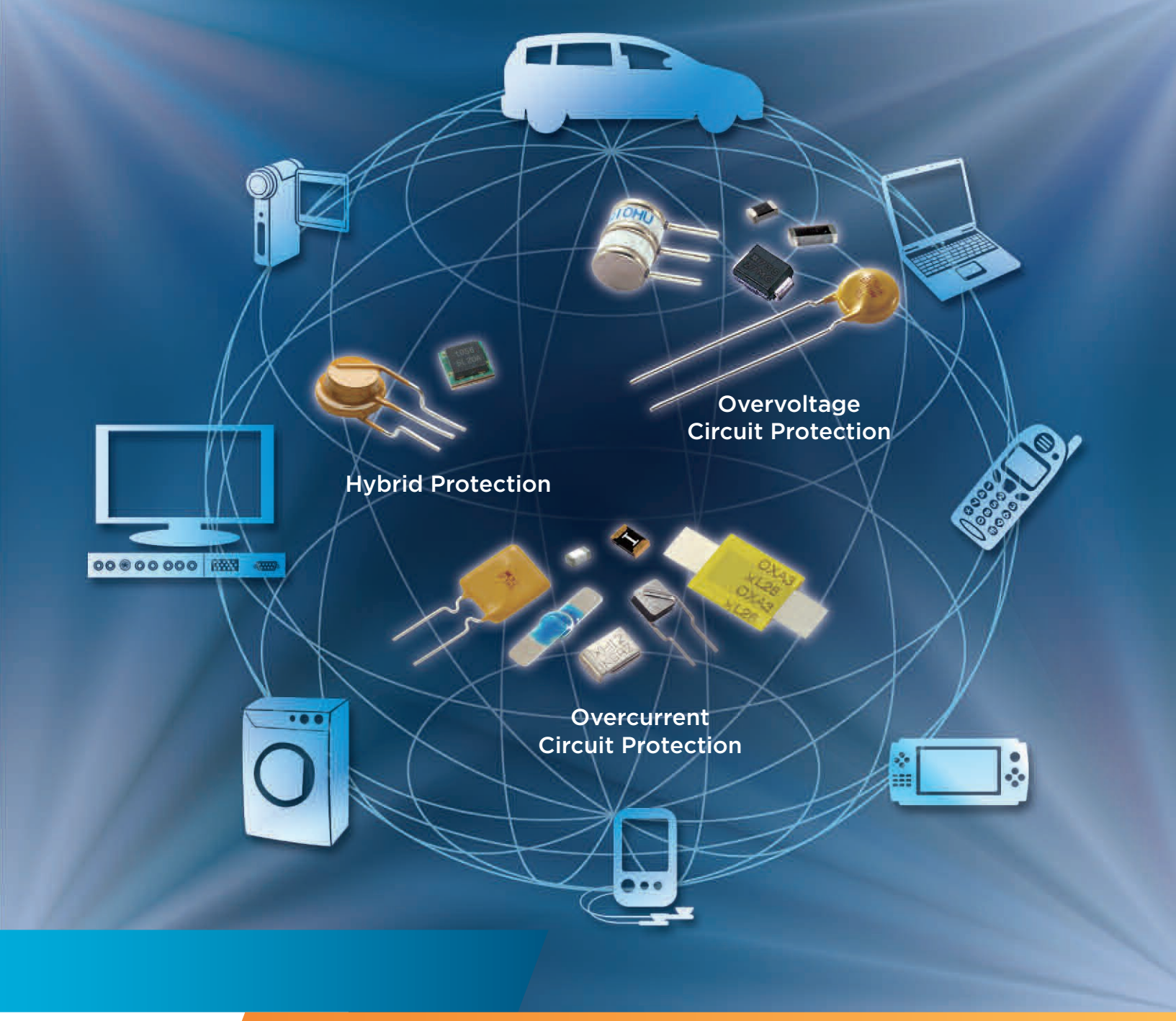

Raychem Circuit Protection Products Catalog 2009

Tyco Electronics

Our commitment. Your advantage.

Tyco Electronics

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Tyco Electronics
Our commitment. Your advantage.

Welcome to Tyco Electronics
With a 50-plus year history of leadership, Tyco Electronics is a US$14.8 billion global provider of engineered electronic components for thousands of consumer and industrial products; network solutions and systems for telecommunications and energy markets; undersea telecommunication systems; and wireless systems for critical communications. We design, manufacture and market products for customers in industries ranging from automotive, appliance, aerospace and defense to telecommunications, computers and consumer electronics. Tyco Electronics is an independent, publicly traded company whose common stock is listed on the New York Stock Exchange (NYSE) under the ticker symbol "TEL."

We manufacture nearly 500,000 precision-engineered products – all backed by approximately 96,000 committed employees with a singular commitment to bringing a performance advantage to every technology, product and service we provide.

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 screens, heat shrink tubing, racks and panels, network interface devices, land mobile radios and networks 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 applications-specific, highly engineered products and systems to satisfy customers' needs. We apply for more than 750 patents annually and hold more than 16,000 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$14.8 billion in fiscal 2008, 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 96,000 dedicated employees who are based throughout the world, with approximately 36,000 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 50 countries, we can collaborate with customers to provide highly engineered products and innovative solutions to meet their needs. Our diverse and capable management team, with an average of more than 20 years of electronics industry experience, is equally dedicated to creating and sustaining those powerful customer alliances – and to earning their business every day.

Raychem Circuit Protection Products

Raychem 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 SiBar thyristor surge protectors, gas discharge tubes (GDT), Raychem metal oxide varistors (ROV) and electrostatic discharge protectors (PESD). 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 the new high-current-rated chip fuses were introduced for use in applications that need to disable the circuit rather than isolate it.

Our two hybrid protection product lines – PolyZen micro-assemblies and 2Pro devices integrate overcurrent and overvoltage protection functions in a single device effectively reducing component count and, 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. Raychem circuit protection products are in compliance with globally recognized ISO9000/TS16949 standards.

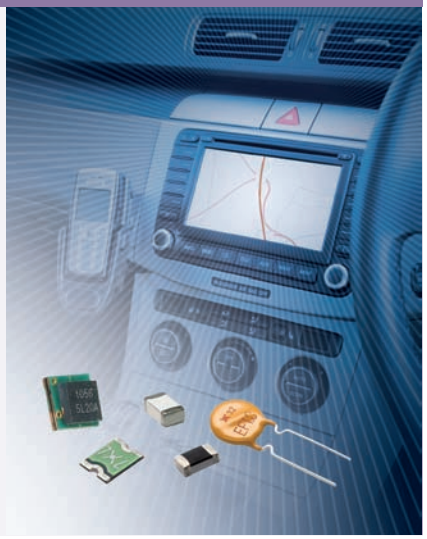
We offer a dedicated engineering sales force, world-wide manufacturing and design centers, and local engineering support devoted to Raychem circuit protection products. This helps us to think, manage, and share globally, yet act locally to meet our customer needs.

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-CAN bus lines, 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
- ROV
- PESD
- 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 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.

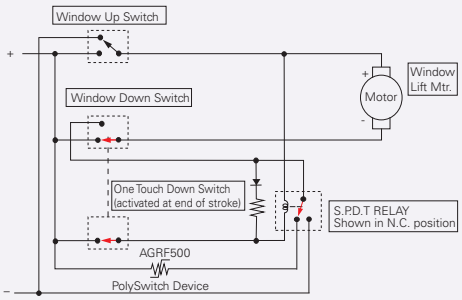
- miniSMD, microSMD, nanoSMD

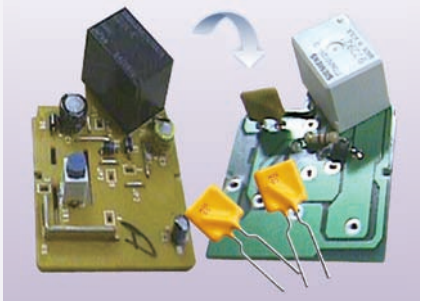
One-Touch-Down Circuit for Power Windows and Power Sunroofs

This lower cost one-touch-down circuit employs a PolySwitch PPTC device to function as both a sense component and as a switch component. This functionality allows a PolySwitch device to replace 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 Circuit



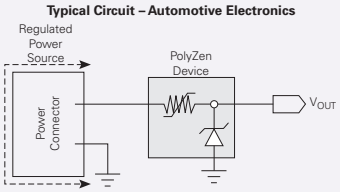


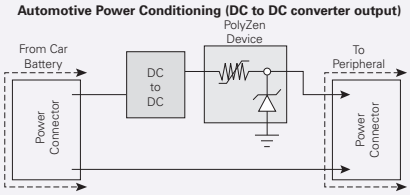
Traditional Design **Tyco Electronics Solution**

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**

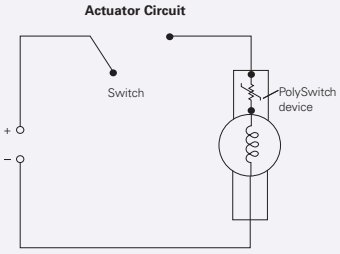




Automotive Actuators and Medium-Size DC Motors

Automotive electric motors can overheat and cause damage to temperature sensitive components. To help protect these components, custom made PolySwitch and overvoltage devices can be designed for specific customer applications.

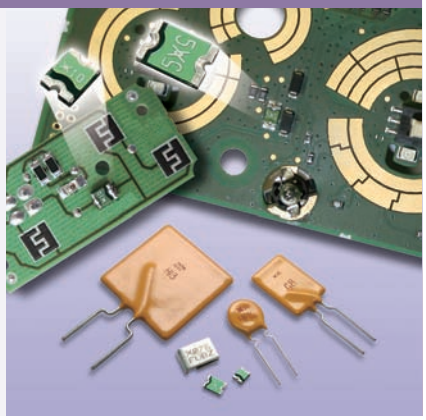
- **AGRF, AHRF, AHEF**
- **SFF, SFS**
- **ROV**



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.

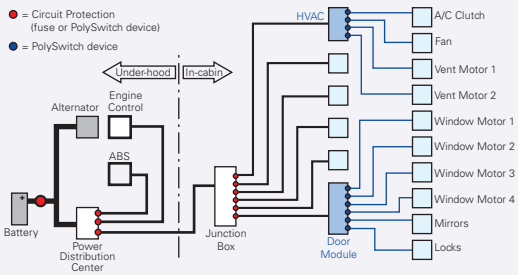
- **AHRF, AGRF, AHEF**
- **AHS, ASMD, miniSMD, microSMD, nanoSMD**



Automobile Harnesses

The wiring harness architectures of light and heavy vehicles have undergone considerable change due to increased vehicle 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.

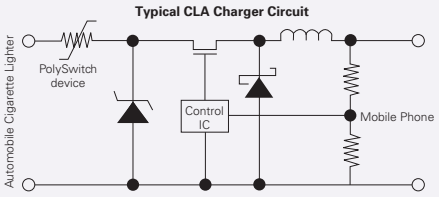
- **AHRF, AGRF, AHEF**
- **VLP, VLR, VTP, LTP, SRP**
- **ASMD**
- **BD280**
- **ROV**



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.

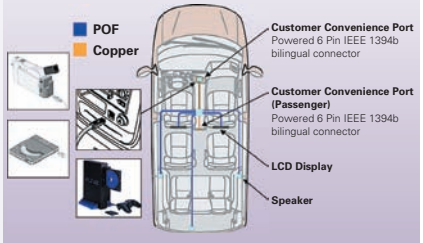
- AHRF, AGRF, AHEF
- AHS, ASMD
- ZEN



Automotive Control Application and Multimedia Buses

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 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.

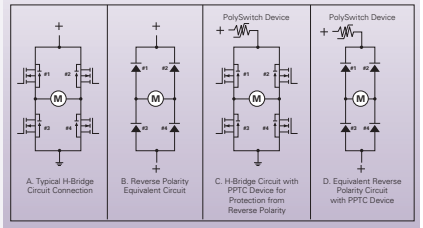
- AHS, ASMD, miniSMD, nanoSMD
- MLV, PESD



H-Bridges

Automotive FET switched H-bridges must be protected from reverse polarity power sources, that 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.

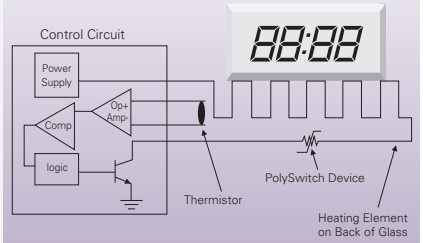
- AHRF, AGRF, AHEF
- AHS, ASMD
- ROV



Liquid Crystal Display Backlight Heaters

There are more and more displays designed into automobiles such as navigation systems, instrumentation displays, video and TV screens. PolySwitch PPTC devices can help protect the heater element in the back of the LCD glass from thermal runaway. A control circuitry failure will cause the PolySwitch PPTC device to thermally trip and help reduce the current flowing through the heater element.

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

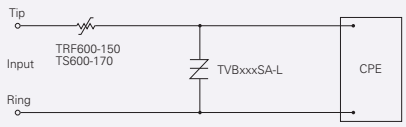


UL60950 and TIA-968-A, (formerly FCC part 68) Requirements

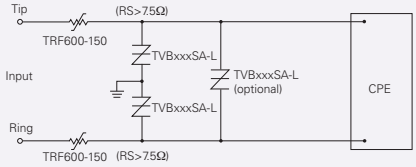
UL60950 and TIA-968-A describe electrical hazards from which customer premise equipment (CPE) in North America must be protected. Below are resettable circuit protection recommendations.

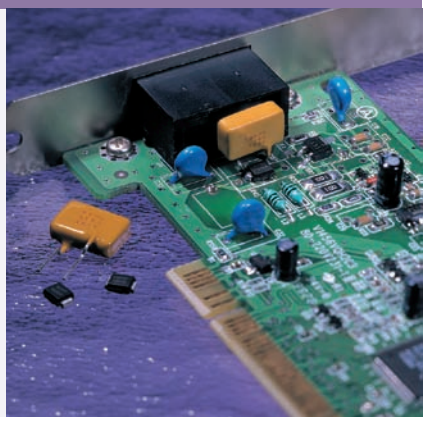
- **TRF600, TS600, TSM600**
- **TVB**

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



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



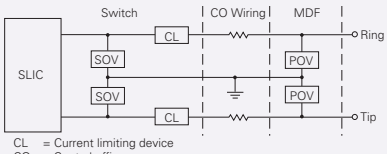


GR-1089 : North America Network Equipment

GR-1089 describes electrical hazards against which Public Switched Telephone Network equipment in North America should be protected. Below are recommended resettable circuit protection solutions.

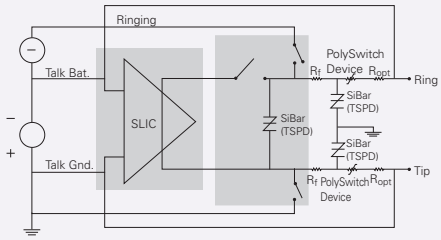
- **TRF600, TS600, TSM600**
- **TVB**

Simplified Model of Central Office End of Subscriber Loop

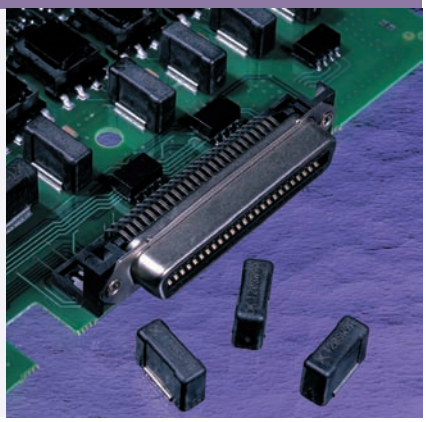


CL = Current limiting device
CO = Central office
MDF = Main distribution frame
POV = Primary overvoltage protection device
SLIC = Subscriber line interface card
SOV = Secondary overvoltage protection device

Simplified Example of a Line Card Design



The use of an optional resistance R_{opt}, and a current-sensing feedback resistor R_f, is explained in Telcordia GR-1089.

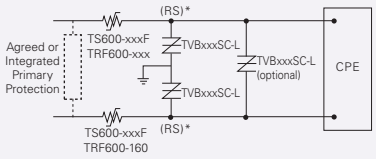


GR-1089-CORE, Issue 4

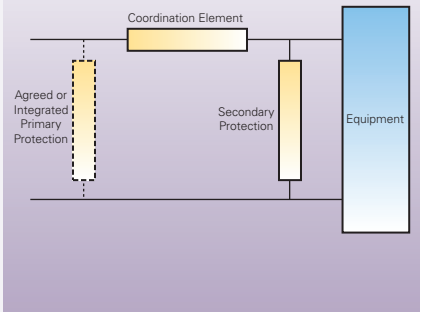
To help prevent damage to telecom equipment, circuits connected to outside lines generally need protection from lightning and power fault events. Protection may be primary only, but in such a case the equipment must be able to withstand the surges that the primary protector lets through. For this reason, secondary and even tertiary protection is included to help limit the potential damage of the surge letthrough. 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 design engineers conserve valuable board space and meet emerging safety and performance standards.

- **TRF600, TS600, TSM600**
- **TVB**



*RS is equal to the total coordinating resistance of the application

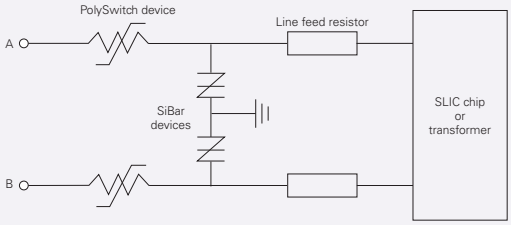


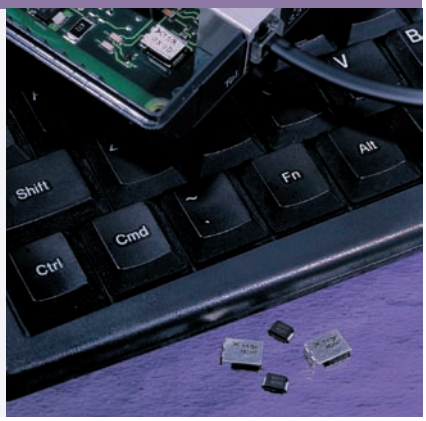
ITU-T Recommendations

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

- **TCF250, TRF250, TS250, TSV250**
- **TVB**

Typical Protection System for Network Equipment





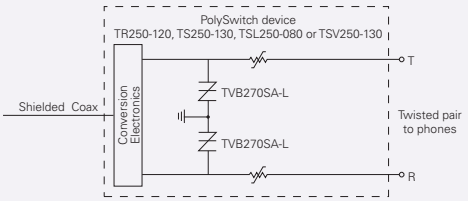
Communications

Short-haul/Intrabuilding Protection Requirements

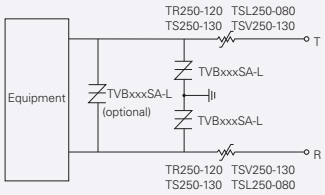
Communications equipment that is not directly connected to the Public Switched Telephone Network is subjected to lower level hazards. Circuit protection recommendations for LAN, WLL, VoIP and other intrabuilding applications.

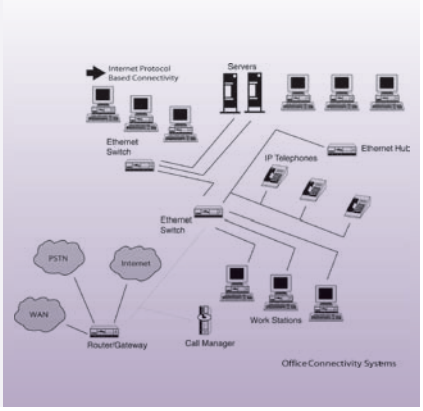
- TRF250, TS250, TSL250, TSV250
- TVB

Fully Resettable Protection Solution for Cable-based Telephony System



Linecard or Grounded CPE Protection



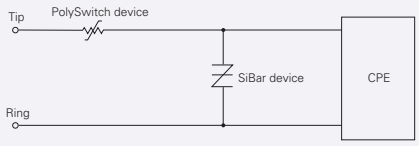


Customer Premise Equipment

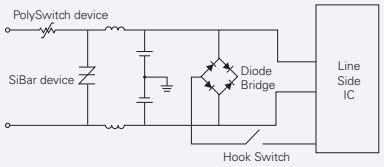
To protect subscribers against damage caused by faults entering from outside wiring, customer premise equipment (CPE) is designed with power cross and lightning protection components. Recommended protection solutions based on regional requirements.

- RXEF
- SMD
- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- TVB
- ROV
- FT600

Generic CPE Interface



Modem Interface

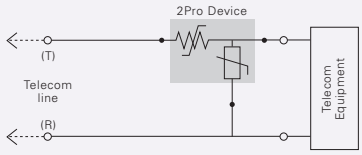


Customer Premise Equipment using 2Pro Devices

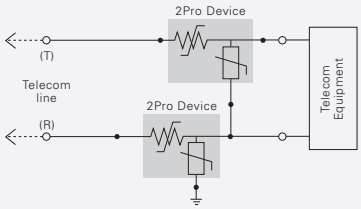
2Pro devices help protect cost-sensitive public switched telephone network (PSTN) and voice over Internet protocol (VoIP) telephony equipment from damage caused by lightning and ESD surges, power contact and induction with AC lines. If left unprotected from these hazards, customer premise equipment (CPE)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

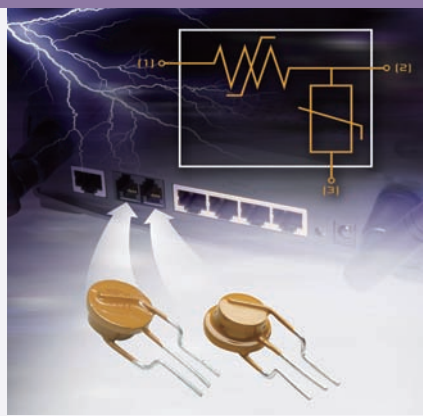
- TM2P

Ungrounded System



Grounded System



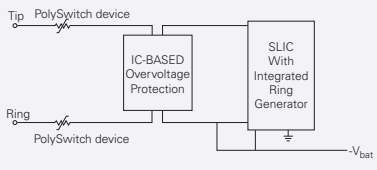


Analog Linecards

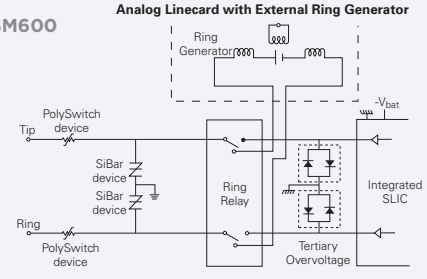
Central office line cards are subject to transient overcurrent and overvoltage faults, which may be generated from nearby power cross, power induction, and lightning events. Circuit protection recommendations based on regional agency specifications are provided.

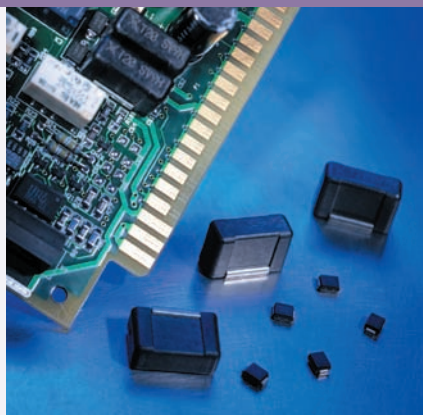
- TRF250, TRF600, TS250, TS600, TSV250, TSM600
- TVB

Analog Linecard with Integrated Ring Generator



Analog Linecard with External Ring Generator



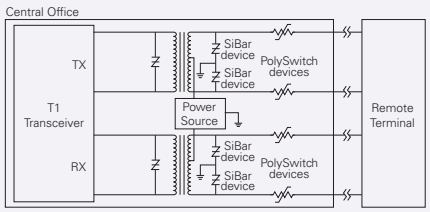


T1/E1 Equipment

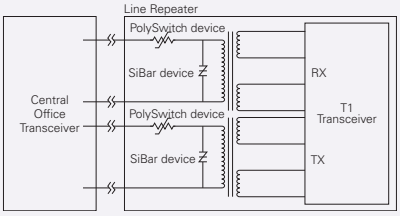
T1/E1 transmission equipment must be protected against damage caused by transient power cross and lightning faults which may enter on outside plant wiring. Circuit protection recommendations based on regional agency specifications are provided.

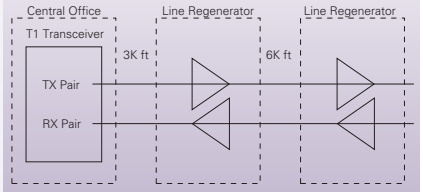
- **TRF250, TRF600, TS250, TS600, TSV250, TSM600**
- **TVB**
- **FT600**

T1/E1 Central Office Transceiver Protection



T1/E1 Line Repeater Protection



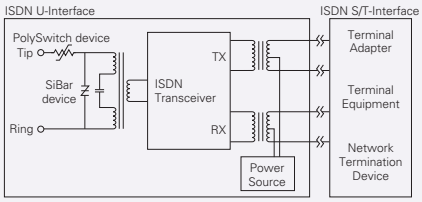


ISDN Equipment

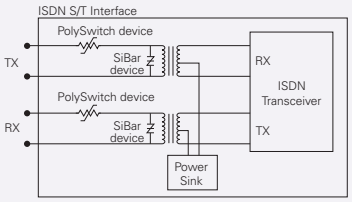
ISDN CO and CPE equipment must be protected against damage caused by transient power cross and lightning faults which may enter via outside plant wiring. Circuit protection recommendations based on regional agency specifications are provided.

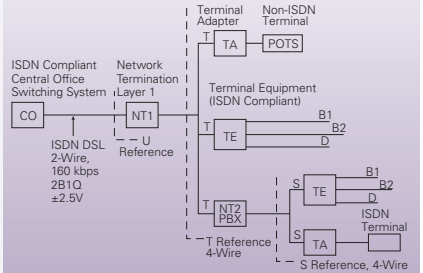
- **TRF250, TRF600, TS250, TS600, TSV250, TSM600**
- **TVB**

ISDN U Interface Protection



ISDN S/T Interface Protection



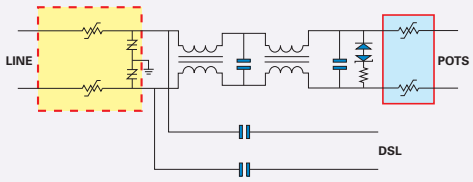


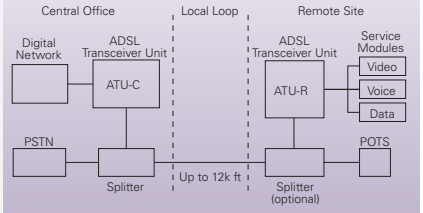
ADSL Equipment

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

- **TRF250, TRF600, TS250, TS600, TSV250, TSM600**
- **TVB**

Splitter Schematic



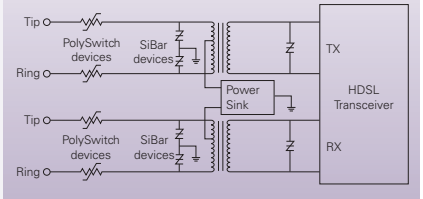


HDSL Equipment

HDSL equipment must be protected against damage caused by transient power cross and lightning faults which may enter on outside plant wiring. Circuit protection recommendations based on regional agency specifications are provided.

- **TRF250, TRF600, TS250, TS600, TSV250, TSM600**
- **TVB**

HDSL Central Office/Remote Terminal

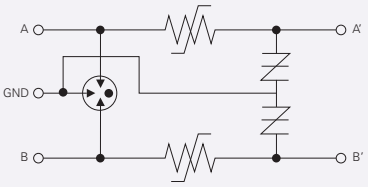


MDF Modules/Primary and Secondary Protection

Telecom systems 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 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
- TVB

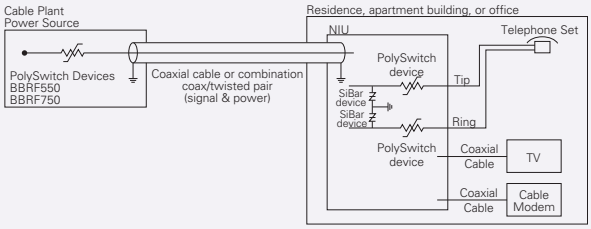


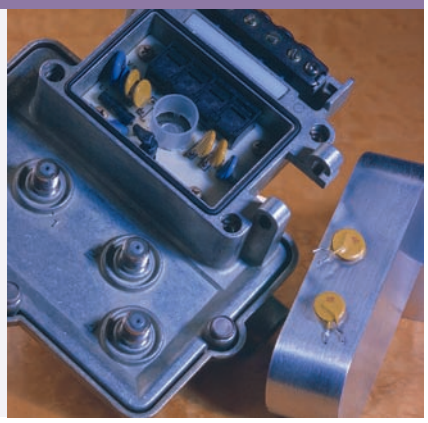
Cable Telephony/Cable Power Passing Tap

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
- TVB
- ROV

Cable Telephony/Cable Power Architecture

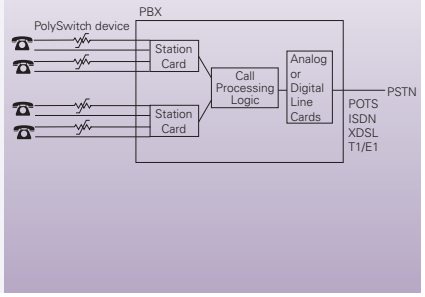




PBX and Key Telephone Systems

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

- RXEF
- miniSMD, SMD
- TRF250, TRF600, TS250, TS600, TSM600
- TVB

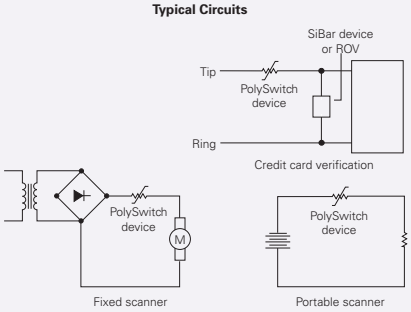


POS Equipment

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
- TVB
- ROV

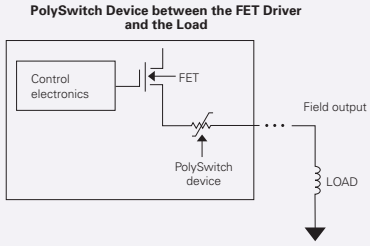
Typical Circuits

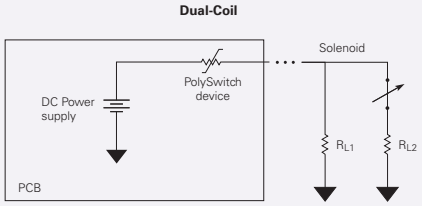


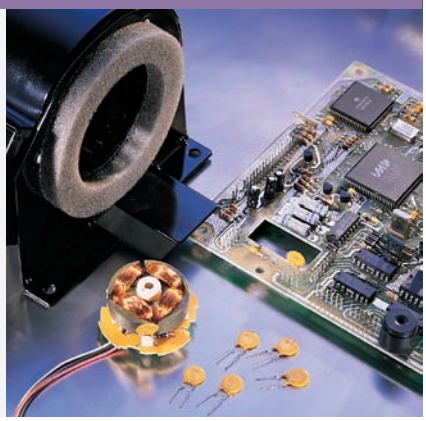
Electromagnetic Loads

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
- ROV



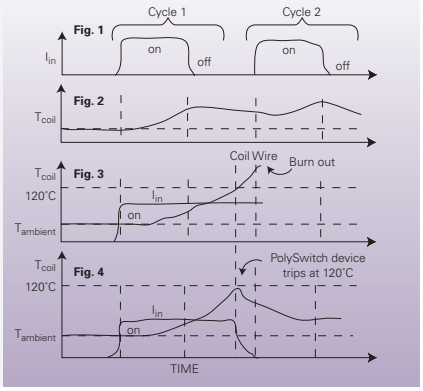




Solenoids

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.

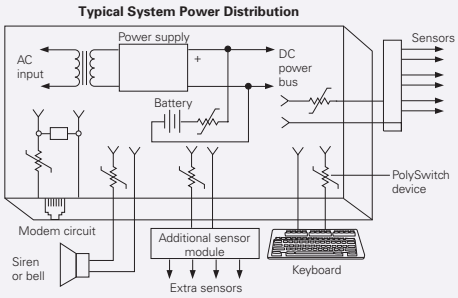
- RGEF, RHEF, RUEF, RXEF
- miniSMD, SMD
- ROV

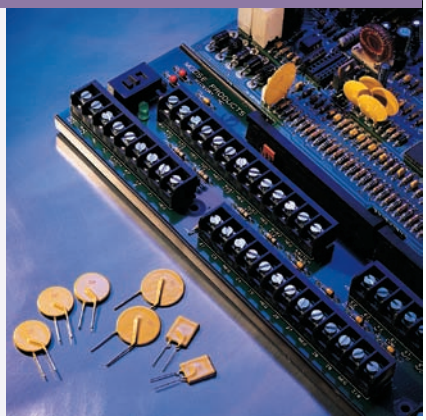


Security and Fire Alarm Systems

Short circuits in the sensor lines, overheating of the battery, protection against damage caused by telecom faults, different current requirements, and helping to meet UL864 requirements create a need for circuit protection.

- RGEF, RUEF, RXEF
- TRF
- TVB
- ROV
- GTC

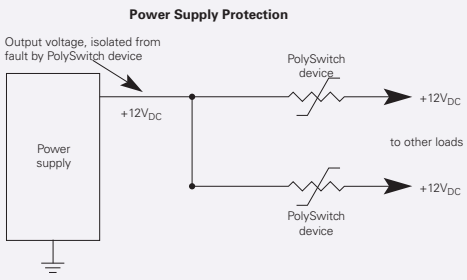


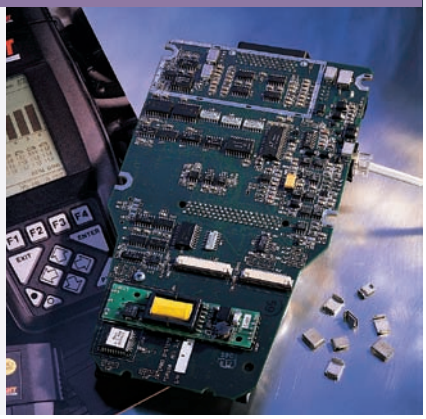


Test and Measurement Equipment

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
- TVB
- ROV



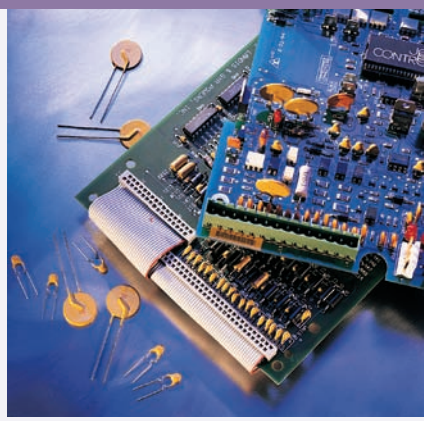


Industrial / Appliance and HVAC

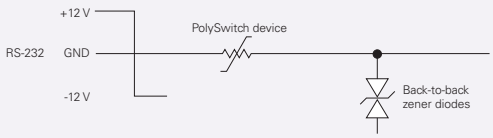
Process and Industrial Controls

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

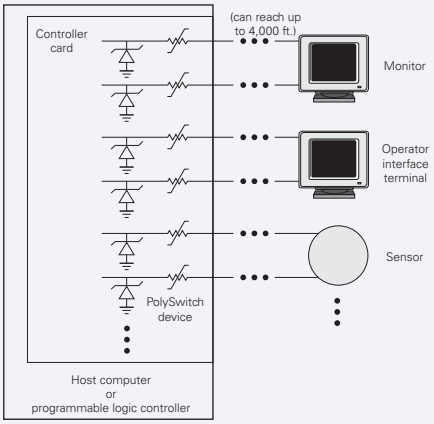
- RHEF, RTEF, RUEF, RXEF
- miniSMD, SMD
- ROV



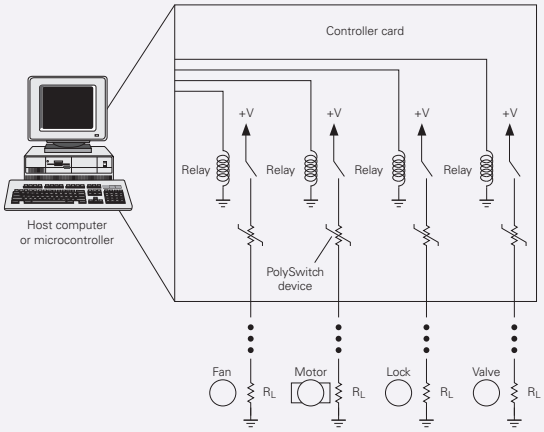
RS-232 Signal with Protection



RS-485 Signal with Protection



Controller Protection

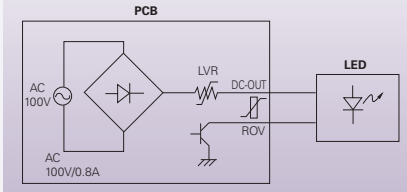


AC Power Input Protection for LED

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. With PolySwitch LVR devices and Metal Oxide Varistors, Tyco Electronics offers designers a complete solution that helps enhance product reliability and safety.

- LVR
- ROV

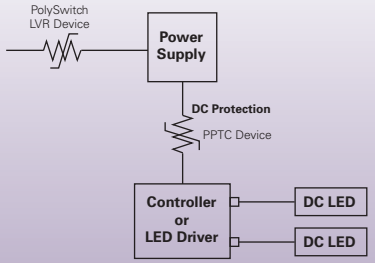


LED Driver Input Protection

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 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.

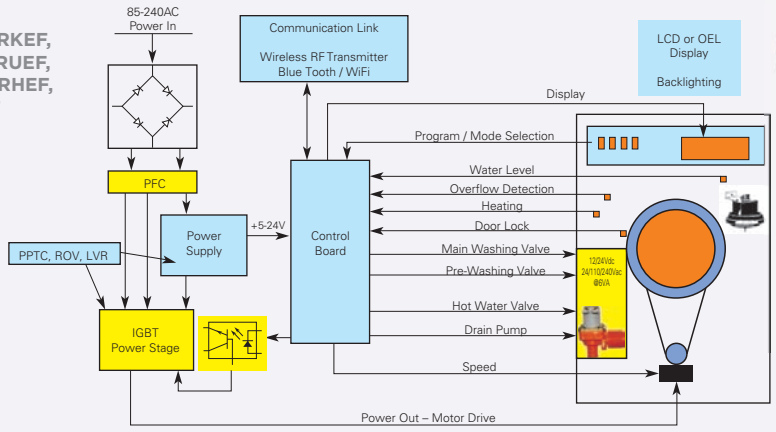
- LVR
- ZEN



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.

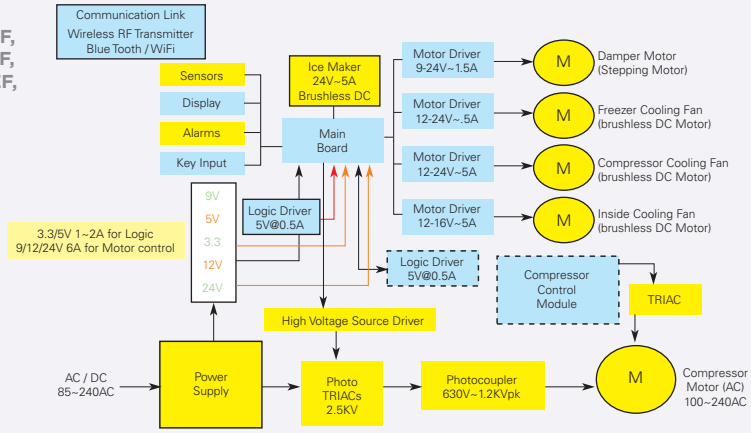
- LVR
- ROV
- RXEF, RKEF, RTEF, RUEF, RGEF, RHEF, RUSBF
- SMD
- TVB



Refrigerators / Freezers

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

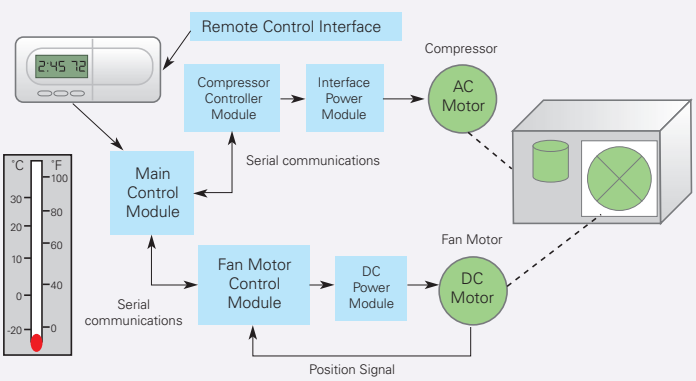
- LVR
- ROV
- RXEF, RKEF, RTEF, RUEF, RGEF, RHEF, RUSBF
- SMD
- TVB

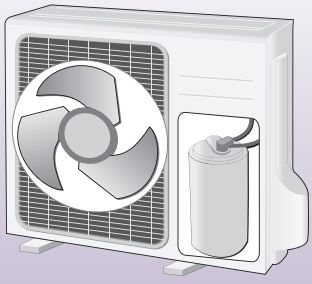


Air Conditioning Units

Resettable PolySwitch devices and metal oxide varistors (MOVs) help provide coordinated overcurrent and overvoltage protection for the motors, fans, displays and interface circuits used in modern HVAC equipment.

- LVR
- ROV
- RXEF, RKEF, RTEF, RUEF, RGEF, RHEF, RUSBF
- SMD





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 Raychem PESD and MLV devices, help shunt ESD away from sensitive circuitry in electronic devices without inducing signal distortion.

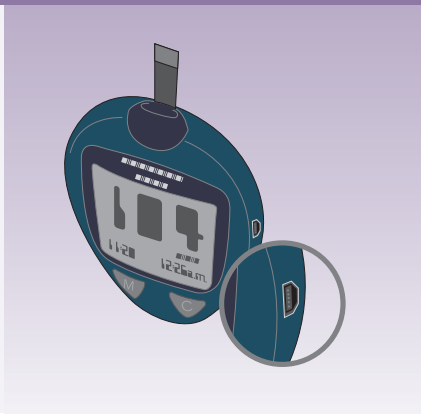
- PESD
- MLV

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.

- RTEF, RUEF, RXEF
- miniSMD, SMD
- TRF

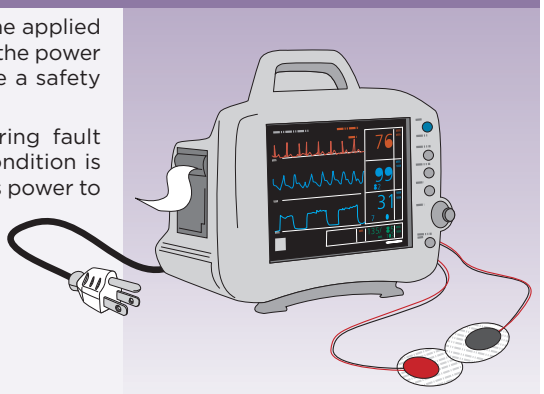


USB Port for Medical Monitoring Systems

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
- miniSMD, SMD
- TRF
- ZEN

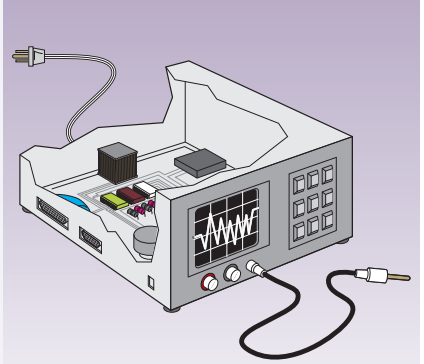


AC Power Input for Medical Diagnostic Equipment

Electrical equipment can be put at risk from high voltage or power transients on the AC inputs due to lightning strikes, power station load switching transients, or from the resulting surge currents.

Overvoltage and overcurrent protection are often viewed as unrelated conditions. With PolySwitch LVR devices and metal oxide varistors (MOVs), Tyco Electronics offers designers a complete solution that helps enhance product protection and reliability.

- LVR
- ROV

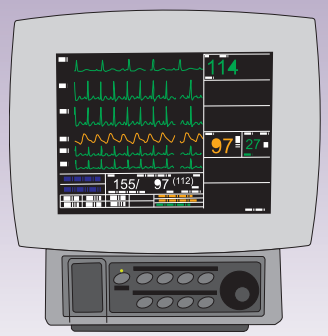


LCD Monitor Controller for Patient Monitoring Systems

Misconnections and mishandling, either during assembly or during use of a wake-up port, can cause large overloads and short-circuits to the system. In addition, component failures on the board can damage the entire board.

Isolating critical circuits with separate PolySwitch devices helps prevent expensive components from being damaged. PolySwitch devices help limit the flow of dangerously high currents during fault conditions and reset back to normal operating mode once the fault condition is removed.

- **RTEF, RUEF, RXEF**
- **miniSMD, SMD**
- **TRF**

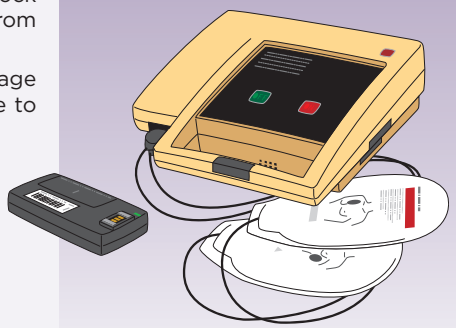


Automated External Defibrillator Electrodes

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**

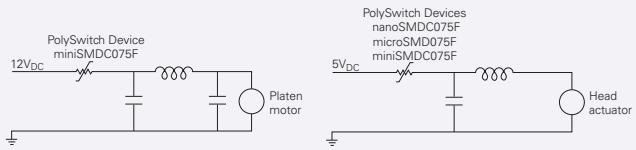


5V/12V Power Lines

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**

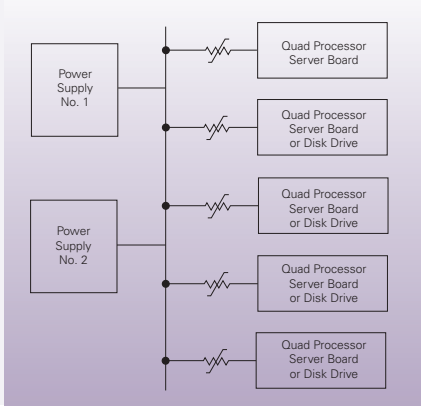
Protection for Disk Drives



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.

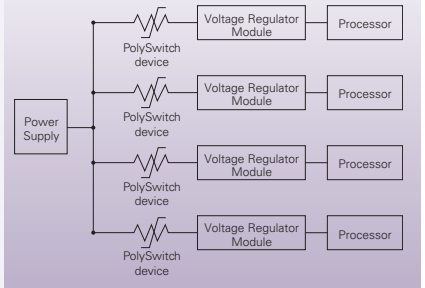
- **RGEF, RXEF**
- **microSMD, miniSMD, SMD**
- **ROV**



Central Processing Units (CPU's)

Voltage regulation modules (VRMs) are used to supply power to processors. 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**

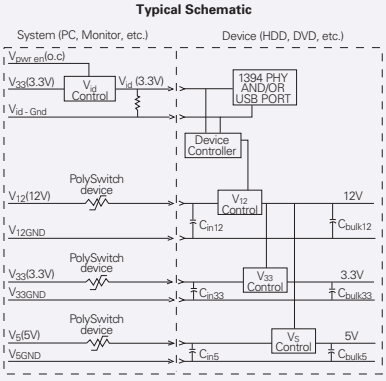


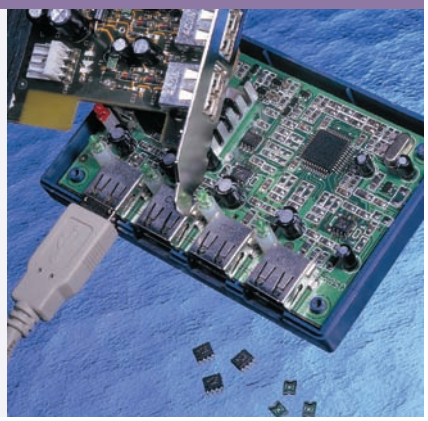
Device Bay

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**

Typical Schematic



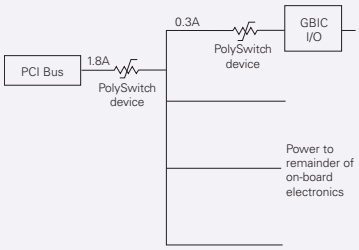


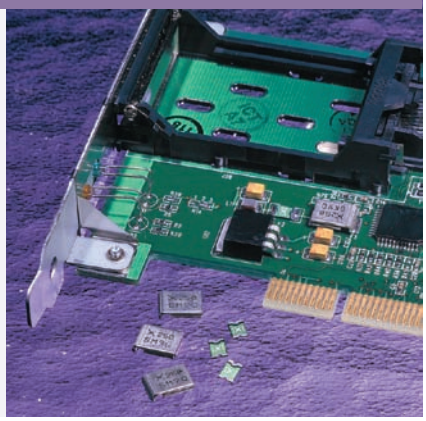
Fibre Channel

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**

Typical Schematic

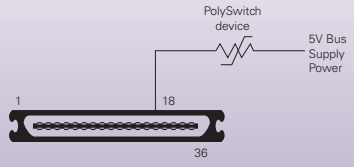




IEEE 1284 Parallel Data Bus

The connector sources up to 350mA at 5V. A misconnection of the connectors or a foreign metal object placed into the connector can cause a significant overcurrent event that could damage system electronics.

- **RXEF**
- **nanoSMD, microSMD, miniSMD**

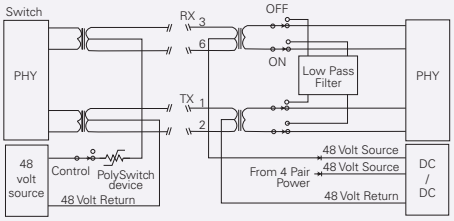


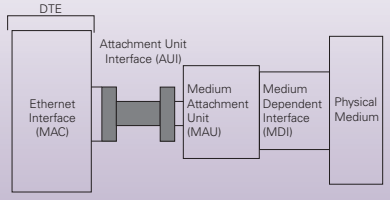
IEEE 802.3 Ethernet LAN (incl. Powered Ethernet)

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**

Typical Schematic



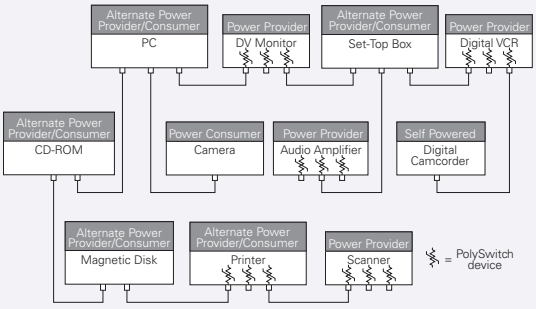


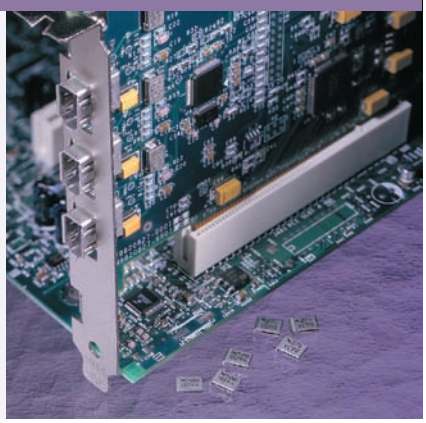
IEEE 1394 FireWire, i.Link

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**

Example of an IEEE 1394 Network





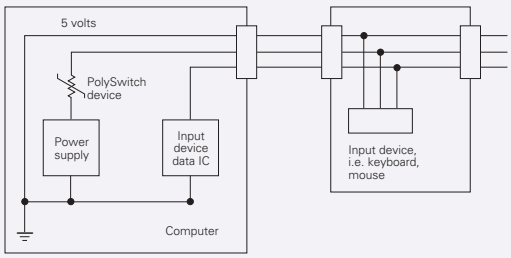
Multimedia

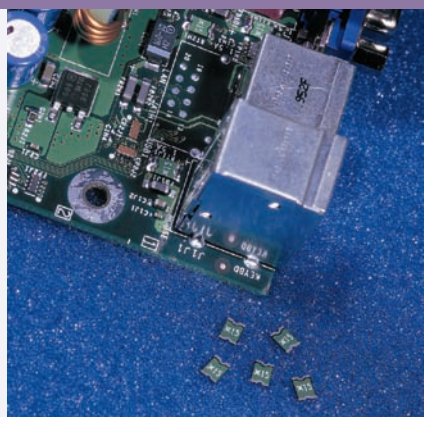
I/O Ports

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

I/O Port Circuit

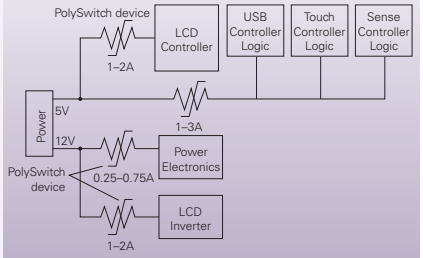




LCD Monitors

Power for LCDs is supplied from the 5V and 12V buses. The LCD controller itself and the surrounding controller logic are powered from the 5V bus. The LCD inverter and the electronics on the board are powered from the 12V bus. Misconnections and mishandling 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

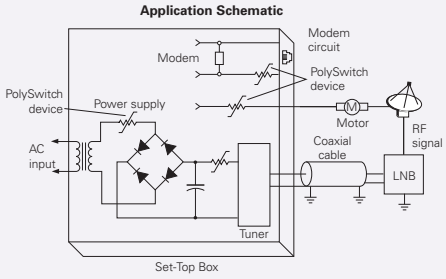


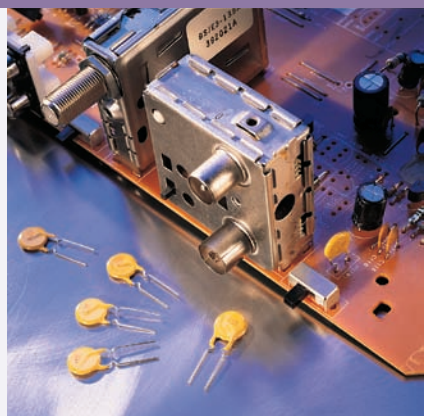
LNB Satellite Set-Tops

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
- ROV

Application Schematic



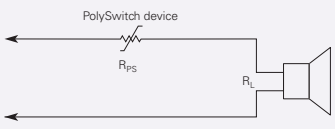


Loudspeakers

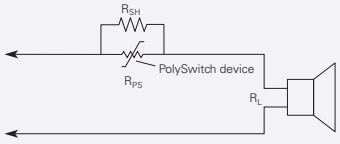
High-powered amplifiers used with low-powered speakers may overdrive the speaker coils with excessive power during sustained high volumes. Low-powered amplifiers may be overdriven so that clipping occurs. This causes an upward frequency shift of power that can overload the tweeters. Digital recordings, 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.

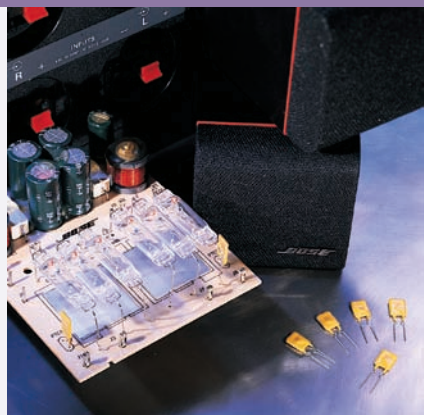
- RXEF

Typical Circuit



Shunt Resistor Circuit



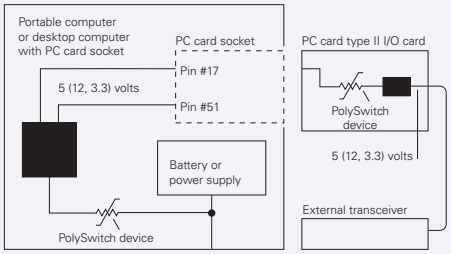


PC Cards and Sockets

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**

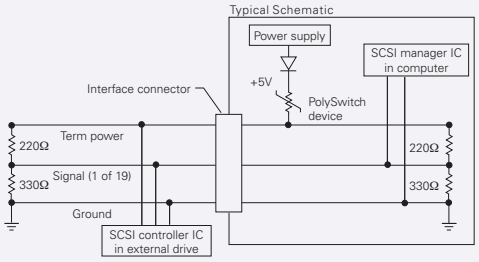
Type II PC Card and Socket

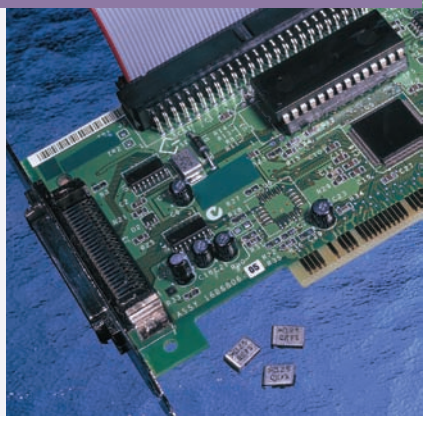


SCSI

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**



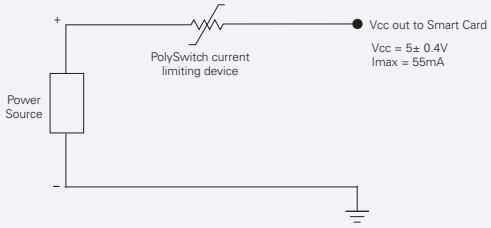


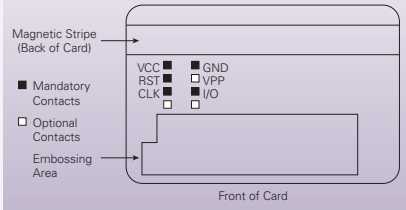
Smart Card Readers

Smart cards are powered from the readers' Vcc. Defective cards or foreign objects placed into the reader can cause a short circuit and permanently damage the reader.

- **microSMD010F**

Smart Card Reader Schematic



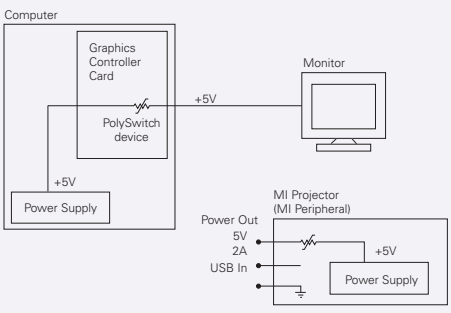


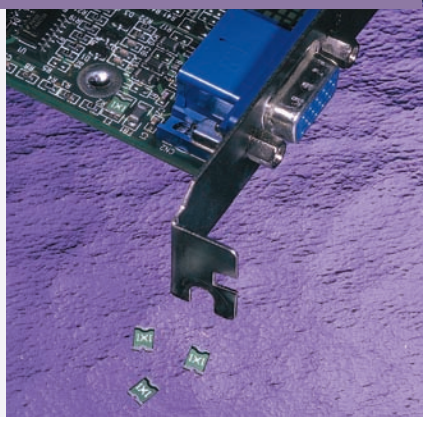
Video Ports (VESA, DDC, DVI)

PolySwitch devices help protect video ports on PCI video cards and motherboard video ports from faults on the 5V interface line in DDC circuits. These ports are designed for Energy Star compliance.

- **RUEF, RUSBF**
- **nanoSMD, microSMD, miniSMD, SMD**

Video Card & M1 Peripherals Circuit Protection



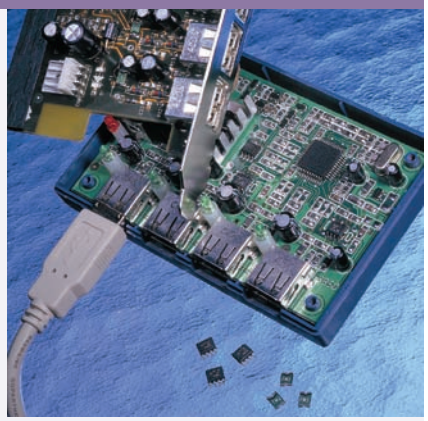


Multimedia

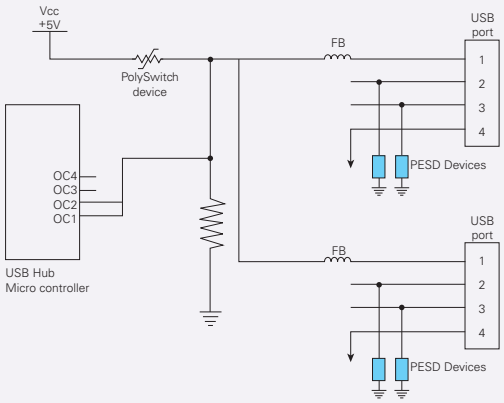
Universal Serial Bus (USB)

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

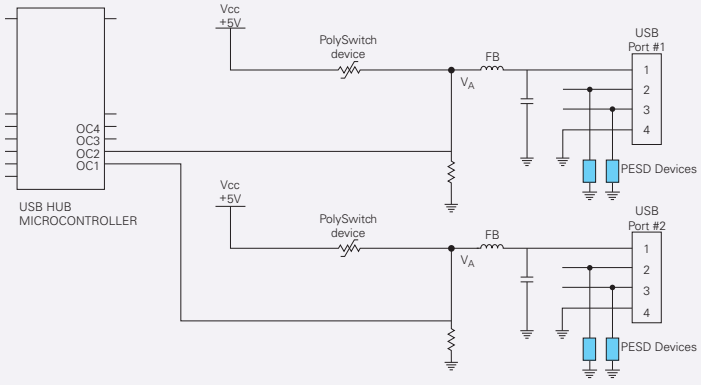
- RUEF, RUSBF
- nanoSMD, microSMD, miniSMD
- PESD



Ganged Port Protection (two-port example)



Low-active Overcurrent Pin Fault Reporting for Individual Port Protection



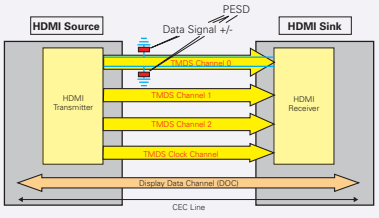
HDMI : LCD, plasma, HDTV, set top box, DVD player

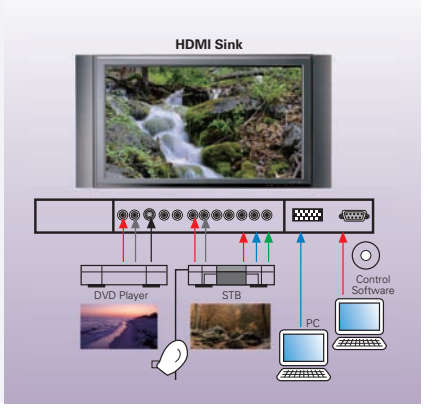
High definition multimedia interface (HDMI) applications such as LCD displays, plasma displays, high definition television set-top boxes, and DVD players are susceptible to electrostatic discharge (ESD). To help protect the high speed TMDS lines against damage caused by ESD hits, PESD devices are used 2 per line.

- PESD

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

HDMI Source



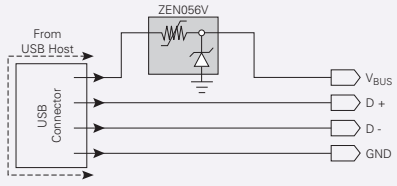


USB Peripherals

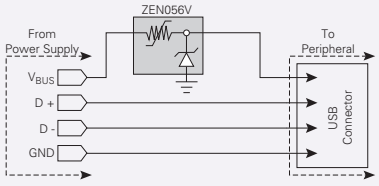
PolyZen devices help protect against damage caused by overvoltage on USB peripherals and devices on the 5V computer bus. The component helps protect sensitive follow-on electronics – such as flash memory and other 6V capable silicon – from inductive voltage spikes, incorrect power supplies, dirty power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

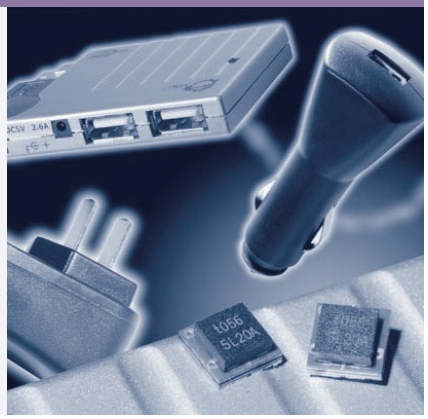
- ZEN

Typical Circuit – USB Peripherals



USB Power Conditioning (Host, Hub, Remote Charger)



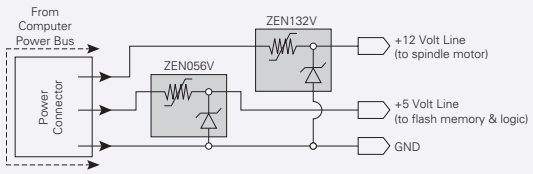


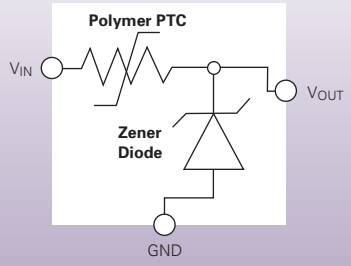
Hard Disk Drives

PolyZen micro-assemblies help protect devices on the 5V and 12V computer bus from overvoltages 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.

