converter output)



Application Solution Guide

	Overcurrent Circuit Protection					Overvoltage Circuit Protection			Hybrid Protection	
	PolySwitch Devices	Slow-Blow Chip Fuses	Fast-Acting Chip Fuses	High-Current-Rated Chip Fuses	Telecom Fuses	GDT	ESD	SESD	2Pro Devices	PolyZen Devices
AUTOMOTIVE ELECTRONICS										
Electronic control modules	x	x	x	x			x	x		
HVAC and climate control	x	x	x	x						
Junction boxes and wire harnesses	x									
Lamp protection	x									
DC Motor protection	x									
Power outlet protection	x									
Powered antennae	x									
Telematics powered components	x	x	x	x			x	x		x
Infotainment and navigation systems	x	x	x	x			x	x		x
Chargeable devices	x	x	x	x			x	x		x
COMMUNICATIONS										
Analog and digital linecards	x	x	x			x			x	
Central office equipment, linecards	x	x	x			x	x	x		
LAN, WAN equipment	x	x	x		x	x	x	x		x
MDF modules	x					x			x	
PBX, key telephone systems	x		x			x	x	x	x	
PoE (Power over Ethernet) systems	x	x				x	x	x		
Set-top boxes (cable & satellite)	x	x	x			x	x	x	x	x
Telephone, fax, modem	x	x	x		x	x	x	x	x	x
VoIP (Voice over Internet Protocol) equipment	x	x	x			x	x	x	x	
xDSL modems and splitters	x	x	x		x	x	x	x		x
Servers	x		x	x		x	x	x	x	x
Power supplies	x			x		x				
Voltage regulator modules (VRMs)	x			x						
CONSUMER ELECTRONICS										
HDDs (Hard Disk Drives)	x	x					x	x		x
IEEE 1394 ports	x		x				x	x		
Inverters		x								
Controller boards			x							
USB 2.0/3.0 & IEEE	x						x	x		x
USB flash memory modules	x						x	x		
USB hub, ports and peripherals	x						x	x		x
Video ports: HDMI, DVI, VGA	x		x				x	x		
LED backlighting	x	x	x				x	x		

	Overcurrent Circuit Protection					Overvoltage Circuit Protection			Hybrid Protection	
	PolySwitch Devices	Slow-Blow Chip Fuses	Fast-Acting Chip Fuses	High-Current-Rated Chip Fuses	Telecom Fuses	GDT	ESD	SESD	2Pro Devices	PolyZen Devices
PORTABLE ELECTRONICS										
Audio MP3 players	x		x				x	x		x
Battery packs	x	x	x				x	x		
Cell Phones and PDAs	x		x				x	x		x
Digital still / video cameras	x		x				x	x		x
Portable game devices	x		x				x	x		x
INDUSTRIAL ELECTRONICS										
Displays	x	x	x				x	x		
Industrial controls-RS485, RS232	x	x	x			x	x	x		
Security systems	x	x	x			x	x	x	x	x
Surge suppression	x					x			x	
UPS (Uninterruptible Power Supply)	x	x	x			x				
APPLIANCES AND HVAC										
Electronic PCB's and controllers	x	x	x				x	x	x	
Motor and compressor winding protection	x									
Power tools			x	x						
Transformer protection	x								x	
LED LIGHTING										
Indoor Lighting	x	x	x				x	x	x	x
Outdoor/Street/Signal/Stadium Lighting	x	x	x			x	x	x		x
Table Lamp/Portable Lighting	x	x	x				x	x		x
MEDICAL ELECTRONICS										
Digital surface thermometers							x	x		
Blood glucose monitors	x						x	x		x
Blood pressure monitors	x	x	x				x	x		x
Automated external defibrillator (AED)	x					x	x	x		
Infra-red ear thermometers							x	x		
Electrocardiograms	x	x	x				x	x		x
Magnetic resonance imaging	x	x	x				x	x		
Ultrasound devices	x	x	x				x	x		x
Pulse oximeters	x						x	x		
Patient monitors	x	x	x			x	x	x		x

Solar / Wind Generating / Renewable Energy Electronics	Overcurrent Circuit Protection					Overvoltage Circuit Protection			Hybrid Protection	
	PolySwitch Devices	Slow-Blow Chip Fuses	Fast-Acting Chip Fuses	High-Current-Rated Chip Fuses	Telecom Fuses	GDT	ESD	SESD	2Pro Devices	PolyZen Devices
Controller Boards / Human Interface Panels	x					x	x		x	
DC / AC Inverters	x					x				
Wiring/Cable/Connector/ Coupler Protection	x									
Communications Interfaces	x				x	x			x	
Tracking Motors	x									
Monitors	x		x				x			
Modules	x					x				
Battery backup/Systems	x									
Uninterruptible Power Supply (UPS)	x					x				

PolyZen Devices

Polymer Protected Zener Diode

PolyZen devices are polymer enhanced precision Zener diode micro-assemblies that help protect sensitive electronics from damage caused by inductive voltage spikes, voltage transients, use of incorrect power supplies and reverse bias.

The PolyZen micro-assembly incorporates a stable Zener diode for precise voltage clamping and a resistively non-linear, polymeric positive temperature coefficient (PPTC) layer that responds to either diode heating or overcurrent events by transitioning from a low to high resistance state.

PolyZen devices help provide resettable protection against damage caused by multi-watt fault events and require only 0.7W power dissipation. In the event of sustained high power conditions, the PPTC element of the device "trips" to limit current and generate voltage drop. This functionality helps protect both the Zener and the follow-on electronics, effectively increasing the diode's power handling capacity.

Benefits

- Helps shield downstream electronics from overvoltage and reverse bias
- Trip events shut out overvoltage and reverse bias sources
- Analog nature of trip events minimize upstream inductive spikes
- Helps reduce design costs with single component placement and minimal heat sinking requirements

Features

- RoHS compliant
- Overvoltage transient suppression
- Hold currents up to 2.3A
- Time delayed, overvoltage trip
- Time delayed, reverse bias trip
- Power handling on the order of 30 watts
- Integrated device construction

Applications

- Portable media players
- Global positioning systems
- Hard disk drives 5V & 12V bus
- Solid State Drives (SSD) 5V bus
- Cellphone charger port and USB power
- Automotive peripheral input power
- DC power port protection
- Industrial handheld POS

Figure PZ1 Typical Application Block Diagram for PolyZen Devices

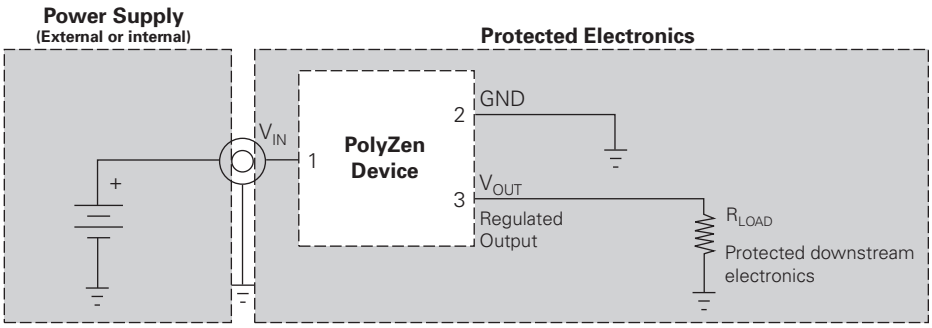


Table PZ1 Electrical Characteristics for PolyZen Devices

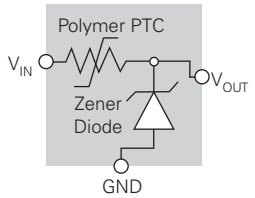
(Performance ratings @ 25°C unless otherwise specified)

	Part Number	V_Z(V) Min.	V_Z(V) Typ.	V_Z(V) Max.	I_{Zt} (A)	I_{HOLD} @ 20°C (A)	R_{Typ} (Ω)	R_{1MAX} (Ω)	$V_{INT\ MAX}$ $V_{INT\ MAX}$ (V)	$V_{INT\ MAX}$ Test Current (A)	$I_{FLT\ MAX}$ $I_{FLT\ MAX}$ (A)	$I_{FLT\ MAX}$ Test Voltage (V)
	ZEN056V130A24LS	5.45	5.6	5.75	0.1	1.3	0.12	0.16	24V	3A	+10/-40	+24/-16V
	ZEN065V130A24LS	6.35	6.5	6.65	0.1	1.3	0.12	0.16	24V	3A	+6/-40	+24/-16V
NEW	ZEN098V130A24LS	9.60	9.8	10.00	0.1	1.3	0.12	0.16	24V	3A	+3.5/-40	+24/-16V
	ZEN132V130A24LS	13.20	13.4	13.60	0.1	1.3	0.12	0.16	24V	3A	+2/-40	+24/-16V
	ZEN164V130A24LS	16.10	16.4	16.60	0.1	1.3	0.12	0.16	24V	3A	+1.25/-40	+24/-16V
	ZEN056V230A16LS	5.45	5.6	5.75	0.1	2.3	0.04	0.06	16V	5A	+5/-40	+16/-12V
	ZEN065V230A16LS	6.35	6.5	6.65	0.1	2.3	0.04	0.06	16V	5A	+3.5/-40	+16/-12V
	ZEN132V230A16LS	13.20	13.4	13.60	0.1	2.3	0.04	0.06	16V	5A	+2/-40	+20/-12V
	ZEN056V075A48LS	5.45	5.6	5.75	0.1	0.75	0.28	0.45	48V	3A	+10/-40	+48/-16V
	ZEN132V075A48LM	13.20	13.4	13.60	0.1	0.75	0.28	0.45	48V	3A	+2/-40	+48/-16V
NEW	ZEN056V115A24LS	5.45	5.6	5.75	0.1	1.15	0.15	0.18	24V	3A	+10/-40	+24/-16V
NEW	ZEN056V130A24GS	5.45	5.6	5.75	0.1	1.30	0.12	0.18	24V	3A	+6/-40	+24/-16V
Coming* Soon	ZEN059V130A24LS†	5.80	5.9	6.00	0.1	1.30	0.12	0.16	24V	3A	+6/-40	+24/-16V

* Data is preliminary
† Maximum Reverse Leakage Current = 650µA@5.0V meets USB suspend mode specification

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}).
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}.



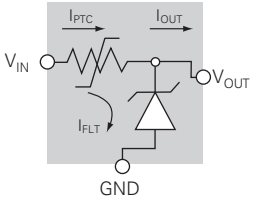


Figure PZ2-PZ9 Typical Performance Curves for PolyZen Devices

Figure PZ2

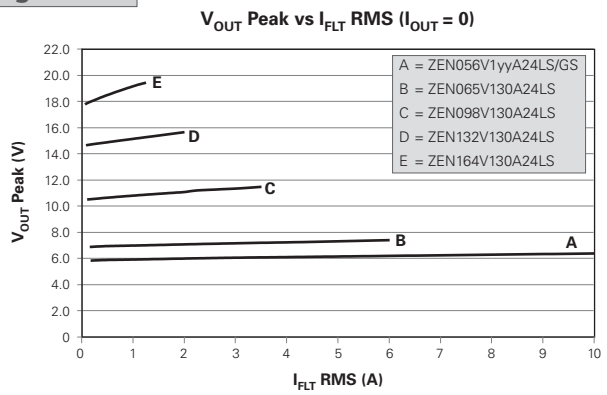
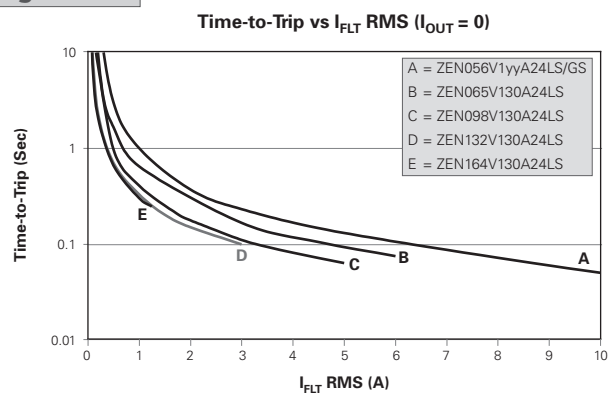


Figure PZ3



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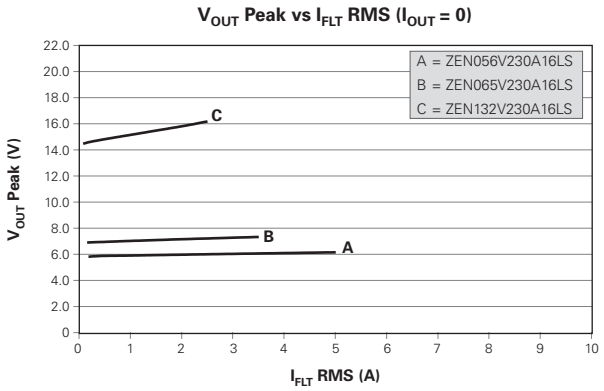

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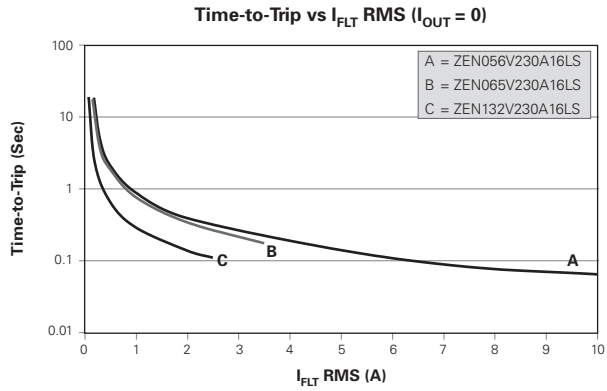
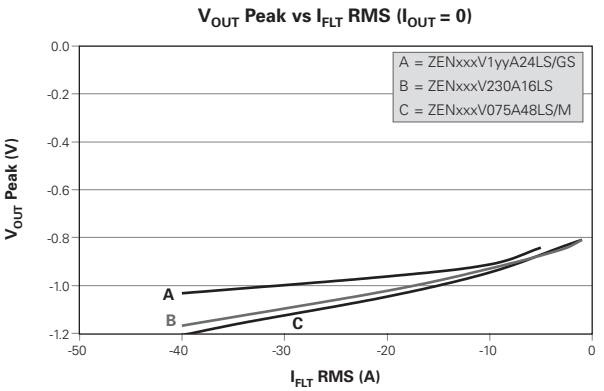


Figure PZ6



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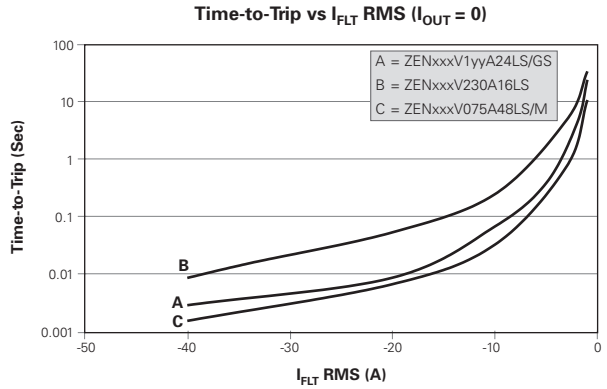
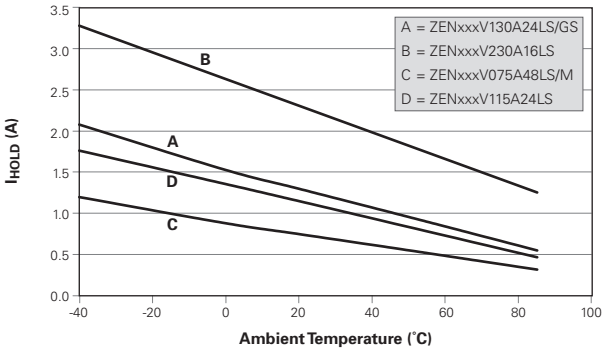


Figure PZ8



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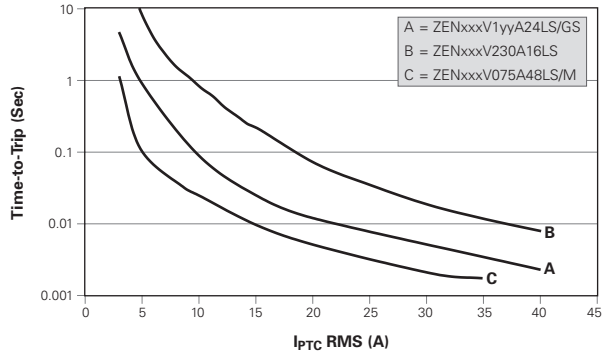


Table PZ3 General Characteristics for PolyZen Devices

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	

Figure PZ10-PZ22 Basic Operation Examples for PolyZen Devices

Figure PZ10

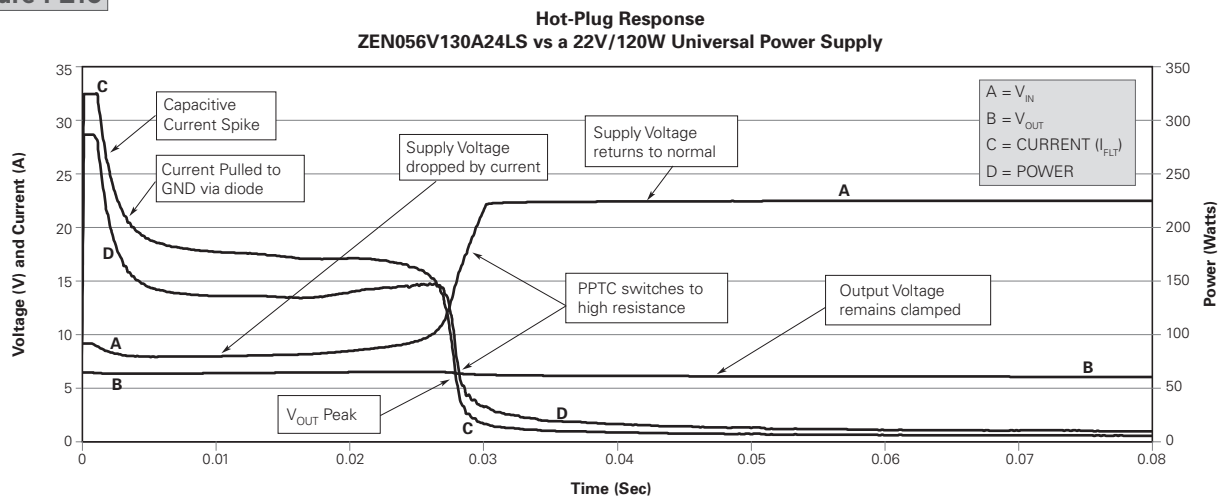


Figure PZ11

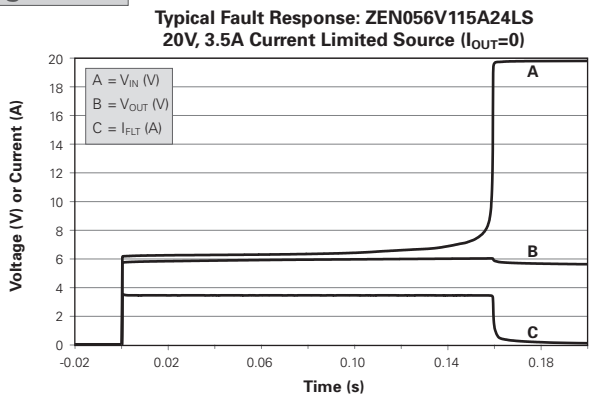


Figure PZ12

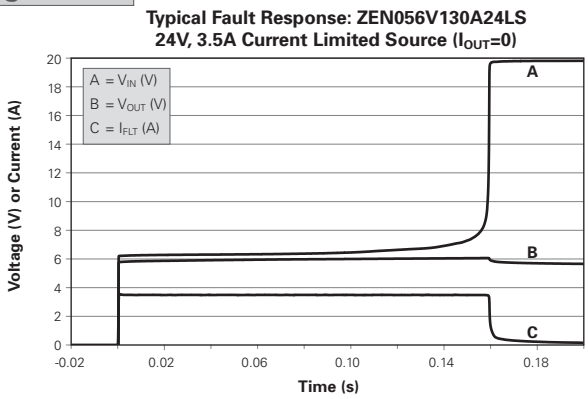


Figure PZ13

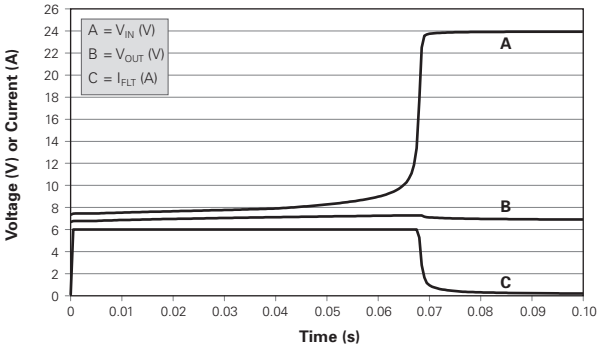


Figure PZ14

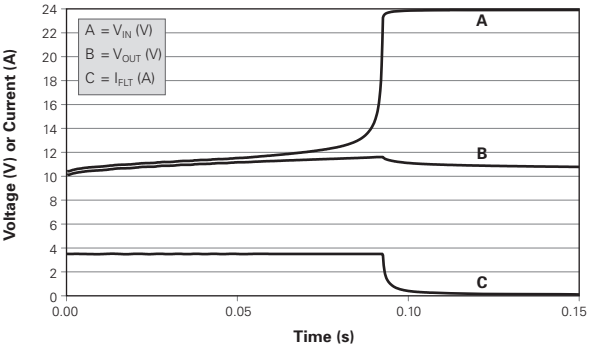


Figure PZ16-PZ22 Basic Operation Examples for PolyZen Devices Cont'd

Figure PZ15

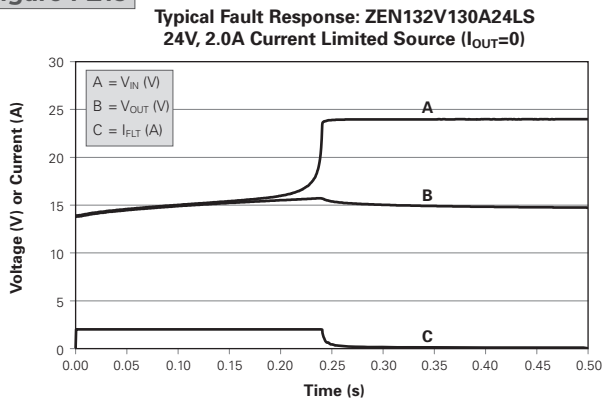
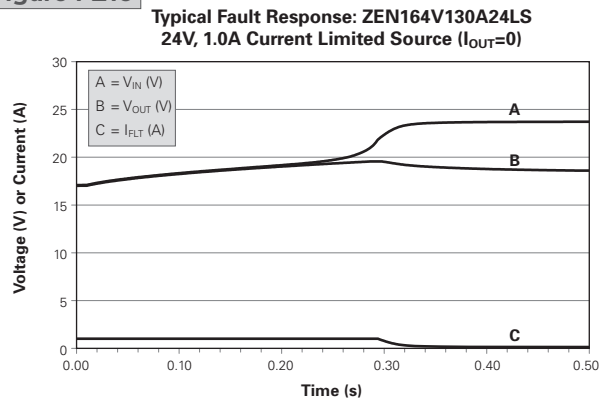


Figure PZ16



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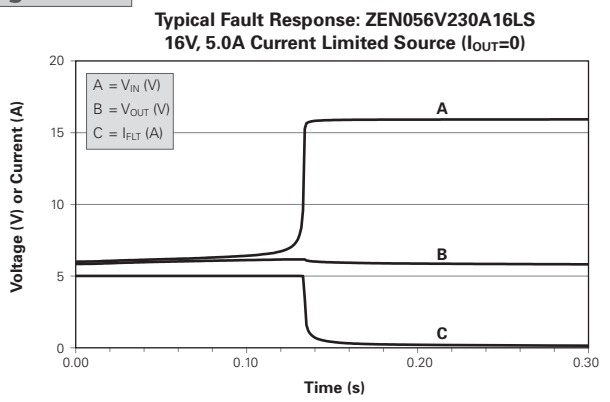

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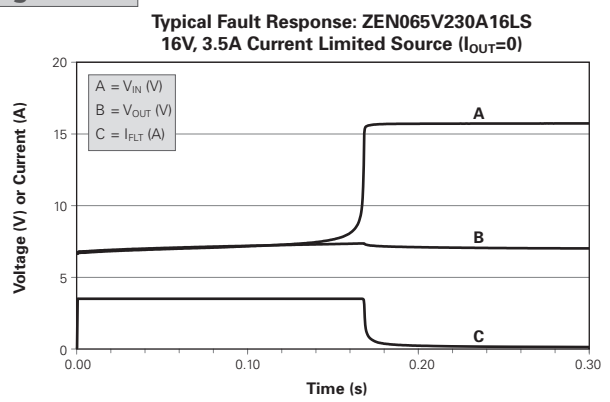

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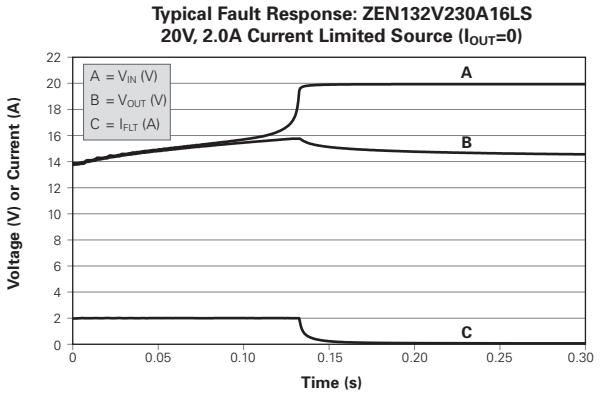

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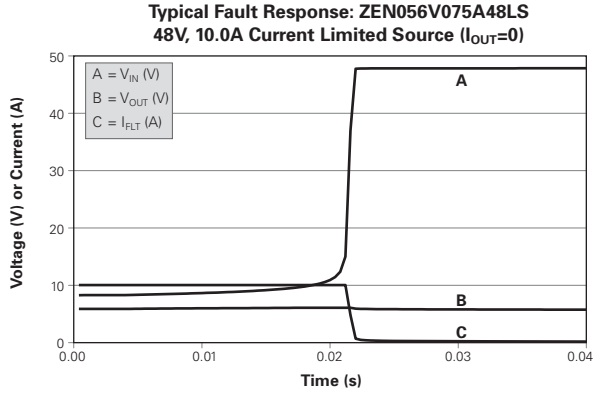

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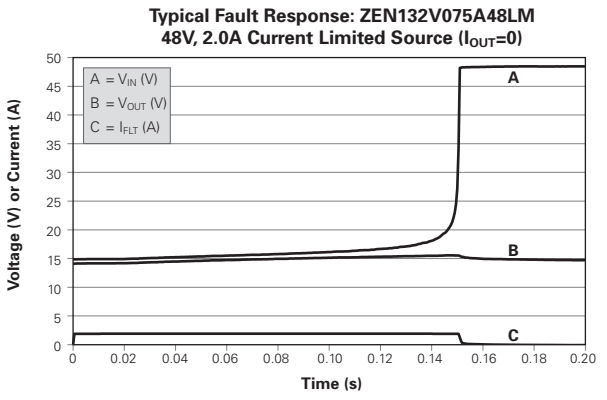


Figure PZ22

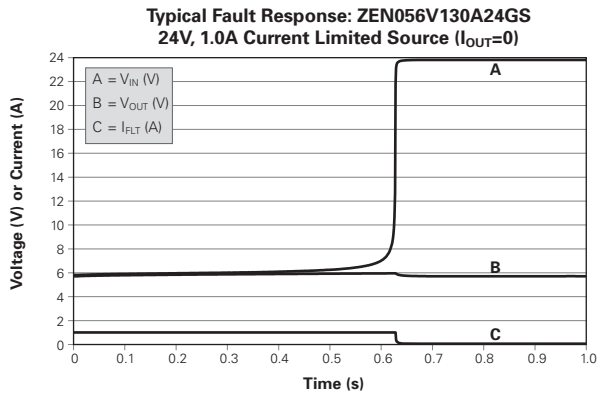


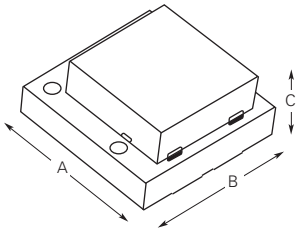
Table PZ4 Packaging and Marking Information for PolyZen Devices

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

Table PZ5 Dimensions for PolyZen Devices

ZENxxxVyyyAzzLS/M Devices

	A		B		C	
	Min.	Max.	Min.	Max.	Min.	Max.
mm	3.85	4.15	3.85	4.15	1.4	2.0
inch	(0.152)	(0.163)	(0.152)	(0.163)	(0.055)	(0.081)



ZENxxxVyyyAzzGS Devices

	L		W		H	
	Min.	Max.	Min.	Max.	Min.	Max.
mm	3.85	4.15	3.85	4.15	1.16	1.25
inch	(0.152)	(0.163)	(0.152)	(0.163)	(0.046)	(0.049)

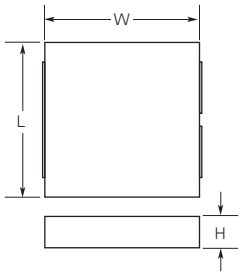
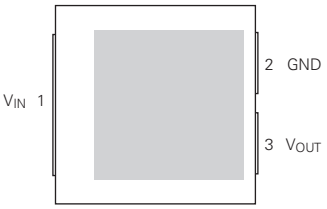


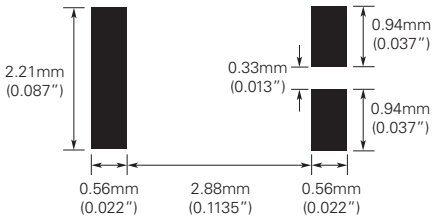
Table PZ6 Pad Layout and Configuration Information for PolyZen Devices

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



RoHS Compliant, ELV Compliant

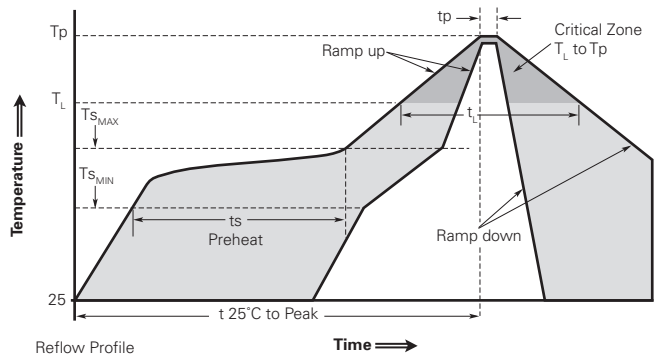
Solder Reflow and Rework Recommendation for PolyZen Devices

Classification Reflow Profiles

Profile Feature	Pb-Free Assembly
Average ramp up rate (Ts_{MAX} to Tp)	3°C/second max.
Preheat	
• Temperature min. (Ts_{MIN})	150°C
• Temperature max. (Ts_{MAX})	200°C
• Time (ts_{MIN} to ts_{MAX})	60-180 seconds
Time maintained above:	
• Temperature (T_L)	217°C
• Time (t_L)	60-150 seconds
Peak/Classification temperature (Tp)	260°C
Time within 5°C of actual peak temperature	
Time (tp)	20-40 seconds
Ramp down rate	6°C/second max.
Time 25°C to peak temperature	8 minutes max.

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

Figure PZ23

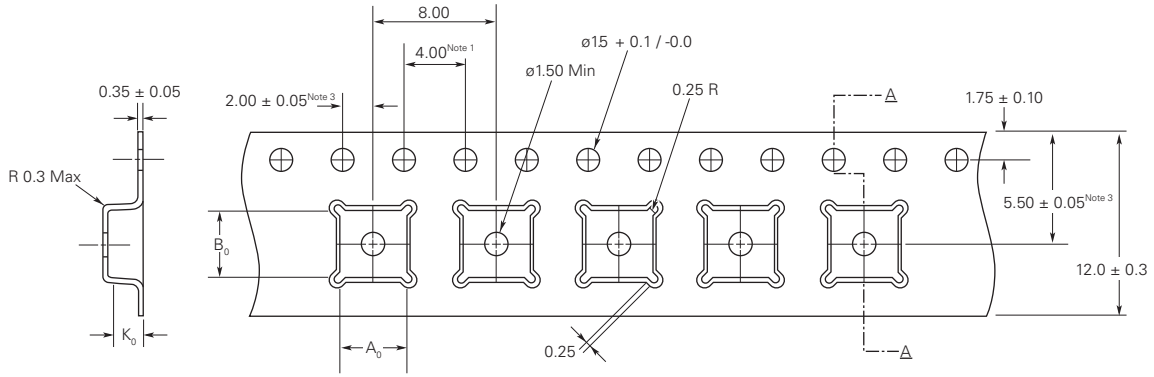


Reflow Profile

Tape and Reel Specifications for PolyZen Devices (in Millimeters)

Figure PZ24 EIA Referenced Taped Component Dimensions for PolyZen Devices (in Millimeters)

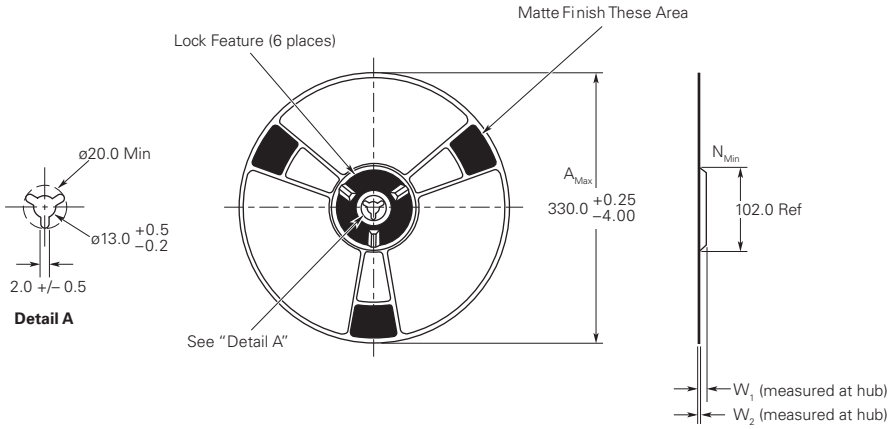
Description	ZENxxxVyyyAzzLS/M Devices	ZENxxxVyyyAzzGS Devices
A_0	4.35	4.35
B_0	4.35	4.35
K_0	2.30	1.80



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 PZ25 Reel Dimensions for PolyZen Devices (in Millimeters)

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



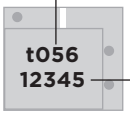
Part Numbering System for PolyZen Devices

ZEN 056V 130A 24 LS/M & GS

- **Special Labeling**
  LS or M = Module Height of 2.0mm
  GS = Module Height of 1.25mm
- **V_{INT} Max Rating (24 = 24V)**
- **PPTC Hold Current Group (130 = 1.3A)**
- **Zener Voltage Group (056 = 5.6V)**
- **PolyZen Series**

Part Marking System for PolyZen Devices

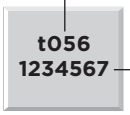
ZENxxxVyyyAzzLS/M Devices



Zener Diode Voltage Rating
056 = 5.6V
059 = 5.9V
065 = 6.5V
098 = 9.8V
132 = 13.4V
164 = 16.4V

Batch Number

ZENxxxVyyyAzzGS Devices



Zener Diode Voltage Rating
056 = 5.6V

Batch Number

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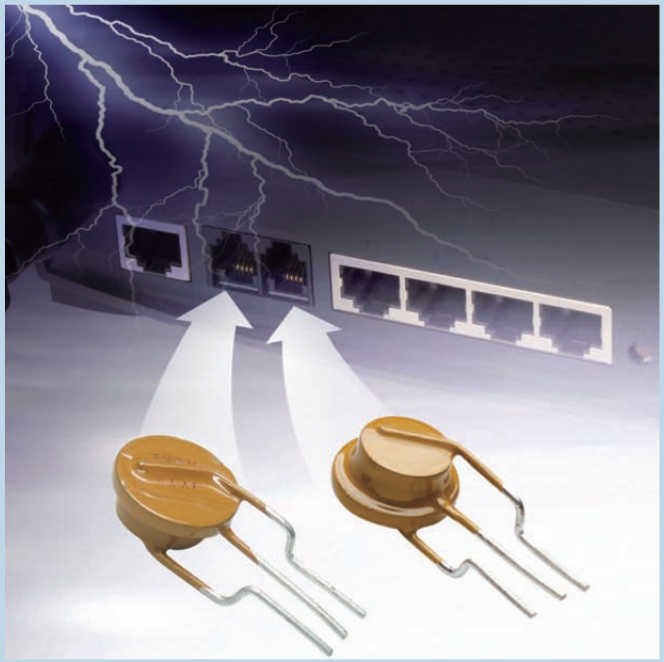
2Pro Devices

The 2Pro product is an integrated overcurrent/overvoltage protection device. The RoHS-compliant component incorporates PolySwitch PPTC (Polymeric Positive Temperature Coefficient) and 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_{1MAX}*	Time to Trip (s)† @ 1A Typ.	Max.
TM2P-10271	0.15	0.30	6.5	14.0	16.0	0.9	3

Overvoltage (terminals 2 – 3)

Part Number	Varistor Voltage V @ 1mA DC(V)	Tolerance	DC Resistance @ 100V (MΩ)	Maximum Clamping Voltage @ 25A (V)	Rated Wattage (W)
TM2P-10271	260	+14% -7%	>10	455	0.25

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

Electrical Schematic

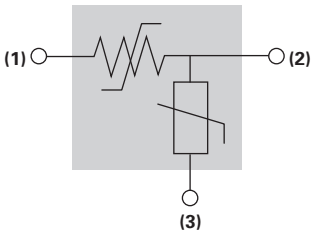


Table 2P2 Dimensions for 2Pro Devices

	A Min.	A Max.	B Min.	B Max.	C Min.	C Max.	D Min.	D Max.	E Nom.	F Min.	F Max.
mm	—	12.0	—	15.0	—	6.6	6.0	—	2.5	—	12.0
inch*	—	(0.47)	—	(0.59)	—	(0.26)	(0.24)	—	(0.10)	—	(0.47)

* The dimensions in inches are rounded approximations.

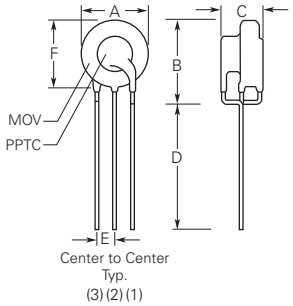


Figure 2P1 Typical Time-to-Trip at 25°C for 2Pro Devices

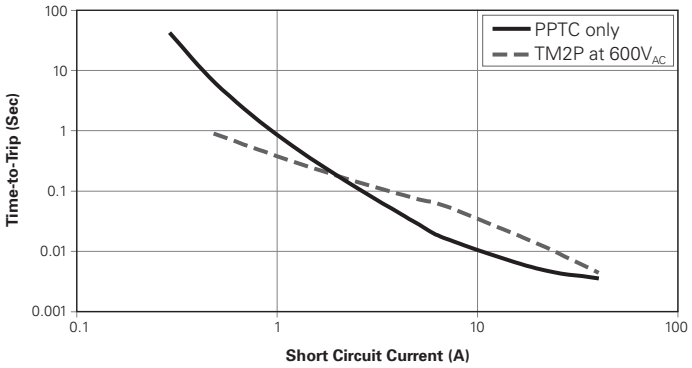


Table 2P3 Physical Characteristics and Environmental Specifications for 2Pro Devices

Physical Characteristics

Lead material	Tin-plated copper, 0.33mm^2 (22AWG), ø0.64mm (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, 60V$_{DC}$ 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.

RoHS Compliant, ELV Compliant HF Halogen Free

Table 2P4 Packaging and Marking Information for 2Pro Devices

Part Number	Bag Quantity	Tape & 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

Table 2P5 Ordering Information for 2Pro Devices

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

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 2P2

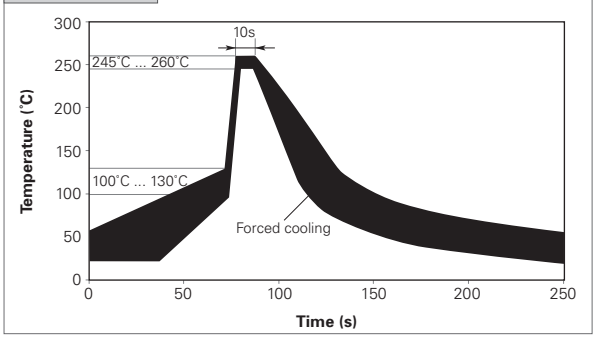


Table 2P6 Tape and Reel Specifications for 2Pro Devices (in Millimeters)

2Pro devices are available in tape and reel packaging per EIA 468-B standard. See Figures 2P3 and 2P4 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	Minimum
Top distance between tape edges	W_6	W_2	3	Maximum
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	Maximum
Overall width with lead protrusion	-	C_1	43.2	Maximum
Overall width without lead protrusion	-	C_2	42.5	Maximum
Lead protrusion	L_1	l_1	1.0	Maximum
Protrusion of cut-out	L	L	11	Maximum
Protrusion beyond hold down tape	l_2	l_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	Maximum
Tape thickness with splice*	t_1	-	2.0	Maximum
Splice sprocket hole alignment	-	-	0	±0.3
Body lateral deviation	Δh	Δh	0	±0.1
Body tape plane deviation	Δp	Δp	0	±1.3
Ordanate 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	Maximum
Reel diameter	a	d	370	Maximum
Space between flanges	w_1	-	51.2	Maximum
Arbor hole diameter	c	f	26	±12.0
Core diameter	n	h	80	Maximum
Box	-	-	56/372/372	Maximum
Consecutive missing pieces*	-	-	3 maximum	-
Empty places per reel*	-	-	Not specified	-

Note: *Differs from EIA specification.

Figure 2P3 EIA Referenced Taped Component Dimensions for 2Pro Devices

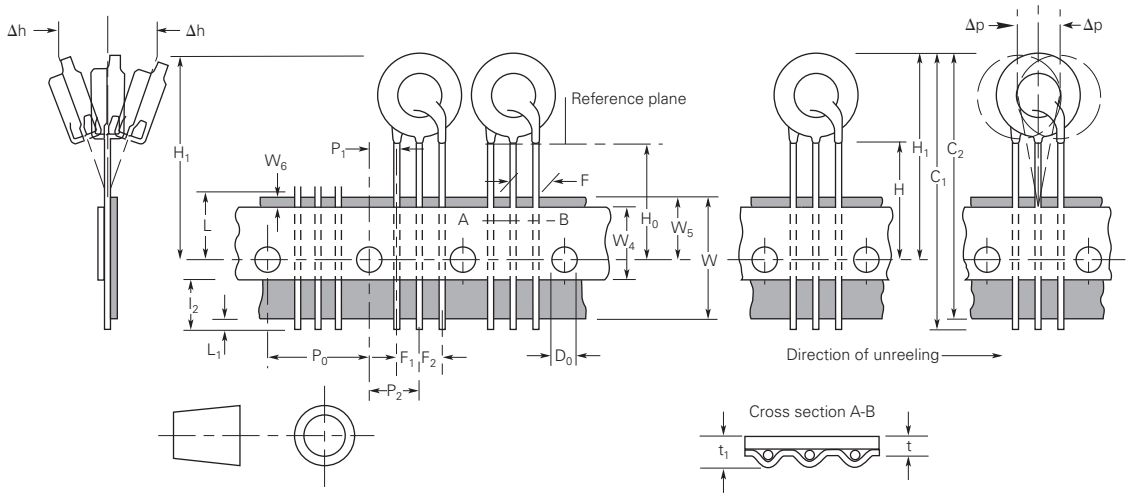
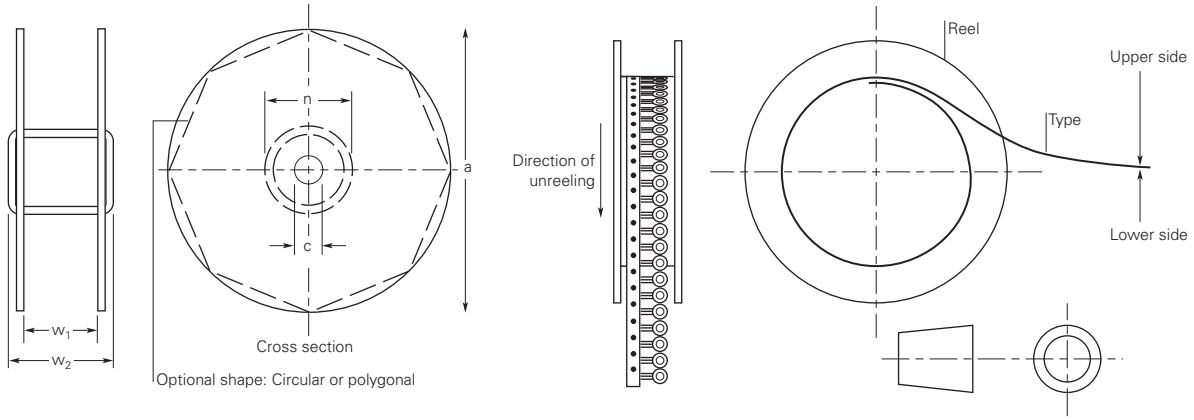


Figure 2P4 EIA Referenced Reel Dimensions for 2Pro Devices



Part Numbering System for 2Pro Devices

TM 2P- 10 271 -2

Packaging
Blank : Bulk
-2 : Tape & 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

Warning :

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RoHS Compliant, ELV Compliant HF Halogen Free

Silicon ESD Protection Devices

NEW

Silicon ESD (SESD) devices help protect electronic circuits against damage from electrostatic discharge (ESD) events. The 0201-sized SESD device's miniature footprint – measuring 0.6mm x 0.3mm x 0.3mm - is approximately 70 percent smaller than prior-generation devices, offering designers flexibility in space-constrained applications.

The SESD0201C-006-058 device is a bi-directional and ultra-low capacitance 0.6 picofarad (pF) device that is suitable for helping to protect very-high-speed data lines, such as USB and HDMI, or low-voltage antenna ports. The device's ultra-low capacitance, low insertion loss (<0.5dB up to 3GHz), and high linearity of capacitance versus frequency helps minimize signal degradation.

The SESD0201C-120-058 device is a higher-capacitance (12pF) bi-directional device that can be used for low-speed generic interfaces such as keypads, power buttons, speakers, and microphone ports in portable electronics. Both SESD0201C-006-058 and SESD0201C-120-058 devices offer 8kV contact and 15kV air discharge protection per the IEC61000-4-2, level 4 standard.

Also included in the product line is the SESD0402S-005-054 device, an ultra-low-capacitance SOD-923 (0402-size package) uni-directional device with 0.5pF typical capacitance. This device offers a 10kV contact discharge rating per IEC61000-4-2, level 4 and can be used with digital applications such as USB and HDMI.