- **ZEN**

Typical Circuit – Hard Disc Drive



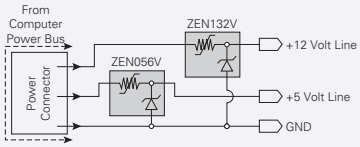


Computer Subsystems and Peripherals

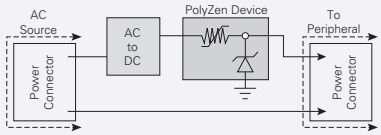
Computer electronics can be exposed to voltages well in excess of the bus voltage, and require protection for power sensitive electronics like flash memory. Voltage spikes can result from a hot disconnect of a peripheral, an internal system shutdown, or other internal power fluctuations. The PolyZen 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.

- **ZEN**

Typical Circuit – Computer Peripherals



Computer Peripherals/Subsystem Power Conditioning (AC to DC converter output)

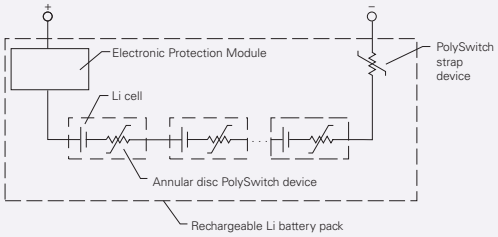


Lithium Cells and Battery Packs

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, VTP**

Typical Rechargeable Lithium Battery Pack Circuit

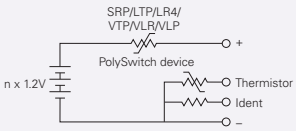


Rechargeable Battery Packs

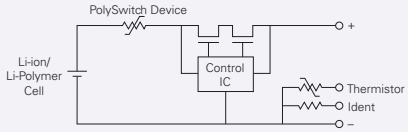
Due to external shorts, runaway charging conditions, or abusive charging, considerable damage can be sustained in both battery cells and pack surroundings. The most common applications are for lithium-ion (Li-ion) battery packs used in cellular phones, digital cameras and laptop/notebook computers or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

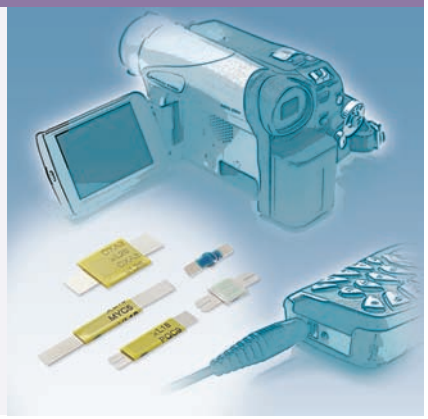
- **LR4, LTP, SRP, VLR, VLP, VTP, MXP**

NiMH/NiCd Battery Pack Circuit Diagram



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



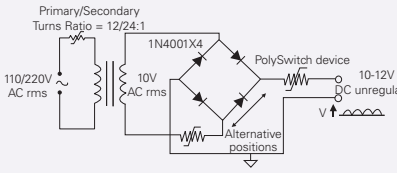


Linear AC/DC Adapters

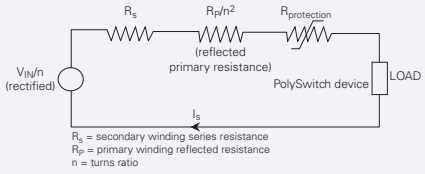
Linear AC/DC adapters, or “wall warts”, can be used in both battery charging applications and in low cost DC power supplies for a variety of consumer equipment. Short circuits or excessive current draw can result in transformer winding overtemperature. PolySwitch devices can help end products meet UL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

- **RTEF, RUEF, RXEF**
- **nanoSMD, microSMD, miniSMD, SMD**
- **ROV**

Example of an Unregulated Linear Adapter Protected by a PolySwitch Device



Transformer Equivalent Circuit

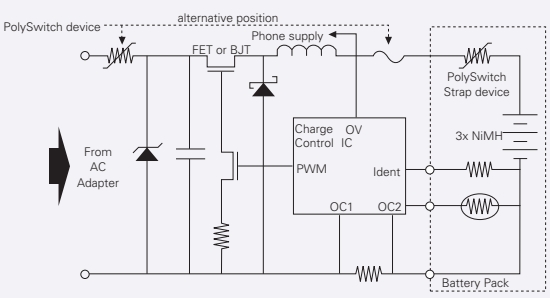


Portable Electronics Input Ports

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**

Typical Portable Electronics Charging Circuit with Protection

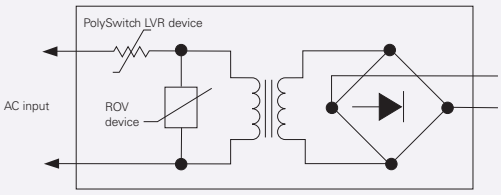


Transformers

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

- RGEF, RHEF, RUEF, RXEF
- SMD
- ROV

Transformer Circuit

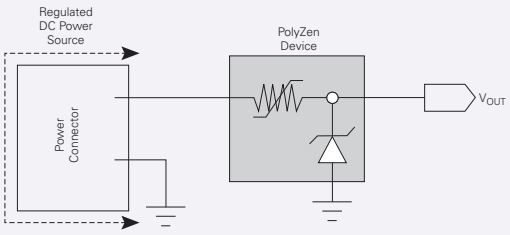


Portable Electronics using PolyZen Devices

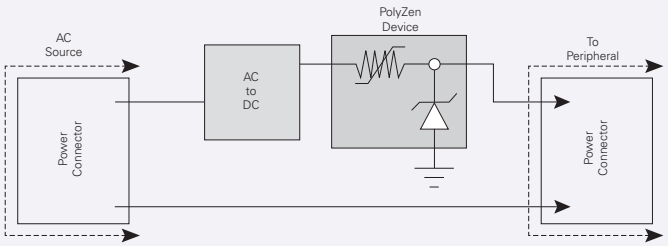
The PolyZen device's unique ability to withstand high inrush currents make it suitable to protect portable electronics and other low-power DC devices such as cell phones, PDAs, MP3 players, digital cameras and USB hubs. Transient protection is particularly important for peripherals that can be powered off computer buses and automotive power buses. 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	SiBar	GDT	ROV	MLV	PESD	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							x				
Lamp protection	x							x				
DC Motor protection	x							x				
Power outlet protection	x							x	x			
Powered antennae	x							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	x			x	
Central office equipment, linecards	x	x	x			x	x	x		x		
LAN, WAN equipment	x	x	x		x	x	x	x		x		x
MDF modules	x					x	x	x			x	
PBX, key telephone systems	x		x			x	x	x	x	x	x	
PoE (Power over Ethernet) systems	x	x				x	x	x	x	x		
Set-top boxes (cable & satellite)	x	x	x			x	x	x	x	x	x	x
Telephone, fax, modem	x	x	x		x	x	x	x	x	x	x	x
VoIP (Voice over Internet Protocol) equipment	x	x	x			x	x	x		x	x	
xDSL modems and splitters	x	x	x		x	x	x	x		x		x
Servers	x		x	x	x		x	x		x	x	x
Power supplies	x			x			x	x				
Voltage regulator modules	x			x		x		x				
CONSUMER ELECTRONICS												
HDDs (Hard Disk Drives)	x	x								x		x
IEEE 1394 ports	x		x						x			
Inverters		x										
Controller boards			x									
USB 2.0 & IEEE	x								x	x		x
USB flash memory modules	x								x	x		
USB hub, ports and peripherals	x								x			x
Video ports: HDMI, DVI, VGA	x		x						x	x		
LED backlighting	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	SiBar	GDT	ROV	MLV	PESD	2Pro Devices	PolyZen Devices
PORTABLE ELECTRONICS												
Audio MP3 players	x		x						x	x		x
Battery packs	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	x		
Security systems	x	x	x			x	x	x		x	x	x
Surge suppression	x					x	x	x			x	
UPS (Uninterruptible Power Supply)	x	x	x			x	x	x				
APPLIANCES AND HVAC												
Electronic PCB's and controllers	x	x	x					x	x	x	x	
Motor and compressor winding protection	x											
Power tools			x	x								
Transformer protection	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		x
Automated External Defibrillator	x						x			x		
Infra-red ear thermometers									x	x		
Electrocardiograms	x	x	x					x	x	x		x
Magnetic resonance imaging	x	x	x					x	x	x		
Ultrasound devices	x	x	x					x	x	x		x
Pulse oximeters	x									x		
Patient monitors	x	x	x				x	x	x	x		x

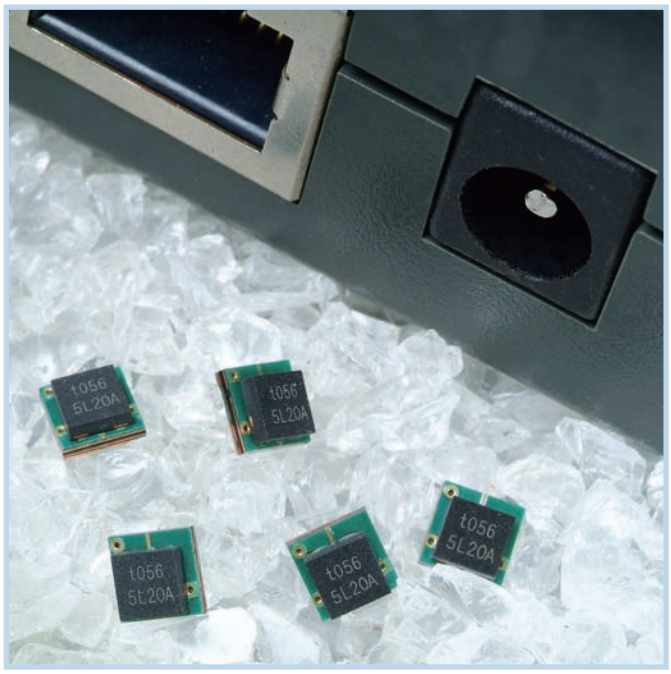
PolyZen Devices

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, 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 drive 5V & 12V bus
- Automotive peripheral input power
- DC power port protection
- Industrial handheld POS

Figure PZ1 Typical Application Block Diagram for PolyZen Devices

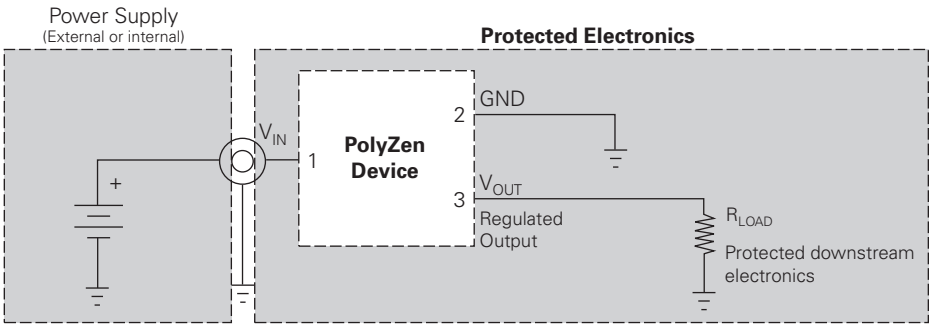


Table PZ1 Electrical Characteristics for PolyZen Devices

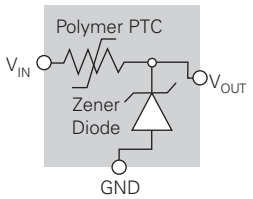
(Performance ratings @ 25°C unless otherwise specified)

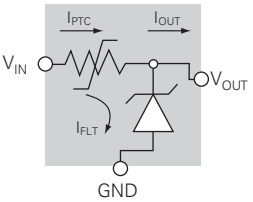
	Part Number	V_Z(V) Min.	V_Z(V) Typ.	V_Z(V) Max.	I_{Zt} (A)	I_{HOLD} @ 20°C (A)	R_{Typ} (Ω)	R_{1MAX} (Ω)	$V_{INT\ MAX}$ (V)	$V_{INT\ MAX}$ Test Current (A)	$I_{FLT\ MAX}$ (A)	$I_{FLT\ MAX}$ Test Voltage (V)
	ZEN056V130A24LS	5.45	5.6	5.75	0.1	1.3	0.12	0.16	24V	3A	+10/-40	+24/-16V
	ZEN065V130A24LS	6.35	6.5	6.65	0.1	1.3	0.12	0.16	24V	3A	+6/-40	+24/-16V
Coming* Soon	ZEN098V130A24LS	9.60	9.8	10.00	0.1	1.3	0.12	0.16	24V	3A	TBD/-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
NEW	ZEN132V230A16LS	13.20	13.4	13.60	0.1	2.3	0.04	0.06	16V	5A	+2/-40	+20/-12V
Coming* Soon	ZEN056V075A48LS	5.45	5.6	5.75	0.1	0.75	0.28	0.45	48V	3A	+10/-40	+48/-16V
NEW	ZEN132V075A48LM	13.20	13.4	13.60	0.1	0.75	0.28	0.45	48V	3A	+2/-40	+48/-16V

* Data is preliminary

Table PZ2 Definition 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}.





RoHS Compliant, ELV Compliant

Figure PZ2-PZ15 Typical Performance Curves for PolyZen Devices

Figure PZ2

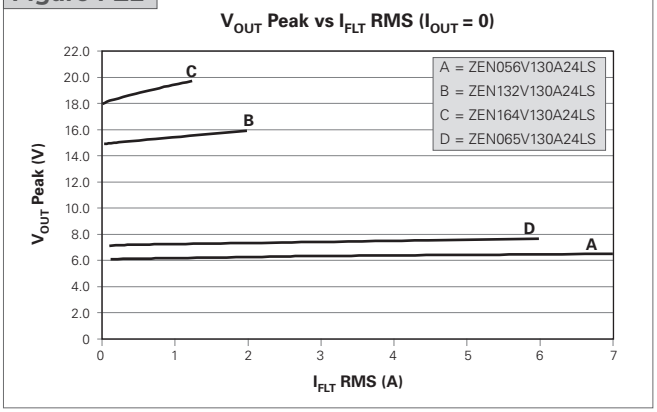


Figure PZ3

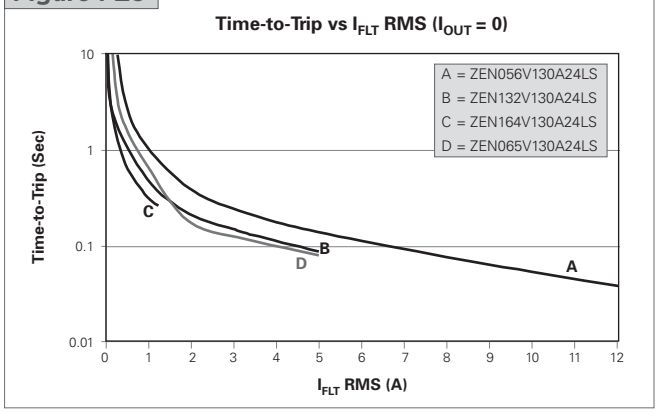


Figure PZ4

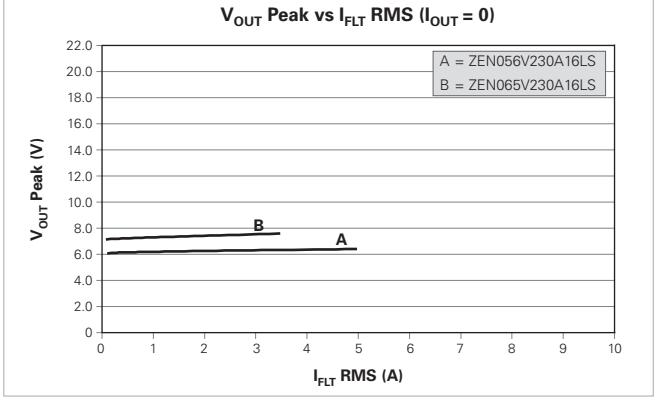


Figure PZ5

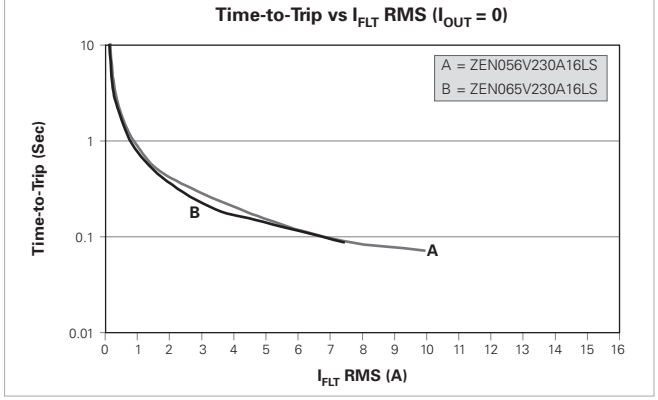


Figure PZ6

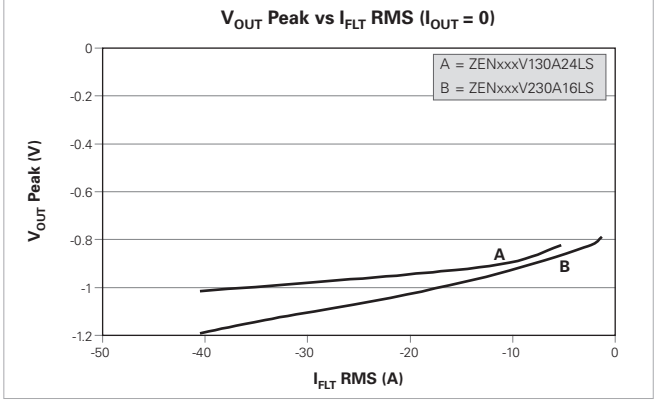


Figure PZ7

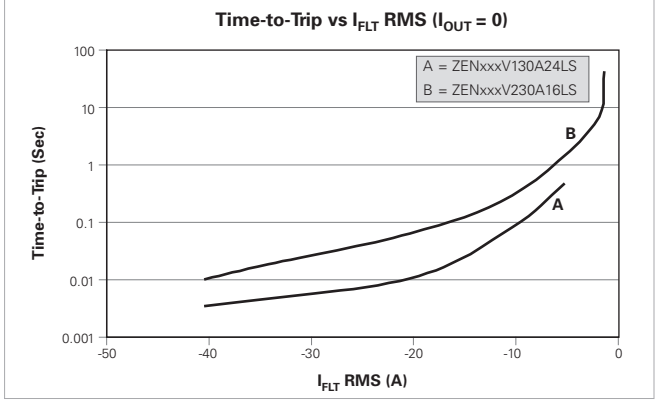


Figure PZ8

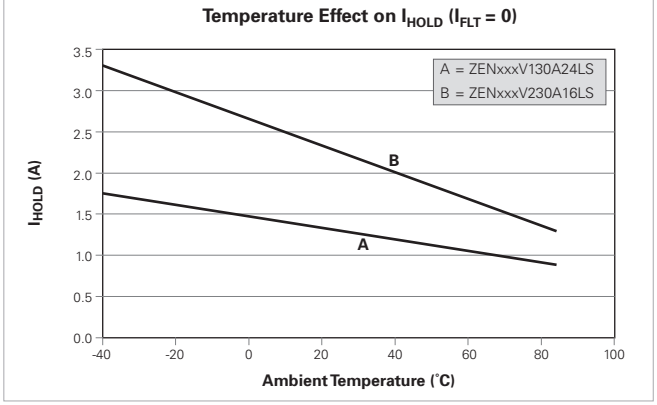


Figure PZ9

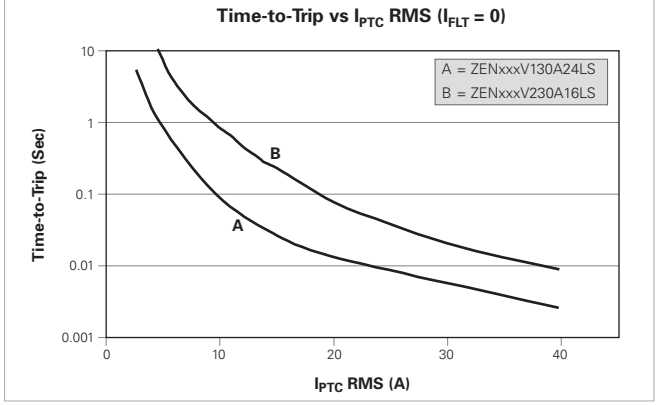


Figure PZ2-PZ15 Typical Performance Curves for PolyZen Devices ... Cont'd

Figure PZ10

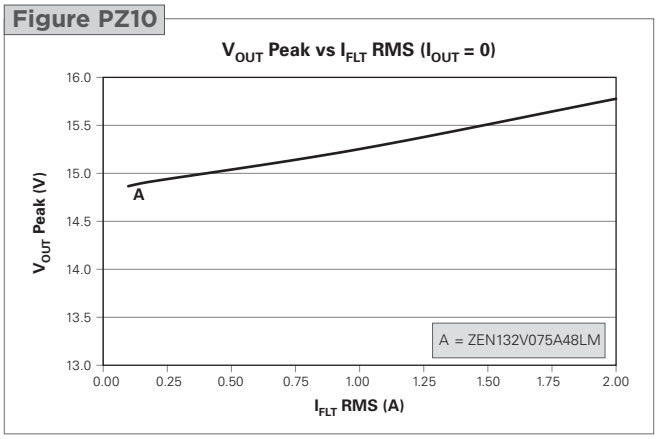


Figure PZ11

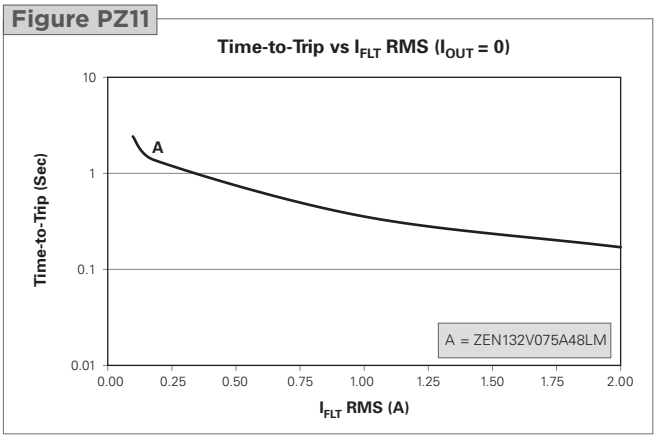


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Figure PZ12

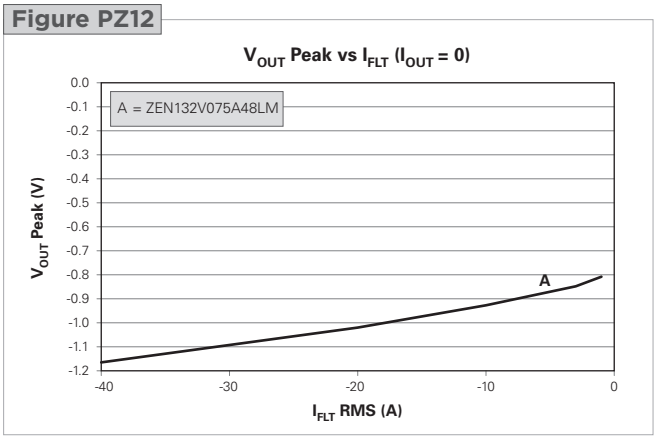

Figure PZ13

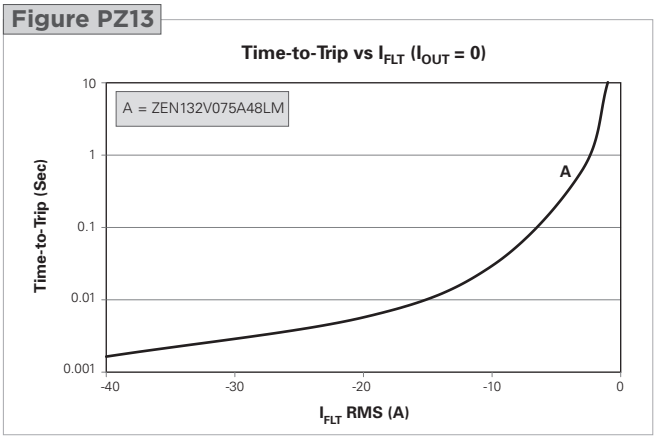

Figure PZ14

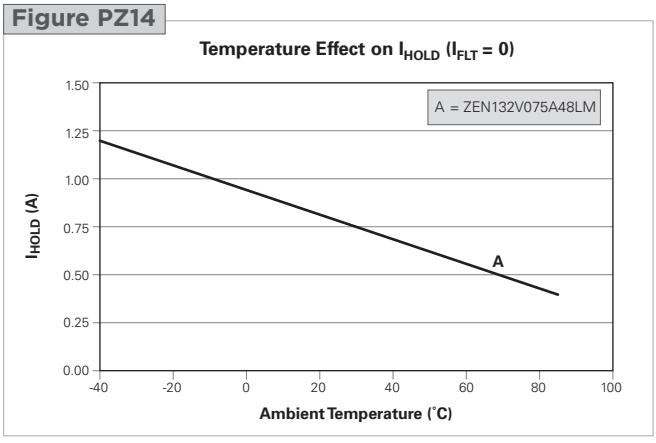

Figure PZ15

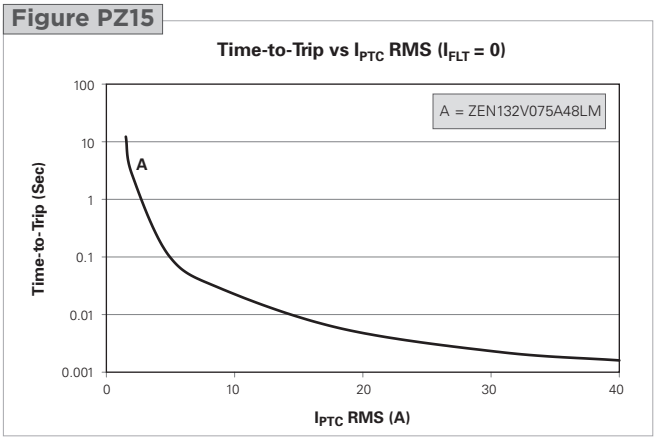

Table PZ3 General Characteristics for PolyZen Devices

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 PZ16-PZ23 Basic Operation Examples for PolyZen Devices

Figure PZ16

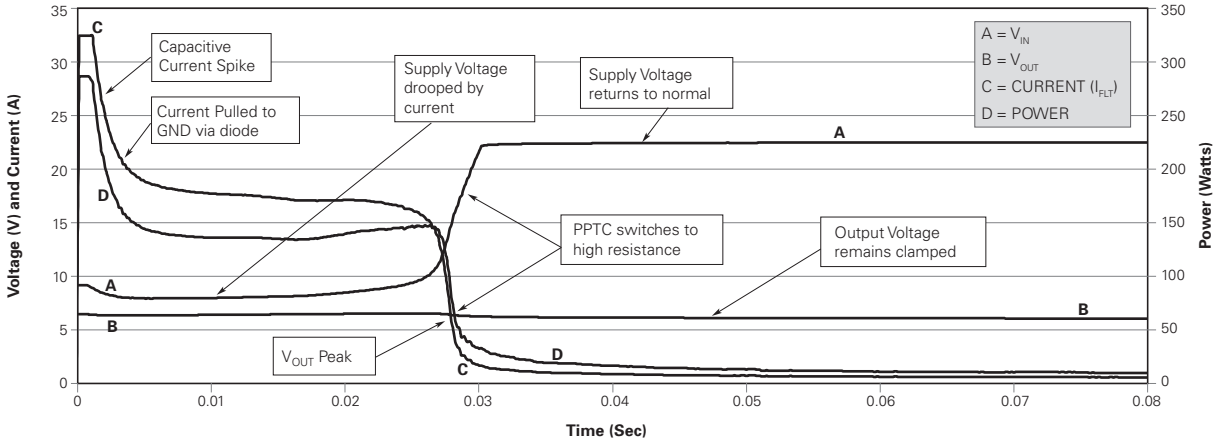

Figure PZ17

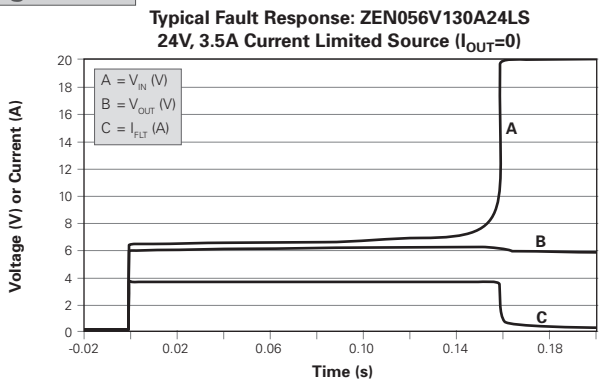

Figure PZ18

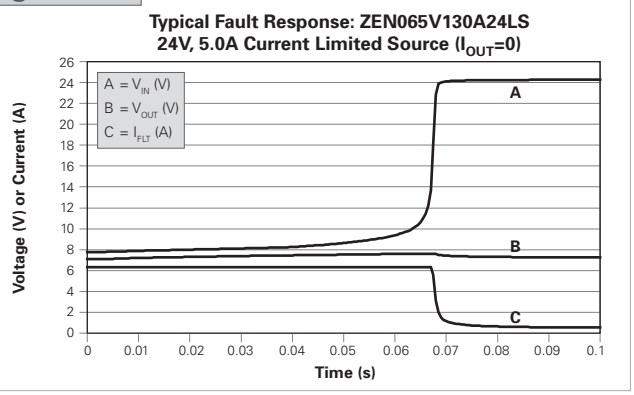

Figure PZ19

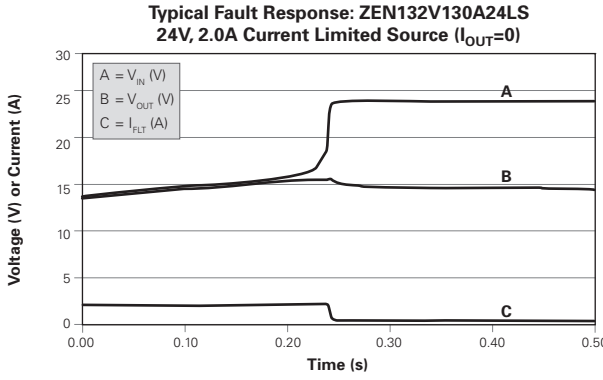

Figure PZ20

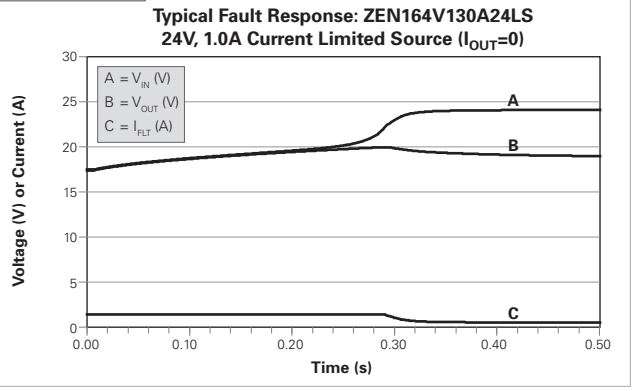

Figure PZ21

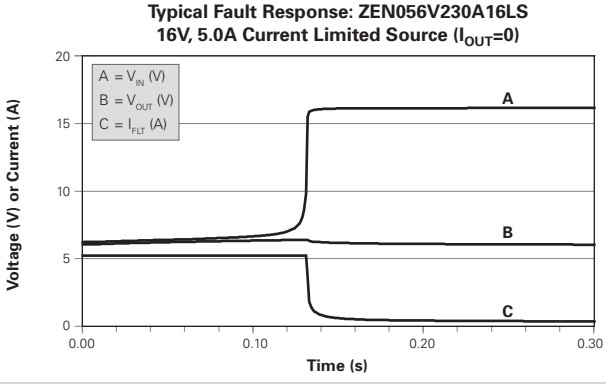

Figure PZ22

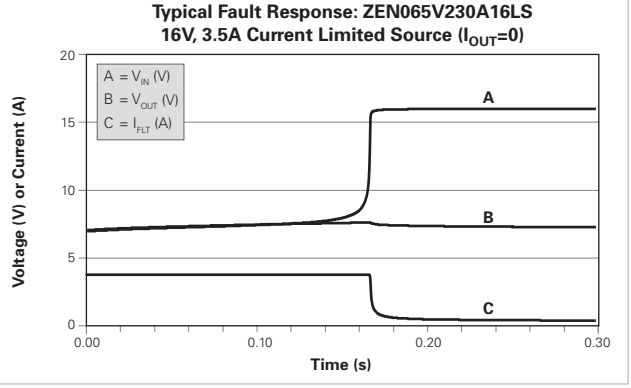

Figure PZ16-PZ23 Basic Operation Examples for PolyZen Devices ... Cont'd

Figure PZ23

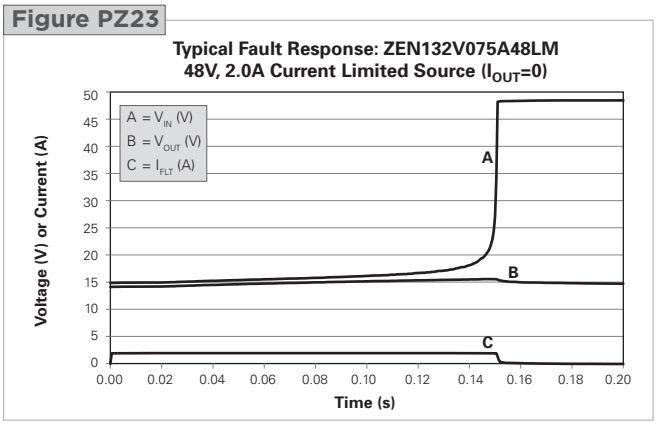

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Table PZ4 Packaging and Marking Information for PolyZen Devices

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

Table PZ5 Dimensions for PolyZen Devices in Millimeters (Inches)

	A		B		C	
	Min.	Max.	Min.	Max.	Min.	Max.
mm	3.85	4.15	3.85	4.15	1.4	2.0
inch	(0.150)	(0.163)	(0.152)	(0.163)	(0.060)	(0.081)

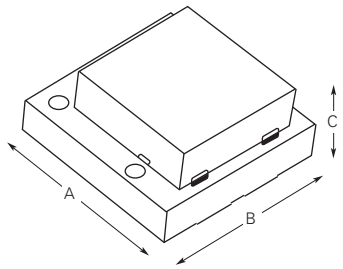
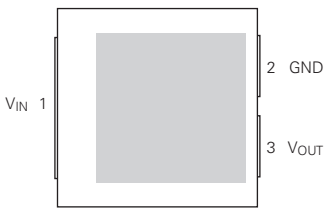


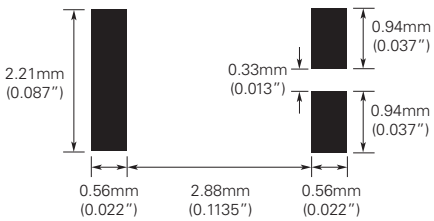
Table PZ6 Pad Layout and Configuration Information for PolyZen Devices

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

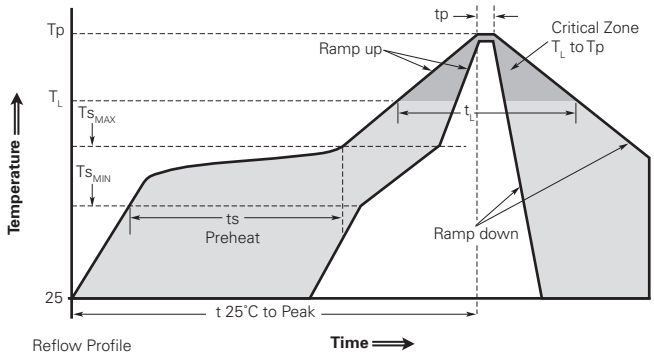
Solder Reflow and Rework Recommendation for PolyZen Devices

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.

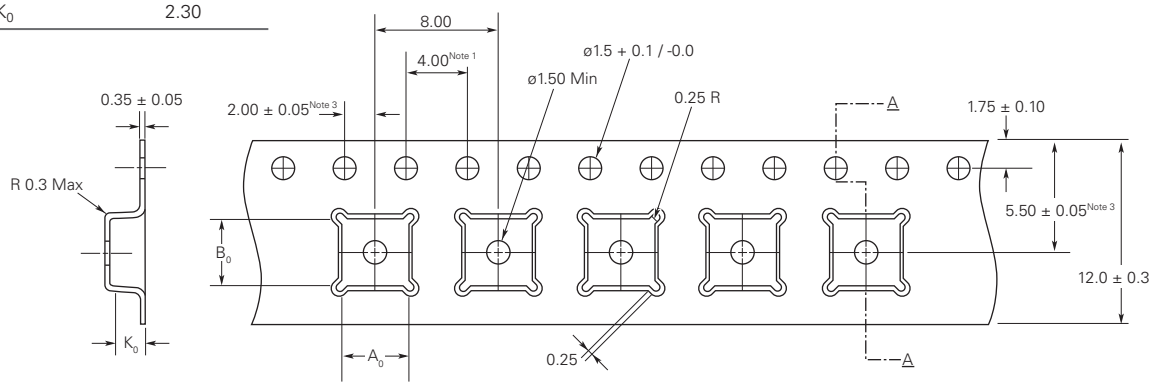
Figure PZ24



Tape and Reel Specifications for PolyZen Devices (in Millimeters)

Figure PZ25 EIA Referenced Taped Component Dimensions for PolyZen Devices (in Millimeters)

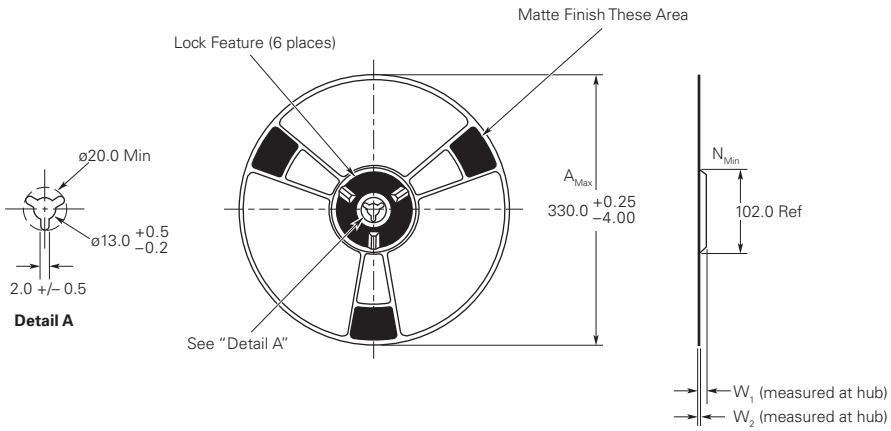
Description	Dimension (mm)
A_0	4.35
B_0	4.35
K_0	2.30



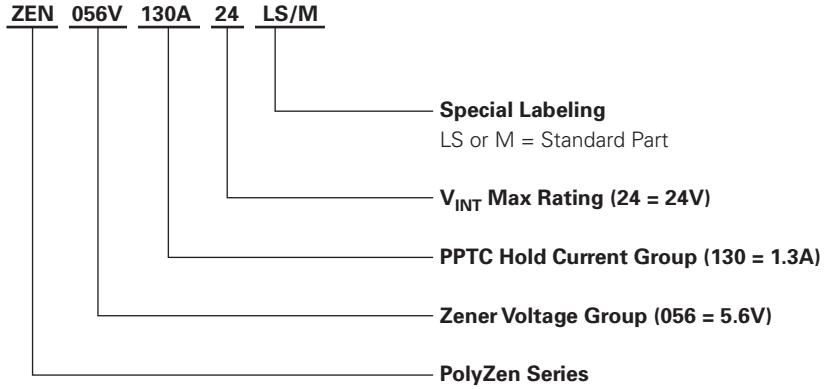
Notes:
1. 10 sprocket hole pitch cumulative tolerance ±0.2
2. Camber in compliance with EIA 481
3. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole

Figure PZ26 Reel Dimensions for PolyZen Devices (in Millimeters)

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

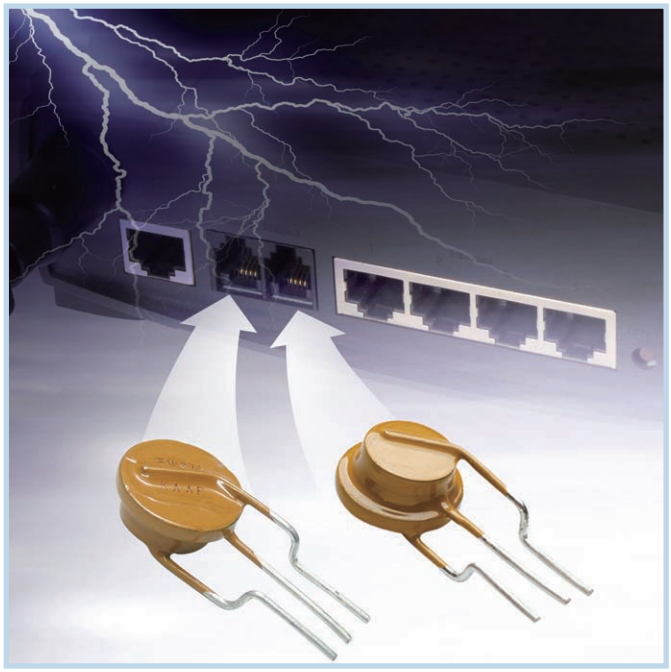


Part Numbering System for PolyZen Devices



RoHS Compliant, ELV Compliant

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

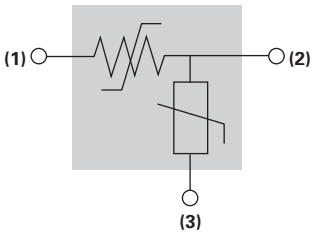
- Cordless telephones
- VoIP gateways
- Fax machines
- Data modems
- Set-top boxes
- Security systems
- MDF modules
- Analog and ISDN linecards

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

Electrical Schematic



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.

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.

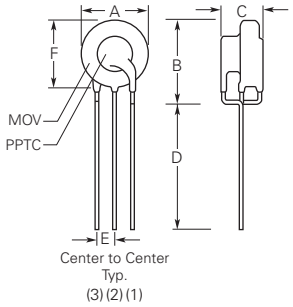


Figure 2P1 Typical Time-to-Trip at 25°C for 2Pro Devices

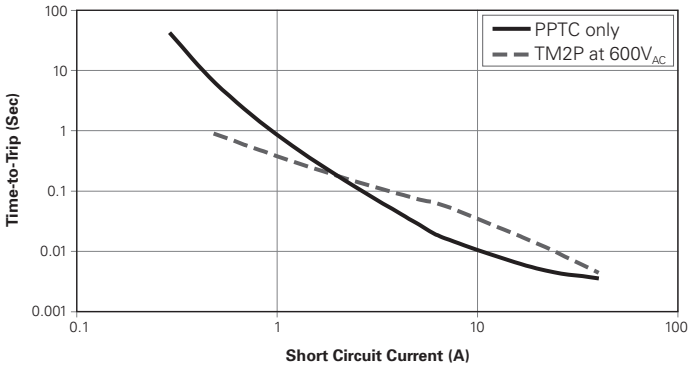


Table 2P3 Physical Characteristics and Environmental Specifications for 2Pro Devices

Physical Characteristics

Lead material	Tin-plated copper, 0.33mm² (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

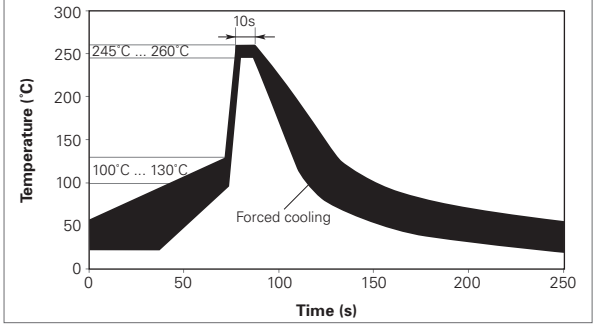


Table 2P6 Tape and Reel Specifications for 2Pro Devices (in Millimeters)

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	I_1	1.0	Maximum
Protrusion of cut-out	L	L	11	Maximum
Protrusion beyond hold down tape	I_2	I_2	Not specified	-
Sprocket hole pitch	P_0	P_0	12.7	±0.3
Pitch tolerance	-	-	20 consecutive	±1
Tape thickness	t	t	0.9	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

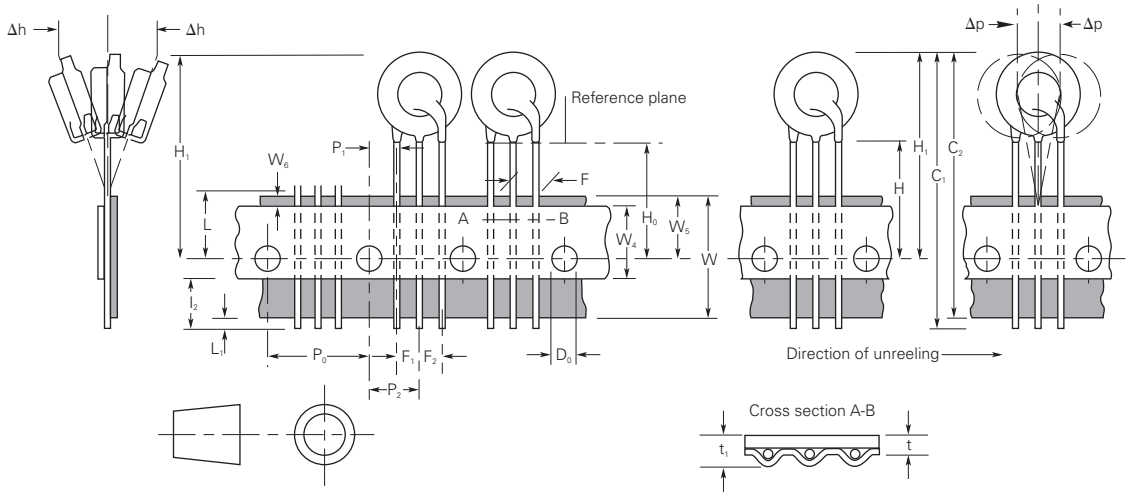
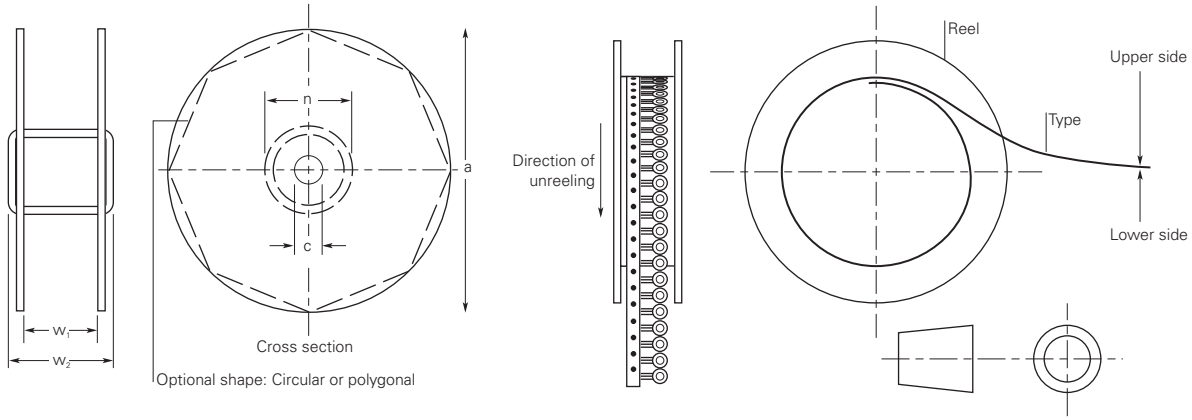


Figure 2P4 EIA Referenced Reel Dimensions for 2Pro Devices



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

RoHS Compliant, ELV Compliant HF Halogen Free

ESD Protection Devices

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

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

PESD protection devices provide low capacitance, and meet transmission line pulse (TLP) testing, as well as IEC61000-4-2 testing.

Benefits

- ESD protection for high frequency applications (HDMI 1.3)
- Smaller form factor for board space savings
- Helps protect sensitive electronic circuits against damage caused by 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 PESD 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 PESD Devices

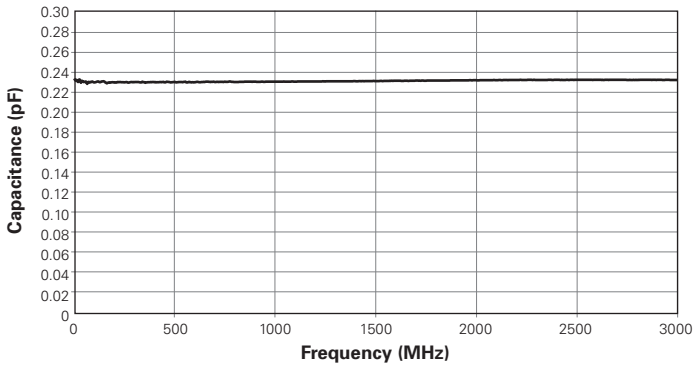


Figure E2 Eye Diagram Performance at 3.4 GHz for PESD Devices

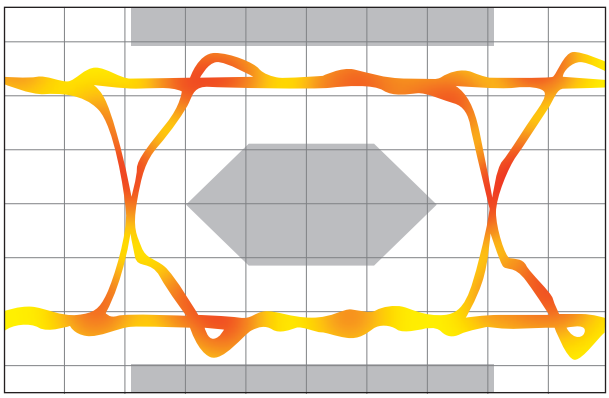
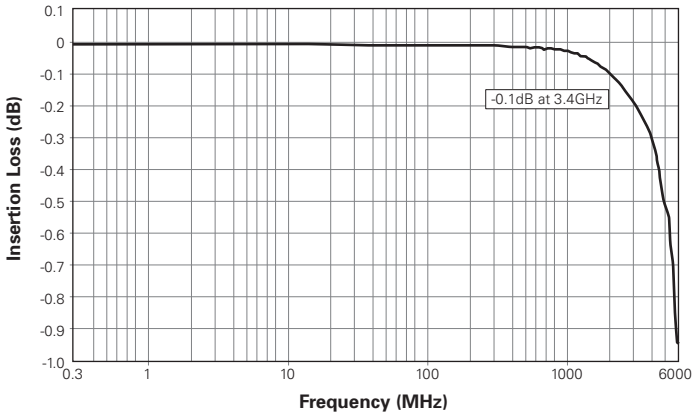


Figure E3 Insertion Loss Diagram for PESD Devices



RoHS Compliant, ELV Compliant HF Halogen Free

Figure E4-E5 ESD Protection for HDMI

Figure E4

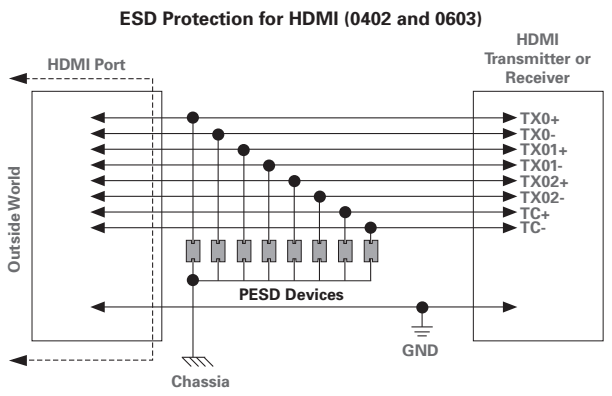


Figure E5

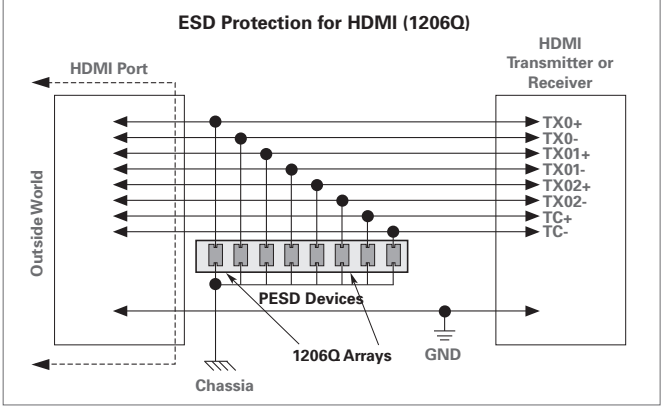


Table E2 Dimensions for PESD Devices in Millimeters (Inches)*

Part Number	A		B		C		D		E		F		Figure
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
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 PESD Devices

Figure E6

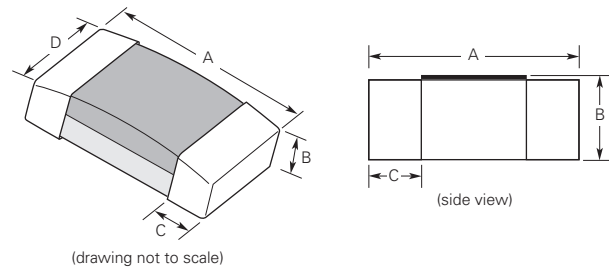


Figure E7

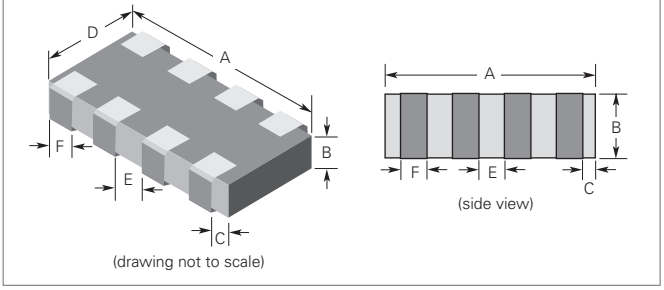


Table E3 Environmental Specifications for PESD Devices

	Test Conditions	Pass / Fail Criteria
Bias humidity test	85°C, 85% RH, $V_{DC\ (max)}$, 1000 hrs	$I_L \leqq 10$ µA
Thermal shock	-55°C to 125°C, 30 min dwell, 1000 cycles	$I_L \leqq 10$ µA
Bias heat test	125°C, $V_{DC\ (max)}$, 1000 hrs	$I_L \leqq 10$ µA
Bias low temp test	-55°C, $V_{DC\ (max)}$, 1000 hrs	$I_L \leqq 10$ µA
Solderability	250°C ± 5°C, 3 ±1s	95% coverage
Solder heat	260°C, 10s	90% coverage
Vibration	10 to 50Hz, 60s cycle, 2 hrs each in X-Y-Z-direction	No physical damage
Solvent resistance	IPA ultrasonic 300s	No physical damage
Shock	1500G, 0.5ms each, 30 shocks in X-Y-Z-direction	No physical damage

Table E4 General Characteristics for PESD Devices

Storage temperature	-40°C to +85°C
Operating temperature	-55°C to +125°C
ESD voltage capability	Contact discharge mode : 8kV (typical), 15kV (max)
(tested per IEC 61000-4-2)	Air discharge mode : 15kV (typical), 25kV (max)
ESD pulse withstand	100 pulses
	(tested per IEC 61000-4-2, level 4,contact method)

Table E5 Materials Information for PESD Devices

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

Table E6 Recommended Pad Layout for PESD Devices in Millimeters (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)	
PESD1206Q-240	3.00	3.40	2.00	2.40	0.40	0.60	0.60	1.00	0.90	1.10	E9
	(0.118)	(0.134)	(0.079)	(0.094)	(0.016)	(0.024)	(0.024)	(0.039)	(0.035)	(0.043)	

*The dimensions in inches are rounded approximations.

Figure E8

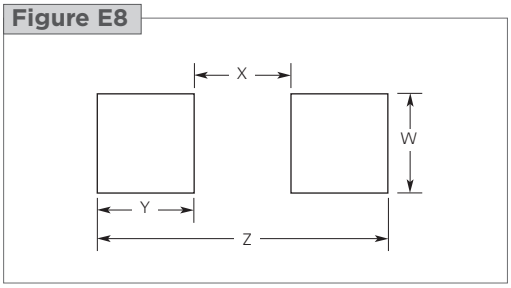
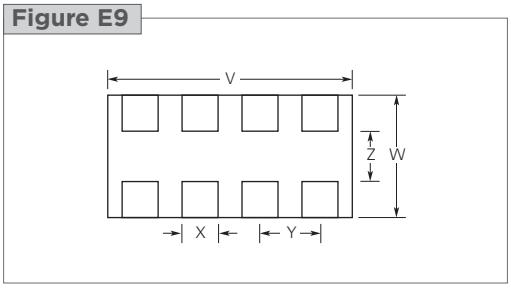


Figure E9

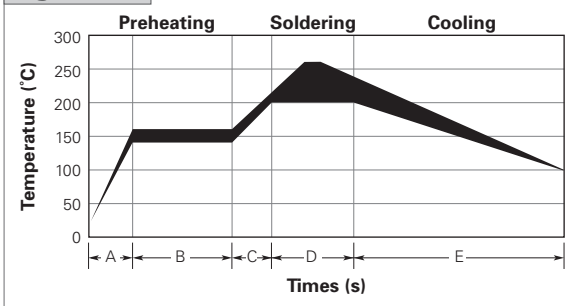


Note: Solder thickness 0.15 to 0.2 mm

Table E7 Solder Reflow Recommendations for PESD Devices

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

Figure E10



Parameter Definitions for PESD Devices

Operation Voltage (V_{DC})

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

Leakage Current (I_L)

Current through device under Operation Voltage V_{DC}.

Trigger Voltage (V_T)

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

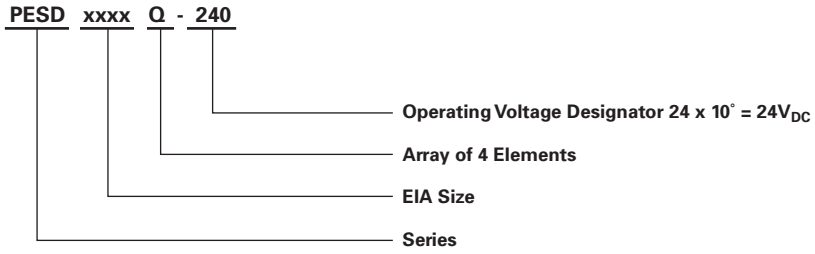
Clamping Voltage (V_C)

Voltage cross device under 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 PESD Devices



⚠ Warning :

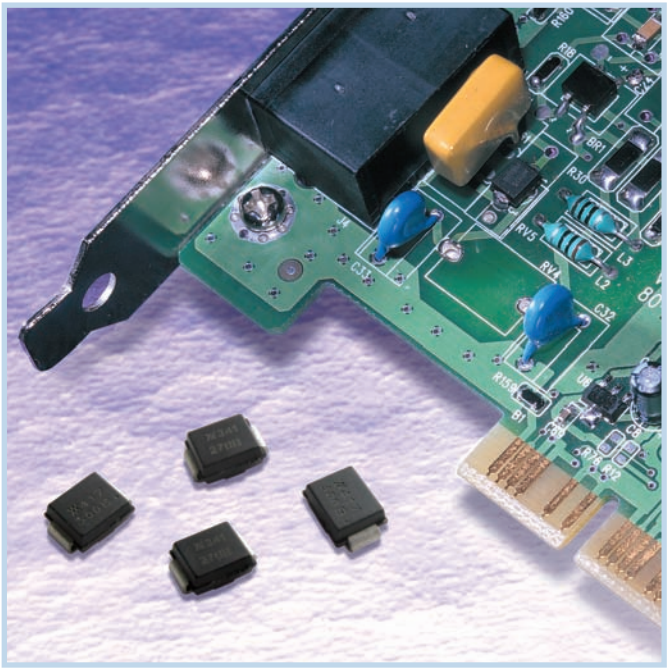
Application Limitations for PESD0402-140, PESD0603-240 and PESD1206Q-240: These parts are not intended to be used under power bus applications. Users should independently evaluate the suitability of and test each product selected for their own application.

SiBar Thyristor Surge Protectors

SiBar thyristor surge protection devices help protect sensitive telecom and datacom equipment from overvoltage events, including lightning transients. The devices operate as shunt devices in response to a surge that exceeds the breakover voltage. When the voltage exceeds the breakover voltage the SiBar device "folds back", creating a low-impedance path, effectively shorting out the overvoltage condition.

Compliant with major standards such as GR-1089 Core, ITU-T-K20/K21, IEC61000-4-5 and FCC part 68, and UL1950, SiBar devices provide fast, bidirectional protection on communications network equipment, including analog and digital linecards, xDSL and ISDN modems, set-top boxes, T1 equipment, Voice over IP (VoIP) and Power over Ethernet (PoE) equipment.

The SiBar thyristor's low on-state voltage allows for smaller form factor devices – as compared with clamping devices of comparable energy handling capability, and their relatively low capacitance makes them suitable for high data rate circuits.



Benefits

- Helps provide protection for sensitive telecom electronic equipment
- Low-leakage current
- Low-power dissipation
- Fast, reliable operation
- No wear-out mechanisms
- Helps designers meet worldwide telecom standards
- Helps reduce warranty and service costs
- Easy installation
- Helps improve power efficiency of equipment

Features

- RoHS compliant
- Bi-directional crowbar transient voltage protection
- High off-state impedance
- Low on-state voltage
- High surge capability
- Expanded voltage offerings (58V-320V)
- Short-circuit failure mode
- Surface-mount technology

Applications

- Modems
- Fax machines
- Phones
- PBX systems
- POS systems
- Analog and digital linecards (xDSL, T1/E1)
- Other customer premise and central office network equipment

Protection Application Guide for SiBar Thyristor Surge Protectors

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.

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

Protection Application Guide for SiBar Thyristor Surge Protectors ... Cont'd

Application	Region/ Specification	SiBar Thyristor Surge Protectors*	Overcurrent Protection		
			Form Factor Radial-leaded	Surface-mount	Chip
LAN intrabuilding power cross protection	**North America**	TVBxxx(N)SA-L	TRF250-080U	TSL250-080F	
LAN equipment, VoIP cards, IP phones	GR1089 Port Type 4‡	TVAxxx(N)SA-L	TRF250-120	TS250-130F	
			TRF250-120T	TSV250-130F	
			TRF250-145		
			TRF250-183		
			TRF250-184		
IEEE 802.3AF/AT Power over		TVB058(N)SA-L		decaSMDC050F/60-2††	
Ethernet protection		TVB058NSB-L			
Powered Ethernet switches and terminals,		TVB058NSC-L			
IP phones, wireless LAN base stations,					
microcellular base stations, VoIP cards					
Cable telephony powering system		N/A	BBRF550 ‡‡		
Power passing taps			BBRF750 ‡‡		

Note : This list is not exhaustive. Tyco Electronics welcomes our customers' input for additional application ideas.

* For more information on PolySwitch resettable devices, refer to the telecommunications and networking devices section.
† 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 fuses. FT600-0500 and FT600-2000 reference also available. See telecom fuse section.
†† For details on decaSMDC050F/60-2, see the PolySwitch surface-mount devices section.
‡‡ For details on BBRF series, see the PolySwitch radial-leaded devices section.