Benefits

- Small size SESD protection diodes for high speed signals
- ESD protection in space-constrained portable electronics and mobile handsets
- Helps protect electronic circuits against damage from ESD
- Assist equipment to pass IEC61000-4-2, level 4 testing

Features

- RoHS compliant
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Low-leakage current – 1.0µA (max)
- Low-breakdown voltage < 5.8V
- Capable of withstanding numerous ESD strikes
- Low capacitance and insertion loss
- SOD-923 case epoxy material meets UL 94 V-0
- SESD0402S devices meet MSL-1 requirements

Applications

- Mobile phones and portable electronics
- High-speed data lines (low capacitance 0201 and 0402)
- Low-voltage antenna ports (bi-directional 0201)
- USB 2.0/3.0, HDMI 1.3/1.4, and DisplayPort
- Applications requiring high ESD performance in a small package

Table SE1 Maximum Ratings for SESD Devices

Part Number	IEC61000-4-2, level 4 (ESD Withstand) Contact (kV)	Air (kV)	Temperature Operating (°C)	Storage (°C)	Total Power Dissipation on FR-4 board* (mW)
SESD0201C-006-058	±8	±15	-40 to +125	-40 to +125	150
SESD0201C-120-058	±8	±15	-40 to +125	-40 to +125	250
SESD0402S-005-054	±10	±15	-55 to +125	-55 to +150	250

*FR-4 board = 30mm x 30mm x 2mm

Table SE2 Electrical Characteristics @T=25°C for SESD Devices

Part Number	Input Capacitance* Typical (pF)	Maximum (pF)	Leakage Current (max) I_L @ V_{WRV} = 5.0V (µA)	Breakdown Voltage (min) V_{br} @ I_T** = 1mA (V)	Working Reverse Voltage V_{WRV} @ peak (V)
SESD0201C-006-058	0.6†	0.9	1.0	±5.8	5.0
SESD0201C-120-058	12.0	13.5	1.0	±5.8	5.0
SESD0402S-005-054	0.5‡	0.9	1.0	+5.4 / -1.0	5.0

* @Vr=0V, f=1MHz
† 0.19pF@f=3GHz
‡ 0.17pF@f=3GHz
** V_{br} is measured at test current I_T

Figure SE1-SE2 Capacitance vs Frequency for SESD Devices

6

Figure SE1

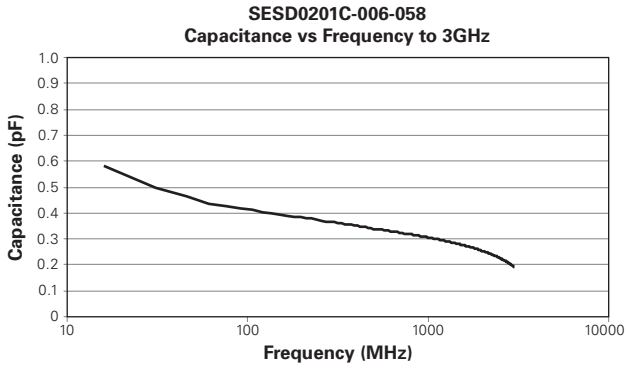


Figure SE2

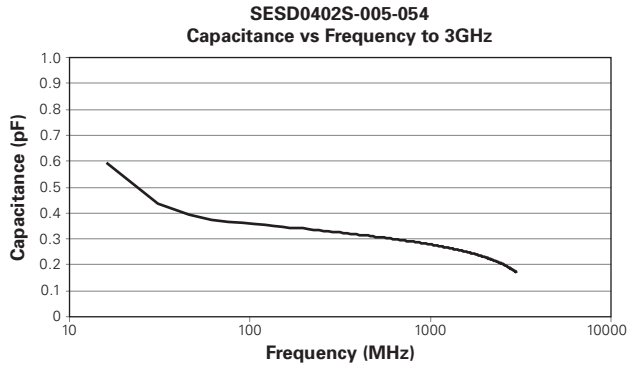
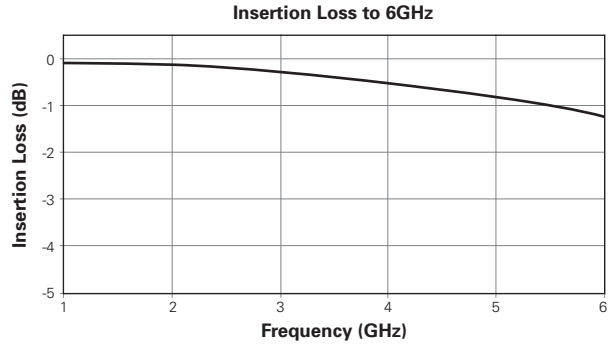


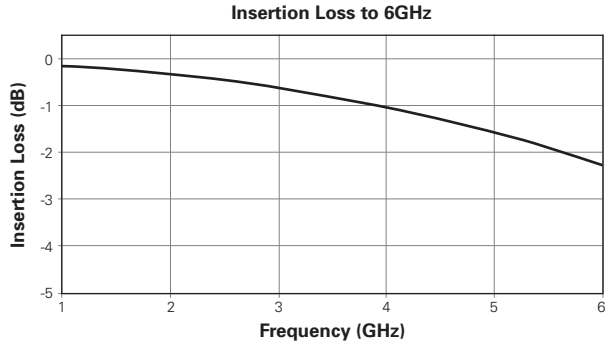
Figure SE3-SE4 Insertion Loss Diagram for SESD Devices

Figure SE3



Applications	Insertion Loss	@Frequency (GHz)
HDMI 1.3 (1080p)	-0.205	2.25
HDMI 1.3 (max spec)	-0.354	3.40
DisplayPort	-0.235	2.70
USB 3.0	-0.791	5.00

Figure SE4



Applications	Insertion Loss	@Frequency (GHz)
HDMI 1.3 (1080p)	-0.300	2.25
HDMI 1.3 (max spec)	-0.735	3.40
DisplayPort	-0.335	2.70
USB 3.0	-1.450	5.00

RoHS Compliant, ELV Compliant HF Halogen Free

Table SE3 Dimensions for SESD Devices in Millimeters (Mils)*

Part Number	A	B	C	D	E	F	G	Figure
SESD0201C	0.60 ± 0.03	0.30 ± 0.03	0.27 ± 0.03	0.15 ± 0.03	0.25 ± 0.03	0.25 ± 0.03	0.005 (max)	SE5
	(23.62 ± 1.20)	(11.81 ± 1.20)	(10.63 ± 1.20)	(5.91 ± 1.20)	(9.84 ± 1.20)	(9.84 ± 1.20)	(0.197) (max)	
SESD0402S	1.00 ± 0.05	0.60 ± 0.05	0.37 ± 0.03	0.20 ± 0.05	0.10 ± 0.05	0.80 ± 0.05	0.12 ± 0.05	SE6
	39.37 ± 0.40	23.62 ± 0.40	14.57 ± 1.20	7.87 ± 2.00	3.94 ± 2.00	31.50 ± 2.00	4.72 ± 2.00	

* Round off approximation

Figure SE5-SE6 Dimension Figures for SESD Devices

Figure SE5

SESD0201C CSP Package

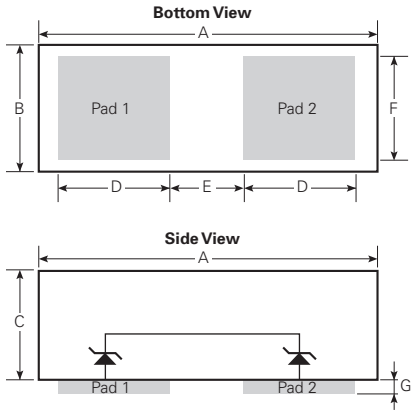


Figure SE6

SESD0402S SOD-923 Package

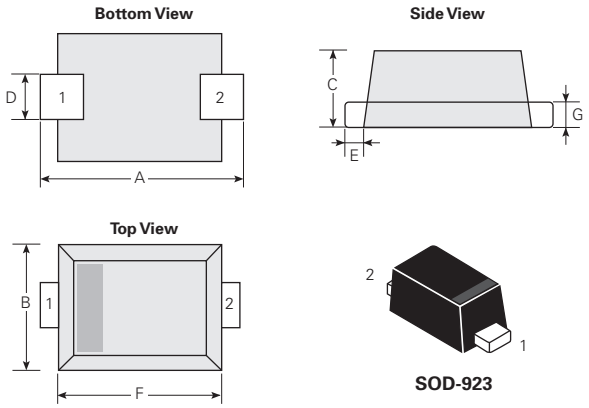


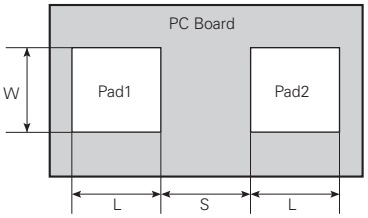
Table SE4 PCB Pad Layout for SESD Devices in Millimeters (Mils)*

Part Number	L	S	W	Figure
SESD0201C	0.28 ± 0.01	0.19 ± 0.01	0.30 ± 0.01	SE7
	(11.0 ± 0.40)	(7.50 ± 0.40)	(11.80 ± 0.40)	
SESD0402S	0.30 ± 0.01	0.60 ± 0.01	0.40 ± 0.01	SE7
	(11.80 ± 0.40)	(23.60 ± 0.40)	(15.70 ± 0.40)	

* Round off approximation

Figure SE7

Recommended Landing Pattern



SESD0201C can be oriented either direction

Figure SE8

Typical SESD Protected Signal

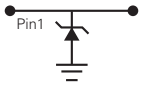
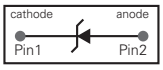


Figure SE9

SESD0402S-005-054 uni-directional board placement



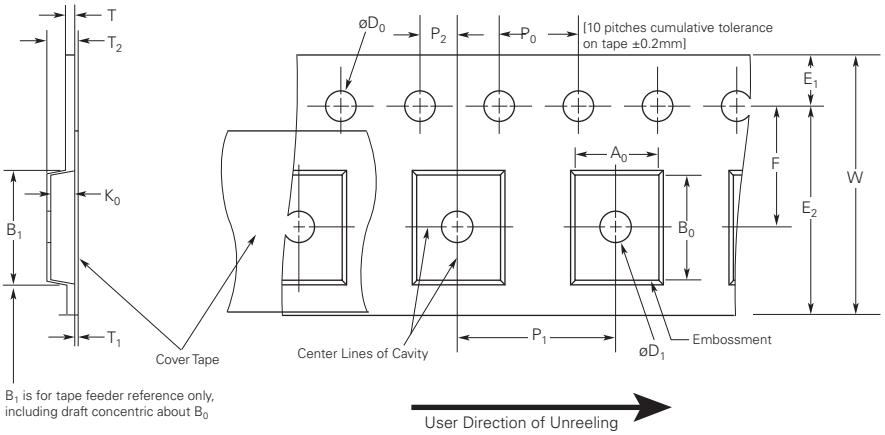
Orient Pin1 to Pad1

Table SE5 Tape and Reel Specifications for SESD Devices

Tape Dimension EIA Mark	SESD0201C-006-058 Dimension (mm)	SESD0201C-120-058 Dimension (mm)	SESD0402S-005-054 Dimension (mm)
A_0	0.37 ± 0.03	0.37 ± 0.03	0.66 ± 0.05
B_0	0.67 ± 0.03	0.67 ± 0.03	1.06 ± 0.05
D_0	1.60 (max)	1.60 (max)	1.60 (max)
D_1	1.00 (min)	1.00 (min)	1.00 (min)
E_1	1.75 ± 0.10	1.75 ± 0.10	1.75 ± 0.10
E_2	5.85 (min)	5.85 (min)	5.85 (min)
F	3.50 ± 0.05	3.50 ± 0.05	3.50 ± 0.05
P_0	4.00 ± 0.10	4.00 ± 0.10	4.00 ± 0.10
P_1	2.00 ± 0.05	2.00 ± 0.05	2.00 ± 0.05
P_2	2.00 ± 0.10	2.00 ± 0.10	2.00 ± 0.10
W	8.00 ± 0.30	8.00 ± 0.30	8.00 ± 0.30
Tape Thickness **EIA Mark**	**Dimension (mm)**	**Dimension (mm)**	**Dimension (mm)**
B_1	0.67 ± 0.03	0.67 ± 0.03	1.06 ± 0.05
K_0	0.35 ± 0.03	0.35 ± 0.03	0.48 ± 0.05
T	0.60 (max)	0.60 (max)	0.60 (max)
T_1	0.10 (min)	0.10 (min)	0.10 (min)
T_2	1.05 ± 0.03	1.05 ± 0.03	1.05 ± 0.03
Reel Dimension **EIA Mark**	**Dimension (mm)**	**Dimension (mm)**	**Dimension (mm)**
A	178 (max)	178 (max)	178 (max)
B	1.60 (min)	1.60 (min)	1.60 (min)
C	13.0 ± 0.2	13.0 ± 0.2	13.0 ± 0.2
D	20.2 (min)	20.2 (min)	20.2 (min)
N	50.0 (min)	50.0 (min)	50.0 (min)
W_1	9.15 ± 0.75	9.15 ± 0.75	9.15 ± 0.75
W_2	14.4 (max)	14.4 (max)	14.4 (max)
W_3	10.9 (max)	10.9 (max)	10.9 (max)

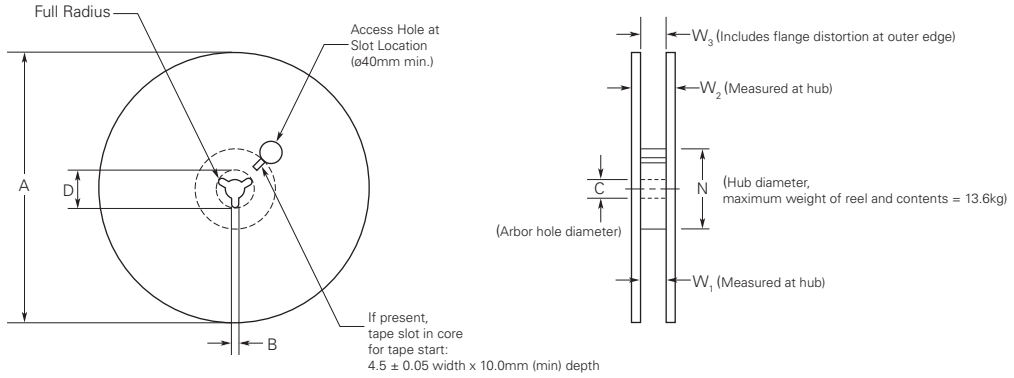
6

Figure SE10 EIA Referenced Taped Component Dimensions for SESD Devices



RoHS Compliant, ELV Compliant HF Halogen Free

Figure SE11 EIA Referenced Reel Dimensions for SESD Devices



Definitions of Terms for SESD Devices

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

Part Numbering System for SESD Devices

SESD 0402 S - 005 - 054

Breakdown Voltage (min)
054 = 5.4V
058 = 5.8V

Input Capacitance (typ)
005 = 0.5pF
006 = 0.6pF
120 = 12.0pF

Package
C = Chip Scale
S = SOD-923

EIA Size
0201
0402

Series
Silicon ESD

Warning :

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ESD Protection Devices

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

ESD 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), ESD 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 ESD 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
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- 0.25 pF (typical) 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 & plasma TV
- 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

Table E1 Electrical Characteristics for ESD Devices

	Continuous Max Operating Voltage	Typical Trigger Voltage*	Typical Clamping Voltage†	Typical Capacitance @1 MHz, $1V_{RMS}$	Typical 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 ESD Devices

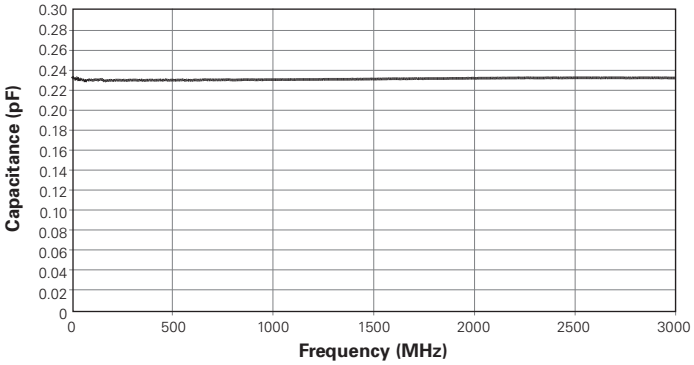


Figure E2 Eye Diagram Performance at 3.4 GHz for ESD Devices

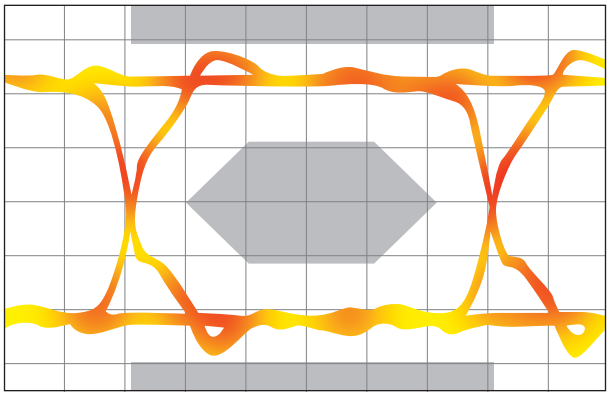
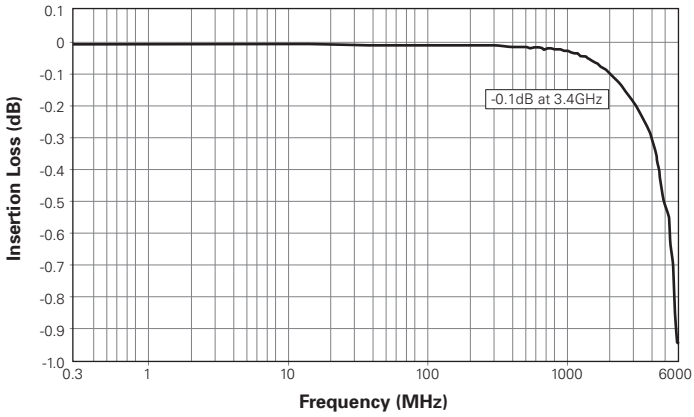


Figure E3 Insertion Loss Diagram for ESD Devices



RoHS Compliant, ELV Compliant HF Halogen Free

Figure E4-E5 ESD Protection for HDMI

Figure E4

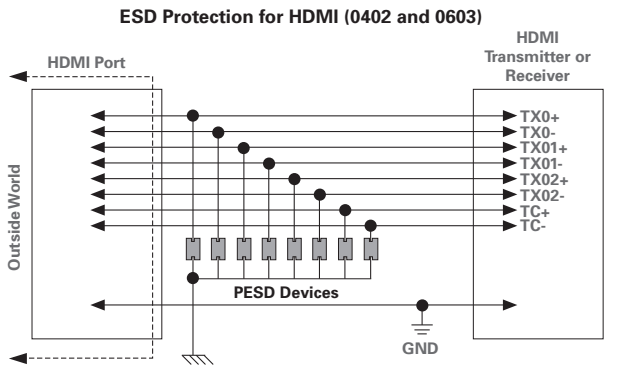


Figure E5

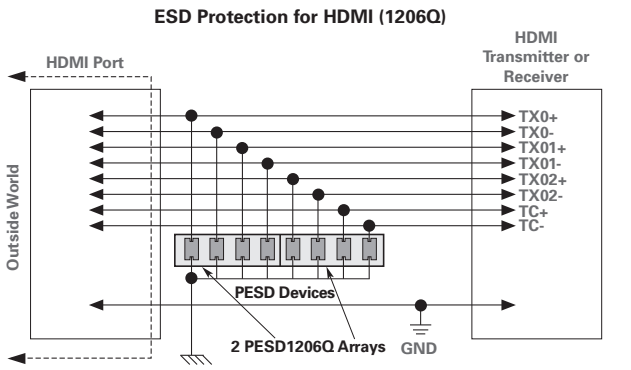


Table E2 Dimensions for ESD Devices in Millimeters (Inches)*

	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	1.00	—	—	—	—	E6
	(0.059)	(0.067)	(0.018)	(0.022)	(0.004)	(0.020)	(0.028)	(0.039)					
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-E7 Dimension Figures for ESD Devices

Figure E6

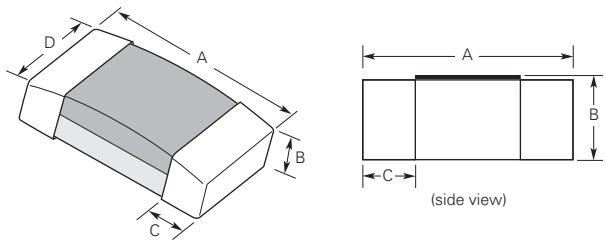


Figure E7

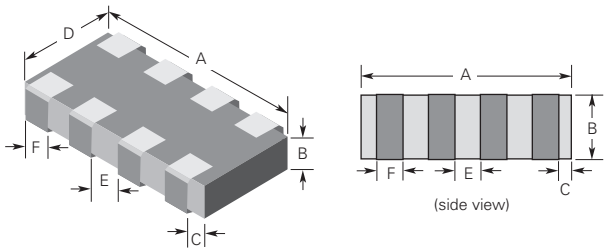


Table E3 Environmental Specifications for ESD Devices

	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 ESD 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 (typical), 15kV (max) Air discharge mode : 15kV (typical), 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 ESD Devices

RoHS compliant	Directive 2002/95/EC compliant
ELV compliant	Directive 2000/53/EC compliant
Halogen free	Halogen free refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm

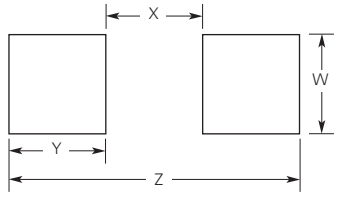
Table E6 Recommended Pad Layout for ESD Devices in Millimeters (Inches)*

	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 0.2 mm

Figure E9

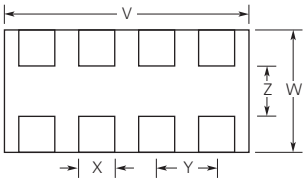
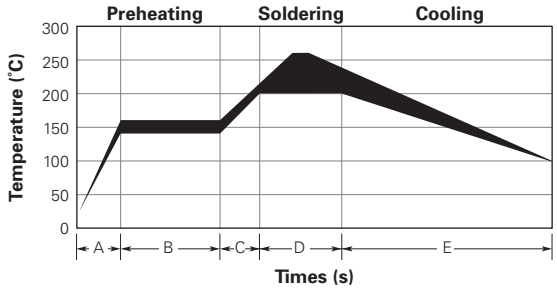


Table E7 Solder Reflow Recommendations for ESD Devices

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

Figure E10



RoHS Compliant, ELV Compliant HF Halogen Free

Table E8 Tape and Reel Specifications for ESD Devices

Tape Dimension	0402		0603		1206Q	
EIA Mark	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	4.00	±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

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 EIA Referenced Taped Component Dimensions for ESD Devices

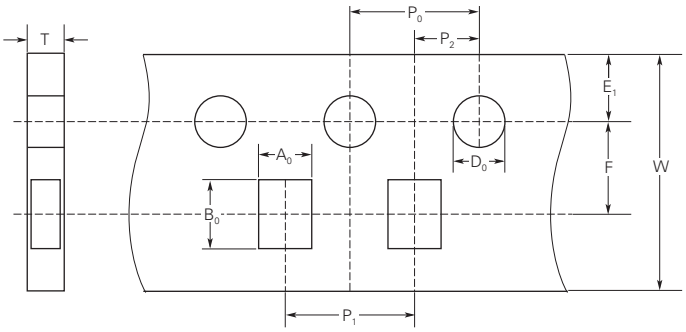
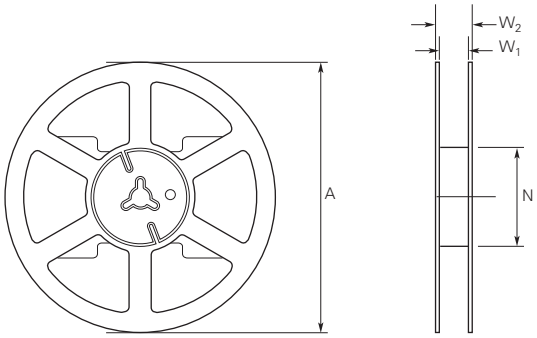


Figure E12 EIA Referenced Reel Dimensions for ESD Devices



Parameter Definitions for ESD 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.

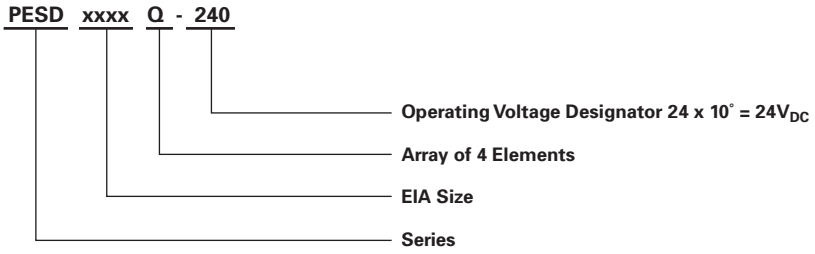
Clamping Voltage (V_C)

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

Capacitance (C_P)

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

Part Numbering System for ESD Devices



7

Warning :

Application Limitations for PESD0402-140, PESD0603-240 and PESD1206Q-240: These parts are not intended to be used under 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

Gas Discharge Tubes

Tyco Electronics' 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 makes them suitable for applications such as MDF (Main Distribution Frame) 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-600V)
- 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

Applications

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

Table G1 Device Voltage Ratings for "R" Series Gas Discharge Tubes

Two Electrode Configuration for R Series GDTs

Part Number	DC Sparkover Voltage @ 100V/s ± 20% Tolerance	Impulse Sparkover Voltage @ 1kV/µs
	75*	600
	90	600
	140	600
GTCS23-XXXM-R01-2	150	600
GTCC23-XXXM-R01-2	200	700
	230	700
	300	900
	350	1000
	400	1000

* DCSO 60~105

Part Number	DC Sparkover Voltage @ 100V/s ± 20% Tolerance	Impulse Sparkover Voltage @ 100V/µs	Impulse Sparkover Voltage @ 1kV/µs	DC Holdover Voltage Per ITU K.12	On-State Voltage Nominal (@1A) (V)
	75	450	550	<52	20
	90	450	550	<52	20
	140	500	600	<80	20
	150	500	600	<80	20
	200	600	700	<135	20
GTCX25-XXXM-R02	230	600	700	<135	20
GTCX26-XXXM-R05	250	600	700	<135	20
GTCX28-XXXM-R05	260	700	800	<135	20
GTCX28-XXXM-R10	300	800	900	<150	20
GTCX28-XXXM-R20**	350	900	1000	<150	20
	400	900	1000	<150	20
	420	900	1000	<150	20
	470	1050	1150	<150	20
	500	1100	1200	<150	20
	550	1300	1400	<150	20
	600	1300	1400	<150	20

** GTCX28-XXXM-R20 parts only up to 350V

Three Electrode Configuration for R series 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)
	75	450	550	<52	20
	90	450	550	<52	20
	140	500	600	<80	20
	150	500	600	<80	20
	200	600	700	<135	20
GTCX35-XXXM-R05	230	600	700	<135	20
GTCX36-XXXM-R05	250	600	700	<135	20
GTCX36-XXXM-R10	260	700	800	<135	20
GTCX37-XXXM-R10	300	800	900	<150	20
GTCX38-XXXM-R10	350	900	1000	<150	20
	400	900	1000	<150	20
	420	900	1000	<150	20
	470	1050	1150	<150	20
	500	1100	1200	<150	20
	550	1300	1400	<150	20
	600	1300	1400	<150	20

RoHS Compliant, ELV Compliant HF Halogen Free

Table G2 Device Surge Rating, Capacitance, Insulation Resistance, and Agency Approval for "R" Series Gas Discharge Tubes

Two Electrode Configuration for R Series GDTs

Part Number	Impulse Discharge Current		Impulse Withstand Voltage	Capacitance	Insulation Resistance	UL Rating
	8x20µs 10 hits (5 hits each polarity)	8x20µs 300 hits (150 hits each ploraity)	10x700µs 10 hits (5 times each polarity)	@ 1MHz	@ 100V_{DC}*	UL497B #E179610
GTCS23-XXXM-R01-2	1kA	100A	4kV	<0.5pF	1,000 (MΩ)	All Devices
GTCC23-XXXM-R01-2	1kA	100A	6kV†	<0.5pF	1,000 (MΩ)	All Devices

* Devices <=150V measured @ 50V_{DC}
† Effective output impedance: 40ohms.

Part Number	Impulse Discharge Current	Impulse Life	AC Discharge Current (1sec duration; 10 hits)	Capacitance	Insulation Resistance	UL Rating
	8x20µs 10 hits	10x1000µs 300 hits	@ 50 Hz	@ 1MHz	@ 100V	UL497B #E179610
GTCX25-XXXM-R02	2.5kA	100A	2.5Arms	<1pF	10,000 (MΩ)	All Devices
GTCX26-XXXM-R05	5kA	100A	5Arms	<1pF	10,000 (MΩ)	All Devices
GTCX28-XXXM-R05	5kA	100A	5Arms	<1pF	10,000 (MΩ)	All Devices
GTCX28-XXXM-R10	10kA	100A	10Arms	<1pF‡	10,000 (MΩ)	All Devices
GTCX28-XXXM-R20	20kA	100A	20Arms	<1.5pF	10,000 (MΩ)	All Devices

‡ <1.2pF for 75V and 90V devices.

Three Electrode Configuration for R series GDTs

Part Number	Impulse Discharge Current (A+B-E)	Impulse Life (A+B-E)	AC Discharge Current (1sec duration; 10 hits) (A+B-E)	Capacitance	Insulation Resistance	UL Rating
	8x20µs 10 hits	10x1000µs 300 hits	@ 50 Hz	@ 1MHz	@ 100V**	UL497B #E179610
GTCX35-XXXM-R05	5kA	100A	5Arms	<1pF	10,000 (MΩ)	All Devices
GTCX36-XXXM-R05	5kA	200A	5Arms	<1pF	10,000 (MΩ)	All Devices
GTCX36-XXXM-R10	10kA	200A	10Arms	<1pF	10,000 (MΩ)	All Devices
GTCX37-XXXM-R10	10kA	200A	10Arms	<1pF	10,000 (MΩ)	All Devices
GTCX38-XXXM-R10	10kA	200A	10Arms	<1pF	10,000 (MΩ)	All Devices

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

Figure G1-G2 Typical Circuits for "R" Series Gas Discharge Tubes

Figure G1

Two Electrode Devices for Ungrounded Circuits

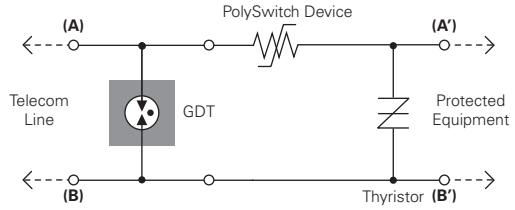


Figure G2

Three Electrode Devices for Grounded Circuits

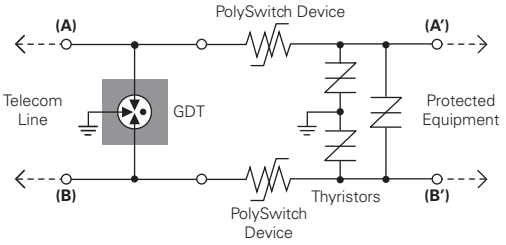
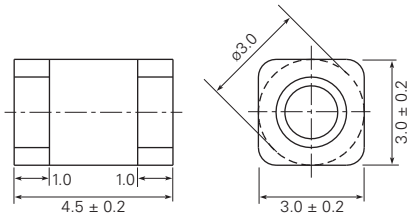


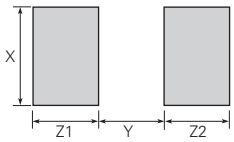
Figure G3-G10 Dimensions for "R" Series Gas Discharge Tubes

Figure G3 Two Electrode 3mm Product Dimensions

Surface-mount (GTCS23-XXXM-R01)



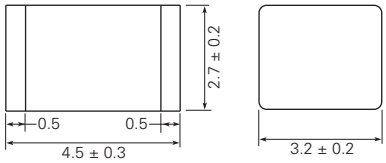
Pad Layout - Surface-mount Devices (GTCS23-XXXM-R01)



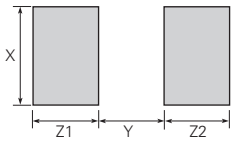
	X Nom.	Y Nom.	Z1 Nom.	Z2 Nom.
mm	3.0	2.0	2.0	2.0
in*	(0.118)	(0.079)	(0.079)	(0.079)

* The dimensions in inches are rounded approximations.

Chip GDT (GTCC23-XXXM-R01)



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

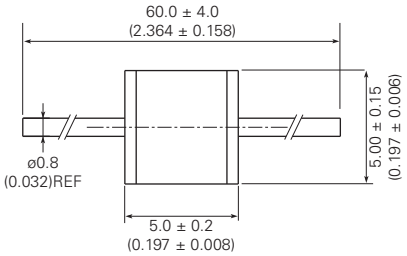


	X Nom.	Y Nom.	Z1 Nom.	Z2 Nom.
mm	3.5	2.7	2.0	2.0
in*	(0.138)	(0.106)	(0.079)	(0.079)

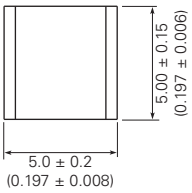
* The dimensions in inches are rounded approximations.

Figure G4 Two Electrode 5mm Product Dimensions

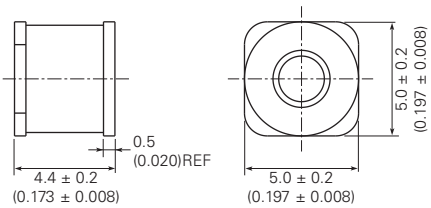
Axial Leads (GTCA25-XXXM-R02)



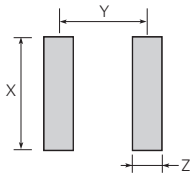
No Leads (GTCN25-XXXM-R02)†



Surface-mount (GTCS25-XXXM-R02)



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



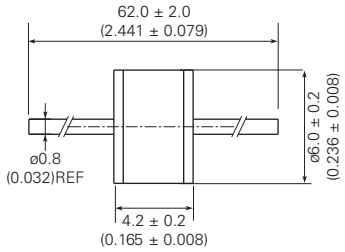
	X Nom.	Y Nom.	Z Nom.
mm	6.0	3.9	1.3
in*	(0.197)	(0.154)	(0.051)

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

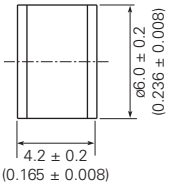
Figure G3-G10 Dimensions for "R" Series Gas Discharge Tubes Cont'd

Figure G5 Two Electrode 6mm Product Dimensions

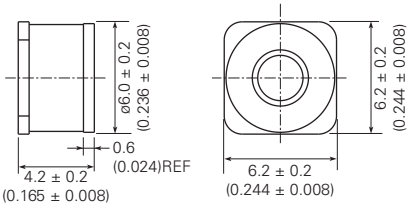
Axial Leads (GTCA26-XXXM-R05)



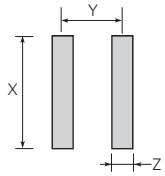
No Leads (GTCN26-XXXM-R05)†



Surface-mount (GTCS26-XXXM-R05)



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

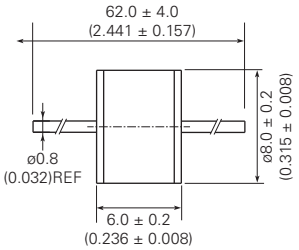


	X Nom.	Y Nom.	Z Nom.
mm	7.0	3.7	1.3
in*	(0.276)	(0.146)	(0.051)

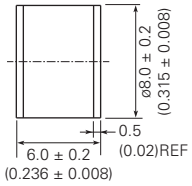
* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G6 Two Electrode 8mm Product Dimensions

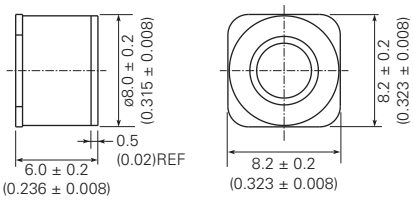
Axial Leads (GTCA28-XXXM-R05, R10 & R20)



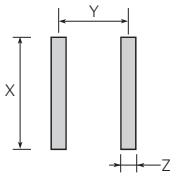
No Leads (GTCN28-XXXM-R05, R10 & R20)†



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



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



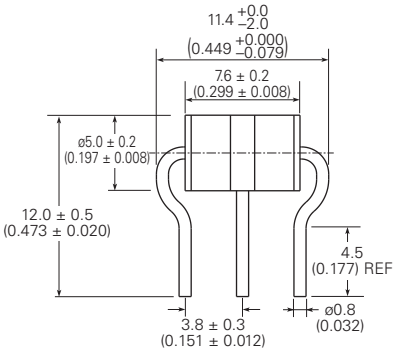
	X Nom.	Y Nom.	Z Nom.
mm	9.0	5.6	1.2
in*	(0.354)	(0.22)	(0.047)

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

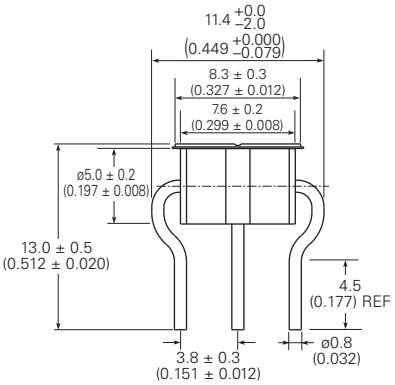
Figure G3-G10 Dimensions for "R" Series Gas Discharge Tubes Cont'd

Figure G7 Three Electrode 5mm Product Dimensions

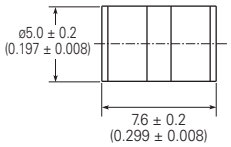
Axial Leaded (GTCA35-XXXM-R05)



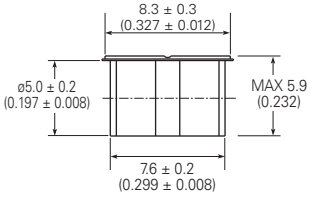
Axial Leaded with-FT (GTCA35-XXXM-R05-FT)



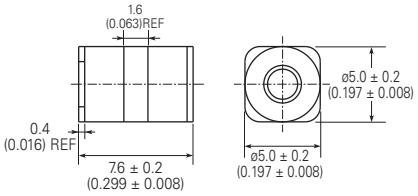
No Leads (GTCN35-XXXM-R05)†



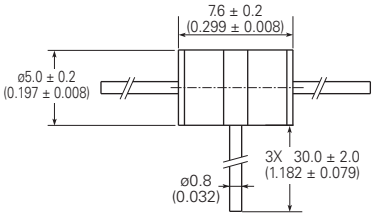
No Leads with-FT (GTCN35-XXXM-R05-FT)†



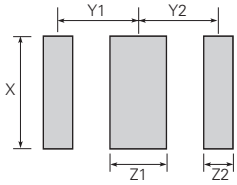
Surface-mount (GTCS35-XXXM-R05)



T Leaded (GTCT35-XXXM-R05)



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



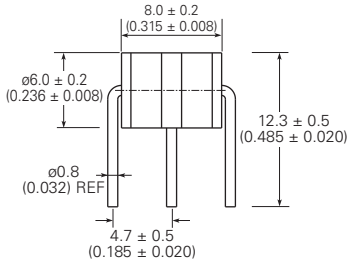
	X	Y1	Y2	Z1	Z2
	Nom.	Nom.	Nom.	Nom.	Nom.
mm	6.0	3.6	3.6	2.5	1.3
in*	(0.236)	(0.142)	(0.142)	(0.098)	(0.051)

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

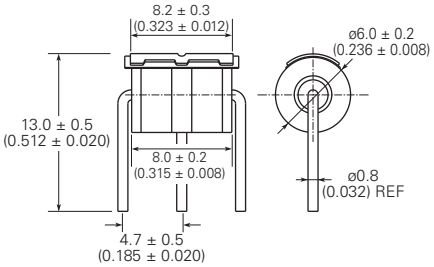
Figure G3-G10 Dimensions for "R" Series Gas Discharge Tubes Cont'd

Figure G8 Three Electrode 6mm Product Dimensions

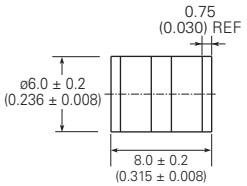
Axial Leaded (GTCA36-XXXM-R05 & R10)



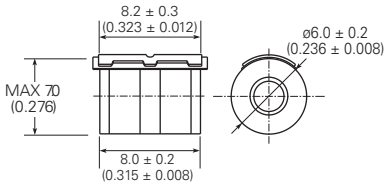
Axial Leaded with-FT (GTCA36-XXXM-R05 & R10-FT)



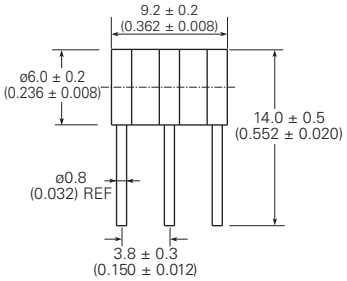
No Leads (GTCN36-XXXM-R05 & R10)†



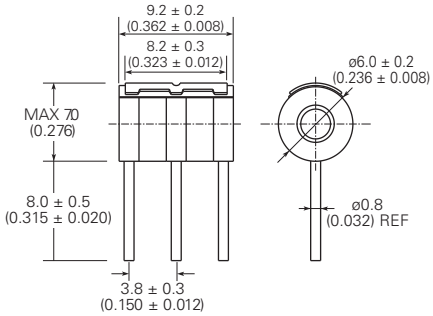
No Leads with-FT (GTCN36-XXXM-R05 & R10-FT)†



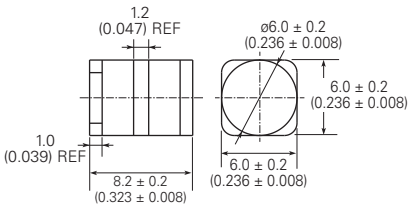
Radial Leaded (GTCR36-XXXM-R05 & R10)



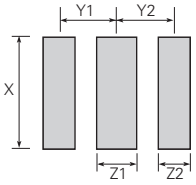
Radial Leaded with-FT (GTCR36-XXXM-R05 & R10-FT)



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



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

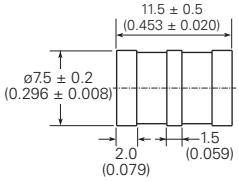


	X Nom.	Y1 Nom.	Y2 Nom.	Z1 Nom.	Z2 Nom.
mm	7.0	3.6	3.6	2.5	2.0
in*	(0.276)	(0.142)	(0.142)	(0.098)	(0.079)

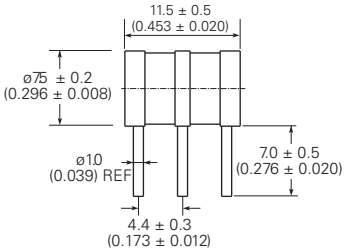
* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G9 Three Electrode 7mm Product Dimensions

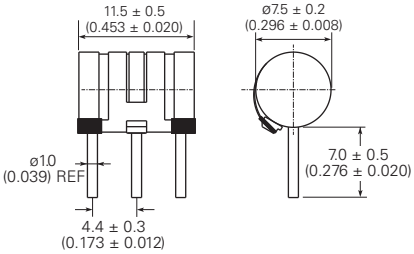
No Leads (GTCN37-XXXM-R10)†



Radial Leaded (GTCR37-XXXM-R10)



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

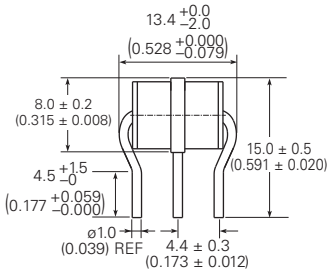


† Parts with no leads are not solderable and are meant for insertion into magazine clips.

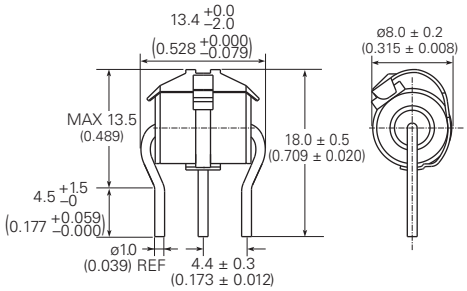
Figure G3-G10 Dimensions for "R" Series Gas Discharge Tubes Cont'd

Figure G10 Three Electrode 8mm Product Dimensions

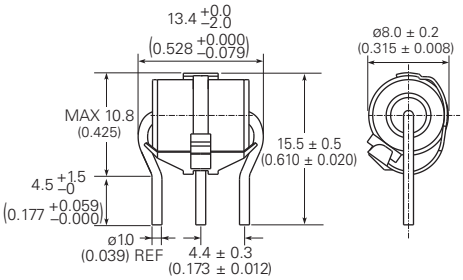
Axial Leaded (GTCA38-XXXM-R10)



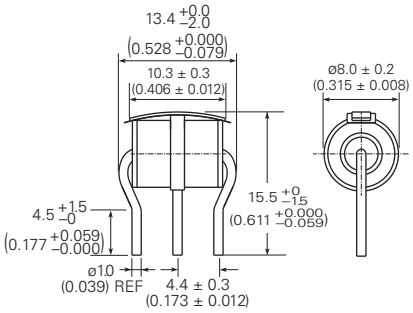
Axial Leaded with-FS (GTCA38-XXXM-R10-FS)



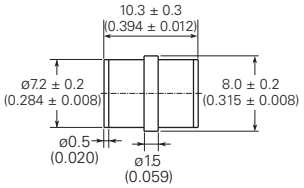
Axial Leaded with-FS (GTCA38-XXXM-R10-FS2)



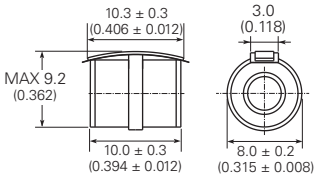
Axial Leaded with-FT (GTCA38-XXXM-R10-FT)



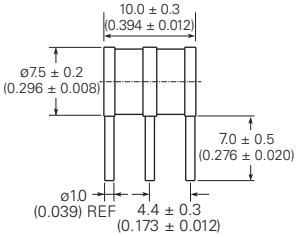
No Leads (GTCN38-XXXM-R10)†



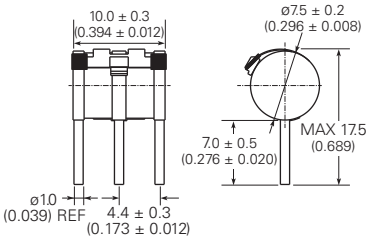
No Leads with-FT (GTCN38-XXXM-R10-FT)†



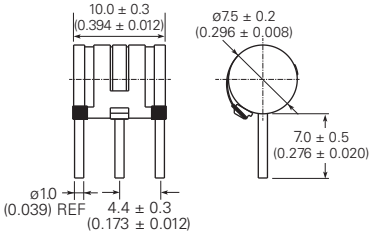
Radial Leaded (GTCR38-XXXM-R10)



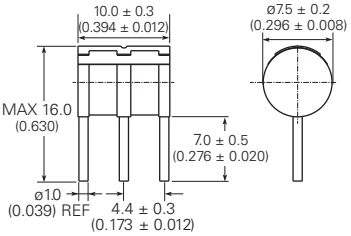
Radial Leaded with-FS (GTCR38-XXXM-R10-FS)



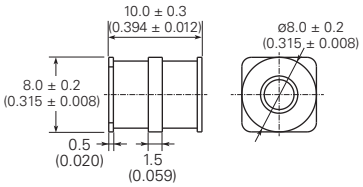
Radial Leaded with-FS (GTCR38-XXXM-R10-FS2)



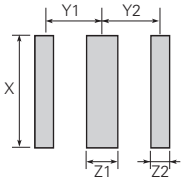
Radial Leaded with-FT (GTCR38-XXXM-R10-FT)



Surface-mount (GTCS38-XXXM-R10)



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.

Fail-Short Mechanism for Gas Discharge Tubes

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.

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. 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.

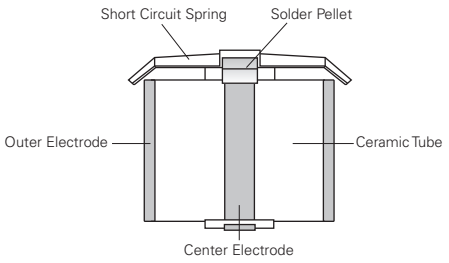


Figure G11

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. 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.

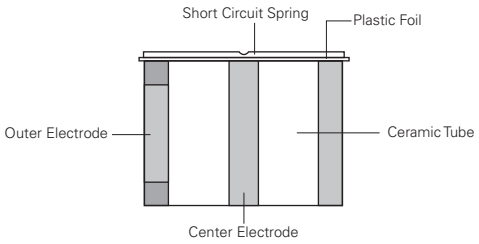


Figure G12

Operation and Storage Temperatures for Gas Discharge Tubes

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 "R" Series Gas Discharge Tubes

	Parts in Bulk		Parts in Tape and Reel	
Part Description	**Min Order Quantity**	**Box Quantity**	**Tape & 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	5000	20000	1500	12000
6mm 2Pole No leads	2000	10000	-	-
6mm 2Pole, Leads	1000	5000	-	-
6mm 2Pole Surface-mount	2000	10000	750	6000
8mm 2pole No leads	2000	10000	-	-
8mm 2Pole, Leads	1000	5000	-	-
8mm 2Pole Surface-mount	2000	10000	400	2400
5mm 3Pole No leads	2500	10000	-	-
5mm 3Pole, Leads	1000	5000	-	-
5mm 3Pole Surface-mount	2500	10000	1000	8000
6mm 3Pole No leads	2500	10000	-	-
6mm 3Pole, Leads	1000	5000	-	-
6mm 3Pole Surface-mount	2500	10000	750	6000
7mm 3Pole, Leads	1000	5000	-	-
8mm 3Pole No leads	1000	10000	-	-
8mm 3Pole, Leads	1000	5000	-	-
8mm 3Pole Surface-mount	1000	10000	500	2500

Installation for Gas Discharge Tubes

Care should be taken when installing Gas Discharge Tubes 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 profile.

Part Numbering System for "R" Series Gas Discharge Tubes

Two Electrode GDT - Example Part Number for R Series Devices

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

Packaging
2 = Tape & reel
Nothing = Tray packaging

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 (at 100V/s)

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

2 Electrode Device

Lead Configuration
A = Axial Leads
C = Chip Type
N = No leads
(Parts with no leads are not solderable and are meant for insertion into magazine clips.)
S = Surface-mount

Ceramic

Gas Tube

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

8

RoHS Compliant, ELV Compliant HF Halogen Free

Part Numbering System for "R" Series Gas Discharge Tubes Cont'd

Three Electrode GDT - Example Part Number for R Series Devices

GT C R 3 8 - 231 M - R 10 - FS - 2

Packaging
2 = Tape & 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
05 = 8x20µs 5kA, 10 hits
10 = 8x20µs 10kA, 10 hits

Product Family Designator
R = R series

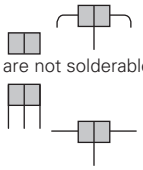
Tolerance of 20% on DC Switch Voltage

DC Switch Voltage of 230V (at 100V/s)

Diameter
5 = 5mm
6 = 6mm
7 = 7mm
8 = 8mm

3 Electrode Device

Lead Configuration
A = Axial Leads
N = No leads
(Parts with no leads are not solderable and are meant for insertion into magazine clips.)
R = Radial Leads
S = Surface-mount
T = T-shape Leads



Ceramic

Gas Tube

Marking Reference Guide - Example

35 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)

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.

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.
- The devices are intended for protection against damage caused by occasional overvoltage fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.

Surface-mount Fuses
Fundamentals

Overview

Tyco Electronics 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.

Tyco Electronics 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 Enhanced Arc Suppression Characteristics

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 1 compared 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 2 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 1

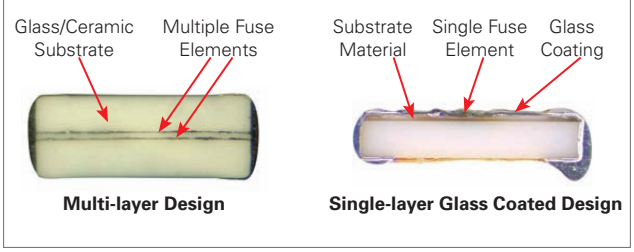
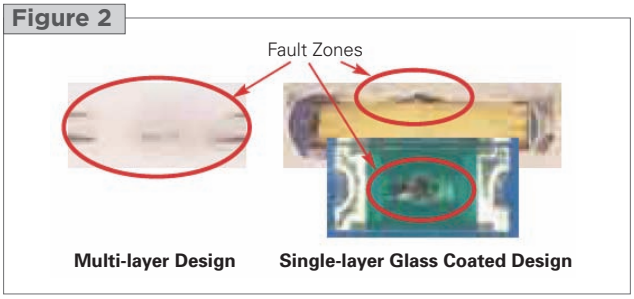


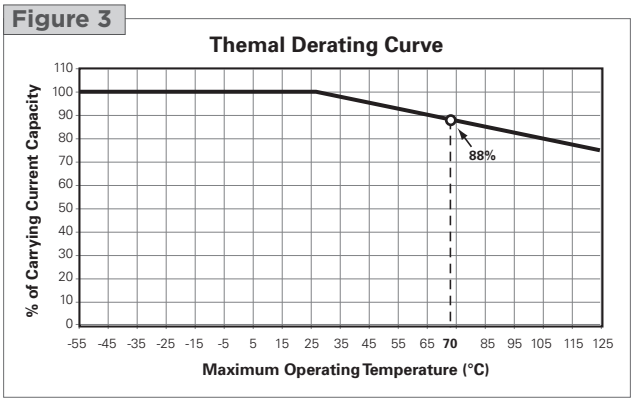
Figure 2



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 Raychem surface mount chip fuses is presented in Figure 3. Use it to determine the derating percentage based on operating temperature and apply it to the derated system current.

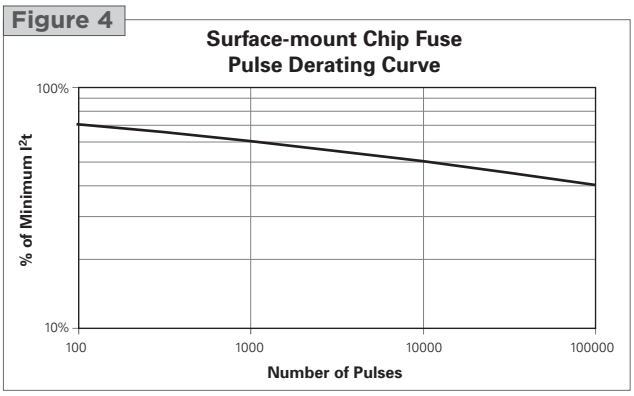
Figure 3



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 4 presents the current pulse derating curve for our surface-mount chip fuses up to 100,000 cycles.

Figure 4



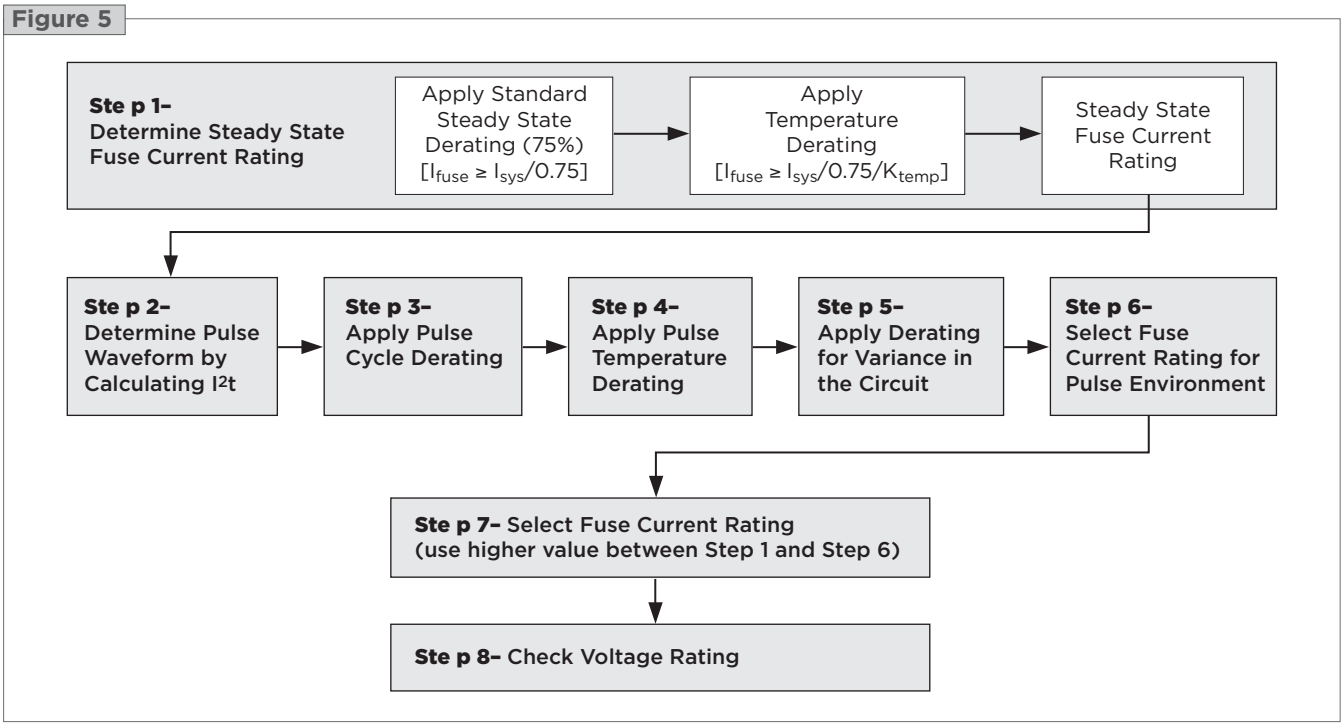
Selecting Surface-mount Chip Fuses

Fuse selection seems straightforward, in that, you pick one which has a current rating just a bit higher than your worstcase system operating current. Unfortunately, it's 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.

Fuse Selection Flowchart

However, the basic considerations for fuse selection are shown in the flowchart presented in Figure 5. Following this flow chart will help you select a fuse best suited for your application conditions.

Figure 5



Surface-mount Fuses
Fast-Acting Chip Fuses

Fast-acting chip fuses help provide overcurrent protection on systems using DC power sources up to $63V_{DC}$. The fuse's monolithic, multilayer design provides the highest hold current in the smallest footprint, reduces diffusion-related aging, improves product reliability and resilience, and enhances 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

- Small size with high-current ratings
- Excellent temperature stability
- High reliability and resilience
- 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

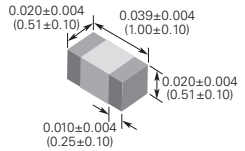
Table FF1 Clear Time Characteristics for Fast-Acting Chip Fuses

% of rated current	Clear time at 25°C
100%	4 hours min.
250%	5 seconds max.
400%	0.05 seconds max.

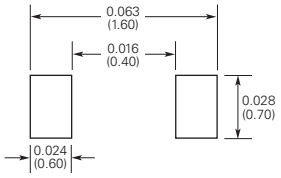
Table FF2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Fast-Acting Chip Fuses

0402 (1005mm) Fast-Acting Chip Fuses

Shape and Dimensions
Inch (mm)



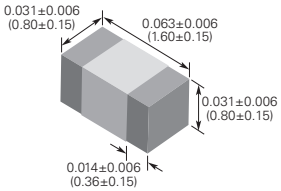
Recommended Pad Layout
Inch (mm)



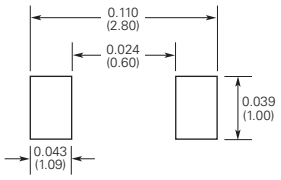
Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2sec)†	Max. Interrupt Ratings: Voltage (V_{DC})	Current (A)
0402SFF050F/24	0.50	0.380	0.0043	24	35
0402SFF075F/24	0.75	0.210	0.0076	24	35
0402SFF100F/24	1.00	0.120	0.0170	24	35
0402SFF150F/24	1.50	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
Inch (mm)



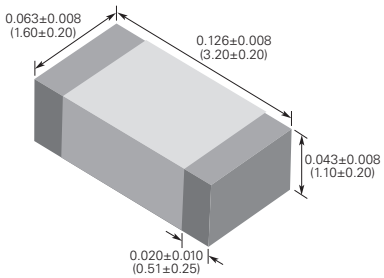
Recommended Pad Layout
Inch (mm)



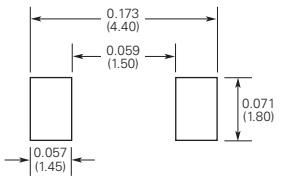
Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2sec)†	Max. Interrupt Ratings: Voltage (V_{DC})	Current (A)
0603SFF050F/32	0.50	0.485	0.0029	32	50
0603SFF075F/32	0.75	0.254	0.0064	32	50
0603SFF100F/32	1.00	0.131	0.0160	32	50
0603SFF150F/32	1.50	0.059	0.0300	32	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
Inch (mm)



Recommended Pad Layout
Inch (mm)



Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2sec)†	Max. Interrupt Ratings: 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/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.

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

Figure FF1

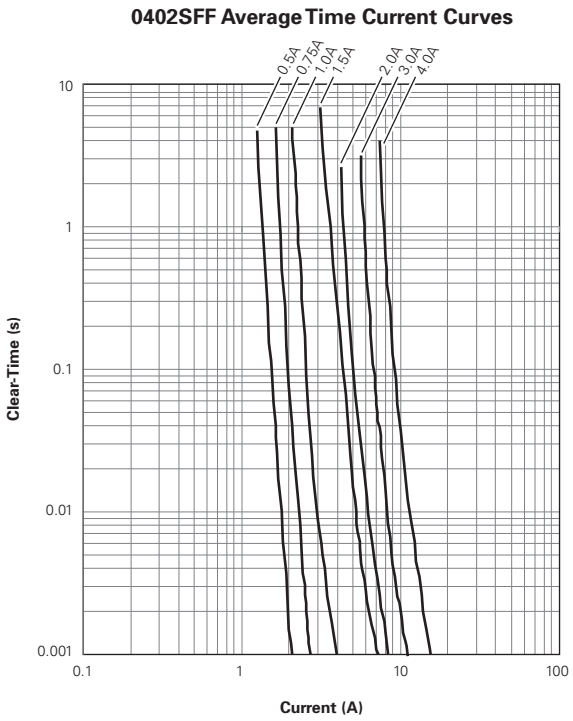
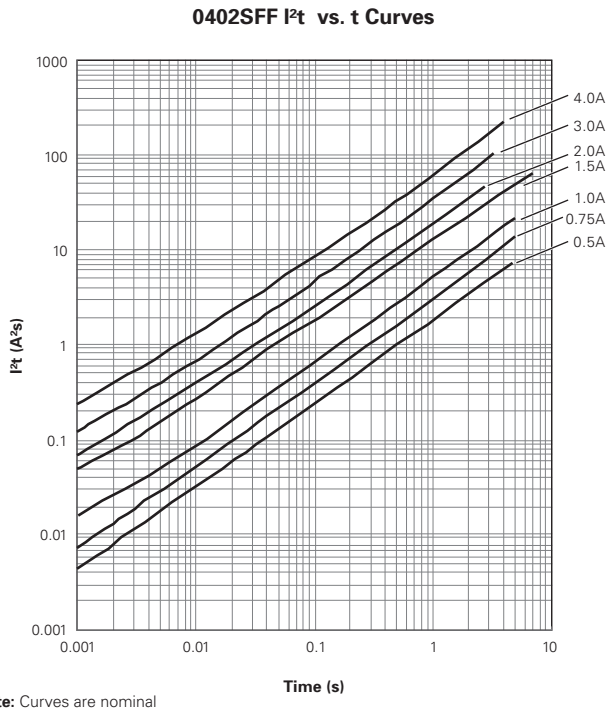


Figure FF2



Note: Curves are nominal

Figure FF3

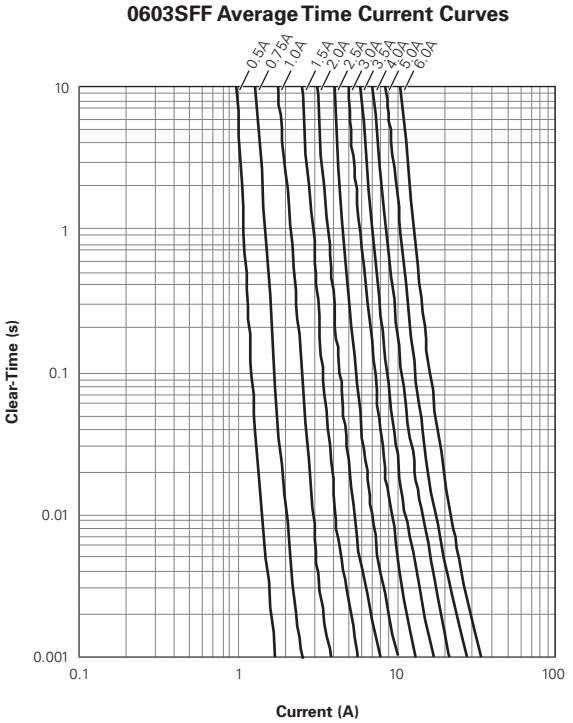
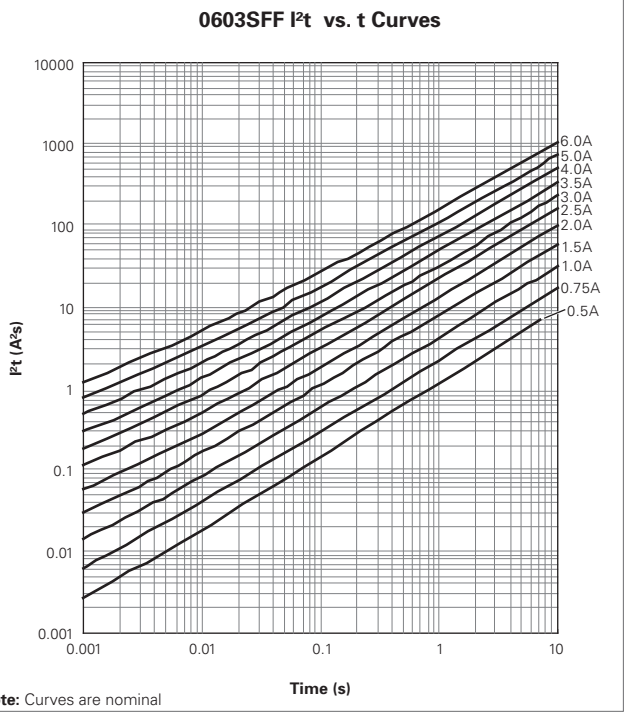


Figure FF4



Note: Curves are nominal

Figure FF1-FF6 Family Performance Curves for Fast-Acting Chip Fuses Cont'd

Figure FF5

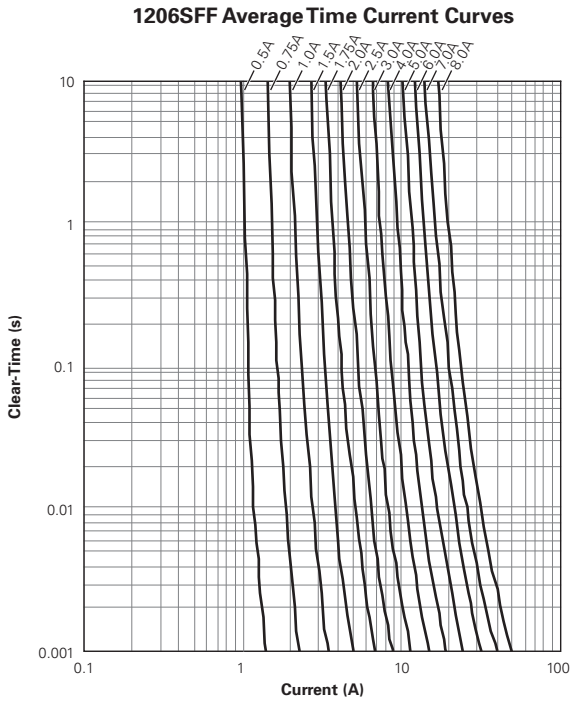
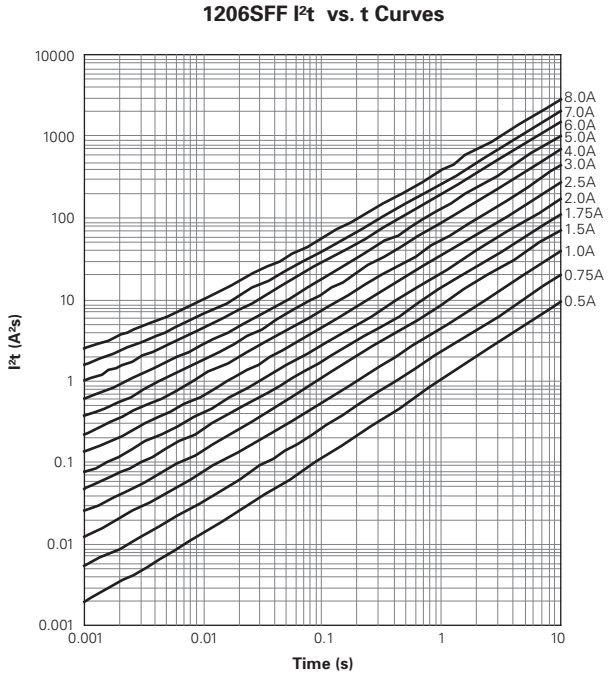


Figure FF6

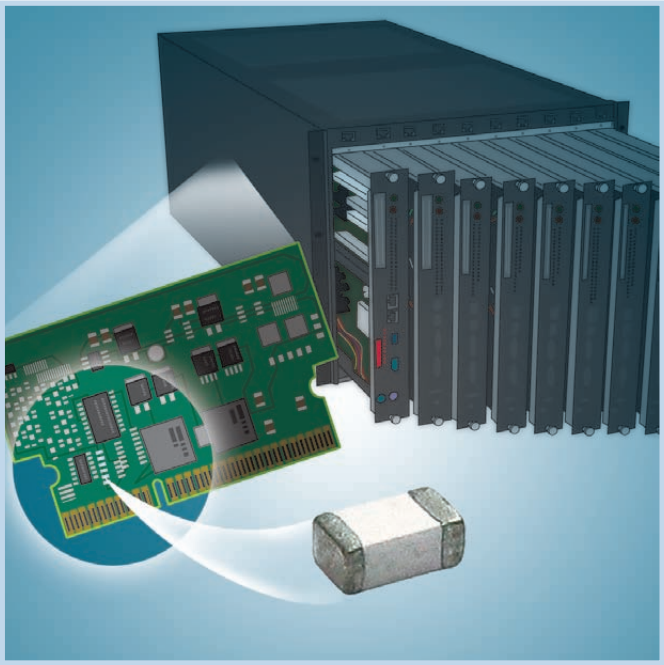


Note: Curves are nominal

➔ **Please go to page 75 for more information for Fast-Acting Chip Fuses.**

Surface-mount Fuses
High-Current-Rated Chip Fuses

The monolithic multilayer design of the Tyco Electronics 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

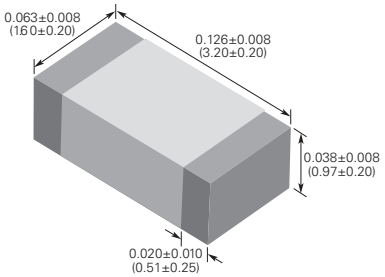
1206SFH Series

% of rated current	Clear time at 25°C
100%	4 hours (min.)
250%	5 seconds (max.)

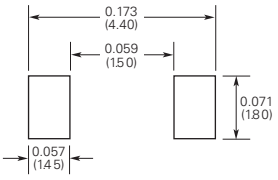
Table FH2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for High-Current-Rated Chip Fuses

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

Shape and Dimensions
Inch (mm)



Recommended Pad Layout
Inch (mm)



Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2sec)†	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.

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

Figure FH1

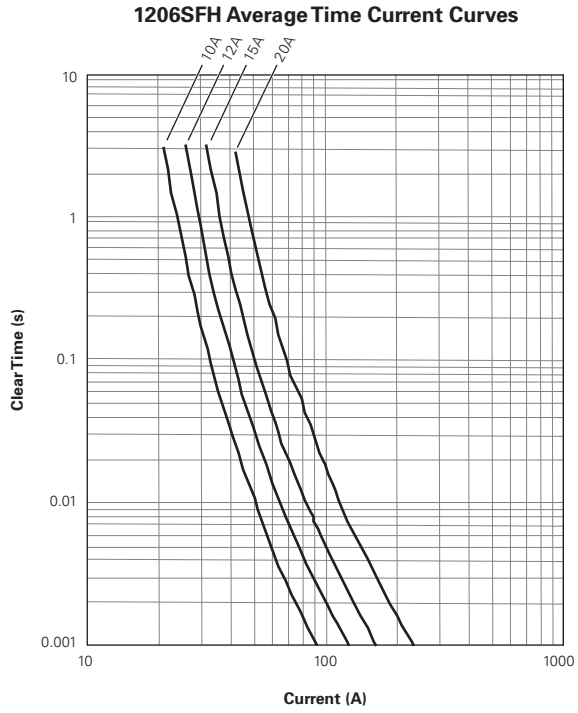
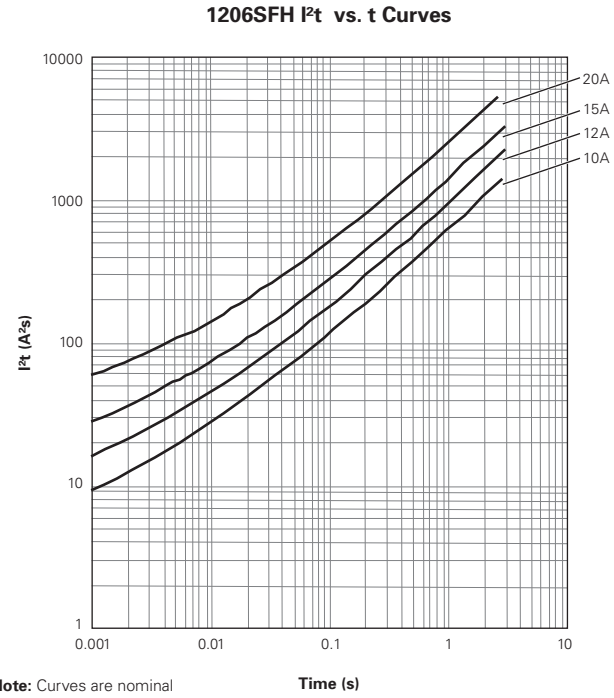


Figure FH2



Note: Curves are nominal

➔ **Please go to page 75 for more information for 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, Tyco Electronics' 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, LCD (Liquid Crystal Display) backlight inverters, electric motors and portable electronics.

Benefits

- Time-delayed design prevents 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 motors 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 hours (min.)	
200%	1 second (min.)	120 seconds (max.)
300%	0.1 second (min.)	3 seconds (max.)
800%(1.0A-1.5A)	0.0005 second (min.)	0.05 seconds (max.)
800%(2.0A-5.0A)	0.001 second (min.)	0.05 seconds (max.)

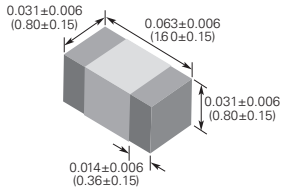
1206SFS Series

% of rated current	Clear time at 25°C	
100%	4 hours (min.)	
200%	1 second (min.)	120 seconds (max.)
300%	0.1 second (min.)	3 seconds (max.)
800%(1.0A-1.5A)	0.0016 second (min.)	0.05 seconds (max.)
800%(2.0A-8.0A)	0.002 second (min.)	0.05 seconds (max.)

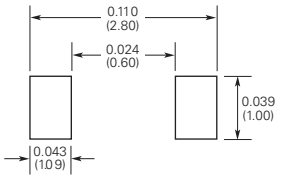
Table FS2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Slow-Blow Chip Fuses

0603 (1608mm) Slow-Blow Chip Fuses

Shape and Dimensions
Inch (mm)



Recommended Pad Layout
Inch (mm)

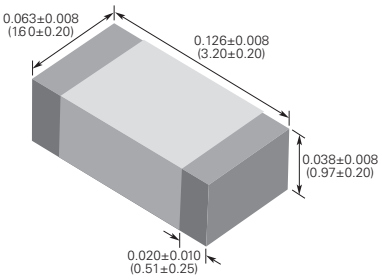


Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2sec)†	Max. Interrupt Ratings: Voltage (V_{DC})	Current (A)
0603SFS100F/32	1.0	0.200	0.093	32	50
0603SFS150F/32	1.5	0.100	0.18	32	50
0603SFS200F/32	2.0	0.052	0.32	32	50
0603SFS250F/32	2.5	0.041	0.63	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

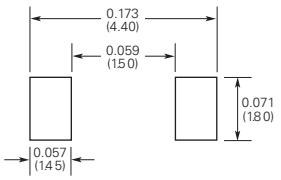
9

1206 (3216mm) Slow-Blow Chip Fuses

Shape and Dimensions
Inch (mm)



Recommended Pad Layout
Inch (mm)



Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I^2t (A^2sec)†	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	0.082	0.63	63	50
1206SFS250F/32	2.5	0.070	0.90	32	50
1206SFS300F/32	3.0	0.032	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 sec clear time.

RoHS Compliant, ELV Compliant HF Halogen Free

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

Figure FS1

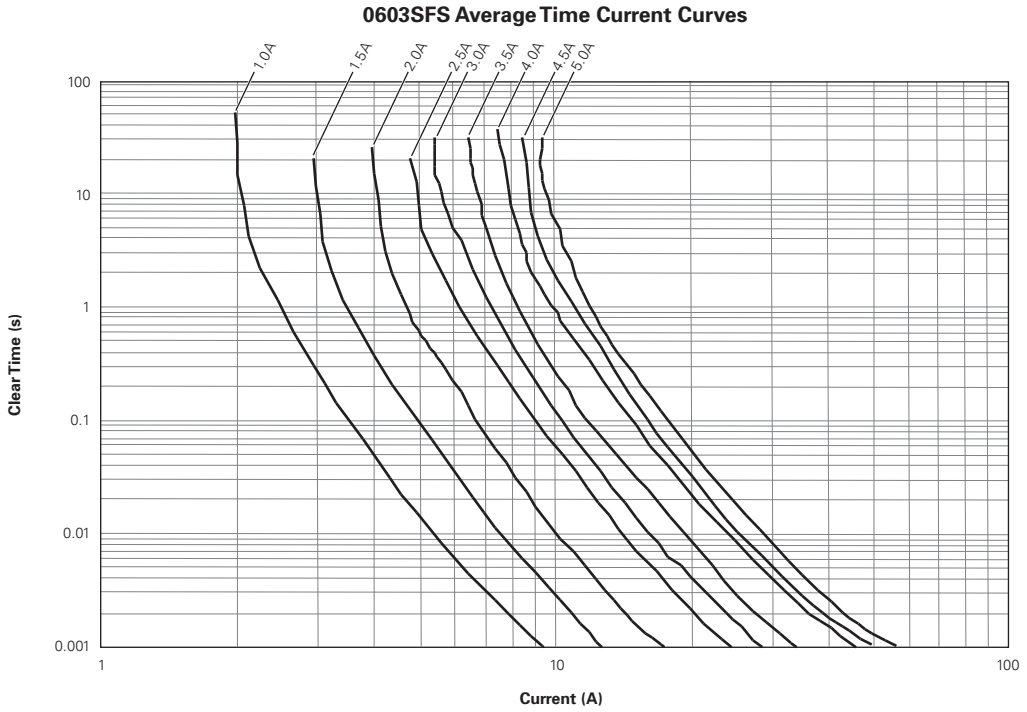
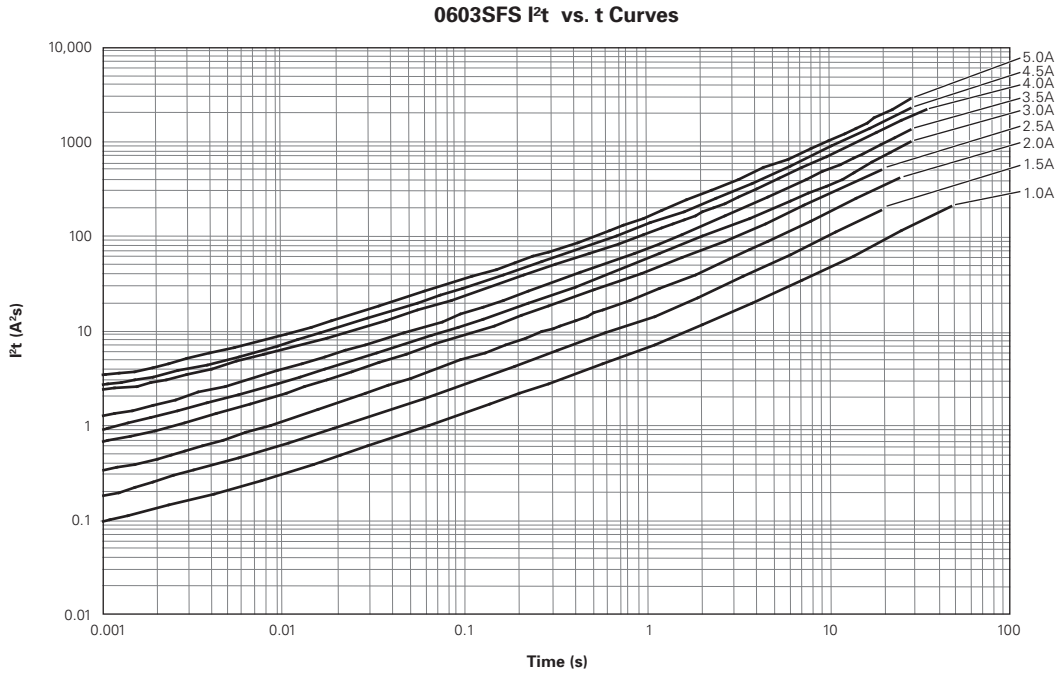


Figure FS2



Note: Curves are nominal

Figure FS1-FS4 Family Performance Curves for Slow-Blow Chip Fuses Cont'd

Figure FS3

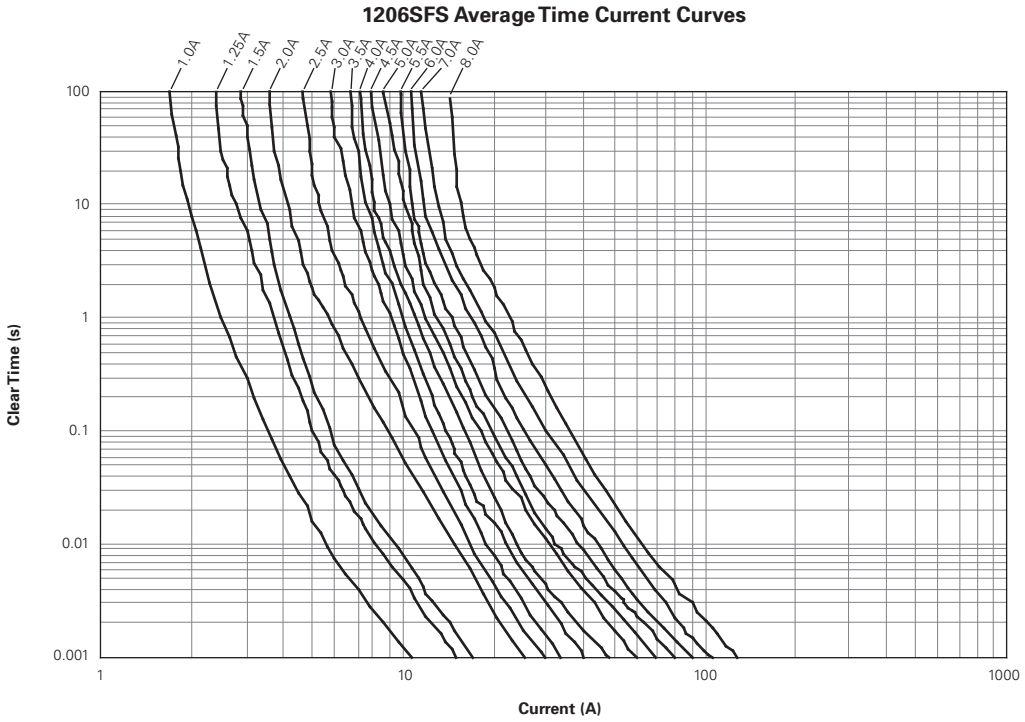
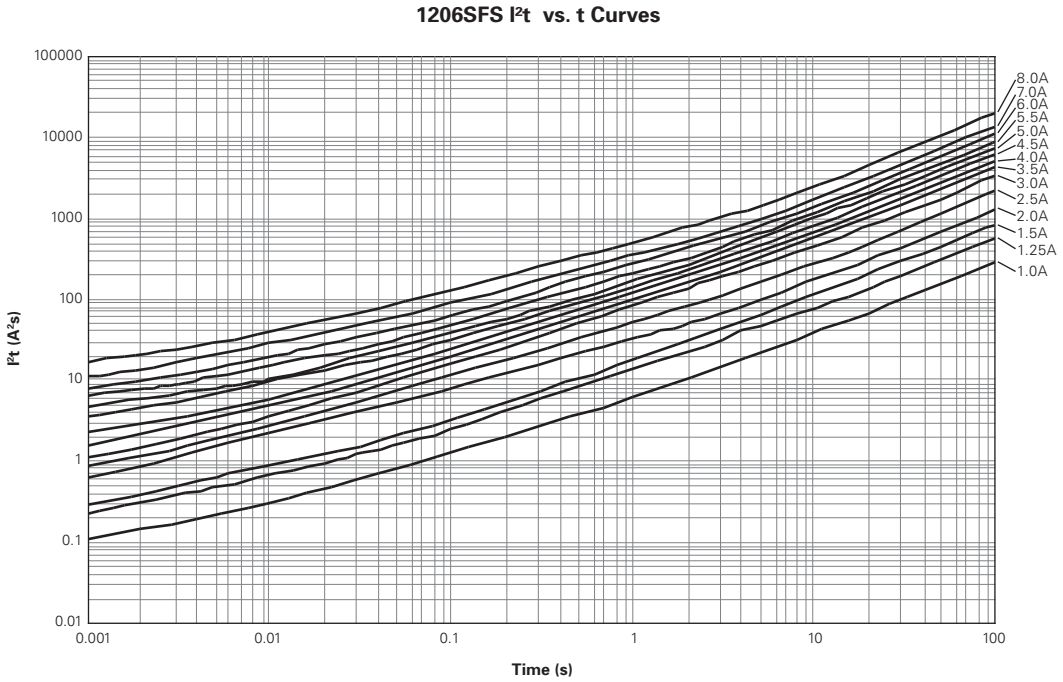


Figure FS4



Note: Curves are nominal

➔ **Please go to page 75 for more information for Slow-Blow Chip Fuses.**

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

Table F1 Environmental Specifications for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses

Operating temperature	-55°C to +125°C
Mechanical vibration	Withstands 5-3000 Hz at 30 Gs when evaluated per Method 204 of MIL-STD-202
Mechanical shock	Withstands 1500 Gs, 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

Table F2 Material Specifications for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses

Construction body material	Ceramic
Termination material	Silver, Nickel, Tin
Fuse element	Silver

Figure F1 Thermal Derating Current for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses

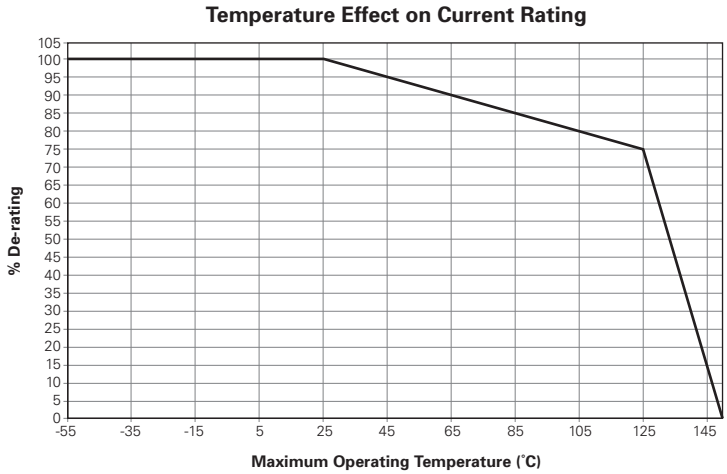


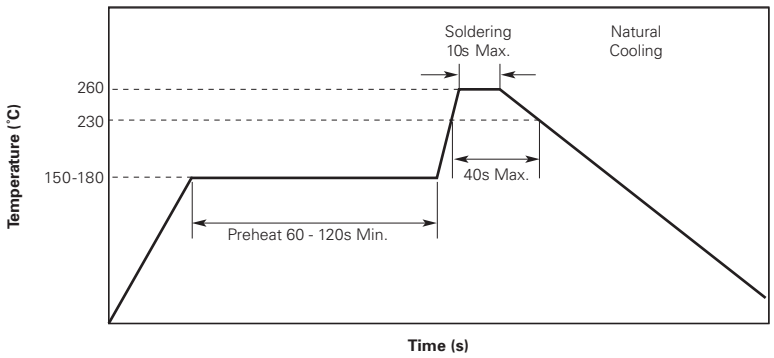
Table F3 Electrical Specifications for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses

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 Raychem fuses 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 Fast-Acting, High-Current-Rated and Slow-Blow Chip 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	5
0603 (1608)	4,000	178mm white plastic	9.0 ± 0.5mm	8.00 ± 0.10mm	Plastic	5	5
1206 (3216)	3,000	178mm white plastic	9.0 ± 0.5mm	8.00 ± 0.10mm	Plastic	5	5

Figure F2 Recommended Soldering Temperature Profile for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses



Recommended conditions for hand soldering:

1. Using 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.
   Maximum temperature of soldering iron tip/soldering time: 350°C /9s or 400°C / 8s.

Table F5 Tape and Reel Specifications for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses

	Dimension in inches (mm)					
Mark	0402 (1005)		0603 (1608)		1206 (3216)	
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)
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)
W	0.318±0.004	(8.00±0.10)	0.318±0.004	(8.00±0.10)	0.318±0.004	(8.00±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)
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)
P_2	0.040±0.002	(1.00±0.05)	0.079±0.002	(2.00±0.05)	0.079±0.002	(2.00±0.05)
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)
D_1	-	-	-	-	0.039 max	(1.00 max)
t	0.009±0.001	(0.23±0.02)	0.009±0.001	(0.23±0.02)	0.009±0.001	(0.23±0.02)
A_0	0.026±0.004	(0.67±0.10)	0.036±0.004	(0.92±0.10)	0.071±0.004	(1.80±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)
K_0	0.025±0.004	(0.63±0.10)	0.033±0.004	(0.85±0.10)	0.050±0.004	(1.27±0.10)

RoHS Compliant, ELV Compliant HF Halogen Free

Figure F3 Component Tape Dimensions for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses

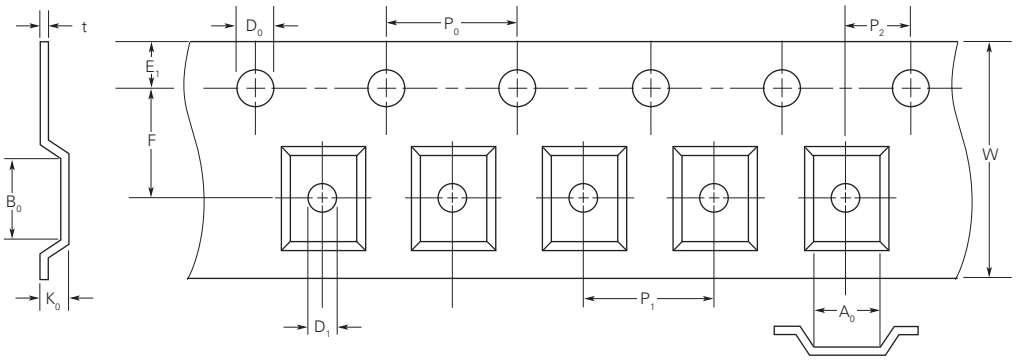
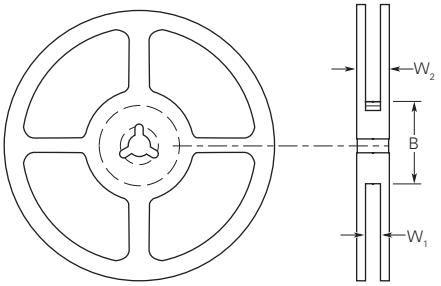


Figure F4 Reel Dimensions for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses

Dimension Description	Mark	Dimensions (mm)
Hub outer diameter	B	60
Reel inside width	W_1	9
Reel outside width	W_2	11.4
Tape width		8



Agency Approvals for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses

UL File # E197536

Part Numbering System for Fast-Acting, High-Current-Rated and Slow-Blow Chip Fuses

1206 SF F 400 F / 24 -2

Packaging
-2 = Tape and Reel

Voltage Rating (V)

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

Rated Current
050 = 0.50 Amps
400 = 4 Amps

Fuse Blow Type
F = Fast Acting
S = Slow Blow
H = High Current

SF = Surface Mount Fuse

Size (1206, 0603, 0402)

Warning :

All information, including illustrations, is believed to be accurate and reliable. Users, however, should independently evaluate the suitability of and test each product selected for their application. Tyco Electronics Corporation makes no warranties as to the accuracy or completeness of the information, and disclaims any liability regarding its use. Tyco Electronics' only obligations are those in the Tyco Electronics' Standard Terms and Conditions of Sale for this product, and in no case will Tyco Electronics be liable for any incidental, indirect, or consequential damages arising from the sale, resale, use, or misuse of the product. Specifications are subject to change without notice. In addition, Tyco Electronics reserves the right to make changes to materials or processing that do not affect compliance with any applicable specification without notification to Buyer.

Surface-mount Fuses
Telecom Fuses

The telecom FT600 fuse helps telecommunications equipment manufacturers comply with North American overcurrent protection requirements, including Telcordia GR-1089, TIA-968-A (formerly FCC Part 68), and UL60950 3rd edition.

Tyco Electronics' telecom fuses offer low temperature-rise performance under sneak current fault events to help prevent damage to circuit traces or multilayer boards, and their low profile and small footprint make them suitable for high-density and space-constrained applications.

Benefits

- High density placement in multi-port system designs
- Improved temperature rise performance over other similar surface-mount fuse devices under sneak current testing
- The FT600, in conjunction with a thyristor surge suppression device, assists designers to meet regulatory standards without additional series components

Features

- Lead free materials and RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Low profile and small footprint
- The lightning robust surface-mount fuse offers overcurrent protection in case of power fault events
- Enables the design of equipment complying with applicable telecom specifications including UL60950, TIA-968-A, and Telcordia GR-1089
- Low resistance

Applications

- ADSL, ADSL2, ADSL2plus, SHDSL, VDSL linecards and modems
- T1/E1 systems
- Twisted-pair telecom ports requiring Telcordia GR-1089, UL60950 and FCC Part TIA-968-A compliance

Protection Application Guide for Telecommunications and Networking Devices

To use this guide, follow the steps below:
1. Select your equipment type from the guide below.
2. Use the Key Device Selection Criteria (time-to-open, surface temperature) to determine best suitability for your application.
3. Use Agency Specification / Selection Guide to select a specific part number for each application based on the agency requirements.

Key Device Selection Criteria

Application	Specification	Faster Time-To-Open	Cooler Surface Temperature
Customer premises equipment, IT equipment	UL 60950	FT600-0500	FT600-2000
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	TIA-968-A	FT600-1250	
Access network equipment	Telcordia GR-1089	FT600-1250	FT600-2000
Remote terminals, line repeaters, multiplexers, cross-connects, WAN equipment	TIA-968-A		
Central office switching equipment	Telcordia GR-1089	FT600-1250	FT600-2000
Analog/POTS linecards, ISDN linecards, xDSL modems, ADSL/VDSL splitters, T1/E1 linecards, multiplexers, CSU/DSU, servers	TIA-968-A		

Note : This list is not exhaustive. Tyco Electronics welcomes our customers' input for additional application ideas for overcurrent protection of telecom applications.

Agency Specification/Selection Guide for FT600 Devices

Use the guide below to select FT600 devices appropriate for use in your application. The following pages contain specifications for part numbers recommended below. FT600 devices enable telecommunication equipment to meet 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
FT600	FT600-0500	TIA-968-A – Types A & B	UL60950, 3rd Ed. – 600V_{AC}, 40A
	FT600-1250	Telcordia GR-1089 – Level 1 and 2	Telcordia GR-1089 – 600 V_{AC}, 40A
	FT600-2000	TIA-968-A	UL60950

Notes: FT600-1250 and FT600-2000 assist equipment in complying with Telcordia GR-1089 specifications. In-circuit testing is strongly recommended.
The FT600-0500, FT600-1250 and FT600-2000 help meet the UL60950 Power Cross and FCC TIA-968-A 68 lightning surge requirements. Note that Type A tests allow for an overcurrent protection component to fuse open during the surge.

9

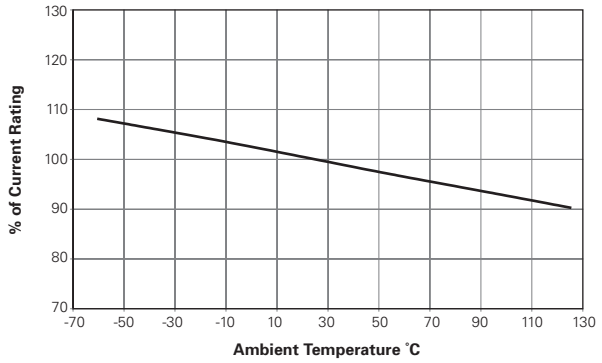
Table FT1 Interrupt Voltage and Current Ratings for FT600 Devices

Part Number	Ampere Rating (A)	Voltage Rating (V)	Typical Resistance (Ω)	Typical I^2t (A^2s)*
FT600-0500	0.50	250	0.50	1
FT600-1250	1.25	250	0.10	16
FT600-2000	2.00	250	0.05	18

Note: The FT600-xxxx devices carry 100% of rated current for 4 hours minimum and 250% of rated current for 1 second minimum, 120 seconds maximum.
Resistance measured at 10% of rated current.

*I^2t is calculated at 10 ms or less.

Figure FT1 Thermal Derating Curve (Normalized) for FT600 Devices



RoHS Compliant, ELV Compliant HF Halogen Free

Table FT2 Dimensions for FT600 Devices in Millimeters (Inches)

	A		B		C		
Part Number	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Figure**
FT600-0500	—	10.2 (0.402)	—	3.1 (0.122)	—	3.1 (0.122)	FT2
FT600-1250	—	10.2 (0.402)	—	3.1 (0.122)	—	3.1 (0.122)	FT2
FT600-2000	—	10.2 (0.402)	—	3.1 (0.122)	—	3.1 (0.122)	FT2

Figure FT2 Dimension Figures for FT600 Devices

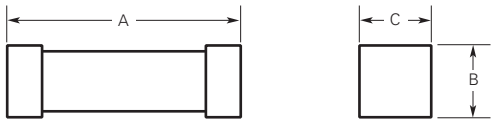


Figure FT3 Typical Time-to-open Characteristics (at 20°C) for FT600 Devices

FT600

A = FT600-0500
B = FT600-1250
C = FT600-2000

Figure FT3

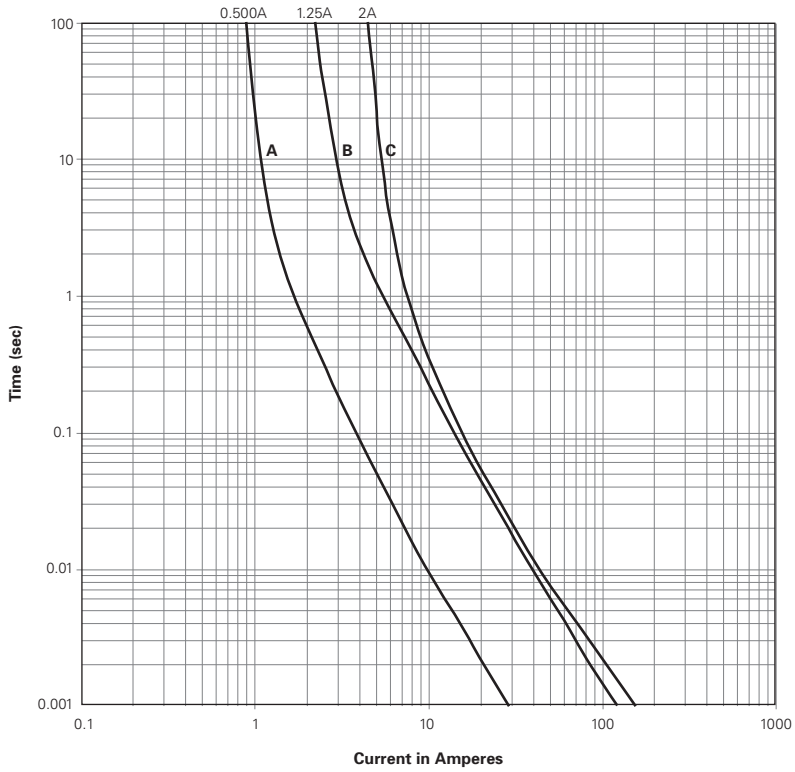


Table FT3 Physical Characteristics and Environmental Specifications for FT600 Devices

Physical Characteristics

Terminal material	Silver-plated brass*
Body material	Ceramic
Termination solderability	Per IEC-60127-4

*FT600 devices use high Pb content solder for internal construction. They are RoHS compliant.

Environmental Specifications

Test	Conditions
Solder heat withstand	Per MIL-STD-202, Method 210, Test Condition J
Solvent resistance	Per MIL-STD-202F, Method 215J
Storage temperature	≤30°C/ 85% RH
Storage humidity	Per MIL-STD-202F, Method 106F

Table FT4 Packaging and Marking Information for FT600 Devices

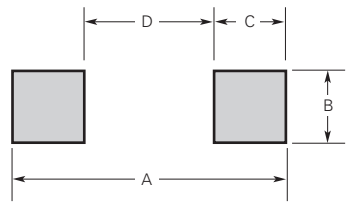
Part Number	Bag Quantity	Tape & Reel Quantity	Standard Package Quantity	Part Marking	Agency Recognition
FT600-0500-2	—	2,500	10,000	500	UL, CSA
FT600-1250-2	—	2,500	10,000	1250	UL, CSA
FT600-2000-2	—	2,500	10,000	2000	UL, CSA

Note: The -2 designates tape and reel, the package style for this product.

Table FT5 Recommended Pad Layouts for FT600 Devices in Millimeters (Inches) Nominal

Device	A	B	C	D	Figure for Dimensions
FT600-0500	12.6 (0.496)	4.0 (0.157)	3.7 (0.145)	5.2 (0.204)	FT4
FT600-1250	12.6 (0.496)	4.0 (0.157)	3.7 (0.145)	5.2 (0.204)	FT4
FT600-2000	12.6 (0.496)	4.0 (0.157)	3.7 (0.145)	5.2 (0.204)	FT4

Figure FT4



Solder Reflow and Rework Recommendations for FT600 Devices

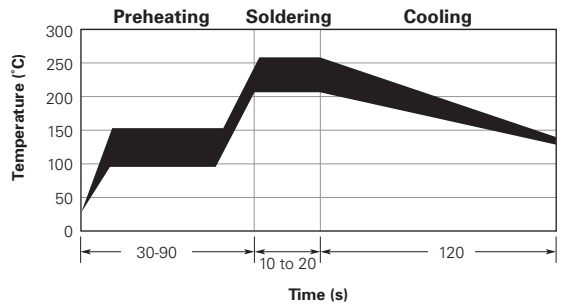
Solder Reflow

- Recommended reflow methods: IR, vapor phase oven, hot air oven
- 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 by a new device

Figure FT5

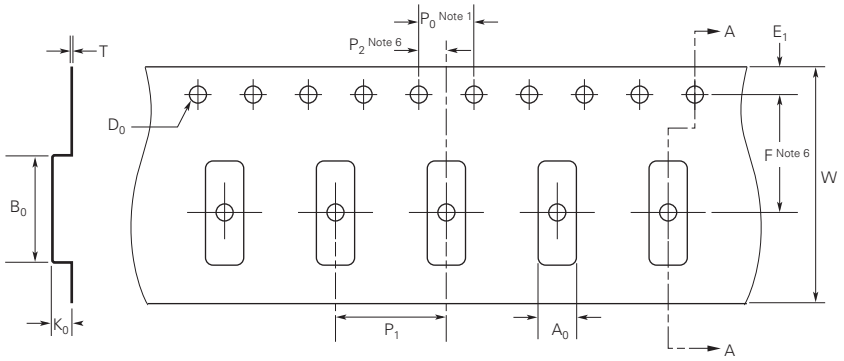


RoHS Compliant, ELV Compliant HF Halogen Free

Table FT6 Tape and Reel Specifications for FT600 Devices

Dimension Description	EIA Mark	Dimension (mm)	Tolerance
Carrier tape width	W	24	±0.3
Sprocket hole pitch	P_0	4	±0.1
	P_1	8	±0.1
	P_2	2	±0.1
	A_0	3.68	±0.1
	B_0	10.44	±0.1
Sprocket hole diameter	D_0	1.5	+0.1 / -0.0
	F	11.5	±0.1
	E_1	1.75	±0.1
Tape thickness	T max.	0.3	±0.05
	K_0	3.25	+1.0 / -0.05
Reel Dimensions			
Reel diameter	A max.	331.5	
Core diameter	N min.	98.5	
Space between flanges less devices	W_0	25	±0.5
Reel width	W_1 max.	31	

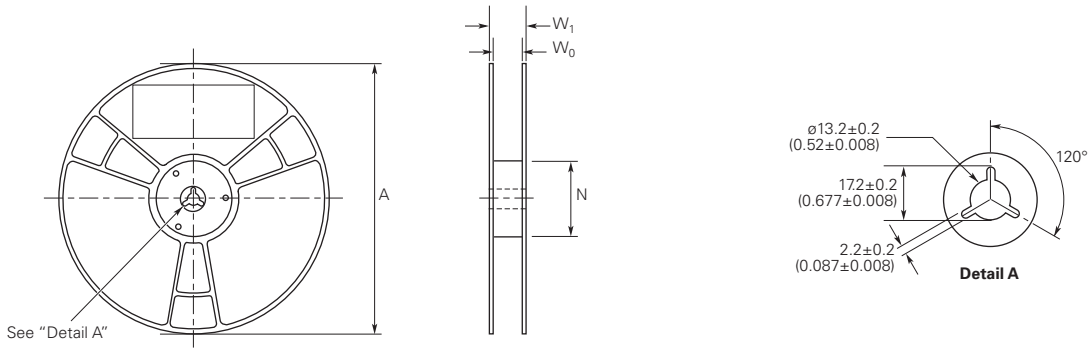
Figure FT6 EIA Referenced Taped Component Dimensions for FT600 Devices



Notes:

1. 10 sprocket hole pitch cumulative tolerance ±0.2
2. Allowable camber to be 1mm/250mm
3. Material: Black conductive
4. A_0 and B_0 measured on a plane 0.3mm above the bottom of the pocket
5. K_0 measured from the plane on the inside bottom of the pocket to the top surface of the carrier
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole
7. Quantity per reel to be 174m

Figure FT7 EIA Referenced Reel Dimensions for FT600 Devices



Part Numbering System for FT600 Devices

FT 600 - 1250 -2

Packaging
-2 = Tape and Reel

Current in Amperes
1250 = 1.25
0500 = 0.500
2000 = 2.00

Voltage Rating

Product Family

Warning :

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RoHS Compliant, ELV Compliant HF Halogen Free

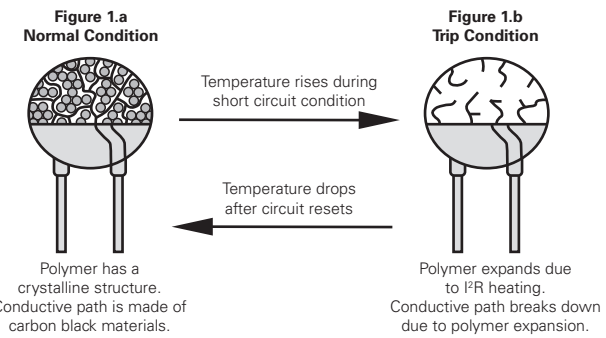
PolySwitch Resettable Devices
Fundamentals

Overview

PolySwitch PPTC (Polymeric Positive Temperature Coefficient) 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

How a PolySwitch Device Works



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.

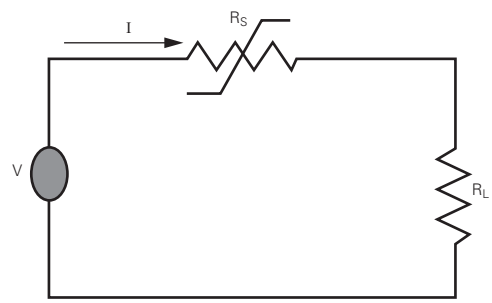
Overcurrent Protection using a PPTC Device

The PPTC device is a series element in a circuit. The PPTC device protects 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

Typical PTC Application



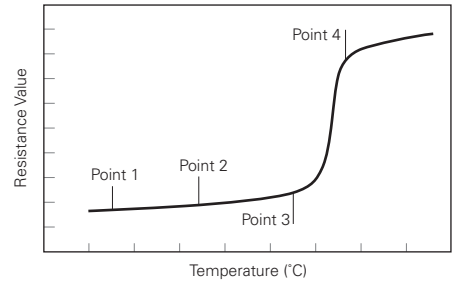
Principles of operation

PolySwitch device 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 Point 1 and 2.

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.