Table SB1 Electrical Characteristics, Part Marking and Agency Approval for SiBar Thyristor Surge Protectors

Part Number	V_{DM} Max. (V)	V_{BO} Max. (V)	I_H Min. (mA)	V_T Max. (V)	C_1 @50V Typ. (pF)	C_2 @ 2V Typ. (pF)	Part Marking	UL Approval
SMA 50A Standard "SA" and "NSA" Devices								
TVA170SA-L	170	265	150	4.0	20	39	170A	X
TVA170NSA-L	170	220	150	4.0	20	39	17NA	X
TVA200SA-L	200	320	150	4.0	17	33	200A	X
TVA220NSA-L	220	300	150	4.0	17	33	22NA	X
TVA270SA-L	270	365	150	4.0	16	31	270A	X
TVA275NSA-L	275	350	150	4.0	16	31	27NA	X
SMB 50A Standard "SA" and "NSA" Devices								
TVB058SA-L	58	77	150	4.0	43	80	058A	–
TVB058NSA-L	58	77	150	4.0	44	84	58NA	X
TVB065NSA-L	65	88	150	4.0	41	79	65NA	X
TVB075NSA-L	75	98	150	4.0	34	65	75NA	X
TVB090NSA-L	90	130	150	4.0	31	58	90NA	X
TVB120NSA-L	120	160	150	4.0	24	46	12NA	X
TVB140NSA-L	140	180	150	4.0	23	44	14NA	X
TVB170SA-L	170	265	150	4.0	18	35	170A	X
TVB170NSA-L	170	220	150	4.0	20	39	17NA	X
TVB180SA-L	180	219	150	4.0	30 (MAX)	60 (MAX)	180A	X
TVB180NSA-L	180	240	150	4.0	19	37	18NA	X
TVB190NSA-L	190	260	150	4.0	19	36	19NA	X
TVB200SA-L	200	320	150	4.0	18	35	200A	X
TVB220NSA-L	220	300	150	4.0	17	33	22NA	X
TVB270SA-L	270	365	150	4.0	15	32	270A	X
TVB275NSA-L	275	350	150	4.0	15	31	27NA	X
TVB300SA-L	300	400	150	4.0	14	27	300A	X
TVB320NSA-L	320	400	150	4.0	14	27	32NA	X

Table SB1 Electrical Characteristics, Part Marking and Agency Approval for SiBar Thyristor Surge Protectors ... Cont'd

Part Number	V_{DM} Max. (V)	V_{BO} Max. (V)	I_H Min. (mA)	V_T Max. (V)	C_1 @50V Typ. (pF)	C_2 @ 2V Typ. (pF)	Part Marking	UL Approval
SMB 80A Standard "SB" and "NSB" Devices								
TVB058NSB-L	58	77	150	4.0	67	129	58NB	X
TVB065NSB-L	65	88	150	4.0	64	123	65NB	X
TVB075NSB-L	75	98	150	4.0	63	122	75NB	X
TVB090NSB-L	90	130	150	4.0	49	95	90NB	X
TVB120NSB-L	120	160	150	4.0	38	75	12NB	X
TVB140NSB-L	140	180	150	4.0	36	70	14NB	X
TVB170NSB-L	170	220	150	4.0	29	59	17NB	X
TVB180NSB-L	180	240	150	4.0	29	59	18NB	X
TVB190NSB-L	190	260	150	4.0	28	56	19NB	X
TVB200SB-L	200	320	150	4.0	30	49	200B	X
TVB220NSB-L	220	300	150	4.0	26	52	22NB	X
TVB270SB-L	270	350	150	4.0	25	50	270B	X
TVB275NSB-L	275	350	150	4.0	23	47	27NB	X
TVB300SB-L	300	400	150	4.0	21	42	300B	X
TVB320NSB-L	320	400	150	4.0	22	44	32NB	X
SMB 100A Standard "SC"and "NSC" Devices								
TVB058NSC-L	58	77	150	4.0	114	222	58NC	X
TVB065NSC-L	65	88	150	4.0	103	198	65NC	X
TVB075NSC-L	75	98	150	4.0	90	176	75NC	X
TVB090NSC-L	90	130	150	4.0	79	154	90NC	X
TVB120NSC-L	120	160	150	4.0	72	140	12NC	X
TVB140NSC-L	140	180	150	4.0	66	130	14NC	X
TVB170SC-L	170	265	150	4.0	60	125	170C	X
TVB170NSC-L	170	220	150	4.0	48	99	17NC	X
TVB180NSC-L	180	240	150	4.0	48	97	18NC	X
TVB190NSC-L	190	260	150	4.0	44	90	19NC	X
TVB200SC-L	200	320	150	4.0	55	115	200C	X
TVB220NSC-L	220	300	150	4.0	41	81	22NC	X
TVB270SC-L	270	365	150	4.0	50	110	270C	X
TVB275NSC-L	275	350	150	4.0	38	76	27NC	X
TVB300SC-L	300	400	150	4.0	47	98	300C	X
TVB320NSC-L	320	400	150	4.0	35	71	32NC	X

Notes : All electrical characteristics are measured at 25°C.
V_{DM} measured per UL497B pulse requirements: at max. off-state leakage current (I_{DM}) = 5µA.
V_{BO} measured at 100V/µs.

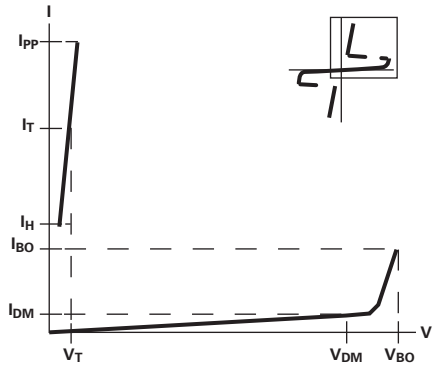
Table SB2 Surge Current Rating for SiBar Thyristor Surge Protectors

	TIA-968			Telcordia GR-1089*		IEC61000-4-5	ITU K.20/21/45*			
	Type A	Type B								
Part Number	I_{PP}(A) 5 x 320µs	I_{PP}(A) 10 x 560µs	I_{PP}(A) 10 x 160µs	I_{PP}(A) 10 x 1000µs	I_{PP}(A) 2 x 10µs	I_{PP}(A) 8 x 20µs	I_{PP}(A) 5 x 310µs (V_{OC}: 10x700µs)	I_{TSM} Min. (A)	di/dt (A/µs)	dV/dt (V/µs)
TVAxxxSA-L	90	70	100	50	150	150	90	22	500	2000
TVAxxxNSA-L	90	70	100	50	150	150	90	22	500	2000
TVB180SA-L	—	75	110	50	—	—	100	32	500	2000
TVBxxxSA-L	90	70	100	50	150	150	90	22	500	2000
TVBxxxNSA-L	90	70	100	50	150	150	90	22	500	2000
TVBxxxSB-L	100	100	150	80	250	250	100	30	500	2000
TVBxxxNSB-L	100	100	150	80	250	250	100	30	500	2000
TVBxxxSC-L	150	150	200	100	500	400	150	60	500	2000
TVBxxxNSC-L	150	150	200	100	500	400	200	60	500	2000

Notes : I_{TSM} : peak on-state surge current is measured at 60 Hz, one cycle.
di/dt : critical rate-of-rise of on-state current (pulsed power amplifier Vmax = 600V; C = 30µF).
dV/dt: critical rate-of-rise of off-stage voltage (linear wave form, V_D = rated V_{BO}, Tj = 25°C

* Lightning current wave forms for applicable industry specification.

Figure SB1 Voltage-Current Characteristics for SiBar Thyristor Surge Protectors



The voltage current (V-I) is useful in depicting the electrical characteristics of the SiBar thyristor surge protectors in relation to each other.

Table SB3 Parameter Definitions for SiBar Thyristor Surge Protectors

Symbol	Parameter	Definition
V_{BO}	Breakover voltage	Maximum voltage across the device at breakdown measured under a specified voltage and current rate of rise.
I_{BO}	Breakover current	Instantaneous current flowing at the breakover voltage (V_{BO}).
I_H	Hold current	Minimum current required to maintain the device in the on-state.
I_T	On-state current	Current through the device in the on-state condition.
V_T	On-state voltage	Voltage across the device in the on-state condition at a specified current (I_T).
V_{DM}	Maximum off-state voltage	Maximum DC voltage that can be applied to the device while maintaining it in the off-state condition.
I_{DM}	Off-state current	Maximum DC value of current that results from the application of the maximum off-state voltage.
I_{PP}	Peak pulse current	Rated peak pulse current of specified amplitude and waveshape that may be applied without damage.
di/dt	Critical rate of rise of on-state current	Maximum current rate of rise the device can withstand without damage.
dV/dt	Critical rate of rise of off-state voltage	Maximum voltage rate of rise the device can withstand without turning on.

Figure SB2-SB5 Typical Electrical Charateristics vs. Temperature for SiBar Thyristor Surge Protectors

Figure SB2

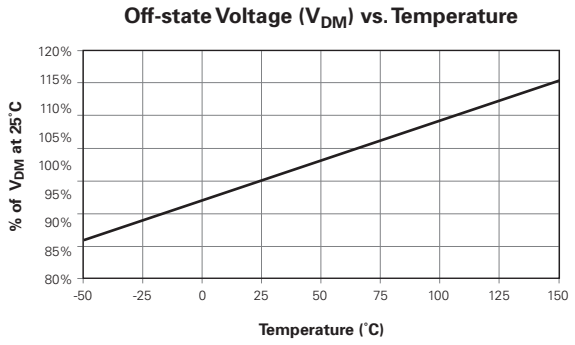


Figure SB3

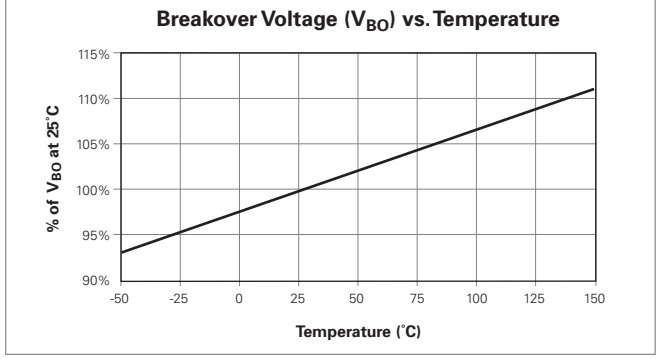


Figure SB4

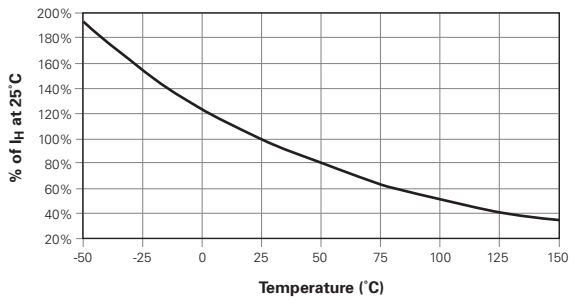


Figure SB5

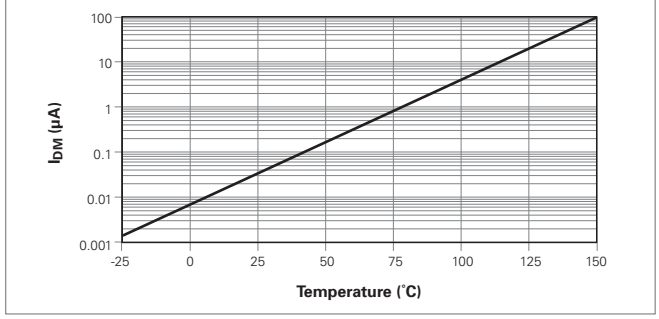


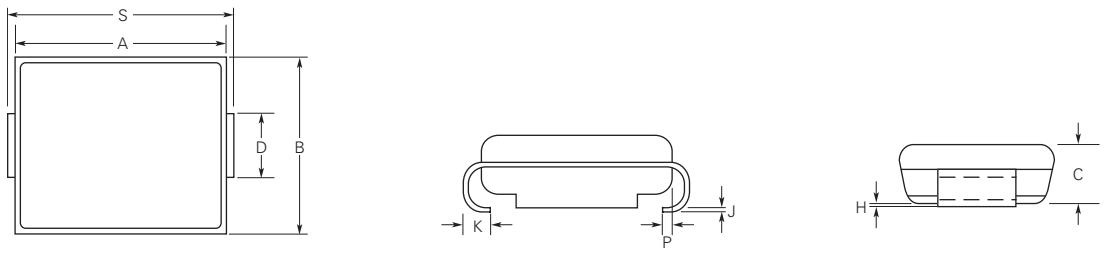
Table SB4 Dimensions for SiBar Thyristor Surge Protectors in Millimeters (Inches)

	A		B		C		D*		H		J		K		P	S	
Dimension	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Ref.**	**Min.**	**Max.**
SMB Package:	4.06	4.57	3.30	3.94	1.90	2.41	1.95	2.20	0.051	0.200	0.150	0.31	0.76	1.27	0.51	5.21	5.59
TVBxxx(N)Sx-L	(0.160)	(0.180)	(0.130)	(0.155)	(0.075)	(0.095)	(0.077)	(0.087)	(0.002)	(0.008)	(0.006)	(0.012)	(0.030)	(0.050)	(0.020)	(0.205)	(0.220)
SMA Package:	4.06	4.57	2.25	2.92	1.90	2.41	1.25	1.65	0.051	0.200	0.150	0.41	0.76	1.52	0.51	4.80	5.59
TVAxxx(N)Sx-L	(0.160)	(0.180)	(0.089)	(0.115)	(0.075)	(0.095)	(0.049)	(0.065)	(0.002)	(0.008)	(0.006)	(0.016)	(0.030)	(0.060)	(0.020)	(0.189)	(0.220)

Notes : TVA series devices use industry standard SMA package type. (JEDEC DO-214AC)
TVB series devices use industry standard SMB package type. (JEDEC DO-214AA)
All devices are bidirectional and may be oriented in either direction for installation.

* Dimension D is measured within dimension P.

Figure SB6 Dimension Figure for SiBar Thyristor Surge Protectors



RoHS Compliant, ELV Compliant

Table SB5 Physical Characteristics and Environmental Specifications for SiBar Thyristor Surge Protectors

Lead material	Matte tin finish (-L devices)
Encapsulating material	Epoxy, meets UL94V-0 requirements
Solderability	per MIL-STD-750, Method 2026
Solder heat withstand	per MIL-STD-750, Method 2031
Solvent resistance	per MIL-STD-750, Method 1022
Mechanical shock	per MIL-STD-750, Method 2016
Vibration	per MIL-STD-750, Method 2056
Storage temperature (°C)	-55°C to 150°C
Operating temperature (°C)	-40°C to 125°C
Junction temperature (°C)	175°C
Maximum lead temperature for soldering purpose; for 10s (°C)	260°C

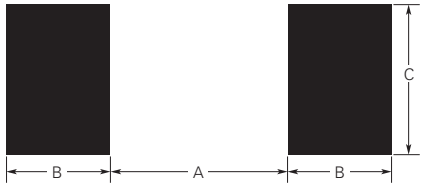
Table SB6 Reliability Tests for SiBar Thyristor Surge Protectors

Test	Conditions	Duration
High temperature, reverse bias	+100°C, 50V_{DC} bias	1000 hours
High humidity, high temperature, reverse bias	85% RH, +85°C, 50V_{DC} bias	1000 hours
High temperature storage life	+150°C	1000 hours
Temperature cycling	-65°C to +150°C, 15 minute dwell	1000 cycles
Autoclave	100% RH, +121°C, 15 PSI	96 hours

Table SB7 Packaging Information for SiBar Thyristor Surge Protectors

			Recommended Pad Layout in Millimeters (Inches)		
Part Description	Tape and Reel Quantity	Standard Package	Dimension A (Nom.)	Dimension B (Nom.)	Dimension C (Nom.)
TVAxxxSA-L	5,000	20,000	2.000 (0.079)	2.000 (0.079)	2.000 (0.079)
TVAxxxNSA-L	5,000	20,000	2.000 (0.079)	2.000 (0.079)	2.000 (0.079)
TVBxxxSA-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVBxxxNSA-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVBxxxSB-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVBxxxNSB-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVBxxxSC-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)
TVBxxxNSC-L	2,500	10,000	2.261 (0.089)	2.159 (0.085)	2.743 (0.108)

Figure SB7 Recommended Pad Layout for SiBar Thyristor Surge Protectors



Agency Recognition for SiBar Thyristor Surge Protectors

UL497B File # E179610

Solder Reflow and Rework Recommendations for SiBar Thyristor Surge Protectors

SiBar thyristors are compatible with standard reflow and wave soldering techniques.

Solder Reflow

- Recommended reflow methods: IR, vapor phase oven, hot air oven.
- Always preheat the device to prevent excessive thermal shock and stress.
- Recommended maximum paste thickness of 0.25mm (0.010 in.).
- Devices may be cleaned using standard industry methods and solvents.

Solder Rework

- Use standard industry practices for the SiBar Thyristor Surge Protectors.

Figure SB8

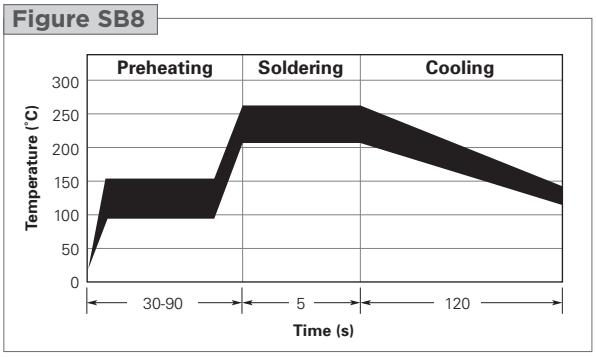
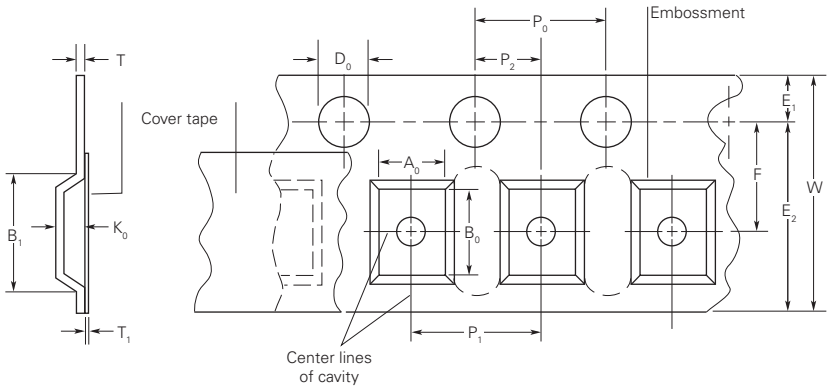


Table SB8 EIA Tape and Reel Specifications for SiBar Thyristor Surge Protectors

SiBar thyristors are supplied on tape and reel per EIA481-1 standard. (See Figure SB9 and SB10 for details.)

	TVB Series		TVA Series	
Description	**Dimensions (mm)**	**Tolerance (mm)**	**Dimensions (mm)**	**Tolerance (mm)**
W	12	+/- 0.30	12	+/- 0.3
P_0	4.0	+/- 0.10	4.0	+/- 0.10
P_1	8.0	+/- 0.10	8.0	+/- 0.10
P_2	2.0	+/- 0.10	2.0	+/- 0.10
A_0	4.3	—	2.9	+/- 0.10
B_0	6.2	—	5.59	+/- 0.10
B_1 max.	8.2	—	8.2	—
D_0	1.5	+ 0.1, -0.0	1.5	+ 0.1, -0
F	5.5	+/- 0.05	5.5	+/- 0.05
E_1	1.75	+/- 0.10	1.75	+/- 0.10
E_2 min.	9.85	—	9.85	—
T max.	0.6	—	0.6	—
T_1 max.	0.1	—	0.1	—
K_0 max.	2.59	+/- 0.10	2.36	+/- 0.10
Leader min.	390	—	390	—
Trailer min.	160	—	160	—

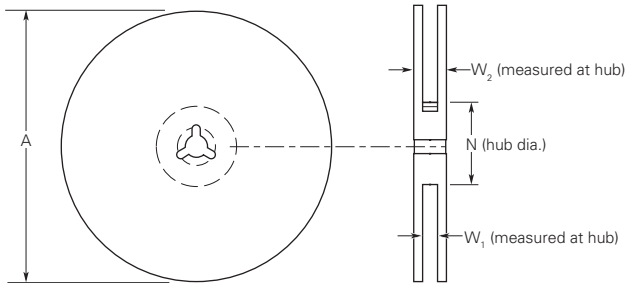
Figure SB9 EIA Referenced Taped Component Dimensions for SiBar Thyristor Surge Protectors



RoHS Compliant, ELV Compliant

Figure SB10 EIA Referenced Reel Dimensions for SiBar Thyristor Surge Protectors

Reel Dimension	
A max.	330
N min.	50
W_1	12.4 + 2.0, -0
W_2 max.	18.4

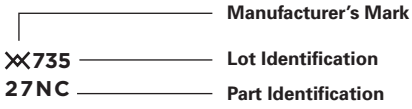


Part Numbering System for SiBar Thyristor Surge Protectors

TV B 270 N SA -L

- **RoHS compliant, Pb-free leads, matte tin finish**
- **Surge current rating**
  SA, SB, SC refer to Table SB2
- **Product Series:**
  (Blank) = Standard Series
  N = New Series
- **V_{DM} (max. off-state voltage indicator)**
- **Package type**
  A = SMA package
  B = SMB package
- **Product Family**

Marking Reference Guide - Example



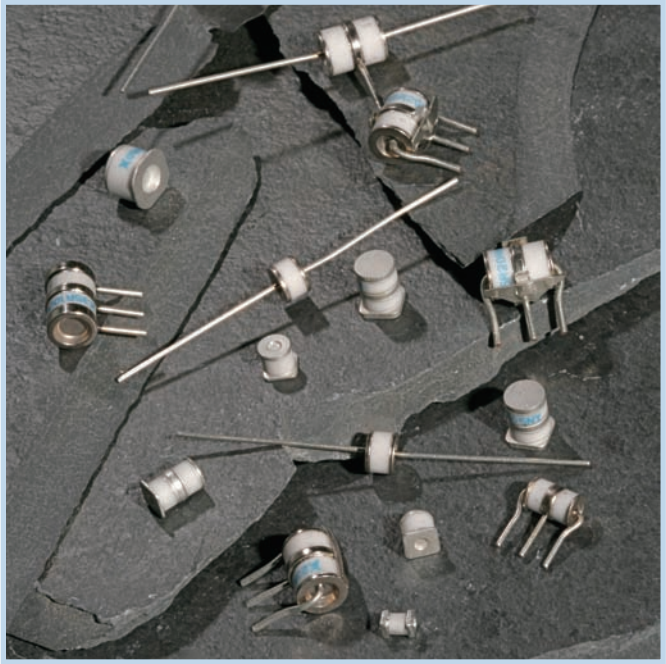
⚠ Warning :

- 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.

Gas Discharge Tubes

Raychem 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.

Raychem 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, SiBar thyristor surge protection devices, and MOV (Metal Oxide Varistor) 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 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

Figure G1 Two electrode devices for ungrounded circuits

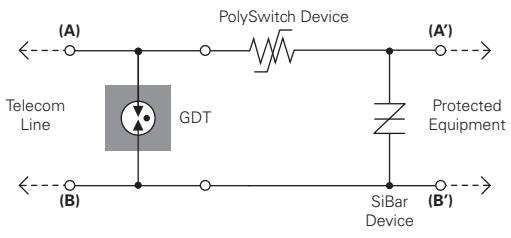


Figure G2 Three electrode devices for grounded circuits

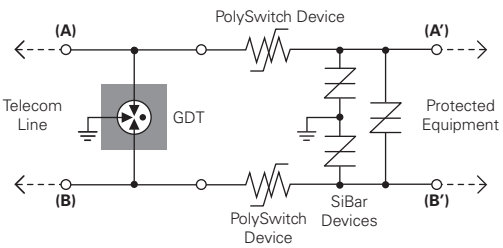


Table G1 Device Voltage Ratings for "R" Series Gas Discharge Tubes

Part Number	DC Sparkover Voltage @ 100V/s ± 20% Tolerance	Impulse Sparkover Voltage @ 1kV/µs
	75*	600
	90	600
	140	600
	150	600
GTCS23-XXXM-R01	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
GTCX25-XXXM-R02	200	600	700	<135	20
GTCX26-XXXM-R05	230	600	700	<135	20
GTCX28-XXXM-R05	250	600	700	<135	20
GTCX28-XXXM-R10	260	700	800	<135	20
GTCX28-XXXM-R20**	300	800	900	<150	20
GTCX35-XXXM-R05	350	900	1000	<150	20
GTCX36-XXXM-R10	400	900	1000	<150	20
GTCX37-XXXM-R10	420	900	1000	<150	20
GTCX38-XXXM-R10	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 230V

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

Part Number	Impulse Discharge Current 8x20µs 10 hits	Impulse Discharge Current 8x20µs 300 hits	Impulse Withstand Voltage 10x700µs 10 hits	Capacitance @ 1MHz	Insulation Resistance @ 100V†	UL Rating UL497B #E179610
GTCS23-XXXM-R01	1kA	100A	4kV	<0.5pF	1,000 (MΩ)	All Devices

Part Number	Impulse Discharge Current 8x20µs 10 hits	Impulse Life 10x100µs 300 hits	AC Discharge Current (1sec duration; 10 hits) @ 50 Hz	Capacitance @ 1MHz	Insulation Resistance @ 100V†	UL Rating 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
GTCX35-XXXM-R05	5kA	100A	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

* <1.2pF for 75V and 90V devices.

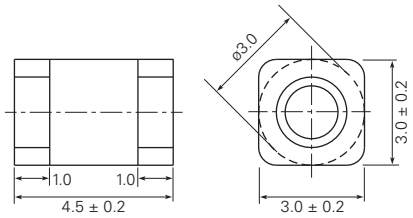
† Insulation resistance measured at 50V for devices less than 90V.
Insulation resistance measured at 250V for devices more than 500V.

RoHS Compliant, ELV Compliant HF Halogen Free

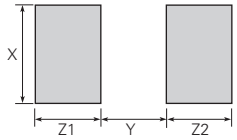
Figure G3-G10 Dimensions for "R" Series Gas Discharge Tubes

Figure G3 Two Electrode 3mm Product Dimensions

Surface-mount (GTCS23-XXXM-R01)



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

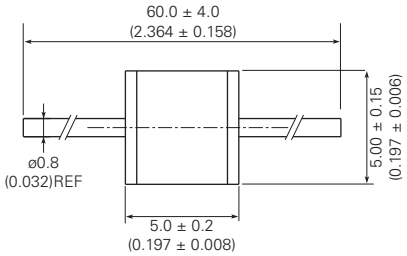


	X	Y	Z1	Z2
	Nom.	Nom.	Nom.	Nom.
mm	3.0	2.0	2.0	2.0
in*	(0.118)	(0.079)	(0.079)	(0.079)

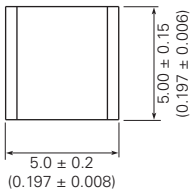
* The dimensions in inches are rounded approximations.

Figure G4 Two Electrode 5mm Product Dimensions

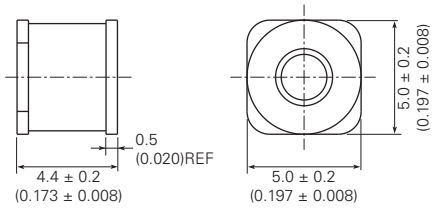
Axial Leads (GTCA25-XXXM-R02)



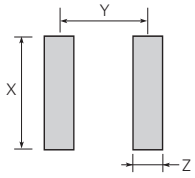
No Leads (GTCN25-XXXM-R02)†



Surface-mount (GTCS25-XXXM-R02)



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

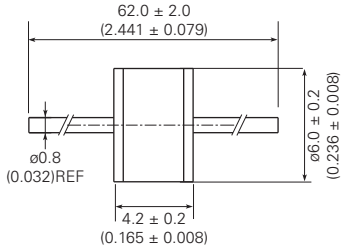


	X	Y	Z
	Nom.	Nom.	Nom.
mm	6.0	3.9	1.3
in*	(0.197)	(0.154)	(0.051)

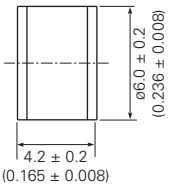
* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G5 Two Electrode 6mm Product Dimensions

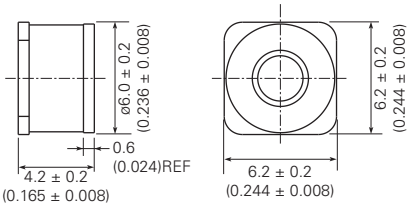
Axial Leads (GTCA26-XXXM-R05)



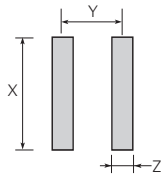
No Leads (GTCN26-XXXM-R05)†



Surface-mount (GTCS26-XXXM-R05)



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



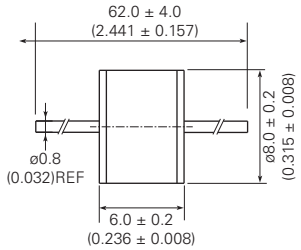
	X	Y	Z
	Nom.	Nom.	Nom.
mm	7.0	3.7	1.3
in*	(0.276)	(0.146)	(0.051)

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

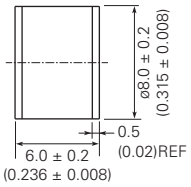
Figure G3-G10 Dimensions for "R" Series Gas Discharge Tubes ... Cont'd

Figure G6 Two Electrode 8mm Product Dimensions

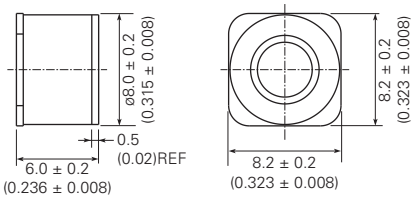
Axial Leads (GTCA28-XXXM-R05, R10 & R20)



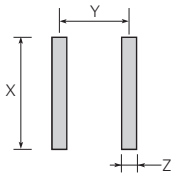
No Leads (GTCN28-XXXM-R05, R10 & R20)†



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



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

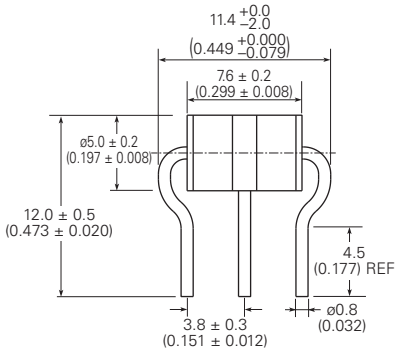


	X Nom.	Y Nom.	Z Nom.
mm	9.0	5.6	1.2
in*	(0.354)	(0.22)	(0.047)

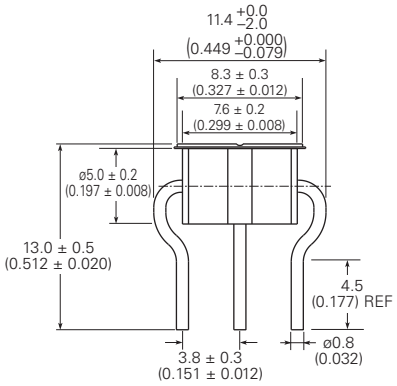
* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G7 Three Electrode 5mm Product Dimensions

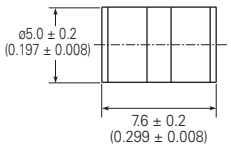
Axial Leaded (GTCA35-XXXM-R05)



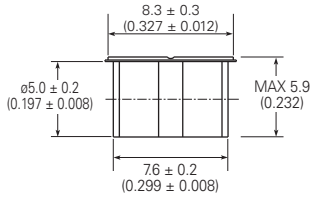
Axial Leaded with-FT (GTCA35-XXXM-R05-FT)



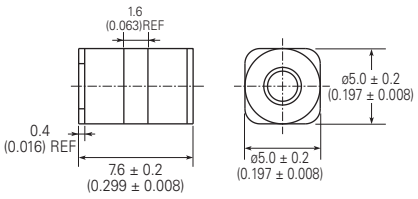
No Leads (GTCN35-XXXM-R05)†



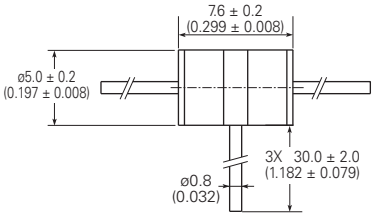
No Leads with-FT (GTCN35-XXXM-R05-FT)†



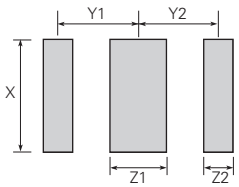
Surface-mount (GTCS35-XXXM-R05)



T Leaded (GTCT35-XXXM-R05)



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



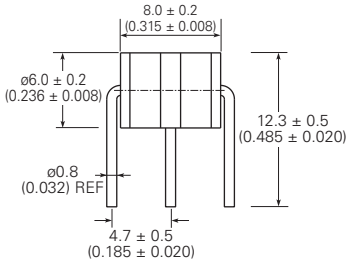
	X Nom.	Y1 Nom.	Y2 Nom.	Z1 Nom.	Z2 Nom.
mm	6.0	3.6	3.6	2.5	1.3
in*	(0.236)	(0.142)	(0.142)	(0.098)	(0.051)

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

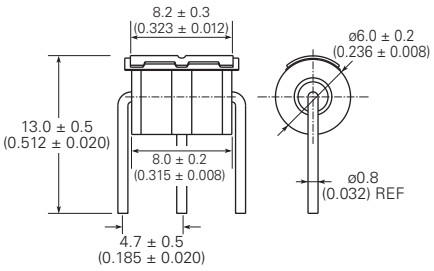
Figure G3-G10 Dimensions for "R" Series Gas Discharge Tubes ... Cont'd

Figure G8 Three Electrode 6mm Product Dimensions

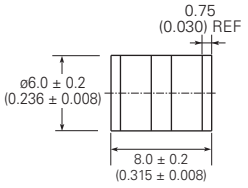
Axial Leaded (GTCA36-XXXM-R10)



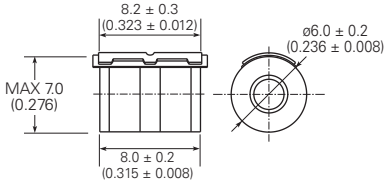
Axial Leaded with-FT (GTCA36-XXXM-R10-FT)



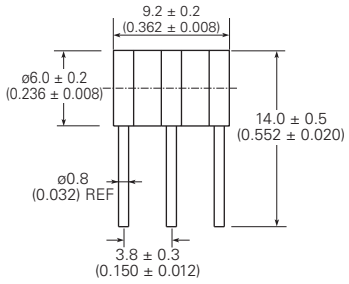
No Leads (GTCN36-XXXM-R10)†



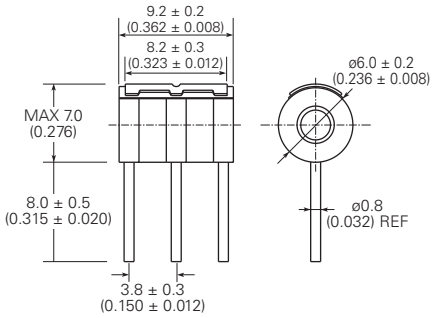
No Leads with-FT (GTCN36-XXXM-R10-FT)†



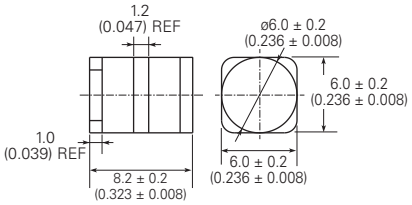
Radial Leaded (GTCR36-XXXM-R10)



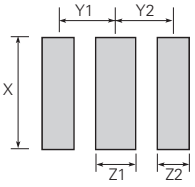
Radial Leaded with-FT (GTCR36-XXXM-R10-FT)



Surface-mount (GTCS36-XXXM-R10)



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

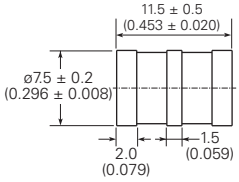


	X	Y1	Y2	Z1	Z2
	Nom.	Nom.	Nom.	Nom.	Nom.
mm	7.0	3.6	3.6	2.5	2.0
in*	(0.276)	(0.142)	(0.142)	(0.098)	(0.079)

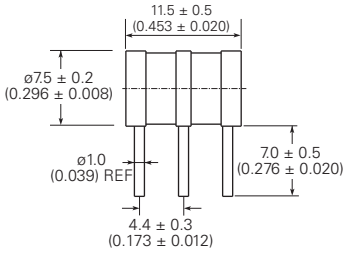
* The dimensions in inches are rounded approximations.
† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G9 Three Electrode 7mm Product Dimensions

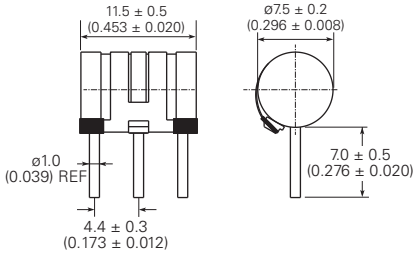
No Leads (GTCN37-XXXM-R10)†



Radial Leaded (GTCR37-XXXM-R10)



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

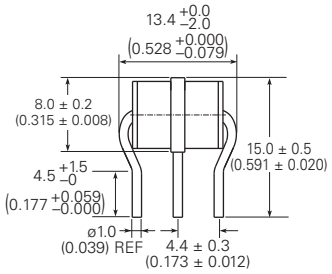


† Parts with no leads are not solderable and are meant for insertion into magazine clips.

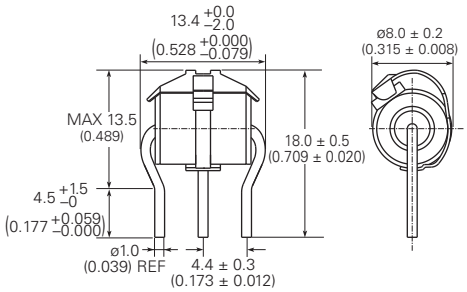
Figure G3-G10 Dimensions for "R" Series Gas Discharge Tubes ... Cont'd

Figure G10 Three Electrode 8mm Product Dimensions

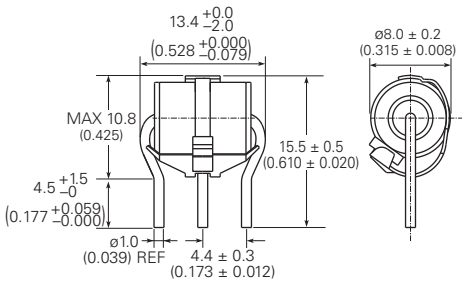
Axial Leaded (GTCA38-XXXM-R10)



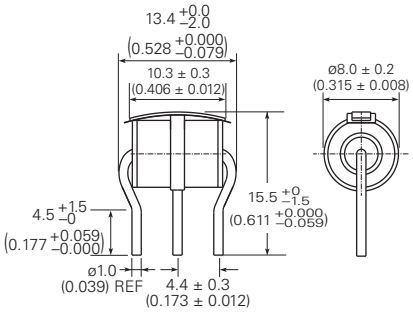
Axial Leaded with-FS (GTCA38-XXXM-R10-FS)



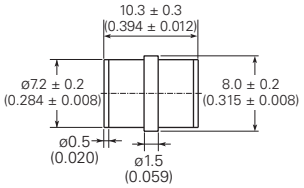
Axial Leaded with-FS (GTCA38-XXXM-R10-FS2)



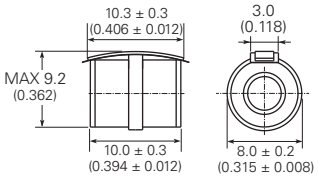
Axial Leaded with-FT (GTCA38-XXXM-R10-FT)



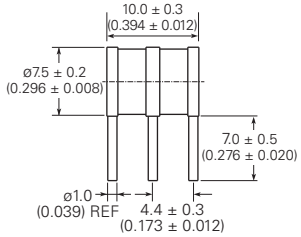
No Leads (GTCN38-XXXM-R10)†



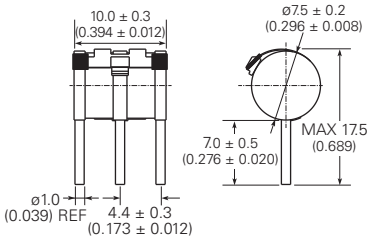
No Leads with-FT (GTCN38-XXXM-R10-FT)†



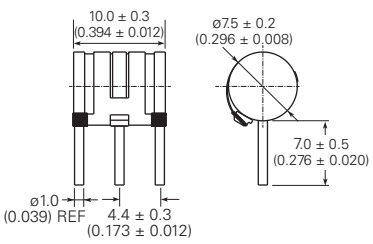
Radial Leaded (GTCR38-XXXM-R10)



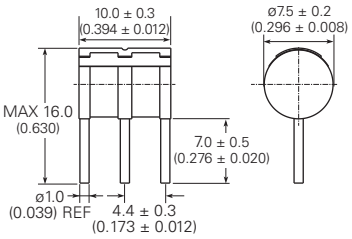
Radial Leaded with-FS (GTCR38-XXXM-R10-FS)



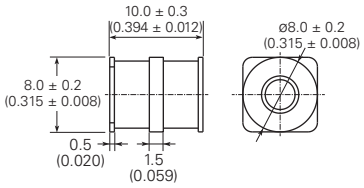
Radial Leaded with-FS (GTCR38-XXXM-R10-FS2)



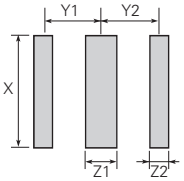
Radial Leaded with-FT (GTCR38-XXXM-R10-FT)



Surface-mount (GTCS38-XXXM-R10)



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



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

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

RoHS Compliant, ELV Compliant HF Halogen Free

Fail-Short Mechanism for Gas Discharge Tubes

Fail-Short Mechanism (FS)

The 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 G14.

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.

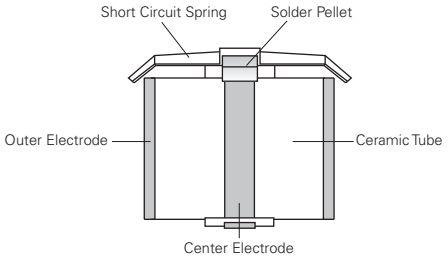


Figure G14

Fail-Short Mechanism (FT)

The 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.

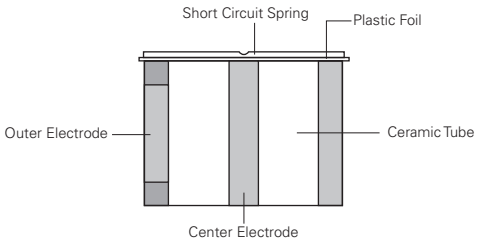


Figure G15

Temperature 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	8000
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	500	2500
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
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 parts available only in surface-mount and tape and reel packaging

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

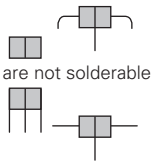
Tolerance of 20% on DC Switch Voltage

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 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.

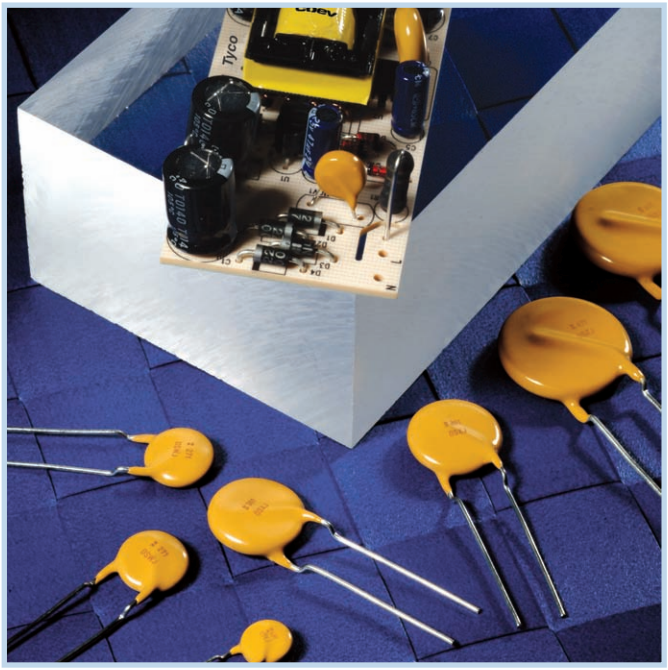
⚠ Warning :

- 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.

ROV Metal Oxide Varistors

ROV metal oxide varistors help protect power systems from damage caused by transient overvoltage faults such as lightning, power contact, and power induction. Suitable for a broad range of applications, ROV devices help protect sensitive electronic equipment from potential power surge damage by clamping high-energy, short-duration impulses.

The ROV's high current handling and energy absorption capability, fast response and low cost make it suitable for overvoltage protection in telecom, datacom and security systems, surge strips, power supplies, control board transformers and electric motors. ROVs can also be used to help protect electrical equipment from damage caused by large voltage or power transients on the AC Mains inputs. In a coordinated circuit protection scheme the ROV can be paired with a PolySwitch overcurrent protection device to help improve equipment reliability and fulfill IEC-61000 test requirements.



Benefits

- Helps provide overvoltage fault protection for a wide variety of power systems
- Helps designers meet UL, CSA, and VDE standards
- Helps reduce warranty and service costs
- Low cost ($/Joule)

Features

- RoHS compliant
- Various diameter sizes:
  5mm, 7mm, 10mm, 14mm, 20mm
- Broad varistor voltage range: 18V - 1800V
- Various surge capabilities:
  standard, high surge, extra high surge
- High current handling and energy absorption capability
- Fast response time
- Low leakage current
- Various lead types:
  straight, kinked, other special lead types
- Various packaging options:
  bulk, tape and reel, ammo pack

Applications

- Power systems
- Surge strips
- Security systems
- Motors
- Telecommunications equipment
- Automotive electrical systems
- Household appliances

Table V1 ROV Metal Oxide Varistors Quick Selection Guide

Standard Series ROV Devices

Varistor Voltage	V_{RMS} AC	Maximum Surge Current (8 x 20μs)	Rated Wattage	Energy (10 x 1000μs)	Possible Varistor Reference
18-68V	11-40V	≦100A	≦0.01W	0.6 – 2.1J	5mm series: 180M - 680K
		≦250A	≦0.02W	1.2 – 4.3J	7mm series: 180M - 680K
		≦500A	≦0.05W	2.4 – 8.5J	10mm series: 180M - 680K
		≦1000A	≦0.10W	4.7 – 17.0J	14mm series: 180M - 680K
		≦2000A	≦0.20W	7.0 – 24.0J	20mm series: 180M - 680L
82-750V	50-460V	≦400A	≦0.10W	2.8 – 22.5J	5mm series: 820K - 751K
82-820V	50-510V	≦1200A	≦0.25W	5.5 – 47.0J	7mm series: 820K - 821K
82-1800V	50-1000V	≦2500A	≦0.40W	11.0 – 174.0J	10mm series: 820K - 182K
		≦4500A	≦0.60W	22.0 – 348.0J	14mm series: 820K - 182K
		≦6500A	≦1.00W	44.0 – 695.0J	20mm series: 820K - 182K

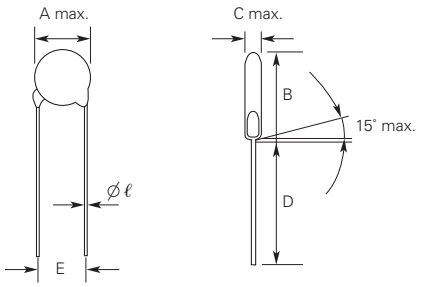
High Surge Series (H Series) ROV Devices

Varistor Voltage	V_{RMS} AC	Maximum Surge Current (8 x 20μs)	Rated Wattage	Energy (10 x 1000μs)	Possible Varistor Reference
18-68V	11-40V	≦250A	≦0.01W	0.7 – 2.6J	5mm series: H180M - H680K
		≦500A	≦0.02W	1.5 – 5.4J	7mm series: H180M - H680K
		≦1000A	≦0.05W	2.6 – 9.8J	10mm series: H180M - H680K
		≦2000A	≦0.10W	5.2 – 20.0J	14mm series: H180M - H680K
		≦3000A	≦0.20W	13.0 – 49.0J	20mm series: H180M - H680L
82-750V	50-460V	≦800A	≦0.10W	3.5 – 29.0J	5mm series: H820K - H751K
82-820V	50-510V	≦1750A	≦0.25W	7.0 – 60.0J	7mm series: H820K - H821K
82-1800V	50-1000V	≦3500A	≦0.40W	14.0 – 155.0J	10mm series: H820K - H182K
		≦6000A	≦0.60W	28.0 – 310.0J	14mm series: H820K - H182K
		≦10000A	≦1.00W	56.0 – 1020.0J	20mm series: H820K - H182K

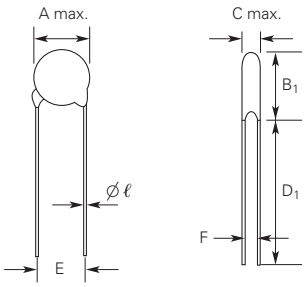
Extra High Surge Series (E Series) ROV Devices

Varistor Voltage	V_{RMS} AC	Maximum Surge Current (8 x 20μs)	Rated Wattage	Energy (10 x 1000μs)	Possible Varistor Reference
200-360V	130-230V	≦6500A	≦0.60W	84.0 – 151.0J	14mm series: E201K - E361K
		≦12500A	≦1.00W	168.0 – 302.0J	20mm series: E201K - E361K

Figure V1 Dimension Figures for ROV Metal Oxide Varistors



Kinked lead (Standard)



Straight lead (-S)

Table V2 Dimensions in Millimeters for ROV Metal Oxide Varistors

Diameter	5mm	7mm	10mm	14mm	20mm
A max.	7.5	9.0	12.5	16.5	23.0
ℓ ± 0.05	0.6	0.6	0.8	0.8	1.0
E ± 1.0	5.0	5.0	7.5	7.5	10.0
B max.	11.0	13.0	18.0 (182k: 19.0)	22.0 (182k: 23.0)	28.0 (182k: 29.0)
D_1 min.	25.0	25.0	25.0	25.0	25.0
D min.	24.0	24.0	24.0	24.0	24.0

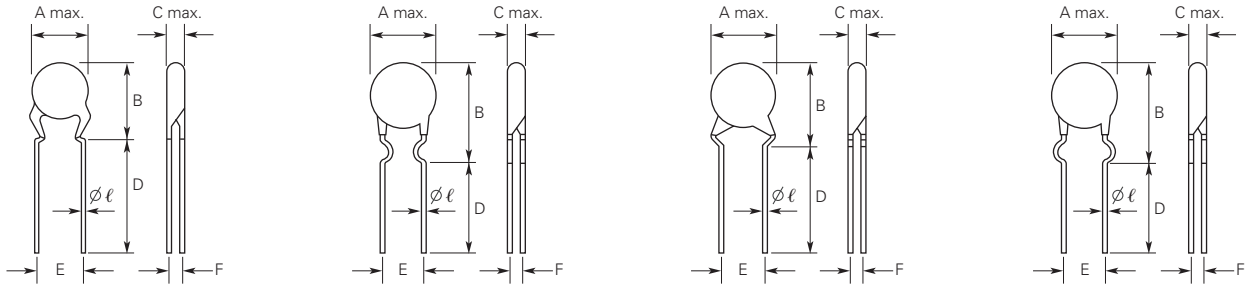
RoHS Compliant, ELV Compliant

Table V2 Dimensions in Millimeters for ROV Metal Oxide Varistors ... Cont'd

C Max. F & B, Max.

Diameter		5mm			7mm			10mm			14mm			20mm	
Type No.	C max.	F±0.8	B_1 max.	C max.	F±0.8	B_1 max.	C max.	F±0.8	B_1 max.	C max.	F±0.8	B_1 max.	C max.	F±0.8	B_1 max.
180M	4.5	0.8	10.5	4.5	0.8	12.0	4.9	0.8	15.5	5.0	0.9	19.5	5.2	0.9	26.5
220L	4.5	0.9	10.5	4.5	0.9	12.0	4.9	0.9	15.5	5.0	1.0	19.5	5.3	1.0	26.5
270K	4.7	0.9	10.5	4.7	0.9	12.0	5.1	0.9	15.5	5.2	1.1	19.5	5.4	1.1	26.5
330K	4.7	1.0	10.5	4.7	1.0	12.0	5.1	1.0	15.5	5.2	1.2	19.5	5.4	1.2	26.5
390K	4.7	1.2	10.5	4.7	1.2	12.0	5.1	1.2	15.5	5.2	1.4	19.5	5.4	1.4	26.5
470K	5.0	1.2	10.5	5.0	1.2	12.0	5.5	1.2	15.5	5.6	1.4	19.5	5.6	1.4	26.5
560K	5.0	1.4	10.5	5.0	1.4	12.0	5.5	1.4	15.5	5.6	1.6	19.5	5.6	1.6	26.5
680K	5.5	1.7	10.5	5.5	1.7	12.0	6.0	1.7	15.5	6.1	1.9	19.5	6.1	1.9	26.5
820K	3.8	0.8	10.5	3.8	0.8	12.0	4.3	0.8	15.5	4.4	1.0	19.5	4.9	1.2	26.5
101K	3.9	0.8	10.5	3.9	0.8	12.0	4.4	0.8	15.5	4.5	1.0	19.5	5.1	1.2	26.5
121K	4.1	0.9	10.5	4.1	0.9	12.0	4.5	0.9	15.5	4.6	1.1	19.5	5.3	1.3	26.5
151K	4.5	1.2	10.5	4.5	1.2	12.0	4.9	1.2	15.5	5.1	1.4	19.5	5.6	1.6	26.5
181K	4.1	1.0	10.5	4.1	1.0	12.0	4.5	1.0	15.5	4.7	1.2	19.5	5.2	1.4	26.5
201K	4.2	1.0	10.5	4.2	1.0	12.0	4.6	1.0	15.5	4.8	1.2	19.5	5.3	1.4	26.5
221K	4.3	1.1	10.5	4.3	1.1	12.0	4.7	1.1	15.5	4.9	1.3	19.5	5.4	1.5	26.5
241K	4.4	1.1	10.5	4.4	1.3	12.0	4.8	1.3	15.5	5.0	1.5	19.5	5.5	1.7	26.5
271K	4.6	1.3	10.5	4.6	1.4	12.0	5.0	1.4	15.5	5.2	1.5	19.5	5.7	1.9	26.5
301K	4.8	1.3	10.5	4.8	1.5	12.0	5.2	1.6	15.5	5.4	1.7	19.5	5.9	2.1	26.5
331K	4.9	1.3	10.5	4.9	1.5	12.0	5.3	1.6	15.5	5.5	1.7	19.5	6.0	2.1	26.5
361K	5.1	1.8	10.5	5.1	1.9	12.0	5.5	1.9	15.5	5.7	2.1	19.5	6.2	2.3	26.5
391K	5.3	2.0	11.0	5.3	2.0	12.5	5.7	2.2	16.0	5.9	2.2	20.0	6.4	2.4	26.5
431K	6.1	2.1	11.0	6.1	2.0	12.5	6.5	2.5	16.0	6.7	2.5	20.0	7.2	2.7	26.5
471K	6.4	2.2	11.0	6.4	2.3	12.5	6.8	2.6	16.0	7.0	2.7	20.0	7.5	2.9	27.0
511K	6.6	2.5	11.5	6.6	2.5	13.0	7.0	3.1	16.5	7.2	3.1	20.5	7.7	3.3	27.0
561K	6.9	2.8	11.5	6.9	2.8	13.0	7.3	3.4	16.5	7.5	3.4	20.5	8.0	3.6	27.0
621K	7.2	3.1	11.5	7.2	3.1	13.0	7.6	4.0	16.5	7.8	3.8	20.5	8.3	4.1	27.0
681K	7.5	3.4	11.5	7.5	3.4	13.0	8.0	4.4	16.5	8.2	4.1	20.5	8.7	4.4	27.0
751K	7.9	3.7	11.5	7.9	3.7	13.0	8.4	4.4	16.5	8.6	4.3	20.5	9.1	4.5	27.0
781K	—	—	—	8.1	3.9	13.0	8.6	4.6	16.5	8.8	4.6	20.5	9.3	4.8	27.0
821K	—	—	—	8.3	4.1	13.0	8.8	4.6	16.5	9.0	4.6	20.5	9.5	4.8	27.0
911K	—	—	—	—	—	—	9.4	5.4	16.5	9.6	5.4	20.5	10.1	5.7	27.0
102K	—	—	—	—	—	—	9.9	5.4	16.5	10.1	5.6	20.5	10.7	5.8	27.0
112K	—	—	—	—	—	—	10.5	5.7	16.5	10.7	6.1	20.5	11.2	6.3	27.0
182K	—	—	—	—	—	—	12.6	9.8	18.5	12.8	10.2	22.5	13.5	10.4	29.0

Figure V2 Special Lead Configurations for ROV Metal Oxide Varistors



"Type A" lead | "Type B" lead | "Type C" lead | "Type D" lead

Table V3 Dimensions in Millimeters* for ROV Metal Oxide Varistors

Lead Type	Diameter	5mm	7mm	10mm	14mm	20mm
A, C	B max.	10.0	12.0	15.0	19.0	26.0
B, D	B max.	12.0	14.0	17.0	21.0	28.0

* All other dimensions are the same as those of the (standard) kinked leads.

Table V4 Rating and Characteristics for Standard Series Specifications — 5mm Devices

Part Number	Varistor Voltage V@0.1mA DC (V)	Varistor Voltage V@0.1mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@5A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV05-180M	18	±20%	11	14	40*	100	50	0.01	0.6	1121	● ■
ROV05-220L	22	±15%	14	18	48*	100	50	0.01	0.7	1233	● ■
ROV05-270K	27	±10%	17	22	60*	100	50	0.01	0.9	1073	● ■
ROV05-330K	33	±10%	20	26	73*	100	50	0.01	1.1	834	● ■
ROV05-390K	39	±10%	25	31	86*	100	50	0.01	1.2	877	● ■
ROV05-470K	47	±10%	30	38	104*	100	50	0.01	1.5	715	● ■
ROV05-560K	56	±10%	35	45	123*	100	50	0.01	1.8	643	● ■
ROV05-680K	68	±10%	40	56	150*	100	50	0.01	2.1	501	● ■
ROV05-820K	82	±10%	50	65	145	400	200	0.10	2.8	269	● ■
ROV05-101K	100	±10%	60	85	175	400	200	0.10	3.5	263	● ■
ROV05-121K	120	±10%	75	100	210	400	200	0.10	4.0	180	● ■
ROV05-151K	150	±10%	95	125	260	400	200	0.10	5.5	180	● ■
ROV05-181K	180	±10%	115	150	320	400	200	0.10	6.5	95	● ■
ROV05-201K	200	±10%	130	170	355	400	200	0.10	7.1	85	◆ ● ▲ ■
ROV05-221K	220	±10%	140	180	380	400	200	0.10	7.8	80	◆ ● ▲ ■
ROV05-241K	240	±10%	150	200	415	400	200	0.10	8.4	74	◆ ● ▲ ■
ROV05-271K	270	±10%	175	225	475	400	200	0.10	9.9	69	◆ ● ▲ ■
ROV05-301K	300	±10%	195	250	525	400	200	0.10	10.5	65	◆ ● ▲ ■
ROV05-331K	330	±10%	210	275	575	400	200	0.10	11.5	60	◆ ● ▲ ■
ROV05-361K	360	±10%	230	300	620	400	200	0.10	13.0	69	◆ ● ▲ ■
ROV05-391K	390	±10%	250	320	675	400	200	0.10	15.0	56	◆ ● ▲ ■
ROV05-431K	430	±10%	275	350	745	400	200	0.10	16.5	47	◆ ● ▲ ■
ROV05-471K	470	±10%	300	385	810	400	200	0.10	17.5	50	◆ ● ▲ ■
ROV05-511K	510	±10%	320	418	880	400	200	0.10	18.5	50	◆ ● ▲ ■
ROV05-561K	560	±10%	350	460	940	400	200	0.10	19.5	50	◆ ● ▲ ■
ROV05-621K	620	±10%	385	505	1050	400	200	0.10	20.5	50	◆ ● ▲ ■
ROV05-681K	680	±10%	420	560	1150	400	200	0.10	21.5	43	◆ ● ▲ ■
ROV05-751K	750	±10%	460	615	1290	400	200	0.10	22.5	—	◆ ● ▲ ■

*The clamping voltages from 180M to 680K are tested at 1A current.

†Certification

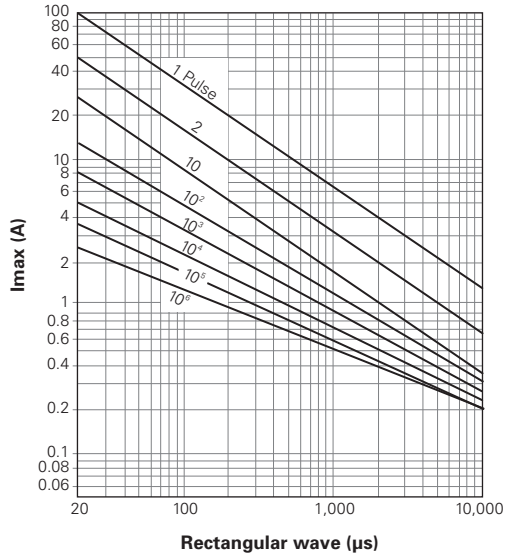
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V3-V4	Standard Series Specifications — 5mm Devices Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V3 - ROV05-180M~ROV05-680K

Pulse Lifetime Ratings



V-I Characteristic Curve

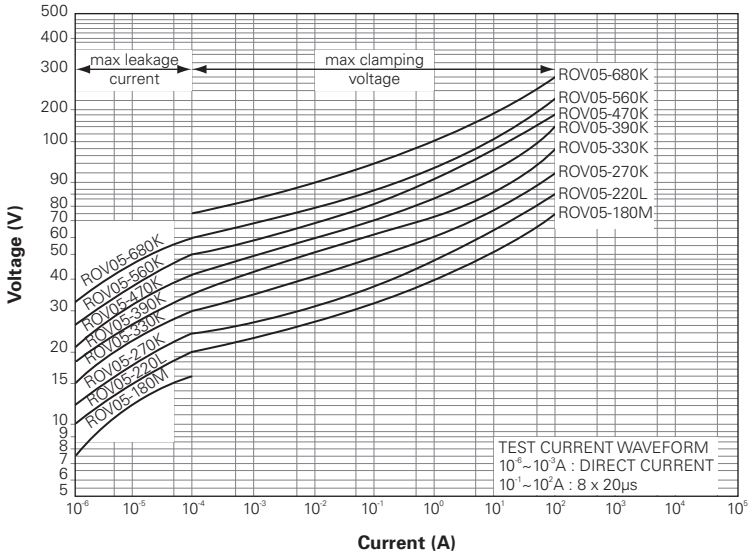
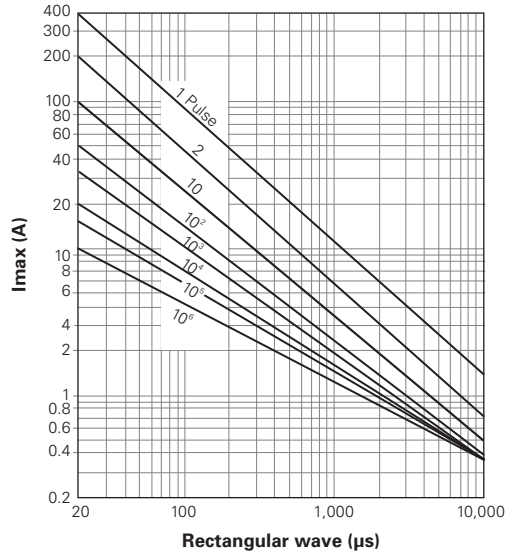


Figure V4 - ROV05-820K~ROV05-471K

Pulse Lifetime Ratings



V-I Characteristic Curve

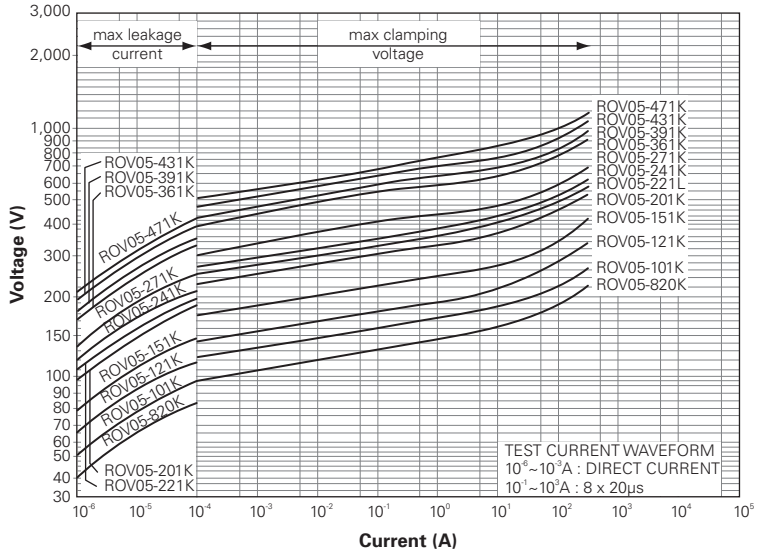


Table V5 Rating and Characteristics for Standard Series Specifications — 7mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@10A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV07-180M	18	±20%	11	14	36*	250	125	0.02	1.2	2918	● ■
ROV07-220L	22	±15%	14	18	43*	250	125	0.02	1.4	2933	● ■
ROV07-270K	27	±10%	17	22	53*	250	125	0.02	1.7	2344	● ■
ROV07-330K	33	±10%	20	26	65*	250	125	0.02	2.2	1840	● ■
ROV07-390K	39	±10%	25	31	77*	250	125	0.02	2.4	1817	● ■
ROV07-470K	47	±10%	30	38	93*	250	125	0.02	3.0	1595	● ■
ROV07-560K	56	±10%	35	45	110*	250	125	0.02	3.5	1333	● ■
ROV07-680K	68	±10%	40	56	135*	250	125	0.02	4.3	1119	● ■
ROV07-820K	82	±10%	50	65	135	1200	600	0.25	5.5	643	● ■
ROV07-101K	100	±10%	60	85	165	1200	600	0.25	7.0	535	● ■
ROV07-121K	120	±10%	75	100	200	1200	600	0.25	8.0	457	● ■
ROV07-151K	150	±10%	95	125	250	1200	600	0.25	11.0	371	● ■
ROV07-181K	180	±10%	115	150	300	1200	600	0.25	13.0	215	● ■
ROV07-201K	200	±10%	130	170	340	1200	600	0.25	14.3	224	◆ ● ▲ ■
ROV07-221K	220	±10%	140	180	360	1200	600	0.25	15.5	190	◆ ● ▲ ■
ROV07-241K	240	±10%	150	200	395	1200	600	0.25	16.8	185	◆ ● ▲ ■
ROV07-271K	270	±10%	175	225	455	1200	600	0.25	19.8	161	◆ ● ▲ ■
ROV07-301K	300	±10%	195	250	505	1200	600	0.25	21.0	135	◆ ● ▲ ■
ROV07-331K	330	±10%	210	275	550	1200	600	0.25	23.0	141	◆ ● ▲ ■
ROV07-361K	360	±10%	230	300	595	1200	600	0.25	26.0	117	◆ ● ▲ ■
ROV07-391K	390	±10%	250	320	650	1200	600	0.25	30.0	110	◆ ● ▲ ■
ROV07-431K	430	±10%	275	350	710	1200	600	0.25	33.0	111	◆ ● ▲ ■
ROV07-471K	470	±10%	300	385	775	1200	600	0.25	35.0	102	◆ ● ▲ ■
ROV07-511K	510	±10%	320	418	842	1200	600	0.25	37.0	100	◆ ● ▲ ■
ROV07-561K	560	±10%	350	460	920	1200	600	0.25	39.0	87	◆ ● ▲ ■
ROV07-621K	620	±10%	385	505	1025	1200	600	0.25	41.0	80	◆ ● ▲ ■
ROV07-681K	680	±10%	420	560	1120	1200	600	0.25	43.0	82	◆ ● ▲ ■
ROV07-751K	750	±10%	460	615	1240	1200	600	0.25	45.0	74	◆ ● ▲ ■
ROV07-781K	780	±10%	485	640	1290	1200	600	0.25	46.0	70	◆ ● ▲ ■
ROV07-821K	820	±10%	510	670	1355	1200	600	0.25	47.0	70	◆ ● ▲ ■

* The clamping voltages from 180M to 680K are tested at 2.5A current.

†Certification

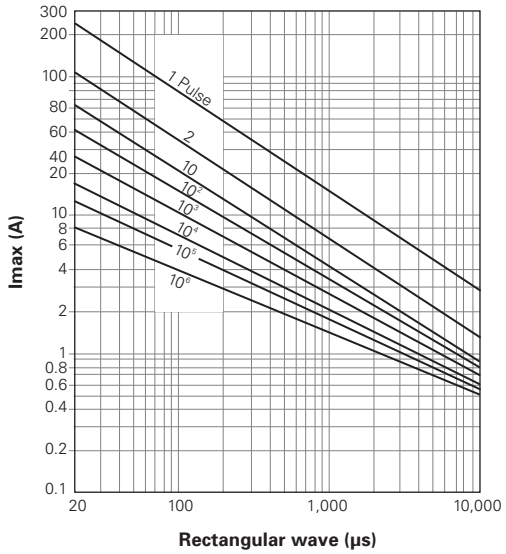
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V5-V6	Standard Series Specifications — 7mm Devices Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V5 - ROV07-180M~ROV07-680K

Pulse Lifetime Ratings



V-I Characteristic Curve

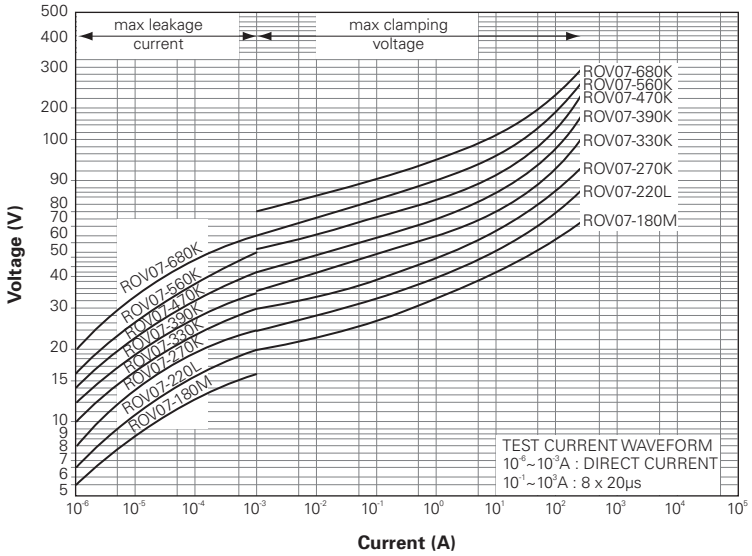
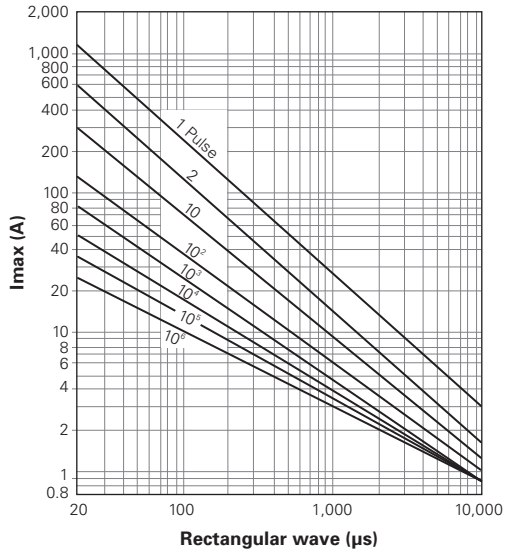


Figure V6 - ROV07-820K~ROV07-471K

Pulse Lifetime Ratings



V-I Characteristic Curve

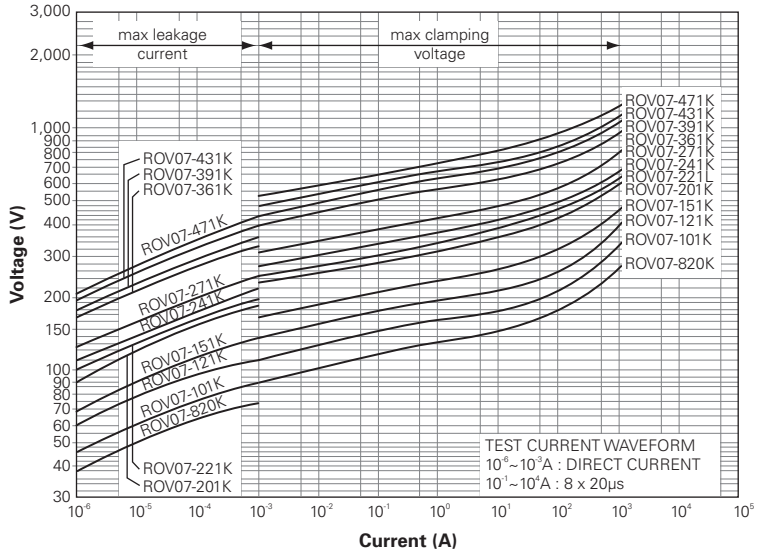


Table V6 Rating and Characteristics for Standard Series Specifications — 10mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@25A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV10-180M	18	±20%	11	14	36*	500	250	0.05	2.4	6500	● ■
ROV10-220L	22	±15%	14	18	43*	500	250	0.05	2.7	5521	● ■
ROV10-270K	27	±10%	17	22	53*	500	250	0.05	3.5	4742	● ■
ROV10-330K	33	±10%	20	26	65*	500	250	0.05	4.4	4247	● ■
ROV10-390K	39	±10%	25	31	77*	500	250	0.05	4.7	3658	● ■
ROV10-470K	47	±10%	30	38	93*	500	250	0.05	6.0	3137	● ■
ROV10-560K	56	±10%	35	45	110*	500	250	0.05	7.0	2900	● ■
ROV10-680K	68	±10%	40	56	135*	500	250	0.05	8.5	2230	● ■
ROV10-820K	82	±10%	50	65	135	2500	1250	0.40	11.0	1261	● ■
ROV10-101K	100	±10%	60	85	165	2500	1250	0.40	14.0	1021	● ■
ROV10-121K	120	±10%	75	100	200	2500	1250	0.40	16.0	946	● ■
ROV10-151K	150	±10%	95	125	250	2500	1250	0.40	22.0	733	● ■
ROV10-181K	180	±10%	115	150	300	2500	1250	0.40	26.0	483	● ■
ROV10-201K	200	±10%	130	170	340	2500	1250	0.40	28.5	400	◆ ● ▲ ■
ROV10-221K	220	±10%	140	180	360	2500	1250	0.40	31.0	393	◆ ● ▲ ■
ROV10-241K	240	±10%	150	200	395	2500	1250	0.40	33.5	325	◆ ● ▲ ■
ROV10-271K	270	±10%	175	225	455	2500	1250	0.40	39.5	334	◆ ● ▲ ■
ROV10-301K	300	±10%	195	250	505	2500	1250	0.40	42.0	278	◆ ● ▲ ■
ROV10-331K	330	±10%	210	275	550	2500	1250	0.40	46.0	275	◆ ● ▲ ■
ROV10-361K	360	±10%	230	300	595	2500	1250	0.40	52.0	231	◆ ● ▲ ■
ROV10-391K	390	±10%	250	320	650	2500	1250	0.40	60.0	247	◆ ● ▲ ■
ROV10-431K	430	±10%	275	350	710	2500	1250	0.40	66.0	216	◆ ● ▲ ■
ROV10-471K	470	±10%	300	385	775	2500	1250	0.40	70.0	210	◆ ● ▲ ■
ROV10-511K	510	±10%	320	418	842	2500	1250	0.40	74.0	187	◆ ● ▲ ■
ROV10-561K	560	±10%	350	460	920	2500	1250	0.40	78.0	186	◆ ● ▲ ■
ROV10-621K	620	±10%	385	505	1025	2500	1250	0.40	82.0	160	◆ ● ▲ ■
ROV10-681K	680	±10%	420	560	1120	2500	1250	0.40	86.0	156	◆ ● ▲ ■
ROV10-751K	750	±10%	460	615	1240	2500	1250	0.40	90.0	133	◆ ● ▲ ■
ROV10-781K	780	±10%	485	640	1290	2500	1250	0.40	92.0	117	◆ ● ▲ ■
ROV10-821K	820	±10%	510	670	1355	2500	1250	0.40	94.0	130	◆ ● ▲ ■
ROV10-911K	910	±10%	550	745	1500	2500	1250	0.40	102.0	111	◆ ● ▲ ■
ROV10-102K	1000	±10%	625	825	1650	2500	1250	0.40	112.0	96	◆ ● ▲ ■
ROV10-112K	1100	±10%	680	895	1815	2500	1250	0.40	124.0	88	◆ ● ▲ ■
ROV10-182K	1800	±10%	1000	1465	2970	2500	1250	0.40	174.0	65	◆ ● ▲ ■

* The clamping voltages from 180M to 680K are tested at 5A current.

†Certification

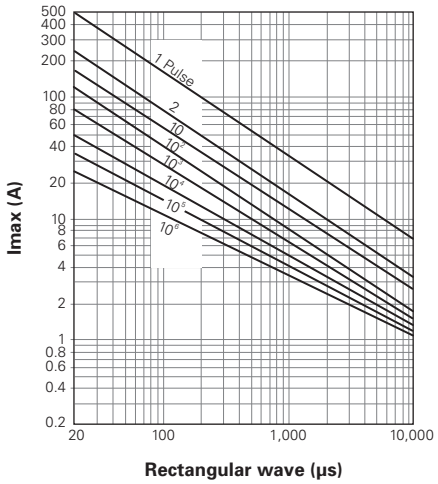
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V7-V9	Standard Series Specifications — 10mm Devices Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V7 - ROV10-180M~ROV10-680K

Pulse Lifetime Ratings



V-I Characteristic Curve

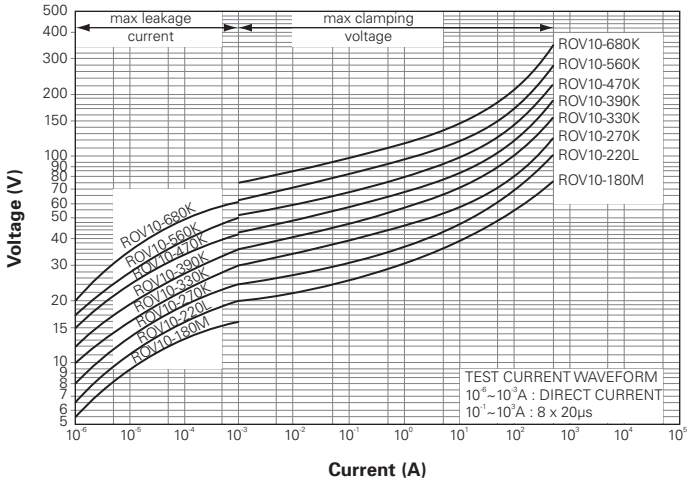
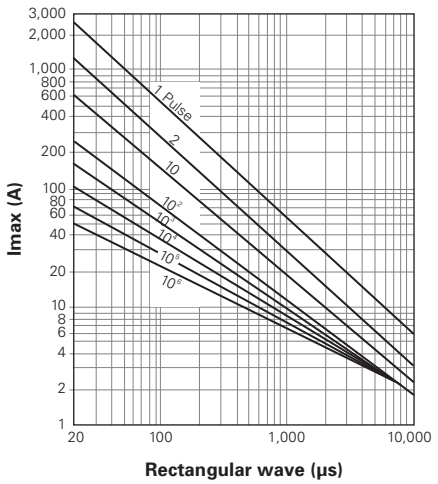


Figure V8 - ROV10-820K~ROV10-511K

Pulse Lifetime Ratings



V-I Characteristic Curve

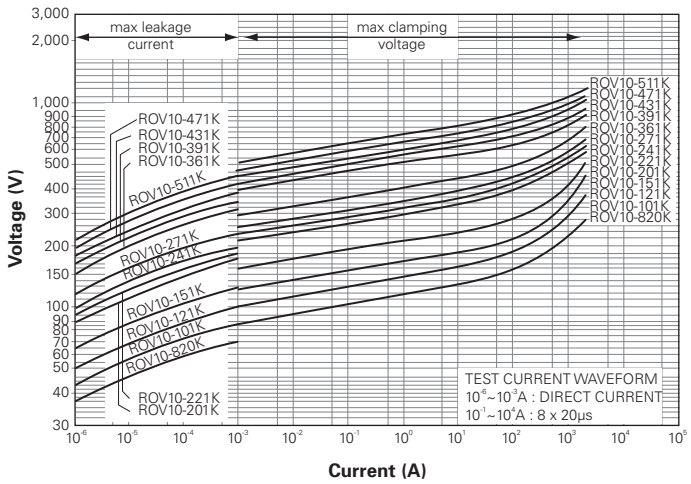
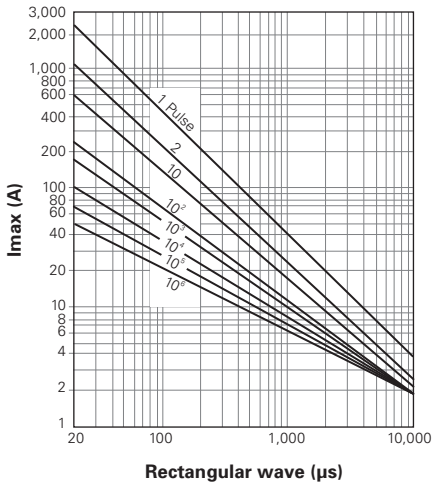


Figure V9 - ROV10-561K~ROV10-182K

Pulse Lifetime Ratings



V-I Characteristic Curve

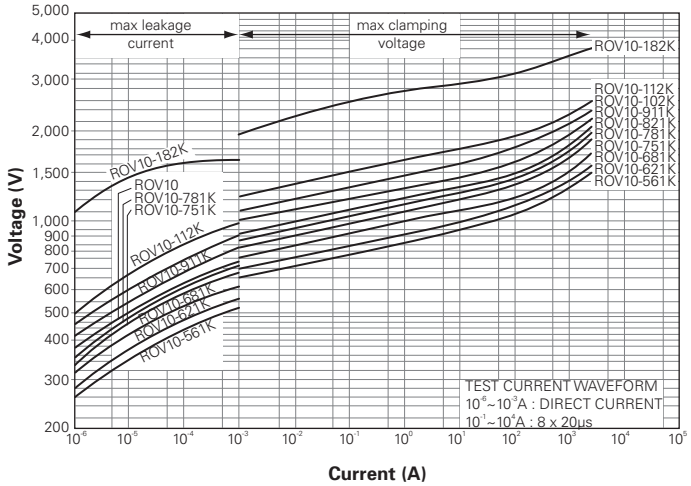


Table V7 Rating and Characteristics for Standard Series Specifications — 14mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@50A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV14-180M	18	±20%	11	14	36*	1000	500	0.1	4.7	14898	● ■
ROV14-220L	22	±15%	14	18	43*	1000	500	0.1	5.4	11957	● ■
ROV14-270K	27	±10%	17	22	53*	1000	500	0.1	6.9	9731	● ■
ROV14-330K	33	±10%	20	26	65*	1000	500	0.1	8.8	7704	● ■
ROV14-390K	39	±10%	25	31	77*	1000	500	0.1	9.4	7622	● ■
ROV14-470K	47	±10%	30	38	93*	1000	500	0.1	12.0	6417	● ■
ROV14-560K	56	±10%	35	45	110*	1000	500	0.1	14.0	5184	● ■
ROV14-680K	68	±10%	40	56	135*	1000	500	0.1	17.0	5099	● ■
ROV14-820K	82	±10%	50	65	135	4500	2500	0.6	22.0	2965	● ■
ROV14-101K	100	±10%	60	85	165	4500	2500	0.6	28.0	2221	● ■
ROV14-121K	120	±10%	75	100	200	4500	2500	0.6	32.0	1742	● ■
ROV14-151K	150	±10%	95	125	250	4500	2500	0.6	44.0	1510	● ■
ROV14-181K	180	±10%	115	150	300	4500	2500	0.6	52.0	922	● ■
ROV14-201K	200	±10%	130	170	340	4500	2500	0.6	57.0	845	◆ ● ▲ ■
ROV14-221K	220	±10%	140	180	360	4500	2500	0.6	62.0	713	◆ ● ▲ ■
ROV14-241K	240	±10%	150	200	395	4500	2500	0.6	67.0	769	◆ ● ▲ ■
ROV14-271K	270	±10%	175	225	455	4500	2500	0.6	79.0	655	◆ ● ▲ ■
ROV14-301K	300	±10%	195	250	505	4500	2500	0.6	84.0	650	◆ ● ▲ ■
ROV14-331K	330	±10%	210	275	550	4500	2500	0.6	92.0	613	◆ ● ▲ ■
ROV14-361K	360	±10%	230	300	595	4500	2500	0.6	104.0	465	◆ ● ▲ ■
ROV14-391K	390	±10%	250	320	650	4500	2500	0.6	120.0	458	◆ ● ▲ ■
ROV14-431K	430	±10%	275	350	710	4500	2500	0.6	132.0	454	◆ ● ▲ ■
ROV14-471K	470	±10%	300	385	775	4500	2500	0.6	140.0	413	◆ ● ▲ ■
ROV14-511K	510	±10%	320	418	842	4500	2500	0.6	148.0	374	◆ ● ▲ ■
ROV14-561K	560	±10%	350	460	920	4500	2500	0.6	156.0	398	◆ ● ▲ ■
ROV14-621K	620	±10%	385	505	1025	4500	2500	0.6	164.0	305	◆ ● ▲ ■
ROV14-681K	680	±10%	420	560	1120	4500	2500	0.6	172.0	312	◆ ● ▲ ■
ROV14-751K	750	±10%	460	615	1240	4500	2500	0.6	180.0	270	◆ ● ▲ ■
ROV14-781K	780	±10%	485	640	1290	4500	2500	0.6	184.0	252	◆ ● ▲ ■
ROV14-821K	820	±10%	510	670	1355	4500	2500	0.6	188.0	265	◆ ● ▲ ■
ROV14-911K	910	±10%	550	745	1500	4500	2500	0.6	204.0	240	◆ ● ▲ ■
ROV14-102K	1000	±10%	625	825	1650	4500	2500	0.6	224.0	200	◆ ● ▲ ■
ROV14-112K	1100	±10%	680	895	1815	4500	2500	0.6	248.0	180	◆ ● ▲ ■
ROV14-182K	1800	±10%	1000	1465	2970	4500	2500	0.6	348.0	118	◆ ● ▲ ■

* The clamping voltages from 180M to 680K are tested at 10A current.

†Certification

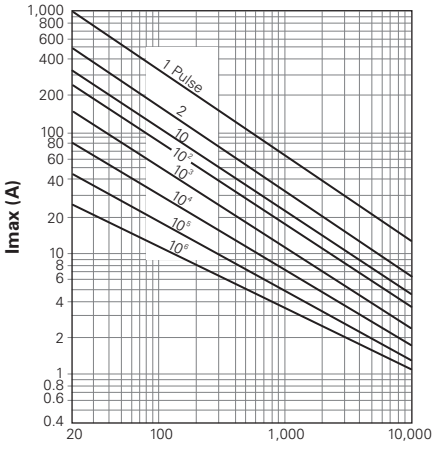
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V10-V12 — Standard Series Specifications — 14mm Devices
Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V10 - ROV14-180M~ROV14-680K

Pulse Lifetime Ratings



V-I Characteristic Curve

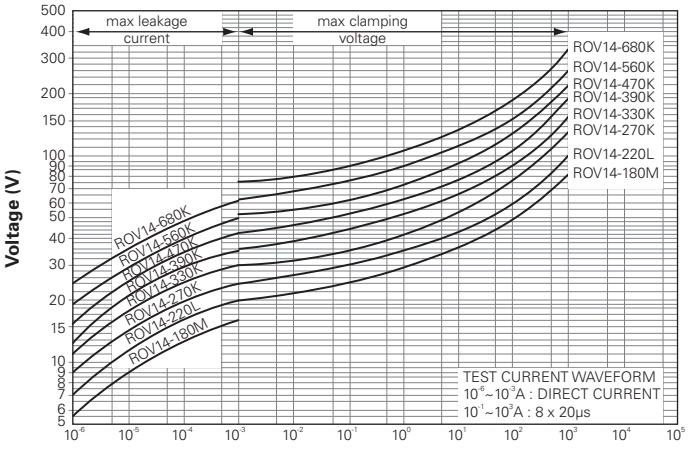
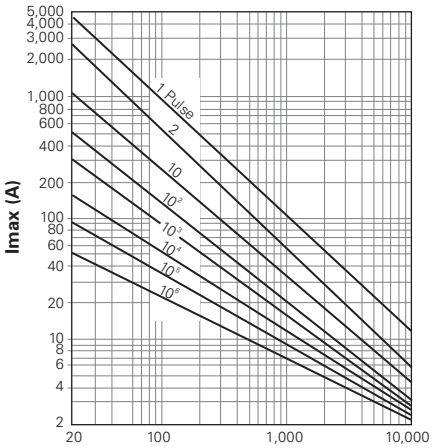


Figure V11 - ROV14-820K~ROV14-511K

Pulse Lifetime Ratings



V-I Characteristic Curve

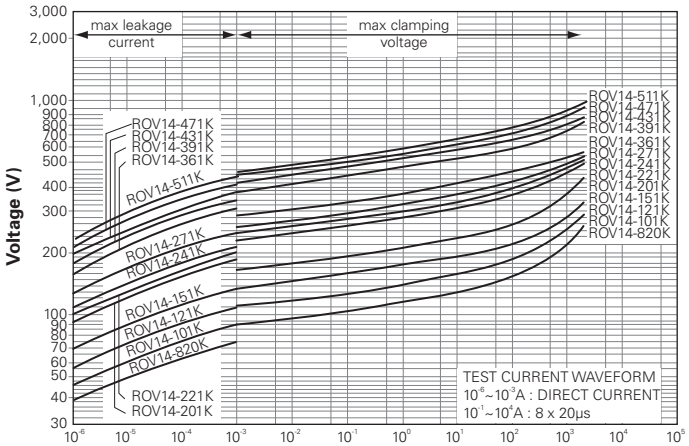
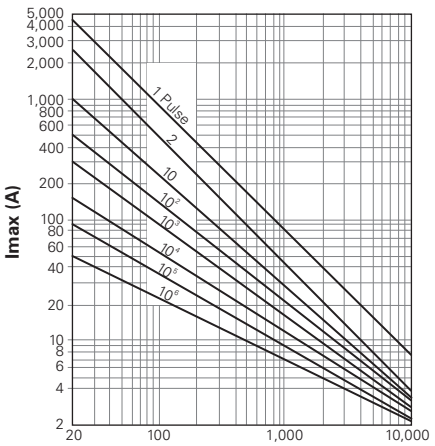


Figure V12 - ROV14-561K~ROV14-182K

Pulse Lifetime Ratings



V-I Characteristic Curve

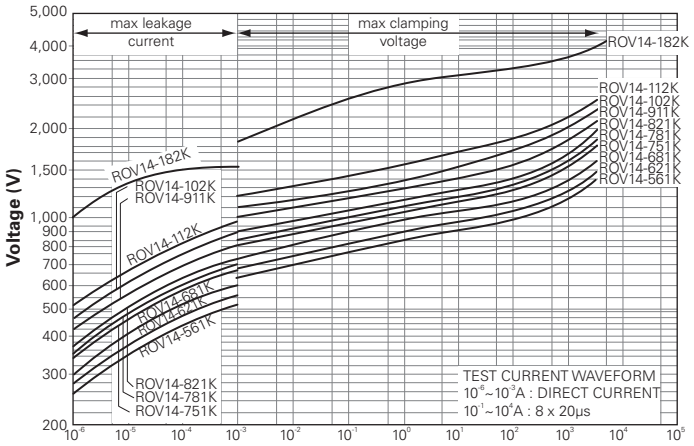


Table V8 Rating and Characteristics for Standard Series Specifications — 20mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@100A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV20-220M	22	±20%	14	18	43*	2000	1000	0.2	8.0	21200	● ■
ROV20-270M	27	±20%	17	22	53*	2000	1000	0.2	10.0	20000	● ■
ROV20-330M	33	±20%	20	26	65*	2000	1000	0.2	12.0	17200	● ■
ROV20-390L	39	±15%	25	31	77*	2000	1000	0.2	14.0	15003	● ■
ROV20-470L	47	±15%	30	38	93*	2000	1000	0.2	17.0	12080	● ■
ROV20-560L	56	±15%	35	45	110*	2000	1000	0.2	20.0	11600	● ■
ROV20-680L	68	±15%	40	56	135*	2000	1000	0.2	24.0	9600	● ■
ROV20-101K	100	±10%	60	85	165	6500	4000	1.0	56.0	4000	● ■
ROV20-121K	120	±10%	75	100	200	6500	4000	1.0	64.0	3800	● ■
ROV20-151K	150	±10%	95	125	250	6500	4000	1.0	88.0	3000	● ■
ROV20-181K	180	±10%	115	150	300	6500	4000	1.0	104.0	2400	● ■
ROV20-201K	200	±10%	130	170	340	6500	4000	1.0	114.0	1829	◆ ● ▲ ■
ROV20-221K	220	±10%	140	180	360	6500	4000	1.0	124.0	1600	◆ ● ▲ ■
ROV20-241K	240	±10%	150	200	395	6500	4000	1.0	134.0	1422	◆ ● ▲ ■
ROV20-271K	270	±10%	175	225	455	6500	4000	1.0	158.0	1261	◆ ● ▲ ■
ROV20-301K	300	±10%	195	250	505	6500	4000	1.0	168.0	1100	◆ ● ▲ ■
ROV20-331K	330	±10%	210	275	550	6500	4000	1.0	184.0	1106	◆ ● ▲ ■
ROV20-361K	360	±10%	230	300	595	6500	4000	1.0	208.0	987	◆ ● ▲ ■
ROV20-391K	390	±10%	250	320	650	6500	4000	1.0	240.0	975	◆ ● ▲ ■
ROV20-431K	430	±10%	275	350	710	6500	4000	1.0	264.0	858	◆ ● ▲ ■
ROV20-471K	470	±10%	300	385	775	6500	4000	1.0	280.0	761	◆ ● ▲ ■
ROV20-511K	510	±10%	320	418	842	6500	4000	1.0	296.0	792	◆ ● ▲ ■
ROV20-561K	560	±10%	350	460	920	6500	4000	1.0	312.0	679	◆ ● ▲ ■
ROV20-621K	620	±10%	385	505	1025	6500	4000	1.0	328.0	605	◆ ● ▲ ■
ROV20-681K	680	±10%	420	560	1120	6500	4000	1.0	344.0	553	◆ ● ▲ ■
ROV20-751K	750	±10%	460	615	1240	6500	4000	1.0	360.0	554	◆ ● ▲ ■
ROV20-781K	780	±10%	485	640	1290	6500	4000	1.0	368.0	481	◆ ● ▲ ■
ROV20-821K	820	±10%	510	670	1355	6500	4000	1.0	376.0	519	◆ ● ▲ ■
ROV20-911K	910	±10%	550	745	1500	6500	4000	1.0	408.0	444	◆ ● ▲ ■
ROV20-102K	1000	±10%	625	825	1650	6500	4000	1.0	448.0	400	◆ ● ▲ ■
ROV20-112K	1100	±10%	680	895	1815	6500	4000	1.0	496.0	360	◆ ● ▲ ■
ROV20-182K	1800	±10%	1000	1465	2970	6500	4000	1.0	695.0	260	◆ ● ▲ ■

* The clamping voltages from 180M to 680K are tested at 20A current.

†Certification

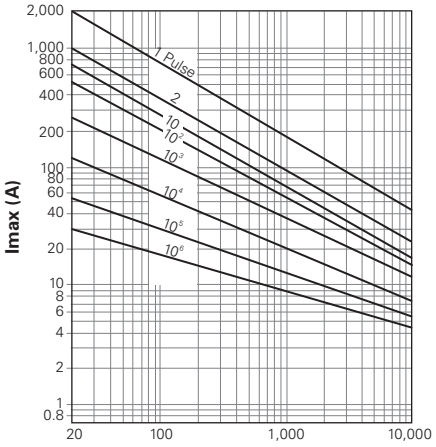
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V13-V15 — Standard Series Specifications — 20mm Devices
Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V13 - ROV20-220M~ROV20-680L

Pulse Lifetime Ratings



V-I Characteristic Curve

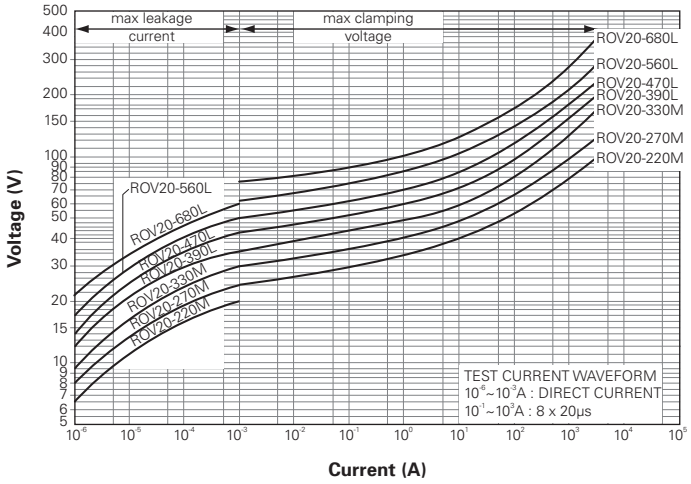
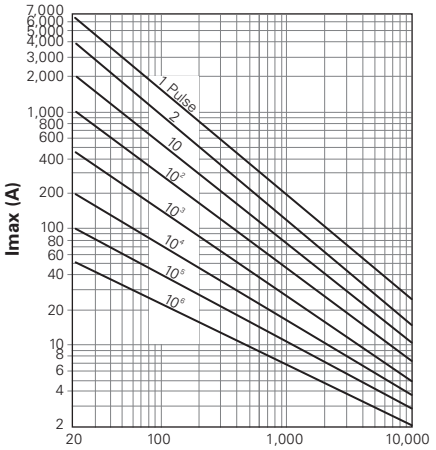


Figure V14 - ROV20-101K~ROV20-511K

Pulse Lifetime Ratings



V-I Characteristic Curve

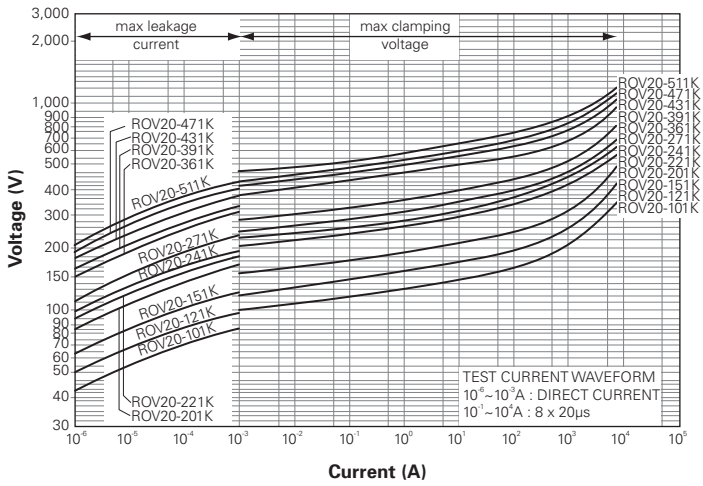
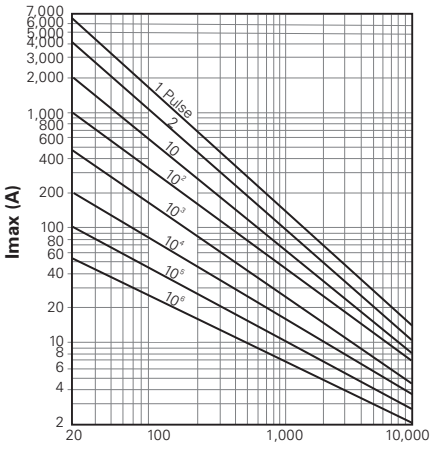


Figure V15 - ROV20-561K-ROV20-182K

Pulse Lifetime Ratings



V-I Characteristic Curve

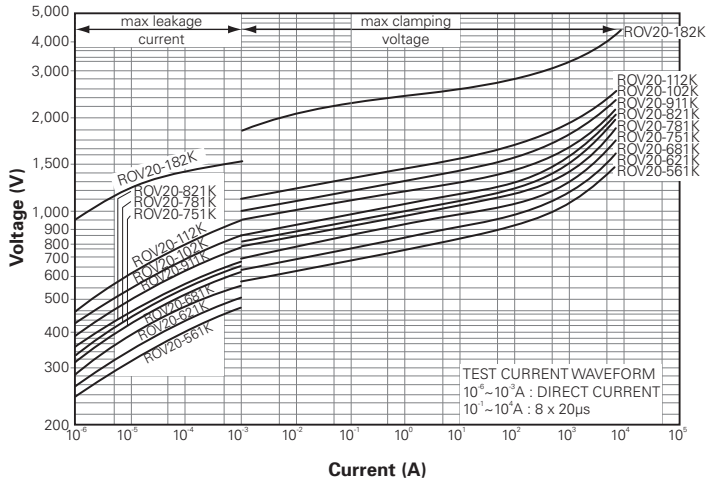


Table V9 Rating and Characteristics for H Series Specifications — 5mm Devices

Part Number	Varistor Voltage V@0.1mA DC (V)	Varistor Voltage V@0.1mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@5A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV05H180M	18	±20%	11	14	40*	250	125	0.01	0.7	1120	● ■
ROV05H220L	22	±15%	14	18	48*	250	125	0.01	0.8	1230	● ■
ROV05H270K	27	±10%	17	22	60*	250	125	0.01	1.1	1070	● ■
ROV05H330K	33	±10%	20	26	73*	250	125	0.01	1.3	830	● ■
ROV05H390K	39	±10%	25	31	86*	250	125	0.01	1.5	880	● ■
ROV05H470K	47	±10%	30	38	104*	250	125	0.01	1.8	720	● ■
ROV05H560K	56	±10%	35	45	123*	250	125	0.01	2.2	640	● ■
ROV05H680K	68	±10%	40	56	150*	250	125	0.01	2.6	500	● ■
ROV05H820K	82	±10%	50	65	145	800	600	0.10	3.5	270	● ■
ROV05H101K	100	±10%	60	85	175	800	600	0.10	4.5	260	● ■
ROV05H121K	120	±10%	75	100	210	800	600	0.10	5.5	180	● ■
ROV05H151K	150	±10%	95	125	260	800	600	0.10	6.5	180	● ■
ROV05H181K	180	±10%	115	150	320	800	600	0.10	8.0	95	● ■
ROV05H201K	200	±10%	130	170	355	800	600	0.10	8.5	85	◆ ● ▲ ■
ROV05H221K	220	±10%	140	180	380	800	600	0.10	9.0	80	◆ ● ▲ ■
ROV05H241K	240	±10%	150	200	415	800	600	0.10	10.5	75	◆ ● ▲ ■
ROV05H271K	270	±10%	175	225	475	800	600	0.10	11.0	70	◆ ● ▲ ■
ROV05H301K	300	±10%	195	250	525	800	600	0.10	12.0	65	◆ ● ▲ ■
ROV05H331K	330	±10%	210	275	575	800	600	0.10	13.0	60	◆ ● ▲ ■
ROV05H361K	360	±10%	230	300	620	800	600	0.10	16.0	70	◆ ● ▲ ■
ROV05H391K	390	±10%	250	320	675	800	600	0.10	17.0	55	◆ ● ▲ ■
ROV05H431K	430	±10%	275	350	745	800	600	0.10	20.0	45	◆ ● ▲ ■
ROV05H471K	470	±10%	300	385	810	800	600	0.10	21.0	50	◆ ● ▲ ■
ROV05H511K	510	±10%	320	418	880	800	600	0.10	22.0	50	◆ ● ▲ ■
ROV05H561K	560	±10%	350	460	940	800	600	0.10	25.0	50	◆ ● ▲ ■
ROV05H621K	620	±10%	385	505	1050	800	600	0.10	27.0	50	◆ ● ▲ ■
ROV05H681K	680	±10%	420	560	1150	800	600	0.10	28.0	40	◆ ● ▲ ■
ROV05H751K	750	±10%	460	615	1290	800	600	0.10	29.0	—	◆ ● ▲ ■

* The clamping voltages from 180M to 680K are tested at 1A current.

†Certification

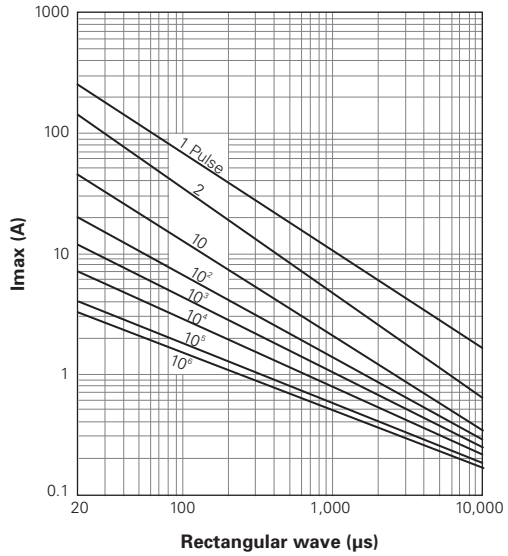
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V16-V17	H Series Specifications — 5mm Devices Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V16 - ROV05H180M~ROV05H680K

Pulse Lifetime Ratings



V-I Characteristic Curve

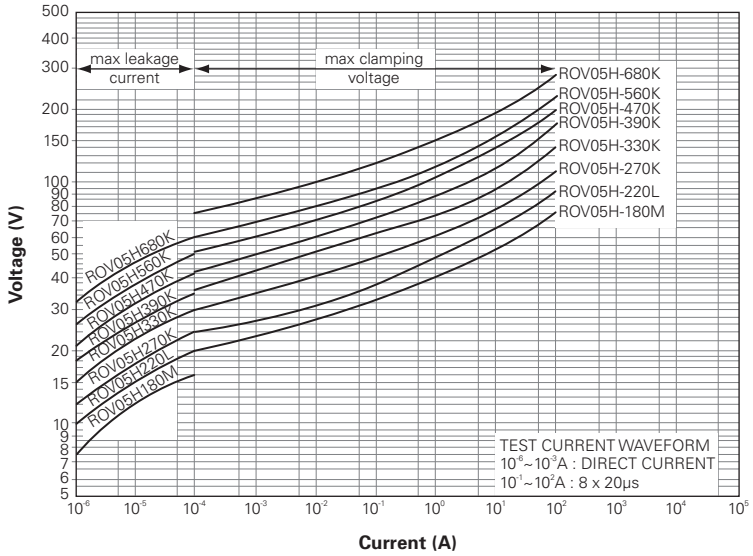
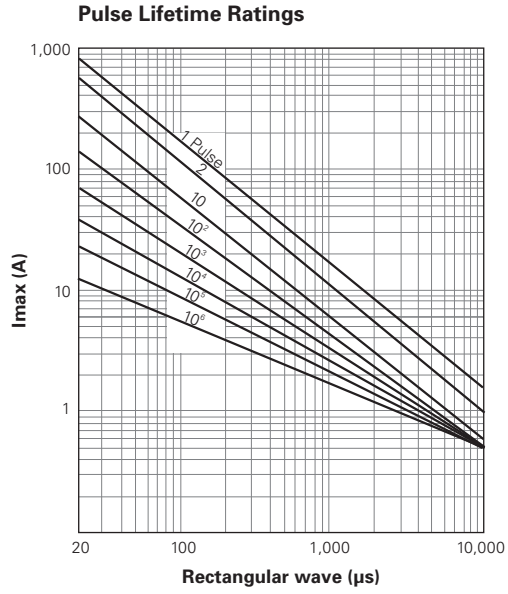


Figure V17 - ROV05H820K~ROV05H471K

Pulse Lifetime Ratings



V-I Characteristic Curve

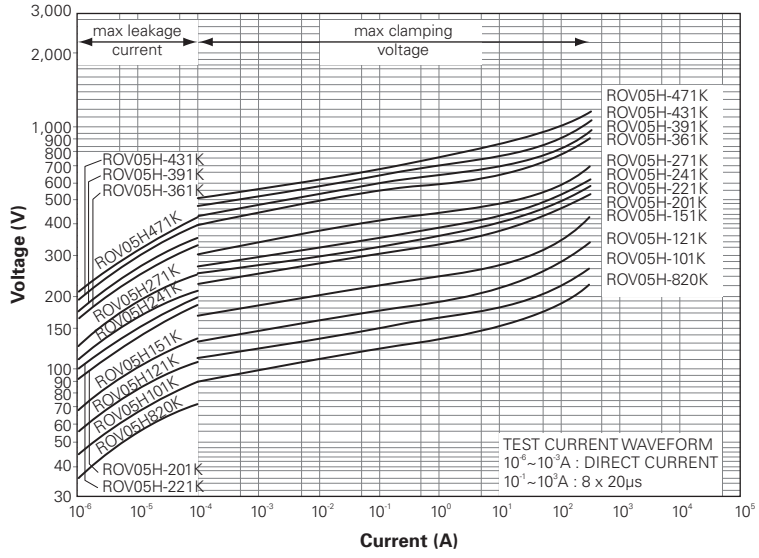


Table V10 Rating and Characteristics for H Series Specifications — 7mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@10A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV07H180M	18	±20%	11	14	36*	500	250	0.02	1.5	2920	● ■
ROV07H220L	22	±15%	14	18	43*	500	250	0.02	1.7	2930	● ■
ROV07H270K	27	±10%	17	22	53*	500	250	0.02	2.1	2340	● ■
ROV07H330K	33	±10%	20	26	65*	500	250	0.02	2.8	1840	● ■
ROV07H390K	39	±10%	25	31	77*	500	250	0.02	3.0	1820	● ■
ROV07H470K	47	±10%	30	38	93*	500	250	0.02	3.8	1600	● ■
ROV07H560K	56	±10%	35	45	110*	500	250	0.02	4.4	1330	● ■
ROV07H680K	68	±10%	40	56	135*	500	250	0.02	5.4	1120	● ■
ROV07H820K	82	±10%	50	65	135	1750	1250	0.25	7.0	640	● ■
ROV07H101K	100	±10%	60	85	165	1750	1250	0.25	9.0	540	● ■
ROV07H121K	120	±10%	75	100	200	1750	1250	0.25	11.0	460	● ■
ROV07H151K	150	±10%	95	125	250	1750	1250	0.25	13.0	370	● ■
ROV07H181K	180	±10%	115	150	300	1750	1250	0.25	16.0	220	● ■
ROV07H201K	200	±10%	130	170	340	1750	1250	0.25	17.5	220	◆ ● ▲ ■
ROV07H221K	220	±10%	140	180	360	1750	1250	0.25	19.0	190	◆ ● ▲ ■
ROV07H241K	240	±10%	150	200	395	1750	1250	0.25	21.0	190	◆ ● ▲ ■
ROV07H271K	270	±10%	175	225	455	1750	1250	0.25	24.0	160	◆ ● ▲ ■
ROV07H301K	300	±10%	195	250	505	1750	1250	0.25	26.0	140	◆ ● ▲ ■
ROV07H331K	330	±10%	210	275	550	1750	1250	0.25	28.0	140	◆ ● ▲ ■
ROV07H361K	360	±10%	230	300	595	1750	1250	0.25	32.0	120	◆ ● ▲ ■
ROV07H391K	390	±10%	250	320	650	1750	1250	0.25	35.0	110	◆ ● ▲ ■
ROV07H431K	430	±10%	275	350	710	1750	1250	0.25	40.0	110	◆ ● ▲ ■
ROV07H471K	470	±10%	300	385	775	1750	1250	0.25	42.0	100	◆ ● ▲ ■
ROV07H511K	510	±10%	320	418	842	1750	1250	0.25	45.0	100	◆ ● ▲ ■
ROV07H561K	560	±10%	350	460	920	1750	1250	0.25	51.0	85	◆ ● ▲ ■
ROV07H621K	620	±10%	385	505	1025	1750	1250	0.25	54.0	80	◆ ● ▲ ■
ROV07H681K	680	±10%	420	560	1120	1750	1250	0.25	56.0	80	◆ ● ▲ ■
ROV07H751K	750	±10%	460	615	1240	1750	1250	0.25	58.0	75	◆ ● ▲ ■
ROV07H781K	780	±10%	485	640	1290	1750	1250	0.25	59.0	70	◆ ● ▲ ■
ROV07H821K	820	±10%	510	670	1355	1750	1250	0.25	60.0	70	◆ ● ▲ ■

* The clamping voltages from 180M to 680K are tested at 2.5A current.

†Certification

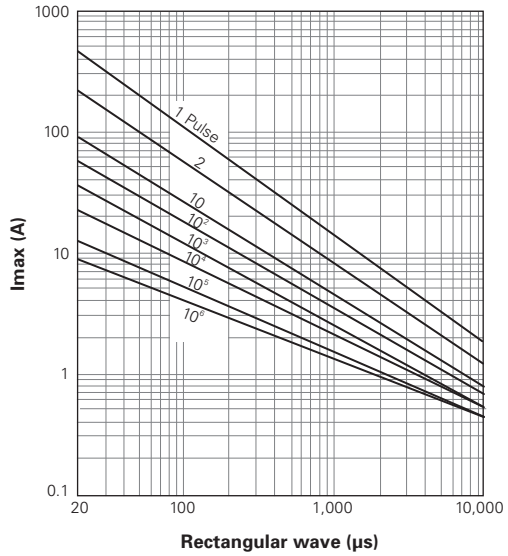
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V18-V19	H Series Specifications — 7mm Devices Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V18 - ROV07H180M~ROV07H680K

Pulse Lifetime Ratings



V-I Characteristic Curve

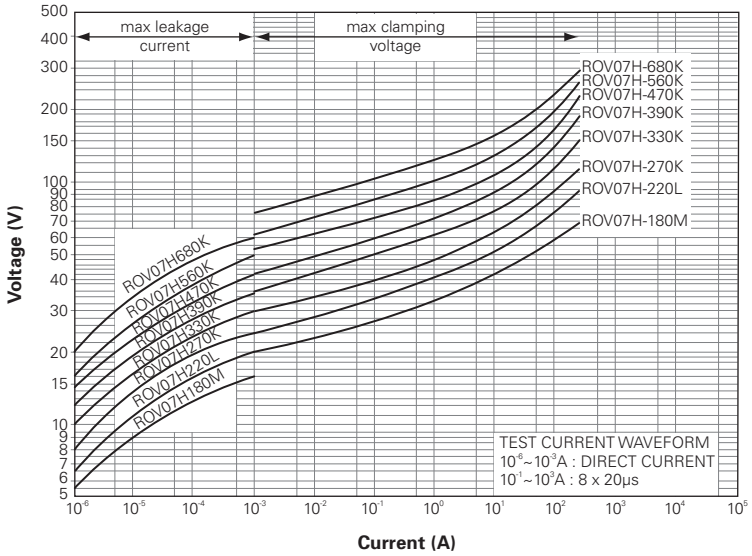
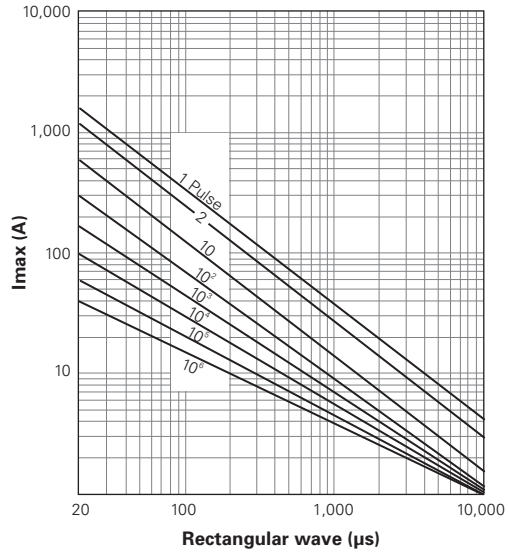


Figure V19 - ROV07H820K~ROV07H471K

Pulse Lifetime Ratings



V-I Characteristic Curve

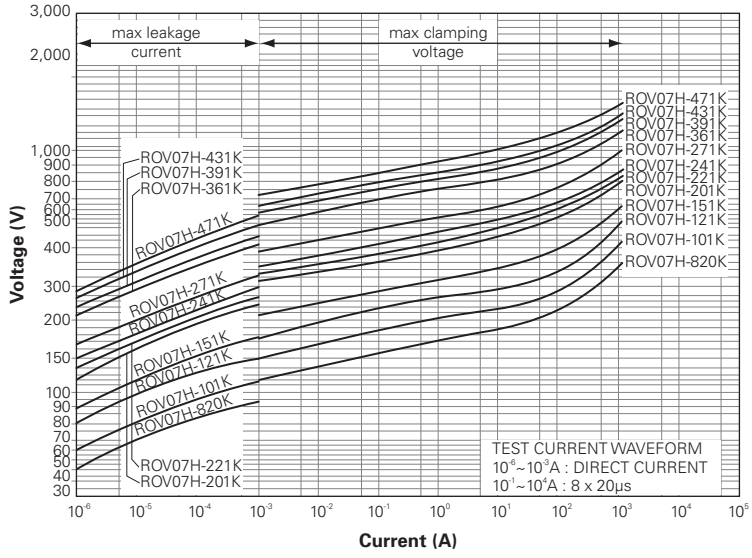


Table V11 Rating and Characteristics for H Series Specifications — 10mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@25A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV10H180M	18	±20%	11	14	36*	1000	500	0.05	2.6	6500	● ■
ROV10H220L	22	±15%	14	18	43*	1000	500	0.05	3.2	5520	● ■
ROV10H270K	27	±10%	17	22	53*	1000	500	0.05	3.9	4740	● ■
ROV10H330K	33	±10%	20	26	65*	1000	500	0.05	4.8	4250	● ■
ROV10H390K	39	±10%	25	31	77*	1000	500	0.05	5.6	3660	● ■
ROV10H470K	47	±10%	30	38	93*	1000	500	0.05	6.8	3140	● ■
ROV10H560K	56	±10%	35	45	110*	1000	500	0.05	8.1	2900	● ■
ROV10H680K	68	±10%	40	56	135*	1000	500	0.05	9.8	2230	● ■
ROV10H820K	82	±10%	50	65	135	3500	2500	0.40	14.0	1260	● ■
ROV10H101K	100	±10%	60	85	165	3500	2500	0.40	18.0	1020	● ■
ROV10H121K	120	±10%	75	100	200	3500	2500	0.40	22.0	950	● ■
ROV10H151K	150	±10%	95	125	250	3500	2500	0.40	25.0	730	● ■
ROV10H181K	180	±10%	115	150	300	3500	2500	0.40	32.0	480	● ■
ROV10H201K	200	±10%	130	170	340	3500	2500	0.40	35.0	400	◆ ● ▲ ■
ROV10H221K	220	±10%	140	180	360	3500	2500	0.40	39.0	390	◆ ● ▲ ■
ROV10H241K	240	±10%	150	200	395	3500	2500	0.40	42.0	330	◆ ● ▲ ■
ROV10H271K	270	±10%	175	225	455	3500	2500	0.40	49.0	330	◆ ● ▲ ■
ROV10H301K	300	±10%	195	250	505	3500	2500	0.40	52.0	280	◆ ● ▲ ■
ROV10H331K	330	±10%	210	275	550	3500	2500	0.40	58.0	280	◆ ● ▲ ■
ROV10H361K	360	±10%	230	300	595	3500	2500	0.40	65.0	230	◆ ● ▲ ■
ROV10H391K	390	±10%	250	320	650	3500	2500	0.40	70.0	250	◆ ● ▲ ■
ROV10H431K	430	±10%	275	350	710	3500	2500	0.40	80.0	220	◆ ● ▲ ■
ROV10H471K	470	±10%	300	385	775	3500	2500	0.40	85.0	210	◆ ● ▲ ■
ROV10H511K	510	±10%	320	418	842	3500	2500	0.40	92.0	190	◆ ● ▲ ■
ROV10H561K	560	±10%	350	460	920	3500	2500	0.40	102.0	190	◆ ● ▲ ■
ROV10H621K	620	±10%	385	505	1025	3500	2500	0.40	107.0	160	◆ ● ▲ ■
ROV10H681K	680	±10%	420	560	1120	3500	2500	0.40	112.0	160	◆ ● ▲ ■
ROV10H751K	750	±10%	460	615	1240	3500	2500	0.40	115.0	130	◆ ● ▲ ■
ROV10H781K	780	±10%	485	640	1290	3500	2500	0.40	116.0	120	◆ ● ▲ ■
ROV10H821K	820	±10%	510	670	1355	3500	2500	0.40	118.0	130	◆ ● ▲ ■
ROV10H911K	910	±10%	550	745	1500	3500	2500	0.40	127.0	110	◆ ● ▲ ■
ROV10H102K	1000	±10%	625	825	1650	3500	2500	0.40	140.0	95	◆ ● ▲ ■
ROV10H112K	1100	±10%	680	895	1815	3500	2500	0.40	155.0	90	◆ ● ▲ ■
ROV10H182K	1800	±10%	1000	1465	2970	3500	2500	0.40	247.0	62	◆ ● ▲ ■

* The clamping voltages from 180M to 680K are tested at 5A current.

†Certification

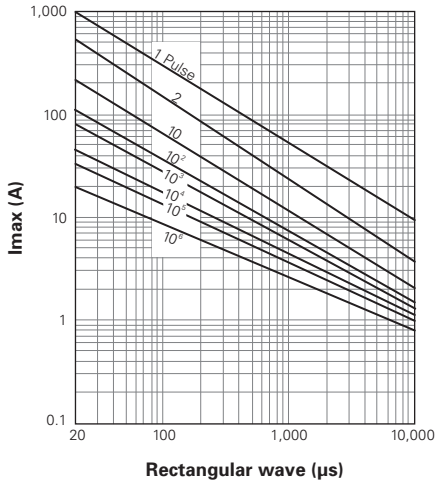
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V20-V22	H Series Specifications — 10mm Devices Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V20 - ROV10H180M~ROV10H680K

Pulse Lifetime Ratings



V-I Characteristic Curve

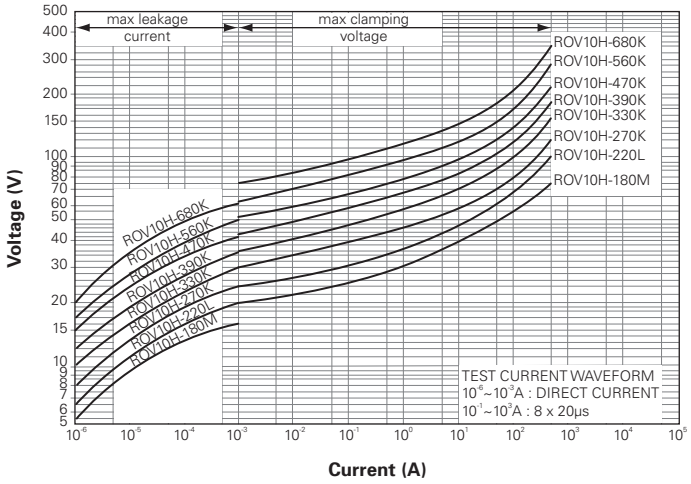
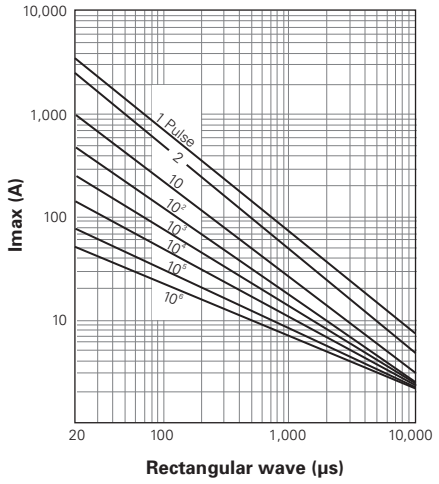


Figure V21 - ROV10H820K~ROV10H511K

Pulse Lifetime Ratings



V-I Characteristic Curve

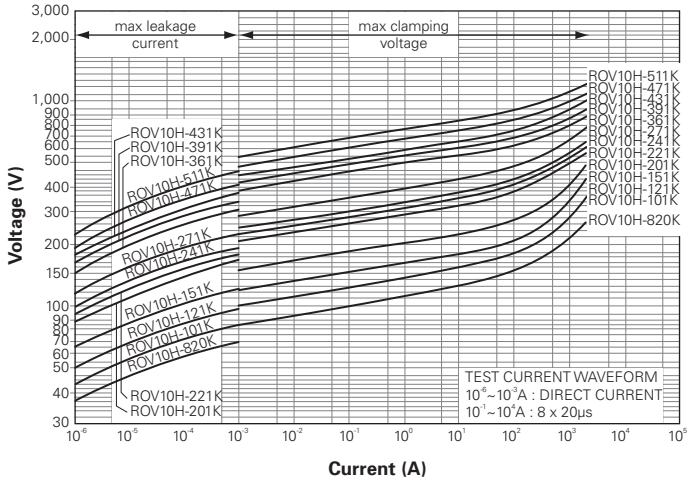
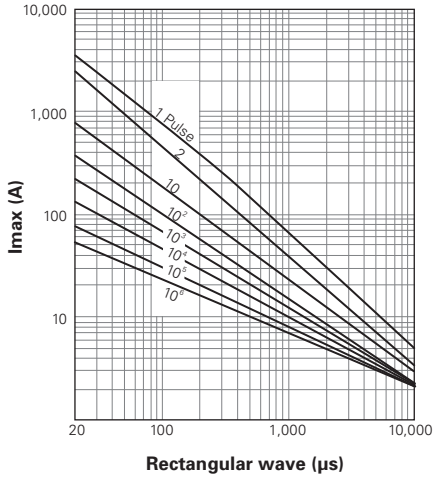


Figure V22 - ROV10H561K~ROV10H182K

Pulse Lifetime Ratings



V-I Characteristic Curve

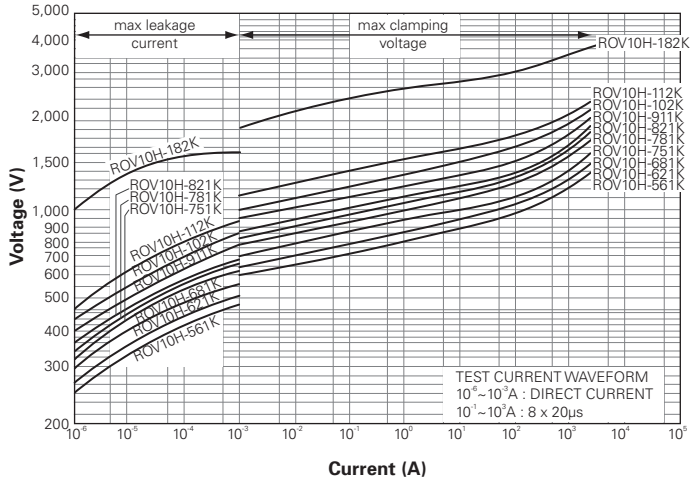


Table V12 Rating and Characteristics for H Series Specifications — 14mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@50A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV14H180M	18	±20%	11	14	36*	2000	1000	0.1	5.2	14890	● ■
ROV14H220L	22	±15%	14	18	43*	2000	1000	0.1	6.3	11960	● ■
ROV14H270K	27	±10%	17	22	53*	2000	1000	0.1	7.8	9730	● ■
ROV14H330K	33	±10%	20	26	65*	2000	1000	0.1	9.5	7700	● ■
ROV14H390K	39	±10%	25	31	77*	2000	1000	0.1	11.0	7620	● ■
ROV14H470K	47	±10%	30	38	93*	2000	1000	0.1	14.0	6420	● ■
ROV14H560K	56	±10%	35	45	110*	2000	1000	0.1	16.0	5180	● ■
ROV14H680K	68	±10%	40	56	135*	2000	1000	0.1	20.0	5100	● ■
ROV14H820K	82	±10%	50	65	135	6000	4500	0.6	28.0	2970	● ■
ROV14H101K	100	±10%	60	85	165	6000	4500	0.6	36.0	2220	● ■
ROV14H121K	120	±10%	75	100	200	6000	4500	0.6	44.0	1740	● ■
ROV14H151K	150	±10%	95	125	250	6000	4500	0.6	53.0	1510	● ■
ROV14H181K	180	±10%	115	150	300	6000	4500	0.6	65.0	920	● ■
ROV14H201K	200	±10%	130	170	340	6000	4500	0.6	70.0	840	◆ ● ▲ ■
ROV14H221K	220	±10%	140	180	360	6000	4500	0.6	78.0	710	◆ ● ▲ ■
ROV14H241K	240	±10%	150	200	395	6000	4500	0.6	84.0	770	◆ ● ▲ ■
ROV14H271K	270	±10%	175	225	455	6000	4500	0.6	99.0	650	◆ ● ▲ ■
ROV14H301K	300	±10%	195	250	505	6000	4500	0.6	105.0	650	◆ ● ▲ ■
ROV14H331K	330	±10%	210	275	550	6000	4500	0.6	115.0	610	◆ ● ▲ ■
ROV14H361K	360	±10%	230	300	595	6000	4500	0.6	130.0	470	◆ ● ▲ ■
ROV14H391K	390	±10%	250	320	650	6000	4500	0.6	140.0	460	◆ ● ▲ ■
ROV14H431K	430	±10%	275	350	710	6000	4500	0.6	155.0	450	◆ ● ▲ ■
ROV14H471K	470	±10%	300	385	775	6000	4500	0.6	175.0	420	◆ ● ▲ ■
ROV14H511K	510	±10%	320	418	842	6000	4500	0.6	190.0	370	◆ ● ▲ ■
ROV14H561K	560	±10%	350	460	920	6000	4500	0.6	205.0	400	◆ ● ▲ ■
ROV14H621K	620	±10%	385	505	1025	6000	4500	0.6	215.0	300	◆ ● ▲ ■
ROV14H681K	680	±10%	420	560	1120	6000	4500	0.6	225.0	310	◆ ● ▲ ■
ROV14H751K	750	±10%	460	615	1240	6000	4500	0.6	230.0	270	◆ ● ▲ ■
ROV14H781K	780	±10%	485	640	1290	6000	4500	0.6	233.0	250	◆ ● ▲ ■
ROV14H821K	820	±10%	510	670	1355	6000	4500	0.6	235.0	260	◆ ● ▲ ■
ROV14H911K	910	±10%	550	745	1500	6000	4500	0.6	255.0	240	◆ ● ▲ ■
ROV14H102K	1000	±10%	625	825	1650	6000	4500	0.6	283.0	200	◆ ● ▲ ■
ROV14H112K	1100	±10%	680	895	1815	6000	4500	0.6	310.0	180	◆ ● ▲ ■
ROV14H182K	1800	±10%	1000	1465	2970	6000	4500	0.6	510.0	121	◆ ● ▲ ■

* The clamping voltages from 180M to 680K are tested at 10A current.