Figure 3

Example of Operating Curve for PPTC Device



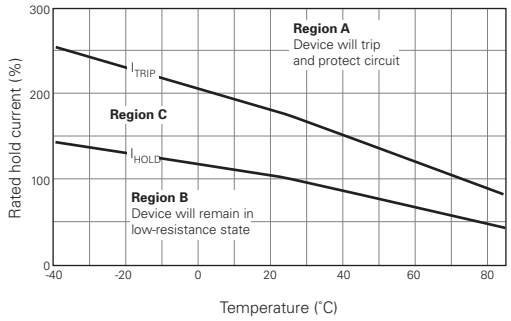
Any further increase in current or ambient temperature will cause the device to generate heat at a rate greater than the rate at which heat can be dissipated, thus causing the device to heat up rapidly. At this stage, a very large increase in resistance occurs for a very small change in temperature, 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 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

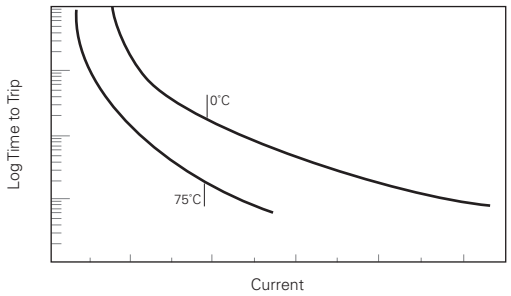


Operating Characteristics of a PPTC Device

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, resulting in a lower trip current at a given trip time (or a faster trip at given trip current).

Figure 5

Example of PPTC Device Operating Characteristics



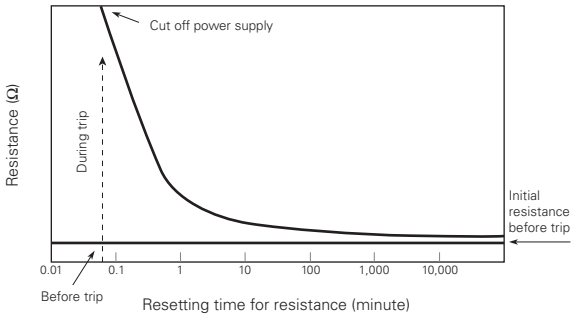
Typical Resistance Recovery after a Trip Event

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 days, months, or years, it is not practical to expect that the device resistance will reach the original value for operation 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



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 (A)	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
LVRL	120V	135V	0.75 to 2A	-20 to 85°C	Radial-leaded	UL, CSA, TÜV	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
RTEF	33V	-	1.2 to 1.9A	-40 to 85°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	9 to 15V	-	0.05 to 0.16A	-40 to 85°C	Surface-mount	UL, CSA	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
miniSMDE	16V	-	1.9A	-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 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
BBRF	99V	-	0.55A	-40 to 85°C	Radial-leaded	UL, CSA	Telecom & Networking
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	-	1.9A	-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
LTP	15 to 24V	-	0.7 to 3.4A	-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	-	2.1 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

Table 2 Thermal Derating

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	-
LVRL	-	1.43	1.21	1.00	0.99	0.95	0.86	0.78	0.70	0.62	0.50	-
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
RTEF	1.48	1.32	1.16	1.00	0.96	0.92	0.84	0.76	0.68	0.60	0.48	-
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
BBRF	1.56	1.37	1.19	1.00	0.95	0.91	0.82	0.72	0.63	0.54	0.40	-
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	-
LTP	1.72	1.48	1.24	1.00	0.94	0.88	0.76	0.64	0.52	0.40	0.22	-
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	-

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 and choose 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 to verify 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 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 to compare the dimensions of the PolySwitch device you selected with the application's space considerations.

Definitions of terms

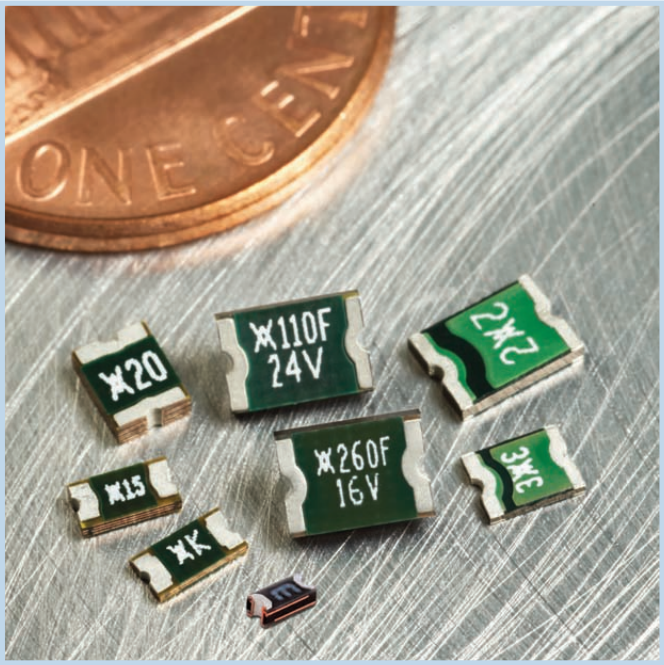
I_H	the maximum steady state current at 20°C that can be passed through a PolySwitch device without causing the device to trip
I_T	the minimum current that will cause the PolySwitch device to trip at 20°C
V_{MAX}	the maximum voltage that can safely be dropped across a PolySwitch device in its tripped 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 PolySwitch device
R_{MIN}	the minimum resistance prior to the trip of 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 PolySwitch 1 hour after the initial trip and reset

PolySwitch Resettable Devices
Surface-mount Devices

PolySwitch surface-mount devices are the preferred 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, we 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, one twelfth the size of the popular miniSMD series.

Recent additions to the PolySwitch surface-mount series include 3.0A miniSMD 4532mm (1812 mils), 2.0A nanoSMD 3216mm (1206 mils) and 0.16A femtoSMD 1608mm (0603 mils) devices.



Benefits

- Smaller size saves board space and cost
- Many product choices give 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 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

Application Selection Table for Surface-mount Devices

- The table below lists PolySwitch surface-mount devices typically used in these applications.
- Specifications for the suggested PolySwitch surface-mount device part numbers can be found in this section.
- 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 & triac		SMD250F	SMD250F	SMD200F
Battery pack protection			nanoSMDC150F	miniSMDC260F	miniSMDE190F
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. Tyco Electronics welcomes our customers' input for additional application ideas for PolySwitch resettable devices.

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

	femtoSMD	picoSMD	nanoSMD	microSMD	miniSMD	midSMD	SMD	SMD2	miniSMDE	decaSMD
Size mm	1608	2012	3216	3225	4532	5050	7555	8763	11550	5050
(mils)	(0603)	(0805)	(1206)	(1210)	(1812)	(2018)	(2920)	(3425)	(4420)	(2018)
Hold Current (A)										
0.050	$15V_{DC}/30.00\Omega$*	—	—	$30V_{DC}/50\Omega$	—	—	—	—	—	—
0.100	$12V_{DC}/8.00\Omega$*	$15V_{DC}/11.00\Omega$*	—	$30V_{DC}/15\Omega$	$60V_{DC}/12.70\Omega$	—	—	—	—	—
0.120	—	$15V_{DC}/9.00\Omega$*	$48V_{DC}/6.50\Omega$	—	—	—	—	—	—	—
0.140	—	—	—	—	$60V_{DC}/6.00\Omega$	—	—	—	—	—
0.160	$9V_{DC}/4.20\Omega$	—	$48V_{DC}/5.00\Omega$	—	—	—	—	—	—	—
0.200	—	$9V_{DC}/3.20\Omega$	$24V_{DC}/3.10\Omega$	—	$30V_{DC}/3.30\Omega$	—	—	—	—	—
0.300	—	—	—	—	$30V_{DC}/1.75\Omega$	$60V_{DC}/2.30\Omega$	$60V_{DC}/4.80\Omega$	—	—	—
0.350	—	$6V_{DC}/1.40\Omega$	$16V_{DC}/1.35\Omega$	$6V_{DC}/1.30\Omega$	—	—	—	—	—	—
0.500	—	—	$13.2V_{DC}/0.75\Omega$	$13.2V_{DC}/0.90\Omega$	$24V_{DC}/1.00\Omega$	—	$60V_{DC}/1.40\Omega$	—	—	$60V_{DC}/1.10\Omega$
0.750	—	$6V_{DC}/0.35\Omega$*	$6V_{DC}/0.30\Omega$	$6V_{DC}/0.40\Omega$	$13.2V_{DC}/0.45\Omega$	—	$30V_{DC}/1.00\Omega$	—	—	—
	—	—	—	—	$24V_{DC}/0.29\Omega$	—	$60V_{DC}/1.00\Omega$	—	—	—
1.000	—	$6V_{DC}/0.19\Omega$*	—	—	—	$15V_{DC}/0.40\Omega$	$30V_{DC}/0.48\Omega$	—	—	—
	—	—	—	—	—	—	$33V_{DC}/0.41\Omega$	—	—	—
1.100	—	—	$6V_{DC}/0.20\Omega$	$6V_{DC}/0.21\Omega$	$8V_{DC}/0.21\Omega$	—	—	—	—	—
	—	—	—	—	$16V_{DC}/0.18\Omega$	—	—	—	—	—
	—	—	—	—	$24V_{DC}/0.18\Omega$	—	—	—	—	—
1.200	—	—	—	—	—	—	$16V_{DC}/0.34\Omega$	—	—	—
1.250	—	—	—	—	$6V_{DC}/0.14\Omega$	—	$15V_{DC}/0.25\Omega$	—	—	—
	—	—	—	—	$16V_{DC}/0.14\Omega$	—	—	—	—	—
1.500	—	—	$6V_{DC}/0.11\Omega$	$6V_{DC}/0.11\Omega$	$6V_{DC}/0.11\Omega$	$15V_{DC}/0.18\Omega$	—	$15V_{DC}/0.25\Omega$	—	—
	—	—	—	—	$12V_{DC}/0.11\Omega$	—	—	$33V_{DC}/0.23\Omega$	—	—
	—	—	—	—	$16V_{DC}/0.11\Omega$	—	—	—	—	—
	—	—	—	—	$24V_{DC}/0.12\Omega$	—	—	—	—	—
1.600	—	—	—	—	$9V_{DC}/0.10\Omega$	—	—	$16V_{DC}/0.15\Omega$	—	—
1.750	—	—	—	$6V_{DC}/0.08\Omega$	—	—	—	—	—	—
1.850	—	—	—	—	—	—	—	$33V_{DC}/0.165\Omega$	—	—
1.900	—	—	—	—	—	—	—	—	$16V_{DC}/0.08\Omega$	—
2.000	—	—	$6V_{DC}/0.072\Omega$	$6V_{DC}/0.06\Omega$	$8V_{DC}/0.07\Omega$	$6V_{DC}/0.10\Omega$	—	$15V_{DC}/0.125\Omega$	—	—
2.500	—	—	—	—	—	—	—	$15V_{DC}/0.85\Omega$	—	—
2.600	—	—	—	—	$6V_{DC}/0.043\Omega$	—	$6V_{DC}/0.075\Omega$	—	—	—
	—	—	—	—	$12V_{DC}/0.047\Omega$	—	—	—	—	—
	—	—	—	—	$13.2V_{DC}/0.050\Omega$	—	—	—	—	—
	—	—	—	—	$16V_{DC}/0.050\Omega$	—	—	—	—	—
3.000	—	—	—	—	$6V_{DC}/0.036\Omega$	—	$6V_{DC}/0.048\Omega$	—	—	—
	—	—	—	—	—	—	$15V_{DC}/0.05\Omega$	—	—	—

* Data is preliminary

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

	Part Number	Maximum Ambient Temperature -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 1608 mm/0603 mils												
coming soon	femtoSMDC005F*	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	—
coming soon	femtoSMDC010F*	0.16	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04	—
NEW	femtoSMDC016F	0.25	0.22	0.18	0.17	0.16	0.14	0.12	0.11	0.10	0.08	0.07	—
	picoSMDC Series Size 2012 mm/0805 mils												
coming soon	picoSMDC010S*	0.17	0.15	0.13	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.05	—
coming soon	picoSMDC012S*	0.20	0.17	0.15	0.13	0.12	0.10	0.09	0.08	0.07	0.06	0.05	—
NEW	picoSMDC020S	0.30	0.27	0.24	0.21	0.20	0.18	0.16	0.15	0.13	0.12	0.11	—
NEW	picoSMDC035S	0.55	0.49	0.44	0.37	0.35	0.31	0.28	0.26	0.23	0.20	0.18	—
coming soon	picoSMDC075S*	1.17	1.05	0.94	0.81	0.75	0.68	0.62	0.57	0.50	0.44	0.41	—
coming soon	picoSMDC100S*	1.52	1.36	1.21	1.10	1.00	0.90	0.83	0.75	0.67	0.60	0.56	—
	nanoSMDC Series Size 3216 mm/1206 mils												
	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	—
	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	—
NEW	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 3225 mm/1210 mils												
	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 4532 mm/1812 mils												
NEW	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	—
NEW	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	—
	miniSMDC100F	1.60	1.45	1.28	1.10	1.07	0.92	0.83	0.71	0.66	0.57	0.52	—
	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	—
	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	—
NEW	miniSMDC300F	4.13	3.75	3.33	3.02	3.00	2.70	2.54	2.35	2.22	2.06	1.98	—

* Data is preliminary

RoHS Compliant, ELV Compliant HF Halogen Free

Table S2 Thermal Derating for Surface-mount 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	80°C	85°C	125°C
miniSMDE Series Size 11550 mm/4420 mils												
miniSMDE190F	3.16	2.74	2.20	1.90	1.74	1.48	1.27	1.10	0.80	0.50	0.35	—
midSMD Series Size 5050 mm/2018 mils												
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 7555 mm/2920 mils												
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	—
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	—
NEW 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 8763 mm/3425 mils												
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 Surface-mount Devices

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

B = miniSMDE190F

C = SMDH120 and SMDH160

Figure S1

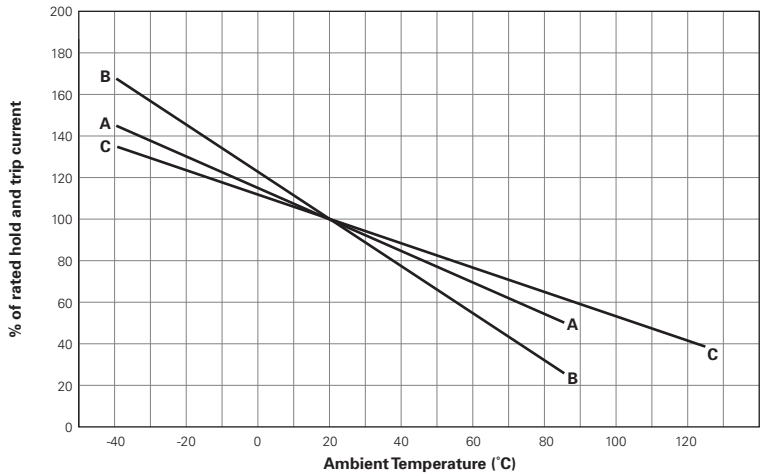


Table S3 Electrical Characteristics for Surface-mount Devices at Room Temperature

	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 1608 mm/0603 mils										
coming soon	femtoSMDC005F*	0.05	0.15	15	40	0.50	0.50	0.10	3.80	30.00	S2
coming soon	femtoSMDC010F*	0.10	0.25	12	40	0.50	0.70	0.10	1.70	8.00	S2
NEW	femtoSMDC016F	0.16	0.40	9	40	0.50	1.00	0.10	1.00	4.20	S2
	picoSMDC Series Size 2012 mm/0805 mils										
coming soon	picoSMDC010S*	0.10	0.30	15	100	0.50	0.50	0.60	1.50	11.00	S2
coming soon	picoSMDC012S*	0.12	0.30	15	100	0.50	1.00	0.10	1.50	9.00	S2
NEW	picoSMDC020S	0.20	0.47	9	100	0.50	2.00	0.10	0.75	3.20	S2
NEW	picoSMDC035S	0.35	0.75	6	100	0.50	1.75	0.20	0.35	1.40	S2
coming soon	picoSMDC075S*	0.75	1.72	6	100	0.60	8.00	0.10	0.10	0.35	S2
coming soon	picoSMDC100S*	1.00	2.10	6	70	0.60	8.00	0.20	0.06	0.19	S2
	nanoSMDC Series Size 3216 mm/1206 mils										
	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
	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
NEW	nanoSMDC200F	2.00	4.00	6	100	1.00	8.00	1.50	0.02	0.072	S2
	microSMD Series Size 3225 mm/1210 mils										
	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 4532 mm/1812 mils										
NEW	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
NEW	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
	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
	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
NEW	miniSMDC300F	3.00	6.00	6	100	1.00	8.00	5.00	0.011	0.036	S2

* Data is preliminary

RoHS Compliant, ELV Compliant HF Halogen Free

Table S3 Electrical Characteristics for 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
miniSMDE Series Size 11550 mm/4420 mils										
miniSMDE190F	1.90	3.80	16	100	1.50	10.00	2.00	0.024	0.08	S2
midSMD Series Size 5050 mm/2018 mils										
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
SMD Series Size 7555 mm/2920 mils										
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
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
NEW SMD300F/15	3.00	6.00	15	40	1.50	8.00	35.00	0.015	0.050	S4
SMD2 Devices Size 8763 mm/3425 mils										
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

Figure S2-S4 Dimension Figures for Surface-mount Devices

Figure S2

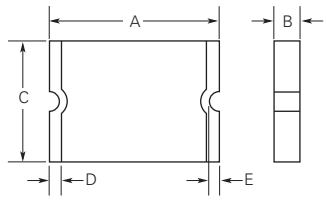


Figure S3

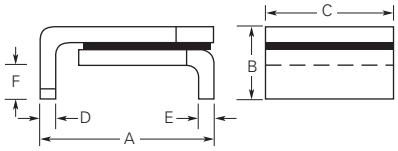


Figure S4

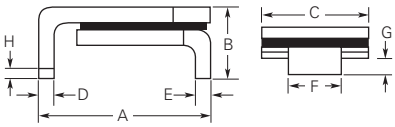


Table S4 Dimensions for Surface-mount Devices in Millimeters (Inches)

	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 1608 mm/0603 mils																
coming soon	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)	—	—	—	—	—	—	
coming soon	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)	—	—	—	—	—	—	
NEW	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)	—	—	—	—	—	—	
	picoSMDC Series Size 2012 mm/0805 mils																
coming soon	picoSMDC010S*	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)	—	—	—	—	—	—	
coming soon	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)	—	—	—	—	—	—	
NEW	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)	—	—	—	—	—	—	
NEW	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)	—	—	—	—	—	—	
coming soon	picoSMDC075S*	2.00	2.20	0.67	0.92	1.30	1.50	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.079)	(0.087)	(0.026)	(0.036)	(0.051)	(0.059)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
coming soon	picoSMDC100S*	2.00	2.20	0.57	0.82	1.30	1.50	0.25	0.75	0.076	—	—	—	—	—	—	S2
		(0.079)	(0.087)	(0.022)	(0.032)	(0.051)	(0.059)	(0.010)	(0.030)	(0.003)	—	—	—	—	—	—	
	nanoSMDC Series Size 3216 mm/1206 mils																
	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)	—	—	—	—	—	—	
	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)	—	—	—	—	—	—	
NEW	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 3225 mm/1210 mils																
	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)	—	—	—	—	—	—	

* Data is preliminary

RoHS Compliant, ELV Compliant HF Halogen Free

Table S4 Dimensions for 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 4532 mm/1812 mils																
NEW 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)	—	—	—	—	—	—	
NEW 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)	—	—	—	—	—	—	
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)	—	—	—	—	—	—	
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)	—	—	—	—	—	—	
NEW 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)	—	—	—	—	—	—	
miniSMDE Series Size 11550 mm/4420 mils																
miniSMDE190F	11.15	11.51	0.33	0.53	4.83	5.33	0.51	1.02	0.381	—	—	—	—	—	—	S2
	(0.439)	(0.453)	(0.013)	(0.021)	(0.190)	(0.210)	(0.020)	(0.040)	(0.015)	—	—	—	—	—	—	

Table S4 Dimensions for 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 5050 mm/2018 mils																
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 7555 mm/2920 mils																
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)	
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)	
NEW 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 8763 mm/3425 mils																
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)	

RoHS Compliant, ELV Compliant HF Halogen Free

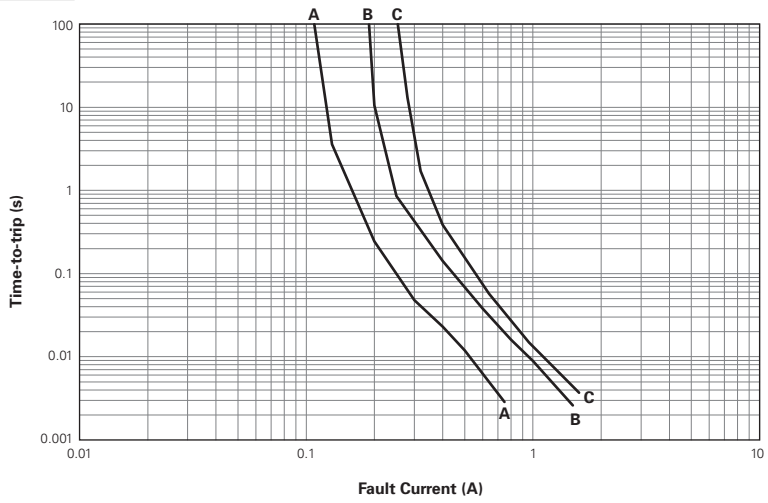
Figure S5-S15 Typical Time-to-trip Curves at 20°C for Surface-mount Devices

femtoSMDCxxxF

A = femtoSMDC005F*
B = femtoSMDC010F*
C = femtoSMDC016F

* Data is preliminary

Figure S5

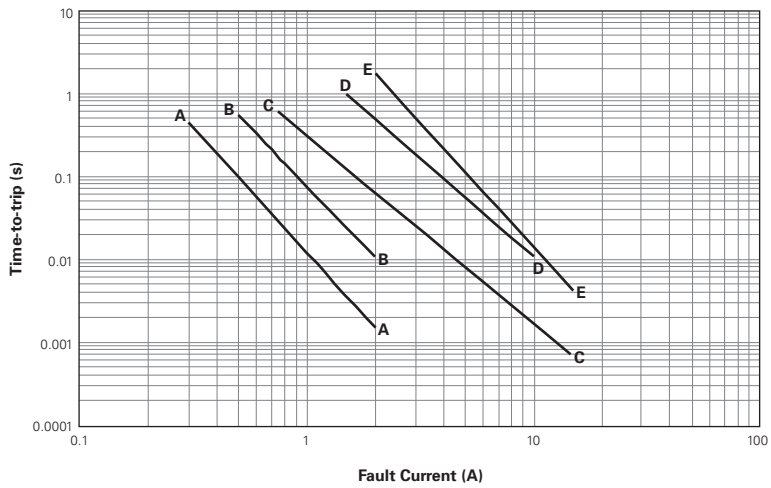


picoSMDCxxxS

A = picoSMDC010S*, picoSMDC012S*
B = picoSMDC020S
C = picoSMDC035S
D = picoSMDC075S*
E = picoSMDC100S*

* Data is preliminary

Figure S6



nanoSMDCxxxF

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

Figure S7

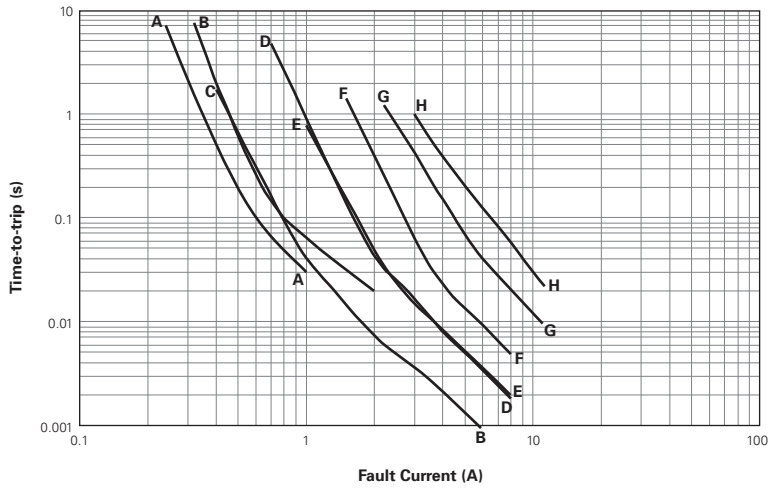
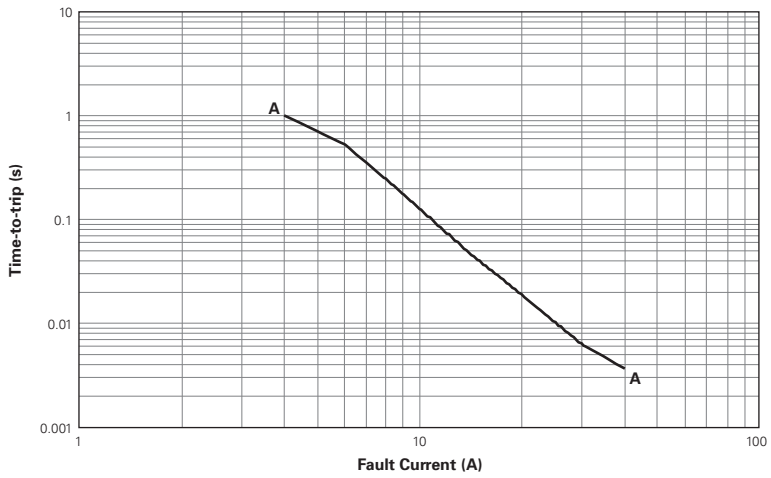


Figure S5-S15 Typical Time-to-trip Curves at 20°C for Surface-mount Devices Cont'd

nanoSMDC200F

A = nanoSMDC200F

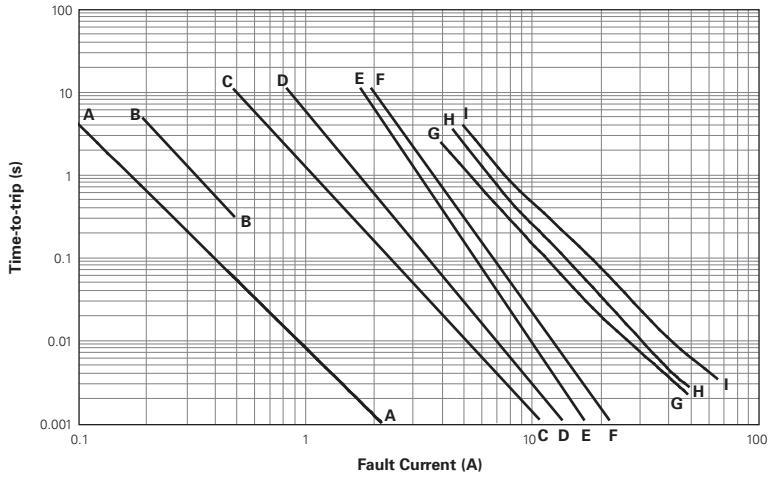
Figure S8



microSMDxxxF

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

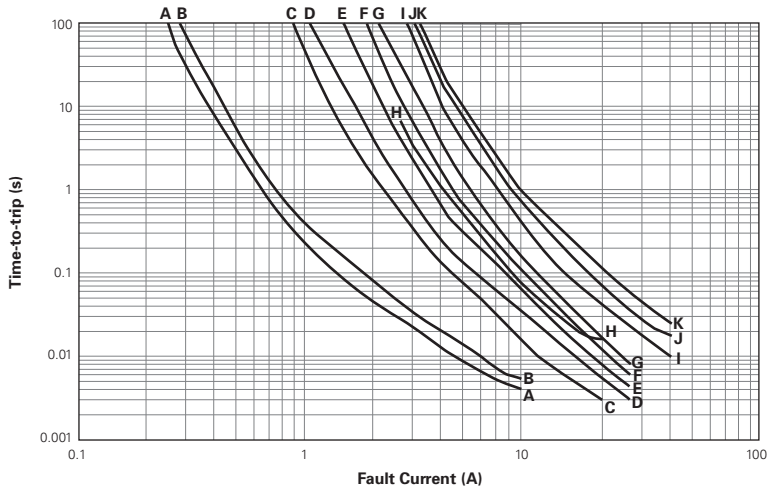
Figure S9



miniSMDCxxxF and miniSMDExxxF

A = miniSMDC010F, miniSMDC014F
B = miniSMDC020F
C = miniSMDC050F
D = miniSMDC075F, miniSMDC075F/24
E = miniSMDC100F, miniSMDC110F, miniSMDC110F/16, miniSMDC110F/24
F = miniSMDC125F, miniSMDC125F/16
G = miniSMDC150F, miniSMDC150F/12, miniSMDC150F/16, miniSMDC150F/24
H = miniSMDC160F
I = miniSMDC200F
J = miniSMDE190F
K = miniSMDC260F, miniSMDC260F/12, miniSMDC260F/13.2, miniSMDC260F/16

Figure S10



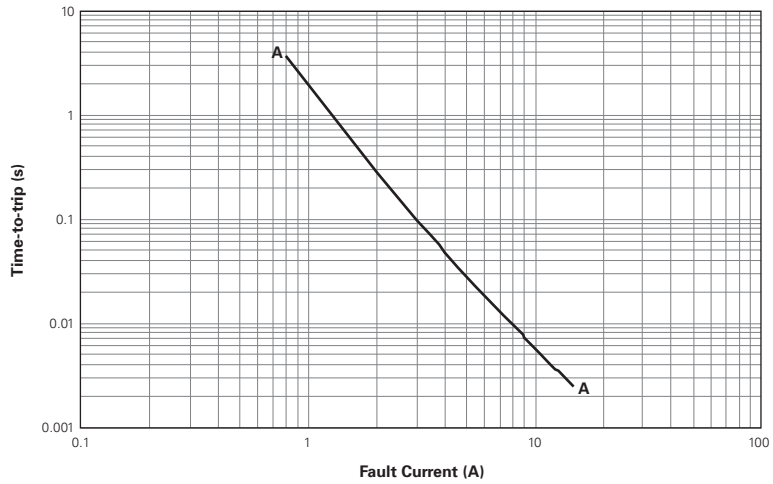
RoHS Compliant, ELV Compliant HF Halogen Free

Figure S5-S15 Typical Time-to-trip Curves at 20°C for Surface-mount Devices Cont'd

miniSMDC030F

A = miniSMDC030F

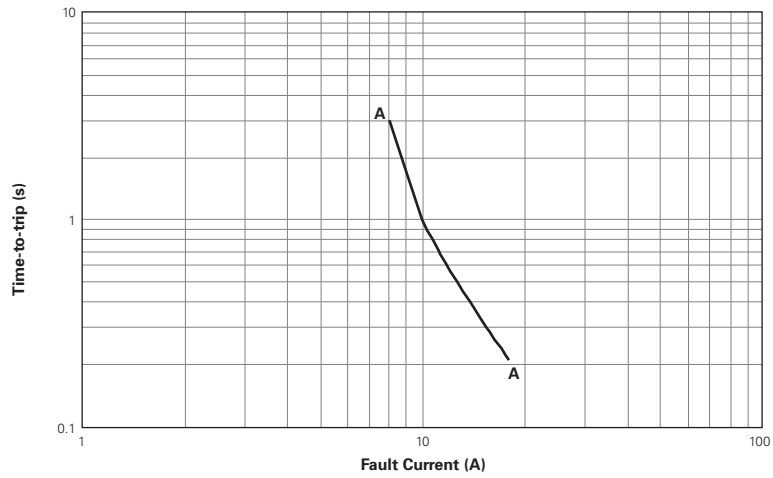
Figure S11



miniSMDC300F

A = miniSMDC300F

Figure S12



midSMD

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

Figure S13

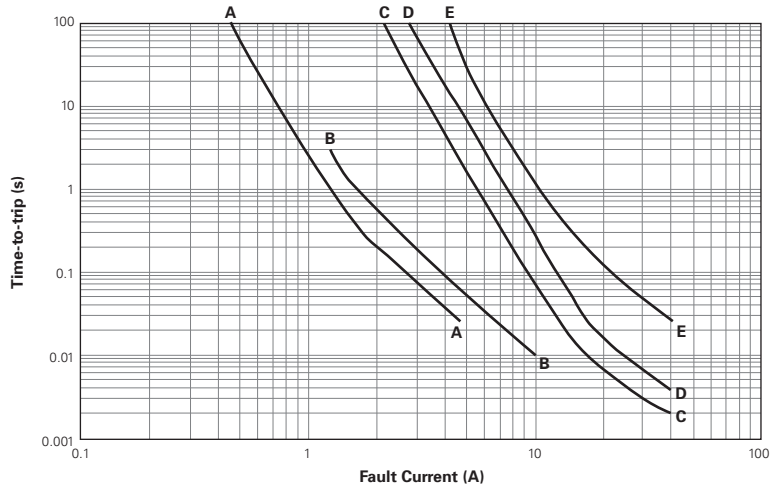
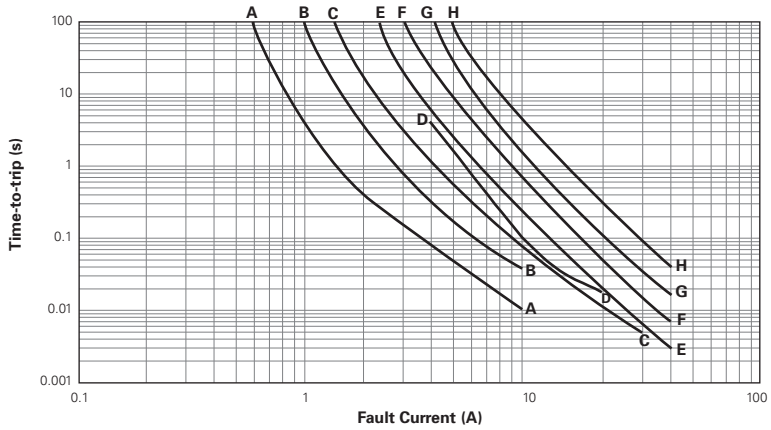


Figure S5-S15 Typical Time-to-trip Curves at 20°C for Surface-mount Devices Cont'd

SMDxxxF

A = SMD030F
B = SMD050F
C = SMD075F, SMD075F/60
D = SMDH120
E = SMD100F, SMD100F/33
F = SMD125F
G = SMD260F
H = SMD300F, SMD300F/15

Figure S14



SMD2xxxF

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

Figure S15

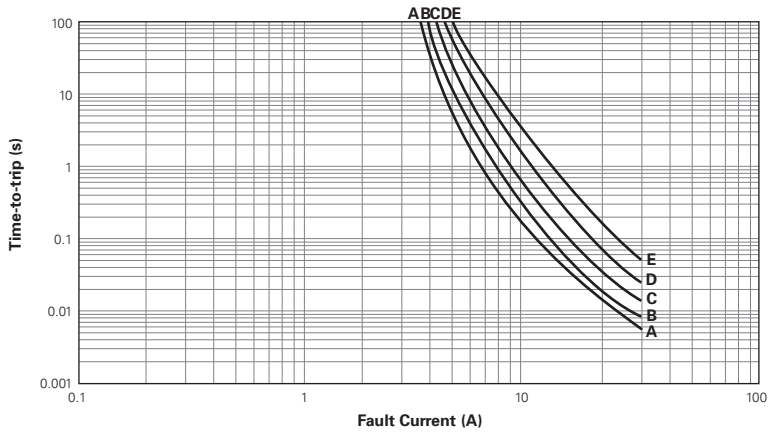


Table S5 Physical Characteristics and Environmental Specifications for Surface-mount Devices

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
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.

Environmental Specifications

Test	Test Method	Conditions	Resistance Change
Storage life	Raychem PS300, Section 5.3.2	60°C, 1000 hours	±3% typical
		85°C, 1000 hours	±5% typical
Humidity aging	Raychem PS300, Section 5.3.1	85°C, 85% RH, 100 hours	±1.2% typical
Thermal shock	MIL-STD-202, Method 107G	85°C, -40°C (20 times)	-33% typical
		125°C, -55°C (10 times)	-33% typical
Vibration	MIL-STD-883C	per MIL-STD-883C	No change
Solvent resistance	Raychem PS300, Section 5.2.2	Freon	No change
		Trichloroethane	No change
		Hydrocarbons	No change

RoHS Compliant, ELV Compliant HF Halogen Free

Table S6 Packaging and Marking Information for Surface-mount Devices

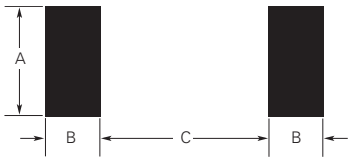
	Part Number	Tape & Reel Quantity	Standard Package	Part Marking	Recommended Pad Layout Figures [mm(In.)] Dimension A (Nom.)	Dimension B (Nom.)	Dimension C (Nom.)	Agency Recognition
	femtoSMDC Series Size 1608 mm/0603 mils							
coming soon	femtoSMDC005F*	4,000	20,000	A	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	UL, CSA
coming soon	femtoSMDC010F*	4,000	20,000	B	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	UL, CSA
NEW	femtoSMDC016F	4,000	20,000	E	0.80 (0.032)	0.60 (0.024)	0.80 (0.032)	UL, CSA
	picoSMDC Series Size 2012 mm/0805 mils							
coming soon	picoSMDC010S*	4,000	20,000	C	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	Pending
coming soon	picoSMDC012S*	4,000	20,000	F	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	Pending
NEW	picoSMDC020S	4,000	20,000	H	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	UL, CSA
NEW	picoSMDC035S	4,000	20,000	I	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	UL, CSA
coming soon	picoSMDC075S*	3,000	15,000	M	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	Pending
coming soon	picoSMDC100S*	3,000	15,000	S	1.50 (0.060)	1.00 (0.039)	1.20 (0.047)	Pending
	nanoSMDC Series Size 3216 mm/1206 mils							
	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
	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
NEW	nanoSMDC200F	3,000	15,000	T	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	UL, CSA, TÜV
	microSMD Series Size 3225 mm/1210 mils							
	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 4532 mm/1812 mils							
NEW	miniSMDC010F	2,000	10,000	10	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA
	miniSMDC014F	2,000	10,000	14	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC020F	2,000	10,000	2	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
NEW	miniSMDC030F	2,000	10,000	3	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA
	miniSMDC050F	2,000	10,000	5	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC075F	2,000	10,000	7	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC075F/24	1,500	7,500	075F 24V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC100F	2,000	10,000	1	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC110F	2,000	10,000	1	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC110F/16	2,000	10,000	110F 16V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC110F/24	1,500	7,500	110F 24V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC125F	2,000	10,000	12	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC125F/16	2,000	10,000	125F 16V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC150F	2,000	10,000	15	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC150F/12	2,000	10,000	150F 12V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC150F/16	2,000	10,000	150 16V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC150F/24	1,000	5,000	150F 24V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC160F	2,000	10,000	16	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC200F	2,000	10,000	20	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC260F	2,000	10,000	260F	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC260F/12	1,500	7,500	260F 12V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC260F/13.2	1,500	7,500	260F 13V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
	miniSMDC260F/16	1,500	7,500	260F 16V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA, TÜV
NEW	miniSMDC300F	2,000	10,000	30	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA

* Data is preliminary

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

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
miniSMDE Series Size 11550 mm/4420 mils							
miniSMDE190F	5,000	20,000	19	4.75 (0.187)	1.45 (0.057)	9.57 (0.377)	UL, CSA, TÜV
midSMD Series Size 5050 mm/2018 mils							
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
SMD Series Size 7555 mm/2920 mils							
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
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
NEW SMD300F/15	2,000	10,000	315F	3.10 (0.12)	2.30 (0.09)	5.10 (0.201)	UL, CSA
SMD2 Devices Size 8763 mm/3425 mils							
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 S16 Recommended Pad Layout for Surface-mount Devices



10

Agency Recognition for 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)

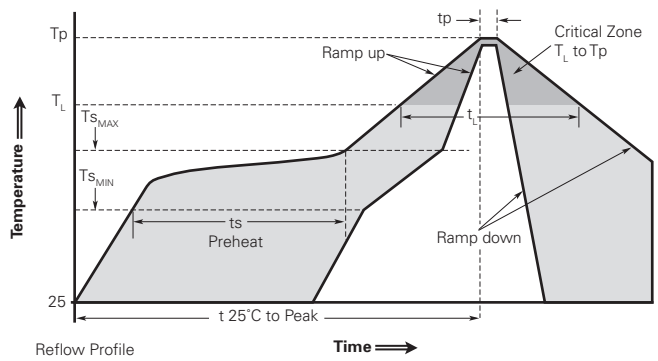
Solder Reflow and Rework Recommendation for Surface-mount Devices

Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp up rate (Ts_{MAX} to Tp)	3°C/second max.	3°C/second max.
Preheat		
• Temperature min. (Ts_{MIN})	100°C	150°C
• Temperature max. (Ts_{MAX})	150°C	200°C
• Time (ts_{MIN} to ts_{MAX})	60-120 seconds	60-120 seconds
Time maintained above:		
• Temperature (T_L)	183°C	217°C
• Time (t_L)	60-150 seconds	60-150 seconds
Peak/Classification temperature (Tp)	235°C	260°C
Time within 5°C of actual peak temperature		
Time (tp)	20 seconds max.	30 seconds max.
Ramp down rate	3°C/second max.	3°C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.

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

Figure S17



Solder Reflow

- Recommended reflow methods:
  - IR
  - Hot air
  - Nitrogen
- Recommended maximum paste thickness: 0.25mm (0.010 inch)
- Devices can be cleaned using standard methods and aqueous solvents.
- We believe 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 (in 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	miniSMDE190 EIA 481-2	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	24.0 ± 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	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	8.0 ± 0.10	12.0 ± 0.10
P_2	2.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.05	2.0 ± 0.10	2.0 ± 0.10	2.0 ± 0.10	2.0 ± 0.10
A_0	Table S8	Table S8	1.95 ± 0.10	2.9 ± 0.10	Table S8	5.70 ± 0.10	5.11 ± 0.15	5.6 ± 0.23	6.9 ± 0.23
B_0	Table S8	Table S8	Table S8	3.50 ± 0.10	Table S8	11.90 ± 0.10	5.6 ± 0.23	8.1 ± 0.15	9.6 ± 0.15
B_1 max.	4.35	4.35	4.35	4.35	8.2	20.1	12.1	12.1	12.1
D_0	1.55 ± .05	1.55 ± .05	1.55 ± .05	1.55 ± .05	1.5 + 0.10/ -.00	1.55 ± .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 ± 0.05	11.50 ± 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	1.75 ± 0.10
E_2 min.	6.25	6.25	6.25	6.25	10.25	22.25	14.25	14.25	14.25
T max.	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
T_1 max.	0.1	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	0.95 ± 0.10	1.8 ± 0.15	3.2 ± 0.15	3.4 ± 0.15
Leader min.	390	390	390	390	390	400	400	400	400
Trailer min.	160	160	160	160	160	160	160	160	160

Table S8 Tape and Reel Specifications for Surface-mount Devices (in Millimeters)

	femtoSMDC005F femtoSMDC010F	femtoSMDC016F	All picoSMDC series except picoSMDC075S picoSMDC100S	picoSMDC075S picoSMDC100S	All nanoSMDC series except nanoSMDC012F nanoSMDC016F	nanoSMDC012F nanoSMDC016F
A_0	1.00 ± 0.1	1.00 ± 0.1	1.55 ± 0.1	1.60 ± 0.1	1.95 ± 0.1	1.95 ± 0.1
B_0	1.85 ± 0.1	1.85 ± 0.1	2.50 ± 0.1	2.45 ± 0.1	3.50 +0.1/-0.08	3.5 ± 0.1
K_0	0.90 ± 0.1	0.80 ± 0.1	0.86 ± 0.1	1.35 ± 0.1	0.89 ± 0.1	1.27 ± 0.1

	All microSMD series except microSMD200F	microSMD200F	miniSMDC014F~075F miniSMDC100F~110F/16 miniSMDC125F~150F/16 miniSMDC160F~260F	miniSMDC075F/24 miniSMDC110F/24 miniSMDC260F/12 miniSMDC260F/13.2 miniSMDC260F/16	miniSMDC150F/24	decaSMDC050F/60
A_0	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	4.95 ± 0.1	4.9 ± 0.1	4.9 ± 0.1	5.4 ± 0.1
K_0	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 Surface-mount Devices (in Millimeters)

	femto/pico/nano/microSMD	miniSMDC	miniSMDE190	midSMD	SMD	SMD2
A max.	185	185	330	330	330	330
N min.	50	50	60	50	50	50
W_1	8.4 + 1.5/-.00	12.4 + 2.0/-.00	24.4 + 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	30.4	22.4	22.4	22.4

RoHS Compliant, ELV Compliant HF Halogen Free

Figure S18 EIA Referenced Taped Component Dimensions for Surface-mount Devices

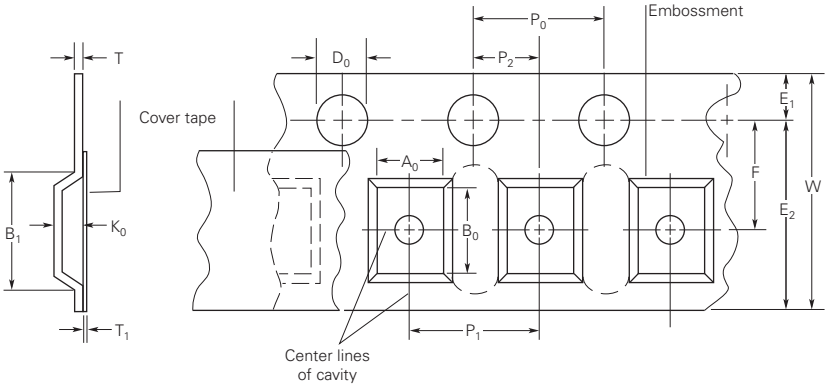
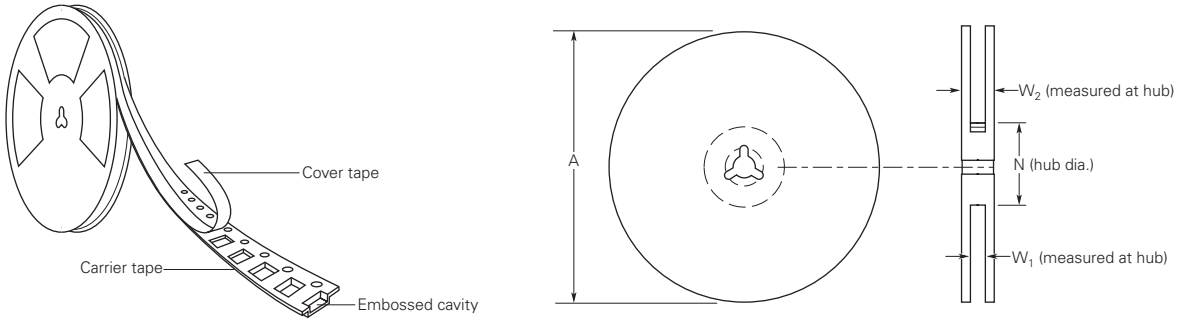


Figure S19 EIA Referenced Reel Dimensions for Surface-mount Devices



Part Numbering System for Surface-mount Devices

SMD 150 F /33 -RB -2

- **-2** — **Packaging**
  2 = Tape and Reel
- **-RB** — **Rx = Resistance Range (Limited part number availability)**
- **/33** — **Alternative Voltage Rating (If applicable)**
- **F** — **Lead Free**
- **150** — **Hold Current Indicator**
- **SMD** — **Product Series**

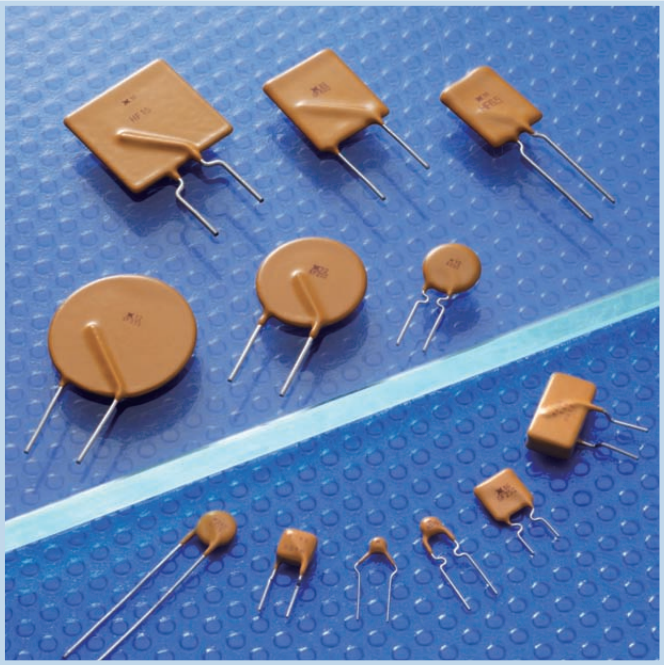
⚠ Warning :

- 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
Radial-leaded Devices

Tyco Electronics' 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
- RTEF series for IEEE-1394 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)
- BBRF series for cable telephone applications
- Now offering RoHS versions of all products



Benefits

- Many product choices give 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
- 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 hub, ports and peripherals
- IEEE1394 ports
- CD-ROMs
- Game machines
- Battery packs
- Phones
- Fax machines
- Analog and digital line cards
- Printers

Application Selection Guide for Radial-leaded Devices

The guide below lists PolySwitch radial-leaded devices that are typically used in these applications.
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)		
IEEE-1394 computer and consumer electronics	RTEF (<33V)		
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. Tyco Electronics welcomes customer's 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	**BBRF 99V**	**RXEF 72V**	**RKEF 60V**	**RXEF 60V**	**RTEF 33V**	**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	1.05Ω	—	—	—	—	—	—	—	—	—	—
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	—	—	—	—	0.097Ω	—	—	—	—	—	0.080Ω
1.350	—	0.155Ω	0.165Ω	—	0.080Ω	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	—	—	—	—	0.054Ω	—	—	—	—	—	—

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

Voltage Rating	BBRF 99V	RXEF 72V	RKEF 60V	RXEF 60V	RTEF 33V	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	—	—	—

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**
BBRF 99V											
BBRF550	0.85	0.75	0.65	0.55	—	0.45	0.40	0.35	0.30	0.22	—
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	—
RTEF 33V											
RTEF120	1.74	1.56	1.38	1.20	1.16	1.00	0.92	0.82	0.73	0.60	—
RTEF135	1.96	1.76	1.55	1.35	1.31	1.12	1.04	0.92	0.82	0.68	—
RTEF190	2.76	2.47	2.19	1.90	1.84	1.58	1.50	1.29	1.16	0.95	—
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	—

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
RGEF 16V											
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	—
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 and BBRF

Figure R1

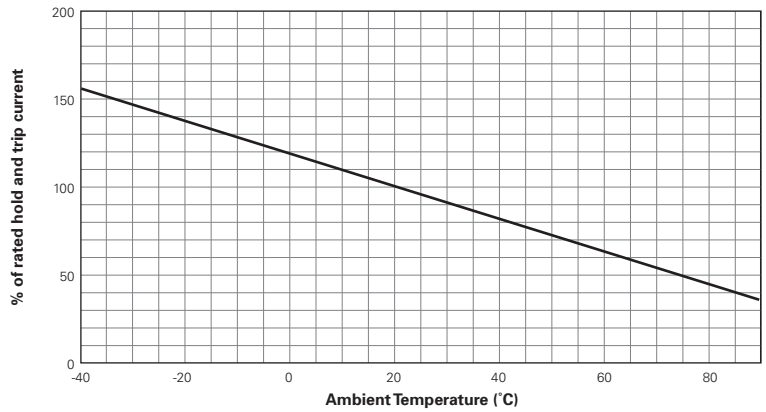
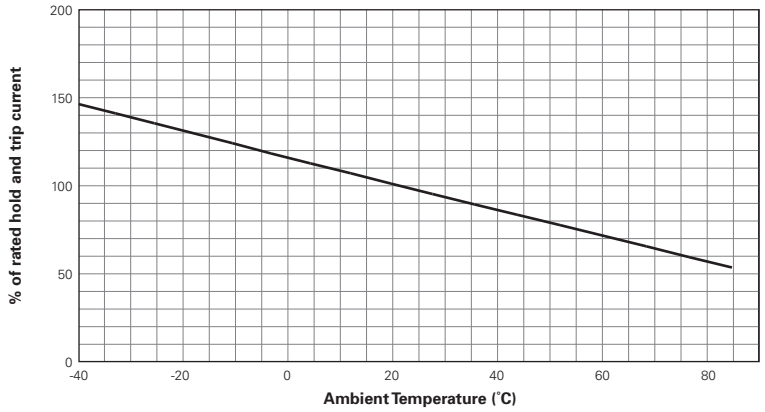


Figure R1-R5 Thermal Derating Curve for Radial-leaded Devices Cont'd

RKEF

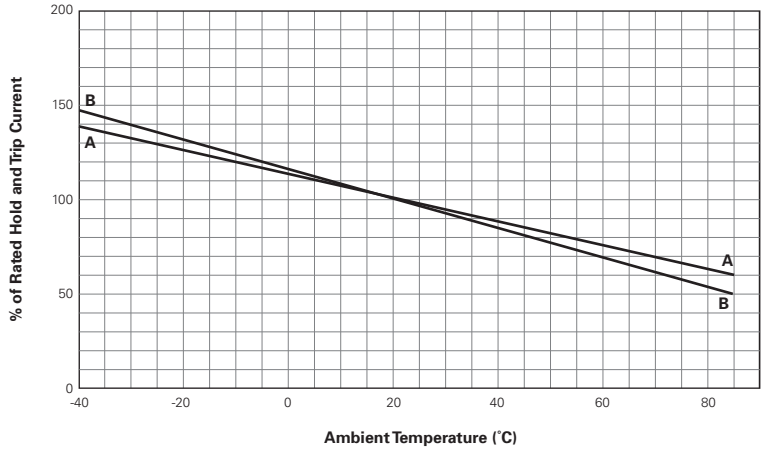
Figure R2



A = RUSBF075, RUSBF120, RUSBF155

B = RUEF, RTEF, and all other RUSBF

Figure R3



RHEF

Figure R4

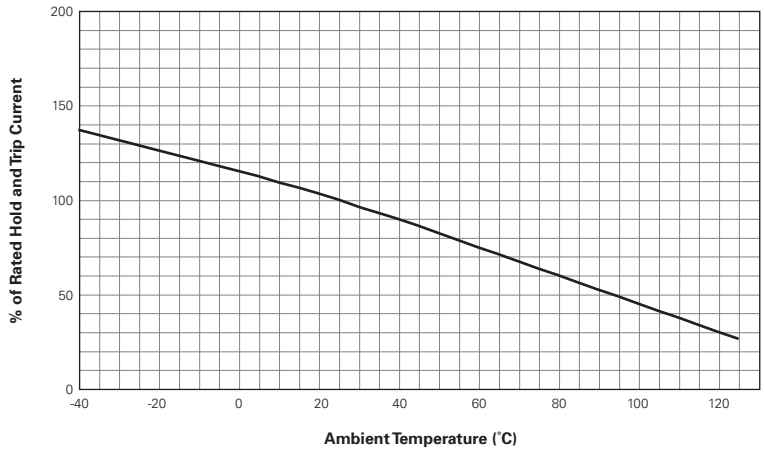


Figure R1-R5 Thermal Derating Curve for Radial-leaded Devices Cont'd

RGEF

Figure R5

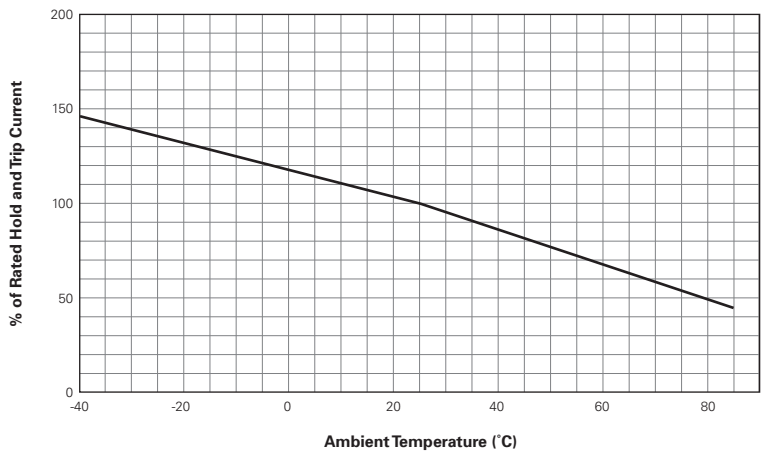


Table R3 Electrical Characteristics for Radial-leaded Devices

Part Number	I_H (A)	I_T (A)	V_{MAX} (V)	I_{MAX} (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 [mm² (AWG)]
BBRF 99V											
BBRF550	0.55	1.10	99	20	1.5	1.60	60	0.8	1.30	1.95	[0.520mm² (20)]
RXEF 60V											
RXEF005	0.05	0.10	60	40	0.22	0.25	5.0	7.3	11.10	20.00	[0.128mm² (26)]
RXEF010	0.10	0.20	60	40	0.38	0.50	4.0	2.5	4.50	7.50	[0.205mm² (24)]
RXEF017	0.17	0.34	60	40	0.48	0.85	3.0	3.3	5.21	8.00	[0.205mm² (24)]
RXEF 72V											
RXEF020	0.20	0.40	72	40	0.41	1.00	2.2	1.83	2.75	4.40	[0.205mm² (24)]
RXEF025	0.25	0.50	72	40	0.45	1.25	2.5	1.25	1.95	3.00	[0.205mm² (24)]
RXEF030	0.30	0.60	72	40	0.49	1.50	3.0	0.88	1.33	2.10	[0.205mm² (24)]
RXEF040	0.40	0.80	72	40	0.56	2.00	3.8	0.55	0.86	1.29	[0.205mm² (24)]
RXEF050	0.50	1.00	72	40	0.77	2.50	4.0	0.50	0.77	1.17	[0.205mm² (24)]
RXEF065	0.65	1.30	72	40	0.88	3.25	5.3	0.31	0.48	0.72	[0.205mm² (24)]
RXEF075	0.75	1.50	72	40	0.92	3.75	6.3	0.25	0.40	0.60	[0.205mm² (24)]
RXEF090	0.90	1.80	72	40	0.99	4.50	7.2	0.20	0.31	0.47	[0.205mm² (24)]
RXEF110	1.10	2.20	72	40	1.50	5.50	8.2	0.15	0.25	0.38	[0.520mm² (20)]
RXEF135	1.35	2.70	72	40	1.70	6.75	9.6	0.12	0.19	0.30	[0.520mm² (20)]
RXEF160	1.60	3.20	72	40	1.90	8.00	11.4	0.09	0.14	0.22	[0.520mm² (20)]
RXEF185	1.85	3.70	72	40	2.10	9.25	12.6	0.08	0.12	0.19	[0.520mm² (20)]
RXEF250	2.50	5.00	72	40	2.50	12.50	15.6	0.05	0.08	0.13	[0.520mm² (20)]
RXEF300	3.00	6.00	72	40	2.80	15.00	19.8	0.04	0.06	0.10	[0.520mm² (20)]
RXEF375	3.75	7.50	72	40	3.20	18.75	24.0	0.03	0.05	0.08	[0.520mm² (20)]
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)]

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

Part Number	I_H (A)	I_T (A)	V_{MAX} (V)	I_{MAX} (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 [mm² (AWG)]
RKEF 60V											
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))
RTEF 33V											
RTEF120	1.20	2.30	33	40	0.78	6.00	3.5	0.074	0.120	0.180	[0.205mm² (24)]
RTEF135	1.35	2.50	33	40	0.84	6.75	4.5	0.059	0.100	0.143	[0.205mm² (24)]
RTEF190	1.90	3.00	33	40	0.90	9.50	3.5	0.045	0.063	0.092	[0.205mm² (24)]
RUEF 30V											
RUEF090	0.90	1.80	30	100	0.60	4.50	5.9	0.070	0.120	0.22	[0.205mm² (24)]
RUEF110	1.10	2.20	30	100	0.70	5.50	6.6	0.070	0.100	0.17	[0.205mm² (24)]
RUEF135	1.35	2.70	30	100	0.80	6.75	7.3	0.040	0.080	0.13	[0.205mm² (24)]
RUEF160	1.60	3.20	30	100	0.90	8.00	8.0	0.030	0.070	0.11	[0.205mm² (24)]
RUEF185	1.85	3.70	30	100	1.00	9.25	8.7	0.030	0.060	0.09	[0.205mm² (24)]
RUEF250	2.50	5.00	30	100	1.20	12.50	10.3	0.020	0.040	0.07	[0.205mm² (24)]
RUEF300	3.00	6.00	30	100	2.00	15.00	10.8	0.020	0.050	0.08	[0.520mm² (20)]
RUEF400	4.00	8.00	30	100	2.50	20.00	12.7	0.010	0.030	0.05	[0.520mm² (20)]
RUEF500	5.00	10.00	30	100	3.00	25.00	14.5	0.010	0.030	0.05	[0.520mm² (20)]
RUEF600	6.00	12.00	30	100	3.50	30.00	16.0	0.005	0.020	0.04	[0.520mm² (20)]
RUEF700	7.00	14.00	30	100	3.80	35.00	17.5	0.005	0.020	0.03	[0.520mm² (20)]
RUEF800	8.00	16.00	30	100	4.00	40.00	18.8	0.005	0.013	0.02	[0.520mm² (20)]
RUEF900	9.00	18.00	30	100	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)	I_{MAX} (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 [mm² (AWG)]
RHEF* 16V - High Temperature											
RHEF200	2.0	3.8	16	100	1.4	10.0	4.3	0.0450	0.07400	0.1100	[0.205mm² (24)]
RHEF300	3.0	6.0	16	100	3.0	15.0	5.0	0.0330	0.05300	0.0790	[0.520mm² (20)]
RHEF400	4.0	7.5	16	100	3.3	20.0	5.0	0.0240	0.04000	0.0600	[0.520mm² (20)]
RHEF450	4.5	7.8	16	100	3.6	22.5	3.0	0.0220	0.03600	0.0540	[0.520mm² (20)]
RHEF550	5.5	10.0	16	100	3.5	27.5	6.0	0.0150	0.02500	0.0370	[0.520mm² (20)]
RHEF600	6.0	10.8	16	100	4.1	30.0	5.0	0.0130	0.02150	0.0320	[0.520mm² (20)]
RHEF650	6.5	12.0	16	100	4.1	32.5	5.5	0.0110	0.01750	0.0260	[0.520mm² (20)]
RHEF700	7.0	13.0	16	100	4.0	35.0	7.0	0.0100	0.01640	0.0250	[0.520mm² (20)]
RHEF750	7.5	13.1	16	100	4.5	37.5	7.0	0.0094	0.01530	0.0220	[0.520mm² (20)]
RHEF800	8.0	15.0	16	100	4.2	40.0	8.0	0.0080	0.01350	0.0200	[0.520mm² (20)]
RHEF900	9.0	16.5	16	100	5.0	45.0	10.0	0.0074	0.01200	0.0170	[0.520mm² (20)]
RHEF1000	10.0	18.5	16	100	5.3	50.0	9.0	0.0062	0.01050	0.0150	[0.520mm² (20)]
RHEF1100	11.0	20.0	16	100	5.5	55.0	11.0	0.0055	0.00900	0.0130	[0.520mm² (20)]
RHEF1300	13.0	24.0	16	100	6.9	65.0	13.0	0.0041	0.00690	0.0100	[0.823mm² (18)]
RHEF1400	14.0	27.0	16	100	6.9	70.0	13.0	0.0030	0.00600	0.0090	[0.823mm² (18)]
RHEF1500	15.0	28.0	16	100	7.0	75.0	20.0	0.0032	0.00613	0.0092	[0.823mm² (18)]
RUSBF 6V											
RUSBF075	0.75	1.30	6	40	0.3	8.0	0.4	0.110	0.1750	0.23	[0.205mm² (24)]
RUSBF120	1.20	2.00	6	40	0.6	8.0	0.5	0.070	0.0975	0.14	[0.205mm² (24)]
RUSBF155	1.55	2.65	6	40	0.6	7.8	2.2	0.040	0.0705	0.10	[0.205mm² (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.

Figure R6-R14 Dimension Figures for Radial-leaded Devices

Figure R6

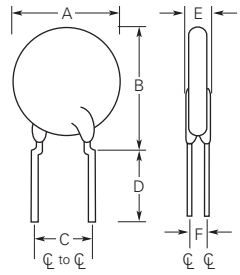


Figure R7

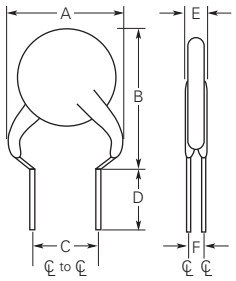


Figure R8

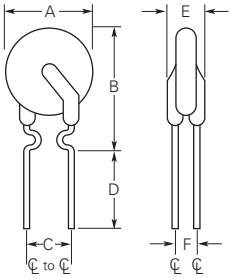


Figure R9

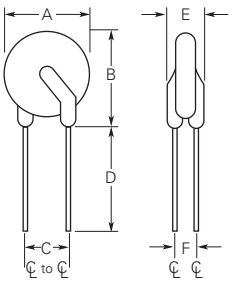


Figure R10

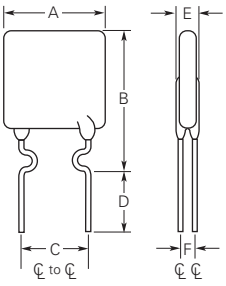


Figure R11

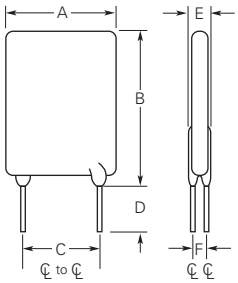


Figure R6-R14 Dimension Figures for Radial-leaded Devices

Cont'd

Figure R12

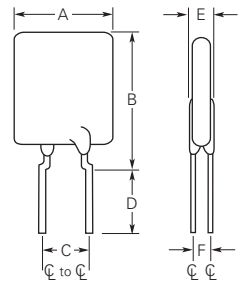


Figure R13

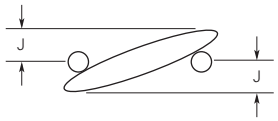


Figure R14

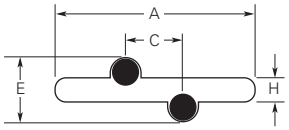


Table R4 Dimensions for Radial-leaded Devices in Millimeters (Inches)

Part Number	A Min.	A Max.	B Min.	B Max.	C Min.	C Max.	D Min.	D Max.	E Min.	E Max.	F Typ.	H Typ.	J Typ.	Figure
BBRF 99V														
BBRF550	—	10.9 (0.43)	—	14.0 (0.55)	4.3 (0.17)	5.8 (0.23)	7.6 (0.3)	—	—	3.6 (0.14)	—	1.37 (0.054)	1.2 (0.05)	R6, R13, R14
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
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)	R7, R13, R14
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)	R7, R13, R14
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table R4 Dimensions for Radial-leaded 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 Typ.	H Typ.	J Typ.	Figure
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
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
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
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
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
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
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
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
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
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
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
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
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
RTEF 33V														
RTEF120	—	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
RTEF135	—	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
RTEF190	—	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
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
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
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
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
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
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
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
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
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
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
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
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
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

Table R4 Dimensions for Radial-leaded 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 Typ.	H Typ.	J Typ.	Figure
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
RGEF1000	15.5 (0.61)	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
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
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
RGEF1400	22.4 (0.88)	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
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
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
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
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
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
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
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

Table R4 Dimensions for Radial-leaded 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 Typ.	H Typ.	J Typ.	Figure
RHEF 16V - High Temperature														
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
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
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
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
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
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
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
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
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
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
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
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

Figure R15-R21 Typical Time-to-trip Curves at 20°C for Radial-leaded Devices

BBRF

A = BBRF550

RTEF

B = RTEF120

C = RTEF135

D = RTEF190

Figure R15

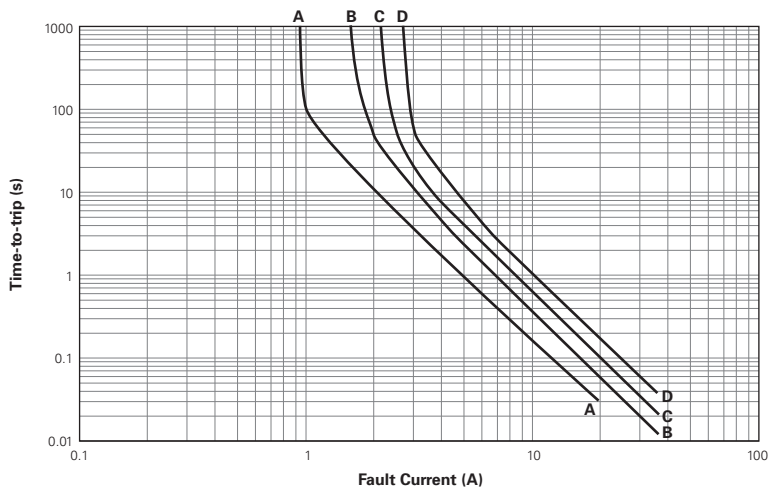
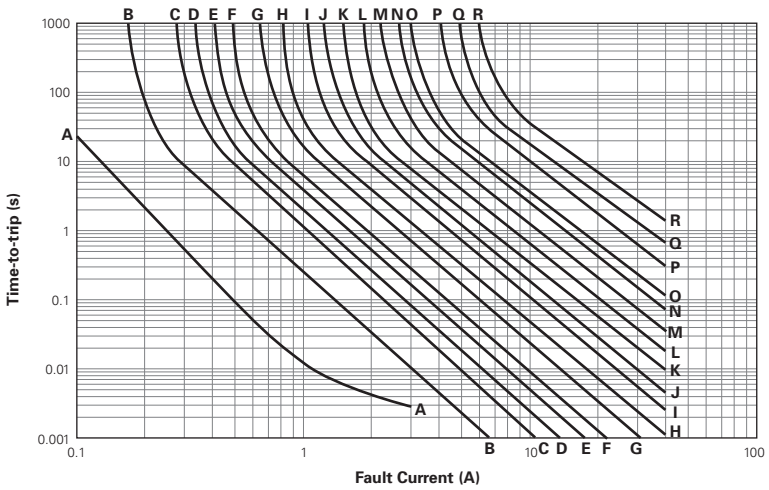


Figure R15-R21 Typical Time-to-trip Curves at 20°C for Radial-leaded Devices Cont'd

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

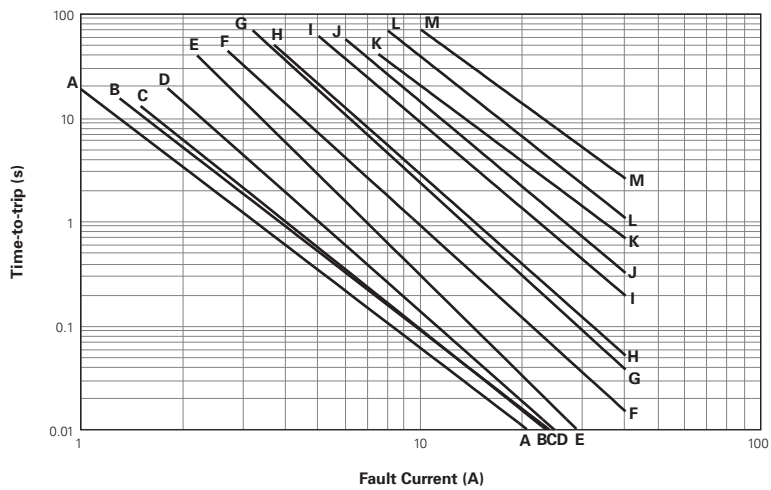
Figure R16



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 R17



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 R18

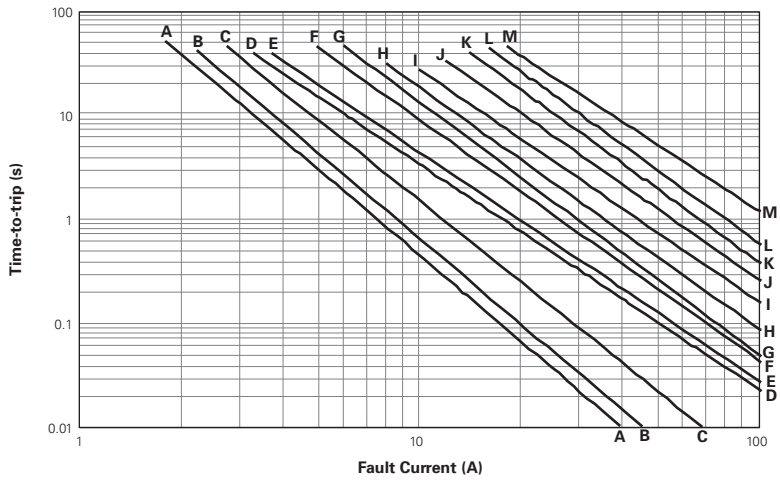
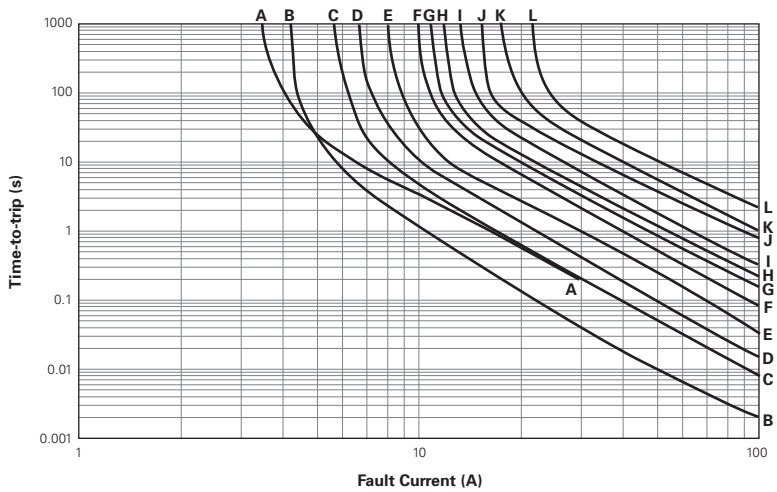


Figure R15-R21 Typical Time-to-trip Curves at 20°C for Radial-leaded Devices Cont'd

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

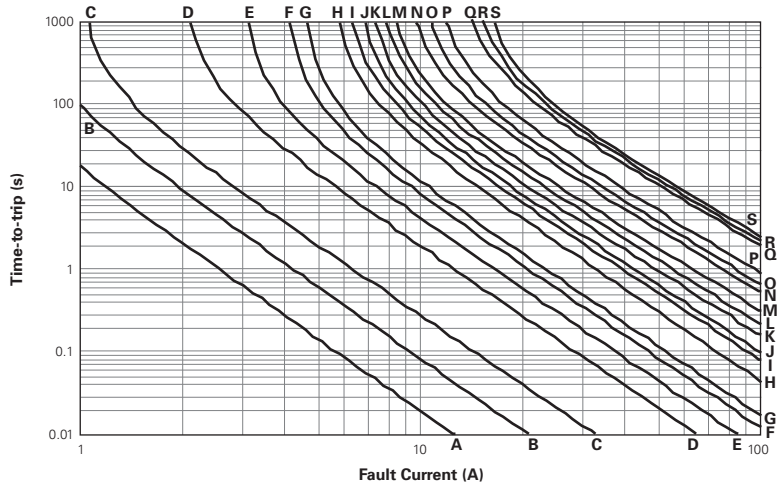
Figure R19



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 R20



RUSBF

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

Figure R21

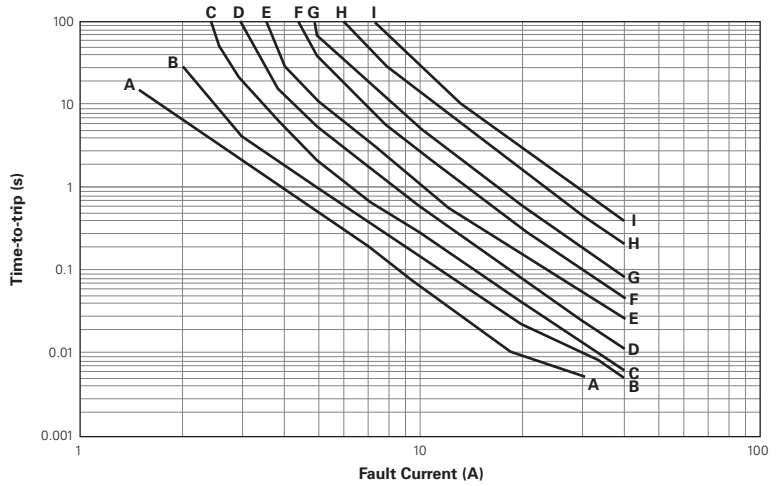


Table R5 Physical Characteristics and Environmental Specifications for Radial-leaded Devices

BBRF

Physical Characteristics

Lead material	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, Method 1A, Condition B, can withstand 10 seconds 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 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85%RH, 1000 hours	±5%
Thermal shock	85°C, -40°C (10 times)	±5%
Solvent resistance	MIL-STD-202, Method 215F	No change

RXEF

Physical Characteristics

Lead material	RXEF005 : Tin-plated nickel-copper alloy, 0.128mm² (26AWG), ø0.40mm (0.016in.)
	RXEF010 : Tin-plated nickel-copper alloy, 0.205mm² (24AWG), ø0.51mm (0.020in.)
	RXEF017 to 040 : Tin-plated copper-clad steel, 0.205mm² (24AWG), ø0.51mm (0.020in.)
	RXEF050 to 090 : Tin-plated copper, 0.205mm² (24AWG), ø0.51mm (0.020in.)
	RXEF110 to 375 : Tin-plated copper, 0.52mm² (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 5 seconds at 260°C ±5°C
	All other sizes: per IEC-STD 68-2-20, Test Tb, Method 1a, condition b; can withstand 10 seconds 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 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85%RH, 1000 hours	±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, 0.205mm² (24AWG), ø0.51mm (0.020in.)
	RKEF110 to 500 : Tin-plated copper, 0.52mm² (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 5 seconds at 260°C ±5°C
	All other sizes: per IEC-STD 68-2-20, Test Tb, Method 1a, condition b; RKEF can withstand 10 seconds 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.

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

RKEF
Environmental Specifications

Test	Conditions	Resistance Change
Passive aging	-40°C, 1000 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85%RH, 1000 hours	±10%
Thermal shock	85°C, -40°C (10 times)	±10%
Solvent resistance	MIL-STD-202, Method 215F	No change

RTEF
Physical Characteristics

Lead material	Tin-plated copper-clad steel, 0.205mm^2 (24AWG), ø0.51mm (0.020in.)
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 seconds 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 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85%RH, 1000 hours	±5%
Thermal shock	85°C, -40°C (10 times)	±5%
Solvent resistance	MIL-STD-202, Method 215F	No change

RUEF
Physical Characteristics

Lead material	RUEF090 to RUEF250: Tin-plated copper-clad steel, 0.205mm^2 (24AWG)
	RUEF300 to RUEF900: Tin-plated copper, 0.52mm^2 (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 10 seconds 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 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85%RH, 1000 hours	±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, 0.205mm^2 (24AWG), ø0.51mm/0.020in.
	RUSBF090 to RUSBF250: Tin-plated copper clad-steel, 0.205mm^2 (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 5 seconds at 260°C ±5°C
	All others: per IEC-STD 68-2-20, Test Tb, Method 1A, Condition B; can withstand 10 seconds 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.

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

RUSBF

Environmental Specifications

Test	Conditions	Resistance Change
Passive aging	70°C, 1000 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85%RH, 1000 hours	±5%
Thermal shock	85°C, -40°C (10 times)	±5%
Solvent resistance	MIL-STD-202, Method 215F	No change

RGEF

Physical Characteristics

Lead material	RGEF250: Tin-plated copper-clad steel, 0.205mm^2 (24AWG), ø0.51mm/0.020in.
	RGEF300 to RGEF1100 : Tin-plated copper, 0.52mm^2 (20AWG), ø0.81mm/0.032in.
	RGEF1200 to RGEF1400 : Tin-plated copper, 0.82mm^2 (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 5 seconds at 260°C ±5°C
	RGEF500 to RGEF1400: per IEC 68-2-20, Test Tb, Method 1a, condition b; can withstand 10 seconds 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 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85%RH, 1000 hours	±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, 0.205mm^2 (24AWG), ø0.51mm/0.020in.
	RHEF300 to RHEF1100 : Tin-plated copper, 0.52mm^2 (20AWG), ø0.81mm/0.032in.
	RHEF1300 to RHEF1500 : Tin-plated copper, 0.82mm^2 (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 withstand 10 seconds 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 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85%RH, 1000 hours	±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 specificed 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 & Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
BBRF 99V						
BBRF550	500	—	—	10,000	BF550	UL, CSA
BBRF550-2	—	1,500	—	7,500	BF550	UL, CSA
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	XF010	UL, CSA, TÜV
RXEF010-2	—	3,000	—	15,000	XF010	UL, CSA, TÜV
RXEF010-AP	—	—	2,000	10,000	XF010	UL, CSA, TÜV
RXEF017	500	—	—	10,000	XF017	UL, CSA, TÜV
RXEF017-2	—	2,500	—	12,500	XF017	UL, CSA, TÜV
RXEF017-AP	—	—	2,000	10,000	XF017	UL, CSA, TÜV
RXEF 72V						
RXEF020	500	—	—	10,000	XF020	UL, CSA, TÜV
RXEF020-2	—	3,000	—	15,000	XF020	UL, CSA, TÜV
RXEF020-AP	—	—	2,000	10,000	XF020	UL, CSA, TÜV
RXEF025	500	—	—	10,000	XF025	UL, CSA, TÜV
RXEF025-2	—	3,000	—	15,000	XF025	UL, CSA, TÜV
RXEF025-AP	—	—	2,000	10,000	XF025	UL, CSA, TÜV
RXEF030	500	—	—	10,000	XF030	UL, CSA, TÜV
RXEF030-2	—	3,000	—	15,000	XF030	UL, CSA, TÜV
RXEF030-AP	—	—	2,000	10,000	XF030	UL, CSA, TÜV
RXEF040	500	—	—	10,000	XF040	UL, CSA, TÜV
RXEF040-2	—	3,000	—	15,000	XF040	UL, CSA, TÜV
RXEF040-AP	—	—	2,000	10,000	XF040	UL, CSA, TÜV
RXEF050	500	—	—	10,000	XF050	UL, CSA, TÜV
RXEF050-2	—	3,000	—	15,000	XF050	UL, CSA, TÜV
RXEF050-AP	—	—	2,000	10,000	XF050	UL, CSA, TÜV
RXEF065	500	—	—	10,000	XF065	UL, CSA, TÜV
RXEF065-2	—	3,000	—	15,000	XF065	UL, CSA, TÜV
RXEF065-AP	—	—	2,000	10,000	XF065	UL, CSA, TÜV
RXEF075	500	—	—	10,000	XF075	UL, CSA, TÜV
RXEF075-2	—	3,000	—	15,000	XF075	UL, CSA, TÜV
RXEF075-AP	—	—	2,000	10,000	XF075	UL, CSA, TÜV
RXEF090	500	—	—	10,000	XF090	UL, CSA, TÜV
RXEF090-2	—	3,000	—	15,000	XF090	UL, CSA, TÜV
RXEF090-AP	—	—	2,000	10,000	XF090	UL, CSA, TÜV
RXEF110	500	—	—	10,000	XF110	UL, CSA, TÜV
RXEF110-2	—	1,500	—	7,500	XF110	UL, CSA, TÜV
RXEF110-AP	—	—	1,000	5,000	XF110	UL, CSA, TÜV
RXEF135	500	—	—	10,000	XF135	UL, CSA, TÜV
RXEF135-2	—	1,500	—	7,500	XF135	UL, CSA, TÜV
RXEF135-AP	—	—	1,000	5,000	XF135	UL, CSA, TÜV
RXEF160	500	—	—	10,000	XF160	UL, CSA, TÜV
RXEF160-2	—	1,500	—	7,500	XF160	UL, CSA, TÜV
RXEF160-AP	—	—	1,000	5,000	XF160	UL, CSA, TÜV
RXEF185	500	—	—	10,000	XF185	UL, CSA, TÜV
RXEF185-2	—	1,500	—	7,500	XF185	UL, CSA, TÜV
RXEF185-AP	—	—	1,000	5,000	XF185	UL, CSA, TÜV

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

Part Number	Bag Quantity	Tape & Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
RXEF 72V						
RXEF250	250	—	—	5,000	XF250	UL, CSA, TÜV
RXEF250-2	—	1,000	—	5,000	XF250	UL, CSA, TÜV
RXEF250-AP	—	—	1,000	5,000	XF250	UL, CSA, TÜV
RXEF300	250	—	—	5,000	XF300	UL, CSA, TÜV
RXEF300-2	—	1,000	—	5,000	XF300	UL, CSA, TÜV
RXEF300-AP	—	—	1,000	5,000	XF300	UL, CSA, TÜV
RXEF375	250	—	—	5,000	XF375	UL, CSA, TÜV
RKEF 60V						
RKEF050	500	—	—	10,000	KF050	UL, CSA, TÜV
RKEF065	500	—	—	10,000	KF065	UL, CSA, TÜV
RKEF075	500	—	—	10,000	KF075	UL, CSA, TÜV
RKEF090	500	—	—	10,000	KF090	UL, CSA, TÜV
RKEF110	500	—	—	10,000	KF110	UL, CSA, TÜV
RKEF135	500	—	—	10,000	KF135	UL, CSA, TÜV
RKEF160	500	—	—	10,000	KF160	UL, CSA, TÜV
RKEF185	500	—	—	10,000	KF185	UL, CSA, TÜV
RKEF250	500	—	—	10,000	KF250	UL, CSA, TÜV
RKEF300	250	—	—	5,000	KF300	UL, CSA, TÜV
RKEF375	250	—	—	5,000	KF375	UL, CSA, TÜV
RKEF400	250	—	—	5,000	KF400	UL, CSA, TÜV
RKEF500	250	—	—	5,000	KF500	UL, CSA, TÜV
RTEF 33V						
RTEF120	500	—	—	10,000	TF120	UL, CSA, TÜV
RTEF120-2	—	3,000	—	15,000	TF120	UL, CSA, TÜV
RTEF120-AP	—	—	2,000	10,000	TF120	UL, CSA, TÜV
RTEF135	500	—	—	10,000	TF135	UL, CSA, TÜV
RTEF135-2	—	3,000	—	15,000	TF135	UL, CSA, TÜV
RTEF135-AP	—	—	2,000	10,000	TF135	UL, CSA, TÜV
RTEF190	500	—	—	10,000	TF190	UL, CSA, TÜV
RTEF190-2	—	3,000	—	15,000	TF190	UL, CSA, TÜV
RTEF190-AP	—	—	2,000	10,000	TF190	UL, CSA, TÜV
RUEF 30V						
RUEF090	500	—	—	10,000	UF090	UL, CSA, TÜV, CQC
RUEF090-2	—	3,000	—	15,000	UF090	UL, CSA, TÜV, CQC
RUEF090-AP	—	—	2,000	10,000	UF090	UL, CSA, TÜV, CQC
RUEF110	500	—	—	10,000	UF110	UL, CSA, TÜV, CQC
RUEF110-2	—	3,000	—	15,000	UF110	UL, CSA, TÜV, CQC
RUEF110-AP	—	—	2,000	10,000	UF110	UL, CSA, TÜV, CQC
RUEF135	500	—	—	10,000	UF135	UL, CSA, TÜV, CQC
RUEF135-2	—	3,000	—	15,000	UF135	UL, CSA, TÜV, CQC
RUEF135-AP	—	—	2,000	10,000	UF135	UL, CSA, TÜV, CQC
RUEF160	500	—	—	10,000	UF160	UL, CSA, TÜV, CQC
RUEF160-2	—	3,000	—	15,000	UF160	UL, CSA, TÜV, CQC
RUEF160-AP	—	—	2,000	10,000	UF160	UL, CSA, TÜV, CQC
RUEF185	500	—	—	10,000	UF185	UL, CSA, TÜV, CQC
RUEF185-2	—	3,000	—	15,000	UF185	UL, CSA, TÜV, CQC
RUEF185-AP	—	—	2,000	10,000	UF185	UL, CSA, TÜV, CQC
RUEF250	500	—	—	10,000	UF250	UL, CSA, TÜV, CQC
RUEF250-2	—	3,000	—	15,000	UF250	UL, CSA, TÜV, CQC
RUEF250-AP	—	—	2,000	10,000	UF250	UL, CSA, TÜV, CQC

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

Part Number	Bag Quantity	Tape & Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
RUEF 30V						
RUEF300	500	—	—	10,000	UF300	UL, CSA, TÜV, CQC
RUEF300-2	—	2,500	—	12,500	UF300	UL, CSA, TÜV, CQC
RUEF300-AP	—	—	1,000	5,000	UF300	UL, CSA, TÜV, CQC
RUEF400	500	—	—	10,000	UF400	UL, CSA, TÜV, CQC
RUEF400-2	—	1,500	—	7,500	UF400	UL, CSA, TÜV, CQC
RUEF400-AP	—	—	1,000	5,000	UF400	UL, CSA, TÜV, CQC
RUEF500	250	—	—	5,000	UF500	UL, CSA, TÜV, CQC
RUEF500-2	—	1,500	—	7,500	UF500	UL, CSA, TÜV, CQC
RUEF500-AP	—	—	1,000	5,000	UF500	UL, CSA, TÜV, CQC
RUEF600	250	—	—	5,000	UF600	UL, CSA, TÜV, CQC
RUEF600-2	—	1,000	—	5,000	UF600	UL, CSA, TÜV, CQC
RUEF600-AP	—	—	1,000	5,000	UF600	UL, CSA, TÜV, CQC
RUEF700	250	—	—	5,000	UF700	UL, CSA, TÜV, CQC
RUEF700-2	—	1,000	—	5,000	UF700	UL, CSA, TÜV, CQC
RUEF700-AP	—	—	1,000	5,000	UF700	UL, CSA, TÜV, CQC
RUEF800	250	—	—	5,000	UF800	UL, CSA, TÜV, CQC
RUEF800-2	—	1,000	—	5,000	UF800	UL, CSA, TÜV, CQC
RUEF800-AP	—	—	1,000	5,000	UF800	UL, CSA, TÜV, CQC
RUEF900	250	—	—	5,000	UF900	UL, CSA, TÜV, CQC
RUEF900-2	—	1,000	—	4,000	UF900	UL, CSA, TÜV, CQC
RUEF900-AP	—	—	1,000	4,000	UF900	UL, CSA, TÜV, CQC
RHEF 30V - High Temperature						
RHEF050	500	—	—	10,000	HF0.5	UL, CSA, TÜV
RHEF050-2	—	2,500	—	12,500	HF0.7	UL, CSA, TÜV
RHEF070	500	—	—	10,000	HF0.7	UL, CSA, TÜV
RHEF070-2	—	2,500	—	12,500	HF0.7	UL, CSA, TÜV
RHEF100	500	—	—	10,000	HF1.0	UL, CSA, TÜV
RHEF100-2	—	2,500	—	12,500	HF1.0	UL, CSA, TÜV
RUSBF 16V						
RUSBF090	500	—	—	10,000	RF090	UL, CSA, TÜV
RUSBF090-2	—	3,000	—	15,000	RF090	UL, CSA, TÜV
RUSBF090-AP	—	—	2,000	10,000	RF090	UL, CSA, TÜV
RUSBF110	500	—	—	10,000	RF110	UL, CSA, TÜV
RUSBF110-2	—	3,000	—	15,000	RF110	UL, CSA, TÜV
RUSBF110-AP	—	—	2,000	10,000	RF110	UL, CSA, TÜV
RUSBF135	500	—	—	10,000	RF135	UL, CSA, TÜV
RUSBF135-2	—	3,000	—	15,000	RF135	UL, CSA, TÜV
RUSBF135-AP	—	—	2,000	10,000	RF135	UL, CSA, TÜV
RUSBF160	500	—	—	10,000	RF160	UL, CSA, TÜV
RUSBF160-2	—	3,000	—	15,000	RF160	UL, CSA, TÜV
RUSBF160-AP	—	—	2,000	10,000	RF160	UL, CSA, TÜV
RUSBF185	500	—	—	10,000	RF185	UL, CSA, TÜV
RUSBF185-2	—	3,000	—	15,000	RF185	UL, CSA, TÜV
RUSBF185-AP	—	—	2,000	10,000	RF185	UL, CSA, TÜV
RUSBF250	500	—	—	10,000	RF250	UL, CSA, TÜV
RUSBF250-2	—	3,000	—	15,000	RF250	UL, CSA, TÜV
RUSBF250-AP	—	—	2,000	10,000	RF250	UL, CSA, TÜV
RGEF 16V						
RGEF250	500	—	—	10,000	GF250	UL, CSA, TÜV
RGEF250-2	—	3,000	—	15,000	GF250	UL, CSA, TÜV
RGEF250-AP	—	—	2,000	10,000	GF250	UL, CSA, TÜV

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

Part Number	Bag Quantity	Tape & Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
RGEF 16V						
RGEF300	500	—	—	10,000	GF300	UL, CSA, TÜV
RGEF300-2	—	2,500	—	12,500	GF300	UL, CSA, TÜV
RGEF300-AP	—	—	2,000	10,000	GF300	UL, CSA, TÜV
RGEF400	500	—	—	10,000	GF400	UL, CSA, TÜV
RGEF400-2	—	2,500	—	12,500	GF400	UL, CSA, TÜV
RGEF400-AP	—	—	2,000	10,000	GF400	UL, CSA, TÜV
RGEF500	500	—	—	10,000	GF500	UL, CSA, TÜV
RGEF500-2	—	2,000	—	10,000	GF500	UL, CSA, TÜV
RGEF500-AP	—	—	2,000	10,000	GF500	UL, CSA, TÜV
RGEF600	500	—	—	10,000	GF600	UL, CSA, TÜV
RGEF600-2	—	2,000	—	10,000	GF600	UL, CSA, TÜV
RGEF600-AP	—	—	2,000	10,000	GF600	UL, CSA, TÜV
RGEF700	500	—	—	10,000	GF700	UL, CSA, TÜV
RGEF700-2	—	1,500	—	7,500	GF700	UL, CSA, TÜV
RGEF700-AP	—	—	1,500	7,500	GF700	UL, CSA, TÜV
RGEF800	500	—	—	10,000	GF800	UL, CSA, TÜV
RGEF800-2	—	1,000	—	5,000	GF800	UL, CSA, TÜV
RGEF800-AP	—	—	1,000	5,000	GF800	UL, CSA, TÜV
RGEF900	500	—	—	10,000	GF900	UL, CSA, TÜV
RGEF900-2	—	1,000	—	5,000	GF900	UL, CSA, TÜV
RGEF900-AP	—	—	1,000	5,000	GF900	UL, CSA, TÜV
RGEF1000	250	—	—	5,000	GF1000	UL, CSA, TÜV
RGEF1000-2	—	1,000	—	5,000	GF1000	UL, CSA, TÜV
RGEF1000-AP	—	—	1,000	5,000	GF1000	UL, CSA, TÜV
RGEF1100	250	—	—	5,000	GF1100	UL, CSA, TÜV
RGEF1100-2	—	1,000	—	5,000	GF1100	UL, CSA, TÜV
RGEF1100-AP	—	—	1,000	5,000	GF1100	UL, CSA, TÜV
RGEF1200	250	—	—	5,000	GF1200	UL, CSA, TÜV
RGEF1200-2	—	1,000	—	5,000	GF1200	UL, CSA, TÜV
RGEF1200-AP	—	—	1,000	5,000	GF1200	UL, CSA, TÜV
RGEF1400	250	—	—	5,000	GF1400	UL, CSA, TÜV
RGEF1400-2	—	1,000	—	5,000	GF1400	UL, CSA, TÜV
RGEF1400-AP	—	—	1,000	5,000	GF1400	UL, CSA, TÜV
RHEF 16V - High Temperature						
RHEF200	500	—	—	10,000	HF2.0	UL, CSA, TÜV
RHEF200-2	—	2,500	—	12,500	HF2.0	UL, CSA, TÜV
RHEF200-AP	—	—	2,500	12,500	HF2.0	UL, CSA, TÜV
RHEF300	500	—	—	10,000	HF3	UL, CSA, TÜV
RHEF300-2	—	2,000	—	10,000	HF3	UL, CSA, TÜV
RHEF300-AP	—	—	2,000	10,000	HF3	UL, CSA, TÜV
RHEF400	500	—	—	10,000	HF4	UL, CSA, TÜV
RHEF400-2	—	1,500	—	7,500	HF4	UL, CSA, TÜV
RHEF400-AP	—	—	1,500	7,500	HF4	UL, CSA, TÜV
RHEF450	500	—	—	10,000	HF4.5	UL, CSA, TÜV
RHEF450-2	—	1,500	—	7,500	HF4.5	UL, CSA, TÜV
RHEF450-AP	—	—	1,500	7,500	HF4.5	UL, CSA, TÜV
RHEF550	500	—	—	10,000	HF5.5	UL, CSA, TÜV
RHEF550-2	—	2,000	—	10,000	HF5.5	UL, CSA, TÜV
RHEF550-AP	—	—	2,000	10,000	HF5.5	UL, CSA, TÜV
RHEF600	500	—	—	10,000	HF6	UL, CSA, TÜV
RHEF600-2	—	1,500	—	7,500	HF6	UL, CSA, TÜV
RHEF600-AP	—	—	1,500	7,500	HF6	UL, CSA, TÜV

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

Part Number	Bag Quantity	Tape & Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
RHEF 16V - High Temperature						
RHEF650	500	—	—	10,000	HF6.5	UL, CSA, TÜV
RHEF650-2	—	1,500	—	7,500	HF6.5	UL, CSA, TÜV
RHEF650-AP	—	—	1,500	7,500	HF6.5	UL, CSA, TÜV
RHEF700	500	—	—	10,000	HF7	UL, CSA, TÜV
RHEF700-2	—	1,500	—	7,500	HF7	UL, CSA, TÜV
RHEF700-AP	—	—	1,500	7,500	HF7	UL, CSA, TÜV
RHEF750	500	—	—	10,000	HF7.5	UL, CSA, TÜV
RHEF750-2	—	1,000	—	5,000	HF7.5	UL, CSA, TÜV
RHEF750-AP	—	—	1,000	5,000	HF7.5	UL, CSA, TÜV
RHEF800	500	—	—	10,000	HF8	UL, CSA, TÜV
RHEF800-2	—	1,000	—	5,000	HF8	UL, CSA, TÜV
RHEF800-AP	—	—	1,000	5,000	HF8	UL, CSA, TÜV
RHEF900	250	—	—	5,000	HF9	UL, CSA, TÜV
RHEF900-2	—	1,000	—	5,000	HF9	UL, CSA, TÜV
RHEF900-AP	—	—	1,000	5,000	HF9	UL, CSA, TÜV
RHEF1000	250	—	—	5,000	HF10	UL, CSA, TÜV
RHEF1000-2	—	1,000	—	5,000	HF10	UL, CSA, TÜV
RHEF1000-AP	—	—	1,000	5,000	HF10	UL, CSA, TÜV
RHEF1100	250	—	—	5,000	HF11	UL, CSA, TÜV
RHEF1100-2	—	1,000	—	5,000	HF11	UL, CSA, TÜV
RHEF1100-AP	—	—	1,000	5,000	HF11	UL, CSA, TÜV
RHEF1300	250	—	—	5,000	HF13	UL, CSA, TÜV
RHEF1300-2	—	1,000	—	5,000	HF13	UL, CSA, TÜV
RHEF1300-AP	—	—	1,000	5,000	HF13	UL, CSA, TÜV
RHEF1400	250	—	—	5,000	HF14	UL, CSA, TÜV
RHEF1400-2	—	1,000	—	5,000	HF14	UL, CSA, TÜV
RHEF1400-AP	—	—	1,000	5,000	HF14	UL, CSA, TÜV
RHEF1500	250	—	—	5,000	HF15	UL, CSA, TÜV
RHEF1500-2	—	1,000	—	5,000	HF15	UL, CSA, TÜV
RHEF1500-AP	—	—	1,000	5,000	HF15	UL, CSA, TÜV
RUSBF 6V						
RUSBF075	500	—	—	10,000	RF075	UL, CSA, TÜV
RUSBF075-2	—	3,000	—	15,000	RF075	UL, CSA, TÜV
RUSBF075-AP	—	—	2,000	10,000	RF075	UL, CSA, TÜV
RUSBF120	500	—	—	10,000	RF120	UL, CSA, TÜV
RUSBF120-2	—	3,000	—	15,000	RF120	UL, CSA, TÜV
RUSBF120-AP	—	—	2,000	10,000	RF120	UL, CSA, TÜV
RUSBF155	500	—	—	10,000	RF155	UL, CSA, TÜV
RUSBF155-2	—	3,000	—	15,000	RF155	UL, CSA, TÜV
RUSBF155-AP	—	—	2,000	10,000	RF155	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, BBRF 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, BBRF550, RKEF050 to RKEF110)	H_0	16.0	± 0.5
Abscissa to top (RXEF010 to RXEF090, BBRF550, 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, BBRF550, 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, BBRF550, 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	l_2	Not specified	—
Sprocket hole pitch	P_0	12.7	± 0.3
Device pitch (RXEF010 to RXEF090, BBRF550, 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, BBRF550, 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, BBRF550, 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, BBRF550, 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.

Table R7 Tape and Reel Specifications for Radial-leaded Devices Cont'd

RUEF, RTEF and RUSBF 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)* (RUEF300 to RUEF900)	H	18.5	± 2.5
Abscissa to plane (kinked lead) (RUSBF075 to RUSBF250, RUEF090 to RUEF250, RTEF120 to RTEF190)	H_0	16.0	± 0.5
Abscissa to top (RUSBF075 to RUSBF250, RUEF090 to RUEF300, RTEF120 to RTEF190)	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, RTEF120 to RTEF190)	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, RTEF120 to RTEF190)	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	l_2	Not specified	—
Sprocket hole pitch	P_0	12.7	± 0.3
Device pitch (RUSBF075 to RUSBF250, RUEF090 to RUEF300, RTEF120 to RTEF190)	—	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 RUEF250, RTEF120 to RTEF190)	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, RTEF120 to RTEF190)	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, RTEF120 to RTEF190)	F	5.05	± 0.75
Lead spacing* (RUEF500 to RUEF900)	F	10.15	± 0.75
Reel width (RUEF090 to RUEF400, RUSBF075 to RUSBF250, RTEF120 to RTEF190)	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, RTEF120 to RTEF190)	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 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) (RGEF250 to RGEF1400)	H	18.5	± 2.5
Abscissa to plane (kinked lead) (RHEF050 to RHEF1500)	H_0	16.0	± 0.5
Abscissa to top (RGEF250 to RGEF500, RHEF050 to RHEF450)	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	l_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* (RGEF600 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* (RGEF600 to RGEF1400, 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 R22 EIA Referenced Taped Component Dimensions for Radial-leaded Devices

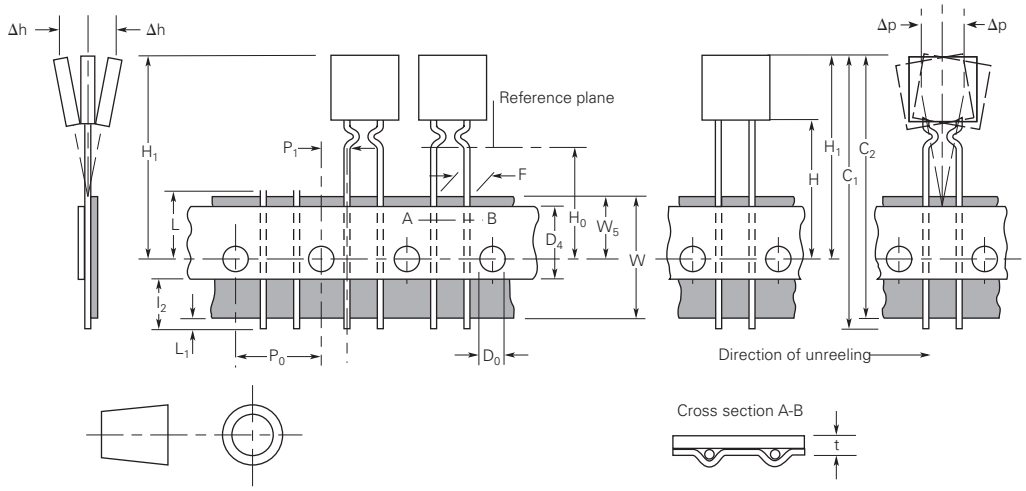
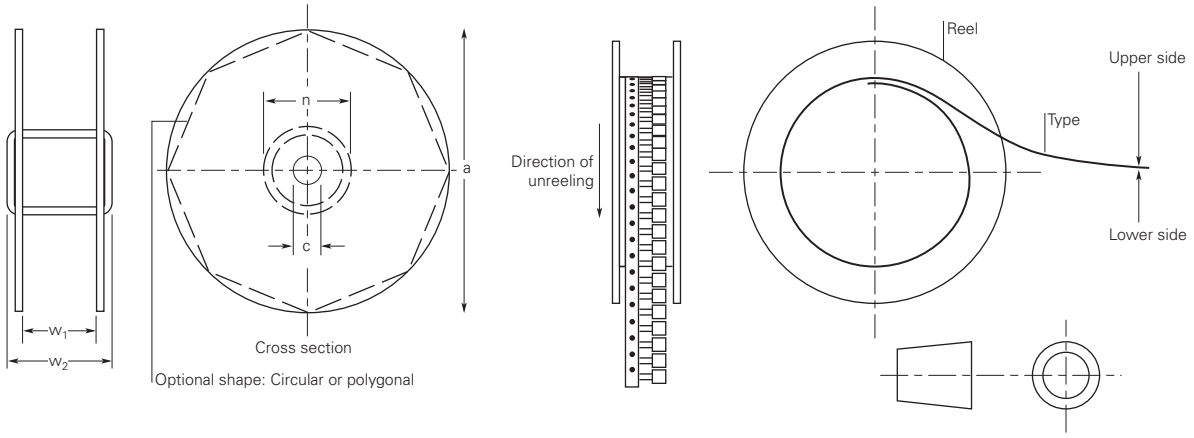


Figure R23 EIA Referenced Reel Dimensions for Radial-leaded Devices



Part Numbering System for Radial-leaded Devices

RUEF 250 U 2

Packaging
Blank = Packaged in bags
-1 = 25.4mm (1.0 inch) minimum lead length
-2 = Tape and reel
-AP = Ammo pack
-X.X = Special lead cut length (inch)

Modifier
K = Standard kinked lead
B = Special kinked lead
S = Straight lead
U = Uncoated device

Hold Current Indicator

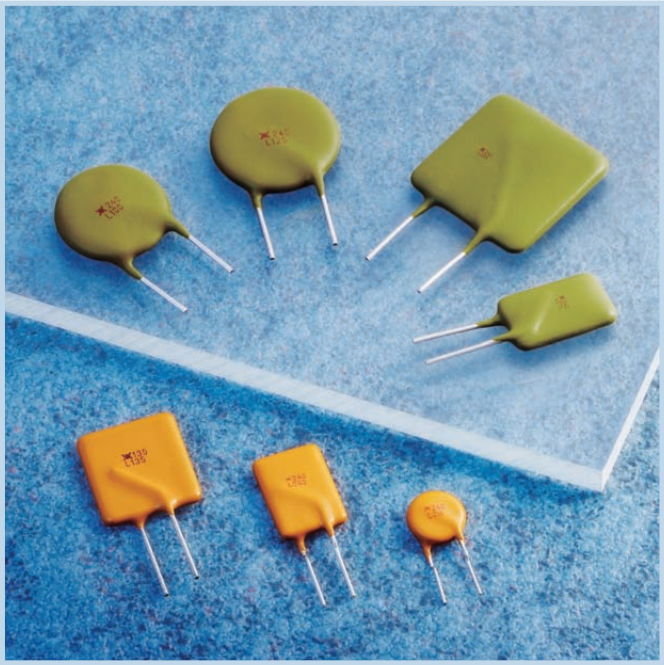
Product Series
An "F" at the end of product series indicates Pb-free version of product.