†Certification

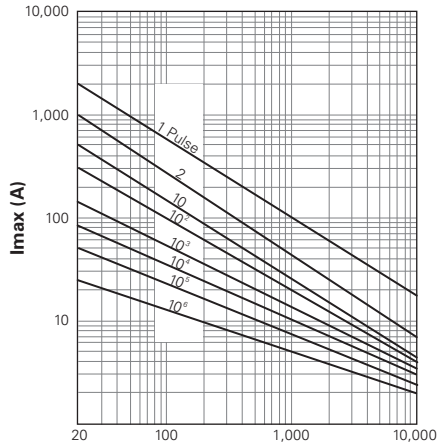
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V23-V25 — H Series Specifications — 14mm Devices
Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V23 - ROV14H180M~ROV14H680K

Pulse Lifetime Ratings



V-I Characteristic Curve

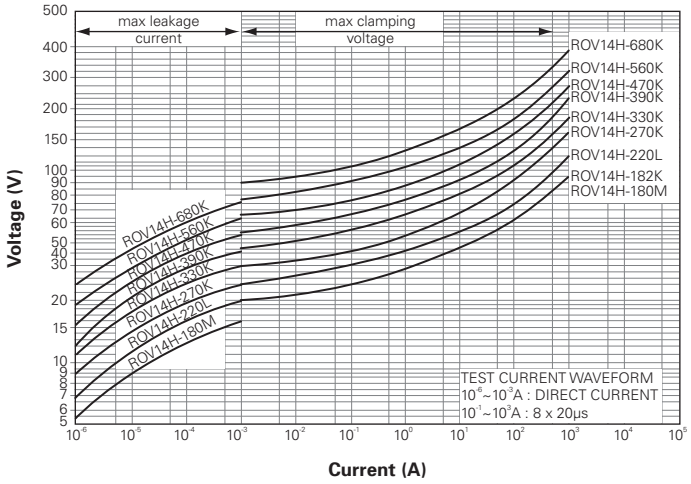
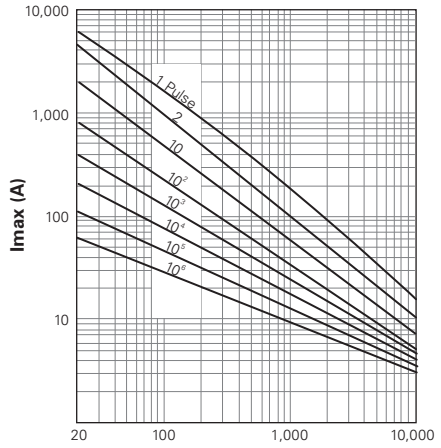


Figure V24 - ROV14H820K~ROV14H511K

Pulse Lifetime Ratings



V-I Characteristic Curve

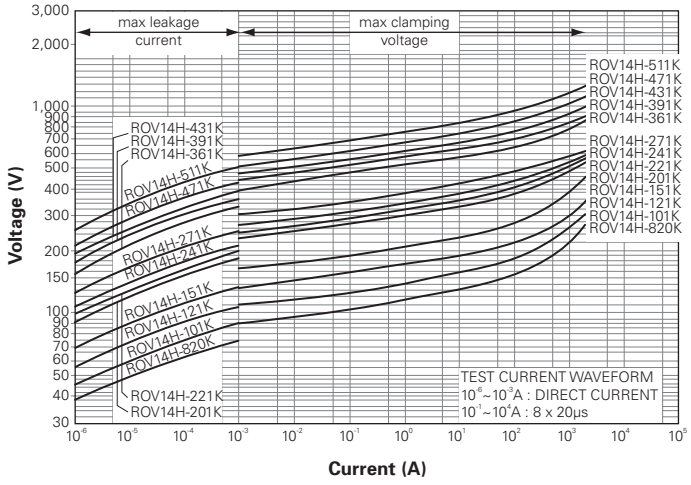
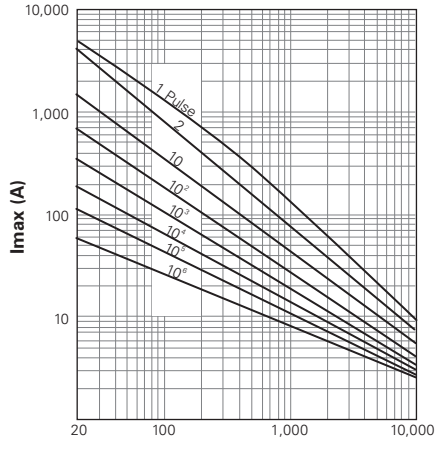


Figure V25 - ROV14H561K~ROV14H182K

Pulse Lifetime Ratings



V-I Characteristic Curve

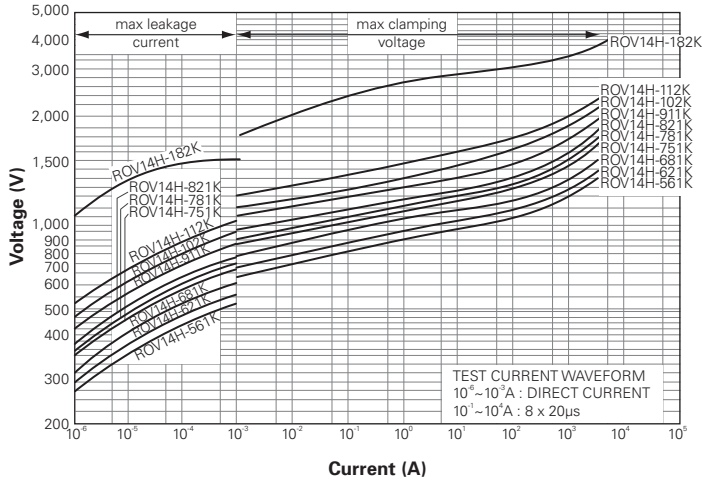


Table V13 Rating and Characteristics for H Series Specifications — 20mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@100A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV20H220M	22	±20%	14	18	43*	3000	2000	0.2	16.0	21200	● ■
ROV20H270M	27	±20%	17	22	53*	3000	2000	0.2	19.0	20000	● ■
ROV20H330M	33	±20%	20	26	65*	3000	2000	0.2	24.0	17200	● ■
ROV20H390L	39	±15%	25	31	77*	3000	2000	0.2	28.0	15000	● ■
ROV20H470L	47	±15%	30	38	93*	3000	2000	0.2	34.0	12100	● ■
ROV20H560L	56	±15%	35	45	110*	3000	2000	0.2	41.0	11600	● ■
ROV20H680L	68	±15%	40	56	135*	3000	2000	0.2	49.0	9600	● ■
ROV20H101K	100	±10%	60	85	165	10000	6500	1.0	72.0	4000	● ■
ROV20H121K	120	±10%	75	100	200	10000	6500	1.0	88.0	3800	● ■
ROV20H151K	150	±10%	95	125	250	10000	6500	1.0	106.0	3000	● ■
ROV20H181K	180	±10%	115	150	300	10000	6500	1.0	130.0	2400	● ■
ROV20H201K	200	±10%	130	170	340	10000	6500	1.0	140.0	1830	◆ ● ▲ ■
ROV20H221K	220	±10%	140	180	360	10000	6500	1.0	155.0	1600	◆ ● ▲ ■
ROV20H241K	240	±10%	150	200	395	10000	6500	1.0	168.0	1420	◆ ● ▲ ■
ROV20H271K	270	±10%	175	225	455	10000	6500	1.0	190.0	1260	◆ ● ▲ ■
ROV20H301K	300	±10%	195	250	505	10000	6500	1.0	210.0	1100	◆ ● ▲ ■
ROV20H331K	330	±10%	210	275	550	10000	6500	1.0	228.0	1110	◆ ● ▲ ■
ROV20H361K	360	±10%	230	300	595	10000	6500	1.0	255.0	990	◆ ● ▲ ■
ROV20H391K	390	±10%	250	320	650	10000	6500	1.0	275.0	980	◆ ● ▲ ■
ROV20H431K	430	±10%	275	350	710	10000	6500	1.0	303.0	860	◆ ● ▲ ■
ROV20H471K	470	±10%	300	385	775	10000	6500	1.0	350.0	760	◆ ● ▲ ■
ROV20H511K	510	±10%	320	418	842	10000	6500	1.0	382.0	790	◆ ● ▲ ■
ROV20H561K	560	±10%	350	460	920	10000	6500	1.0	410.0	680	◆ ● ▲ ■
ROV20H621K	620	±10%	385	505	1025	10000	6500	1.0	420.0	600	◆ ● ▲ ■
ROV20H681K	680	±10%	420	560	1120	10000	6500	1.0	430.0	550	◆ ● ▲ ■
ROV20H751K	750	±10%	460	615	1240	10000	6500	1.0	440.0	550	◆ ● ▲ ■
ROV20H781K	780	±10%	485	640	1290	10000	6500	1.0	450.0	480	◆ ● ▲ ■
ROV20H821K	820	±10%	510	670	1355	10000	6500	1.0	460.0	520	◆ ● ▲ ■
ROV20H911K	910	±10%	550	745	1500	10000	6500	1.0	510.0	440	◆ ● ▲ ■
ROV20H102K	1000	±10%	625	825	1650	10000	6500	1.0	566.0	400	◆ ● ▲ ■
ROV20H112K	1100	±10%	680	895	1815	10000	6500	1.0	620.0	360	◆ ● ▲ ■
ROV20H182K	1801	±11%	1000	1465	2970	10000	6500	1.0	1020.0	250	◆ ● ▲ ■

* The clamping voltages from 180M to 680K are tested at 20A current.

†Certification

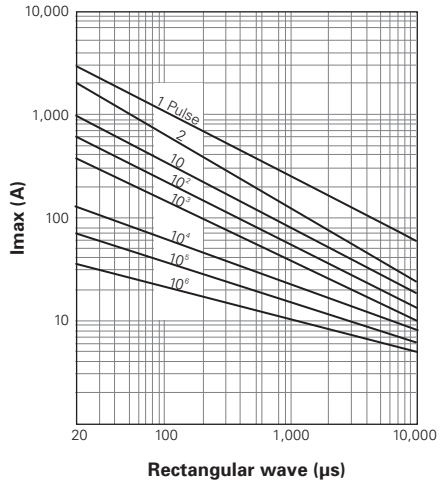
Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

RoHS Compliant, ELV Compliant

Figure V26-V28	H Series Specifications — 20mm Devices Pulse Lifetime Ratings and V-I Characteristic Curves

Figure V26 - ROV20H220M~ROV20H680L

Pulse Lifetime Ratings



V-I Characteristic Curve

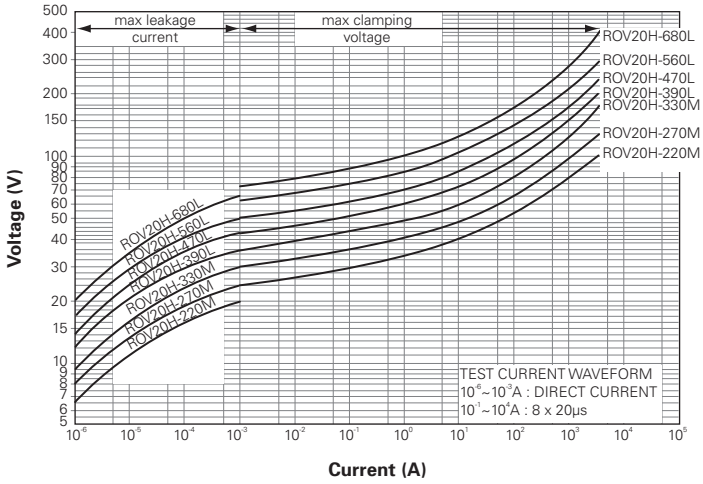
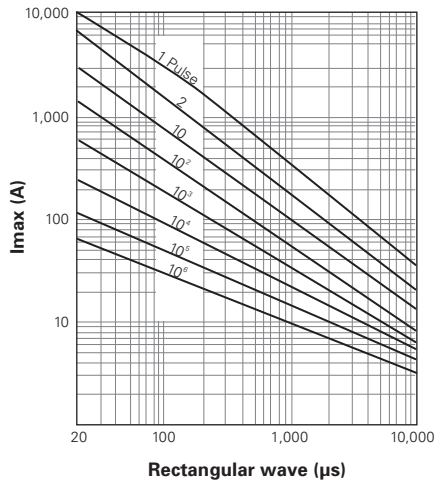


Figure V27 - ROV20H101K~ROV20H511K

Pulse Lifetime Ratings



V-I Characteristic Curve

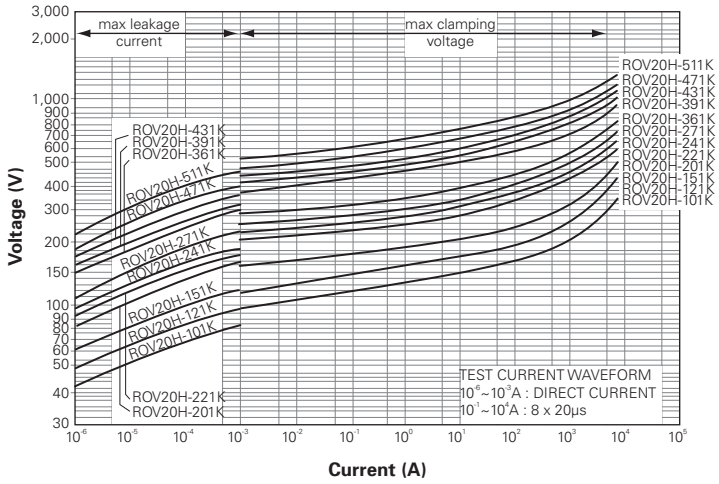
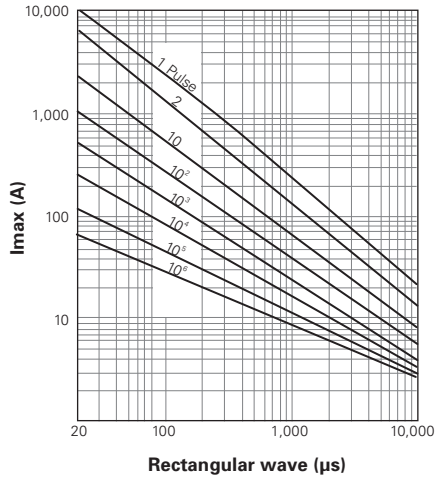


Figure V28 - ROV20H561K~ROV20H182K

Pulse Lifetime Ratings



V-I Characteristic Curve

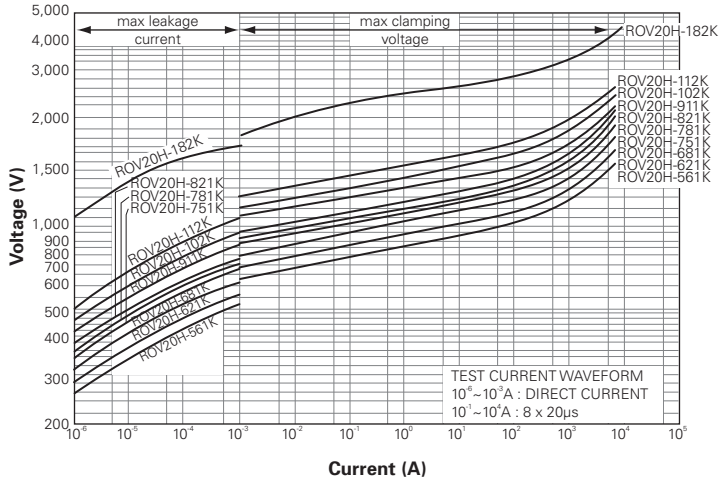


Table V14 Rating and Characteristics for E Series Specifications — 14mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@50A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV14E201K	200	±10%	130	170	340	6500	6000	0.6	84.0	840	●▲
ROV14E221K	220	±10%	140	180	360	6500	6000	0.6	93.0	710	●▲
ROV14E241K	240	±10%	150	200	395	6500	6000	0.6	101.0	770	●▲
ROV14E271K	270	±10%	175	225	455	6500	6000	0.6	113.0	—	——
ROV14E301K	300	±10%	195	250	505	6500	6000	0.6	126.0	—	——
ROV14E331K	330	±10%	210	275	550	6500	6000	0.6	138.0	—	——
ROV14E361K	360	±10%	230	300	595	6500	6000	0.6	151.0	—	——

Table V15 Rating and Characteristics for E Series Specifications — 20mm Devices

Part Number	Varistor Voltage V@1.0mA DC (V)	Varistor Voltage V@1.0mA Tolerance	Maximum Allowance Voltage AC (V_{RMS})	Maximum Allowance Voltage DC (V)	Maximum Clamping Voltage V@100A (V)	Maximum Surge Current (8x20µs) 1 Time (A)	Maximum Surge Current (8x20µs) 2 Times (A)	Rated Waltage (W)	Energy (10x1000µs) (J)	Capacitance (Typical) (pF)	Certification†
ROV20E201K	200	±10%	130	170	340	12500	10000	1.0	168.0	1830	●▲
ROV20E221K	220	±10%	140	180	360	12500	10000	1.0	186.0	1600	●▲
ROV20E241K	240	±10%	150	200	395	12500	10000	1.0	202.0	1420	●▲
ROV20E271K	270	±10%	175	225	455	12500	10000	1.0	227.0	—	——
ROV20E301K	300	±10%	195	250	505	12500	10000	1.0	252.0	—	——
ROV20E331K	330	±10%	210	275	550	12500	10000	1.0	277.0	—	——
ROV20E361K	360	±10%	230	300	595	12500	10000	1.0	302.0	—	——

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†Certification

Standard	UL1414	UL1449 (3rd Edition)	CSA	VDE
Title	Across-the-Line Components	Surge Protective Devices	Accessories and Parts for Electronic Equipment	Varistors for Use in Electronic Equipment
Symbols	◆	●	▲	■
File Number	E223034	E332226	220978	40006997

Mechanical and Environmental Tests for ROV Metal Oxide Varistors

Humidity

The part is subjected to 40±2˚C, 90 to 95% R.H. for 1000 hours without load and then stored at room temperature and ambient humidity for 1 to 2 hours. The change of V_B, (ΔV_B), is then measured and must meet the requirement of $\Delta V_B / V_B \leq \pm 5\%$, where V_B is the initial value.

Impulse Life

The maximum surge current (8 x 20µs) listed in this catalog is applied 1000 times continuously with an interval of 30 seconds at room temperature. The change of V_B, (ΔV_B), is then measured and must meet the requirement of $\Delta V_B / V_B \leq \pm 10\%$, where V_B is the initial value.

Low-Temperature Storage

The part is subjected to -40±2°C without load for 1000 hours and then stored at room temperature and ambient humidity for 1 to 2 hours. The change of V_B, (ΔV_B), is then measured and must meet the requirement of $\Delta V_B / V_B \leq \pm 5\%$, where V_B is the initial value.

High-Temperature Load

After the Maximum Allowable Voltage is applied at 85±2°C for 1000 hours, the part is stored at room temperature and ambient humidity for 1 to 2 hours. The change of V_B, (ΔV_B), is then measured and must meet the requirement of $\Delta V_B / V_B \leq \pm 10\%$, where V_B is the initial value.

High-Temperature Storage

The part is subjected to 125±2°C for 1000 hours in a drying oven without load and then stored at room temperature and ambient humidity for 1 to 2 hours. The change of V_B, (ΔV_B), is then measured and must meet the requirement of $\Delta V_B / V_B \leq \pm 5\%$, where V_B is the initial value.

RoHS Compliant, ELV Compliant

Mechanical and Environmental Tests for ROV Metal Oxide Varistors ... Cont'd

Maximum Voltage

The specified voltage is applied between the terminals of the part for 1 minute. No mechanical damage should be noticeable.

	Test Voltage (AC)
Dielectric Withstand	2500 $_{VRMS}$

Terminal Pull Strength

After gradually applying the load specified below and keeping the unit fixed for 10 ±1s, no mechanical damage should be noticeable.

Terminal Diameter	Loading Weight in Pull Strength
0.6mm	10N (1.02Kg)
0.8mm	10N (1.02Kg)
1.0mm	20N (2.04Kg)

Terminal Bending Strength

The device is secured with one terminal in vertical position and the weight specified below is applied to the other terminal. The terminal is gradually bent by 90° in one direction, then 90° in the opposite direction and again back to the original position. This is repeated two times. No mechanical damage should be noticeable.

Terminal Diameter	Loading Weight in Pull Strength
0.6mm	5N (0.51Kg)
0.8mm	5N (0.51Kg)
1.0mm	10N (1.02Kg)

Vibration

The device is subjected to a simple harmonic motion of 0.75mm amplitude with 1.5mm maximum total excursion between limits. A 10-55Hz frequency scan is traversed in 1 minute. This motion is applied for a period of 2 hours in each of 3 mutually perpendicular directions. No mechanical damage should be noticeable.

Solderability

After dipping the terminal to a depth of approximately 3mm from the body in a soldering bath of 235±5°C for 2±0.5s, the terminal is visually examined. Approximately 95% of the terminals should be uniformly covered with new solder.

Resistance to Soldering Heat

The terminal is dipped into a soldering bath with a temperature of 260±5°C to a point of 2~2.5mm from the body of the unit. It is held there for 10±1s (5 Standard series: 5±1s) and then stored at room temperature and normal humidity for 1 to 2 hours. The change of V_B, (ΔV_BB), is then measured and must meet the requirement of $\Delta V_B/V_B \leqq \pm 5\%$, (where V_B is the initial value) with no noticeable mechanical damage.

Damp Heat Load

The device is subjected to 40±2°C, 90 to 95% R.H. and the maximum allowable voltage for 1000 hours and then stored at room temperature and ambient humidity for 1 to 2 hours. The change of V_B, (ΔV_BB), is then measured and must meet the requirement of $\Delta V_B/V_B \leqq 10\%$, where V_B is the initial value.

Temperature Cycle

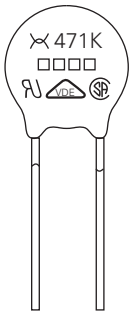
The following temperature cycle is repeated 5 times:

1. -40±3°C for 30±3 minutes
2. Room temperature for 15±3 minutes
3. 125±2°C for 30±3 minute.
4. Room temperature for 15±3 minutes

Afterwards, the part is stored at room temperature and ambient humidity for 1 to 2 hours. The change of V_B, (ΔV_BB), is then measured and must meet the requirement of $\Delta V_B/V_B \leqq \pm 5\%$, (where V_B is the initial value) with no noticeable mechanical damage.

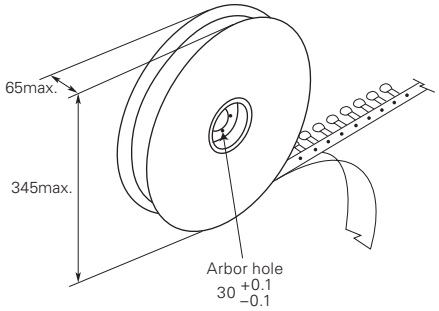
Figure V29-V30 Marking and Packaging Specifications for ROV Metal Oxide Varistors

Figure V29 - Marking



⋌ : Manufacturer's mark
471 : Varistor Voltage Indicator
K : Varistor Voltage Tolerance
□□□□ : Lot Identification

Figure V30 - Packaging in Millimeters



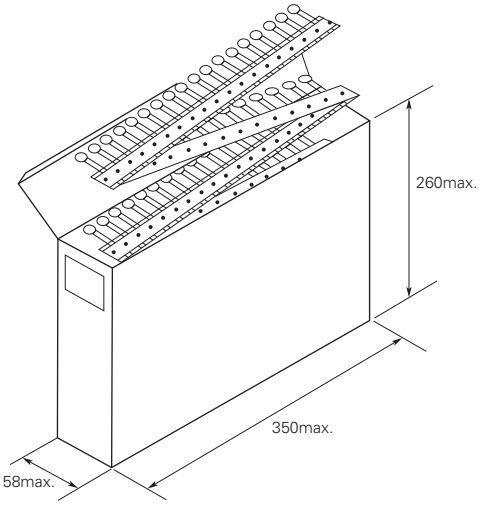


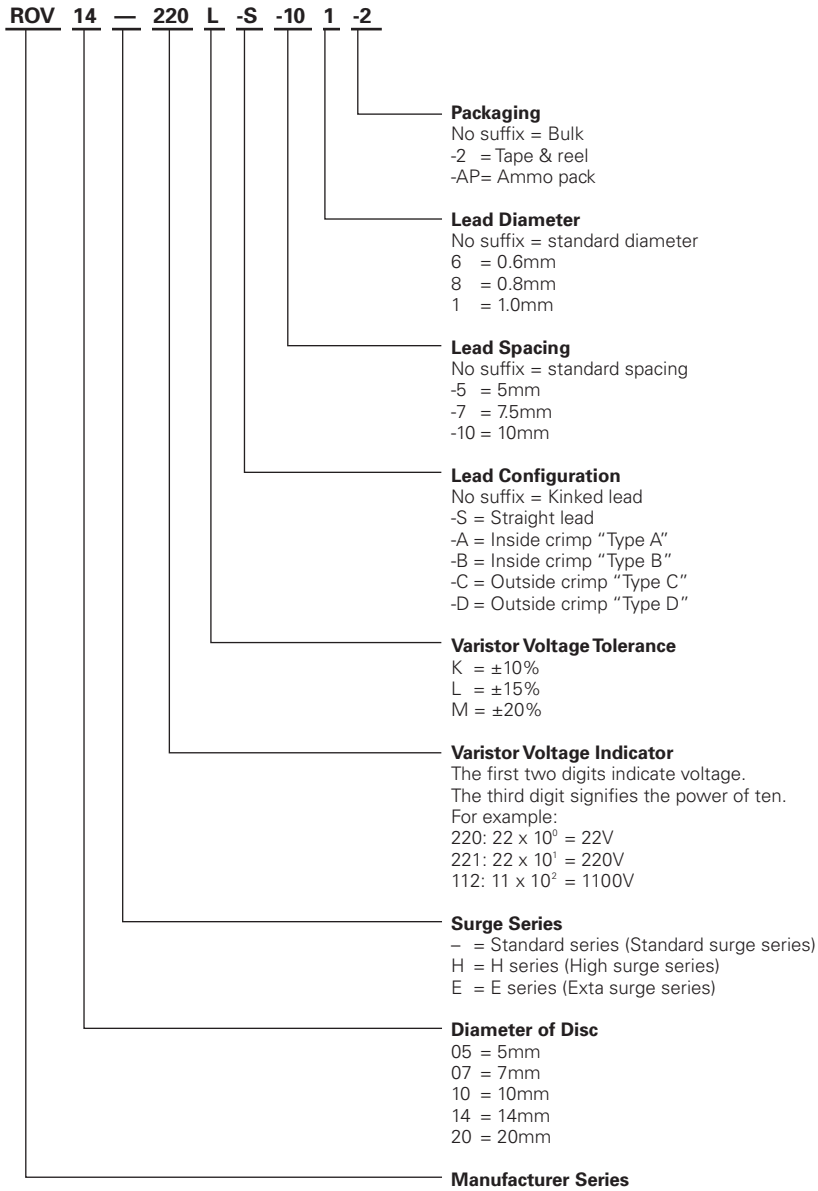
Table V16 Packaging Quantity in Pieces for ROV Metal Oxide Varistors

	Series														
	5mm			7mm			10mm			14mm			20mm		
Part Number	Bulk (Box)	Reel	Ammo	Bulk (Box)	Reel	Ammo	Bulk (Box)	Reel	Ammo	Bulk (Box)	Reel	Ammo	Bulk (Box)	Reel	Ammo
180M	5000	1500	1500	5000	1500	1500	2500	1000	500	1500	750	500	—	—	—
220M~470K	5000	1500	1500	5000	1500	1500	2500	1000	500	1500	750	500	150	500	500
560K~680K	5000	1500	1000	5000	1500	1000	2500	1000	500	1500	750	500	150	500	500
820K	5000	1500	1500	5000	1500	1500	2500	1000	500	1500	750	500	—	—	—
101K~331K	5000	1500	1500	5000	1500	1500	2500	1000	500	1500	750	500	150	500	500
361K~391K	5000	1500	1000	5000	1500	1000	2500	1000	500	1500	750	500	150	500	500
431K~471K	5000	1500	1000	5000	1000	1000	2000	750	500	1500	750	500	150	500	500
511K~681K	4000	1000	1000	4000	1000	1000	1500	500	500	750	500	500	150	500	500
751K	4000	1000	1000	4000	1000	1000	1500	500	500	750	500	500	150	—	—
781K~911K	—	—	—	—	—	—	1500	500	500	750	500	500	150	—	—
102K~112K	—	—	—	—	—	—	1500	500	500	750	—	—	150	—	—
182K	—	—	—	—	—	—	750	—	—	450	—	—	75	—	—

Packaging	Bulk (box)	Reel	Reel (14mm, 20mm)	Ammo (5mm, 7mm)	Ammo (10mm, 14mm)	Ammo (20mm)
Box size (mm)	290 x 155 x 110	350 x 350 x 105	346 x 346 x 72	335 x 245 x 43	347 x 246 x 50	348 x 255 x 60
Carton size (mm)	310 x 328 x 250	370 x 370 x 590	370 x 370 x 468	515 x 354 x 258	515 x 364 x 246	535 x 365 x 275
One carton with	4 Boxes	5 Boxes (10 reels)	6 Boxes (6 reels)	10 Boxes	8 Boxes	8 Boxes

RoHS Compliant, ELV Compliant

Part Numbering System for ROV Metal Oxide Varistors



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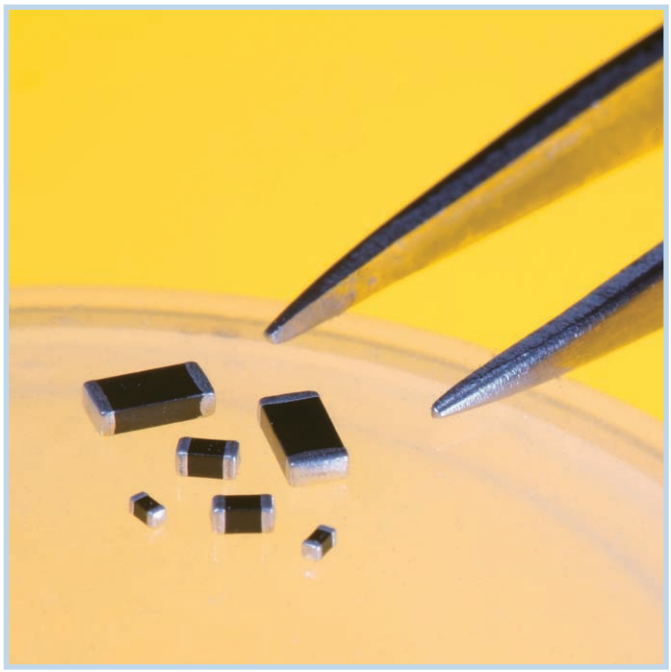
⚠ Warning :

- 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.

Multi Layer Varistors

Multi Layer Varistors (MLVs) are small, leadless, surface mount components made of multiple layers of Zinc Oxide with electrodes between them. They are used to help protect integrated circuits and other sensitive equipment. Their small size is suitable for high density printed circuit boards.

Tyco Electronics also offers the "E" series, which is a family of low capacitance MLVs. They provide ESD protection in high data rate applications.



Benefits

- Standard series helps protect sensitive equipment against damage caused by transients and other events such as, ESD (electrostatic discharge), EMC (electromagnetic compatibility), and EOS (electrical over stress)
- "E" series helps protect sensitive equipment against damage caused by typical ESD events
- Cost efficient assembly and protection
- Resistance to standard wave solder fluxes and provides excellent solderability
- Space savings
- Longer battery life due to low leakage current

Features

- RoHS compliant
- Halogen free
  (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Bi-directional clamping
- Compatible with standard surface-mount methods
- Low and stable leakage current
- Low-clamping voltage
- Quick response time (<1ns)
- High transient current capability
- "E" series low capacitance

Applications

Standard series: ESD, EMC and EOS protection of:

- Computer I/O ports and interfaces (USB, IEEE 1394, etc...)
- Portable devices
- Automotive electronic circuits
- Telecom equipment
- Medical instruments

"E" series: ESD protection of:

- High-speed computer I/O ports and interfaces (USB, IEEE 1394, etc...)
- Portable devices
- Telecom equipment

Figure VM1 Construction for Multi Layer Varistors

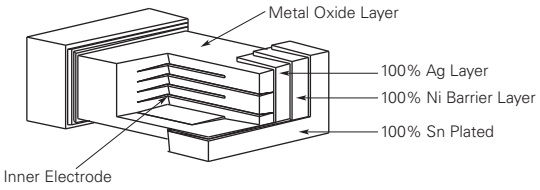


Table VM1 Dimensions for Multi Layer Varistors in Millimeters (Inches)

Multi Layer Varistors Standard Series

Part Number	Length A Min.	Length A Max.	Height B Min.	Height B Max.	Terminal Width C Min.	Terminal Width C Max.	Width D Min.	Width D Max.
Size 0402 (1005mm)								
MLV0402-080M-C221	0.85 (0.033)	1.15 (0.045)	0.4 (0.016)	0.6 (0.024)	0.1 (0.004)	0.4 (0.016)	0.4 (0.016)	0.6 (0.024)
MLV0402-250K-C400	0.85 (0.033)	1.15 (0.045)	0.4 (0.016)	0.6 (0.024)	0.1 (0.004)	0.4 (0.016)	0.4 (0.016)	0.6 (0.024)
Size 0603 (1608mm)								
MLV0603-130M-C201	1.4 (0.060)	1.8 (0.070)	0.6 (0.024)	1.0 (0.040)	0.1 (0.004)	0.5 (0.020)	0.6 (0.024)	1.0 (0.040)
Size 1206 (3216mm)								
MLV1206-700K	3.0 (0.118)	3.4 (0.134)	–	1.7 (0.067)	0.25 (0.010)	0.75 (0.030)	1.4 (0.060)	1.8 (0.070)

Multi Layer Varistors "E" Series

Part Number	Length A Min.	Length A Max.	Height B Min.	Height B Max.	Terminal Width C Min.	Terminal Width C Max.	Width D Min.	Width D Max.
Size 0402 (1005mm)								
MLV0402-180-E030	0.85 (0.033)	1.15 (0.045)	0.4 (0.016)	0.6 (0.024)	0.1 (0.004)	0.4 (0.016)	0.4 (0.016)	0.6 (0.024)
MLV0402-120-E120	0.85 (0.033)	1.15 (0.045)	0.4 (0.016)	0.6 (0.024)	0.1 (0.004)	0.4 (0.016)	0.4 (0.016)	0.6 (0.024)

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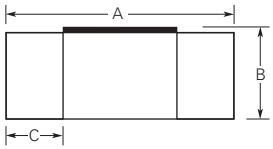
Figure VM2 Dimension Figures for Multi Layer Varistors



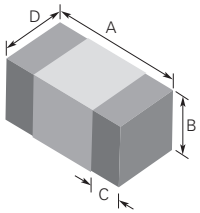
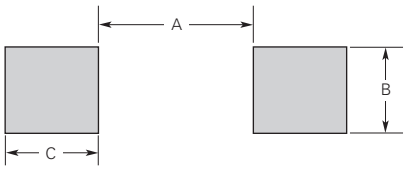


Table VM2 Recommended Pad Layout for Multi Layer Varistors in Millimeters (Inches)

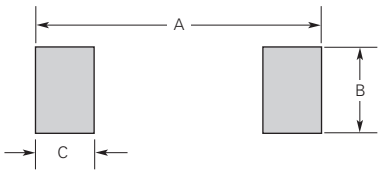
Part Number	Chip Size	A	B	C
MLV0402 & MLV0603	0402 (1005)	0.35 (0.014)	0.75 (0.030)	0.85 (0.033)
	0603 (1608)	0.50 (0.020)	0.76 (0.030)	1.02 (0.040)
MLV1206	1206 (3216)	4.06 (0.160)	1.65 (0.065)	1.02 (0.040)

Figure VM3 Pad Layout Figures for Multi Layer Varistors

MLV0402 & MLV0603



MLV1206



RoHS Compliant, ELV Compliant HF Halogen Free

Table VM3 Electrical Characteristics for Multi Layer Varistors @ (25 ± 5°C)

Multi Layer Varistors Standard Series

	Varistor Voltage	Maximum Working Voltage		Clamping Voltage	Peak Current	Max Transient Energy	Typical Capacitance†
Symbol	Vv	V_{RMS}	V_{DC}	Vc	I_{MAX}	W_{MAX}	Cp
Units	V	V	V (Max)	V	A (Min)	J (Max)	pF
Test Conditions	@ 1mA DC	<10µA	<10µA	@ 1A 8/20µs	8/20µs	10/1000µs	@ 1MHz
MLV0402-080M-C221	8 ± 20%	4	5.5	20	20	0.05	220
MLV0402-250K-C400	25 ± 10%	14	18	50	20	0.05	40
MLV0603-130M-C201	13.5 ± 20 %	7	9	30	30	0.1	200
MLV1206-700K	70 ± 10 %	40*	56*	120	200	1	180

* Test Conditions < 50µA

† Cp - Device capacitance measured with zero volt bias and $1V_{RMS}$ signal.

Multi Layer Varistors "E" Series

	Maximum Working Voltage	Typical Clamping Voltage‡	Leakage Current	Typical Capacitance
Symbol	V_{DC}	Vc	I_L	Cp
Units	V (Max)	V	µA (Max)	pF
Test Conditions	< 10µA	IEC Pulse	@12V	@ 1MHz
MLV0402-180-E030	18	350	<1	3
MLV0402-120-E120	12	100	<1	12

‡ Measure per IEC61000-4-2, 8kV contact discharge, 30 ns after initiation of the ESD pulse.

Table VM4 General Characteristics and Environmental Specificaitons for Multi Layer Varistors

MLV0402 & MLV0603

General Characteristics

Operating temperature	-40 to +85°C
Storage temperature	-40 to +85°C

Environmental Specifications

Characteristics	Specifications	Test Conditions
Bias humidity	ΔVv / Vv ≤ ± 10%	90% RH, 40°C, maximum working Voltage V_{DC}, 1000 hours
Thermal shock	ΔVv / Vv ≤ ± 10%	-40°C to +85°C, 30 min. cycle, 5 cycles
Full load voltage	ΔVv / Vv ≤ ± 10%	Maximum working Voltage V_{DC},85°C, 1000 hours
Solderability	95% Coverage	230°C, 3s
Solder heat resistance	90% Coverage	260°C, 10s

MLV1206

General Characteristics

Operating temperature	-55 to +125°C
Storage temperature	-55 to +150°C

Environmental Specifications

Characteristics	Specifications	Test Conditions
Bias humidity	ΔVv / Vv ≤ ± 10%	90% RH, 40°C, maximum working Voltage V_{DC}, 1000 hours
Thermal shock	ΔVv / Vv ≤ ± 10%	-55°C to +125°C, 30 min. cycle, 5 cycles
Full load voltage	ΔVv / Vv ≤ ± 10%	Maximum working Voltage V_{DC},125°C, 1000 hours
Solderability	95% Coverage	230°C, 3s
Solder heat resistance	90% Coverage	260°C, 10s

Table VM5 Solder Reflow Recommendations for Multi Layer Varistors

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	60s to 70s
		at 220°C	50s to 60s
		at 240°C	30s to 40s
		at 260°C	5s to 10s
E	Cooling	From main heating temperature to 100°C	max 4°C/s

Figure VM4

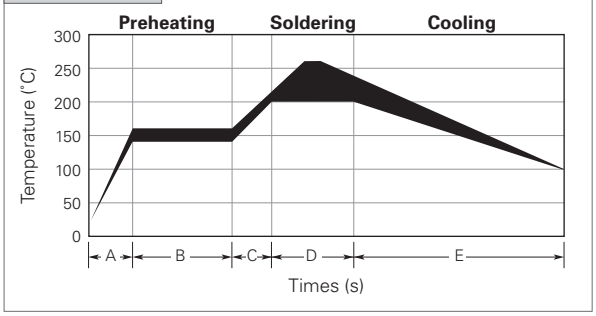


Table VM6 Tape and Reel Specifications for Multi Layer Varistors

	MLV0402		MLV0603		MLV1206	
Description	**Dimensions (mm)**	**Tolerance (mm)**	**Dimensions (mm)**	**Tolerance (mm)**	**Dimensions (mm)**	**Tolerance (mm)**
A	0.62	±0.03	0.90	±0.20	1.90	±0.20
B	1.12	±0.03	1.80	±0.20	3.50	±0.20
W	8.00	±0.30	8.00	±0.30	8.00	±0.30
E	1.75	±0.05	1.75	±0.10	1.75	±0.10
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	4.00	±0.10	4.00	±0.10
P_2	2.00	±0.05	2.00	±0.05	2.00	±0.05
D_0	1.50	±0.10	1.50	±0.10	1.50	±0.10
T	0.60	±0.05	0.95	±0.05	0.95	±0.05

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Figure VM5 Referenced Taped Component Dimensions for Multi Layer Varistors

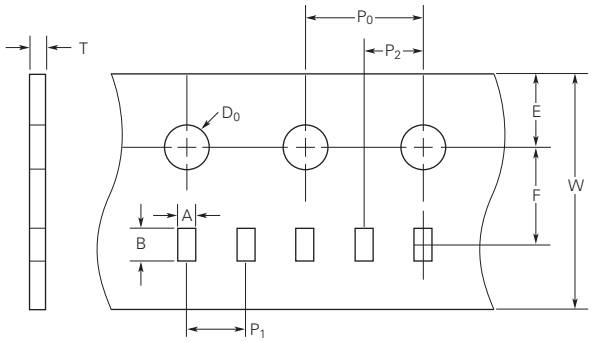


Figure VM6 Reel Dimensions for Multi Layer Varistors

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

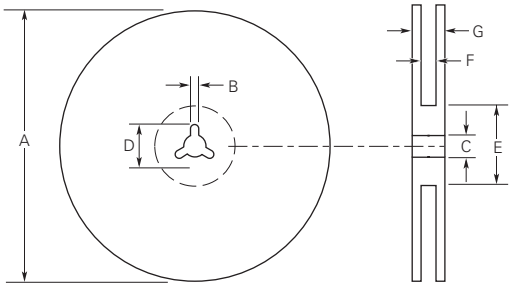


Table VM7 Packaging Specifications for Multi Layer Varistors

Chip Size	Parts Quantity per reel
0402 (1005)	10,000
0603 (1608)	4,000
1206 (3216)	4,000

Part Numbering System for Multi Layer Varistors

Multi Layer Varistors Standard Series

MLV 0402 - 080 M - CXXX

Capacitance
C = Capacitance (Standard Series)
XXX = Capacitance value
221: 22 x 10^1 = 220pF

Tolerance
K = ±10%
L = ±15%
M = ±20%

Varistor Voltage(Vv) Denominator
The first two digits indicate voltage.
The third digit signifies the power of ten.
For example:
080: 8 x 10^0 = 8V
...
700: 70 x 10^0 = 70V

EIA Size

Manufacturer Series
MLV = Multi Layer Varistors

Multi Layer Varistors "E" Series

MLV 0402 - 120 - EXXX

Capacitance
E = Capacitance ("E" Series for low capacitance devices)
XXX = Capacitance value
030: 3 x 10^0 = 3pF
120: 12 x 10^0 = 12pF

Operating Voltage Denominator
The first two digits indicate voltage.
The third digit signifies the power of ten.
For example:
180: 18 x 10^0 = 18V
120: 12 x 10^0 = 12V

EIA Size

Manufacturer Series
MLV = Multi Layer Varistors

⚠ Warning :

- 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.

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

- 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 range

Applications

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

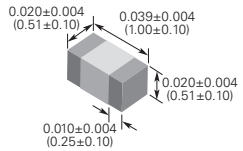
Table FF1 Clear Time Characteristics for Fast-Acting Chip Fuses

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

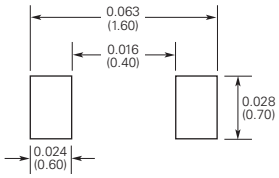
Table FF2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Fast-Acting Chip Fuses

0402 (1005mm) Fast-Acting Chip Fuses

Shape and Dimensions
Inch (mm)



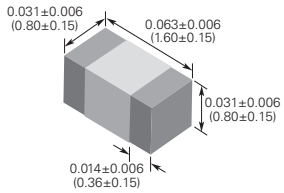
Recommended Pad Layout
Inch (mm)



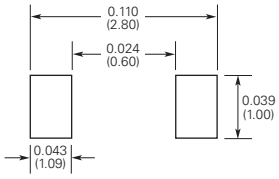
Part Number	Typical Electrical Characteristics: Rated Current (A)	Typical Electrical Characteristics: Nominal Cold DCR* (Ω)	Max. Interrupt Ratings: Voltage (V_{DC})	Max. Interrupt Ratings: Current (A)
0402SFF050F/24	0.50	0.380	24	35
0402SFF075F/24	0.75	0.210	24	35
0402SFF100F/24	1.00	0.120	24	35
0402SFF150F/24	1.50	0.056	24	35
0402SFF200F/24	2.00	0.035	24	35
0402SFF300F/24	3.00	0.021	24	35
0402SFF400F/24	4.00	0.014	24	35

0603 (1608mm) Fast-Acting Chip Fuses

Shape and Dimensions
Inch (mm)



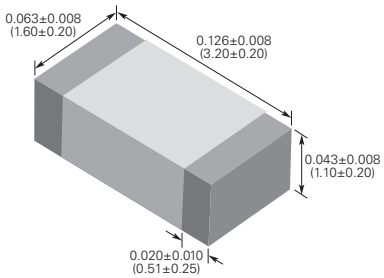
Recommended Pad Layout
Inch (mm)



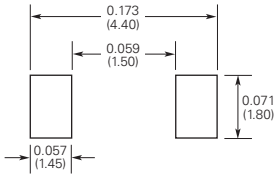
Part Number	Typical Electrical Characteristics: Rated Current (A)	Typical Electrical Characteristics: Nominal Cold DCR* (Ω)	Max. Interrupt Ratings: Voltage (V_{DC})	Max. Interrupt Ratings: Current (A)
0603SFF050F/32	0.50	0.485	32	50
0603SFF075F/32	0.75	0.254	32	50
0603SFF100F/32	1.00	0.131	32	50
0603SFF150F/32	1.50	0.059	32	35
0603SFF200F/32	2.00	0.044	32	35
0603SFF250F/32	2.50	0.032	32	35
0603SFF300F/32	3.00	0.025	32	35
0603SFF350F/32	3.50	0.024	32	35
0603SFF400F/32	4.00	0.018	32	35
0603SFF500F/32	5.00	0.013	32	35
0603SFF600F/24	6.00	0.010	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)	Typical Electrical Characteristics: Nominal Cold DCR* (Ω)	Max. Interrupt Ratings: Voltage (V_{DC})	Max. Interrupt Ratings: Current (A)
1206SFF050F/63	0.50	0.500	63	50
1206SFF075F/63	0.75	0.330	63	50
1206SFF100F/63	1.00	0.220	63	50
1206SFF150F/63	1.50	0.120	63	50
1206SFF175F/63	1.75	0.100	63	50
1206SFF200F/63	2.00	0.050	63	50
1206SFF250F/32	2.50	0.035	32	50
1206SFF300F/32	3.00	0.031	32	50
1206SFF400F/32	4.00	0.022	32	45
1206SFF500F/32	5.00	0.015	32	45
1206SFF600F/24	6.00	0.012	24	45
1206SFF700F/24	7.00	0.011	24	45
1206SFF800F/24	8.00	0.008	24	45

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

RoHS Compliant, ELV Compliant HF Halogen Free

Figure FF1-FF6 Family Performance Curves

Figure FF1

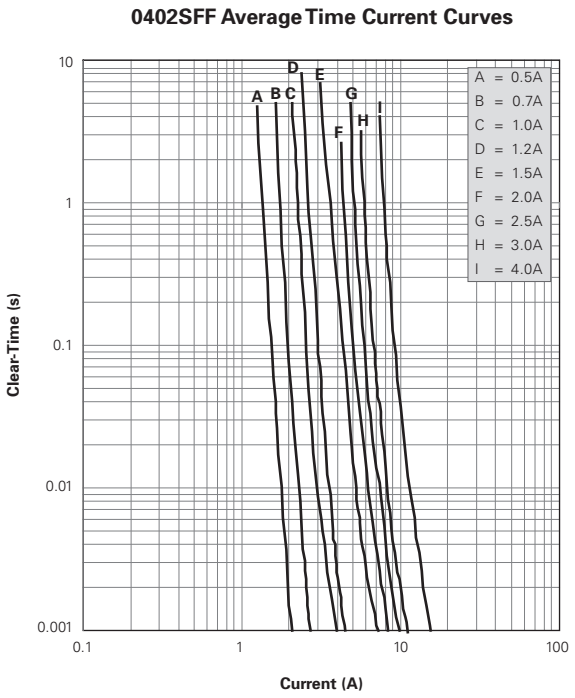
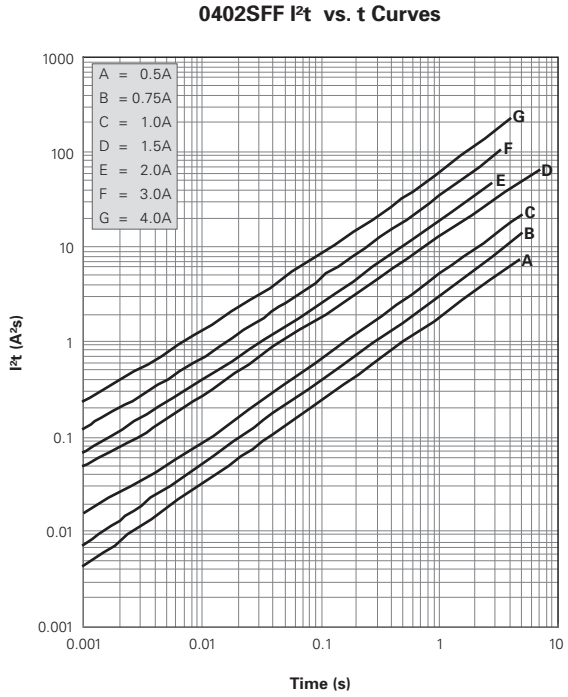


Figure FF2



Note: Curves are nominal

Figure FF3

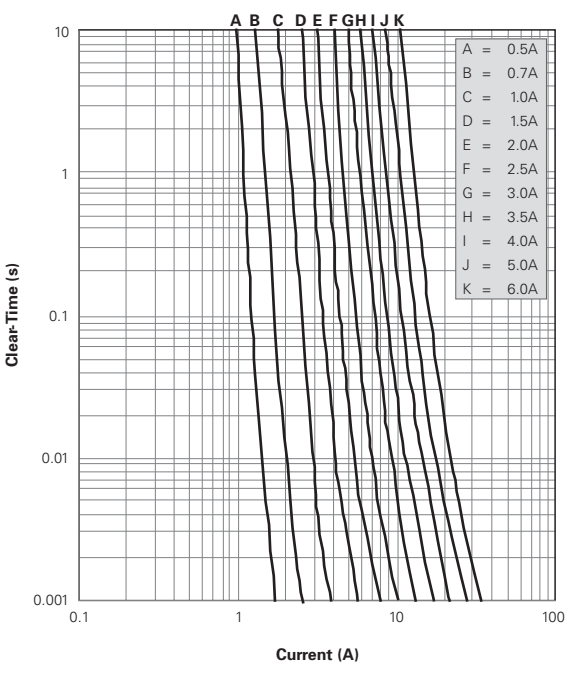
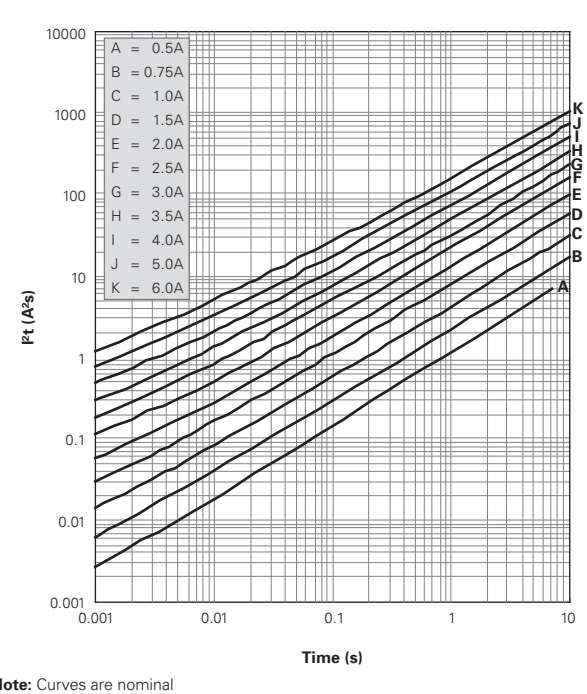


Figure FF4



Note: Curves are nominal

Figure FF1-FF6 Family Performance Curves ... Cont'd

Figure FF5

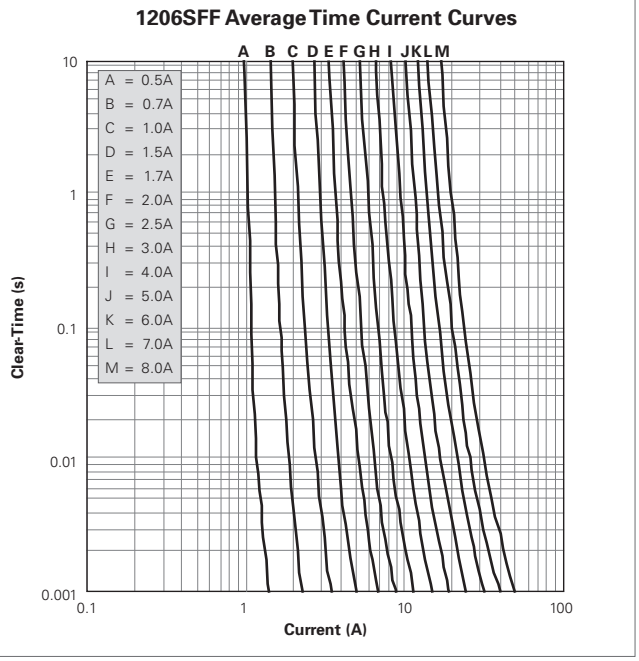
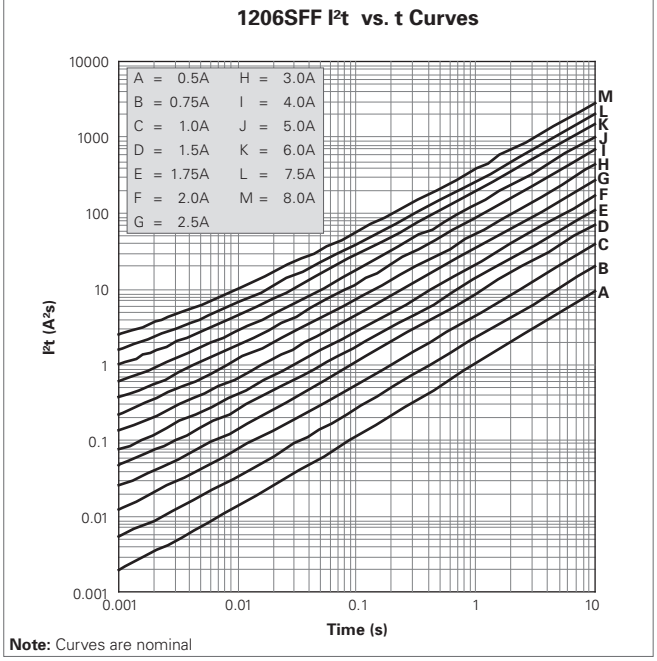


Figure FF6



Note: Curves are nominal

Table FF3 Environmental Specifications for Fast-Acting 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

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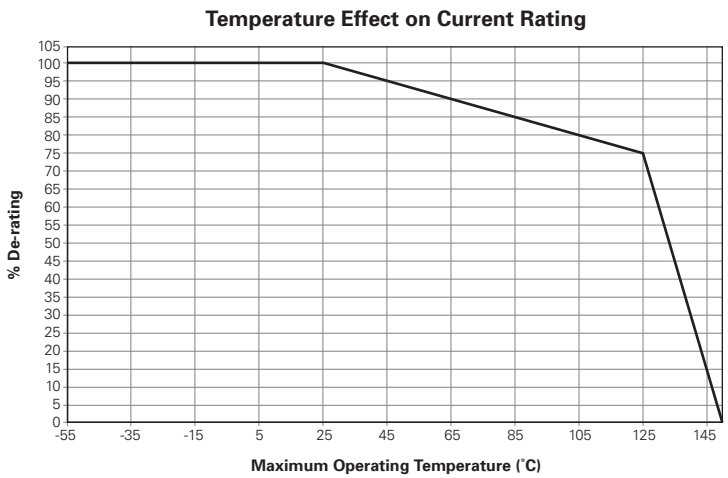
Table FF4 Material Specifications for Fast-Acting Chip Fuses

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

Figure FF7 Thermal Derating Current for Fast-Acting Chip Fuses



RoHS Compliant, ELV Compliant HF Halogen Free

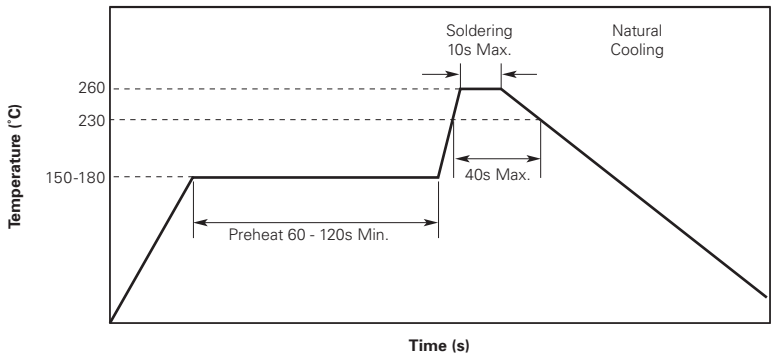
Table FF5 Electrical Specifications for Fast-Acting Chip Fuses

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 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 FF6 Packaging Information for Fast-Acting 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 FF8 Recommended Soldering Temperature Profile for Fast-Acting 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 FF7 Tape and Reel Material Characteristics for Fast-Acting Chip Fuses

Tolerance X ± 1mm; 0.X ± 0.5mm; 0.XX ± 0.2mm

		Range	
Performance	Testing Method	Min.	Max.
MVR	ASTM D1238	3.60	4.40
Vicat softening temperature	ASTM D1525	97.8	-
Elasticity at break	ASTM D638	50.0	-

Table FF8 Tape and Reel Specifications for Fast-Acting 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)

Figure FF9 Taped Component Dimensions for Fast-Acting Chip Fuses

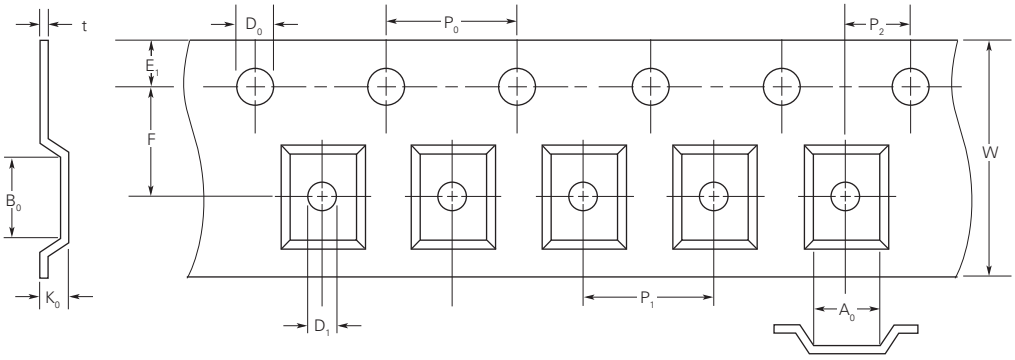
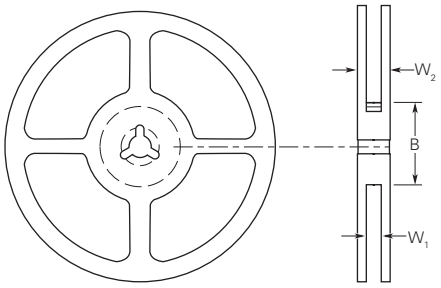


Figure FF10 Reel Dimensions for Fast-Acting Chip Fuses

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 Chip Fuses

UL File # E197536

Part Numbering System for Fast-Acting Chip Fuses

1206 SF F 400 F / 24 -2

Packaging
-2 = Tape and Reel

Voltage Rating (V)

Special Code
F = RoHS Compliant
M = Marked

Rated Current
050 = 0.50 Amps
400 = 4 Amps

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

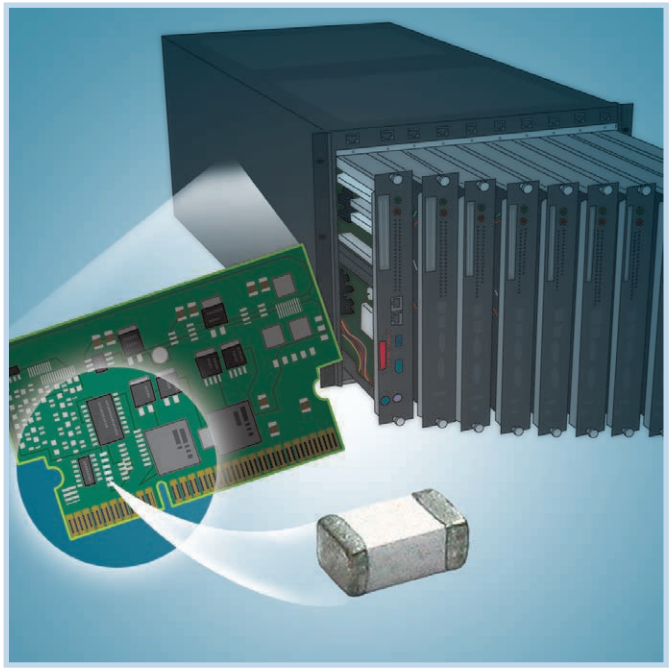
SF = Surface Mount Fuse

Size (1206, 0603, 0402)

High-Current Rated Chip Fuses

NEW

The monolithic multilayer design 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

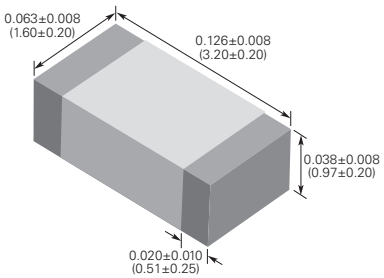
1206SFH Series

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

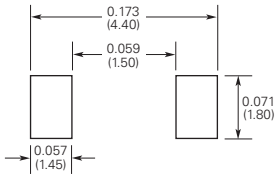
Table FH2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for High-Current Rated Chip Fuses

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)
NEW	1206SFH100F/24	10	0.010	9	24	100
NEW	1206SFH120F/24	12	0.008	14	24	100
NEW	1206SFH150F/24	15	0.005	26	24	100
NEW	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

Figure FH1

1206SFH Average Time Current Curves

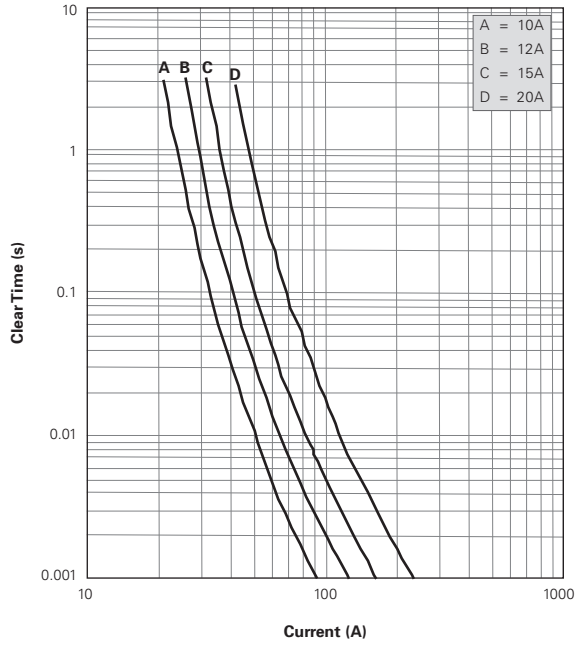
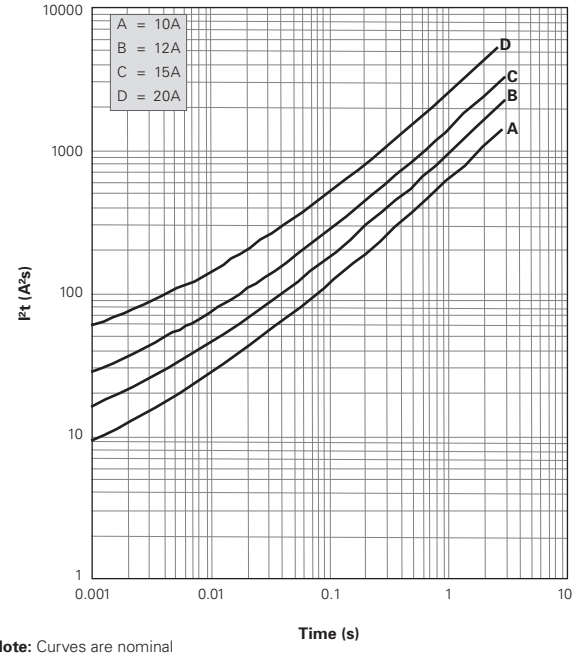


Figure FH2

1206SFH I^2t vs. t Curves



Note: Curves are nominal

RoHS Compliant, ELV Compliant HF Halogen Free

Table FH3 Environmental Specifications for High-Current Rated 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 FH4 Material Specifications for High-Current Rated Chip Fuses

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

Figure FH3 Thermal Derating Current for High-Current Rated Chip Fuses

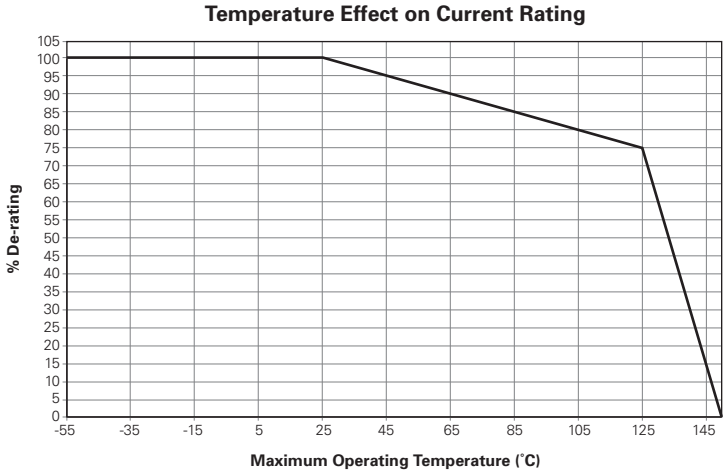


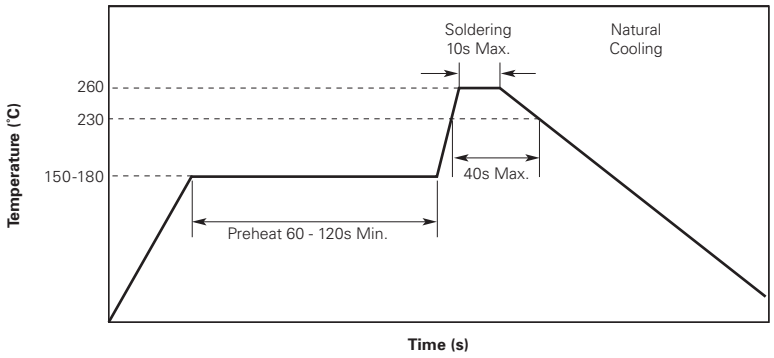
Table FH5 Electrical Specifications for High-Current Rated Chip Fuses

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 FH6 Packaging Information for High-Current Rated 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
1206 (3216)	3,000	178mm white plastic	9.0 ± 0.5mm	8.00 ± 0.10mm	Plastic	5	5

Figure FH4 Recommended Soldering Temperature Profile for High-Current Rated 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 FH7 Tape and Reel Material Characteristics for High-Current Rated Chip Fuses

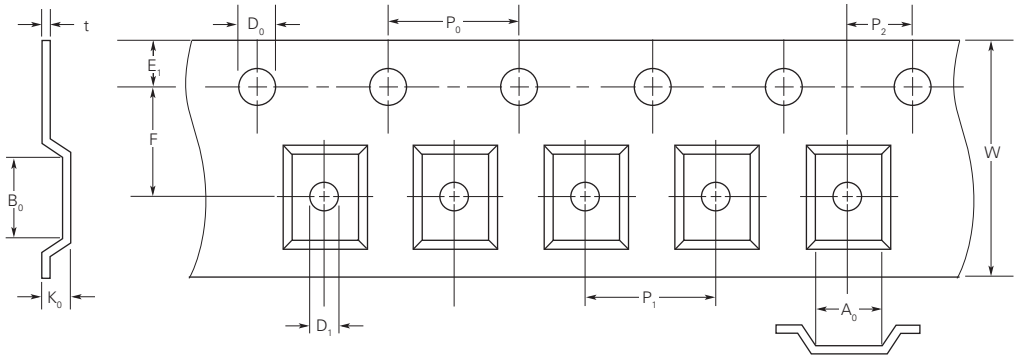
Tolerance X ± 1mm; 0.X ± 0.5mm; 0.XX ± 0.2mm

		Range	
Performance	**Testing Method**	**Min.**	**Max.**
MVR	ASTM D1238	3.60	4.40
Vicat softening temperature	ASTM D1525	97.8	-
Elasticity at break	ASTM D638	50.0	-

Table FH8 Tape and Reel Specifications for High-Current Rated Chip Fuses

	Dimension in inches (mm)	
Mark	**1206 (3216)**	
E_1	0.069±0.004	(1.75±0.10)
F	0.138±0.002	(3.50±0.05)
W	0.318±0.004	(8.00±0.10)
P_1	0.157±0.004	(4.00±0.10)
P_0	0.157±0.004	(4.00±0.10)
P_2	0.079±0.002	(2.00±0.05)
D_0	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)
A_0	0.071±0.004	(1.80±0.10)
B_0	0.138±0.004	(3.50±0.10)
K_0	0.050±0.004	(1.27±0.10)

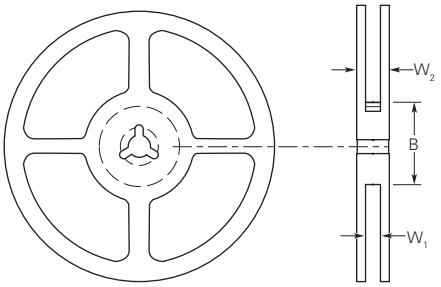
Figure FH5 Tape Component Dimensions for High-Current Rated Chip Fuses



RoHS Compliant, ELV Compliant HF Halogen Free

Figure FH6 Reel Dimensions for High-Current Rated 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 High-Current Rated Chip Fuses

UL File # E197536

Part Numbering System for High-Current Rated Chip Fuses

1206 SF H 200 F / 24 -2

Packaging
-2 = Tape and Reel

Voltage Rating (V)

Special Code
F = RoHS Compliant
M = Marked

Rated Current
200 = 20 Amps

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

SF = Surface Mount Fuse

Size (1206, 0603, 0402)

Slow-Blow Chip Fuses

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

The Raychem 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

- 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.)

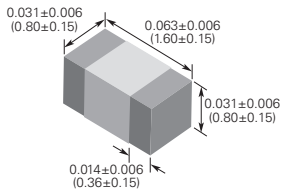
1206SFS Series

% 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.)

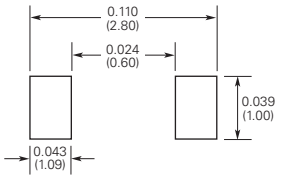
Table FS2 Typical Electrical Characteristics, Dimensions and Recommended Pad Layout for Slow-Blow Chip Fuses

0603 (1608mm) Slow-Blow Chip Fuses

Shape and Dimensions
Inch (mm)



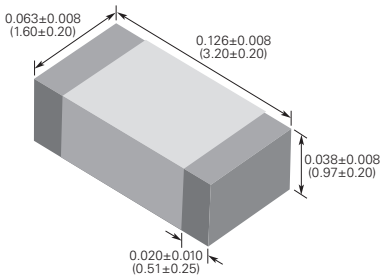
Recommended Pad Layout
Inch (mm)



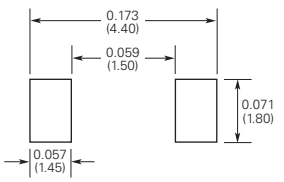
Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I²t (A²sec)†	Max. Interrupt Ratings: Voltage (V_{DC})	Current (A)
0603SFS100F/32	1.0	0.200	0.093	32	50
0603SFS150F/32	1.5	0.100	0.18	32	50
0603SFS200F/32	2.0	0.052	0.32	32	50
0603SFS250F/32	2.5	0.041	0.63	32	50
0603SFS300F/32	3.0	0.031	0.87	32	50
0603SFS350F/32	3.5	0.021	1.20	32	50
0603SFS400F/32	4.0	0.017	2.30	32	50
0603SFS450F/32	4.5	0.015	2.70	32	50
0603SFS500F/32	5.0	0.013	3.20	32	50

1206 (3216mm) Slow-Blow Chip Fuses

Shape and Dimensions
Inch (mm)



Recommended Pad Layout
Inch (mm)



Part Number	Typical Electrical Characteristics: Rated Current (A)	Nominal Cold DCR (Ω)*	Nominal I²t (A²sec)†	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 I²t at 0.001 sec clear time.

RoHS Compliant, ELV Compliant HF Halogen Free

Figure FS1-FS4 Family Performance Curves

Figure FS1

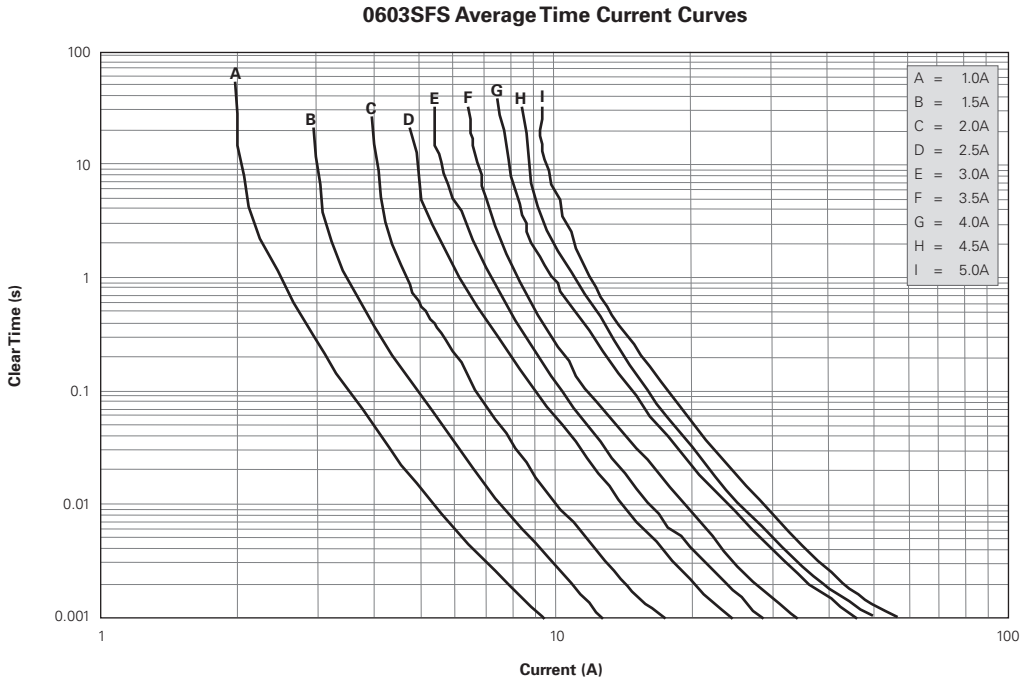
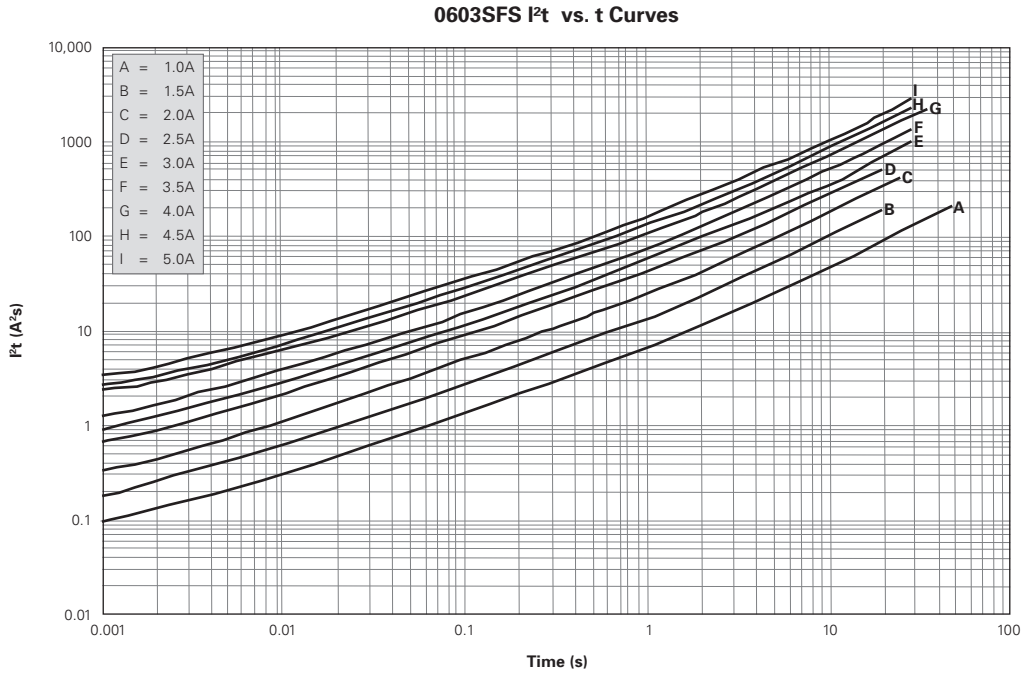


Figure FS2



Note: Curves are nominal

Figure FS1-FS4 Family Performance Curves ... Cont'd

Figure FS3

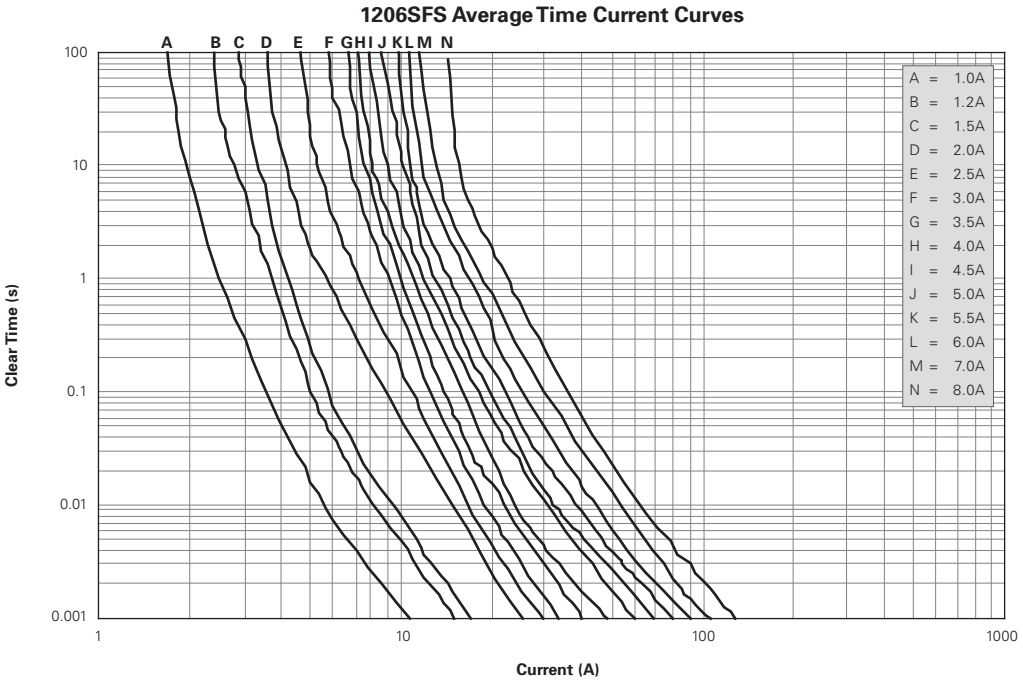
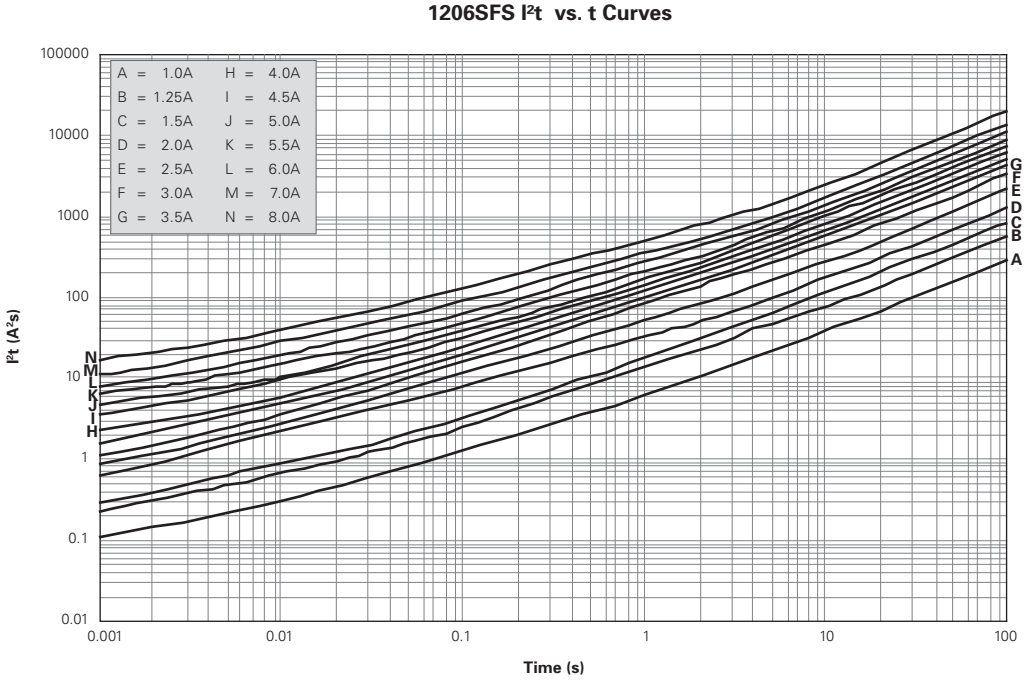


Figure FS4



Note: Curves are nominal

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Table FS3 Environmental Specifications for 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 FS4 Material Specifications for Slow-Blow Chip Fuses

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

Figure FS5 Thermal Derating Current for Slow-Blow Chip Fuses

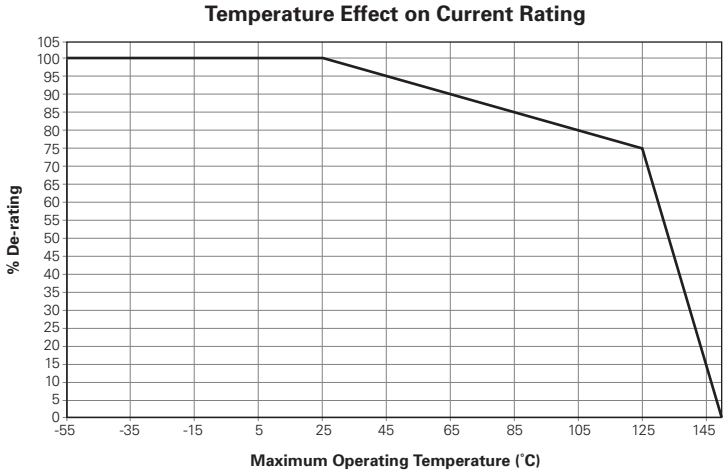


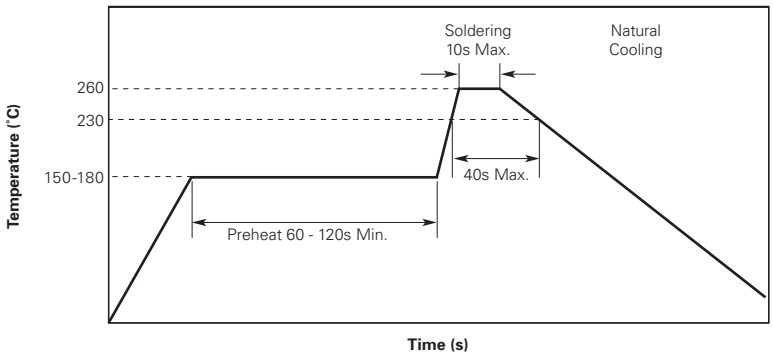
Table FS5 Electrical Specifications for Slow-Blow Chip Fuses

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 FS6 Packaging Information for 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
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 FS6 Recommended Soldering Temperature Profile for 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 FS7 Tape and Reel Material Characteristics for Slow-Blow Chip Fuses

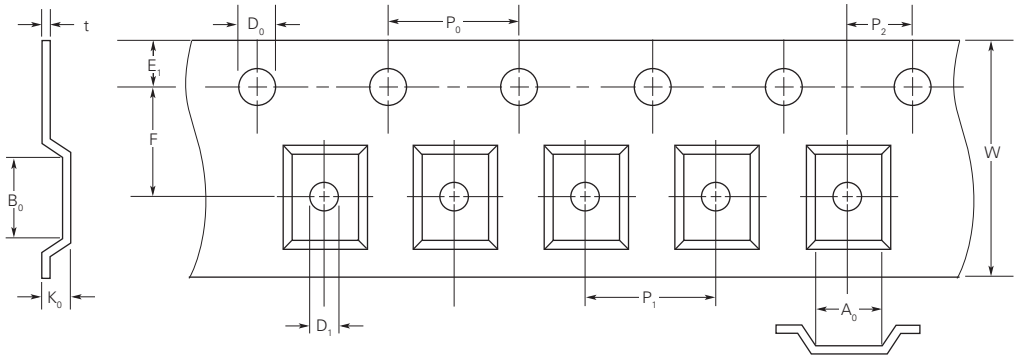
Tolerance X ± 1mm; 0.X ± 0.5mm; 0.XX ± 0.2mm

		Range	
Performance	**Testing Method**	**Min.**	**Max.**
MVR	ASTM D1238	3.60	4.40
Vicat softening temperature	ASTM D1525	97.8	-
Elasticity at break	ASTM D638	50.0	-

Table FS8 Tape and Reel Specifications for Slow-Blow Chip Fuses

	Dimension in inches (mm)			
Mark	**0603 (1608)**		**1206 (3216)**	
E_1	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)
W	0.318±0.004	(8.00±0.10)	0.318±0.004	(8.00±0.10)
P_1	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)
P_2	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)
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)
A_0	0.036±0.004	(0.92±0.10)	0.071±0.004	(1.80±0.10)
B_0	0.071±0.004	(1.80±0.10)	0.138±0.004	(3.50±0.10)
K_0	0.033±0.004	(0.85±0.10)	0.050±0.004	(1.27±0.10)

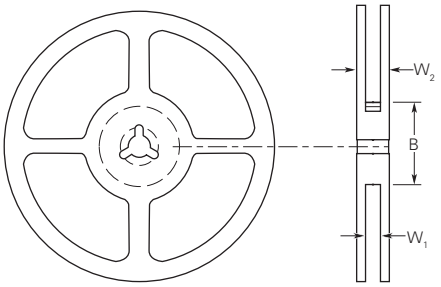
Figure FS7 Taped Component Dimensions for Slow-Blow Chip Fuses



RoHS Compliant, ELV Compliant HF Halogen Free

Figure FS8 Reel Dimensions for 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 Slow-Blow Chip Fuses

UL File # E197536

Part Numbering System for Slow-Blow Chip Fuses

1206 SF S 400 F / 24 -2

Packaging
-2 = Tape and Reel

Voltage Rating (V)

Special Code
F = RoHS Compliant
M = Marked

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)

Telecom Fuses

The Raychem 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.

Raychem 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.

When used in conjunction with SiBar thyristor surge suppression devices, FT600 fuses help designers implement a coordinated overcurrent/overvoltage solution and comply with regulatory standards.

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 SiBar overvoltage protection device, assists designers to meet regulatory standards without additional series components

Features

- 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 over-current 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	SiBar Thyristor Surge Protectors*
Customer premises equipment, IT equipment Analog modems, V.90 modems, ISDN modems, xDSL modems, ADSL splitters, phone sets, fax machines, answering machines, caller ID, internet appliances, PBX systems, POS terminals, wall plugs	UL 60950 TIA-968-A	FT600-0500 FT600-1250	FT600-2000	TVBxxx(N)SC-L
Access network equipment Remote terminals, line repeaters, multiplexers, cross-connects, WAN equipment	Telcordia GR-1089 TIA-968-A	FT600-1250	FT600-2000	TVBxxx(N)SC-L
Central office switching equipment Analog/POTS linecards, ISDN linecards, xDSL modems, ADSL/VDSL splitters, T1/E1 linecards, multiplexers, CSU/DSU, servers	Telcordia GR-1089 TIA-968-A	FT600-1250	FT600-2000	TVBxxx(N)SC-L

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

* Refer to the SiBar product section for more information.

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.

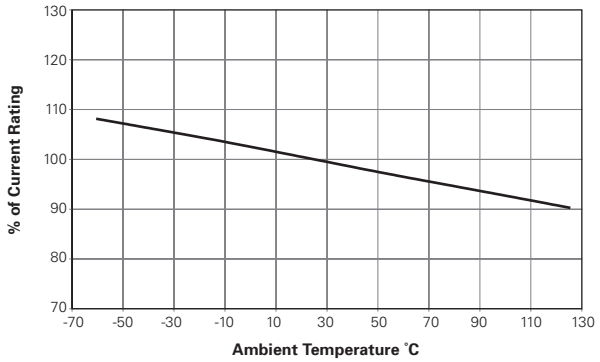
Table FT1 Interrupt Voltage and Current Ratings for FT600 Devices

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

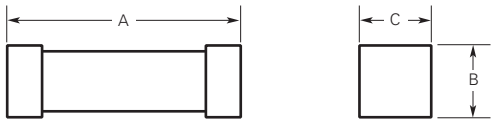


Figure FT3 Typical Time-to-open Characteristics (at 20°C) for FT600 Devices

FT600

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

Figure FT3

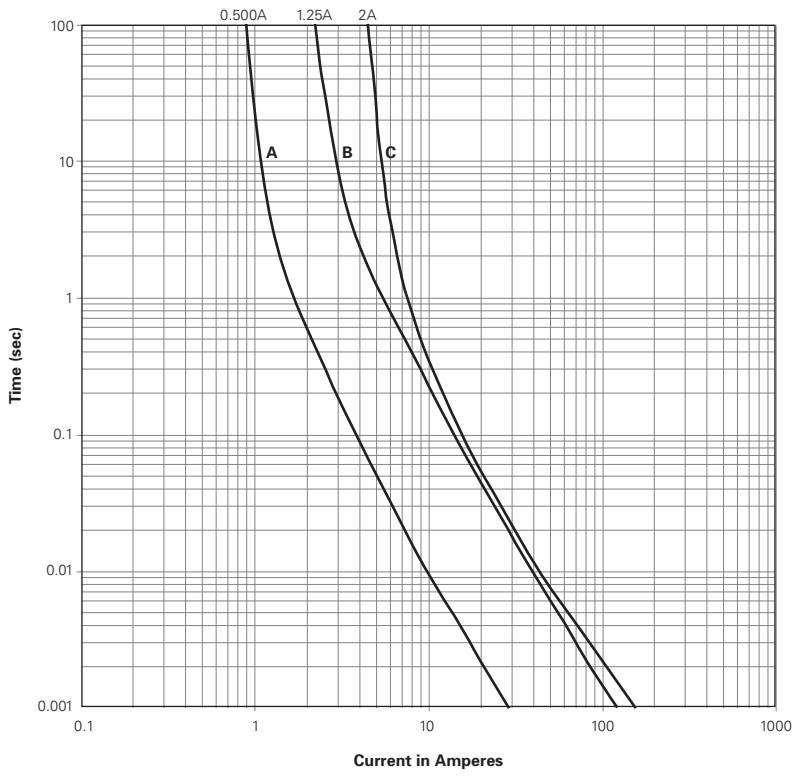


Table FT3 Physical Characteristics and Environmental Specifications for FT600 Devices

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	-40/+85°C
Storage humidity	Per MIL-STD-202F, Method 106F

Table FT4 Packaging and Marking Information for FT600 Devices

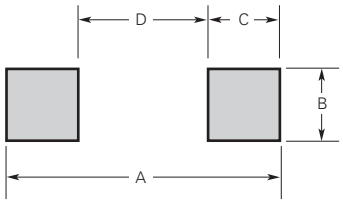
Part Number	Bag Quantity	Tape & Reel Quantity	Standard Package Quantity	Part Marking	Agency Recognition
FT600-0500-2	—	2,500	10,000	500	UL, CSA
FT600-1250-2	—	2,500	10,000	1250	UL, CSA
FT600-2000-2	—	2,500	10,000	2000	UL, CSA

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



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Solder Reflow and Rework Recommendations for FT600 Devices

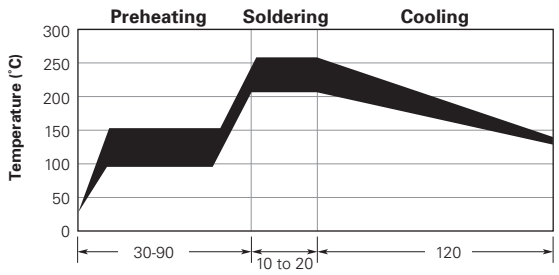
Solder Reflow

- Recommended reflow methods: IR, vapor phase oven, hot air oven
- Devices can be cleaned using standard industry methods and solvents

Rework

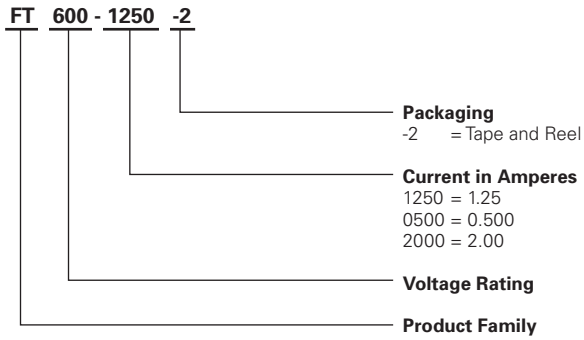
- If a device is removed from the board, it should be discarded and replaced by a new device

Figure FT5



RoHS Compliant, ELV Compliant HF Halogen Free

Part Numbering System for FT600 Devices



PolySwitch Resettable Devices
Fundamentals

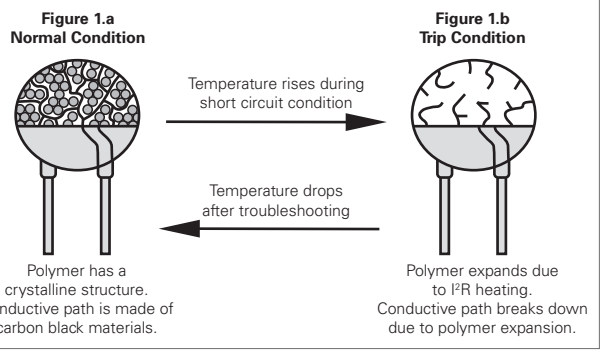
Overview

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.

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.

Figure 1

How a PolySwitch Device works



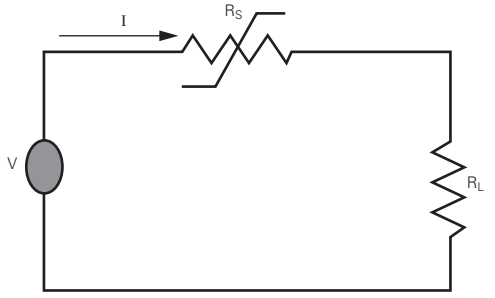
Overcurrent Protection using a PPTC Device

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



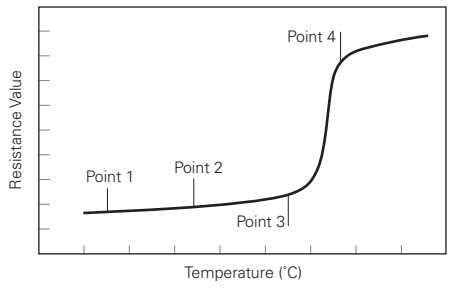
Principles of operation

PolySwitch device operation is based on an overall energy balance. 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 in Figure 3.

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

Figure 3

Example of Operating Curve for PPTC Device



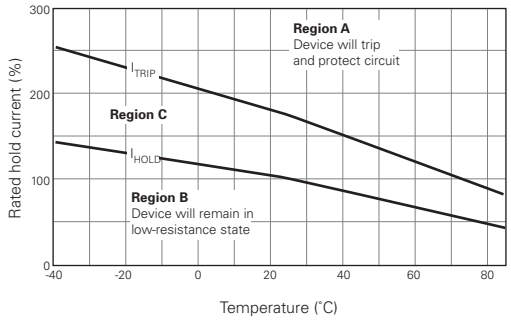
Any further increase in current or ambient temperature will cause the device to generate heat at a rate greater than the rate at which heat can be dissipated, thus causing the device to heat up rapidly. At this stage, a very large increase in resistance occurs for a very small change in temperature, between points 3 and 4 of Figure 3. 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 of Figure 3). 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

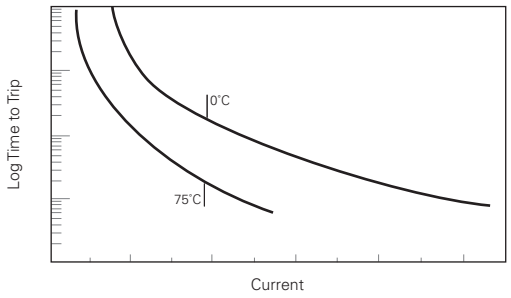


Operating Characteristics of a PPTC Device

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



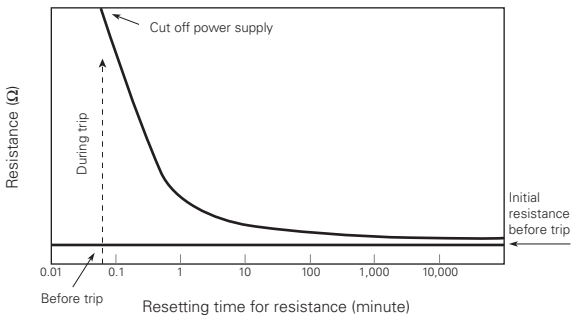
Typical Resistance Recovery after a Trip Event

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,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
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	-	0.14 to 2.6A	-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
picoSMD	6V	-	0.35A	-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
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 30V	-	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	-	0.55 to 0.75A	-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	0.08 to 0.184A	-40 to 85˚C	Radial-leaded	UL, CSA, TÜV	Telecom & Networking
TRF600	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	-	1.7 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 2.4A	-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	-
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	-
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 family or part for the PolySwitch device that will best accommodate the circuit.

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 interrupt 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 across the device. Identifying the PolySwitch device's time-to-trip is important in order to provide the desired protection capabilities. If the device you choose trips too fast, undesired or nuisance tripping will occur. If the device trips too slowly, the components being protected may be damaged before the device switches to a high-resistance state.

Use the Typical Time-to-trip Curves at 20°C to determine if the PolySwitch device's time-to-trip is too fast or too slow for the circuit. If it is 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 or after reflow soldering. Also called: Maximum Resistance
$R_{Tripped\ Typ}$	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 effort to reduce the size and cost of surface mount devices, we introduced the miniSMD product series in 1995. Subsequently, we developed the microSMD, nanoSMD and picoSMD family of products. The picoSMD series reduced the device size to a 2012mm (0805 mils) foot print, one fourth the size of the popular miniSMD series.

Recent additions to the PolySwitch surface-mount series include 24V miniSMD 4532mm (1812 mils), 60V decaSMD 5050mm (2018 mils), and 2.0A microSMD 3225mm (1210 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
- 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

Protection Application Selection Table for Surface-mount Devices

- The table below lists PolySwitch devices and SiBar 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			picoSMD035F	picoSMD035F	picoSMD035F
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
Smart card reader			microSMD010F	microSMD035F	microSMD005F
Telecom - modem	Digital line	OC	miniSMDC014F	miniSMDC014F	miniSMDC014F
		OV	TVBxxx(N)SC-L*	TVBxxx(N)SC-L*	TVBxxx(N)SC-L*
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.

*Refer to the SiBar product section for more information.

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

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

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

	Maximum Ambient Temperature											
Part Number	**-40°C**	**-20°C**	**0°C**	**20°C**	**25°C**	**40°C**	**50°C**	**60°C**	**70°C**	**80°C**	**85°C**	**125°C**
picoSMD Series Size 2012 mm/0805 mils												
picoSMD035F	0.58	0.51	0.44	0.35	0.32	0.31	0.28	0.24	0.21	0.18	0.16	-
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	-
coming soon nanoSMDC200F*	3.56	3.08	2.60	2.12	2.00	1.79	1.64	1.50	1.36	1.21	1.14	-

* Data is preliminary

RoHS Compliant, ELV Compliant

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

		Maximum Ambient Temperature											
	Part Number	-40°C	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	80°C	85°C	125°C
	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												
	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	-
	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	-
NEW	miniSMDC150F/16	2.40	2.10	1.80	1.50	1.44	1.25	1.13	1.00	0.88	0.75	0.69	-
	miniSMDC150F/24	2.10	1.90	1.70	1.50	1.44	1.25	1.13	1.00	0.88	0.75	0.69	-
	miniSMDC160F	2.50	2.19	1.89	1.60	1.53	1.31	1.16	1.10	0.95	0.79	0.71	-
	miniSMDC200F	2.60	2.44	2.22	2.00	1.96	1.78	1.67	1.50	1.45	1.34	1.29	-
NEW	miniSMDC200S	2.60	2.40	2.10	2.00	1.93	1.77	1.66	1.60	1.44	1.33	1.27	-
	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	-
	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	-
	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	-

RoHS Compliant, ELV Compliant

Figure S1 Thermal Derating Curve for Surface-mount Devices

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

B = miniSMDE190F

C = SMDH120 and SMDH160

Figure S1

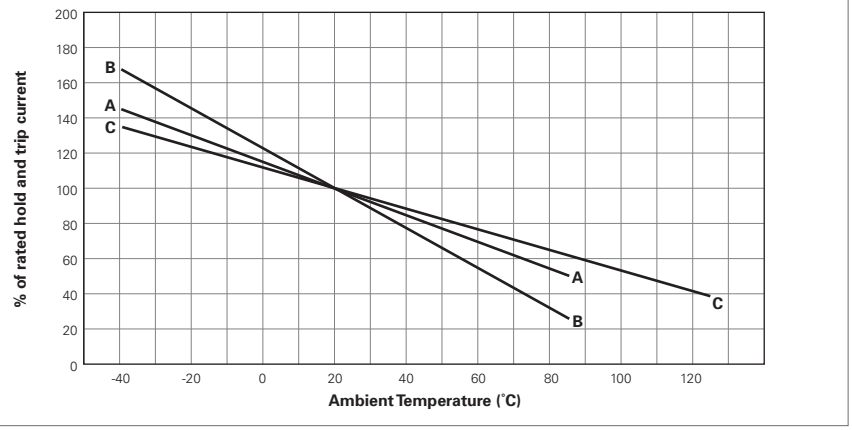


Table S3 Electrical Characteristics for Surface-mount Devices at Room Temperature

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
picoSMD Series Size 2012 mm/0805 mils										
picoSMD035F	0.35	0.75	6	20	0.60	3.50	0.10	0.42	1.40	S6
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
coming soon nanoSMDC200F*	2.00	4.00	6	100	1.00	8.00	TBD	0.02	0.07	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	S3
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										
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
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
NEW 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

* Data is preliminary

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
miniSMDC Series Size 4532 mm/1812 mils										
miniSMDC200F	2.00	4.00	8	100	1.00	8.00	5.00	0.020	0.070	S2
NEW miniSMDC200S	2.00	4.00	8	100	1.00	8.00	5.00	0.020	0.060	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
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	S4
decaSMDC050F/60	0.55	1.10	60	10	1.00	8.00	0.10	0.400	1.10	S2
SMD100F-2018	1.10	2.20	15	40	1.40	8.00	0.50	0.100	0.40	S4
SMD150F-2018	1.50	3.00	15	40	1.80	8.00	1.00	0.070	0.18	S4
SMD200F-2018	2.00	4.20	6	40	1.50	8.00	3.00	0.048	0.10	S4
SMD Series Size 7555 mm/2920 mils										
SMD030F	0.30	0.60	60	10	1.70	1.50	3.00	1.200	4.800	S5
SMD050F	0.50	1.00	60	10	1.70	2.50	4.00	0.350	1.400	S5
SMD075F	0.75	1.50	30	40	1.70	8.00	0.30	0.350	1.000	S5
SMD075F/60	0.75	1.50	60	10	1.70	8.00	0.30	0.350	1.000	S5
SMD100F	1.10	2.20	30	40	1.70	8.00	0.50	0.120	0.480	S5
SMD100F/33	1.10	2.20	33	40	1.70	8.00	0.50	0.120	0.410	S5
SMDH120	1.20	2.30	16	50	2.00	8.00	2.00	0.150	0.340	S5
SMD125F	1.25	2.50	15	40	1.70	8.00	2.00	0.070	0.250	S5
SMD260F	2.60	5.20	6	40	1.70	8.00	20.00	0.025	0.075	S5
SMD300F	3.00	6.00	6	40	1.50	8.00	35.00	0.015	0.048	S5
SMD2 Devices Size 8763 mm/3425 mils										
SMD150F	1.50	3.00	15	40	1.90	8.00	5.00	0.060	0.250	S5
SMD150F/33	1.50	3.00	33	40	1.90	8.00	5.00	0.080	0.230	S5
SMDH160	1.60	3.20	16	70	2.20	8.00	15.00	0.050	0.150	S5
SMD185F	1.85	3.60	33	40	1.50	8.00	5.00	0.065	0.165	S5
SMD200F	2.00	4.00	15	40	1.90	8.00	12.00	0.050	0.125	S5
SMD250F	2.50	5.00	15	40	1.90	8.00	25.00	0.035	0.085	S5

Figure S2-S6 Dimension Figures for Surface-mount Devices

Figure S2

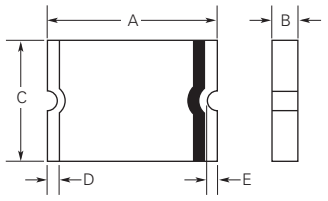


Figure S3

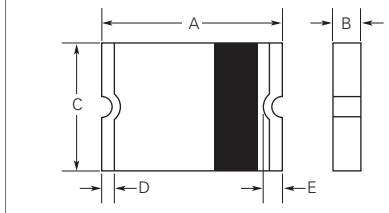


Figure S4

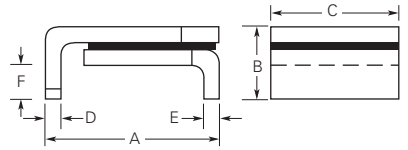


Figure S5

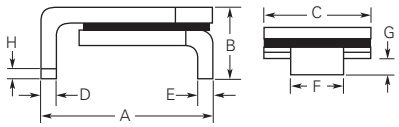
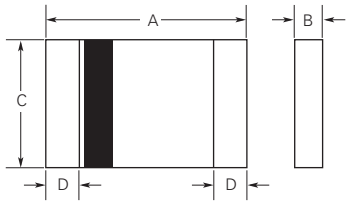


Figure S6



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RoHS Compliant, ELV Compliant

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
picoSMD Series Size 2012 mm/0805 mils																
picoSMD035F	1.80	2.21	0.38	0.81	1.17	1.45	0.15	0.60	-	-	-	-	-	-	-	S6
	(0.071)	(0.087)	(0.015)	(0.032)	(0.046)	(0.057)	(0.006)	(0.024)	-	-	-	-	-	-	-	
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)	-	-	-	-	-	-	
coming soon nanoSMDC200F*	3.00	3.40	0.68	1.25	1.37	1.80	0.25	0.75	0.076	-	-	-	-	-	-	S2
	(0.118)	(0.134)	(0.027)	(0.049)	(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	-	-	-	-	-	-	S3
	(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)	-	-	-	-	-	-	
miniSMDC Series Size 4532 mm/1812 mils																
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)	-	-	-	-	-	-	
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)	-	-	-	-	-	-	

* Data is preliminary

RoHS Compliant, ELV Compliant

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																
	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)	-	-	-	-	-	-	
NEW	miniSMDC150F/16	4.37	4.83	0.28	0.48	3.07	3.41	0.25	0.95	0.20	-	-	-	-	-	-	S2
		(0.172)	(0.190)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	-	-	-	-	-	-	
	miniSMDC150F/24	4.37	4.83	1.00	1.94	3.07	3.41	0.25	0.95	0.20	-	-	-	-	-	-	S2
		(0.172)	(0.190)	(0.040)	(0.077)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	-	-	-	-	-	-	
	miniSMDC160F	4.37	4.73	0.28	0.48	3.07	3.41	0.25	0.95	0.20	-	-	-	-	-	-	S2
		(0.172)	(0.186)	(0.011)	(0.019)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	-	-	-	-	-	-	
	miniSMDC200F	4.37	4.73	0.51	1.22	3.07	3.41	0.25	0.95	0.20	-	-	-	-	-	-	S2
		(0.172)	(0.186)	(0.020)	(0.048)	(0.121)	(0.134)	(0.010)	(0.040)	(0.008)	-	-	-	-	-	-	
NEW	miniSMDC200S	4.37	4.73	0.36	0.60	3.07	3.41	0.25	0.95	0.20	-	-	-	-	-	-	S2
		(0.172)	(0.186)	(0.014)	(0.024)	(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)	-	-	-	-	-	-	
	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)	-	-	-	-	-	-	-
	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	-	-	-	S4
		(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	-	-	-	S4
		(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	-	-	-	S4
		(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	-	-	-	S4
		(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	S5
		(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	S5
		(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	S5
		(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	S5
		(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	S5
		(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	S5
		(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	S5
		(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	S5
		(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	S5
		(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	S5
		(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)	-

RoHS Compliant, ELV Compliant

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

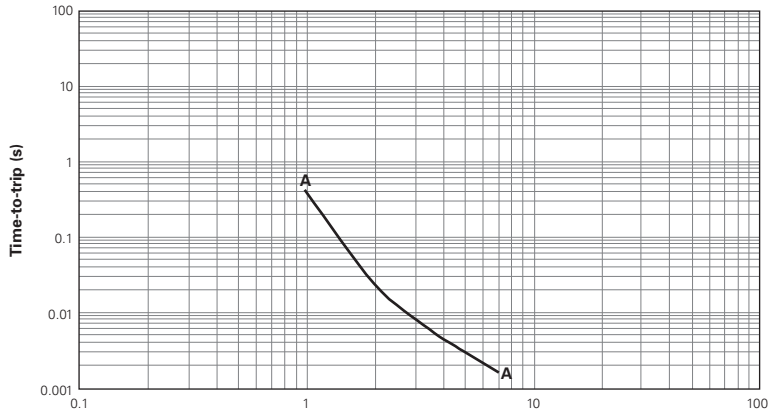
Part Number	A Min.	A Max.	B Min.	B Max.	C Min.	C Max.	D Min.	D Max.	E Min.	E Max.	F Min.	F Max.	G Min.	G Max.	H Min.	Figure
SMD2 Devices Size 8763 mm/3425 mils																
SMD150F	8.00	9.40	-	3.00	6.00	6.71	0.56	0.71	0.56	0.71	3.68	3.94	0.66	1.37	0.43	S5
	(0.315)	(0.370)	-	(0.118)	(0.236)	(0.264)	(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	S5
	(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	S5
	(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	S5
	(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	S5
	(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	S5
	(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)	-

Figure S7-S13 Typical Time-to-trip Curves at 20°C for Surface-mount Devices

picoSMDxxxF

A = picoSMD035F

Figure S7



nanoSMDCxxxF

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

Figure S8

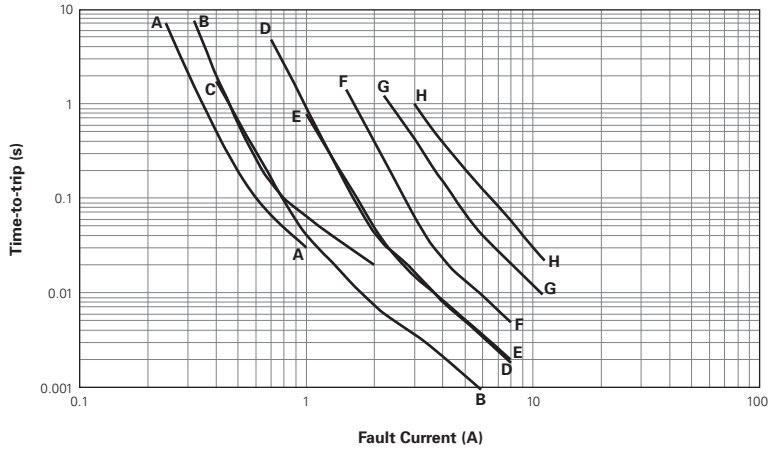
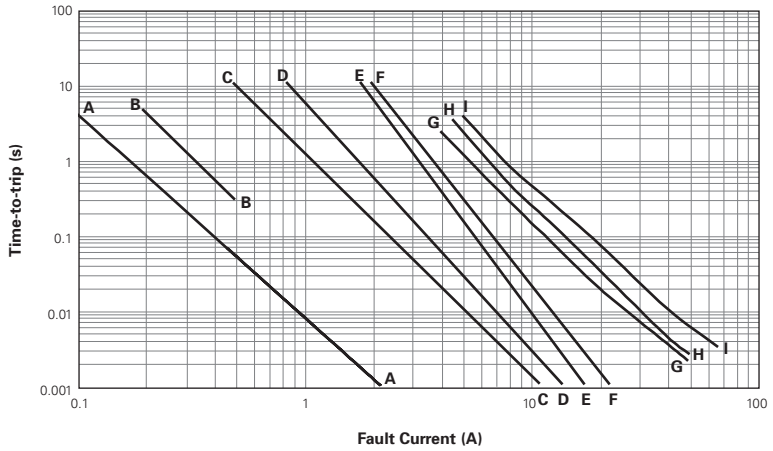


Figure S7-S13 Typical Time-to-trip Curves at 20°C for Surface-mount Devices ... Cont'd

microSMDxxxF

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

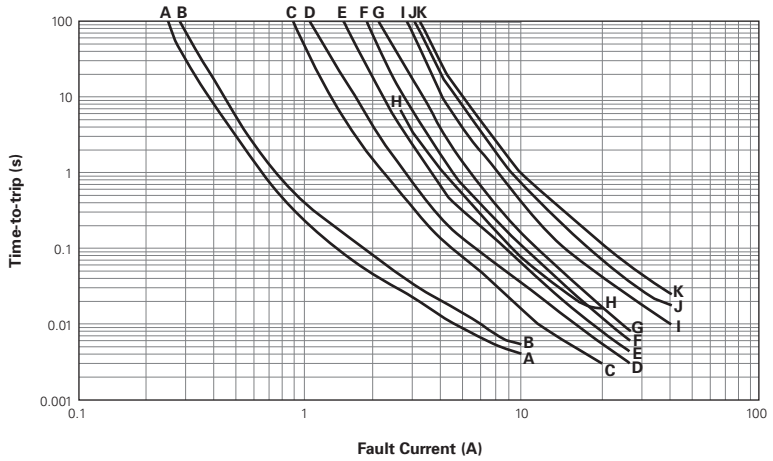
Figure S9



miniSMDCxxxF and miniSMDExxxF

A = 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, miniSMDC200S
J = miniSMDE190F
K = miniSMDC260F, miniSMDC260F/12, miniSMDC260F/13.2, miniSMDC260F/16

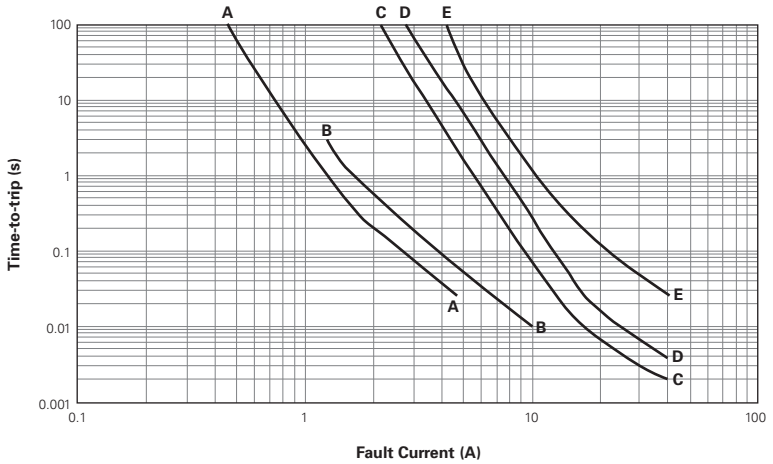
Figure S10



midSMD

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

Figure S11



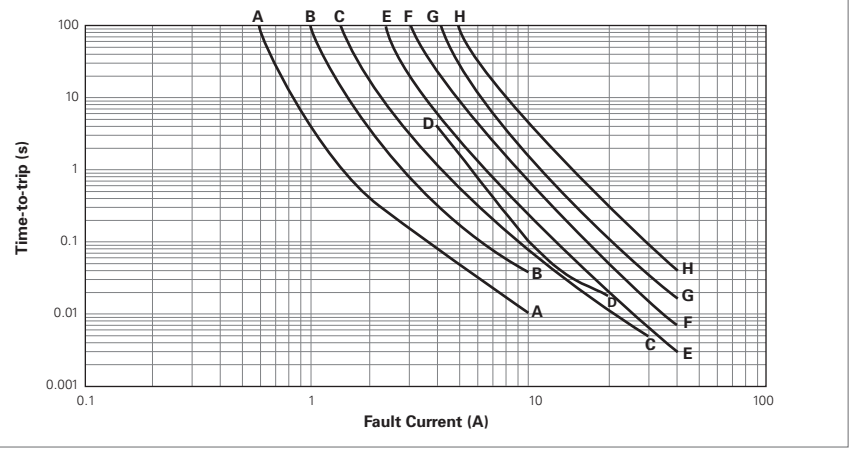
RoHS Compliant, ELV Compliant

Figure S7-S13 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

Figure S12



SMD2xxxF

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

Figure S13

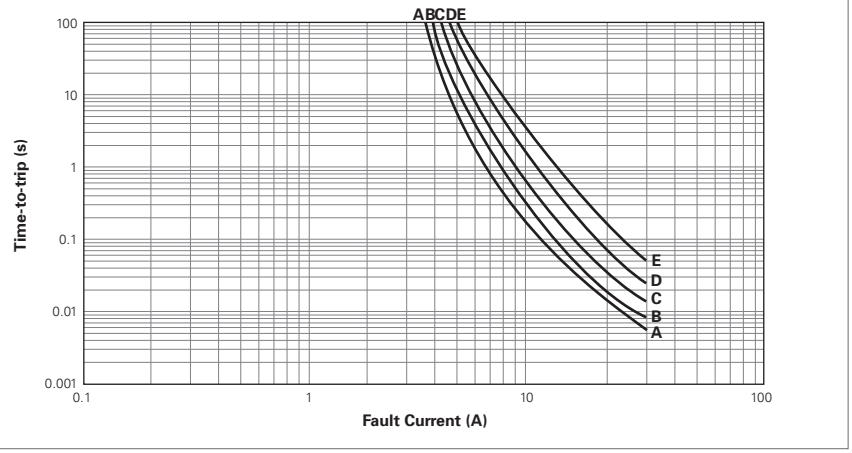


Table S5 Physical Characteristics and Environmental Specifications for Surface-mount Devices

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; gold with nickel underplate for picoSMD
Soldering characteristics	ANSI/J-STD-002 Category 3 for 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

Table S6 Packaging and Marking Information for Surface-mount Devices

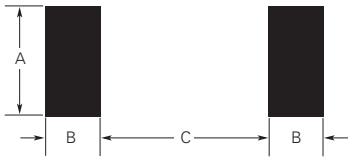
	Part Number	Tape & Reel Quantity	Standard Package	Part Marking	Recommended Pad Layout Figures [mm(In.)] Dimension A (Nom.)	Dimension B (Nom.)	Dimension C (Nom.)	Agency Recognition
	picoSMD Series Size 2012 mm/0805 mils							
	picoSMD035F	4,000	20,000	I	1.50 (0.060)	1.17(0.046)	1.00(0.040)	UL, CSA, TÜV
	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
coming soon	nanoSMDC200F*	TBD	TBD	TBD	1.60 (0.063)	1.00 (0.039)	2.00 (0.079)	Pending
	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							
	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
	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
NEW	miniSMDC150F/16	2,000	10,000	150 16V	2.95 (0.114)	1.68 (0.066)	3.10 (0.122)	UL, CSA
	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
NEW	miniSMDC200S	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
	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

* 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
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
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 S14 Recommended Pad Layout for Surface-mount Devices



Agency Recognition for Surface-mount Devices

UL	File # E74889 for all surface-mount devices
CSA	File # CA78165 for all surface-mount devices
TÜV	Certificate # R72072068 for picoSMD series Certificate # R72041439 for nanoSMD series Certificate # R72041438 for microSMD and miniSMD series Certificate # R72090019 for decaSMD series Certificate # R72041427 for SMD series Certificate # R72072048 for SMDH series

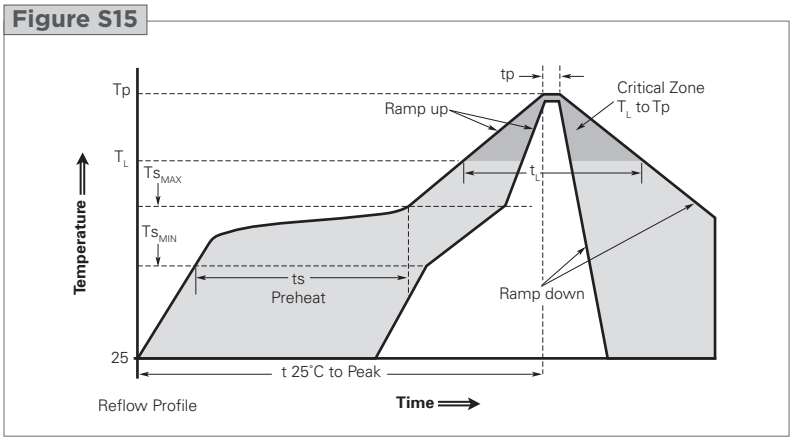
Solder Reflow and Rework Recommendation for Surface-mount Devices

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	60-180 seconds
Time maintained above:		
• Temperature (T_L)	183°C	217°C
• Time (t_L)	30-70 seconds	30-70 seconds
Peak/Classification temperature (Tp)	240°C	260°C
Time within 5°C of actual peak temperature		
Time (tp)	10-30 seconds	20-40 seconds
Ramp down rate	6°C/second max.	6°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 S15



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

- 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	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	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
P_1	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 ± 0.10	2.0 ± 0.10	2.0 ± 0.10	2.0 ± 0.10
A_0	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	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	8.2	20.1	12.1	12.1	12.1
D_0	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	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
E_2 min.	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
T_1 max.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
K_0	Table S8	Table S8	Table S8	Table S8	0.95 ± 0.10	1.8 ± 0.15	3.2 ± 0.15	3.4 ± 0.15
Leader min.	390	390	390	390	400	400	400	400
Trailer min.	160	160	160	160	160	160	160	160

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

	picoSMD035F	All nanoSMDC series except nanoSMDC012F nanoSMDC016F	nanoSMDC012F nanoSMDC016F	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_o	1.70 ± 0.1	1.95 ± 0.1	1.95 ± 0.1	2.9 ± 0.1	2.90 ± 0.1	3.50 ± 0.1	3.7 ± 0.1	3.70 ± 0.1	5.0 ± 0.1
B_o	2.45 ± 0.1	3.50 +0.1/-0.08	3.50 ± 0.1	3.5 ± 0.1	3.50 ± 0.1	4.95 ± 0.1	4.9 ± 0.1	4.90 ± 0.1	5.4 ± 0.1
K_o	0.86 ± 0.1	0.89 ± 0.1	1.27 ± 0.1	0.9 ± 0.1	1.27 ± 0.1	0.90 ± 0.1	1.4 ± 0.1	1.78 ± 0.1	1.7 ± 0.1

Table S9 Reel Dimensions for Surface-mount Devices (in Millimeters)

	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

Figure S16 EIA Referenced Taped Component Dimensions for Surface-mount Devices

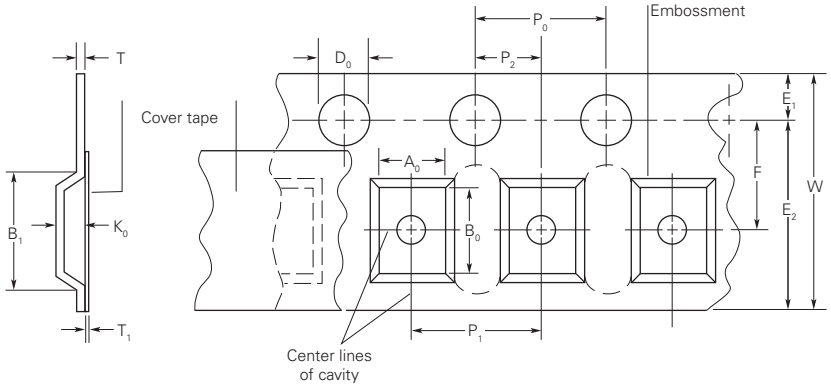
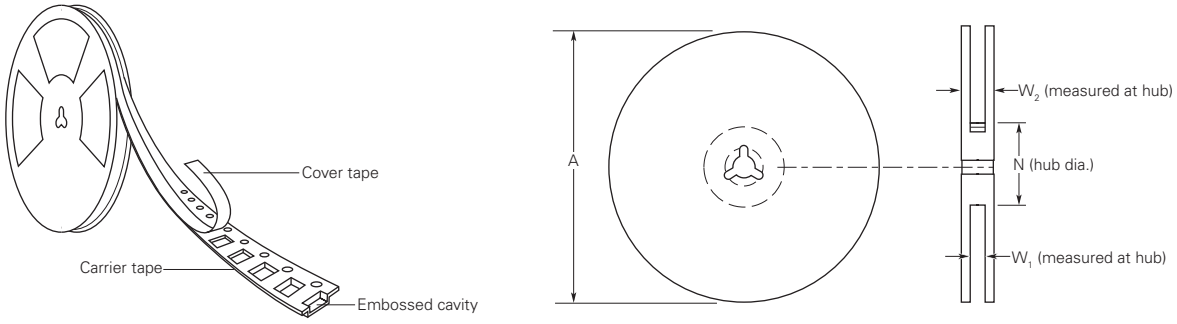
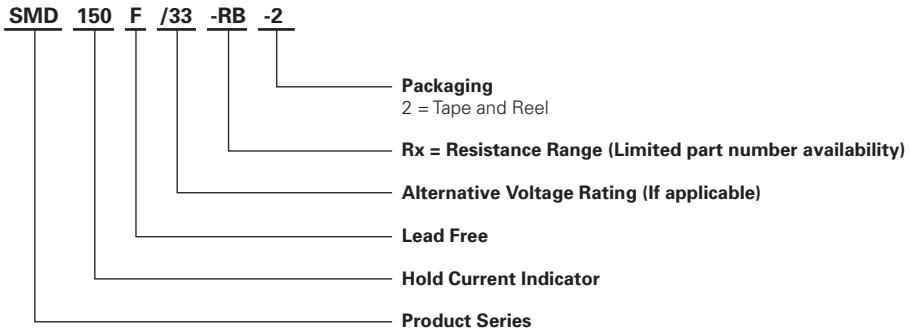


Figure S17 EIA Referenced Reel Dimensions for Surface-mount Devices



Part Numbering System for Surface-mount Devices



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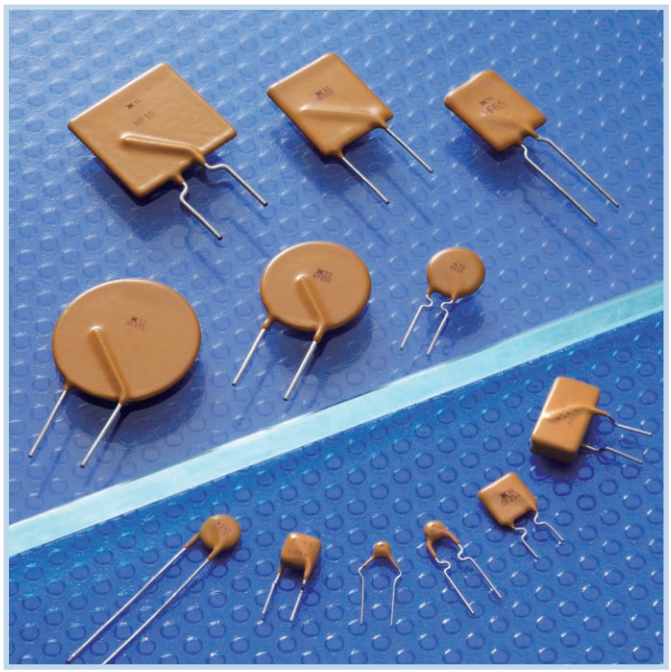
⚠ Warning :

- 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

PolySwitch radial-leaded products represent the most comprehensive and complete set of PPTC products available in the industry today.