Note: Kinked part is recommended to well control the height of part on the PCB in non-auto PCB application.

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
Line-Voltage-Rated Devices



PolySwitch 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, 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/LVRL 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

- Many product choices give engineers more 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 ballast
- 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

Table L1 Product Series - Current Rating, Voltage Rating / Typical Resistance for LVR Devices

Voltage Rating	LVR 240V$_{AC}$ / 120V$_{AC}$	LVRL 120V$_{AC}$
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	0.325Ω
1.000	0.276Ω	0.224Ω
1.250	0.209Ω	0.148Ω
1.350	—	0.138Ω
2.000	0.110Ω	0.097Ω

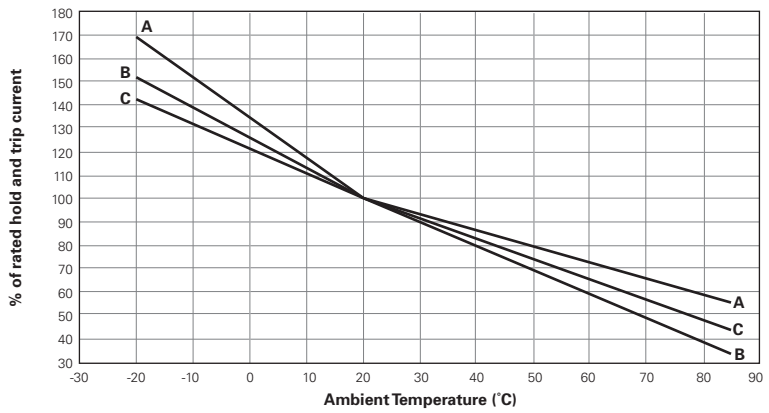
Table L2 Thermal Derating for LVR Devices [Hold Current (A) at Ambient Temperature (°C)]

	Maximum Ambient Temperature								
Part Number	**-20°C**	**0°C**	**20°C**	**25°C**	**40°C**	**50°C**	**60°C**	**70°C**	**85°C**
LVR/LVRL									
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
LVRL075	1.08	0.93	0.75	0.74	0.64	0.57	0.51	0.44	0.35
LVRL100	1.40	1.19	1.00	0.94	0.82	0.73	0.65	0.57	0.45
LVRL125	1.80	1.53	1.25	1.20	1.04	0.94	0.83	0.73	0.60
LVRL135	2.00	1.65	1.35	1.29	1.12	1.01	0.90	0.78	0.65
LVRL200	3.05	2.55	2.00	1.97	1.72	1.55	1.39	1.22	0.98

Figure L1 Thermal Derating Curve for LVR Devices

A = LVR075-LVR200
B = LVRL075-LVRL200
C = LVR005N-LVR055

Figure L1



RoHS Compliant, ELV Compliant

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/LVRL												
LVR005NK	0.05	0.12	240	265	1.0	0.9	0.25	10.0	18.500	31.000	65.000	[0.51mm(24)]
			120	135	20.0							
LVR005NS	0.05	0.12	240	265	1.0	0.9	0.25	10.0	18.500	31.000	65.000	[0.51mm(24)]
			120	135	20.0							
LVR008NK	0.08	0.19	240	265	1.2	0.9	0.40	10.0	7.400	12.000	26.000	[0.51mm(24)]
			120	135	20.0							
LVR008NS	0.08	0.19	240	265	1.2	0.9	0.40	10.0	7.400	12.000	26.000	[0.51mm(24)]
			120	135	20.0							
LVR012K	0.12	0.30	240	265	1.2	1.0	0.60	15.0	3.000	6.500	12.000	[0.51mm(24)]
			120	135	20.0							
LVR012S	0.12	0.30	240	265	1.2	1.0	0.60	15.0	3.000	6.500	12.000	[0.51mm(24)]
			120	135	20.0							
LVR016K	0.16	0.37	240	265	2.0	1.4	0.80	15.0	2.500	4.100	7.800	[0.51mm(24)]
			120	135	20.0							
LVR016S	0.16	0.37	240	265	2.0	1.4	0.80	15.0	2.500	4.100	7.800	[0.51mm(24)]
			120	135	20.0							
LVR025K	0.25	0.56	240	265	3.5	1.5	1.25	18.5	1.300	2.100	3.800	[0.64mm(22)]
			120	135	20.0							
LVR025S	0.25	0.56	240	265	3.5	1.5	1.25	18.5	1.300	2.100	3.800	[0.64mm(22)]
			120	135	20.0							
LVR033K	0.33	0.74	240	265	4.5	1.7	1.65	21.0	0.770	1.240	2.600	[0.64mm(22)]
			120	135	20.0							
LVR033S	0.33	0.74	240	265	4.5	1.7	1.65	21.0	0.770	1.240	2.600	[0.64mm(22)]
			120	135	20.0							
LVR040K	0.40	0.90	240	265	5.5	2.0	2.00	24.0	0.600	0.970	1.900	[0.64mm(22)]
			120	135	20.0							
LVR040S	0.40	0.90	240	265	5.5	2.0	2.00	24.0	0.600	0.970	1.900	[0.64mm(22)]
			120	135	20.0							
LVR055K	0.55	1.25	240	265	7.0	3.4	2.75	26.0	0.450	0.730	1.450	[0.81mm(20)]
			120	135	20.0							
LVR055S	0.55	1.25	240	265	7.0	3.4	2.75	26.0	0.450	0.730	1.450	[0.81mm(20)]
			120	135	20.0							
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)]
LVRL075S	0.75	1.52	120	135	7.5	1.8	3.75	14.0	0.250	0.400	0.690	[0.81mm(20)]
LVRL100S	1.00	2.00	120	135	10.0	2.2	5.00	13.6	0.179	0.269	0.470	[0.81mm(20)]
LVRL125S	1.25	2.50	120	135	12.5	2.0	6.25	18.0	0.117	0.179	0.320	[0.81mm(20)]
LVRL135S	1.35	2.70	120	135	13.5	2.8	6.75	20.0	0.109	0.167	0.300	[0.81mm(20)]
LVRL200S	2.00	4.20	120	135	20.0	3.9	10.00	36.0	0.075	0.117	0.205	[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.

Warning : Application Limitations for the LVR Product Line

1) Users should independently evaluate the suitability of and test each product selected for their own application.
2) 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.
3) 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.
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) 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.
6) 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.
7) 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.
8) Devices are not recommended for reflow soldering.
9) Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, or mechanical procedures for electronic components.
10) 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.
11) Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.

Figure L2-L5 Dimension Figures for LVR Devices

Figure L2

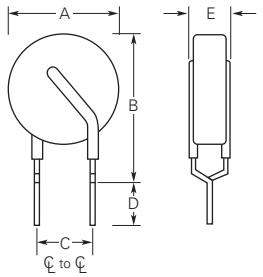


Figure L3

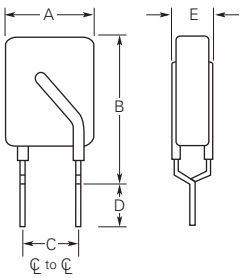


Figure L4

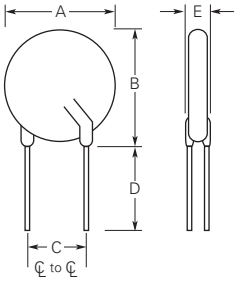


Figure L5

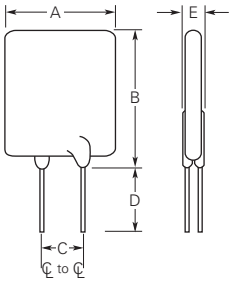


Table L4 Dimensions for LVR Devices in Millimeters (Inches)

Part Number	A Min.	A Max.	B Min.	B Max.	C Min.	C Max.	D Min.	D Max.	E Min.	E Max.	Figure
LVR/LVRL											
LVR005NK	—	6.9 (0.27)	—	12.1 (0.48)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.6 (0.18)	L2
LVR005NS	—	6.9 (0.27)	—	9.9 (0.39)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.6 (0.18)	L4
LVR008NK	—	7.2 (0.28)	—	12.4 (0.49)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.6 (0.18)	L2
LVR008NS	—	7.2 (0.28)	—	10.2 (0.40)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.6 (0.18)	L4
LVR012K	—	8.3 (0.33)	—	12.9 (0.51)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L2
LVR012S	—	8.3 (0.33)	—	10.7 (0.43)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L4
LVR016K	—	9.9 (0.39)	—	13.8 (0.54)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L2
LVR016S	—	9.9 (0.39)	—	12.5 (0.50)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L4
LVR025K	—	9.6 (0.38)	—	18.8 (0.74)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L3
LVR025S	—	9.6 (0.38)	—	17.4 (0.69)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L5
LVR033K	—	11.4 (0.45)	—	19.0 (0.75)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L3
LVR033S	—	11.4 (0.45)	—	16.5 (0.65)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L5
LVR040K	—	11.5 (0.46)	—	20.9 (0.82)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L3
LVR040S	—	11.5 (0.46)	—	19.5 (0.77)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	3.8 (0.15)	L5
LVR055K	—	14.0 (0.55)	—	22.4 (0.88)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.1 (0.16)	L3
LVR055S	—	14.0 (0.55)	—	21.7 (0.85)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.1 (0.16)	L5
LVR075S	—	11.5 (0.45)	—	23.4 (0.92)	4.1 (0.16)	6.1 (0.24)	5.1 (0.20)	—	—	4.8 (0.19)	L5
LVR100S	—	18.7 (0.74)	—	24.4 (0.96)	8.9 (0.35)	11.4 (0.45)	5.1 (0.20)	—	—	5.1 (0.20)	L4
LVR125S	—	21.2 (0.84)	—	27.4 (1.08)	8.9 (0.35)	11.4 (0.45)	5.1 (0.20)	—	—	5.3 (0.21)	L4
LVR200S	—	24.9 (0.98)	—	33.8 (1.33)	8.9 (0.35)	11.4 (0.45)	5.1 (0.20)	—	—	6.1 (0.24)	L5
LVRL075S	—	10.9 (0.43)	—	17.0 (0.67)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.1 (0.16)	L5
LVRL100S	—	11.5 (0.45)	—	20.1 (0.79)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.1 (0.16)	L5
LVRL125S	—	14.0 (0.55)	—	21.7 (0.85)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.1 (0.16)	L5
LVRL135S	—	16.3 (0.64)	—	21.7 (0.85)	4.3 (0.17)	5.8 (0.23)	7.6 (0.30)	—	—	4.1 (0.16)	L5
LVRL200S	—	23.5 (0.93)	—	31.8 (1.25)	9.4 (0.37)	10.9 (0.43)	7.6 (0.30)	—	—	4.1 (0.16)	L5

Figure L6 Typical Time-to-trip curves at 20°C for LVR Devices

LVR/LVRL

A	=	LVR005N	K	=	LVRL100
B	=	LVR008N	L	=	LVR100
C	=	LVR012	M	=	LVRL125
D	=	LVR016	N	=	LVR125
E	=	LVR025	O	=	LVRL135
F	=	LVR033	P	=	LVRL200
G	=	LVR040	Q	=	LVR200
H	=	LVR055			
I	=	LVRL075			
J	=	LVR075			

Figure L6

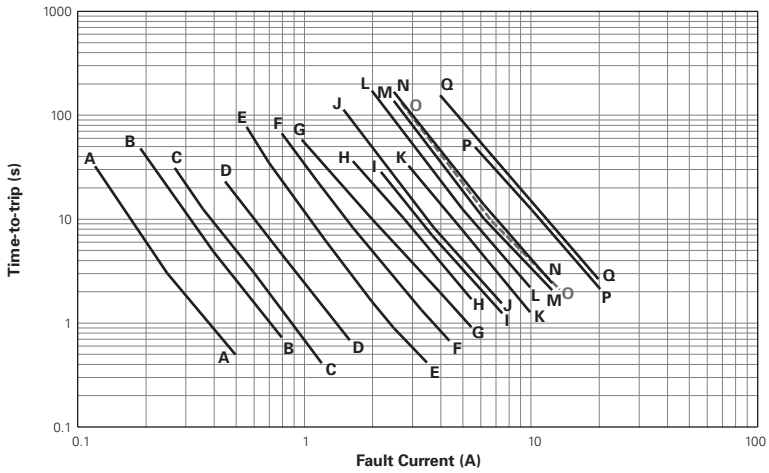


Table L5 Physical Characteristics and Environmental Specifications for LVR Devices

LVR/LVRL
Physical Characteristics

Lead material	LVR005N-016	: Tin-plated copper, (24AWG), ø0.51mm (0.020in.)
	LVR025-040	: Tin-plated copper, (22AWG), ø0.64mm (0.025in.)
	LVR055-200	: Tin-plated copper, (20AWG), ø0.81mm (0.032in.)
	LVRL	: 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 seconds at 260°C ±5°C	
Insulating material	LVR005N-055	: Cured, flame-retardant epoxy polymer, meets UL 94V-0
	LVR075-200	: Cured, flame-retardant modified silicone, meets UL 94V-0
	LVRL	: Cured, flame-retardant epoxy polymer, meets UL 94V-0

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

Environmental Specifications

Test	Conditions	Resistance Change
Passive aging	70°C, 1000 hours	±10%
	85°C, 1000 hours	±10%
Humidity aging	85°C, 85%RH, 1000 hours	±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 & Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
LVR/LVRL						
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
LVRL075S	500	—	—	10,000	L075	UL,CSA, TÜV
LVRL100S	500	—	—	10,000	L100	UL,CSA, TÜV
LVRL125S	500	—	—	10,000	L125	UL,CSA, TÜV
LVRL135S	500	—	—	10,000	L135	UL,CSA, TÜV
LVRL200S	250	—	—	5,000	L200	UL,CSA, TÜV

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 L7 and L8 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 LVR016)	H	18.5	± 2.5
Abscissa to plane (kinked lead) (LVR005N to LVR016)	H_0	16.0	± 0.5
Abscissa to top (LVR005N to LVR016)	H_1	32.2	Maximum
Abscissa to top* (LVR025 to LVR055)	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 LVR055)	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 LVR055)	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	l_2	Not specified	—
Sprocket hole pitch	P_0	12.7	± 0.3
Device pitch (LVR005N to LVR040)	—	12.7	± 0.3
Device pitch (LVR055)	—	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)	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)	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)	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 L7 EIA Referenced Taped Component Dimensions for LVR Devices

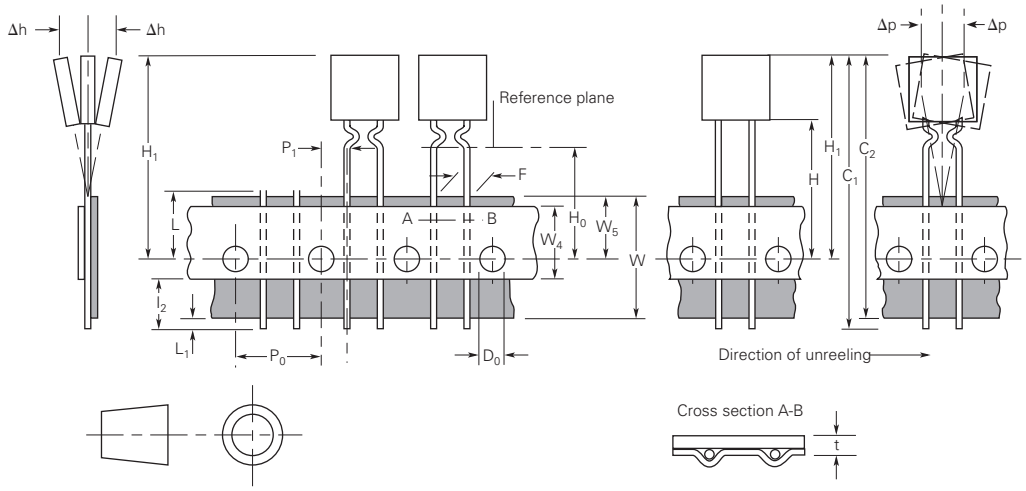
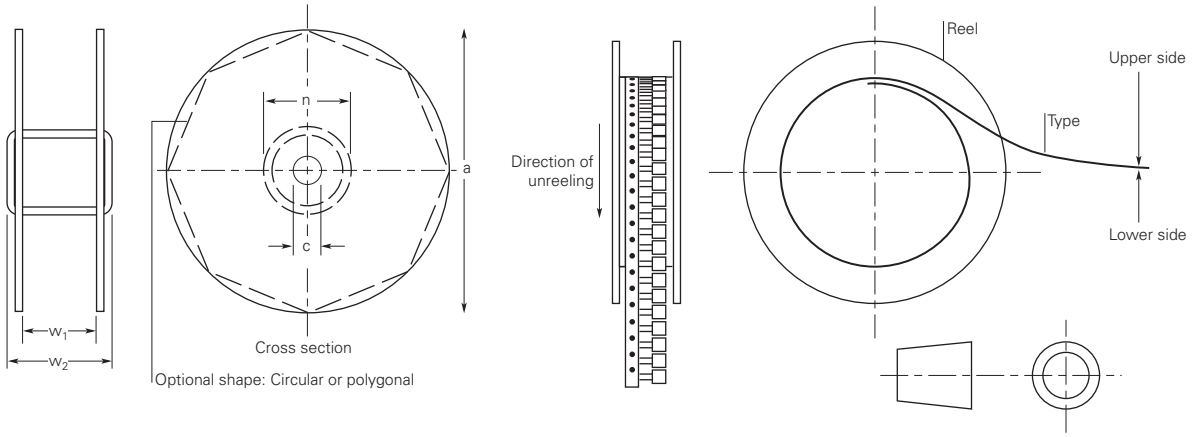


Figure L8 EIA Referenced Reel Dimensions for LVR Devices



Part Numbering System for LVR Devices

LVR 075 S 2

Packaging
Blank = Packaged in bags
-1 = 25.4mm (1.0 inch) minimum lead length
-2 = Tape and reel
-X.X = Special lead cut length (inch)

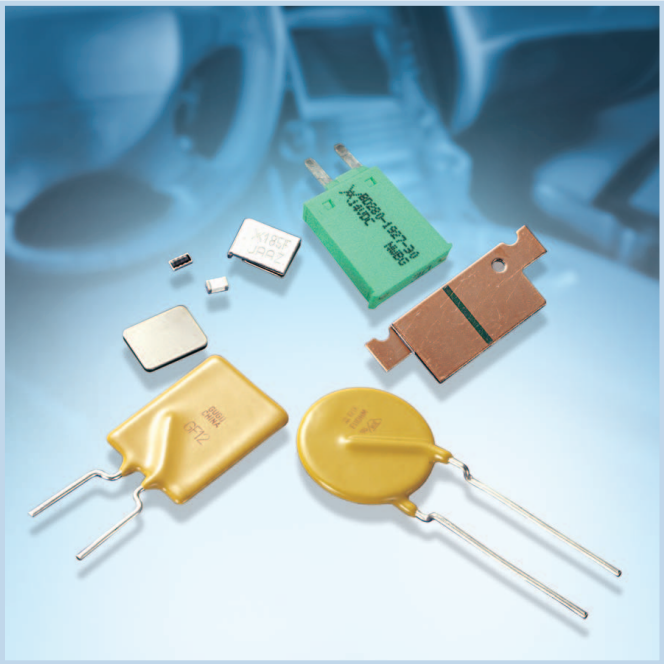
Modifier
K = Standard kinked lead
S = Straight lead

Hold Current Indicator

Product Series
LVR = 240V rated
LVRL = 120V rated

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, we developed automotive specific versions of our PolySwitch PPTC devices (AHS, ASMD, AHRF, AHEF, AGRF and BD). These products are qualified and sold under 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 followed according to a series of rigorous tests related to the automotive environment. As a result, they are characterized by specific additional values determined post 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 busses
- Air-flow detection and overcurrent protection in HVAC and cooling fan systems
- Stall detection in express window and sunroof circuits
- Power distribution, electrical centers and junction box resettable overcurrent protection
- 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 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	—	—	—	—	0.25Ω	—	—	—	—
1.00	—	—	0.225Ω	0.2250Ω	—	—	0.30Ω	—	—
1.25	—	—	—	—	—	0.16Ω	—	—	—
1.50	—	—	—	—	—	0.14Ω	—	—	—
1.60	—	—	—	—	0.10Ω	—	—	—	—
2.00	—	0.0565Ω	—	—	0.07Ω	0.09Ω	—	—	—
2.50	—	—	—	—	—	0.06Ω	—	—	—
3.00	—	0.0410Ω	—	0.0520Ω	0.05Ω	—	—	—	—
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	—	—	—	—	—	—	0.0115Ω
9.00	0.0070Ω	0.0100Ω	—	—	—	—	—	—	—
10.00	0.0056Ω	0.0083Ω	—	0.0083Ω	—	—	—	—	—
11.00	0.0050Ω	0.0069Ω	—	—	—	—	—	—	—
12.00	0.0046Ω	—	—	—	—	—	—	—	0.0060Ω
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

Table A2 Thermal Derating for 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	—

Table A2 Thermal Derating for Automotive Devices [Hold Current (A) at Ambient Temperature (°C)]

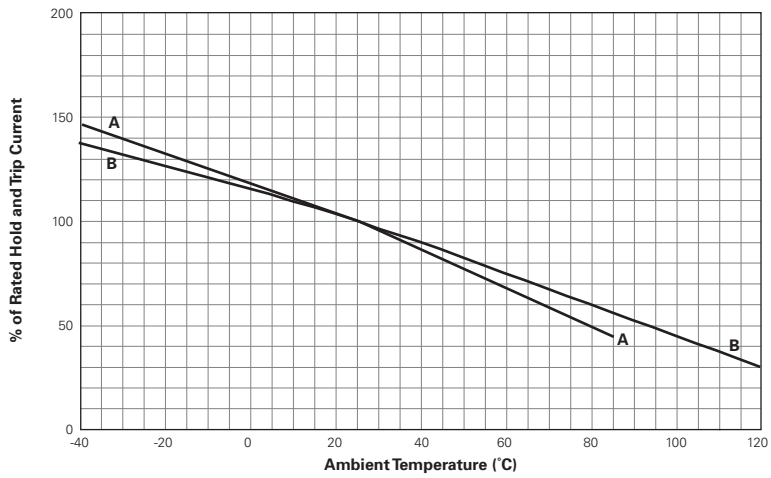
Cont'd

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
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	2.00	1.8	1.6	1.5	1.3	1.1	0.5
AHRF300	4.1	3.7	3.4	3.1	3.00	2.7	2.4	2.2	2.0	1.7	0.7
AHRF400	5.6	5.1	4.7	4.2	4.00	3.6	3.3	3.0	2.7	2.3	1.0
AHRF450	6.1	5.6	5.1	4.6	4.50	4.0	3.6	3.3	3.0	2.5	1.1
AHRF550	7.5	6.9	6.2	5.7	5.50	4.9	4.4	4.0	3.7	3.1	1.4
AHRF600	8.2	7.5	6.8	6.2	6.00	5.3	4.9	4.4	4.0	3.3	1.5
AHRF650	8.8	8.1	7.4	6.7	6.50	5.7	5.3	4.8	4.3	3.6	1.6
AHRF700	9.5	8.7	8.0	7.2	7.00	6.2	5.6	5.2	4.7	3.9	1.7
AHRF750	10.2	9.4	8.6	7.7	7.50	6.6	6.1	5.6	5.0	4.1	1.9
AHRF800	10.9	10.0	9.1	8.2	8.00	7.1	6.4	5.9	5.3	4.4	2.0
AHRF900	12.2	11.2	10.2	9.3	9.00	8.0	7.2	6.6	6.0	5.0	2.2
AHRF1000	13.6	12.5	11.4	10.3	10.00	8.8	8.1	7.4	6.6	5.5	2.5
AHRF1100	14.9	13.7	12.5	11.3	11.00	9.7	8.8	8.1	7.3	6.1	2.7
AHRF1300	17.7	16.3	14.8	13.4	13.00	11.4	10.5	9.6	8.6	7.2	3.3
AHRF1400	19.0	17.5	15.9	14.4	14.00	12.4	11.2	10.3	9.3	7.8	3.5
AHRF1500	20.4	18.8	17.1	15.5	15.00	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	0.80	0.77	0.68	0.62	0.60	0.53	0.46	0.26
AHS160	2.15	1.96	1.78	1.60	1.55	1.42	1.33	1.24	1.15	1.01	0.64
AHS200	2.90	2.50	2.20	2.00	1.94	1.80	1.75	1.70	1.40	1.18	0.67
AHS300	4.20	3.80	3.70	3.00	2.92	2.63	2.44	2.10	2.00	1.76	1.00
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	—
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	—
BD 14V— Bladed Device											
NEW BD280-1130-10/16	12.4	11.0	9.7	8.3	8.0	7.0	6.3	5.6	5.0	4.0	—
NEW BD280-1130-15/16	17.4	15.7	14.1	12.4	12.0	10.8	9.9	9.1	8.3	7.0	—
NEW BD280-1130-20/16	24.0	21.6	19.1	16.6	16.0	14.1	12.9	11.7	10.4	8.6	—
NEW 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	—
NEW 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	—

Figure A1-A4 Thermal Derating Curves for Automotive Devices

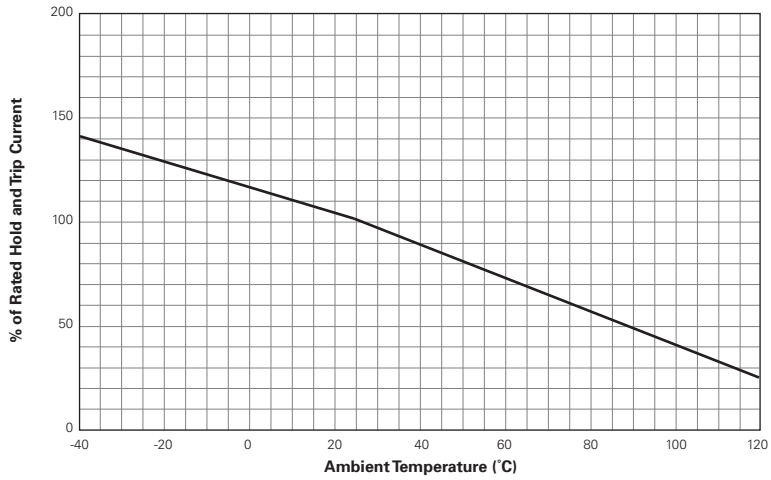
A = AGRF
B = AHRF

Figure A1



AHEF

Figure A2



A = ASMD
B = AHS

Figure A3

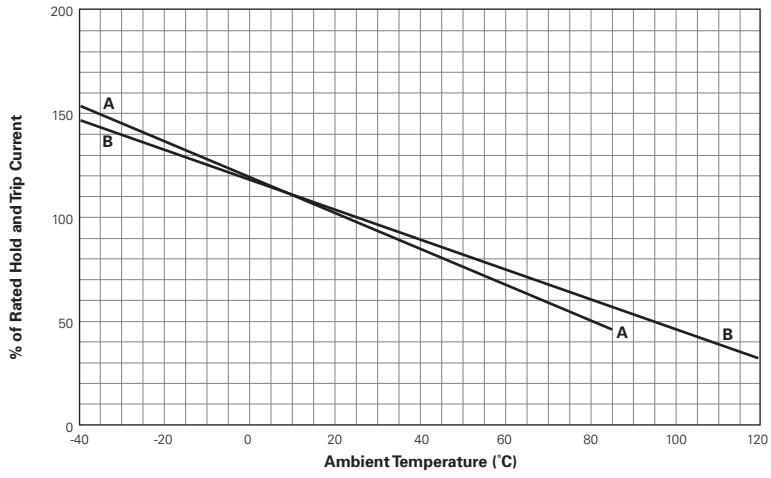


Figure A1-A4 Thermal Derating Curves for Automotive Devices Cont'd

BD

Figure A4

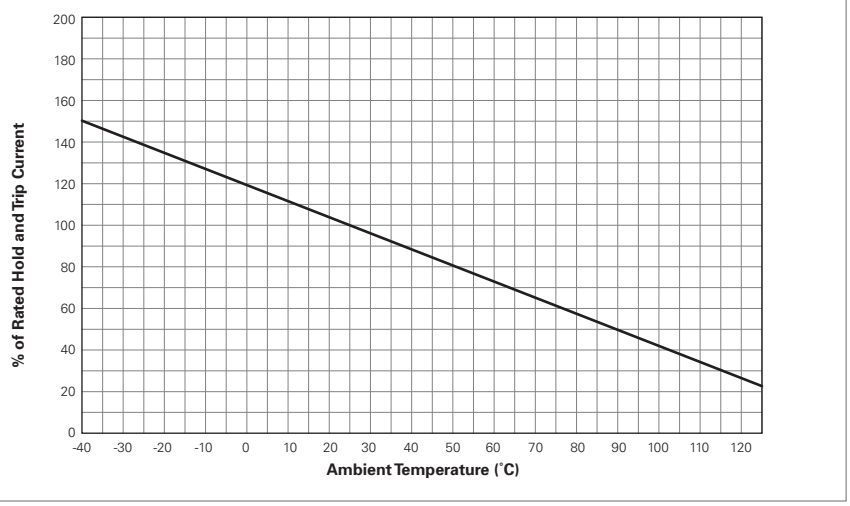


Table A3 Electrical Characteristics for Automotive Devices

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, A10
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	0.110	0.110	A8, A9, A10
AHRF300	3.0	3.0	6.5	16	100	3.0	15.0	5.0	0.0290	0.079	0.079	A5, A8, A9
AHRF400	4.0	4.0	7.4	16	100	3.3	20.0	5.0	0.0210	0.060	0.060	A5, A8, A9
AHRF450	4.5	4.5	8.7	16	100	3.6	22.5	4.0	0.0170	0.054	0.054	A5, A8, A9
AHRF550	5.5	5.5	10.0	16	100	3.5	27.5	6.0	0.0130	0.037	0.037	A5, A8, A9
AHRF600	6.0	6.0	12.0	16	100	4.1	30.0	6.5	0.0100	0.032	0.032	A5, A8, A9
AHRF650	6.5	6.5	13.7	16	100	4.3	32.5	7.0	0.0090	0.026	0.026	A5, A8, A9
AHRF700	7.0	7.0	13.1	16	100	4.0	35.0	7.0	0.0087	0.025	0.025	A5, A8, A9
AHRF750	7.5	7.5	14.8	16	100	4.5	37.5	8.0	0.0074	0.022	0.022	A5, A8, A9
AHRF800	8.0	8.0	15.0	16	100	4.2	40.0	8.0	0.0072	0.020	0.020	A5, A8, A9
AHRF900	9.0	9.0	18.5	16	100	5.0	45.0	11.5	0.0061	0.017	0.017	A5, A8, A9
AHRF1000	10.0	10.0	20.5	16	100	5.3	50.0	10.5	0.0051	0.015	0.015	A5, A8, A9
AHRF1100	11.0	11.0	21.2	16	100	5.5	55.0	11.0	0.0048	0.013	0.013	A5, A8, A9
AHRF1300	13.0	13.0	27.0	16	100	6.9	65.0	15.0	0.0034	0.010	0.010	A5, A8, A9
AHRF1400	14.0	14.0	28.3	16	100	6.9	70.0	15.5	0.0029	0.009	0.009	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 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
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
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
BD 14V — Bladed Device												
NEW BD280-1130-10/16	8	8	13	14	100	4.4	40	8	0.0095	0.0185	0.0185	A13
NEW BD280-1130-15/16	12	12	20	14	100	4.5	60	8	0.0050	0.0070	0.0070	A13
NEW BD280-1130-20/16	16	16	26	14	100	5.2	80	10	0.0028	0.0064	0.0064	A13
NEW BD280-1927-25/16-W	20	20	32	14	100	6.0	100	13	0.0024	0.0042	0.0042	A14
NEW 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.

Figure A5-A14 Dimension Figures for Automotive Devices

Figure A5

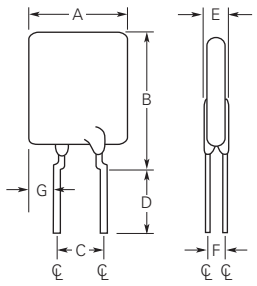


Figure A6

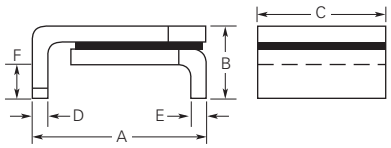


Figure A7

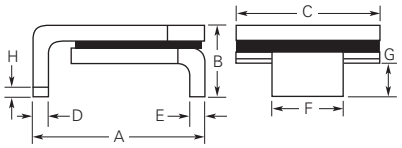


Figure A8

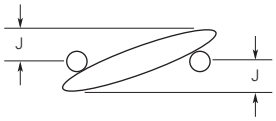


Figure A9

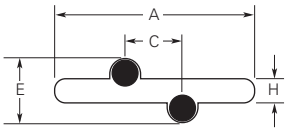


Figure A10

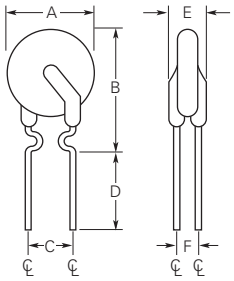


Figure A11

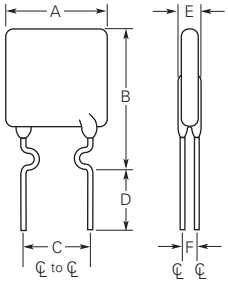


Figure A12

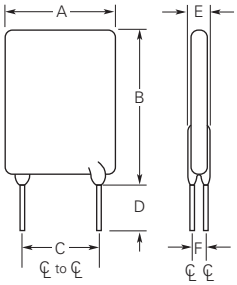


Figure A13

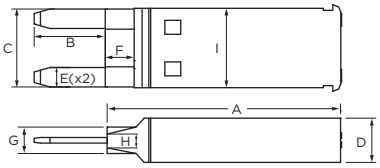


Figure A14

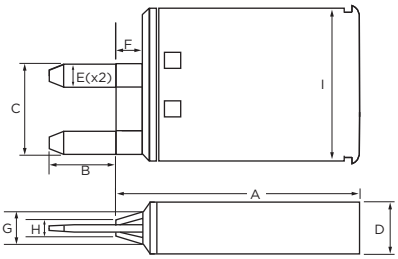


Table A4 Dimensions for Automotive Devices in Millimeters (Inches)

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 Typ.	J Max.	Figure
AGRF 16V — Radial-leaded																	
AGRF400	—	8.9 (0.35)	—	14.1 (0.56)	—	3.0 (0.12)	7.6 (0.3)	—	4.3 (0.17)	5.8 (0.20)	1.2 (0.15)	—	—	3.10 (0.120)	1.24 (0.049)	1.4 (0.06)	A5, A8, A9
AGRF500	—	10.4 (0.41)	—	15.6 (0.61)	—	3.0 (0.12)	7.6 (0.3)	—	4.3 (0.17)	5.8 (0.20)	1.2 (0.05)	—	—	3.94 (0.155)	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AGRF600	—	10.7 (0.42)	—	18.4 (0.73)	—	3.0 (0.12)	7.6 (0.3)	—	4.3 (0.17)	5.8 (0.20)	1.2 (0.05)	—	—	4.07 (0.160)	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AGRF700	—	11.2 (0.44)	—	21.0 (0.73)	—	3.0 (0.12)	7.6 (0.3)	—	4.3 (0.17)	5.8 (0.20)	1.2 (0.05)	—	—	4.49 (0.177)	1.24 (0.049)	1.7 (0.07)	A5, A8, A9
AGRF800	—	12.7 (0.50)	—	22.2 (0.88)	—	3.0 (0.12)	7.6 (0.3)	—	4.3 (0.17)	5.8 (0.20)	1.2 (0.05)	—	—	5.08 (0.200)	1.24 (0.049)	1.8 (0.07)	A5, A8, A9
AGRF900	—	14.0 (0.55)	—	23.0 (0.91)	—	3.0 (0.12)	7.6 (0.3)	—	4.3 (0.17)	5.8 (0.20)	1.2 (0.05)	—	—	5.69 (0.224)	1.24 (0.049)	2.0 (0.08)	A5, A8, A9
AGRF1000	—	16.51 (0.65)	—	25.7 (1.01)	—	3.0 (0.12)	7.6 (0.3)	—	4.3 (0.17)	5.8 (0.20)	1.2 (0.05)	—	—	6.96 (0.274)	1.24 (0.049)	2.0 (0.08)	A5, A8, A9
AGRF1100	—	17.5 (0.69)	—	26.5 (1.04)	—	3.0 (0.12)	7.6 (0.3)	—	4.3 (0.17)	5.8 (0.20)	1.2 (0.05)	—	—	7.47 (0.294)	1.24 (0.049)	2.4 (0.09)	A5, A8, A9
AGRF1200	—	17.5 (0.69)	—	28.8 (1.14)	—	3.5 (0.14)	7.6 (0.3)	—	9.4 (0.37)	10.9 (0.43)	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)	—	3.5 (0.14)	7.6 (0.3)	—	9.4 (0.37)	10.9 (0.43)	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)	—	3.3 (0.13)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A8, A9, A10
AHRF070	—	6.9 (0.27)	—	10.8 (0.43)	—	3.3 (0.13)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF100	—	9.7 (0.38)	—	13.6 (0.54)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A8, A9, A10
AHRF (High Temperature) 16V — Radial-leaded																	
AHRF200	—	9.4 (0.37)	—	14.4 (0.57)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A8, A9, A10
AHRF300	—	8.8 (0.35)	—	13.8 (0.55)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF400	—	10.0 (0.39)	—	15.0 (0.59)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF450	—	10.4 (0.41)	—	15.6 (0.61)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	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)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF600	—	11.2 (0.44)	—	21.0 (0.73)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	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)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	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)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF750	—	14.0 (0.55)	—	23.5 (0.93)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	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)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF900	—	16,5 (0.65)	—	25.7 (1.01)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	1.2 (0.05)	—	—	—	—	—	A5, A8, A9
AHRF1000	—	17.5 (0.69)	—	26.5 (1.04)	—	3.0 (0.12)	7.6 (0.30)	—	9.4 (0.37)	10.9 (0.43)	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)	—	3.0 (0.12)	7.6 (0.30)	—	9.4 (0.37)	10.9 (0.43)	1.2 (0.05)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9

Table A4 Dimensions for Automotive 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 Typ.	J Max.	Figure
AHRF (High Temperature) 16V — Radial-leaded																	
AHRF1300	—	23.5 (0.925)	—	28.7 (1.13)	—	3.5 (0.14)	7.6 (0.30)	—	9.4 (0.37)	10.9 (0.43)	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)	—	3.6 (0.14)	7.6 (0.30)	—	9.4 (0.37)	10.9 (0.43)	1.4 (0.06)	—	—	—	1.24 (0.049)	1.6 (0.06)	A5, A8, A9
AHRF1500	—	23.5 (0.93)	—	28.7 (1.13)	—	3.5 (0.14)	7.6 (0.30)	—	9.4 (0.37)	10.9 (0.43)	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

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
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
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

Table A4 Dimensions for Automotive Devices in Millimeters (Inches) Cont'd

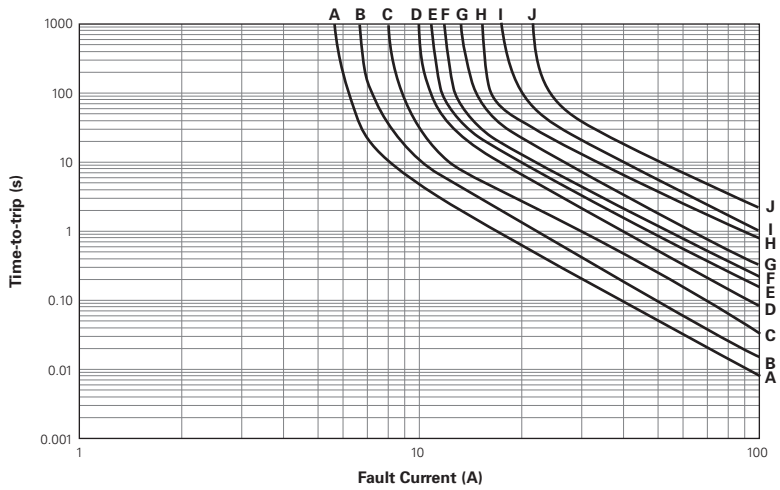
	Part Number	A Min.	A Max.	B Min.	B Max.	C Min.	C Max.	D Min.	D Max.	E(x2) Min.	E(x2) Max.	F Min.	F Max.	G Min.	G Max.	H Min.	H Max.	I Min.	I Max.	Figure
	BD																			
	14V — Bladed Device																			
NEW	BD280-1130-10/16	29.50	30.10	8.70	9.30	10.75	11.25	6.05	6.65	2.55	3.05	3.30	3.90	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)	
NEW	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)	
NEW	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)	
NEW	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)	
NEW	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)	

Figure A15-A20 Typical Time-to-trip at 25°C for Automotive Devices

AGRF

A = AGRF400
B = AGRF500
C = AGRF600
D = AGRF700
E = AGRF800
F = AGRF900
G = AGRF1000
H = AGRF1100
I = AGRF1200
J = AGRF1400

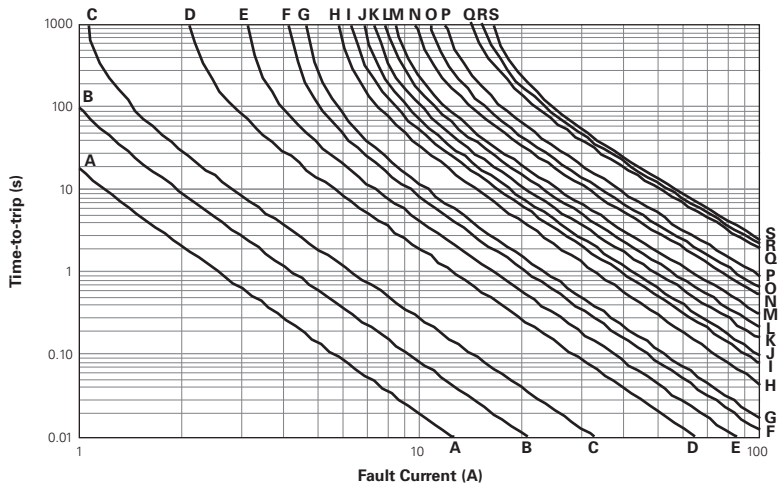
Figure A15



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 A16



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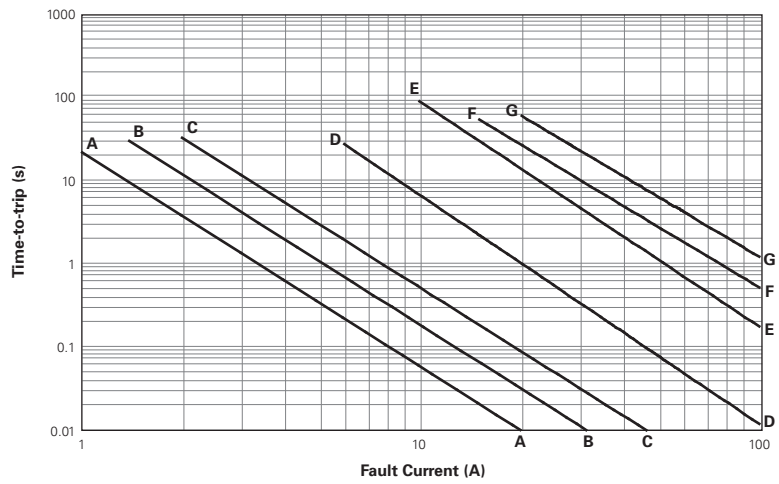
RoHS Compliant, ELV Compliant

Figure A15-A20 Typical Time-to-trip at 25°C for Automotive Devices Cont'd

AHEF

A = AHEF050
B = AHEF070
C = AHEF100
D = AHEF300
E = AHEF500
F = AHEF750
G = AHEF1000

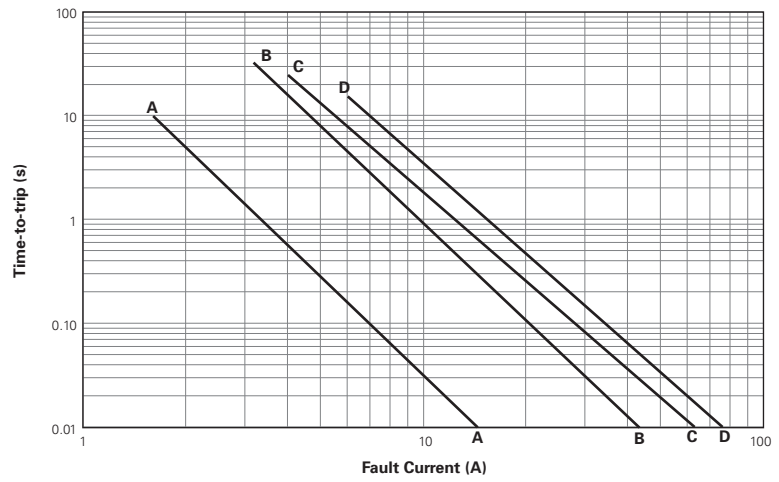
Figure A17



AHS

A = AHS080-2018
B = AHS160
C = AHS200
D = AHS300

Figure A18



ASMD

A = ASMD030F
B = ASMD050F
C = ASMD075F
D = ASMD100F
E = ASMD125F
F = ASMD150F
G = ASMD200F
H = ASMD250F

Figure A19

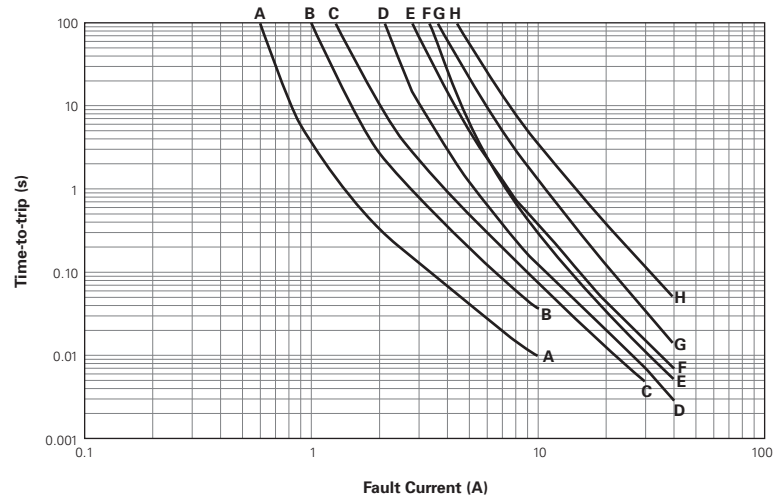


Figure A15-A20 Typical Time-to-trip at 25°C for Automotive Devices Cont'd

BD

A = BD30A
B = BD25A
C = BD20A
D = BD15A
E = BD10A

Figure A20

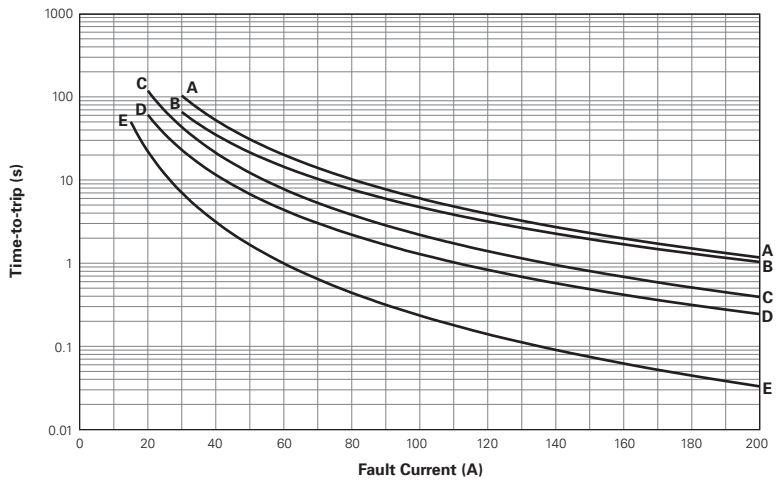


Table A5 Physical Characteristics and Environmental Specifications for Automotive Devices

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 seconds at 260°C ± 5°C AGRF500-AGRF1400: per IEC68-2-20 Test Tb, Method 1A, Condition B: can withstand 10 seconds 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 designed to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive aging	70°C, 1000 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85% RH, 1000 hours	±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.

Table A5 Physical Characteristics and Environmental Specifications for Automotive Devices Cont'd

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/0.032 in AHRF1300 to AHRF1500 : Tin-plated copper 0.82mm^2 (18 AWG), ø 1.0mm/0.04 in
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 seconds 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 designed to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive aging	70°C, 1000 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85% RH, 1000 hours	±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/0.04 in
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 seconds 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 designed to be placed through a reflow process.

Environmental Specifications

Test	Conditions	Resistance Change
Passive aging	70°C, 1000 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85% RH, 1000 hours	±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 seconds
Operation temperature	-40°C~125°C

Note: See PS400 for other physical characteristics.

Environmental Specifications

Test	Conditions	Resistance Change
Passive aging	70°C, 1000 hours	±3% Typical
	85°C, 1000 hours	±5% Typical
Humidity aging	85°C, 85% RH, 1000 hours	±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.