- **AGRF and AHRF series qualified per PS400 derived from AECQ200 for automotive applications**
- **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

Protection Application Selection Guide for Radial-leaded Devices

The guide below lists PolySwitch 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	—	—	—	—	—	—

RoHS Compliant, ELV Compliant

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)]

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
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

		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
	RKEF 60V											
NEW	RKEF050	0.73	0.65	0.58	0.50	0.48	0.42	0.38	0.34	0.31	0.26	—
NEW	RKEF065	0.94	0.85	0.75	0.65	0.63	0.54	0.50	0.44	0.40	0.34	—
NEW	RKEF075	1.09	0.98	0.86	0.75	0.73	0.62	0.58	0.51	0.46	0.39	—
NEW	RKEF090	1.30	1.17	1.04	0.90	0.87	0.75	0.69	0.61	0.55	0.47	—
NEW	RKEF110	1.60	1.43	1.27	1.10	1.06	0.92	0.85	0.75	0.67	0.57	—
NEW	RKEF135	1.96	1.76	1.55	1.35	1.31	1.12	1.04	0.92	0.83	0.71	—
NEW	RKEF160	2.32	2.08	1.84	1.60	1.55	1.33	1.23	1.08	0.98	0.83	—
NEW	RKEF185	2.68	2.41	2.13	1.85	1.79	1.54	1.43	1.26	1.13	0.96	—
NEW	RKEF250	3.63	3.25	2.88	2.50	2.43	2.08	1.93	1.70	1.52	1.31	—
NEW	RKEF300	4.35	3.90	3.45	3.00	2.91	2.50	2.30	2.04	1.84	1.55	—
NEW	RKEF375	5.44	4.88	4.31	3.75	3.64	3.11	2.90	2.54	2.29	1.94	—
NEW	RKEF400	5.80	5.20	4.60	4.00	3.88	3.32	3.08	2.73	2.45	2.08	—
NEW	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

	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**
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

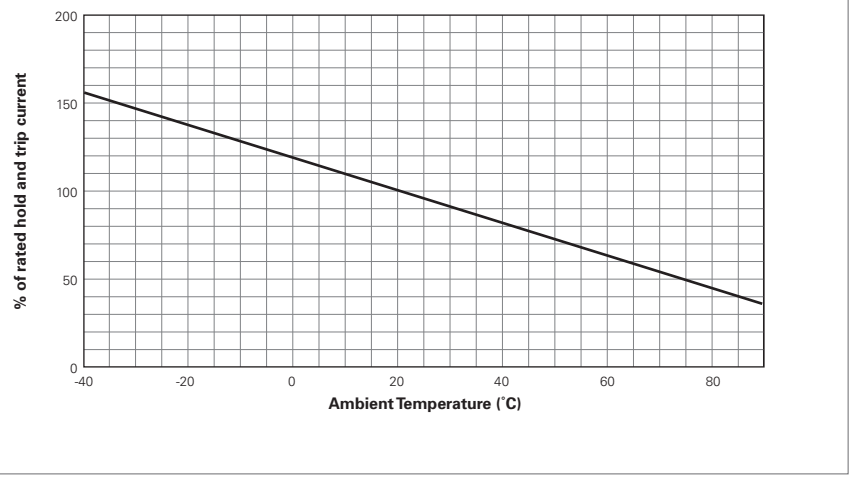
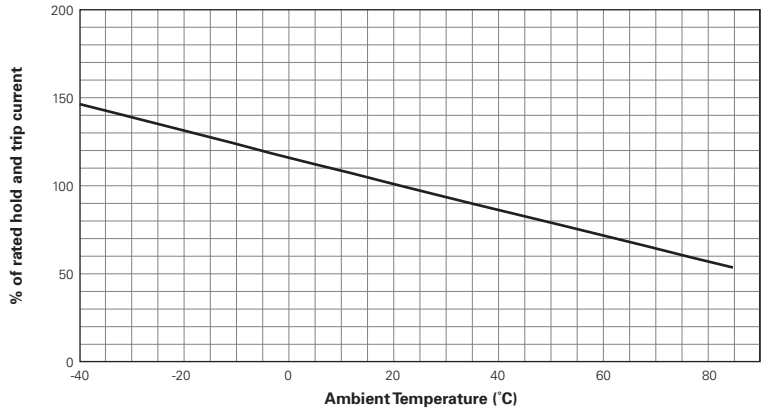


Figure R1-R5 Thermal Derating Curve for Radial-leaded Devices ... Cont'd

RKEF

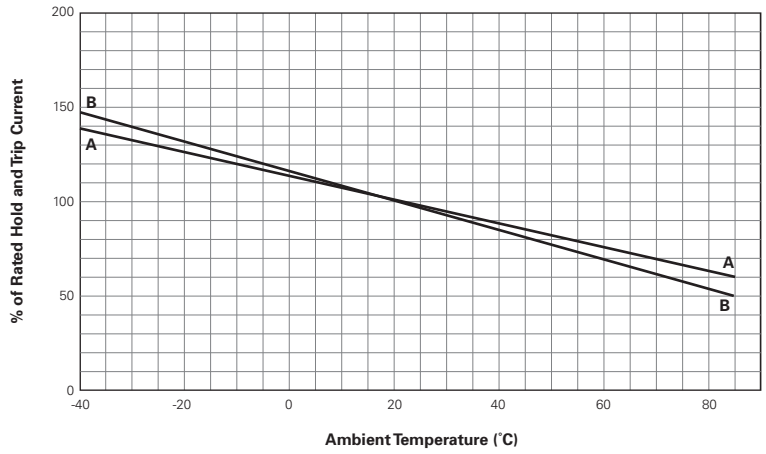
Figure R2



A = RUSBF075, RUSBF120, RUSBF155

B = RUEF, RTEF, and all other RUSBF

Figure R3



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RHEF

Figure R4

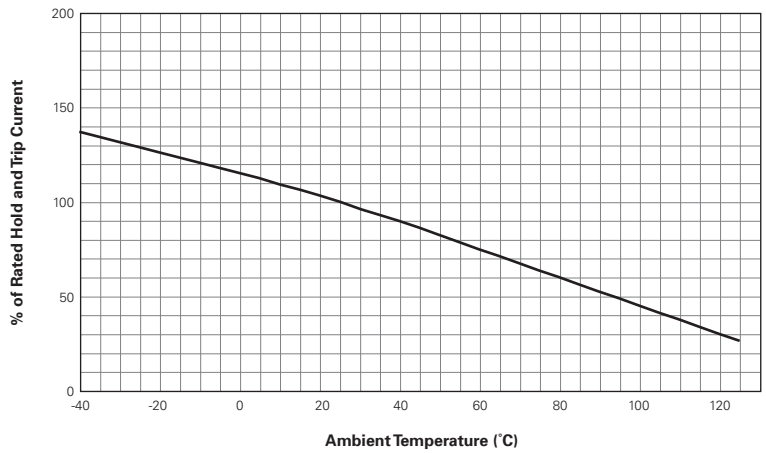


Figure R1-R5 Thermal Derating Curve for Radial-leaded Devices ... Cont'd

RGEF

Figure R5

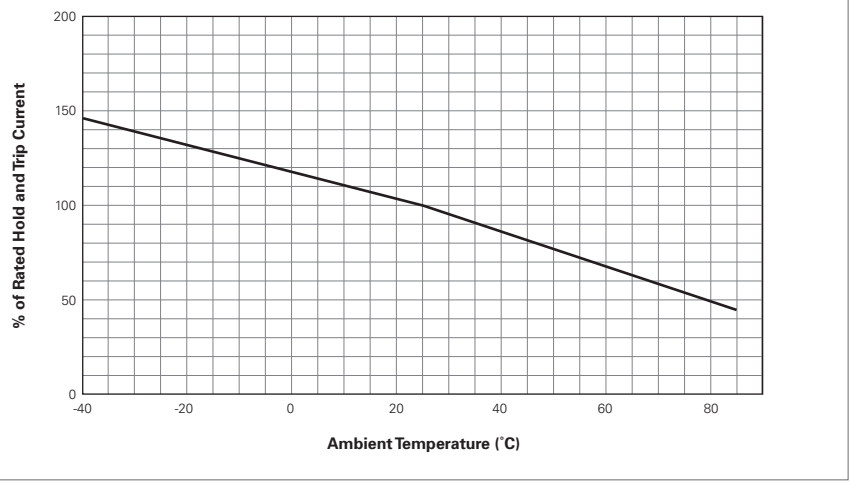


Table R3 Electrical Characteristics for Radial-leaded Devices

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											
NEW RKEF050	0.50	1.00	60	40	1.00	8.00	0.8	0.320	0.529	0.900	[0.205mm² (24)]
NEW RKEF065	0.65	1.30	60	40	1.25	8.00	1.0	0.250	0.450	0.720	[0.205mm² (24)]
NEW RKEF075	0.75	1.50	60	40	1.40	8.00	1.5	0.200	0.390	0.640	[0.205mm² (24)]
NEW RKEF090	0.90	1.80	60	40	1.50	8.00	2.0	0.190	0.320	0.520	[0.205mm² (24)]
NEW RKEF110	1.10	2.20	60	40	2.20	8.00	3.0	0.170	0.280	0.470	[0.520mm² (20)]
NEW 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_{DTyp} (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											
NEW	RKEF160	1.60	3.20	60	40	2.40	8.20	9.0	0.100	0.200	0.320	[0.520mm² (20)]
NEW	RKEF185	1.85	3.70	60	40	2.60	9.25	12.6	0.060	0.152	0.250	[0.520mm² (20)]
NEW	RKEF250	2.50	5.00	60	40	2.80	12.50	15.6	0.040	0.085	0.140	[0.520mm² (20)]
NEW	RKEF300	3.00	6.00	60	40	3.20	15.00	19.8	0.030	0.050	0.080	[0.520mm² (20)]
NEW	RKEF375	3.75	7.50	60	40	3.40	18.75	22.0	0.017	0.040	0.060	[0.520mm² (20)]
NEW	RKEF400	4.00	8.00	60	40	3.70	20.00	24.0	0.014	0.038	0.060	[0.520mm² (20)]
NEW	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)]

RoHS Compliant, ELV Compliant

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

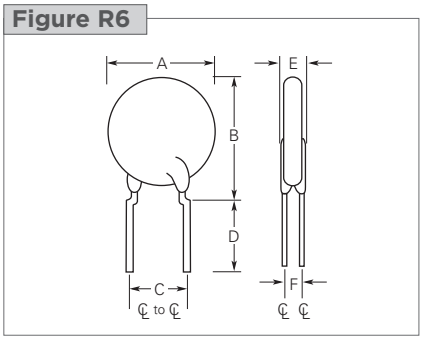


Figure R7

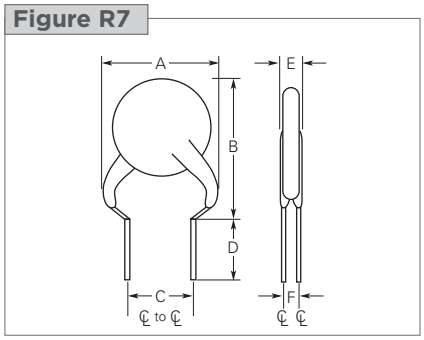


Figure R8

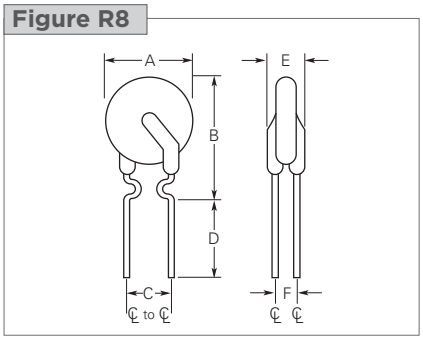


Figure R9

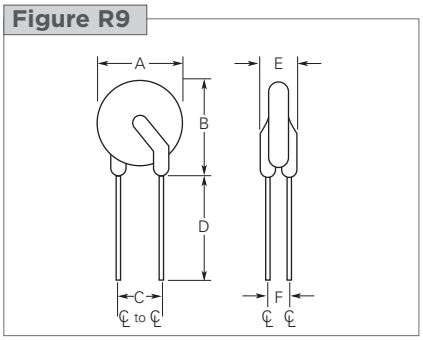


Figure R10

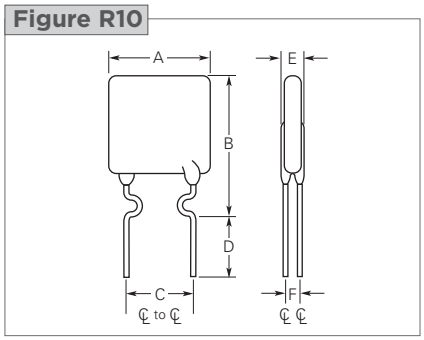


Figure R11

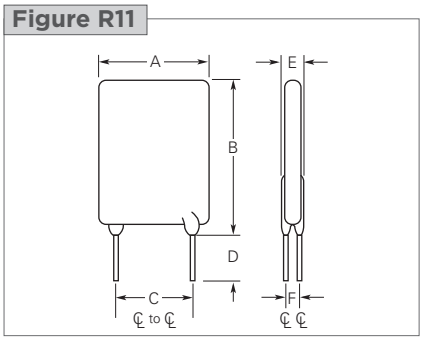


Figure R6-R14 Dimension Figures for Radial-leaded Devices

Figure R12

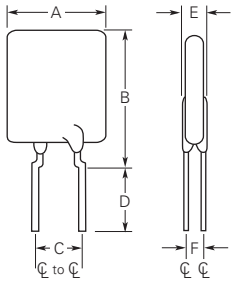


Figure R13

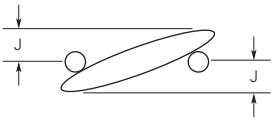


Figure R14

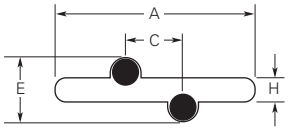


Table R4 Dimensions for Radial-leaded Devices in Millimeters (Inches)

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														
NEW	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
NEW	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
NEW	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
NEW	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
NEW	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
NEW	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
NEW	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
NEW	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
NEW	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
NEW	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
NEW	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
NEW	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
NEW	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

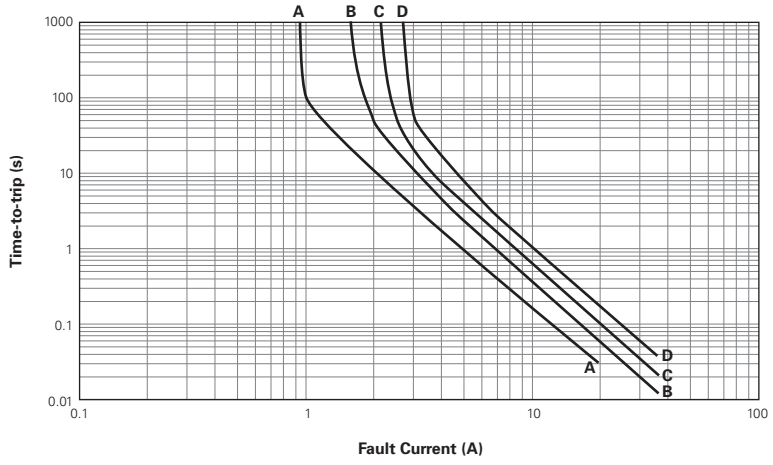
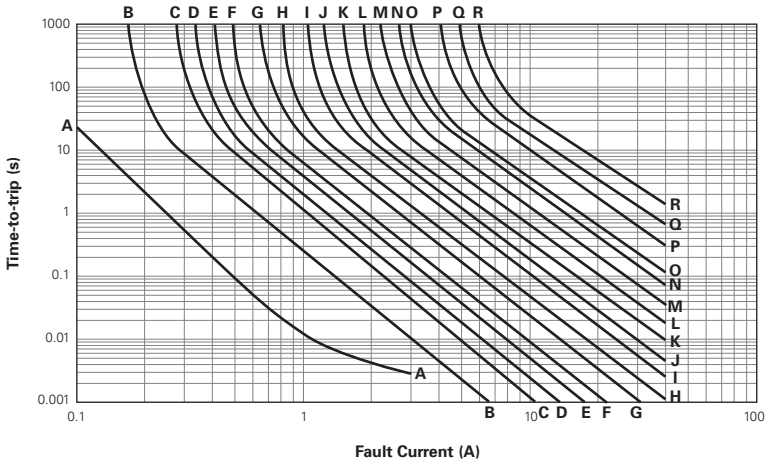


Figure R15-R21 Typical Time-to-trip Curves at 20°C for Radial-leaded Devices ... Cont'd

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

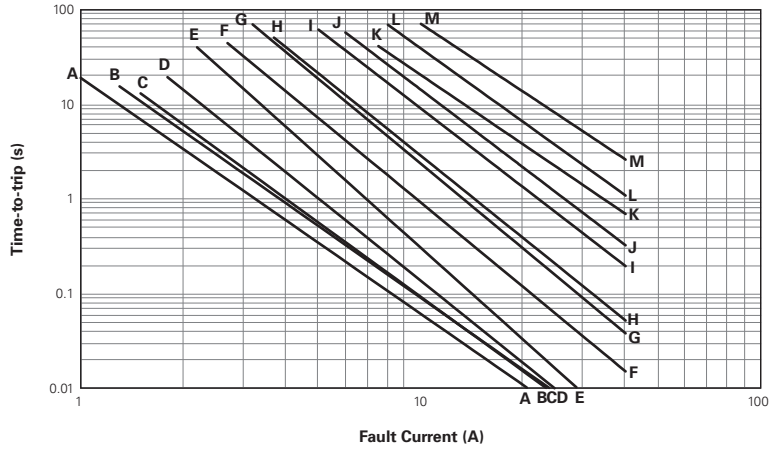
Figure R16



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			

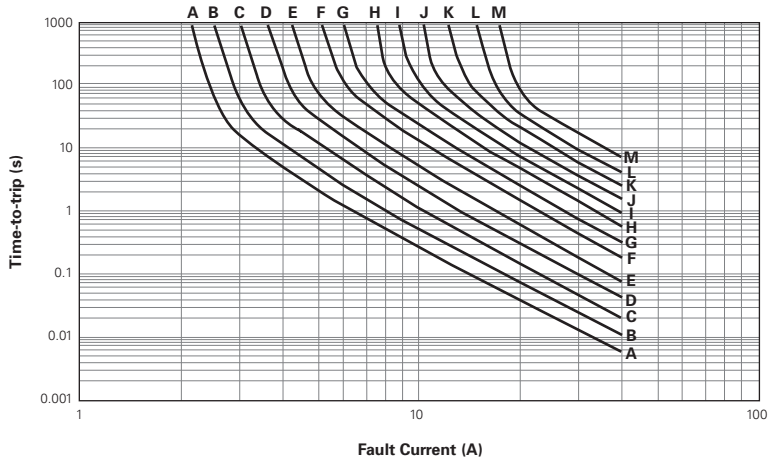
Figure R17



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



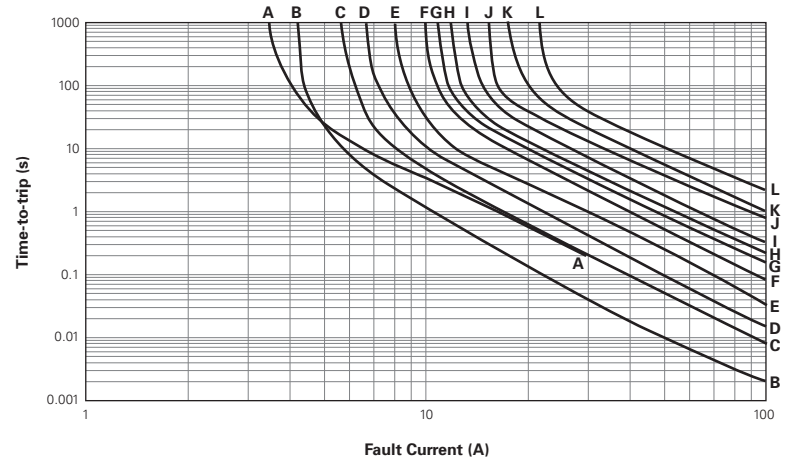
RoHS Compliant, ELV Compliant

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

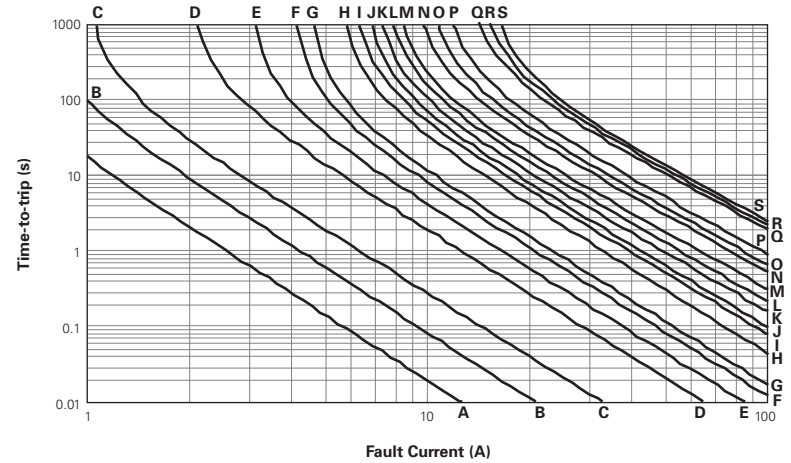
Figure R19



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

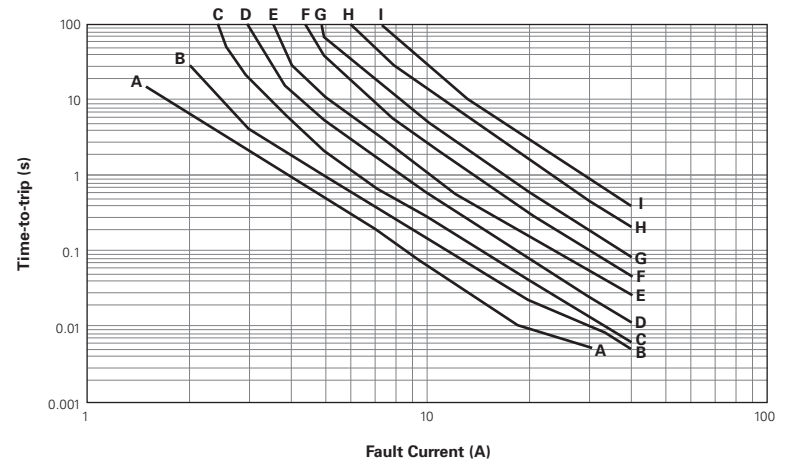


Table R5 Physical Characteristics and Environmental Specifications for Radial-leaded Devices

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

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	RXEF017- 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	

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	

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

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

RTEF

Physical Characteristics

Lead material	Tin-plated copper-clad steel, 0.205mm² (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

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, 0.205mm² (24AWG)
	RUEF300 to RUEF900: Tin-plated copper, 0.52mm² (20AWG), ø0.81mm (0.032in.)
Soldering characteristics	Solderability per ANSI/J-STD-002 Category 3
Solder heat withstand	per IEC-STD 68-2-20, Test Tb, Method1A, Condition B, can withstand 10 seconds at 260°C ±5°C
Insulating material	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	±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, 0.205mm² (24AWG), ø0.51mm/0.020in.
	RUSBF090 to RUSBF250: Tin-plated copper clad-steel, 0.205mm² (24AWG), ø0.51mm/0.020in.
Soldering characteristics	Solderability per ANSI/J-STD-002 Category 3 except
	RUSBF075 meet ANSI/J-STD-002 Category 1
Solder heat withstand	RUSBF120: per IEC-STD 68-2-20, Test Tb, Method 1A, Condition A; can withstand 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

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

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

RGEF

Physical Characteristics

Lead material	RGEF300 to RGEF1100 : Tin-plated copper, 0.52mm² (20AWG), ø0.81mm/0.032in.
	RGEF1200 to RGEF1400 : Tin-plated copper, 0.82mm² (18AWG), ø1.0mm/0.04in.
Soldering characteristics	Solderability per ANSI/J-STD-002 Category 3
Solder heat withstand	RGEF300 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

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, 0.205mm² (24AWG), ø0.51mm/0.020in.
	RHEF300 to RHEF1100 : Tin-plated copper, 0.52mm² (20AWG), ø0.81mm/0.032in.
	RHEF1300 to RHEF1500 : Tin-plated copper, 0.82mm² (18AWG), ø1.0mm/0.04in.
Soldering characteristics	Solderability per ANSI/J-STD-002 Category 3
Solder heat withstand	per IEC 68-2-20, Test Tb, Method 1A, Condition B; can withstand 10 seconds at 260°C ±5°C
Insulating material	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	±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

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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.

Agency Recognitions for Radial-leaded Devices

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

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						
NEW	RKEF050	500	—	—	10,000	KF050	UL, CSA, TÜV
NEW	RKEF065	500	—	—	10,000	KF065	UL, CSA, TÜV
NEW	RKEF075	500	—	—	10,000	KF075	UL, CSA, TÜV
NEW	RKEF090	500	—	—	10,000	KF090	UL, CSA, TÜV
NEW	RKEF110	500	—	—	10,000	KF110	UL, CSA, TÜV
NEW	RKEF135	500	—	—	10,000	KF135	UL, CSA, TÜV
NEW	RKEF160	500	—	—	10,000	KF160	UL, CSA, TÜV
NEW	RKEF185	500	—	—	10,000	KF185	UL, CSA, TÜV
NEW	RKEF250	500	—	—	10,000	KF250	UL, CSA, TÜV
NEW	RKEF300	250	—	—	5,000	KF300	UL, CSA, TÜV
NEW	RKEF375	250	—	—	5,000	KF375	UL, CSA, TÜV
NEW	RKEF400	250	—	—	5,000	KF400	UL, CSA, TÜV
NEW	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

RoHS Compliant, ELV Compliant

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	—	—	2,500	12,500	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

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	5.08	+0.75/-0.5
Lead spacing* RXEF250 to RXEF300, RKEF375 to RKEF500	F	10.2	+0.75/-0.5
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	5.08	+0.75/-0.5
Lead spacing* RUEF500 to RUEF900	F	10.2	+0.75/-0.5
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	I_2	Not specified	—
Sprocket hole pitch	P_0	12.7	± 0.3
Device pitch RGEF250 to RGEF700, RHEF050 to RHEF600	—	25.4	± 0.61
Device pitch RGEF800 to RGEF1400, RHEF650 to RHEF1500	—	25.4	± 0.6
Pitch tolerance	—	20 consecutive	± 1
Tape thickness	t	0.9	Maximum
Overall tape and lead thickness* RGEF250 to RGEF1100, RHEF050 to RHEF1100	t_1	2.0	Maximum
Overall tape and lead thickness* RGEF1200 to RGEF1400, RHEF1300 to RHEF1500	t_1	2.3	Maximum
Splice sprocket hole alignment	—	0	± 0.3
Body lateral deviation	Δh	0	± 1.0
Body tape plane deviation	Δp	0	± 1.3
Ordinate to adjacent component lead RGEF250 to RGEF1100, RHEF050 to RHEF900	P_1	3.81	± 0.7
Ordinate to adjacent component lead RGEF1200 to RGEF1400, RHEF1000 to RHEF1500	P_1	7.62	± 0.7
Lead spacing* RGEF250 to RGEF1100, RHEF050 to RHEF900	F	5.08	+0.75 /-0.5
Lead spacing* RGEF1200 to RGEF1400, RHEF1000 to RHEF1500	F	10.2	+ 0.75/-0.5
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

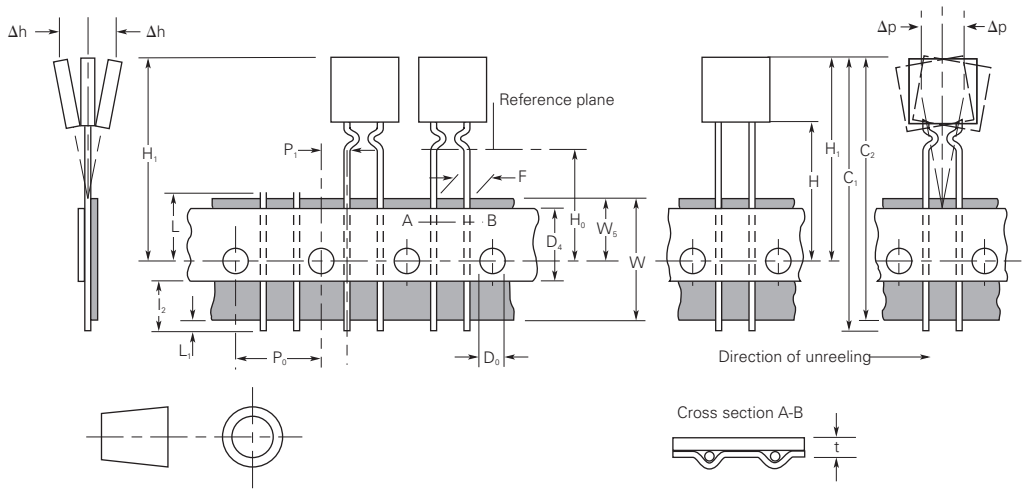
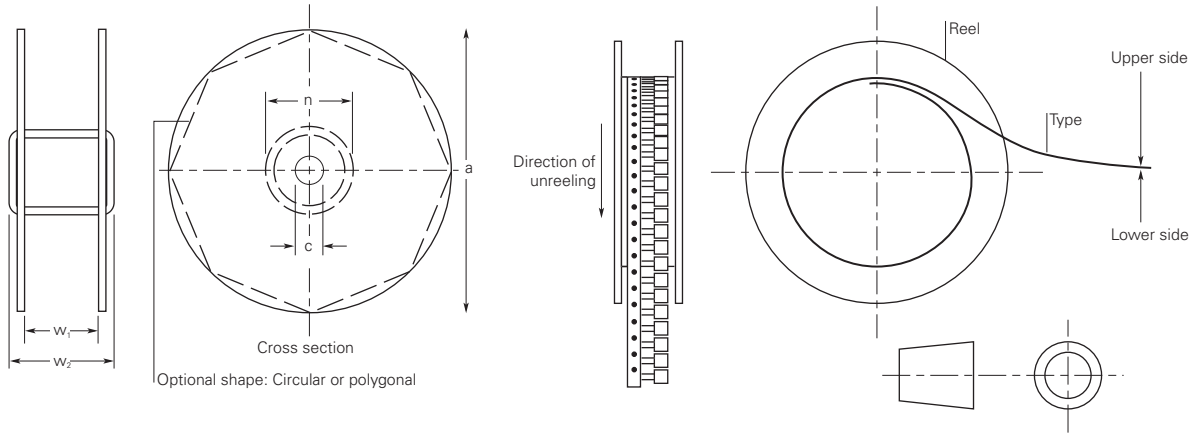


Figure R23 EIA Referenced Reel Dimensions for Radial-leaded Devices



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

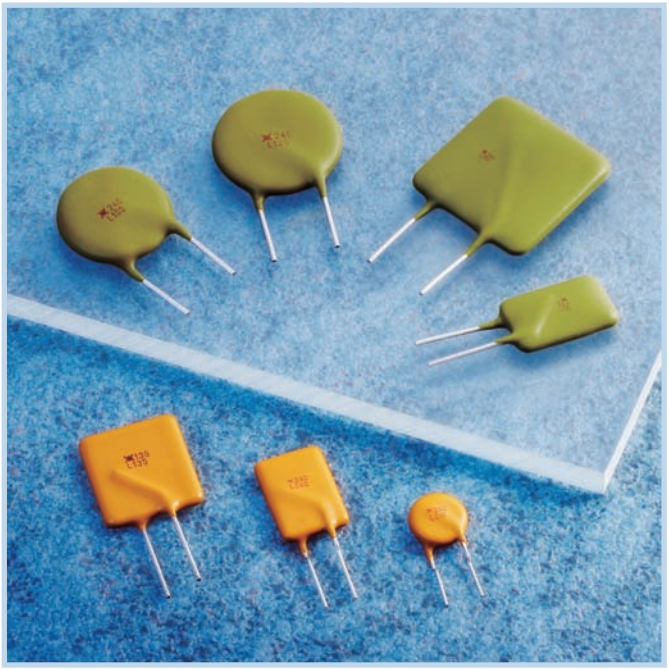
Product Series
An "F" at the end of product series indicates Pb-free version of product.

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

⚠ Warning :

- 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 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	0.431Ω

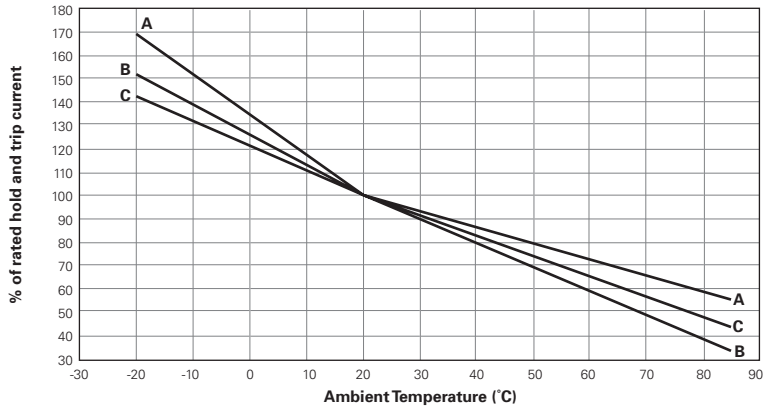
Table L2 Thermal Derating for LVR Devices [Hold Current (A) at Ambient Temperature (°C)]

		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									
NEW	LVR005N	0.08	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02
NEW	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
NEW	LVR075	1.23	0.98	0.75	0.74	0.60	0.56	0.49	0.45	0.41
NEW	LVR100	1.65	1.30	1.00	0.94	0.80	0.75	0.65	0.60	0.55
NEW	LVR125	1.55	1.63	1.25	1.20	1.00	0.94	0.81	0.75	0.69
NEW	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												
NEW	LVR005NK	0.05	0.12	240 120	265 135	1.0 20.0	0.9	0.25	10.0	18.500	31.000	65.000	[0.51mm(24)]
NEW	LVR005NS	0.05	0.12	240 120	265 135	1.0 20.0	0.9	0.25	10.0	18.500	31.000	65.000	[0.51mm(24)]
NEW	LVR008NK	0.08	0.19	240 120	265 135	1.2 20.0	0.9	0.40	10.0	7.400	12.000	26.000	[0.51mm(24)]
NEW	LVR008NS	0.08	0.19	240 120	265 135	1.2 20.0	0.9	0.40	10.0	7.400	12.000	26.000	[0.51mm(24)]
	LVR012K	0.12	0.30	240 120	265 135	1.2 20.0	1.0	0.60	15.0	3.000	6.500	12.000	[0.51mm(24)]
	LVR012S	0.12	0.30	240 120	265 135	1.2 20.0	1.0	0.60	15.0	3.000	6.500	12.000	[0.51mm(24)]
	LVR016K	0.16	0.37	240 120	265 135	2.0 20.0	1.4	0.80	15.0	2.500	4.100	7.800	[0.51mm(24)]
	LVR016S	0.16	0.37	240 120	265 135	2.0 20.0	1.4	0.80	15.0	2.500	4.100	7.800	[0.51mm(24)]
	LVR025K	0.25	0.56	240 120	265 135	3.5 20.0	1.5	1.25	18.5	1.300	2.100	3.800	[0.64mm(22)]
	LVR025S	0.25	0.56	240 120	265 135	3.5 20.0	1.5	1.25	18.5	1.300	2.100	3.800	[0.64mm(22)]
	LVR033K	0.33	0.74	240 120	265 135	4.5 20.0	1.7	1.65	21.0	0.770	1.240	2.600	[0.64mm(22)]
	LVR033S	0.33	0.74	240 120	265 135	4.5 20.0	1.7	1.65	21.0	0.770	1.240	2.600	[0.64mm(22)]
	LVR040K	0.40	0.90	240 120	265 135	5.5 20.0	2.0	2.00	24.0	0.600	0.970	1.900	[0.64mm(22)]
	LVR040S	0.40	0.90	240 120	265 135	5.5 20.0	2.0	2.00	24.0	0.600	0.970	1.900	[0.64mm(22)]
	LVR055K	0.55	1.25	240 120	265 135	7.0 20.0	3.4	2.75	26.0	0.450	0.730	1.450	[0.81mm(20)]
	LVR055S	0.55	1.25	240 120	265 135	7.0 20.0	3.4	2.75	26.0	0.450	0.730	1.450	[0.81mm(20)]
NEW	LVR075S	0.75	1.50	240	265	7.5	2.6	3.75	18.0	0.316	0.483	0.839	[0.81mm(20)]
NEW	LVR100S	1.00	2.00	240	265	10.0	2.9	5.00	21.0	0.218	0.334	0.580	[0.81mm(20)]
NEW	LVR125S	1.25	2.50	240	265	12.5	3.3	6.25	23.0	0.165	0.253	0.440	[0.81mm(20)]
NEW	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

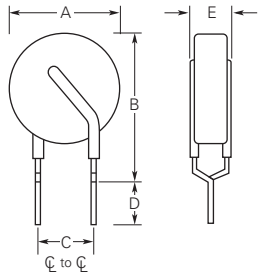


Figure L3

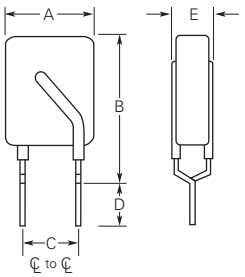


Figure L4

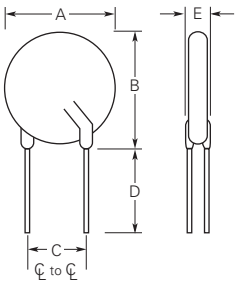
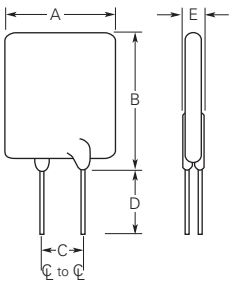


Figure L5



RoHS Compliant, ELV Compliant

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

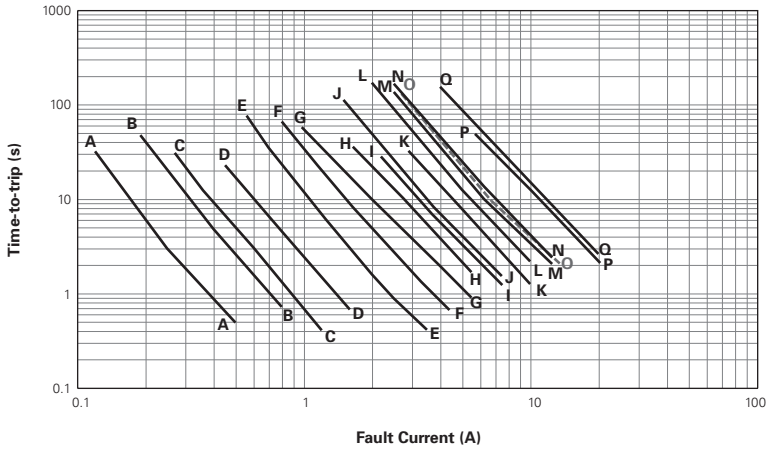


Table L5 Physical Characteristics and Environmental Specifications for LVR Devices

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

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Agency Recognitions for LVR Devices

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

RoHS Compliant, ELV Compliant

Table L6 Packaging and Marking Information for LVR Devices ... Cont'd

	Part Number	Bag Quantity	Tape & Reel Quantity	Ammo Pack Quantity	Standard Package Quantity	Part Marking	Agency Recognition
	LVR/LVRL						
NEW	LVR005NK	500	—	—	10,000	L005	UL,CSA, TÜV
NEW	LVR005NK-2	—	1,500	—	7,500	L005	UL,CSA, TÜV
NEW	LVR005NS	500	—	—	10,000	L005	UL,CSA, TÜV
NEW	LVR005NS-2	—	1,500	—	7,500	L005	UL,CSA, TÜV
NEW	LVR008NK	500	—	—	10,000	L008	UL,(CSA, TÜV pending)
NEW	LVR008NK-2	—	1,500	—	7,500	L008	UL,(CSA, TÜV pending)
NEW	LVR008NS	500	—	—	10,000	L008	UL,(CSA, TÜV pending)
NEW	LVR008NS-2	—	1,500	—	7,500	L008	UL,(CSA, TÜV pending)
	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
NEW	LVR075S	500	—	—	10,000	L075	UL,CSA, TÜV
NEW	LVR100S	250	—	—	5,000	L100	UL,CSA, TÜV
NEW	LVR125S	250	—	—	5,000	L125	UL,CSA, TÜV
NEW	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

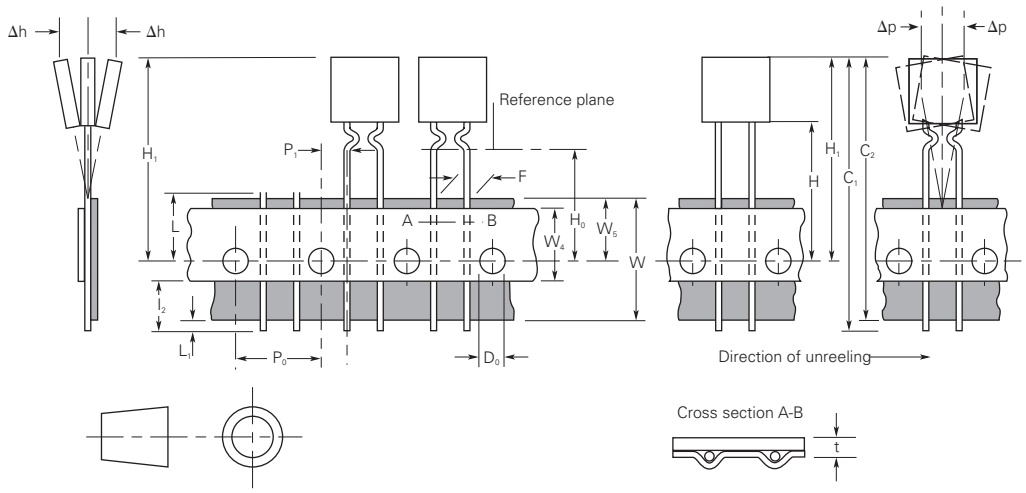
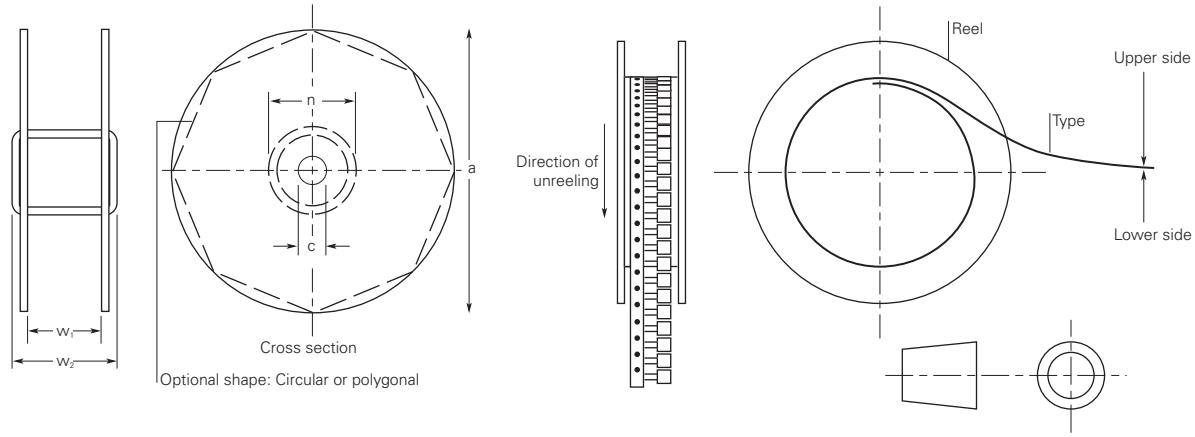


Figure L8 EIA Referenced Reel Dimensions for LVR Devices



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 and AGRF). 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 the Raychem 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
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	—	—	—	—	—	—
9.00	0.0070Ω	0.0100Ω	—	—	—	—	—	—
10.00	0.0056Ω	0.0083Ω	—	0.0083Ω	—	—	—	—
11.00	0.0050Ω	0.0069Ω	—	—	—	—	—	—
12.00	0.0046Ω	—	—	—	—	—	—	—
13.00	—	0.0055Ω	—	—	—	—	—	—
14.00	0.0040Ω	0.0050Ω	—	—	—	—	—	—
15.00	—	0.0050Ω	—	—	—	—	—	—

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	—
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

RoHS Compliant, ELV Compliant

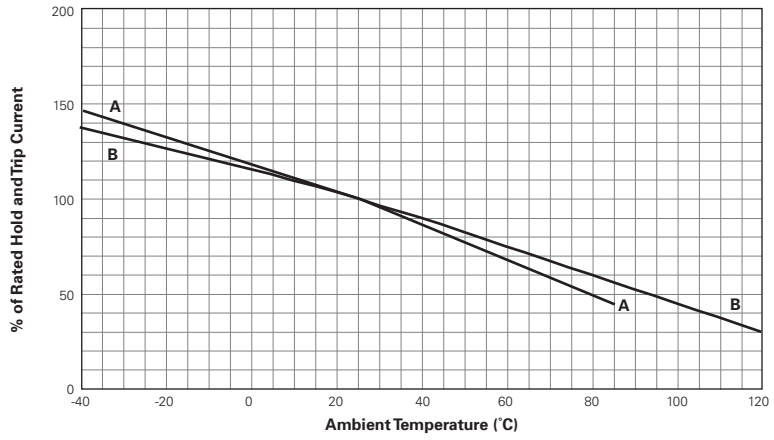
Table A2 Thermal Derating for Automotive Devices [Hold Current (A) at Ambient Temperature (°C)] ... Cont'd

		Maximum Ambient Temperature										
	Part Number	-40°C	-20°C	0°C	20°C	25°C	40°C	50°C	60°C	70°C	85°C	125°C
	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											
NEW	AHEF050	0.7	0.6	0.60	0.5	0.5	0.4	0.400	0.40	0.30	0.300	0.1
NEW	AHEF070	1.0	0.9	0.80	0.7	0.7	0.6	0.600	0.50	0.50	0.400	0.2
NEW	AHEF100	1.4	1.2	1.10	1.0	1.0	0.9	0.800	0.70	0.70	0.600	0.2
NEW	AHEF300	4.1	3.8	3.42	3.1	3.0	2.7	2.430	2.22	1.98	1.650	0.6
NEW	AHEF500	6.8	6.3	5.70	5.2	5.0	4.5	4.050	3.70	3.30	2.750	1.0
NEW	AHEF750	10.2	9.4	8.55	7.7	7.5	6.7	6.075	5.55	4.95	4.125	1.5
NEW	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
NEW	AHS200	2.90	2.50	2.20	2.00	1.94	1.80	1.75	1.70	1.40	1.18	0.67
NEW	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	—

Figure A1-A3 Thermal Derating Curves for Automotive Devices

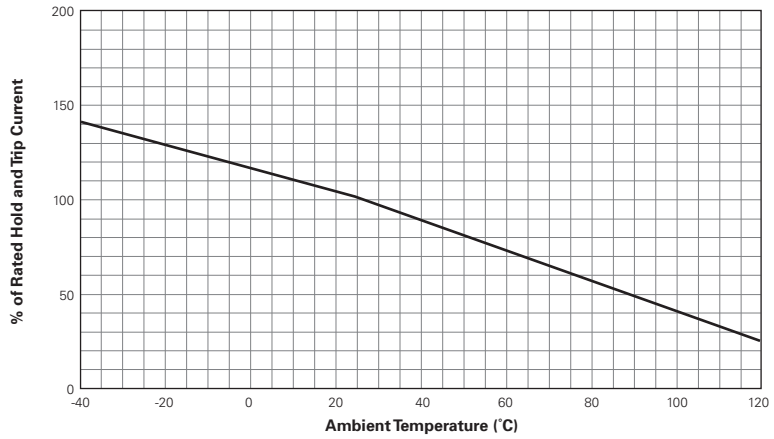
A = AGRF
B = AHRF

Figure A1



AHEF

Figure A2



A = ASMD
B = AHS

Figure A3

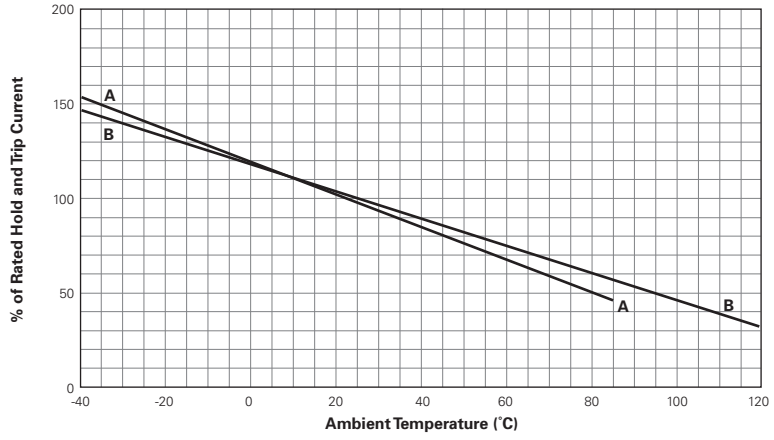


Table A3 Electrical Characteristics for Automotive Devices

	Part Number	I_H(A)@ R_{1MAX}	I_H(A)@ R_{aMAX}	I_T (A)	V_{MAX} (V_{DC})	I_{MAX} (A)	P_{DTyp} (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	A4, A7, A8
	AGRF500	5.0	4.3	9.4	16	100	2.7	25.0	2.5	0.0140	0.0340	0.0480	A4, A7, A8
	AGRF600	6.0	5.3	10.7	16	100	2.8	30.0	3.5	0.0095	0.0280	0.0320	A4, A7, A8
	AGRF700	7.0	6.5	13.2	16	100	3.0	35.0	4.0	0.0066	0.0200	0.0220	A4, A7, A8
	AGRF800	8.0	7.6	15.0	16	100	3.2	40.0	5.5	0.0049	0.0175	0.0181	A4, A7, A8
	AGRF900	9.0	8.6	16.5	16	100	3.4	45.0	6.0	0.0041	0.0135	0.0140	A4, A7, A8
	AGRF1000	10.0	9.6	18.5	16	100	3.6	50.0	7.0	0.0034	0.0102	0.0106	A4, A7, A8
	AGRF1100	11.0	10.5	20.3	16	100	3.7	55.0	7.5	0.0033	0.0089	0.0093	A4, A7, A8
	AGRF1200	12.0	11.5	22.1	16	100	4.2	60.0	8.0	0.0030	0.0086	0.0091	A4, A7, A8
	AGRF1400	14.0	13.0	27.3	16	100	4.6	70.0	9.0	0.0022	0.0064	0.0067	A4, A7, A8
	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	A7, A8, A9
	AHRF070	0.7	0.7	1.4	30	40	1.4	3.5	3.2	0.2300	0.800	0.800	A4, A7, A8
	AHRF100	1.0	1.0	1.9	30	40	1.4	5.0	6.2	0.1500	0.430	0.430	A7, A8, A9
	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	A7, A8, A9
	AHRF300	3.0	3.0	6.5	16	100	3.0	15.0	5.0	0.0290	0.079	0.079	A4, A7, A8
	AHRF400	4.0	4.0	7.4	16	100	3.3	20.0	5.0	0.0210	0.060	0.060	A4, A7, A8
	AHRF450	4.5	4.5	8.7	16	100	3.6	22.5	4.0	0.0170	0.054	0.054	A4, A7, A8
	AHRF550	5.5	5.5	10.0	16	100	3.5	27.5	6.0	0.0130	0.037	0.037	A4, A7, A8
	AHRF600	6.0	6.0	12.0	16	100	4.1	30.0	6.5	0.0100	0.032	0.032	A4, A7, A8
	AHRF650	6.5	6.5	13.7	16	100	4.3	32.5	7.0	0.0090	0.026	0.026	A4, A7, A8
	AHRF700	7.0	7.0	13.1	16	100	4.0	35.0	7.0	0.0087	0.025	0.025	A4, A7, A8
	AHRF750	7.5	7.5	14.8	16	100	4.5	37.5	8.0	0.0074	0.022	0.022	A4, A7, A8
	AHRF800	8.0	8.0	15.0	16	100	4.2	40.0	8.0	0.0072	0.020	0.020	A4, A7, A8
	AHRF900	9.0	9.0	18.5	16	100	5.0	45.0	11.5	0.0061	0.017	0.017	A4, A7, A8
	AHRF1000	10.0	10.0	20.5	16	100	5.3	50.0	10.5	0.0051	0.015	0.015	A4, A7, A8
	AHRF1100	11.0	11.0	21.2	16	100	5.5	55.0	11.0	0.0048	0.013	0.013	A4, A7, A8
	AHRF1300	13.0	13.0	27.0	16	100	6.9	65.0	15.0	0.0034	0.010	0.010	A4, A7, A8
	AHRF1400	14.0	14.0	28.3	16	100	6.9	70.0	15.5	0.0029	0.009	0.009	A4, A7, A8
	AHRF1500	15.0	15.0	33.0	16	100	7.0	75.0	20.0	0.0027	0.0092	0.0092	A4, A7, A8
	AHEF (High Temperature) 32V — Radial-leaded												
NEW	AHEF050	0.5	0.5	1.0	32	100	0.9	2.5	3.0	0.3500	1.100	1.100	A7, A8, A9
NEW	AHEF070	0.7	0.7	1.4	32	100	0.9	3.5	3.2	0.2300	0.800	0.800	A7, A8, A10
NEW	AHEF100	1.0	1.0	1.9	32	100	1.4	5.0	6.2	0.1500	0.430	0.430	A7, A8, A9
NEW	AHEF300	3.0	3.0	6.0	32	100	3.2	15.0	5.0	0.0350	0.110	0.110	A7, A8, A11
NEW	AHEF500	5.0	5.0	10.0	32	100	5.3	25.0	9.0	0.0150	0.040	0.040	A7, A8, A11
NEW	AHEF750	7.5	7.5	15.0	32	100	6.5	37.5	13.0	0.0074	0.023	0.023	A7, A8, A11
NEW	AHEF1000	10.0	10.0	20.0	32	100	7.0	50.0	15.0	0.0060	0.016	0.016	A7, A8, A11
	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	A5
	AHS160	1.60	1.60	3.20	16	70	2.2	8.0	15.0	0.050	0.150	0.150	A6
NEW	AHS200	2.00	2.00	4.00	16	70	2.3	8.0	13.4	0.050	0.140	0.140	A6
NEW	AHS300	3.00	3.00	6.00	16	70	3.0	15.0	8.0	0.024	0.083	0.083	A6

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_{DTyp} (W)	Max. Time-to-trip (A)	Max. Time-to-trip (s)	R_{MIN} (Ω)	R_{1MAX} (Ω)	R_{aMAX} (Ω)	Figure for Dimensions
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	A6
ASMD050F	0.37	0.37	0.98	60	10	1.7	1.95	20.0	0.290	1.400	1.400	A6
ASMD075F	0.60	0.60	1.48	30	40	1.1	3.00	20.0	0.290	1.000	1.000	A6
ASMD100F	0.90	0.90	2.16	30	40	1.1	4.50	20.0	0.098	0.480	0.480	A6
ASMD125F	1.04	1.04	2.46	16	40	1.1	5.20	20.0	0.057	0.250	0.250	A6
ASMD150F	1.27	1.27	2.95	16	40	1.2	6.35	25.0	0.049	0.250	0.250	A6
ASMD200F	1.73	1.73	3.93	16	40	1.2	8.65	30.0	0.050	0.120	0.120	A6
ASMD250F	1.97	1.97	5.00	16	40	1.2	9.85	30.0	0.035	0.085	0.085	A6

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 A4-A11 Dimension Figures for Automotive Devices

Figure A4

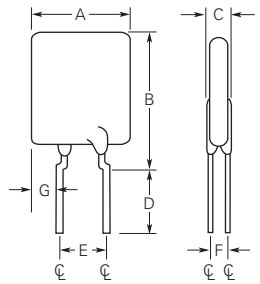


Figure A5

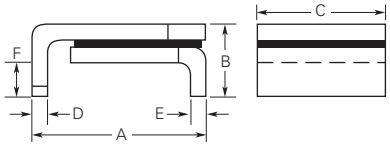


Figure A6

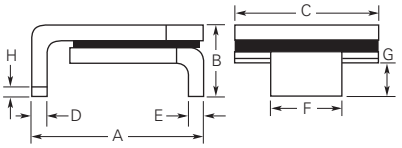


Figure A7

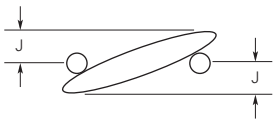


Figure A8

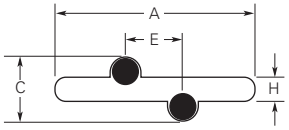


Figure A9

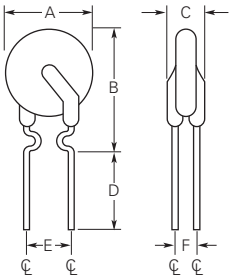


Figure A10

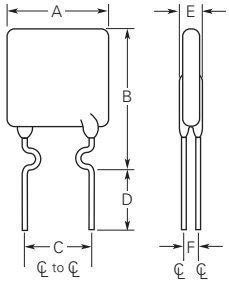
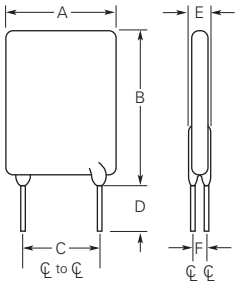


Figure A11



RoHS Compliant, ELV Compliant

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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A7, A8, A9
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)	A4, A7, A8
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)	A7, A8, A9
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)	A7, A8, A9
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8
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)	—	—	—	—	—	A4, A7, A8
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)	A4, A7, A8
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)	A4, A7, A8

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)	A4, A7, A8
	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)	A4, A7, A8
	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)	—	—	A4, A7, A8
	AHEF (High Temperature) 32V — Radial-leaded																	
NEW	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)	—	—	—	—	—	—	A7, A8, A9
NEW	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)	—	—	—	—	—	—	A7, A8, A10
NEW	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)	—	—	—	—	—	—	A7, A8, A9
NEW	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)	—	—	—	—	—	—	A7, A8, A11
NEW	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)	—	—	—	—	—	—	A7, A8, A11
NEW	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)	—	—	—	—	—	—	A7, A8, A11
NEW	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)	—	—	—	—	—	—	A7, A8, A11

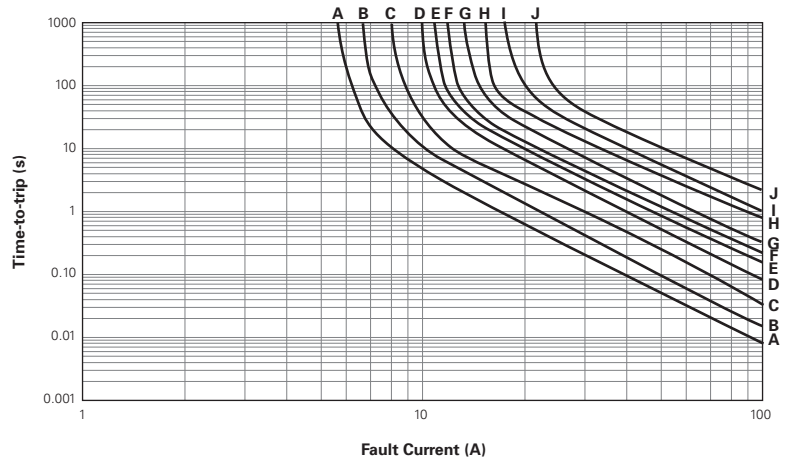
	Part Number	A Min.	A Max.	B Min.	B Max.	C Min.	C Max.	D Min.	D Max.	E Min.	E Max.	F Min.	F Max.	G Min.	G Max.	H Min.	H Max.	Figure
	AHS (High Temperature) 16V — Surface-mount																	
	AHS080-2018	4.72 (0.186)	5.44 (0.214)	—	1.52 (0.060)	4.22 (0.166)	4.93 (0.194)	0.25 (0.010)	0.36 (0.014)	0.25 (0.010)	0.36 (0.014)	0.30 (0.012)	0.46 (0.018)	—	—	—	—	A5
	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)	—	A6
NEW	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)	—	A6
NEW	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)	—	A6
	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)	—	A6
	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)	—	A6
	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)	—	A6
	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)	—	A6
	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)	—	A6
	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)	—	A6
	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)	—	A6
	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)	—	A6

Figure A12-A16 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

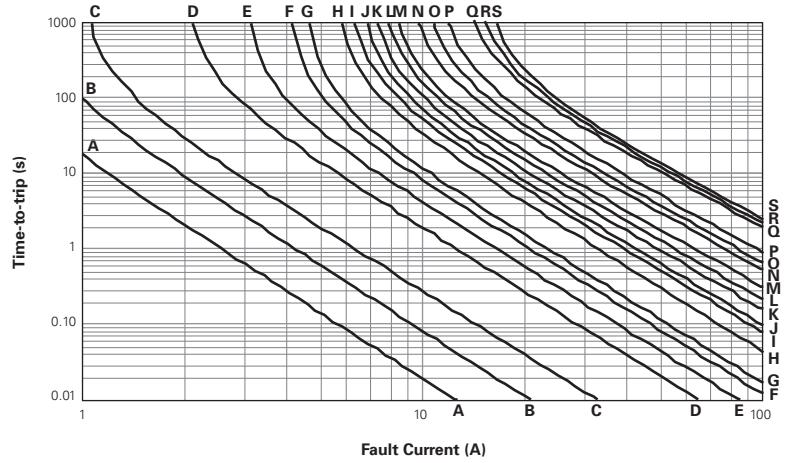
Figure A12



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 A13



AHEF

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

Figure A14

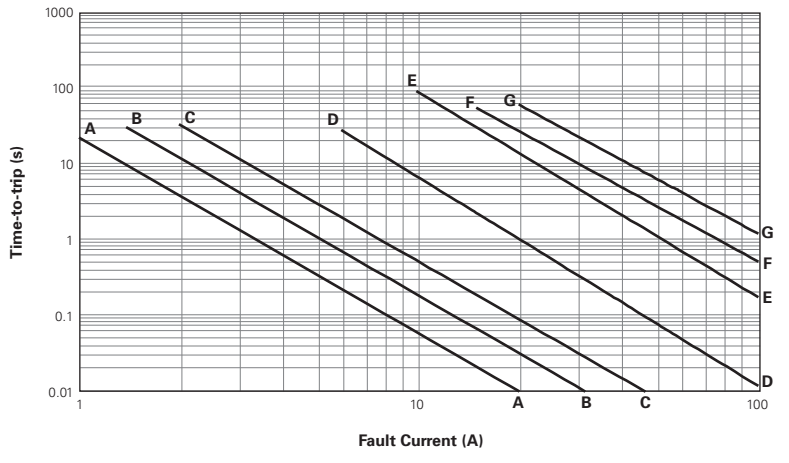
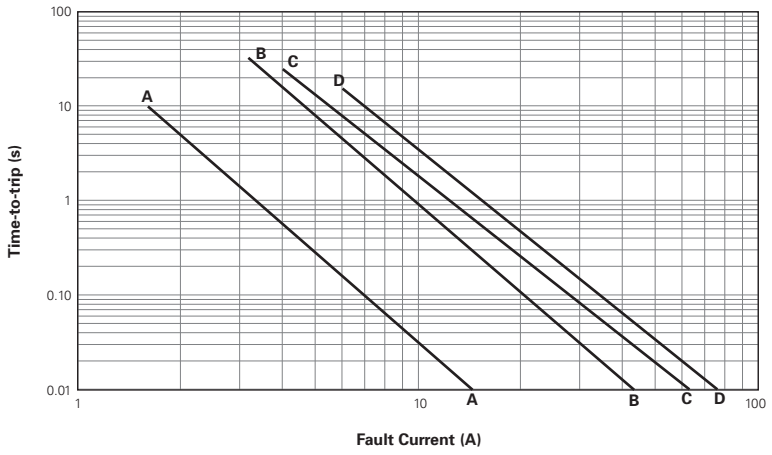


Figure A12-A16 Typical Time-to-trip at 25°C for Automotive Devices ... Cont'd

AHS

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

Figure A15



ASMD

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

Figure A16

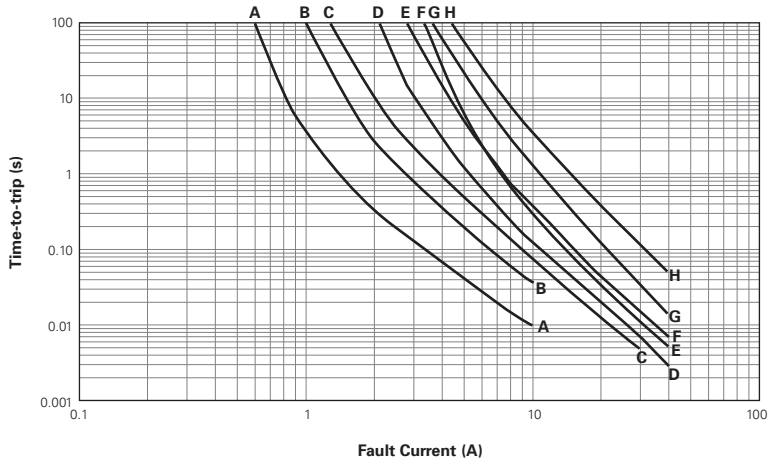


Table A5 Physical Characteristics and Environmental Specifications for Automotive Devices

AGRF

Physical Characteristics

Lead material	AGRF400 to AGRF1100 : Tin Plated Copper, 0.52mm² (20AWG) ø 0.8 mm/0.032in
	AGRF1200 to AGRF1400 : Tin Plated Copper, 0.82mm² (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

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.