Table A5 Physical Characteristics and Environmental Specifications for Automotive Devices Cont'd

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 seconds
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 hours	±3% typical
	85°C, 1000 hours	±5% typical
Humidity aging	85°C, 85% RH, 100 hours	±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 hours	±5%
Humidity aging	85°C, 85% RH,1000 hours	±5%
	85°C, 85% RH (with 10% I_{HOLD}), 500 hours	±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 Automotive Devices

Part Number	Bag Quantity	Tape & Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
AGRF Radial-leaded						
AGRF400	500	—	—	10,000	GF4	*
AGRF400-2	—	2,500	—	12,500	GF4	*
AGRF400-AP	—	—	2,000	10,000	GF4	*
AGRF500	500	—	—	10,000	GF5	*
AGRF500-2	—	2,000	—	10,000	GF5	*
AGRF500-AP	—	—	2,000	10,000	GF5	*
AGRF600	500	—	—	10,000	GF6	*
AGRF600-2	—	2,000	—	10,000	GF6	*
AGRF600-AP	—	—	2,000	10,000	GF6	*
AGRF700	500	—	—	10,000	GF7	*
AGRF700-2	—	1,500	—	7,500	GF7	*
AGRF700-AP	—	—	1,500	7,500	GF7	*
AGRF800	500	—	—	10,000	GF8	*
AGRF800-2	—	1,000	—	5,000	GF8	*
AGRF800-AP	—	—	1,000	5,000	GF8	*
AGRF900	500	—	—	10,000	GF9	*
AGRF900-2	—	1,000	—	5,000	GF9	*
AGRF900-AP	—	—	1,000	5,000	GF9	*
AGRF1000	250	—	—	5,000	GF10	*
AGRF1000-2	—	1,000	—	5,000	GF10	*
AGRF1000-AP	—	—	1,000	5,000	GF10	*
AGRF1100	250	—	—	5,000	GF11	*
AGRF1100-2	—	1,000	—	5,000	GF11	*
AGRF1100-AP	—	—	1,000	5,000	GF11	*
AGRF1200	250	—	—	5,000	GF12	*
AGRF1200-2	—	1,000	—	5,000	GF12	*
AGRF1200-AP	—	—	1,000	5,000	GF12	*
AGRF1400	250	—	—	5,000	GF14	*
AGRF1400-2	—	1,000	—	5,000	GF14	*
AGRF1400-AP	—	—	1,000	5,000	GF14	*
AHRF (High Temperature) Radial-leaded						
AHRF050	500	—	—	10,000	HF0.5	*
AHRF050-2	—	2,500	—	12,500	HF0.7	*
AHRF050-AP	—	—	2,500	12,500	HF0.7	*
AHRF070	500	—	—	10,000	HF0.7	*
AHRF070-2	—	2,500	—	12,500	HF0.7	*
AHRF070-AP	—	—	2,500	12,500	HF0.7	*
AHRF100	500	—	—	10,000	HF1.0	*
AHRF100-2	—	2,500	—	12,500	HF1.0	*
AHRF100-AP	—	—	2,500	12,500	HF1.0	*
AHRF200	500	—	—	10,000	HF2	*
AHRF200-2	—	2,500	—	12,500	HF2	*
AHRF200-AP	—	—	2,500	12,500	HF2	*
AHRF300	500	—	—	10,000	HF3	*
AHRF300-2	—	2,000	—	10,000	HF3	*
AHRF300-AP	—	—	2,000	10,000	HF3	*
AHRF400	500	—	—	10,000	HF4	*
AHRF400-2	—	1,500	—	7,500	HF4	*
AHRF400-AP	—	—	1,500	7,500	HF4	*

* These devices have been designed for use in automotive applications.
For commercial alternatives to these product series please see the radial-leaded devices section or surface-mount devices section.

Table A6 Packaging and Marking Information for Automotive Devices Cont'd

Part Number	Bag Quantity	Tape & Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
AHRF (High Temperature) Radial-leaded						
AHRF450	500	—	—	10,000	HF4.5	*
AHRF450-2	—	1,500	—	7,500	HF4.5	*
AHRF450-AP	—	—	1,500	7,500	HF4.5	*
AHRF550	500	—	—	10,000	HF5.5	*
AHRF550-2	—	2,000	—	10,000	HF5.5	*
AHRF550-AP	—	—	2,000	10,000	HF5.5	*
AHRF600	500	—	—	10,000	HF6	*
AHRF600-2	—	2,000	—	10,000	HF6	*
AHRF600-AP	—	—	2,000	10,000	HF6	*
AHRF650	500	—	—	10,000	HF6.5	*
AHRF650-2	—	1,500	—	7,500	HF6.5	*
AHRF650-AP	—	—	1,500	7,500	HF6.5	*
AHRF700	500	—	—	10,000	HF7	*
AHRF700-2	—	1,500	—	7,500	HF7	*
AHRF700-AP	—	—	1,500	7,500	HF7	*
AHRF750	500	—	—	10,000	HF7.5	*
AHRF750-2	—	1,000	—	5,000	HF7.5	*
AHRF750-AP	—	—	1,000	5,000	HF7.5	*
AHRF800	500	—	—	10,000	HF8	*
AHRF800-2	—	1,000	—	5,000	HF8	*
AHRF800-AP	—	—	1,000	5,000	HF8	*
AHRF900	250	—	—	5,000	HF9	*
AHRF900-2	—	1,000	—	5,000	HF9	*
AHRF900-AP	—	—	1,000	5,000	HF9	*
AHRF1000	250	—	—	5,000	HF10	*
AHRF1000-2	—	1,000	—	5,000	HF10	*
AHRF1000-AP	—	—	1,000	5,000	HF10	*
AHRF1100	250	—	—	5,000	HF11	*
AHRF1100-2	—	1,000	—	5,000	HF11	*
AHRF1100-AP	—	—	1,000	5,000	HF11	*
AHRF1300	250	—	—	5,000	HF13	*
AHRF1300-2	—	1,000	—	5,000	HF13	*
AHRF1300-AP	—	—	1,000	5,000	HF13	*
AHRF1400	250	—	—	5,000	HF14	*
AHRF1400-2	—	1,000	—	5,000	HF14	*
AHRF1400-AP	—	—	1,000	5,000	HF14	*
AHRF1500	250	—	—	5,000	HF15	*
AHRF1500-2	—	1,000	—	5,000	HF15	*
AHRF1500-AP	—	—	1,000	5,000	HF15	*
AHEF (High Temperature) Radial-leaded						
AHEF050	500	—	—	10,000	EF0.5	*
AHEF070	500	—	—	10,000	EF0.7	*
AHEF100	500	—	—	10,000	EF1.0	*
AHEF300	500	—	—	10,000	EF3	*
AHEF500	250	—	—	5,000	EF5	*
AHEF750	250	—	—	5,000	EF7.5	*
AHEF1000	250	—	—	5,000	EF10	*

* These devices have been designed for use in automotive applications.
For commercial alternatives to these product series please see the radial-leaded devices section or surface-mount devices section.

Table A6 Packaging and Marking Information for Automotive Devices Cont'd

Part Number	Tape & Reel Quantity	Standard Package Quantity	Part Marking	Recommended Pad Layouts [mm(in) See Figure A21] 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)	*
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)	*
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)	*

* These devices have been designed for use in automotive applications.
For commercial alternatives to these product series 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				
NEW	BD280-1130-10/16	200	1600	BD280-1130-10	*
NEW	BD280-1130-15/16	200	1600	BD280-1130-15	*
NEW	BD280-1130-20/16	200	1600	BD280-1130-20	*
NEW	BD280-1927-25/16-W	200	1600	BD280-1927-25	*
NEW	BD280-1927-30/16-W	200	1600	BD280-1927-30	*

* These devices have been designed for use in automotive applications.
For commercial alternatives to these product series please see the radial-leaded devices section or surface-mount devices section.

Figure A21 Recommended Pad Layout for Automotive Devices

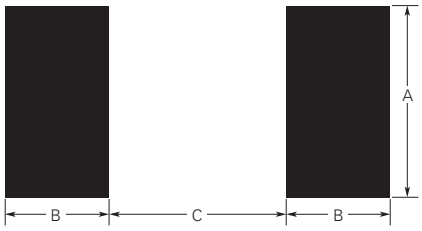


Table A7 Tape and Reel Specifications for AGRF/AHRF/AHEF Automotive Devices

AGRF, AHRF and AHEF devices are available in tape and reel packaging per EIA468-B/IEC286-2 and EIA 481-2 standards. See Figures A22 and A23 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	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 A22 EIA Referenced Taped Component Dimensions for AGRF/AHRF/AHEF Automotive Devices

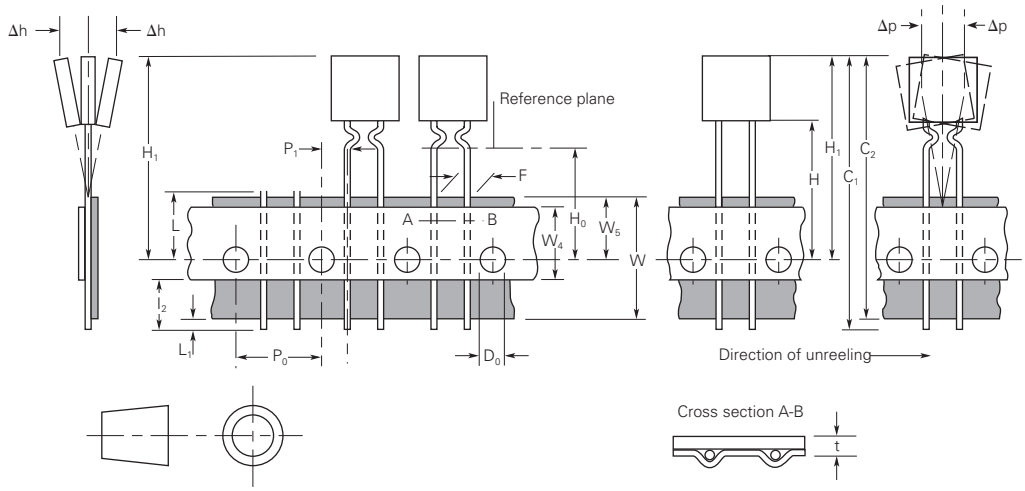


Figure A23 EIA Referenced Reel Dimensions for AGRF/AHRF/AHEF Automotive Devices

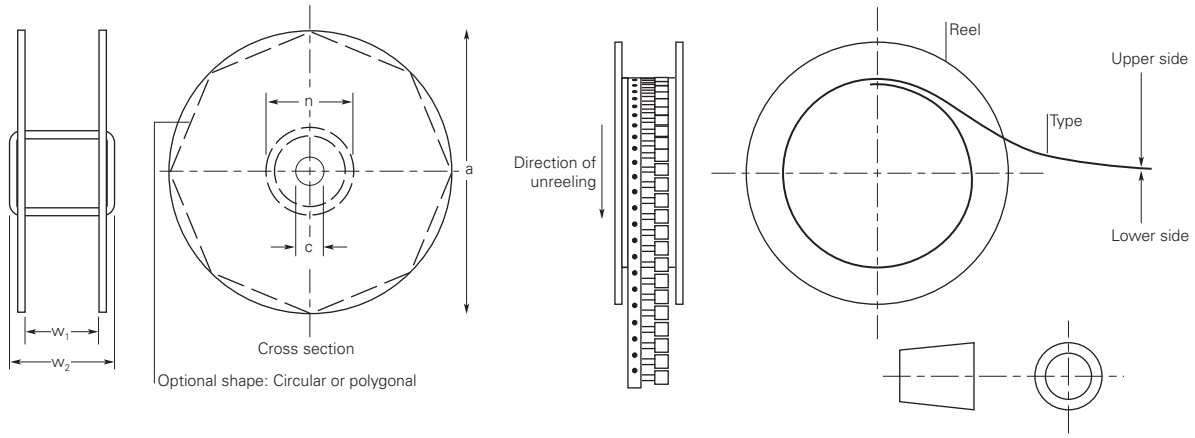


Table A8 Tape and Reel Specifications for AHS/ASMD Automotive Devices

AHS and ASMD devices are available in tape and reel packaging per EIA 468-2 standards. See Figures A24 and A25 for details.

Description	EIA Mark	Dimension (mm)	Tolerance
Carrier tape width	W	16.0	± 0.3
Sprocket hole pitch	P_0	4.0	± 0.10
Embossed cavity pitch (ASMD030F to ASMD125F & AHS080-2018)	P_1	8.0	± 0.10
Embossed cavity pitch (ASMD150F to ASMD250F & AHS160 to AHS300)	P_1	12.0	± 0.10
Ordinate to embossed cavity center	P_2	2.0	± 0.10
Embossed cavity length (inside) (AHS080-2018)	A_0	5.11	± 0.15
Embossed cavity length (inside) (ASMD030F to ASMD125F)	A_0	5.6	± 0.23
Embossed cavity length (inside) (ASMD150F to ASMD250F & AHS160 to AHS300)	A_0	6.9	± 0.23
Embossed cavity width (inside) (AHS080-2018)	B_0	5.6	± 0.23
Embossed cavity width (inside) (ASMD030F to ASMD125F)	B_0	8.1	± 0.15
Embossed cavity width (inside) (ASMD150F to ASMD250F & AHS160 to AHS300)	B_0	9.6	± 0.15
Embossed cavity length (outside)	B_1 max.	12.1	—
Sprocket hole diameter	D_0	1.5	+ 0.1, -0
Abscissa to embossed cavity center	F	7.5	± 0.10
Sprocket hole location	E_1	1.75	± 0.10
Sprocket hole location (across embossed cavity)	E_2 min.	14.25	—

Table A8 Tape and Reel Specifications for AHS/ASMD Automotive Devices Cont'd

Description	EIA Mark	Dimension (mm)	Tolerance
Carrier tape thickness	T max.	0.6	—
Cover tape thickness	T_1 max.	0.1	—
(AHS080-2018)	K_0	1.8	± 0.15
(ASMD030F to ASMD125F)	K_0	3.2	± 0.15
(ASMD150F to ASMD250F & AHS160 to AHS300)	K_0	3.4	± 0.15
Embossed cavity depth (inside)	K_0	—	± 0.15
Leader min.	—	400	—
Trailer min.	—	160	—
Reel diameter	A max.	330	—
Core diameter	N min.	50	—
Reel width measured at inside hub	W_1	16.4	+ 2.0, -0
Reel width measured at outside hub	W_2 max.	22.4	—

Figure A24 EIA Referenced Taped Component Dimensions for AHS/ASMD Devices

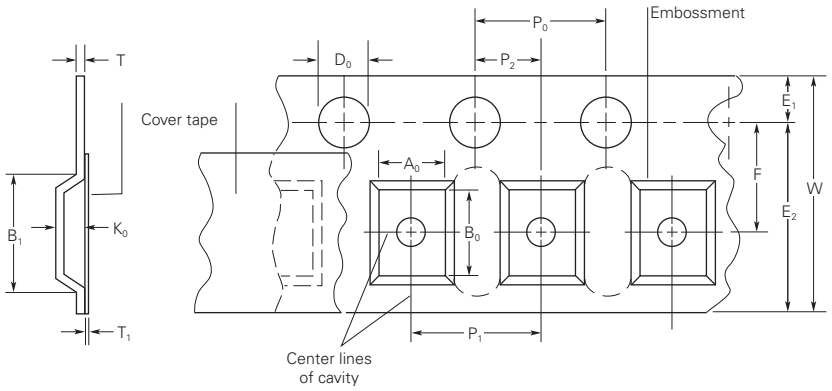
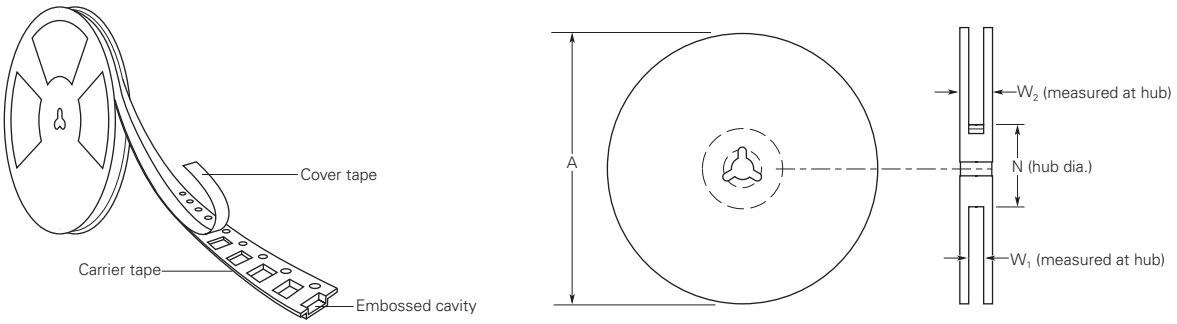


Figure A25 EIA Referenced Reel Dimensions for AHS/ASMD Devices



Part Numbering System for Automotive Devices

AGRF 800 -2

- **Packaging option**
  (Blank) = Bulk
  2 = Tape and reel packaging
  AP = Ammo pack
- **Hold Current Indicator**
- **Product Series**
  An "F" at the end of the series indicates Pb-free version of product

AHS 080 -2

- **Packaging**
  2 = Tape and reel
- **Hold Current Indicator**
- **Product Series**

BD280 -1130 -10/16

- **Rating Current / Maximum Operating Voltage**
  10 = Rating current (hold current of BD device is 70%~80% of rating current)
  16 = Max operating voltage is 16V (nominal operating voltage of BD device is 14V)
- **Typical Cap's Size**
- **Product Series**

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

Tyco Electronics, a pioneer of polymeric positive temperature coefficient resettable devices, has developed several material platforms to help protect battery applications. Each of these material platforms offers different performance characteristics, allowing the engineer greater design flexibility. PolySwitch devices for battery protection include SRP, LTP, LR4, VTP, VLP, VLR and MXP series, disc, and special application strap devices.

Benefits

- Many material platforms and device form factors give 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 0.7A to 13A
- Voltage ratings from 6V to 30V
- Agency recognition, UL, CSA, TÜV
- Fast time-to-trip
- Low resistance

Applications

- Mobile phone battery packs
- Cordless phone battery packs
- Mobile radio battery packs
- Computer battery packs
- Camcorder battery packs
- Portable music 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 these 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	Flexprint	miniSMDE190F	—
		Surface Mount	refer to Surface-mount section of this catalog	
		Prismatic	MXP190BB	VLR175F
Cordless phone battery packs	NiMH	Cylindrical	VLP210F	VTP170F
			SRP175F	
Mobile radio battery packs	NiMH	Cylindrical	LR4-380F	LTP340F
			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
			VTP175F	—
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	LTP	MXP	SRP	LR4	miniSMDE
	Typical Activation Temperature							
Hold Current (A)	**85°C**	**90°C**	**90°C**	**110°C**	**120°C**	**125°C**	**125°C**	**110°C**
0.70	—	—	—	15V/0.150Ω	—	—	—	—
1.00	—	—	—	24V/0.100Ω	—	—	—	—
1.10	—	—	16V/0.054Ω	—	—	—	—	—
1.20	—	—	—	—	—	15V/0.123Ω	—	—
1.70	12V/0.025Ω	—	16V/0.041Ω	—	—	—	—	—
1.75	12V/0.024Ω	—	16V/0.040Ω	—	—	15V/0.070Ω	—	—
1.80	—	—	—	24V/0.054Ω	—	—	—	—
1.90	—	—	—	24V/0.044Ω	6V/0.010Ω	—	15V/0.056Ω	16V/0.032Ω
2.00	—	—	—	—	—	30V/0.045Ω	—	—
2.10	—	16V/0.024Ω	16V/0.024Ω	—	—	—	—	—
2.20	—	16V/0.023Ω	—	—	—	—	—	—
2.30	12V/0.015Ω	—	—	—	—	—	—	—
2.40	—	—	—	—	—	—	—	—
2.60	—	—	—	24V/0.034Ω	—	—	15V/0.031Ω	—
2.70	—	16V/0.015Ω	—	—	—	—	—	—
3.00	—	—	—	—	—	—	—	—
3.40	—	—	—	24V/0.022Ω	—	—	—	—
3.50	—	—	—	—	—	30V/0.024Ω	—	—
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	—
8.80	—	—	—	—	—	—	—	—
9.00	—	—	—	—	—	—	20V/0.008Ω	—
13.00	—	—	—	—	—	—	20V/0.006Ω	—

Table B2 Thermal Derating for Strap Battery Devices [Hold Current (A) at Ambient Temperature (°C)]

	Maximum Ambient Temperature										
	-40°C	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	80°C	85°C
Part Number	**Amps**										
85°C Typical Activation VLR*											
VLR170F	3.5	2.9	2.4	1.84	1.70	1.2	1.0	0.7	0.3	—	—
VLR170LF	3.5	2.9	2.4	1.84	1.70	1.2	1.0	0.7	0.3	—	—
VLR170UF	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	—	—
VLR175UF	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*											
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
VTP170SSF	3.2	2.7	2.2	1.80	1.70	1.3	1.0	0.8	0.5	0.3	0.1
VTP170XF	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
VTP175UF	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
VTP210SLF	4.1	3.5	2.9	2.26	2.10	1.6	1.3	1.0	0.7	0.4	0.1
110°C Typical Activation LTP											
LTP070F	1.1	1.0	0.8	0.7	0.65	0.5	0.4	0.3	0.2	0.2	0.1
LTP100SF	1.8	1.6	1.4	1.0	0.99	0.8	0.7	0.6	0.4	0.3	0.2
LTP180LF	3.1	2.6	2.2	1.8	1.67	1.3	1.1	0.9	0.6	0.4	0.3
LTP190F	3.3	2.8	2.4	1.9	1.79	1.4	1.2	1.1	0.7	0.5	0.4
LTP260F	4.3	3.7	3.1	2.6	2.42	1.9	1.6	1.4	1.1	0.8	0.6
LTP340F	5.5	4.7	4.0	3.4	3.17	2.6	2.2	1.9	1.5	1.1	0.9
miniSMDE											
miniSMDE190F	3.16	2.74	2.2	1.9	1.74	1.48	1.27	1.10	0.80	0.50	0.35
120°C Typical Activation MXP*											
MXP190BB	—	—	2.6	—	1.90	—	—	0.85	—	—	—
125°C Typical Activation 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
LR4-260SF	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.

Table B2 Thermal Derating for Strap Battery Devices [Hold Current (A) at Ambient Temperature (°C)] Cont'd

Part Number	Maximum Ambient Temperature -40°C Amps	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	80°C	85°C
SRP											
SRP120F	1.9	1.7	1.5	1.20	1.17	1.0	0.9	0.8	0.6	0.5	0.4
SRP120LF	1.9	1.7	1.5	1.20	1.17	1.0	0.9	0.8	0.6	0.5	0.4
SRP120SF	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
SRP175LF	2.5	2.2	2.0	1.75	1.68	1.4	1.3	1.2	1.0	0.9	0.8
SRP175SF	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

Figure B1 Thermal Derating Curve for Strap Battery Devices

A = LR4
B = SRP
C = LTP
D = VTP, VLP, MXP
E = VLR

Figure B1

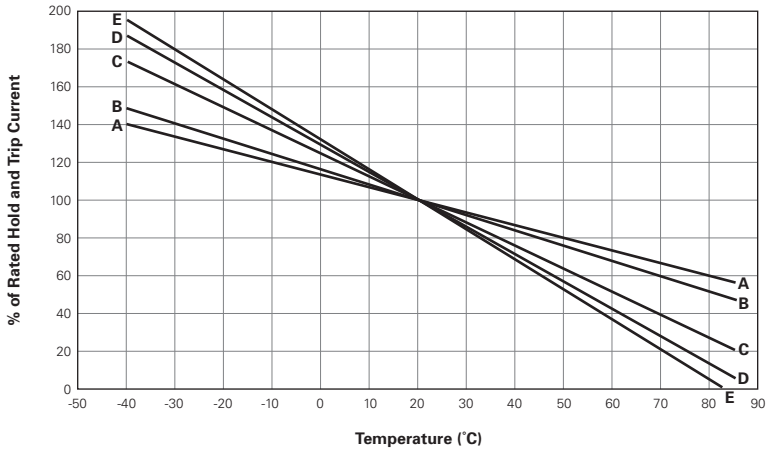


Table B3 Electrical Characteristics for Strap Battery Devices

Part Number	I_H (A)	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	$P_{D\,Typ}$ (W)	Max. Time-to-trip (A)	Max. Time-to-trip (s)	R_{MIN} (Ω)	R_{Typ} (Ω)	R_{MAX} (Ω)	$R_{Tripped\,Typ}$ (Ω)	R_{1MAX} (Ω)	Figure for Dimensions
85°C Typical Activation VLR*													
VLR170F	1.70	4.1	12	100	1.4	8.50	5.0	0.018	0.025	0.032	0.050	0.064	B3
VLR170LF	1.70	4.1	12	100	1.4	8.50	5.0	0.018	0.025	0.032	0.050	0.064	B3
VLR170UF	1.70	4.1	12	100	1.4	8.50	5.0	0.018	0.025	0.032	0.050	0.064	B5
VLR175F	1.75	4.2	12	100	1.4	8.75	5.0	0.017	0.024	0.031	0.048	0.062	B3
VLR175LF	1.75	4.2	12	100	1.4	8.75	5.0	0.017	0.024	0.031	0.048	0.062	B3
VLR175UF	1.75	4.2	12	100	1.4	8.75	5.0	0.017	0.024	0.031	0.048	0.062	B5
VLR230F	2.30	5.0	12	100	1.4	10.00	5.0	0.012	0.015	0.018	0.030	0.036	B3
90°C Typical Activation VLP*													
VLP210F	2.10	5.0	16	60	0.8	10.50	5.0	0.018	0.024	0.030	0.048	0.060	B2
VLP220F	2.20	5.3	16	60	0.8	11.00	5.0	0.017	0.023	0.029	0.046	0.058	B3
VLP270F	2.70	6.5	16	60	1.2	13.50	5.0	0.012	0.015	0.018	0.030	0.036	B3

* 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)	$P_{D\,Typ}$ (W)	Max. Time-to-trip (A)	Max. Time-to-trip (s)	R_{MIN} (Ω)	R_{Typ} (Ω)	R_{MAX} (Ω)	$R_{Tripped\,Typ}$ (Ω)	R_{1MAX} (Ω)	Figure for Dimensions
VTP*													
VTP110F	1.10	2.7	16	100	0.7	5.50	5.0	0.038	0.054	0.070	0.108	0.140	B5
VTP170F	1.70	3.4	16	100	1.0	8.50	5.0	0.030	0.041	0.052	0.082	0.105	B2
VTP170SSF	1.70	3.4	16	100	1.0	8.50	5.0	0.030	0.041	0.052	0.082	0.105	B8
VTP170XF	1.70	3.4	16	100	0.7	8.50	5.0	0.030	0.041	0.052	0.082	0.105	B3
VTP170XSF	1.70	3.4	16	100	0.7	8.50	5.0	0.030	0.041	0.052	0.082	0.105	B4
VTP175F	1.75	3.6	16	100	0.8	8.75	5.0	0.029	0.040	0.051	0.080	0.102	B3
VTP175LF	1.75	3.6	16	100	0.8	8.75	5.0	0.029	0.040	0.051	0.080	0.102	B3
VTP175UF	1.75	3.6	16	100	0.8	8.75	5.0	0.029	0.040	0.051	0.080	0.102	B5
VTP210GF	2.10	4.7	16	100	1.2	10.00	5.0	0.018	0.024	0.030	0.048	0.060	B3
VTP210SF	2.10	4.7	16	100	1.2	10.00	5.0	0.018	0.024	0.030	0.048	0.060	B4
VTP210SLF	2.10	4.7	16	100	1.2	10.00	5.0	0.018	0.024	0.030	0.048	0.060	B4
110°C Typical Activation LTP													
LTP070F	0.70	1.45	15	100	0.7	3.50	5.0	0.100	0.150	0.200	0.300	0.340	B6
LTP100SF	1.00	2.50	24	100	0.9	5.00	7.0	0.070	0.100	0.130	0.200	0.260	B7
LTP180LF	1.80	3.80	24	100	1.0	9.00	2.9	0.040	0.054	0.068	0.108	0.120	B6
LTP190F	1.90	4.20	24	100	1.5	10.00	3.0	0.030	0.044	0.057	0.088	0.100	B6
LTP260F	2.60	5.20	24	100	1.3	13.00	5.0	0.025	0.034	0.042	0.068	0.076	B6
LTP340F	3.40	6.80	24	100	1.6	17.00	5.0	0.016	0.022	0.027	0.044	0.050	B6
miniSMDE													
miniSMDE190F	1.90	3.8	16	100	1.5	10.00	2.0	0.024	0.032	0.040	0.060	0.080†	B13
120°C Typical Activation MXP*													
MXP190BB	1.90	4.9	6	50	0.4	9.50	2.0	0.007	0.010	0.015	0.015	0.024	B14
125°C Typical Activation LR4													
LR4-190F	1.90	3.9	15	100	0.8	9.50	5.0	0.0390	0.0560	0.0720	0.079	0.102	B9
LR4-260F	2.60	5.8	15	100	1.0	13.00	5.0	0.0200	0.0310	0.0420	0.046	0.063	B9
LR4-260SF	2.60	5.8	15	100	1.0	13.00	5.0	0.0200	0.0310	0.0420	0.046	0.063	B10
LR4-380F	3.80	8.3	15	100	1.2	19.00	5.0	0.0130	0.0200	0.0260	0.028	0.037	B9
LR4-380XF	3.80	8.3	15	100	1.2	19.00	5.0	0.0130	0.0200	0.0260	0.028	0.037	B9
LR4-450F	4.50	8.9	20	100	1.4	22.50	5.0	0.0110	0.0160	0.0200	0.022	0.028	B9
LR4-550F	5.50	10.5	20	100	2.0	27.50	5.0	0.0090	0.0130	0.0160	0.018	0.022	B9
LR4-600F	6.00	11.7	20	100	1.7	30.00	5.0	0.0070	0.0110	0.0140	0.015	0.019	B9
LR4-600XF	6.00	11.7	20	100	1.7	30.00	5.0	0.0075	0.0120	0.0140	0.015	0.019	B9
LR4-730F	7.30	14.1	20	100	1.9	30.00	5.0	0.0060	0.0090	0.0120	0.011	0.015	B9
LR4-900F	9.00	16.7	20	100	3.0	45.00	5.0	0.0060	0.0080	0.0100	0.011	0.014	B9
LR4-1300SSF	13.00	21.2	20	100	2.2	65.00	5.0	0.0035	0.0060	0.0065	0.008	0.009	B12
SRP													
SRP120F	1.20	2.7	15	100	0.8	6.00	5.0	0.085	0.123	0.160	0.170	0.220	B6
SRP120LF	1.20	2.7	15	100	0.8	6.00	5.0	0.085	0.123	0.160	0.170	0.220	B6
SRP120SF	1.20	2.7	15	100	0.8	6.00	5.0	0.085	0.123	0.160	0.170	0.220	B11
SRP175F	1.75	3.8	15	100	0.9	8.75	5.0	0.050	0.070	0.090	0.093	0.120	B6
SRP175LF	1.75	3.8	15	100	0.9	8.75	5.0	0.050	0.070	0.090	0.093	0.120	B6
SRP175SF	1.75	3.8	15	100	0.9	8.75	5.0	0.050	0.070	0.090	0.093	0.120	B11
SRP200F	2.00	4.4	30	100	1.6	10.00	4.0	0.030	0.045	0.060	0.075	0.100	B6
SRP350F	3.50	6.3	30	100	1.9	20.00	3.0	0.017	0.024	0.031	0.040	0.050	B6
SRP420F	4.20	7.6	30	100	2.2	20.00	6.0	0.012	0.018	0.024	0.030	0.040	B6

* Product electrical characteristics determined at 25°C.

† R_{1MAX} value for this device is the maximum resistance of the device at 20°C one hour after reflow.

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_{Typ} : Typical resistance of device as supplied at 20°C unless otherwise specified.
$R_{Tripped\,Typ}$: Typical resistance, measured at 20°C unless otherwise specified, of device one hour after being tripped the first time.
R_{MAX} : Maximum resistance of device as supplied at 20°C unless otherwise specified.

Figure B2-B14 Dimension Figures for Strap Battery Devices

Figure B2

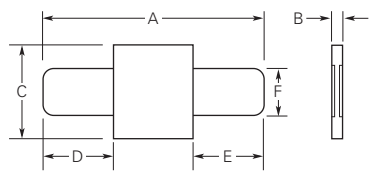


Figure B3

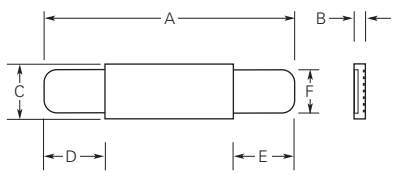


Figure B4

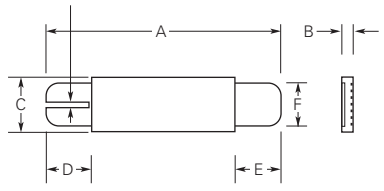


Figure B5

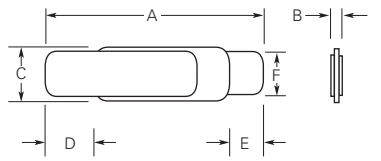


Figure B6

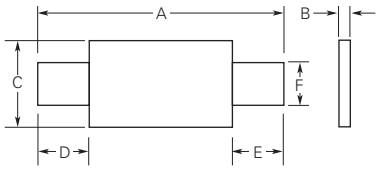


Figure B7

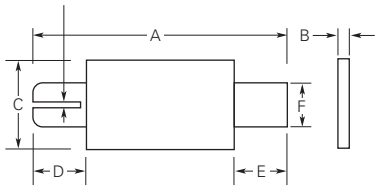


Figure B8

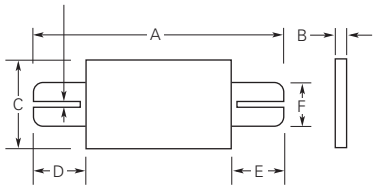


Figure B9

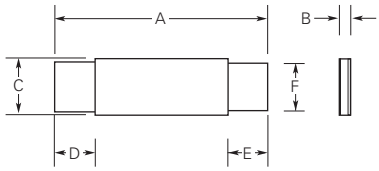


Figure B10

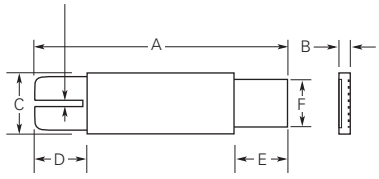


Figure B11

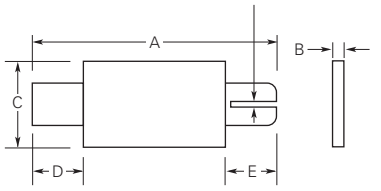


Figure B12

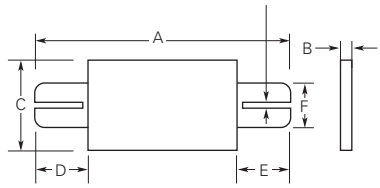


Figure B13

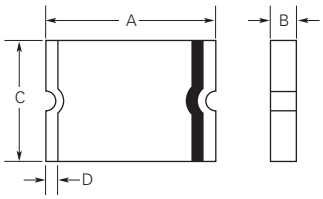


Figure B14

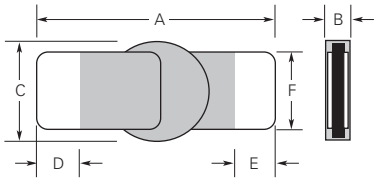


Table B4 Dimensions for Strap Battery Devices in Millimeters (Inches)

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	23.2	—	0.8	3.5	3.9	4.5	6.5	4.5	6.5	2.4	2.6	B3
	(0.82)	(0.91)	—	(0.03)	(0.14)	(0.15)	(0.18)	(0.26)	(0.18)	(0.26)	(0.09)	(0.10)	
VLR170LF	38.8	41.2	—	0.8	3.5	3.9	8.7	10.3	18.7	20.3	2.4	2.6	B3
	(1.53)	(1.62)	—	(0.03)	(0.14)	(0.15)	(0.34)	(0.41)	(0.74)	(0.80)	(0.09)	(0.10)	
VLR170UF	20.8	23.2	—	0.07	3.5	3.7	5.3	6.7	5.3	6.7	2.4	2.6	B5
	(0.81)	(0.91)	—	(0.03)	(0.14)	(0.15)	(0.21)	(0.26)	(0.21)	(0.26)	(0.09)	(0.10)	
VLR175F	23.0	24.5	0.5	0.8	2.9	3.3	4.7	7.2	3.8	5.4	2.4	2.6	B3
	(0.91)	(0.96)	(0.02)	(0.03)	(0.11)	(0.13)	(0.19)	(0.28)	(0.15)	(0.21)	(0.09)	(0.10)	
VLR175LF	29.3	31.7	—	0.8	2.9	3.3	5.2	6.8	10	12.5	2.4	2.6	B3
	(1.15)	(1.25)	—	(0.03)	(0.11)	(0.13)	(0.21)	(0.27)	(0.39)	(0.49)	(0.09)	(0.10)	
VLR175UF	23.0	24.5	—	0.7	2.9	3.1	5.2	7.5	4.3	5.7	2.4	2.6	B5
	(0.91)	(0.96)	—	(0.03)	(0.11)	(0.12)	(0.20)	(0.30)	(0.17)	(0.22)	(0.09)	(0.10)	
VLR230F	20.9	23.1	—	0.8	4.9	5.3	4.1	5.8	4.1	5.8	3.9	4.1	B3
	(0.82)	(0.91)	—	(0.03)	(0.19)	(0.21)	(0.16)	(0.23)	(0.16)	(0.23)	(0.15)	(0.16)	
90°C Typical Activation VLP													
VLP210F	15.4	17.5	0.6	0.8	6.9	7.3	4.0	6.2	4.0	6.2	3.9	4.1	B2
	(0.61)	(0.69)	(0.02)	(0.03)	(0.27)	(0.29)	(0.16)	(0.24)	(0.16)	(0.24)	(0.15)	(0.16)	
VLP220F	21.1	23.3	0.6	0.8	3.5	3.9	5.1	6.8	5.1	6.8	2.9	3.1	B3
	(0.83)	(0.92)	(0.02)	(0.03)	(0.13)	(0.15)	(0.20)	(0.27)	(0.20)	(0.27)	(0.11)	(0.12)	
VLP270F	20.9	23.1	0.6	0.8	4.9	5.3	4.1	5.8	4.1	5.8	3.9	4.1	B3
	(0.82)	(0.91)	(0.02)	(0.03)	(0.19)	(0.21)	(0.16)	(0.23)	(0.16)	(0.23)	(0.15)	(0.16)	
VTP													
VTP110F	23.6	25.6	—	0.7	2.7	2.9	7.0	8.0	7.0	8.0	2.3	2.5	B5
	(0.93)	(1.01)	—	(0.03)	(0.11)	(0.11)	(0.28)	(0.32)	(0.28)	(0.32)	(0.09)	(0.10)	
VTP170F	15.4	17.5	0.5	0.8	7.0	7.4	4.0	6.2	4.0	6.2	3.9	4.1	B2
	(0.606)	(0.689)	(0.02)	(0.03)	(0.275)	(0.292)	(0.157)	(0.244)	(0.157)	(0.244)	(0.15)	(0.16)	
VTP170SSF	15.4	17.5	0.5	0.8	7.0	7.4	4.0	6.2	4.0	6.2	3.9	4.1	B8
	(0.606)	(0.689)	(0.02)	(0.03)	(0.275)	(0.292)	(0.157)	(0.244)	(0.157)	(0.244)	(0.154)	(0.161)	
VTP170XF	20.9	22.9	0.5	0.8	4.9	5.3	6.0	8.6	6.0	8.6	3.9	4.1	B3
	(0.82)	(0.90)	(0.02)	(0.03)	(0.19)	(0.21)	(0.23)	(0.34)	(0.23)	(0.34)	(0.15)	(0.16)	
VTP170XSF	20.9	22.9	0.5	0.8	4.9	5.3	6.0	8.6	6.0	8.6	3.9	4.1	B4
	(0.82)	(0.90)	(0.02)	(0.03)	(0.19)	(0.21)	(0.23)	(0.34)	(0.23)	(0.34)	(0.15)	(0.16)	
VTP175F	21.2	23.2	—	0.8	3.5	3.9	4.6	6.6	4.6	6.6	2.9	3.1	B3
	(0.83)	(0.91)	—	(0.03)	(0.14)	(0.15)	(0.18)	(0.26)	(0.18)	(0.26)	(0.11)	(0.12)	
VTP175LF	25.8	28.2	—	0.8	3.5	3.9	5.7	7.3	8.7	10.3	2.4	2.6	B3
	(1.02)	(1.11)	—	(0.03)	(0.13)	(0.15)	(0.22)	(0.29)	(0.34)	(0.41)	(0.09)	(0.10)	
VTP175UF	21.2	23.2	—	0.7	3.5	3.7	5.6	6.8	5.6	6.8	2.9	3.1	B5
	(0.83)	(0.91)	—	(0.03)	(0.13)	(0.15)	(0.22)	(0.27)	(0.22)	(0.27)	(0.11)	(0.12)	
VTP210GF	20.9	23.1	0.6	0.8	4.9	5.3	4.1	5.8	4.1	5.8	3.9	4.1	B3
	(0.82)	(0.91)	(0.02)	(0.03)	(0.19)	(0.21)	(0.16)	(0.23)	(0.16)	(0.23)	(0.15)	(0.16)	
VTP210SF	20.9	23.1	0.6	0.8	4.9	5.3	4.1	5.8	4.1	5.8	3.9	4.1	B4
	(0.82)	(0.91)	(0.02)	(0.03)	(0.19)	(0.21)	(0.16)	(0.23)	(0.16)	(0.23)	(0.15)	(0.16)	
VTP210SLF	29.0	32.0	0.6	0.8	4.9	5.3	12.5	14.5	3.5	5.8	3.9	4.1	B4
	(1.14)	(1.26)	(0.02)	(0.03)	(0.19)	(0.21)	(0.49)	(0.57)	(0.13)	(0.23)	(0.15)	(0.16)	
110°C Typical Activation LTP													
LTP070F	19.9	22.1	0.7	1.2	4.9	5.2	5.5	7.5	5.5	7.5	3.9	4.1	B6
	(0.783)	(0.870)	(0.027)	(0.048)	(0.192)	(0.205)	(0.216)	(0.296)	(0.216)	(0.296)	(0.153)	(0.162)	
LTP100SF	20.9	23.1	0.6	1.0	4.9	5.2	4.1	5.5	4.1	5.5	3.9	4.1	B7
	(0.82)	(0.91)	(0.02)	(0.04)	(0.19)	(0.20)	(0.16)	(0.22)	(0.16)	(0.22)	(0.15)	(0.16)	
LTP180LF	35.5	37.5	0.6	1.0	4.9	5.2	9.7	11.0	9.7	11.0	3.9	4.1	B6
	(1.40)	(1.48)	(0.02)	(0.04)	(0.19)	(0.20)	(0.38)	(0.44)	(0.38)	(0.44)	(0.15)	(0.16)	
LTP190F	21.3	23.4	0.5	1.1	10.2	11.0	5.0	7.6	5.0	7.6	4.8	5.4	B6
	(0.84)	(0.92)	(0.02)	(0.04)	(0.40)	(0.43)	(0.20)	(0.30)	(0.20)	(0.30)	(0.19)	(0.21)	
LTP260F	24.0	26.0	0.6	1.0	10.8	11.9	5.0	7.0	5.0	7.0	5.9	6.1	B6
	(0.94)	(1.02)	(0.02)	(0.04)	(0.43)	(0.47)	(0.20)	(0.28)	(0.20)	(0.28)	(0.23)	(0.24)	
LTP340F	24.0	26.0	0.6	1.0	14.8	15.9	4.0	5.0	4.0	5.0	5.9	6.1	B6
	(0.94)	(1.02)	(0.02)	(0.04)	(0.58)	(0.63)	(0.16)	(0.20)	(0.16)	(0.20)	(0.23)	(0.24)	

Table B4 Dimensions for Strap Battery Devices in Millimeters (Inches) Cont'd

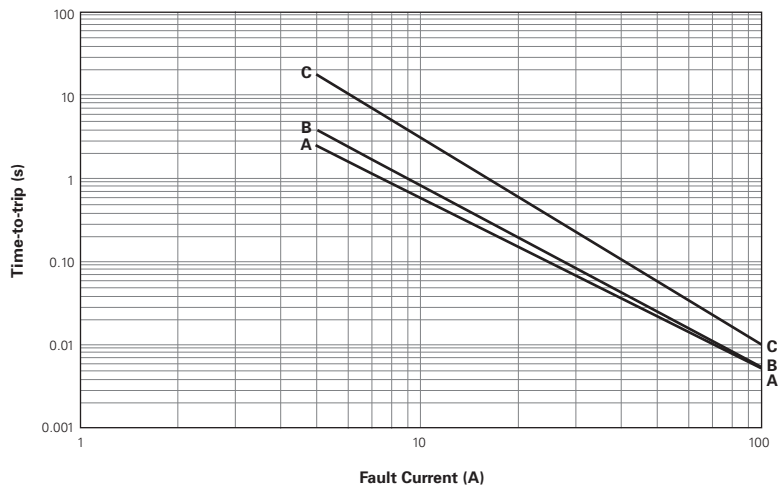
Part Number	A Min.	A Max.	B Min.	B Max.	C Min.	C Max.	D Min.	D Max.	E Min.	E Max.	F Min.	F Max.	Figure
miniSMDE													
miniSMDE190F	11.15	11.51	0.33	0.53	4.83	5.33	0.51	1.02	—	—	—	—	B13
	(0.439)	(0.453)	(0.013)	(0.021)	(0.19)	(0.21)	(0.02)	(0.04)	—	—	—	—	
120°C Typical Activation MXP													
MXP190BB	9.2	10.8	0.7	1.1	2.96	3.26	1.6	3.1	1.6	3.1	2.2	2.4	B14
	(0.36)	(0.43)	(0.03)	(0.04)	(0.01)	(0.13)	(0.06)	(0.12)	(0.06)	(0.12)	(0.09)	(0.09)	
125°C Typical Activation LR4													
LR4-190F	19.9	22.1	0.6	1.0	4.9	5.5	5.5	7.5	5.5	7.5	3.9	4.1	B9
	(0.78)	(0.87)	(0.02)	(0.04)	(0.19)	(0.22)	(0.22)	(0.30)	(0.22)	(0.30)	(0.15)	(0.16)	
LR4-260F	20.9	23.1	0.6	1.0	4.9	5.5	4.1	5.5	4.1	5.5	3.9	4.1	B9
	(0.82)	(0.91)	(0.02)	(0.04)	(0.19)	(0.22)	(0.16)	(0.22)	(0.16)	(0.22)	(0.15)	(0.16)	
LR4-260SF	20.9	23.1	0.6	1.0	4.9	5.5	4.1	5.5	4.1	5.5	3.9	4.1	B10
	(0.82)	(0.91)	(0.02)	(0.04)	(0.19)	(0.22)	(0.16)	(0.22)	(0.16)	(0.22)	(0.15)	(0.16)	
LR4-380F	24.0	26.0	0.6	1.0	6.9	7.5	4.1	5.5	4.1	5.5	4.9	5.1	B9
	(0.94)	(1.02)	(0.02)	(0.04)	(0.27)	(0.30)	(0.16)	(0.22)	(0.16)	(0.22)	(0.19)	(0.20)	
LR4-380XF	32.2	35.8	0.6	1.0	4.9	5.5	5.5	7.5	5.5	7.5	3.9	4.1	B9
	(1.27)	(1.41)	(0.02)	(0.04)	(0.19)	(0.22)	(0.22)	(0.30)	(0.22)	(0.30)	(0.15)	(0.16)	
LR4-450F	24.0	26	0.6	1.0	9.9	10.5	5.3	6.7	5.3	6.7	5.9	6.1	B9
	(0.94)	(1.02)	(0.02)	(0.04)	(0.41)	(0.39)	(0.21)	(0.26)	(0.21)	(0.26)	(0.23)	(0.24)	
LR4-550F	35.0	37.0	0.6	1.0	6.9	7.5	5.3	6.7	5.3	6.7	4.9	5.1	B9
	(1.38)	(1.46)	(0.02)	(0.04)	(0.27)	(0.30)	(0.21)	(0.26)	(0.21)	(0.26)	(0.19)	(0.20)	
LR4-600F	24.0	26.0	0.6	1.0	13.9	14.5	4.1	5.5	4.1	5.5	5.9	6.1	B9
	(0.95)	(1.02)	(0.02)	(0.04)	(0.55)	(0.57)	(0.16)	(0.22)	(0.16)	(0.22)	(0.23)	(0.24)	
LR4-600XF	40.5	42.7	0.6	1.0	6.9	7.5	5.2	6.8	5.2	6.8	4.9	5.1	B9
	(1.59)	(1.68)	(0.02)	(0.04)	(0.27)	(0.30)	(0.20)	(0.27)	(0.20)	(0.27)	(0.19)	(0.20)	
LR4-730F	27.1	29.1	0.6	1.0	13.9	14.5	4.1	5.5	4.1	5.5	5.9	6.1	B9
	(1.06)	(1.15)	(0.02)	(0.04)	(0.54)	(0.57)	(0.16)	(0.22)	(0.16)	(0.22)	(0.23)	(0.24)	
LR4-900F	45.4	47.6	0.9	1.3	7.9	8.5	4.6	6.2	4.6	6.2	5.9	6.1	B9
	(1.79)	(1.87)	(0.04)	(0.05)	(0.31)	(0.33)	(0.18)	(0.24)	(0.18)	(0.24)	(0.23)	(0.24)	
LR4-1300SSF	61.5	66.5	0.9	1.3	9.4	10.0	5.0	7.5	5.0	7.5	5.9	6.1	B12
	(0.42)	(2.62)	(0.04)	(0.05)	(0.37)	(0.39)	(0.20)	(0.30)	(0.20)	(0.30)	(0.23)	(0.24)	
SRP													
SRP120F	19.9	22.1	0.6	1.0	4.9	5.2	5.5	7.5	5.5	7.5	3.9	4.1	B6
	(0.78)	(0.87)	(0.02)	(0.04)	(0.19)	(0.20)	(0.22)	(0.30)	(0.22)	(0.30)	(0.15)	(0.16)	
SRP120LF	24.9	27.1	0.6	1.0	4.9	5.2	5.5	7.5	10.5	12.5	3.9	4.1	B6
	(0.98)	(1.07)	(0.02)	(0.04)	(0.19)	(0.20)	(0.22)	(0.30)	(0.41)	(0.49)	(0.15)	(0.16)	
SRP120SF	19.9	22.1	0.6	1.0	4.9	5.2	5.5	7.5	5.5	7.5	3.9	4.1	B11
	(0.78)	(0.87)	(0.02)	(0.04)	(0.19)	(0.20)	(0.22)	(0.30)	(0.22)	(0.30)	(0.15)	(0.16)	
SRP175F	20.9	23.1	0.6	1.0	4.9	5.2	4.1	5.5	4.1	5.5	3.9	4.1	B6
	(0.82)	(0.91)	(0.02)	(0.04)	(0.19)	(0.20)	(0.16)	(0.22)	(0.16)	(0.22)	(0.15)	(0.16)	
SRP175LF	29.9	32.1	0.6	1.0	4.9	5.2	10.5	12.5	5.5	7.5	3.9	4.1	B6
	(1.18)	(1.26)	(0.02)	(0.04)	(0.19)	(0.20)	(0.41)	(0.49)	(0.22)	(0.30)	(0.15)	(0.16)	
SRP175SF	20.9	23.1	0.6	1.0	4.9	5.2	4.1	5.5	4.1	5.5	3.9	4.1	B11
	(0.82)	(0.91)	(0.02)	(0.04)	(0.19)	(0.20)	(0.16)	(0.22)	(0.16)	(0.22)	(0.15)	(0.16)	
SRP200F	21.3	23.4	0.5	1.1	10.2	11.0	5.0	7.6	5.0	7.6	4.8	5.4	B6
	(0.84)	(0.92)	(0.02)	(0.04)	(0.40)	(0.43)	(0.20)	(0.30)	(0.20)	(0.30)	(0.19)	(0.21)	
SRP350F	28.4	31.8	0.5	1.1	13.0	13.5	6.3	8.9	6.3	8.9	6.0	6.6	B6
	(1.12)	(1.25)	(0.02)	(0.04)	(0.53)	(0.51)	(0.25)	(0.35)	(0.25)	(0.35)	(0.24)	(0.26)	
SRP420F	30.6	32.4	0.5	1.1	12.9	13.6	5.0	7.5	5.0	7.5	6.0	6.7	B6
	(1.20)	(1.28)	(0.02)	(0.04)	(0.51)	(0.54)	(0.20)	(0.30)	(0.20)	(0.30)	(0.24)	(0.26)	

Figure B15-B22 Typical Time-to-trip Curves at 20°C for Strap Battery Devices

VLR (data at 25°C)

A = VLR170F
B = VLR175F
C = VLR230F

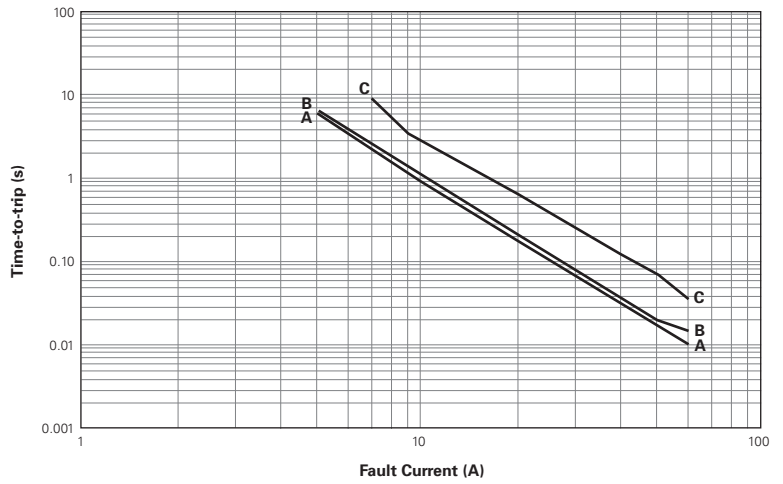
Figure B15



VLP (data at 25°C)

A = VLP210F
B = VLP220F
C = VLP270F

Figure B16



VTP (data at 25°C)

A = VTP110F
B = VTP170F
C = VTP175F
D = VTP210GF

Figure B17

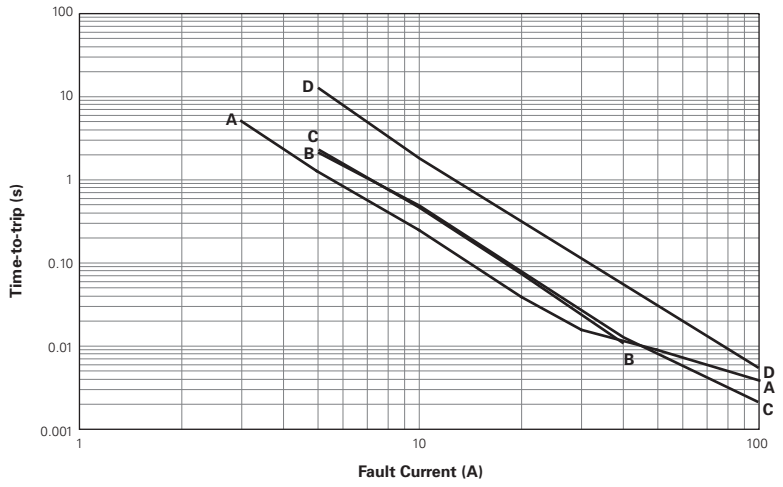
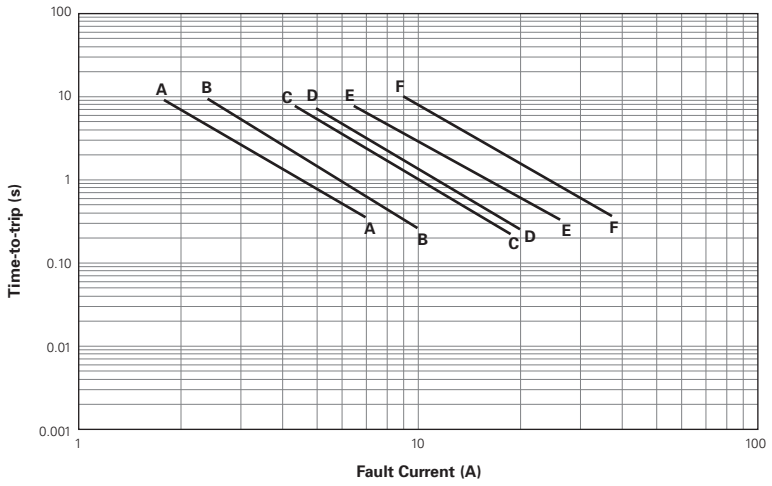


Figure B15-B22 Typical Time-to-trip Curves at 20°C for Strap Battery Devices Cont'd

LTP

A = LTP070F
B = LTP100SF
C = LTP180LF
D = LTP190F
E = LTP260F
F = LTP340F

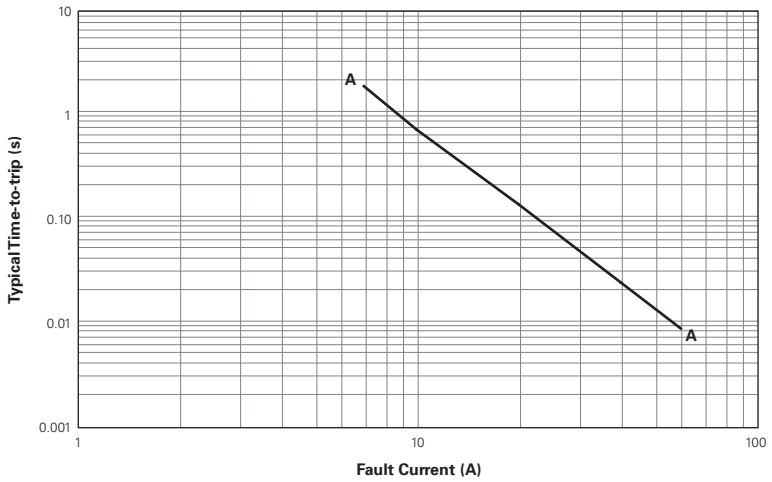
Figure B18



MXP (data at 25°C)

A = MXP190BB

Figure B19



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 B20

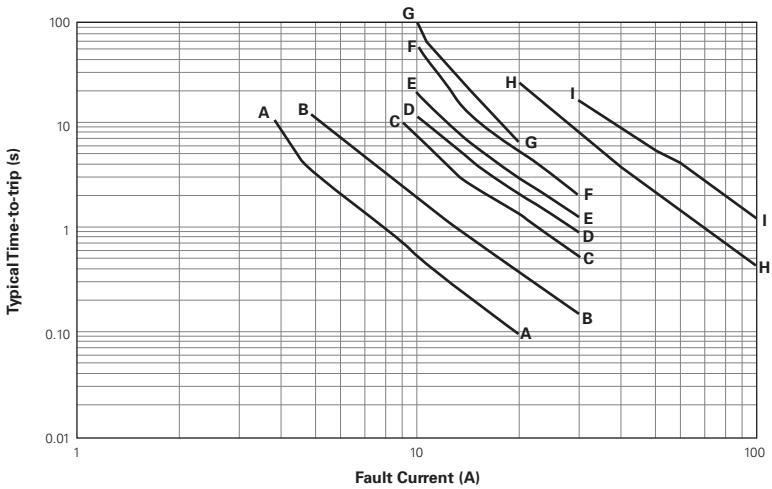
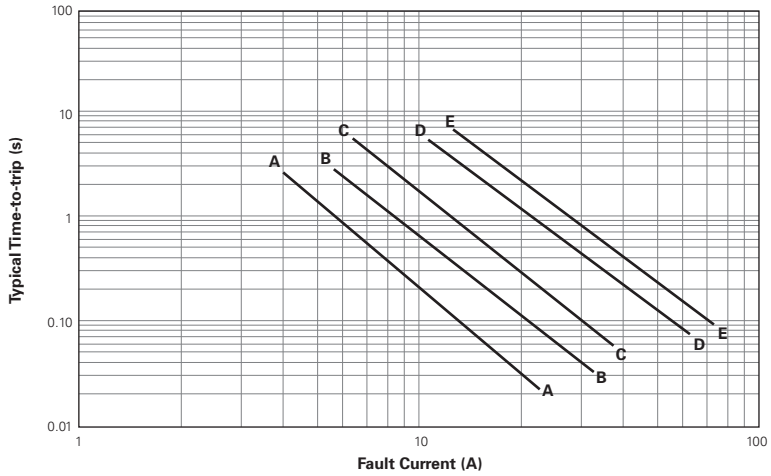


Figure B15-B22 Typical Time-to-trip Curves at 20°C for Strap Battery Devices Cont'd

SRP

A = SRP120F
B = SRP175F
C = SRP200F
D = SRP350F
E = SRP420F

Figure B21



miniSMDE

A = miniSMDE190F

Figure B22

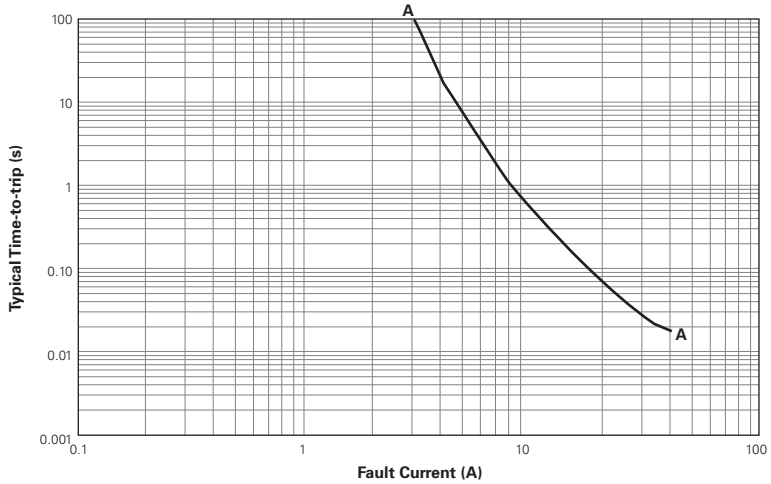


Table B5 Physical Characteristics and Environmental Specifications for Strap Battery Devices

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 hours	±5%
	60°C, 1000 hours	±20%
Humidity aging	60°C/95% RH, 1000 hours	±30%
Thermal shock	85°C, -40°C (10 times)	±5%
Vibration	MIL-STD-883D, Method 2026	No change

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 hours	±5%
	60°C, 1000 hours	±10%
Humidity aging	60°C/95% RH, 1000 hours	±10%
Thermal shock	85°C, -40°C (10 times)	±5%
Vibration	MIL-STD-883D, Method 2026	No change

LTP

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 hours	±10%
Humidity aging	85°C/85% RH, 7 days	±15%
Vibration	MIL-STD-883C, Test Condition A	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 hours	±5%
	60°C, 1000 hours	±20%
Humidity aging	60°C/95% RH, 1000 hours	±30%
Thermal shock	85°C, -40°C (10 times)	±5%
Vibration	MIL-STD-883D, Method 2026	No change

Table B5 Physical Characteristics and Environmental Specifications for Strap Battery Devices Cont'd

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 hours	±10%
Humidity aging	85°C/85% RH, 7 days	±5%
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 hours	±10%
Humidity aging	85°C/85% RH, 7 days	±5%
Vibration	MIL-STD-883C, Test Condition A	No change

miniSMDE

Physical Characteristics

Termination pad materials	Solder-plated copper
Termination pad solderability	Meets EIA specification RS186-9E, ANSI/J-STD-002 Category 3

Environmental Specifications

Test	Conditions	Resistance Change
Passive aging	60°C, 1000 hours	±5% typical
	85°C, 1000 hours	±5% typical
Humidity aging	85°C/85% RH, 100 days	±15% typical
Thermal shock	85°C, -40°C (20 times)	-33% typical
	125°C, -55°C (10 times)	-33% typical
Vibration	MIL-STD-883D, Method 2026	No change
Reflow conditions	260°C for 10-20 seconds	Less than R_{1MAX}
Tape and reel specifications	Per EIA 481-1	N/A

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 & Reel Quantity	Standard Package Quantity	Part Marking	Agency Recognition
85°C Typical Activation VLR					
VLR170F	1,000	—	10,000	R17	UL, CSA,TÜV
VLR170LF	1,000	—	10,000	R17	UL, CSA,TÜV
VLR170UF	1,000	—	10,000	—	UL, CSA,TÜV
VLR175F	1,000	—	10,000	R1X	UL, CSA,TÜV
VLR175LF	1,000	—	10,000	R1X	UL, CSA,TÜV
VLR175UF	1,000	—	10,000	—	UL, CSA,TÜV
VLR230F	1,000	—	10,000	R23	UL, CSA,TÜV
90°C Typical Activation VLP					
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
VTP170SSF	1,000	—	10,000	V17	UL, CSA, TÜV
VTP170XF	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
VTP175UF	1,000	—	10,000	—	UL, CSA, TÜV
VTP210GF	1,000	—	10,000	V21	UL, CSA, TÜV
VTP210SF	1,000	—	10,000	V21	UL, CSA, TÜV
VTP210SLF	1,000	—	10,000	V21	UL, CSA, TÜV
110°C Typical Activation LTP					
LTP070F	2,000	—	10,000	L07	UL, CSA, TÜV
LTP100SF	2,000	—	10,000	L10	UL, CSA, TÜV
LTP180LF	500	—	10,000	L18	UL, CSA, TÜV
LTP190F	500	—	10,000	L19	UL, CSA, TÜV
LTP260F	1,000	—	10,000	L26	UL, CSA, TÜV
LTP340F	500	—	10,000	L34	UL, CSA, TÜV
miniSMDE					
miniSMDE190F-2	—	5,000	5,000	19	UL, CSA, TÜV
120°C Typical Activation MXP					
MXP190BB	4,000	—	8,000	—	UL, CSA, TÜV
125°C Typical Activation LR4					
LR4-190F	2,000	—	10,000	E19	UL, CSA, TÜV
LR4-260F	1,000	—	10,000	E26	UL, CSA, TÜV
LR4-260SF	1,000	—	10,000	E26	UL, CSA, TÜV
LR4-380F	1,000	—	10,000	E38	UL, CSA, TÜV
LR4-380XF	1,000	—	10,000	E3X	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

Table B6 Packaging and Marking Information/Agency Recognition for Strap Battery Devices Cont'd

Part Number	Bag Quantity	Tape & Reel Quantity	Standard Package Quantity	Part Marking	Agency Recognition
SRP					
SRP120F	1,000	—	10,000	120	UL, CSA, TÜV
SRP120LF	1,000	—	10,000	120	UL, CSA, TÜV
SRP120SF	2,000	—	10,000	120	UL, CSA, TÜV
SRP175F	2,000	—	10,000	175	UL, CSA, TÜV
SRP175LF	1,000	—	10,000	175	UL, CSA, TÜV
SRP175SF	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

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 designed 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 designed 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 indentification 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 small PPTC chip size and therefore have weaker peel strength between polymer and Ni-foil of the chip. Excessive mechanical force to the device may cause delamination of Ni-foil from polymer.

Part Numbering System for Strap Battery Devices

LTP 190 SS

Modifier
F = Lead-free version
G = Global design (standard product)
L = Long lead or leads
S = Slit lead
SS = Both leads slit
X = Rotated chip
U = Untaped

Hold Current Indicator

Product Series

VTP 210 SL 19.2/5.8

Maximum length of leads (mm)

Modifier
F = Lead-free version
G = Global design (standard product)
L = Long lead or leads
S = Slit lead
SS = Both leads slit
X = Rotated chip
U = Untaped

Hold Current Indicator

Product Series

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
Telecommunications & Networking Devices

This family of telecommunication and networking devices was initially designed over 10 years ago to 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, Tyco Electronics' PolySwitch devices help improve the reliability of customer premise and network equipment world wide.

Benefits

- Many product choices give engineers more design flexibility
- Compatible with high volume electronics assembly
- Assist in meeting regulatory equipment requirements
- Improved 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 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 Tyco Electronics representative.

		Overcurrent Protection		
		Form Factor		
Application	**Region/ Specification**	**Radial-leaded**	**Surface-mount**	**Chip**
Customer Premises equipment	**North America**	TRF600-150	TS600-170F	
IT equipment	TIA-968-A,	TR600-150F-EX	TS600-200F	
Analog modems, V.90 modems,	UL 60950,	TRF600-160	TSM600-250F	
ISDN modems, xDSL modems,	GR1089 Port Type 3‡	TRF600-400	TSM600-400F	
ADSL splitters, phone sets, fax machines,	**Europe/Asia/**	TRF250-120	TS250-130F	
answering machines, caller ID, internet	**South America**	TRF250-120T	TSV250-130F	
appliances, PBX systems, POS terminals,	ITU K.21	TRF250-145		
wall plugs		TRF250-183		
		TRF250-184		
Access network equipment (†)	**North America**	TRF600-160	TS600-170F	
Remote terminals, line repeaters,	GR1089 Port Type 5‡	TRF600-400	TS600-200F	
multiplexers, cross-connects,			TS600-400F	
WAN equipment			TSM600-250F	
			TSM600-400F	
			FT600-1250**	
	Europe/Asia/	TRF250-120	TS250-130F	
	South America	TRF250-120T	TSV250-130F	
	ITU K.45	TRF250-145		
		TRF250-183		
		TRF250-184		
Central office switching equipment (†)	**North America**	TRF600-160	TS600-170F	
Analog/POTS linecards, ISDN linecards,	GR1089 Port Type 1‡	TRF600-400	TS600-200F	
xDSL modems, ADSL/VDSL splitters,			TS600-400F	
T1/E1 linecards, multiplexers,			TSM600-250F	
CSU/DSU, servers			TSM600-400F	
			FT600-1250**	
	Europe/Asia/	TRF250-120	TS250-130F	TCF250-180
	South America	TRF250-120T	TSV250-130F	
	ITU K.20	TRF250-145		
		TRF250-183		
		TRF250-184		
Primary protection modules (†)	**North America**	TRF250-183		
MDF modules, Network Interface	Telcordia GR-974	TRF250-184		
Devices (NID)	**Europe/Asia/**	TRF250-055UT	TSL250-080F	TCF250-100T
	South America	TRF250-080U	TS250-130F	TCF250-120T
	ITU K.20	TRF250-110U	TSV250-130F	TCF250-145T
		TRF250-120		TCF250-180
		TRF250-120T		
		TRF250-145		
		TRF250-183		
		TRF250-184		
Short-haul/intrabuilding communications	**North America**	TRF250-080U	TSL250-080F	
equipment (†)	GR1089 Port Type 2‡	TRF250-120	TS250-130F	
LAN equipment, VoIP cards, cable	GR1089 Port Type 4‡	TRF250-120T	TSV250-130F	
telephony NIUs, wireless local loop		TRF250-145		
handsets		TRF250-183		
		TRF250-184		
	Europe/Asia/	TRF250-120	TS250-130F	
	South America	TRF250-120T	TSV250-130F	
	ITU K.21	TRF250-145		
		TRF250-183		
		TRF250-184		

Protection Application Guide for Telecommunications and Networking Devices* Cont'd

Application	Region/ Specification	Overcurrent Protection Form Factor Radial-leaded	Surface-mount	Chip
LAN intrabuilding power cross protection	**North America**	TRF250-080U	TSL250-080F	
LAN equipment, VoIP cards, IP phones	GR1089 Port Type 4‡	TRF250-120	TS250-130F	
		TRF250-120T	TSV250-130F	
		TRF250-145		
		TRF250-183		
		TRF250-184		
IEEE 802.3AF/AT Power over Ethernet protection			decaSMDC050F/60-2††	
Powered Ethernet switches and terminals, IP phones, wireless LAN base stations, microcellular base stations, VoIP cards				
Cable telephony powering system				
Power passing taps		BBRF550‡‡		

* This list is not exhaustive. Tyco Electronics 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.
‡‡ For details on BBRF series, see radial-leaded devices section.

Agency Specification/Selection Guide for Telecommunications and Networking Devices

Use the guide below to select the PolySwitch devices which 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 & 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 & 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 Telecommunications and Networking Devices Cont'd

Family	Product*	Lightning	Power Cross/Contact/Induction
TRF250	**TRF250-055UT**	ITU K.20 – 1.0kV 10/700µs	ITU K.20 – 230V_{AC}, 10Ω
	TRF250-080U	ITU K.20 – 1.0kV 10/700µs	ITU K.20 – 230V_{AC}, 10Ω
		GR-1089 Port Types 2 & 4 – 1st Level	ITU K.20 – 0.2A^2s
			ITU K.20 – 1A^2s†
			GR-1089 Port Type 4 – 120V_{AC}, 25Asc
	TRF250-110U	ITU K.20/21/45 – 1.5kV 10/700µs	ITU K.20/21/45 – 230V_{AC}, 10Ω
	TRF250-120	ITU K.20/21/45 – 4.0kV 10/700µs†	ITU K.20/21/45 – 0.2A^2s
	TRF250-120T	GR-1089 Port Types 2 & 4 – 1st Level	ITU K.20/21/45 – 1A^2s†
	TRF250-120U		ITU K.20/21/45 – 10A^2s†
	TRF250-120UT		GR-1089 Port Type 4 – 120V_{AC}, 25Asc
	TRF250-145		
	TRF250-145U		
	TRF250-183		
	TRF250-184	ITU K.20/21/45 – 1.5kV 10/700µs	ITU K.20/21/45 – 230V_{AC}, 10Ω **
		ITU K.20/21/45 – 4.0kV 10/700µs‡	ITU K.20/21/45 – 0.2A^2s
		GR-1089 Port Types 2 & 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
TS250/TSV250	**TSV250-130F**	ITU K.20/21/45 – 1.5kV 10/700µs	ITU K.20/21/45 – 230V_{AC}, 10Ω
	TS250-130F	ITU K.20/21/45 – 4.0kV 10/700µs†	ITU K.20/21/45 – 0.2A^2s
		GR-1089 Port Types 2 & 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
	TS250-130F-RB	ITU K.20/21/45 – 1.5kV 10/700µs	ITU K.20/21/45 – 230V_{AC}, 10Ω
		ITU K.20/21/45 – 4.0kV 10/700µs‡	ITU K.20/21/45 – 0.2A^2s
		GR-1089 Port Types 2 & 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
TSL250	**TSL250-080F**	GR-1089 Port Types 2 & 4 – 1st Level	GR-1089 Port Type 4 – 120V_{AC}, 25Asc
		ITU K.20 – 1.0kV 10/700µs	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**	TIA-968-A Types A & B	UL60950 – 600V_{AC}, 40Asc
	TR600-150F-EX	GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level††	UL60950 – 600V_{AC}, 40Asc
	TR600-150F-EX-RA-B-0.5	GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level††	UL60950 – 600V_{AC}, 40Asc
	TRF600-160	GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level††	Telcordia GR-1089 – 600V_{AC}, 60Asc
	TRF600-400	GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level	Telcordia GR-1089 – 600V_{AC}, 60Asc
TS600	**TS600-170F**	TIA-968-A Types A & B	UL60950 – 600V_{AC}, 40Asc
	TS600-200F-RA	GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level††	Telcordia GR-1089 – 600V_{AC}, 60Asc
	TS600-400F		
TSM600	**TSM600-250F**	TIA-968-A Types A & B	UL60950 – 600V_{AC}, 40Asc
	TSM600-250F-RA	GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level††	Telcordia GR-1089 – 600V_{AC}, 60Asc
	TSM600-400F	TIA-968-A Types A & B	UL60950 – 600V_{AC}, 40Asc
		GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level	Telcordia GR-1089 – 600V_{AC}, 60Asc
FT600‡‡	**FT600-0500**	TIA-968-A - Types A & B	UL60950 – 600V_{AC}, 40Asc
	FT600-1250		
	FT600-2000	GR-1089 Port Types 1, 3, & 5 – 1st & 2nd Level	Telcordia GR-1089 – 600V_{AC}, 60Asc

* Applies to all products which 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 Telecommunications and Networking Devices

	TCF250	TRF250	TS250	TSV250	TSL250	TS600 TSM600	TRF600
Voltage Rating (V_{AC})* (Interrupt)	250	250	250	250	250	600	600
Specification	ITU GR-1089 Ports 2 & 4	ITU GR-1089 Ports 2 & 4	ITU GR-1089 Ports 2 & 4	ITU GR-1089 Ports 2 & 4	GR-1089 Ports 2 & 4	UL60950 GR-1089 Ports 1, 3, & 5	UL60950 GR-1089 Ports 1, 3, & 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	—	—	—	—	—
0.200	—	—	—	—	—	8.5Ω	—
0.250	—	—	—	—	—	3.5Ω	—
0.400	—	—	—	—	—	1.2Ω	1.2Ω

Voltage Ratings for Telecommunications and Networking Devices

For Raychem 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 Raychem circuit protection devices are certified at 60V but can withstand higher V_{MAX} Interrupt conditions as noted above. 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 have been designed to 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 Telecommunications and Networking Devices [Hold Current (A) at Ambient Temperature (°C)]

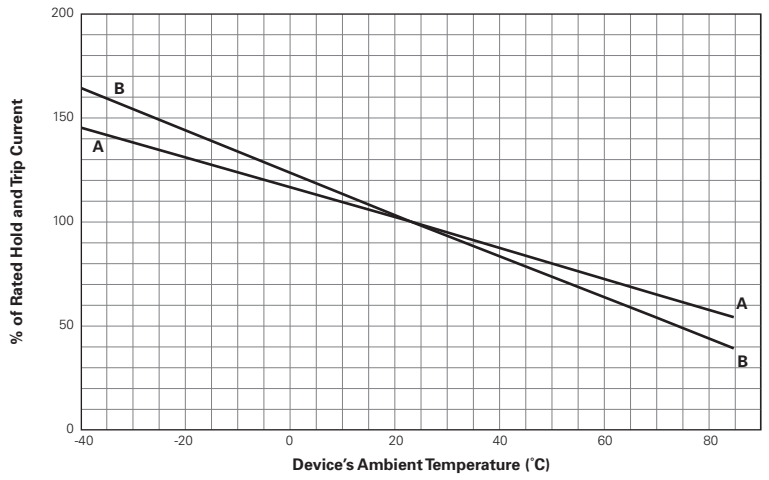
	Part Number	Maximum Ambient Temperature -40°C	-20°C	0°C	20°C	40°C	50°C	60°C	70°C	85°C
	Chip* — 250V$_{AC}$ TCF250									
	TCF250-100T	0.155	0.138	0.119	0.100	0.083	0.073	0.064	0.055	0.042
	TCF250-120T	0.186	0.165	0.143	0.120	0.099	0.088	0.077	0.066	0.050
	TCF250-145T	0.225	0.199	0.172	0.145	0.119	0.106	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									
NEW	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
NEW	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
	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
NEW	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 are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.
† 600V$_{AC}$ interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 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, TSx, TSM series devices

Figure T1



RoHS Compliant, ELV Compliant

Table T3 Electrical Characteristics for 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											
NEW 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
NEW 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**
Radial-leaded† — 600V_{AC} TRF600											
TRF600-150	0.150	0.300	250	600	3.0	1.0	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
NEW 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 are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.
† 600V_{AC} interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 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.

Table T3 Electrical Characteristics for 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 have been designed to 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 have been designed to 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 are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.
† 600V_{AC} interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

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.

Figure T2-T13 Dimension Figures for Telecommunications and Networking Devices

Figure T2

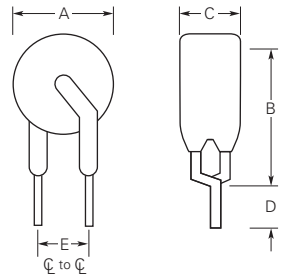


Figure T3

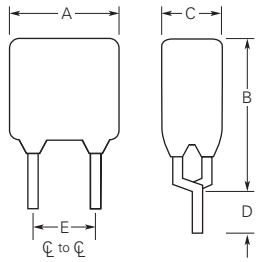


Figure T4

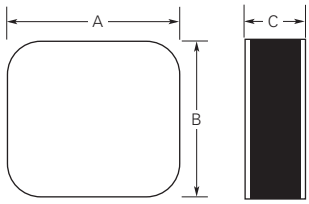


Figure T2-T13 Dimension Figures for Telecommunications and Networking Devices Cont'd

Figure T5

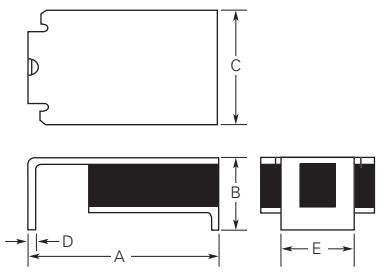


Figure T6

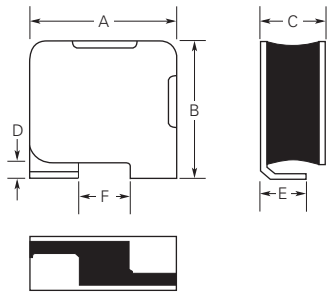


Figure T7

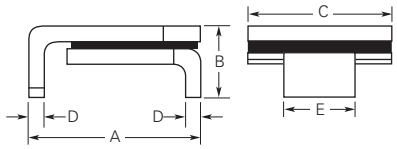


Figure T8

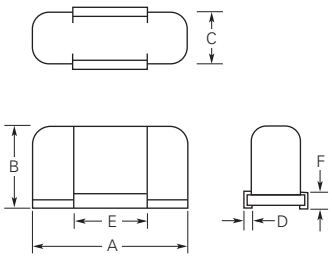


Figure T9

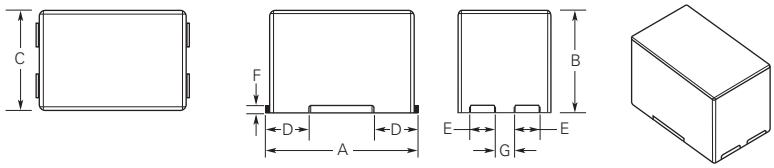


Figure T10

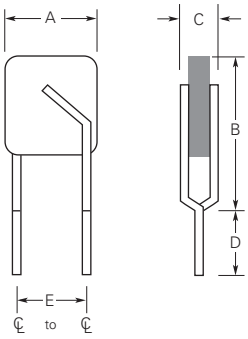


Figure T11

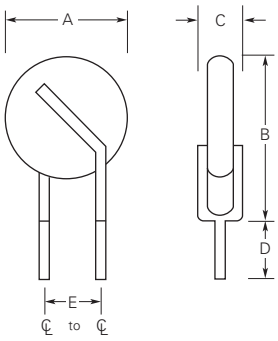


Figure T12

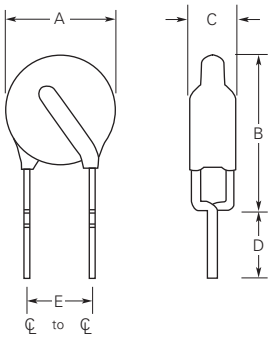


Figure T13

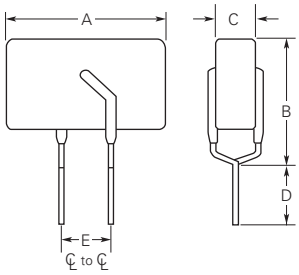


Table T4 Dimensions for Telecommunications and Networking Devices in Millimeters (Inches)

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.	Figure
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
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
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
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
TRF250 250V*															
NEW TRF250-055UT	—	4.8 (0.19)	—	9.3 (0.37)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T2
TRF250-080T	—	5.8 (0.23)	—	9.9 (0.39)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T2
TRF250-080U	—	4.8 (0.19)	—	9.3 (0.37)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T11
TRF250-110U	—	5.3 (0.21)	—	9.4 (0.37)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T11
TRF250-120	—	6.5 (0.26)	—	11.0 (0.43)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T3
TRF250-120U	—	6.0 (0.24)	—	10.0 (0.39)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T10
TRF250-145	—	6.5 (0.26)	—	11.0 (0.43)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T3
TRF250-145U	—	6.0 (0.24)	—	10.0 (0.39)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T10
TRF250-183	—	7.5 (0.29)	—	10.5 (0.41)	—	4.1 (0.16)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T2
NEW TRF250-184	—	7.7 (0.30)	—	10.5 (0.41)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T12
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
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
TSV250-130F	—	6.1 (0.24)	—	6.9 (0.27)	—	3.2 (0.13)	0.56 (0.02)	—	—	1.9 (0.08)	1.6 (0.07)	2.3 (0.09)	—	—	T6
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
TR600-150F-EX	—	13.5 (0.53)	—	12.6 (0.50)	—	6.0 (0.18)	4.7 (0.19)	—	5.0 (0.20)	—	—	—	—	—	T3
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
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)	—	—	T3
NEW TRF600-400	—	14.8 (0.58)	—	13.1 (0.52)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	—	—	—	—	T13

* $250V_{AC}$ interrupt products are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.
† $600V_{AC}$ interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.
‡ Indicates dimension is typical, not minimum.

Table T4 Dimensions for Telecommunications and Networking 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.	Figure
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
	(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
	(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
	(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	17.00	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
	(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	17.00	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
	(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	17.00	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
	(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)	

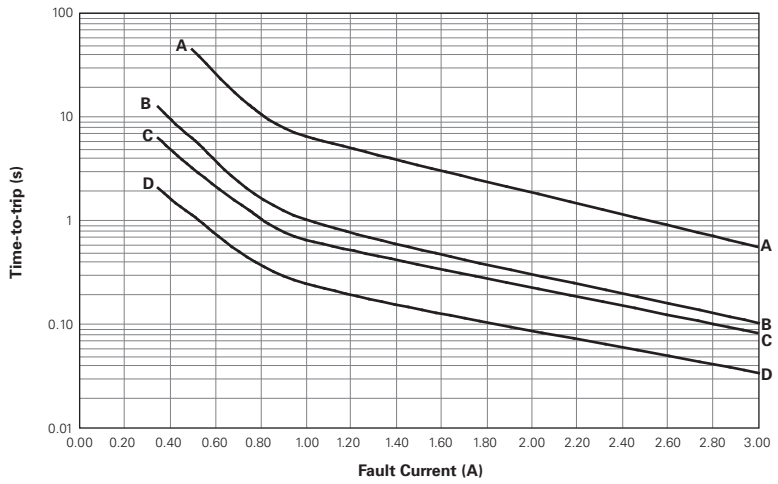
† 600V_{AC} interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

Figure T14-T17 Typical Time-to-trip Curves at 20°C for Telecommunications and Networking Devices

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

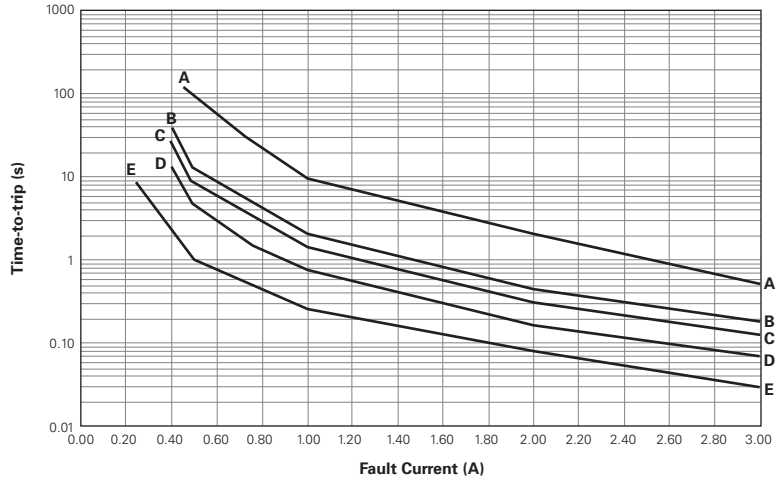


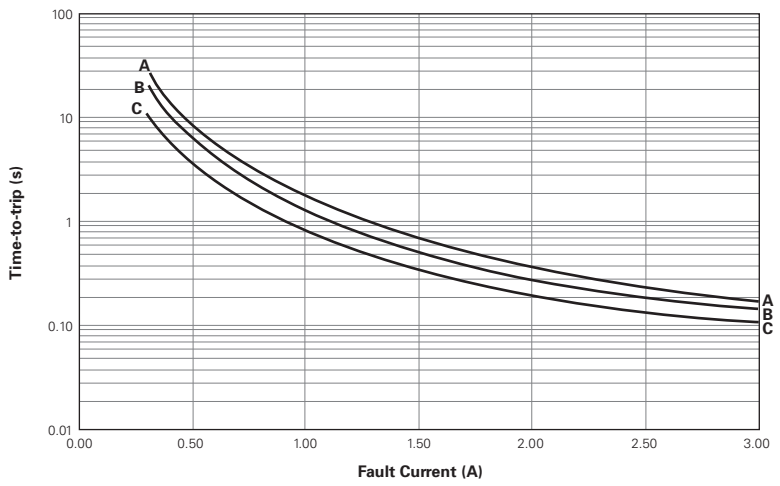
Figure T14-T17 Typical Time-to-trip Curves at 20°C for Telecommunications and Networking Devices

Cont'd

TS250/TSV250/TSL250

A = TSV250-130F
B = TS250-130F
C = TSL250-080F

Figure T16



TRF600/TS600/TSM600

A = TRF600-400/TS600-400/ TSM600-400F
B = TSM600-250F/ TS600-170F/200F
C = TRF600-160
D = TR600-150F-EX
E = TRF600-150

Figure T17

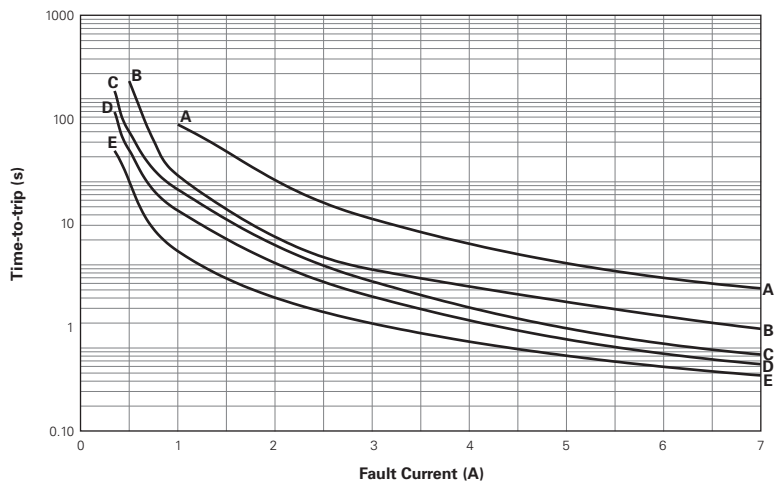


Table T5 Physical Characteristics and Environmental Specifications for Telecommunications and Networking Devices

10

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 hours 85°C, 1000 hours
Humidity aging	85°C, 85% RH, 1000 hours
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 are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.

RoHS compliant, ELV compliant

Table T5 Physical Characteristics and Environmental Specifications for 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 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 seconds at 260°C±5°C

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

Environmental Specifications

Test	Conditions
Passive aging	60°C, 1000 hours 85°C, 1000 hours
Humidity aging	85°C, 85% RH, 1000 hours
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 hours 85°C, 1000 hours
Humidity aging	85°C, 85% RH, 500 hours
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 seconds at 260°C±5°C

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

Environmental Specifications

Test	Conditions
Passive aging	60°C, 1000 hours 85°C, 1000 hours
Humidity aging	85°C, 85% RH, 1000 hours‡
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 are designed to help equipment pass ITU K.20, K.21, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.
† $600V_{AC}$ interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 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 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 20s
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 hours
	85°C, 1000 hours
Humidity aging	85°C, 85% RH, 1000 hours
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 20s
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 hours
	85°C, 1000 hours
Humidity aging	85°C, 85% RH, 1000 hours
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 are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

Table T6 Packaging and Marking Information for Telecommunications and Networking Devices

Part Number	Bag Quantity	Tape & 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					
NEW 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
NEW 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
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
NEW 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, & K.45 recommendations and Telcordia GR-1089 Port Type 2 & 4 requirements.
† 600V$_{AC}$ interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 & 5 requirements.

Agency Recognition for 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 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

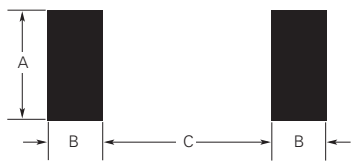


Figure T19

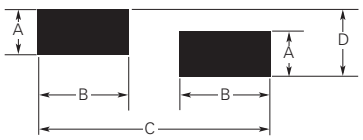
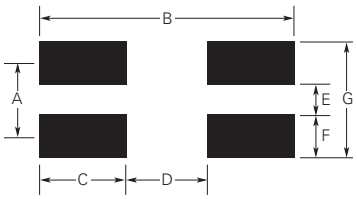


Figure T20

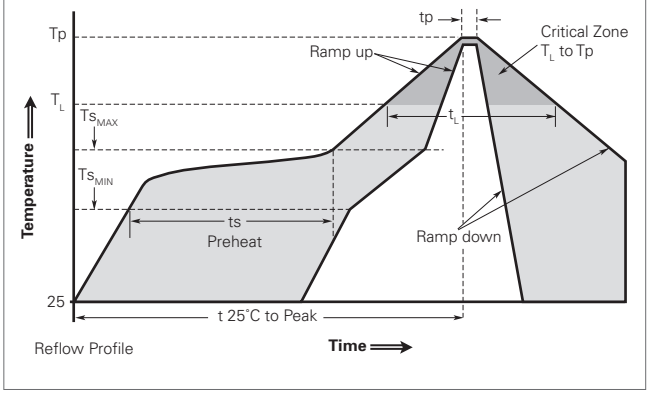


Solder Reflow and Rework Recommendations for Telecommunications Surface-mount Devices

Profile Feature	Pb-Free Assembly
Average ramp up rate (Ts_{MAX} to Tp)	3°C/second max.
Preheat	
• Temperature min. (Ts_{MIN})	150°C
• Temperature max. (Ts_{MAX})	200°C
• Time (ts_{MIN} to ts_{MAX})	60-180 seconds
Time maintained above:	
• Temperature (T_L)	217°C
• Time (t_L)	60-150 seconds
Peak/Classification temperature (Tp)	260°C
Time within 5°C of actual peak temperature	
Time (tp)	20-40 seconds
Ramp down rate	6°C/second max.
Time 25°C to peak temperature	8 minutes 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 designed to be wave soldered to the bottom side of the board.
- Recommended maximum paste thickness of 0.25mm (0.010 in).
- 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.

Wave Soldering and Rework Recommendations for 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

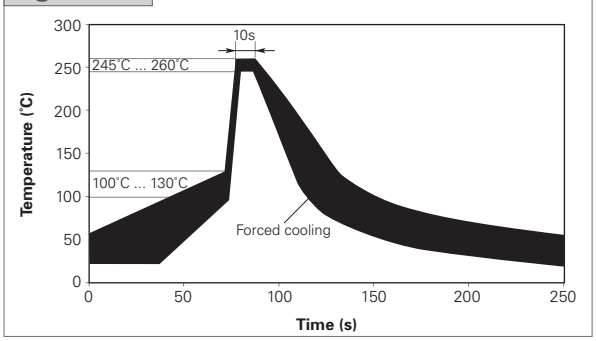


Table T8 TRF250/TRF600 Tape and Reel Specifications for Telecommunications and Networking Device

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	Minimum
Top distance between tape edges	W_6	W_2	3	Maximum
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	Maximum
Overall width with lead protrusion	—	C_1	43.2	Maximum
Overall width without lead protrusion	—	C_2	42.5	Maximum
Lead protrusion	L_1	l_1	1.0	Maximum
Protrusion of cut-out	L	L	11	Maximum
Protrusion beyond hold down tape	l_2	l_2	Not specified	—
Sprocket hole pitch	P_0	P_0	12.7	±0.3
Device pitch (TRF250 & TRF600-150)	—	—	12.7	—
Device pitch (TRF600-160/400)	—	—	25.4	—
Pitch tolerance	—	—	20 consecutive	±1
Tape thickness	t	t	0.9	Maximum
Tape thickness with splice*	t_1	—	2.0	Maximum
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	Maximum
Reel diameter	a	d	370	Maximum
Space between flanges less device	w_1	—	4.75	±3.25
Arbor hole diameter	c	f	26	±12.0
Core diameter	n	h	80	Maximum
Box	—	—	56/372/372	Maximum
Consecutive missing pieces*	—	—	3 maximum	—
Empty places per reel*	—	—	Not specified	—

* Differs from EIA specification.

Figure T23 EIA Referenced Taped Component Dimensions for TRF Devices

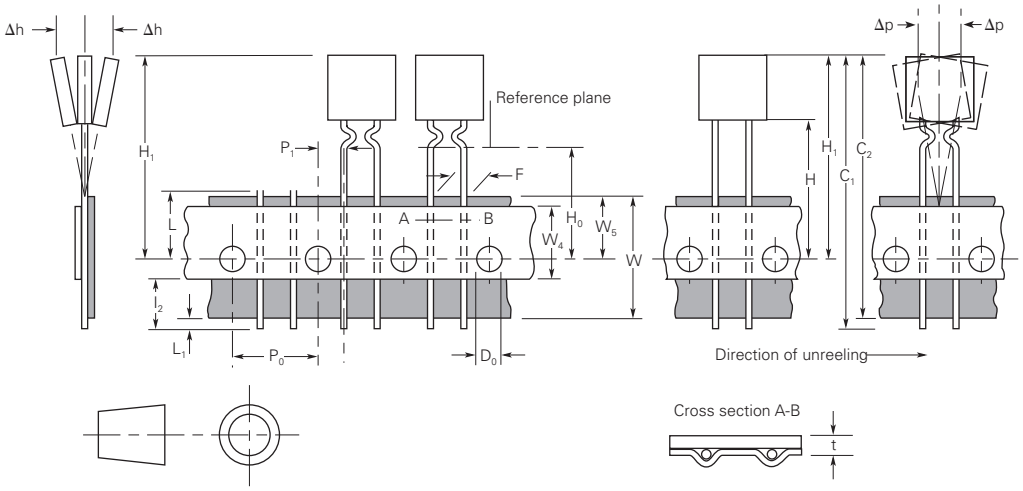


Figure T24 Reel Dimensions for TRF Devices

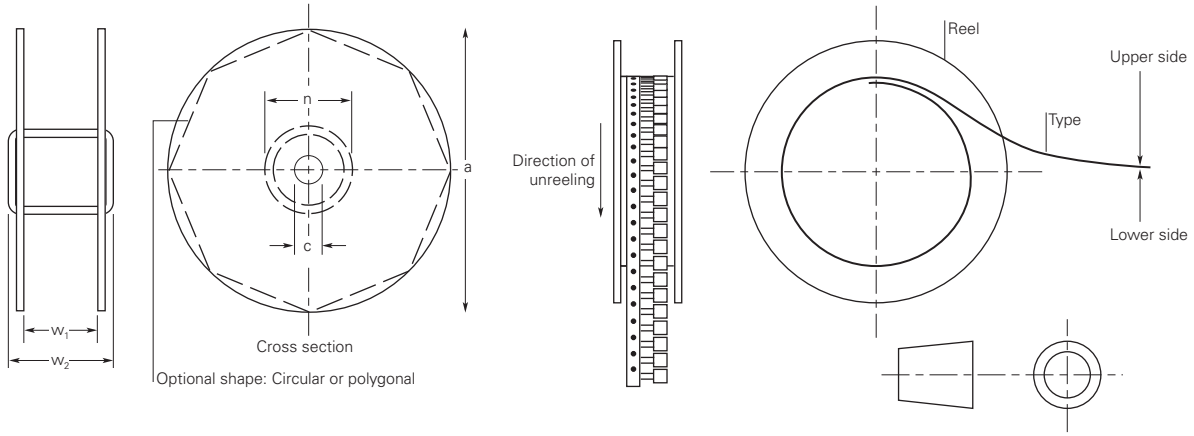


Table T9 TS Tape and Reel Specifications for Telecommunications and Networking Devices

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 Dimension(mm)	TS250 Tolerance(mm)	TSV250 Dimension(mm)	TSV250 Tolerance(mm)	TSL250 Dimension(mm)	TSL250 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 splice cover tape thickness	T_1 max.	0.1	—	0.1	—	0.1	—
	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 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 TS Devices

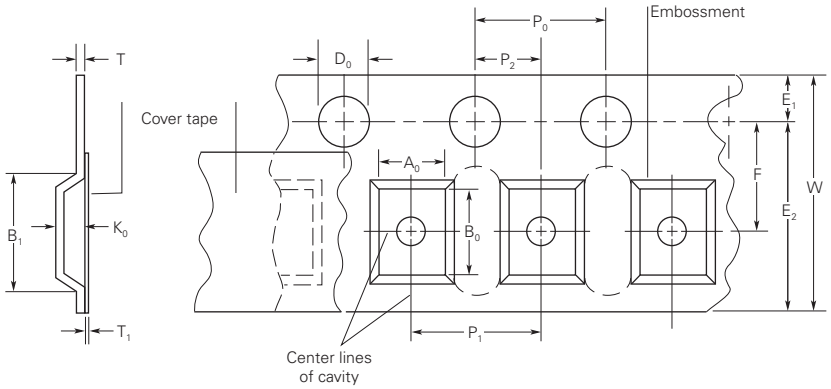
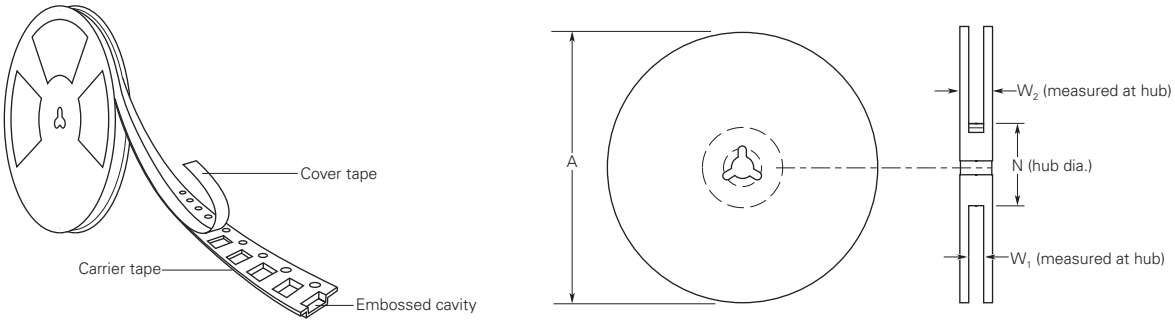


Figure T26 EIA Referenced Reel Dimensions for TS Devices



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

- Greater flexibility for design engineers.
- Lower resistance devices can allow for increased loop length on line card designs.
- Higher resistance devices may 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 reduce the tip-ring resistance differential, reducing the possibility of line imbalance.

Part Numbering System for Radial-leaded Telecommunications and Networking Devices

TRF*250 -120 T -RA -B-0.5 -2

Packaging
2 = Tape and Reel
0.130 = special lead length in inches
(Blank) = Bulk

B-x.x = Resistance matched in bins of x.xΩ (optional)

Rx = Resistance range (optional)

Modifier (optional)
U = Uncoated
S = Straight lead
T = Fast Trip device

Hold Current (mA)

Product Series (TRF250, TRF600)

* F = RoHS compliant, ELV compliant

Part Numbering System for Surface-mount Telecommunications and Networking Devices

TSx -200 F -RA -B-0.5 -2

Packaging
2 = Tape and Reel
(Blank) = Bulk

B-x.x = Resistance matched in bins of x.xΩ (optional)

Rx = Resistance range (optional)

F = RoHS Compliant, ELV Compliant

Hold Current (mA)

Product Series (TS250, TSV250, TSL250, TS600, TSM600)

Part Numbering System for Chip Telecommunications and Networking Devices

TCF*250 -120 T -RA -B-0.5

- **B-x.x = Resistance matched in bins of x.xΩ (optional)**
- **Rx = Resistance range (optional)**
- **Modifier (optional)**
  T = Fast Trip device
- **Hold Current (mA)**
- **Product Series**

* F = RoHS compliant, ELV compliant

Circuit Protection Business Unit Headquarters
308 Constitution Drive, Building H
Menlo Park, CA USA 94025-1164
Tel : (800) 227-7040, (650) 361-6900
Fax : (650) 361-4600

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Fax : 33-1-34202324

Nordic / Baltic
Tel : 49-89-6089485
Fax : 49-89-6089394

France
Tel : 33-1-34202129
Fax : 33-1-34202324

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Fax : 82-2-3486-1786

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Fax : 886-2-8768-1277

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Tel : 86-10-6569-3488 x 16522
Fax : 86-10-6569-3206

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