RoHS Compliant, ELV Compliant

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, 0.205mm² (24 AWG), ø 0.51mm/0.020in AHRF300 to AHRF1100 : Tin-plated copper 0.52mm² (20 AWG), ø 0.81mm/0.032 in AHRF1300 to AHRF1500 : Tin-plated copper 0.82mm² (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

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, 0.205mm² (24 AWG), ø 0.51mm/0.020in. AHEF300 to AHEF750 : Tin-plated Copper 0.52mm² (20 AWG), ø 0.81mm/0.032in AHEF1000 : Tin-plated copper 0.82mm² (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

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

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

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.

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	*

* 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.

RoHS Compliant, ELV Compliant

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						
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	*
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	*

* 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						
	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						
NEW	AHEF050	500	—	—	10,000	EF0.5	*
NEW	AHEF070	500	—	—	10,000	EF0.7	*
NEW	AHEF100	500	—	—	10,000	EF1.0	*
NEW	AHEF300	500	—	—	10,000	EF3	*
NEW	AHEF500	250	—	—	5,000	EF5	*
NEW	AHEF750	250	—	—	5,000	EF7.5	*
NEW	AHEF1000	250	—	—	5,000	EF10	*

					Recommended Pad Layouts [mm(in) See Figure A17]			
	Part Number	Tape & Reel Quantity	Standard Package Quantity	Part Marking	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 (0.09)	3.4 (0.134)	*
	AHS160	1,500	7,500	160	4.6 (0.18)	2.3 (0.09)	6.1 (0.240)	*
NEW	AHS200	1,500	7,500	H200	4.6 (0.18)	2.3 (0.09)	6.1 (0.240)	*
NEW	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.

Figure A17 Recommended Pad Layout for Automotive Devices

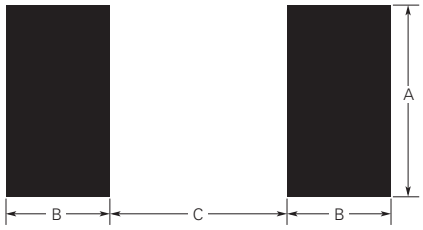


Table A7 Tape and Reel Specifications for AGRF/AHRF/AHEF Automotive Devices

AGRF, AHRF and AHEF devices are available in tape and reel packaging per EIA468-B/IEC286-2 and EIA 481-2 standards. See Figures A18 and A19 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	5.08	±0.75/-0.5
Lead spacing AGRF1200 to AGRF1400, AHRF1000 to AHRF1500*, AHEF750 to AHEF1000	F	10.2	±0.75/-0.5
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 A18 EIA Referenced Taped Component Dimensions for AGRF/AHRF/AHEF Automotive Devices

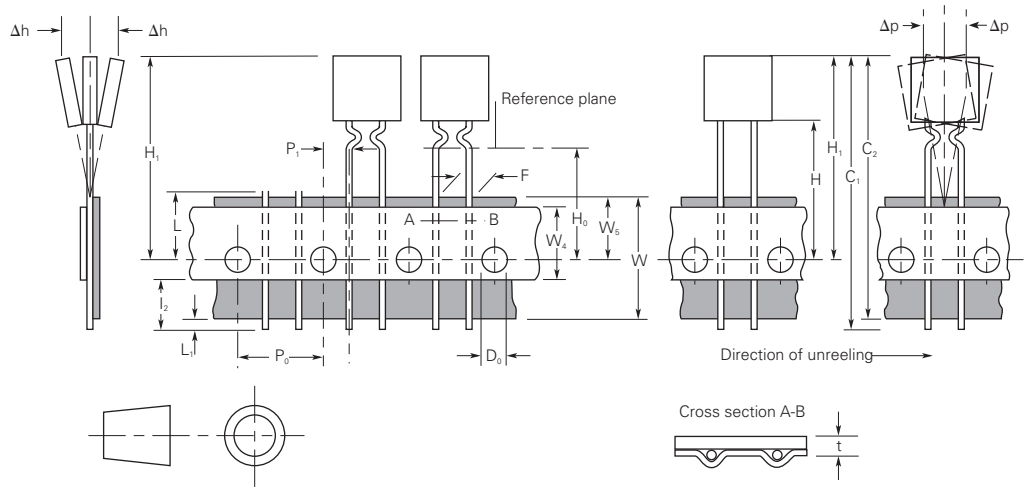


Figure A19 EIA Referenced Reel Dimensions for AGRF/AHRF/AHEF Automotive Devices

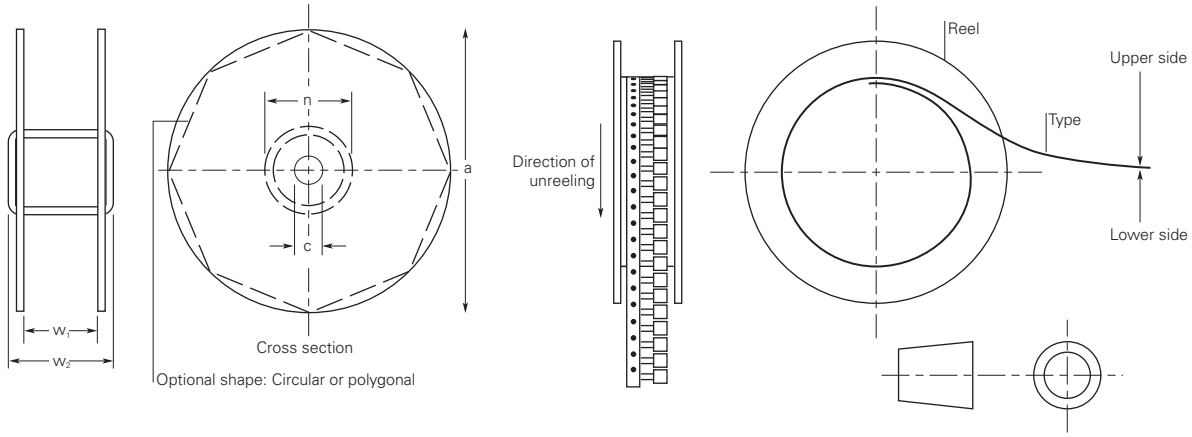


Table A8 Tape and Reel Specifications for AHS/ASMD Automotive Devices

AHS and ASMD devices are available in tape and reel packaging per EIA 468-2 standards. See Figures A20 and A21 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 A20 EIA Referenced Taped Component Dimensions for AHS/ASMD Devices

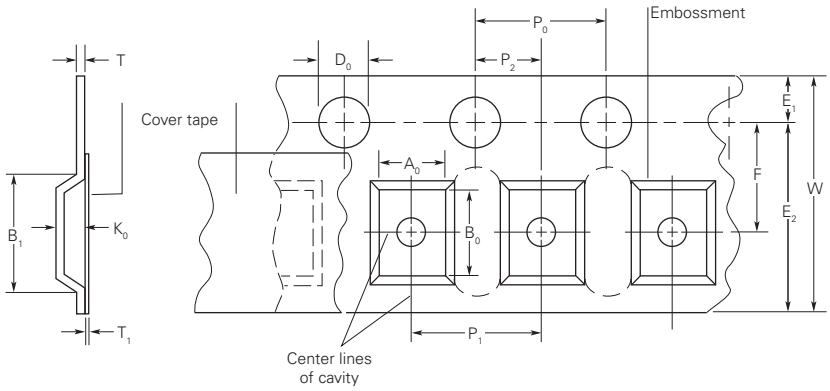
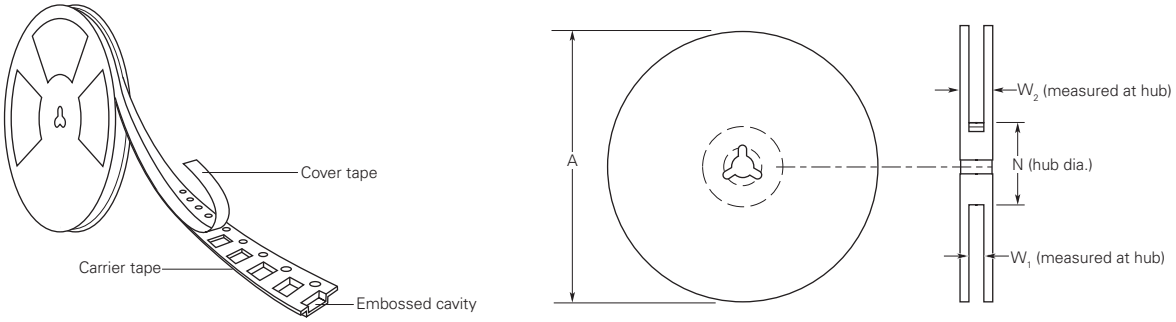
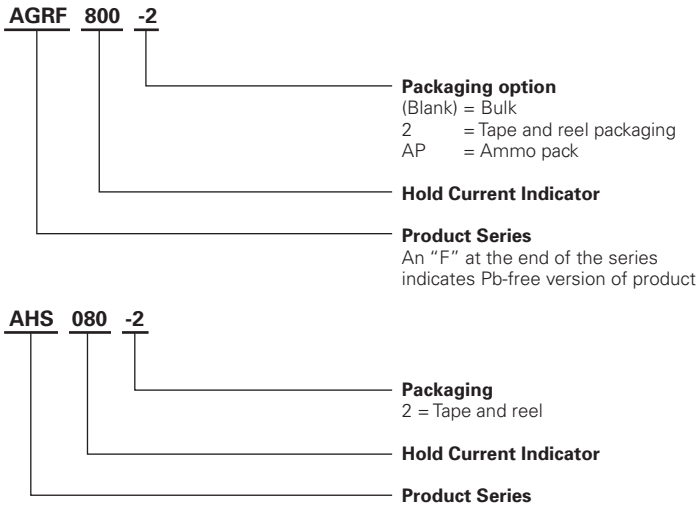


Figure A21 EIA Referenced Reel Dimensions for AHS/ASMD Devices



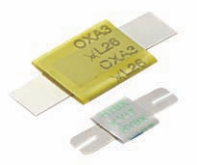
Part Numbering System for Automotive Devices



⚠ Warning :

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

RoHS Compliant, ELV Compliant



PolySwitch Resettable Devices
Strap Battery Devices

Tyco Electronics, a pioneer of polymeric positive temperature coefficient resettable devices, has developed several material platforms specifically tailored 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)

Protection Application Selection Guide for Strap Battery Devices

The guide below lists PolySwitch 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
Hold	**Typical Activation Temperature**							
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	—	—	—	15V/0.061Ω	—
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	—	—	16V/0.031Ω	—	—	30V/0.045Ω	—	—
2.10	—	16V/0.024Ω	16V/0.024Ω	—	—	—	—	—
2.20	—	16V/0.023Ω	—	—	—	—	—	—
2.30	12V/0.015Ω	—	—	—	—	—	—	—
2.40	—	—	16V/0.020Ω	—	—	—	—	—
2.60	—	—	—	24V/0.034Ω	—	—	15V/0.031Ω	—
2.70	—	16V/0.015Ω	—	—	—	—	—	—
3.00	—	—	—	24V/0.023Ω	—	—	—	—
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	—	—	—	—	—	—	20V/0.085Ω	—
9.00	—	—	—	—	—	—	20V/0.008Ω	—
13.00	—	—	—	—	—	—	20V/0.006Ω	—

RoHS Compliant, ELV Compliant

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

	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	—	—
VLR230-C36F	5.0	4.2	3.4	2.52	2.30	1.7	1.3	0.9	0.4	—	—
VLR230UF	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
VTP200GF	3.7	3.2	2.6	2.12	2.00	1.5	1.2	0.9	0.5	0.3	0.1
VTP200UF	3.7	3.2	2.6	2.12	2.00	1.5	1.2	0.9	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
VTP210SSF	4.1	3.5	2.9	2.26	2.10	1.6	1.3	1.0	0.7	0.4	0.1
VTP240F	4.4	3.7	3.1	2.54	2.40	1.8	1.5	1.2	0.9	0.5	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
LTP070SF	1.1	1.0	0.8	0.7	0.65	0.5	0.4	0.3	0.2	0.2	0.1
LTP100F	1.8	1.6	1.4	1.0	0.99	0.8	0.7	0.6	0.4	0.3	0.2
LTP100SF	1.8	1.6	1.4	1.0	0.99	0.8	0.7	0.6	0.4	0.3	0.2
LTP100SLF	1.8	1.6	1.4	1.0	0.99	0.8	0.7	0.6	0.4	0.3	0.2
LTP180F	3.1	2.6	2.2	1.8	1.67	1.3	1.1	0.9	0.6	0.4	0.3
LTP180LF	3.1	2.6	2.2	1.8	1.67	1.3	1.1	0.9	0.6	0.4	0.3
LTP180SF	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
LTP300F	5.1	4.4	3.7	3.0	2.82	2.3	1.9	1.6	1.2	0.9	0.7
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	—	—	—

* Product electrical characteristics determined at 25°C.

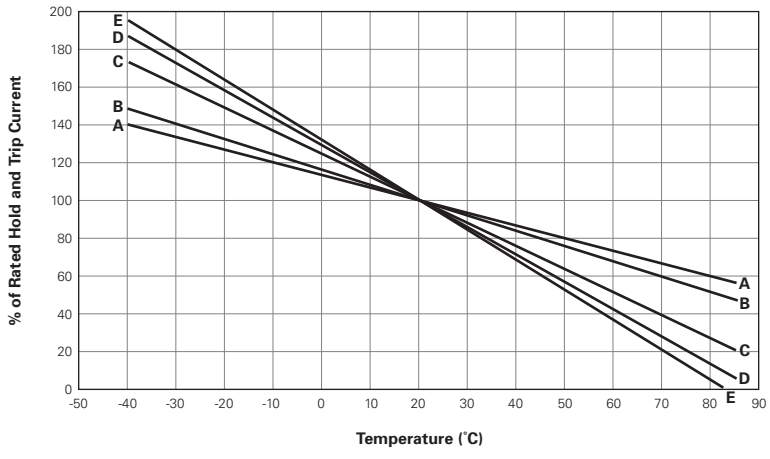
Table B2 Thermal Derating for Strap Battery Devices [Hold Current (A) at Ambient Temperature (°C)] ... Cont'd

	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**										
125°C Typical Activation LR4											
LR4-170UF	2.5	2.2	2.0	1.7	1.64	1.4	1.3	1.2	1.0	0.9	0.8
LR4-190F	2.8	2.5	2.3	1.9	1.86	1.6	1.5	1.4	1.2	1.1	1.0
LR4-190SF	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
LR4-880SSF	12.3	11.0	9.8	8.8	8.30	7.4	6.8	6.2	5.5	4.8	4.5
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
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
SRP175SSF	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



RoHS Compliant, ELV Compliant

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	B6
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	B6
VLR230F	2.30	5.0	12	100	1.4	10.00	5.0	0.012	0.015	0.018	0.030	0.036	B3
VLR230-C36F	2.30	5.0	12	100	2.5	10.00	5.0	0.012	0.015	0.018	0.030	0.036	B10
VLR230UF	2.30	5.0	12	100	1.4	10.00	5.0	0.012	0.015	0.018	0.030	0.036	B6
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
VTP*													
VTP110F	1.10	2.7	16	100	0.7	5.50	5.0	0.038	0.054	0.070	0.108	0.140	B6
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	B9
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	B6
VTP200GF	2.00	4.7	16	100	0.9	10.00	5.0	0.022	0.031	0.039	0.062	0.078	B3
VTP200UF	2.00	4.7	16	100	0.9	10.00	5.0	0.022	0.031	0.039	0.062	0.078	B6
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
VTP210SSF	2.10	4.7	16	100	1.2	10.00	5.0	0.018	0.024	0.030	0.048	0.060	B5
VTP240F	2.40	5.9	16	100	1.2	12.00	5.0	0.014	0.020	0.026	0.040	0.052	B3
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	B7
LTP070SF	0.70	1.45	15	100	0.7	3.50	5.0	0.100	0.150	0.200	0.300	0.340	B8
LTP100F	1.00	2.50	24	100	0.9	5.00	7.0	0.070	0.100	0.130	0.200	0.260	B7
LTP100SF	1.00	2.50	24	100	0.9	5.00	7.0	0.070	0.100	0.130	0.200	0.260	B8
LTP100SLF	1.00	2.50	24	100	0.9	5.00	7.0	0.070	0.100	0.130	0.200	0.260	B8
LTP180F	1.80	3.80	24	100	1.0	9.00	2.9	0.040	0.054	0.068	0.108	0.120	B7
LTP180LF	1.80	3.80	24	100	1.0	9.00	2.9	0.040	0.054	0.068	0.108	0.120	B7
LTP180SF	1.80	3.80	24	100	1.0	9.00	2.9	0.040	0.054	0.068	0.108	0.120	B8
LTP190F	1.90	4.20	24	100	1.5	10.00	3.0	0.030	0.044	0.057	0.088	0.100	B7
LTP260F	2.60	5.20	24	100	1.3	13.00	5.0	0.025	0.034	0.042	0.068	0.076	B7
LTP300F	3.00	6.30	24	100	1.7	15.00	4.0	0.015	0.023	0.031	0.046	0.055	B7
LTP340F	3.40	6.80	24	100	1.6	17.00	5.0	0.016	0.022	0.027	0.044	0.050	B7
miniSMDE													
miniSMDE190F	1.90	3.8	16	100	1.5	10.00	2.0	0.024	0.032	0.040	0.060	0.080†	B15
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	B16

* 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.

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
125°C Typical Activation													
LR4													
LR4-170UF	1.70	3.4	15	100	0.8	8.50	5.0	0.0440	0.0610	0.0780	0.089	0.1140	B12
LR4-190F	1.90	3.9	15	100	0.8	9.50	5.0	0.0390	0.0560	0.0720	0.079	0.1020	B10
LR4-190SF	1.90	3.9	15	100	0.8	9.50	5.0	0.0390	0.0560	0.0720	0.079	0.1020	B11
LR4-260F	2.60	5.8	15	100	1.0	13.00	5.0	0.0200	0.0310	0.0420	0.046	0.0630	B10
LR4-260SF	2.60	5.8	15	100	1.0	13.00	5.0	0.0200	0.0310	0.0420	0.046	0.0630	B11
LR4-380F	3.80	8.3	15	100	1.2	19.00	5.0	0.0130	0.0200	0.0260	0.028	0.0370	B10
LR4-380XF	3.80	8.3	15	100	1.2	19.00	5.0	0.0130	0.0200	0.0260	0.028	0.0370	B10
LR4-450F	4.50	8.9	20	100	1.4	22.50	5.0	0.0110	0.0160	0.0200	0.022	0.0280	B10
LR4-550F	5.50	10.5	20	100	2.0	27.50	5.0	0.0090	0.0130	0.0160	0.018	0.0220	B10
LR4-600F	6.00	11.7	20	100	1.7	30.00	5.0	0.0070	0.0110	0.0140	0.015	0.0190	B10
LR4-600XF	6.00	11.7	20	100	1.7	30.00	5.0	0.0075	0.0120	0.0140	0.015	0.0190	B10
LR4-730F	7.30	14.1	20	100	1.9	30.00	5.0	0.0060	0.0090	0.0120	0.011	0.0150	B10
LR4-880SSF	8.80	16.0	20	100	2.0	44.00	5.0	0.0065	0.0085	0.0105	0.012	0.0145	B14
LR4-900F	9.00	16.7	20	100	3.0	45.00	5.0	0.0060	0.0080	0.0100	0.011	0.0140	B10
LR4-1300SSF	13.00	21.2	20	100	2.2	65.00	5.0	0.0035	0.0060	0.0065	0.008	0.0090	B14
SRP													
SRP120F	1.20	2.7	15	100	0.8	6.00	5.0	0.085	0.123	0.160	0.170	0.220	B7
SRP120LF	1.20	2.7	15	100	0.8	6.00	5.0	0.085	0.123	0.160	0.170	0.220	B7
SRP120SF	1.20	2.7	15	100	0.8	6.00	5.0	0.085	0.123	0.160	0.170	0.220	B13
SRP175F	1.75	3.8	15	100	0.9	8.75	5.0	0.050	0.070	0.090	0.093	0.120	B7
SRP175LF	1.75	3.8	15	100	0.9	8.75	5.0	0.050	0.070	0.090	0.093	0.120	B7
SRP175SF	1.75	3.8	15	100	0.9	8.75	5.0	0.050	0.070	0.090	0.093	0.120	B13
SRP175SSF	1.75	3.8	15	100	0.9	8.75	5.0	0.050	0.070	0.090	0.093	0.120	B14
SRP200F	2.00	4.4	30	100	1.6	10.00	4.0	0.030	0.045	0.060	0.075	0.100	B7
SRP350F	3.50	6.3	30	100	1.9	20.00	3.0	0.017	0.024	0.031	0.040	0.050	B7
SRP420F	4.20	7.6	30	100	2.2	20.00	6.0	0.012	0.018	0.024	0.030	0.040	B7

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-B16 Dimension Figures for Strap Battery Devices

Figure B2

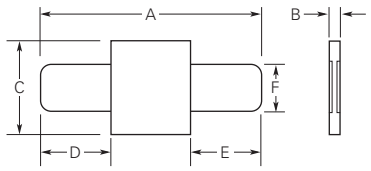


Figure B3

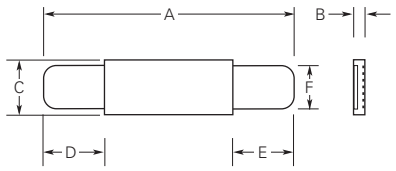


Figure B4

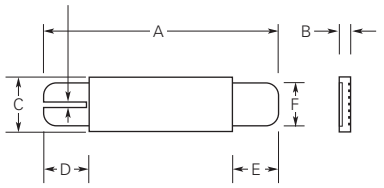


Figure B5

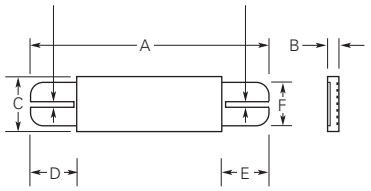


Figure B6

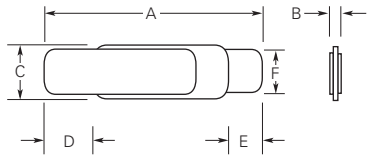


Figure B7

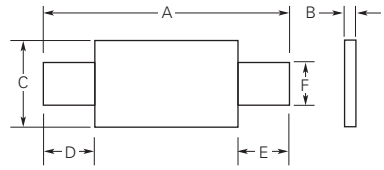


Figure B8

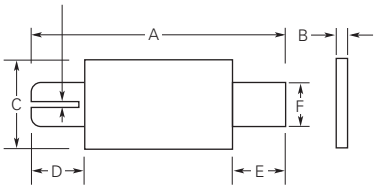


Figure B9

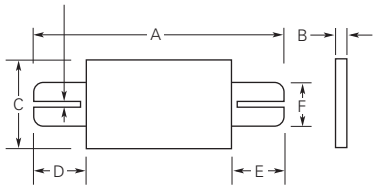


Figure B10

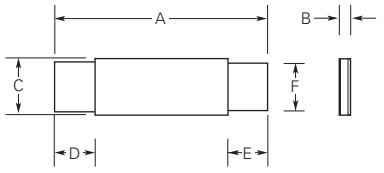


Figure B11

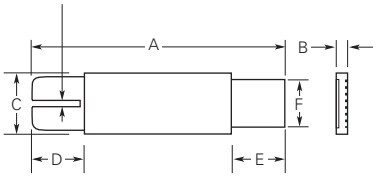


Figure B12

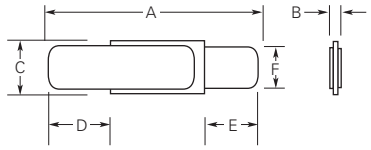


Figure B13

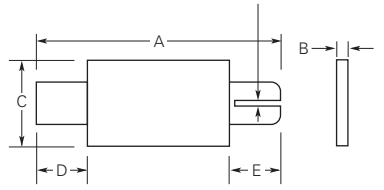


Figure B14

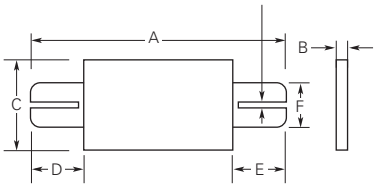


Figure B15

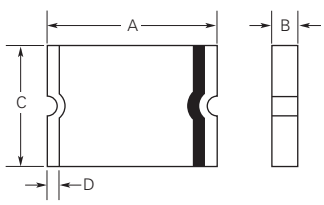


Figure B16

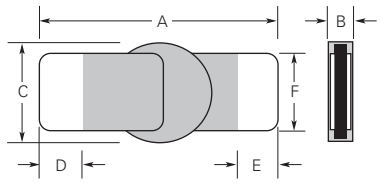


Table B4 Dimensions for Strap Battery Devices in Millimeters (Inches)

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	B6
	(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	B6
	(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)	—
VLR230-C36F	25.3	27.7	—	0.8	3.5	3.9	3.5	5.7	3.5	5.7	2.9	3.1	B10
	(0.10)	(1.09)	—	(0.03)	(0.14)	(0.15)	(0.14)	(0.22)	(0.14)	(0.22)	(0.11)	(0.12)	—
VLR230UF	20.9	23.1	—	0.7	4.9	5.1	4.1	6.0	4.1	6.0	3.9	4.1	B6
	(0.82)	(0.91)	—	(0.03)	(0.19)	(0.20)	(0.16)	(0.24)	(0.16)	(0.24)	(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	B6
	(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	B9
	(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	B6
	(0.83)	(0.91)	—	(0.03)	(0.13)	(0.15)	(0.22)	(0.27)	(0.22)	(0.27)	(0.11)	(0.12)	—
VTP200GF	20.9	23.1	—	0.8	4.1	4.5	3.0	4.8	3.0	4.8	2.9	3.1	B3
	(0.82)	(0.91)	—	(0.03)	(0.16)	(0.18)	(0.11)	(0.19)	(0.11)	(0.19)	(0.11)	(0.12)	—
VTP200UF	20.9	23.1	—	0.7	4.1	4.3	4.0	5.4	4.0	5.4	2.9	3.1	B6
	(0.82)	(0.91)	—	(0.03)	(0.16)	(0.17)	(0.16)	(0.21)	(0.16)	(0.21)	(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)	—
VTP210SSF	20.9	23.1	0.6	0.8	4.9	5.3	4.1	5.8	4.1	5.8	3.9	4.1	B5
	(0.82)	(0.91)	(0.02)	(0.03)	(0.19)	(0.21)	(0.16)	(0.23)	(0.16)	(0.23)	(0.15)	(0.16)	—
VTP240F	23.8	26.2	—	0.8	4.9	5.3	3.5	5.7	3.5	5.7	3.9	4.1	B3
	(0.93)	(1.03)	—	(0.03)	(0.19)	(0.21)	(0.13)	(0.23)	(0.13)	(0.23)	(0.15)	(0.16)	—

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
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	B7
	(0.783)	(0.870)	(0.027)	(0.048)	(0.192)	(0.205)	(0.216)	(0.296)	(0.216)	(0.296)	(0.153)	(0.162)	—
LTP070SF	19.9	22.1	0.7	1.2	4.9	5.2	5.5	7.5	5.5	7.5	3.9	4.1	B8
	(0.783)	(0.870)	(0.027)	(0.048)	(0.192)	(0.205)	(0.216)	(0.296)	(0.216)	(0.296)	(0.153)	(0.162)	—
LTP100F	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)	—
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	B8
	(0.82)	(0.91)	(0.02)	(0.04)	(0.19)	(0.20)	(0.16)	(0.22)	(0.16)	(0.22)	(0.15)	(0.16)	—
LTP100SLF	29.0	32.0	0.6	1.0	4.9	5.2	12.5	14.5	3.5	5.5	3.9	4.1	B8
	(1.14)	(1.26)	(0.02)	(0.04)	(0.19)	(0.20)	(0.49)	(0.57)	(0.14)	(0.22)	(0.15)	(0.16)	—
LTP180F	24.0	26.0	0.6	1.0	4.9	5.2	4.1	5.5	4.1	5.5	3.9	4.1	B7
	(0.94)	(1.02)	(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	B7
	(1.40)	(1.48)	(0.02)	(0.04)	(0.19)	(0.20)	(0.38)	(0.44)	(0.38)	(0.44)	(0.15)	(0.16)	—
LTP180SF	24.0	26.0	0.6	1.0	4.9	5.2	4.1	5.5	4.1	5.5	3.9	4.1	B8
	(0.94)	(1.02)	(0.02)	(0.04)	(0.19)	(0.20)	(0.16)	(0.22)	(0.16)	(0.22)	(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	B7
	(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	B7
	(0.94)	(1.02)	(0.02)	(0.04)	(0.43)	(0.47)	(0.20)	(0.28)	(0.20)	(0.28)	(0.23)	(0.24)	—
LTP300F	28.4	31.8	0.5	1.1	13	13.5	6.3	8.9	6.3	8.9	6.0	6.6	B7
	(1.12)	(1.25)	(0.02)	(0.04)	(0.51)	(0.53)	(0.25)	(0.35)	(0.25)	(0.35)	(0.24)	(0.26)	—
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	B7
	(0.94)	(1.02)	(0.02)	(0.04)	(0.58)	(0.63)	(0.16)	(0.20)	(0.16)	(0.20)	(0.23)	(0.24)	—
miniSMDE													
miniSMDE190F	11.15	11.51	0.33	0.53	4.83	5.33	0.51	1.02	—	—	—	—	B15
	(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	B16
	(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													
LR4-170UF	19.0	21.0	0.5	0.7	3.8	4.1	5.3	6.5	5.3	6.5	2.9	3.1	B12
	(0.75)	(0.83)	(0.02)	(0.03)	(0.15)	(0.16)	(0.21)	(0.26)	(0.21)	(0.26)	(0.11)	(0.12)	—
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	B10
	(0.78)	(0.87)	(0.02)	(0.04)	(0.19)	(0.22)	(0.22)	(0.30)	(0.22)	(0.30)	(0.15)	(0.16)	—
LR4-190SF	19.9	22.1	0.6	1.0	4.9	5.5	5.5	7.5	5.5	7.5	3.9	4.1	B11
	(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	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)	—
LR4-260SF	20.9	23.1	0.6	1.0	4.9	5.5	4.1	5.5	4.1	5.5	3.9	4.1	B11
	(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	B10
	(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	B10
	(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	B10
	(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	B10
	(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	B10
	(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	B10
	(1.59)	(1.68)	(0.02)	(0.04)	(0.27)	(0.30)	(0.20)	(0.27)	(0.20)	(0.27)	(0.19)	(0.20)	—

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
125°C Typical Activation LR4													
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	B10
	(1.06)	(1.15)	(0.02)	(0.04)	(0.54)	(0.57)	(0.16)	(0.22)	(0.16)	(0.22)	(0.23)	(0.24)	—
LR4-880SSF	62.8	65.2	0.6	1.0	7.9	8.5	10.0	12.0	10.0	12.0	5.9	6.1	B14
	(2.47)	(2.57)	(0.02)	(0.04)	(0.31)	(0.33)	(0.39)	(0.47)	(0.39)	(0.47)	(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	B10
	(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	B14
	(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	B7
	(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	B7
	(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	B13
	(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	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)	—
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	B7
	(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	B13
	(0.82)	(0.91)	(0.02)	(0.04)	(0.19)	(0.20)	(0.16)	(0.22)	(0.16)	(0.22)	(0.15)	(0.16)	—
SRP175SSF	20.9	23.1	0.6	1.0	4.9	5.2	4.1	5.5	4.1	5.5	3.9	4.1	B14
	(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	B7
	(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	B7
	(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	B7
	(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 B17-B24 Typical Time-to-trip Curves at 20°C for Strap Battery Devices

VLR (data at 25°C)

A = VLR170F
B = VLR175F
C = VLR230F

Figure B17

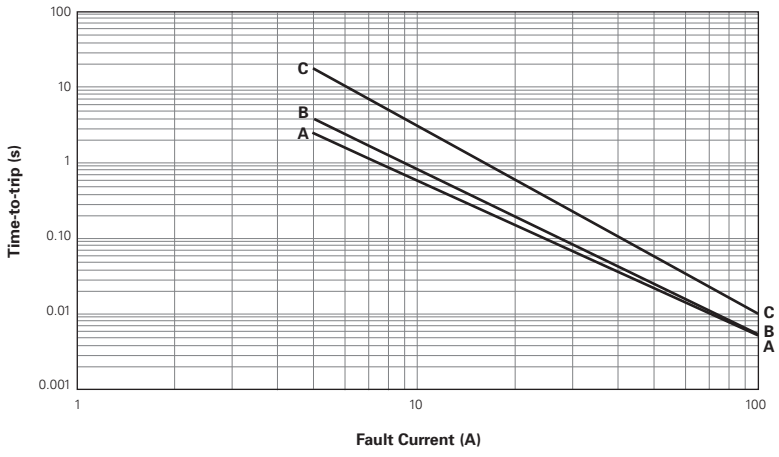


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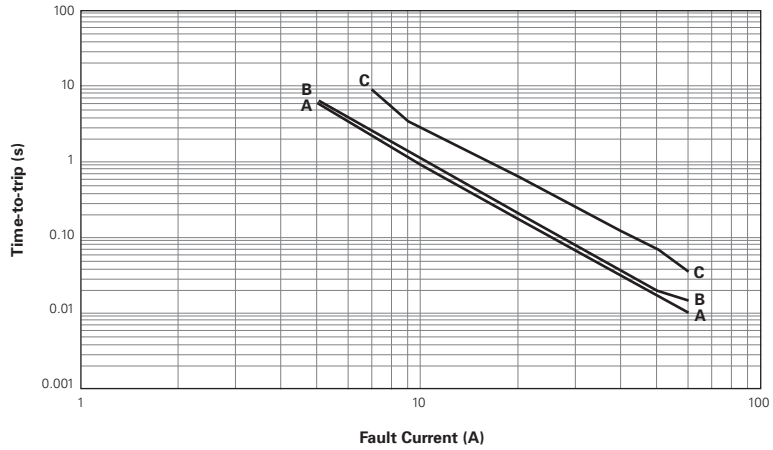
Figure B17-B24 Typical Time-to-trip Curves at 20°C for Strap Battery Devices ... Cont'd

VLP (data at 25°C)

A = VLP210F
B = VLP220F
C = VLP270F

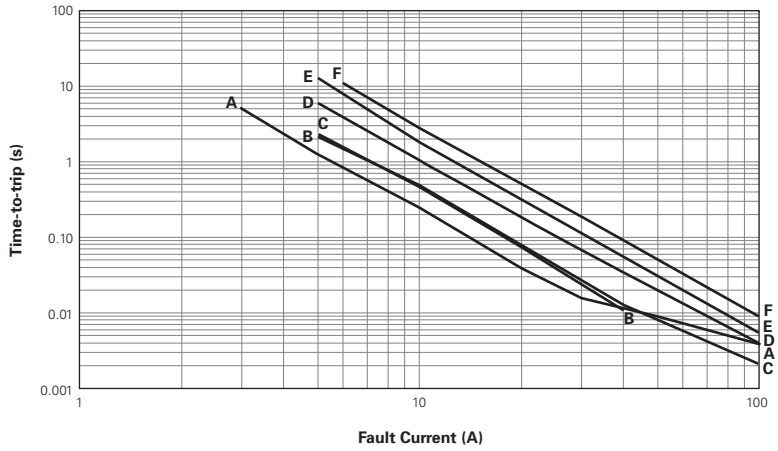
Figure B18



VTP (data at 25°C)

A = VTP110F
B = VTP170F
C = VTP175F
D = VTP200GF
E = VTP210GF
F = VTP240F

Figure B19



LTP

A = LTP070F
B = LTP100F
C = LTP180F
D = LTP190F
E = LTP260F
F = LTP300F
G = LTP340F

Figure B20

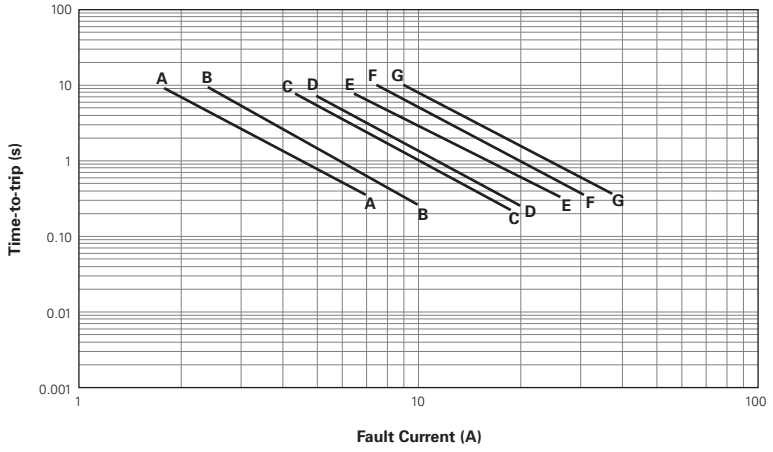
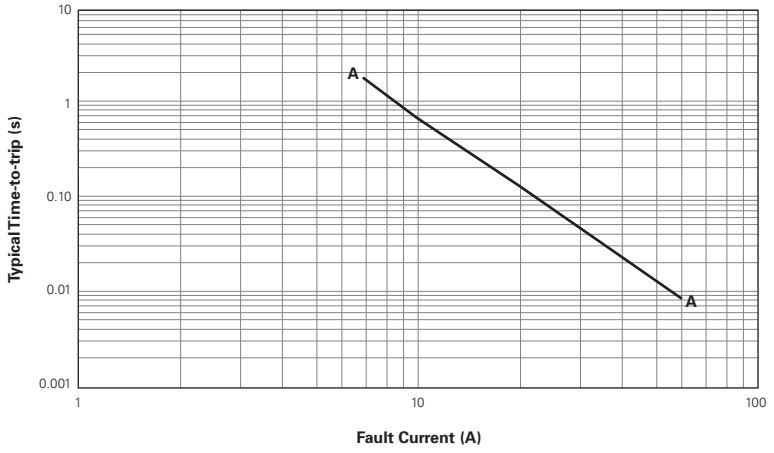


Figure B17-B24 Typical Time-to-trip Curves at 20°C for Strap Battery Devices ... Cont'd

MXP (data at 25°C)

A = MXP190BB

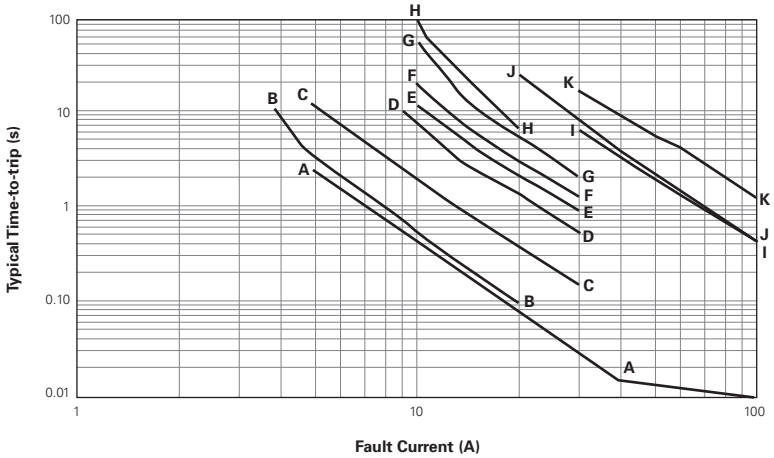
Figure B21



LR4

A = LR4-170UF
B = LR4-190F
C = LR4-260F
D = LR4-380F
E = LR4-450F
F = LR4-550F
G = LR4-600F
H = LR4-730F
I = LR4-880SSF
J = LR4-900F
K = LR4-1300SSF

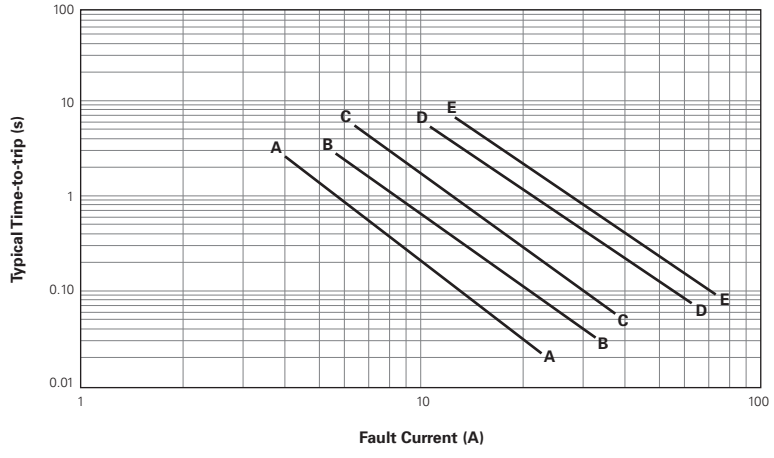
Figure B22



SRP

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

Figure B23



RoHS Compliant, ELV Compliant

Figure B17-B24 Typical Time-to-trip Curves at 20°C for Strap Battery Devices ... Cont'd

miniSMDE

A = miniSMDE190F

Figure B24

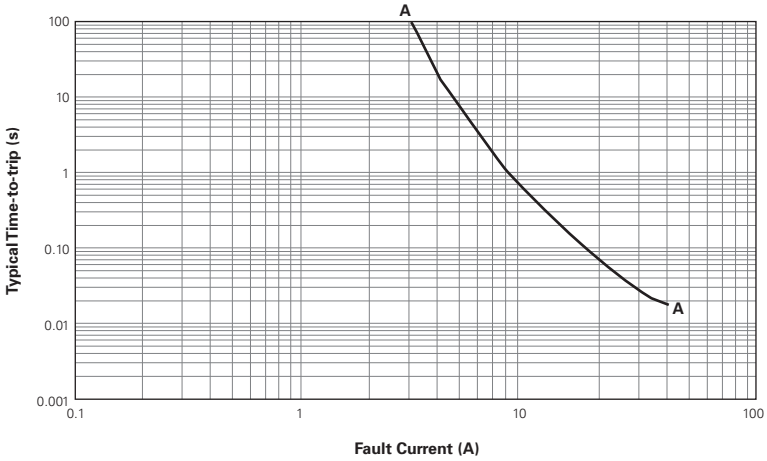


Table B5 Physical Characteristics and Environmental Specifications for Strap Battery Devices

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

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

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

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.

RoHS Compliant, ELV Compliant

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
VLR230-C36F	1,000	—	10,000	R23	UL, CSA,TÜV
VLR230UF	1,000	—	10,000	—	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
VTP200GF	1,000	—	10,000	V20	UL, CSA, TÜV
VTP200UF	1,000	—	10,000	—	UL, CSA, TÜV
VTP210GF	1,000	—	10,000	V21	UL, CSA, TÜV
VTP210GUF	1,000	—	10,000	—	UL, CSA, TÜV
VTP210SF	1,000	—	10,000	V21	UL, CSA, TÜV
VTP210SLF	1,000	—	10,000	V21	UL, CSA, TÜV
VTP210SSF	1,000	—	10,000	V21	UL, CSA, TÜV
VTP240F	1,000	—	10,000	V24	UL, CSA, TÜV
110°C Typical Activation					
LTP					
LTP070F	2,000	—	10,000	L07	UL, CSA, TÜV
LTP070SF	2,000	—	10,000	L07	UL, CSA, TÜV
LTP100F	2,000	—	10,000	L10	UL, CSA, TÜV
LTP100SF	2,000	—	10,000	L10	UL, CSA, TÜV
LTP100SLF	2,000	—	40,000	L10	UL, CSA, TÜV
LTP180F	2,000	—	10,000	L18	UL, CSA, TÜV
LTP180LF	500	—	10,000	L18	UL, CSA, TÜV
LTP180SF	2,000	—	10,000	L18	UL, CSA, TÜV
LTP190F	500	—	10,000	L19	UL, CSA, TÜV
LTP260F	1,000	—	10,000	L26	UL, CSA, TÜV
LTP300F	500	—	10,000	L30	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

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
125°C Typical Activation					
LR4					
LR4-170UF	2,000	—	10,000	NA	UL, CSA, TÜV
LR4-190F	2,000	—	10,000	E19	UL, CSA, TÜV
LR4-190SF	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
LR4-880SSF	250	—	8,000	E88	(UL, CSA, TÜV pending)
LR4-900F	500	—	10,000	E90	UL, CSA, TÜV
LR4-1300SSF	250	—	10,000	EX3	UL, CSA, TÜV
SRP					
SRP120F	2,000	—	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
SRP175SSF	2,000	—	10,000	175	UL, CSA, TÜV
SRP200F	500	—	10,000	200	UL, CSA, TÜV
SRP350F	500	—	10,000	350	UL, CSA, TÜV
SRP420F	500	—	10,000	420	UL, CSA, TÜV

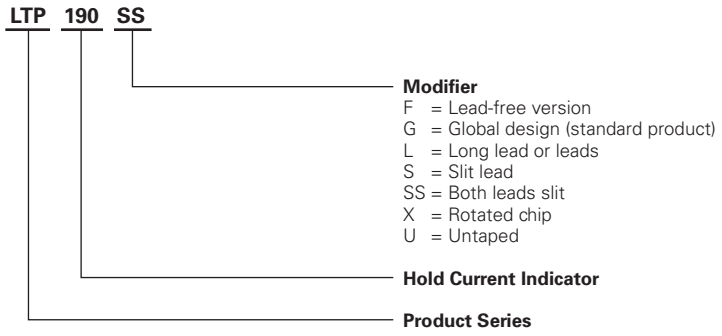
Agency Recognition for Strap Battery Devices

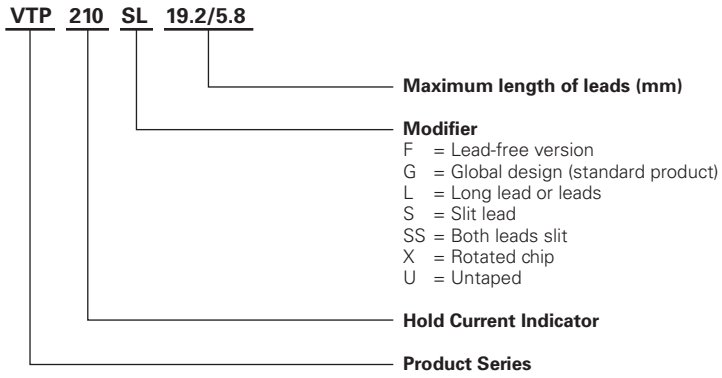
UL	File # E74889
CSA	File # 78165C
TÜV	Certificate number available on request

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





⚠ Warning :

- 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

PolySwitch devices for telecommunication and networking applications were initially designed over ten 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, 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 IP equipment)
- LAN, WAN equipment
- Customer premise equipment
- Access network hardware

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. 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 Circuit Protection product representative.

		Overcurrent Protection			Overvoltage Protection
		Form Factor			
Application	**Region/ Specification**	**Radial-leaded**	**Surface-mount**	**Chip**	**SiBar Thyristor Surge Protectors****
Customer Premises equipment	**North America**	TRF600-150	TS600-170F		TVBxxx(N)SA-L
IT equipment	TIA-968-A,	TRF600-160	TS600-200F		TVBxxx(N)SB-L
Analog modems, V.90 modems,	UL 60950,	TRF600-400	TSM600-250F		TVAxxx(N)SA-L
ISDN modems, xDSL modems,	GR1089 Port Type 3‡		TSM600-400F		
ADSL splitters, phone sets, fax machines,	**Europe/Asia/**	TRF250-120	TS250-130F		TVBxxx(N)SA-L
answering machines, caller ID, internet	**South America**	TRF250-120T	TSV250-130F		TVAxxx(N)SA-L
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		TVBxxx(N)SC-L
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		TVBxxx(N)SA-L
	South America	TRF250-120T	TSV250-130F		TVAxxx(N)SA-L
	ITU K.45	TRF250-145			
		TRF250-183			
		TRF250-184			
Central office switching equipment (†)	**North America**	TRF600-160	TS600-170F		TVBxxx(N)SC-L
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	TVBxxx(N)SA-L
	South America	TRF250-120T	TSV250-130F		TVAxxx(N)SA-L
	ITU K.20	TRF250-145			
		TRF250-183			
		TRF250-184			
Primary protection modules (†)	**North America**	TRF250-183			N/A
MDF modules, Network Interface	Telcordia GR-974	TRF250-184			
Devices (NID)	**Europe/Asia/**	TRF250-080U	TSL250-080F	TCF250-100T	TVBxxx(N)SA-L
	South America	TRF250-120	TS250-130F	TCF250-120T	TVBxxx(N)SB-L
	ITU K.20	TRF250-120T	TSV250-130F	TCF250-145T	TVBxxx(N)SC-L
		TRF250-145		TCF250-180	
		TRF250-183			
		TRF250-184			
Short-haul/intrabuilding communications	**North America**	TRF250-080U	TSL250-080F		TVBxxx(N)SA-L
equipment (†)	GR1089 Port Type 2‡	TRF250-120	TS250-130F		TVAxxx(N)SA-L
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		TVBxxx(N)SA-L
	South America	TRF250-120T	TSV250-130F		TVAxxx(N)SA-L
	ITU K.21	TRF250-145			
		TRF250-183			
		TRF250-184			

RoHS Compliant, ELV Compliant

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

Application	Region/ Specification	Overcurrent Protection – Form Factor: Radial-leaded	Overcurrent Protection – Form Factor: Surface-mount	Overcurrent Protection – Form Factor: Chip	Overvoltage Protection – SiBar Thyristor Surge Protectors**
LAN intrabuilding power cross protection	**North America**	TRF250-080U	TSL250-080F		TVBxxx(N)SA-L
LAN equipment, VoIP cards, IP phones	GR1089 Port Type 4‡	TRF250-120	TS250-130F		TVAxxx(N)SA-L
		TRF250-120T	TSV250-130F		
		TRF250-145			
		TRF250-183			
		TRF250-184			
IEEE 802.3AF/AT Power over Ethernet protection			decaSMDC050F/60-2‡‡		TVB058(N)SA-L TVB058NSB-L TVB058NSC-L
Powered Ethernet switches and terminals, IP phones, wireless LAN base stations, microcellular base stations, VoIP cards					
Cable telephony powering system		BBRF550***			N/A
Power passing taps		BBRF750***			

* 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.
** For more information on SiBar thyristor surge protectors, refer to the SiBar product section.
†† 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.
‡ 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.

Agency Specification/Selection Guide for Telecommunications and Networking Devices ... Cont'd

Family	Product*	Lightning	Power Cross/Contact/Induction
TRF250	**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
	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)							
0.080	—	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)]

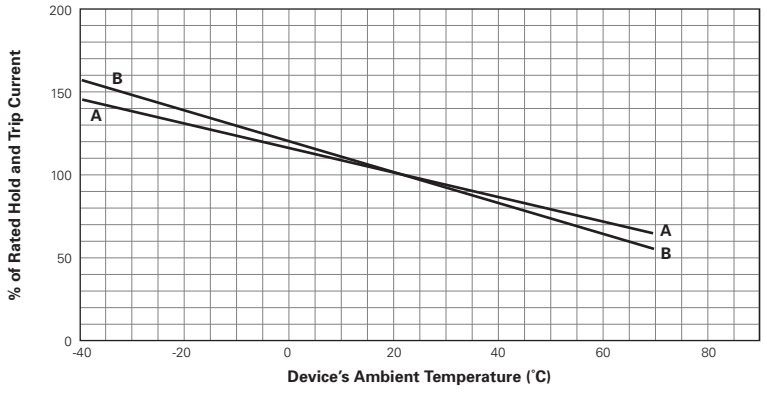
		Maximum Ambient Temperature								
	Part Number	**-40°C**	**-20°C**	**0°C**	**20°C**	**40°C**	**50°C**	**60°C**	**70°C**	**85°C**
	Chip* — 250V_{AC} TCF250									
	TCF250-100T	0.155	0.138	0.119	0.100	0.083	0.073	0.064	0.055	0.042
	TCF250-120T	0.186	0.165	0.143	0.120	0.099	0.088	0.077	0.066	0.050
	TCF250-145T	0.225	0.199	0.172	0.145	0.119	0.106	0.093	0.080	0.060
	TCF250-180‡	0.269	0.240	0.211	0.180	0.153	0.138	0.123	0.109	0.087
	Radial-leaded* — 250V_{AC} TRF250									
	TRF250-080U	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
NEW	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	0.233	0.206	0.178	0.150	0.124	0.110	0.096	0.083	0.062
	TRF600-160	0.249	0.219	0.190	0.160	0.132	0.117	0.103	0.088	0.066
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
NEW	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											
	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
NEW	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
	TRF600-160	0.160	0.320	250	600	3.0	1.0	1.0	7.5	4.0	10.0	18.0
	TRF600-160-RA	0.160	0.320	250	600	3.0	1.0	1.0	9.5	4.0	7.0	16.0
	TRF600-160-R1	0.160	0.320	250	600	3.0	1.0	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
	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
NEW	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.

‡ Product is not currently available in a resistance matched or sorted option.

** R_{1MAX} measured 1 hour post-trip, or 24 hours post-reflow at 20°C.

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⚠ Warning :

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum volatge or current 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.
- Operation in circuits with a large inductance can generate a circuit voltage (Ldi/dt) above the rated voltage of the PolySwitch resettable device. This product should not be used in an application where the maximum interrupt voltage can be exceeded by inductive spikes.
- 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.
- 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.

Figure T2-T13 Dimension Figures for Telecommunications and Networking Devices

Figure T2

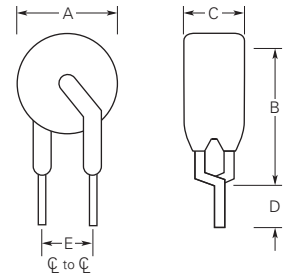

Figure T3

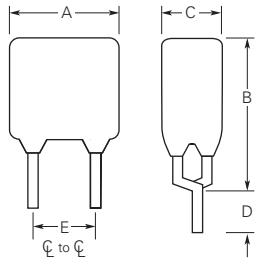

Figure T4

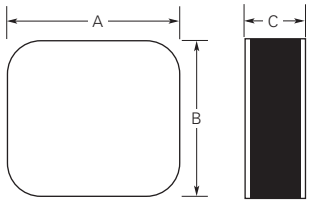

Figure T5

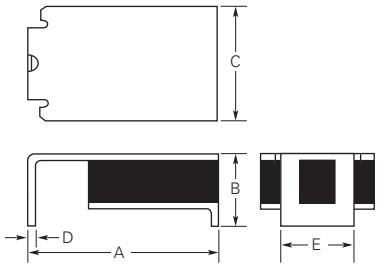

Figure T6

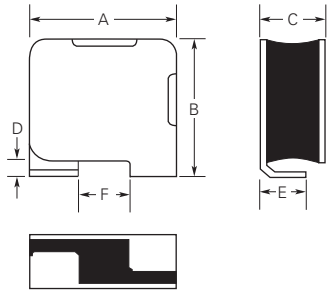

Figure T7

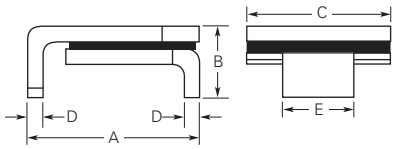

Figure T8

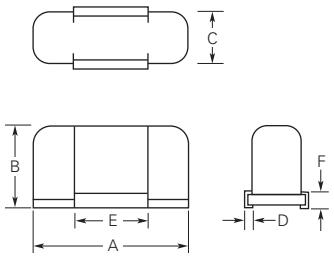

Figure T9

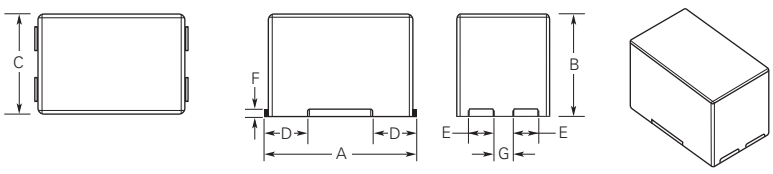

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Figure T2-T13 Dimension Figures for Telecommunications and Networking Devices ... Cont'd

Figure T10

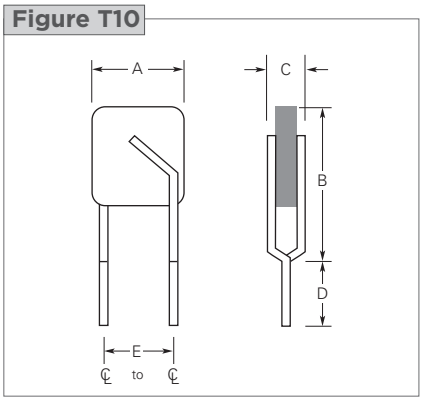

Figure T11

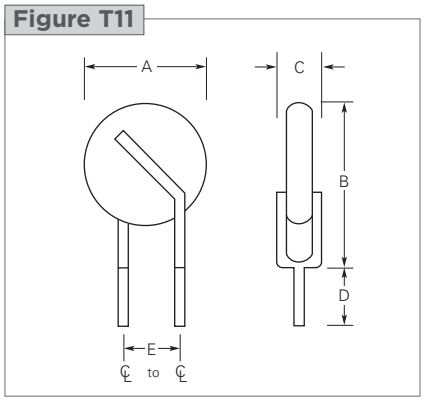

Figure T12

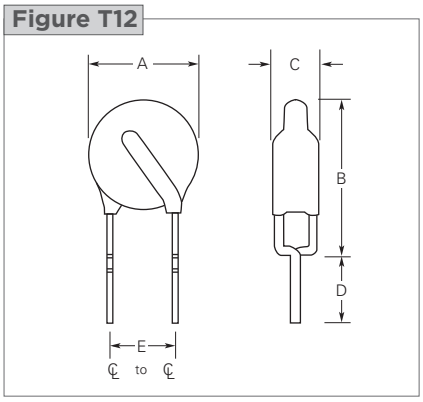

Figure T13

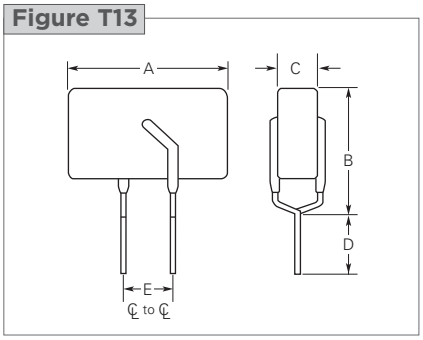

Table T4 Dimensions for Telecommunications and Networking Devices in Millimeters (Inches)

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*															
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)	—	7.0 (0.28)	—	—	—	T3
TRF250-120U	—	6.0 (0.24)	—	10.0 (0.39)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	6.0 (0.24)	—	—	—	T10
TRF250-145	—	6.5 (0.26)	—	11.0 (0.43)	—	4.6 (0.18)	4.7 (0.19)	—	5.0‡ (0.20)	—	7.0 (0.28)	—	—	—	T3
TRF250-145U	—	6.0 (0.24)	—	10.0 (0.39)	—	3.8 (0.15)	4.7 (0.19)	—	5.0‡ (0.20)	—	6.0 (0.24)	—	—	—	T10
NEW 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

* 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.

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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
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
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
TS600/TSM600 600V†															
TS600-170F	18.3 (0.72)	19.4 (0.77)	11.6 (0.46)	12.3 (0.49)	7.2 (0.29)	8.3 (0.33)	1.7 (0.07)	2.4 (0.10)	9.9 (0.39)	10.4 (0.41)	1.5 (0.06)	2.3 (0.09)	—	—	T8
TS600-200F-RA	18.3 (0.72)	19.4 (0.77)	11.6 (0.46)	12.3 (0.49)	7.2 (0.29)	8.3 (0.33)	1.7 (0.07)	2.4 (0.10)	9.9 (0.39)	10.4 (0.41)	1.5 (0.06)	2.3 (0.09)	—	—	T8
NEW TS600-400F	18.3 (0.72)	19.4 (0.77)	11.6 (0.46)	12.3 (0.49)	7.2 (0.29)	8.3 (0.33)	1.7 (0.07)	2.4 (0.10)	9.9 (0.39)	10.4 (0.41)	1.5 (0.06)	2.3 (0.09)	—	—	T8
TSM600-250F	17.00 (0.67)	17.60 (0.69)	11.20 (0.44)	11.70 (0.46)	10.40 (0.41)	11.20 (0.44)	4.80 (0.19)	5.20 (0.20)	2.50 (0.10)	2.80 (0.11)	0.60 (0.02)	1.0 (0.04)	2.2 (0.09)	3.1 (0.12)	T9
TSM600-400F	17.00 (0.67)	17.60 (0.69)	11.20 (0.44)	11.70 (0.46)	10.40 (0.41)	11.20 (0.44)	4.80 (0.19)	5.20 (0.20)	2.50 (0.10)	2.80 (0.11)	0.60 (0.02)	1.0 (0.04)	2.2 (0.09)	3.1 (0.12)	T9

* $250V_{AC}$ 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.

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

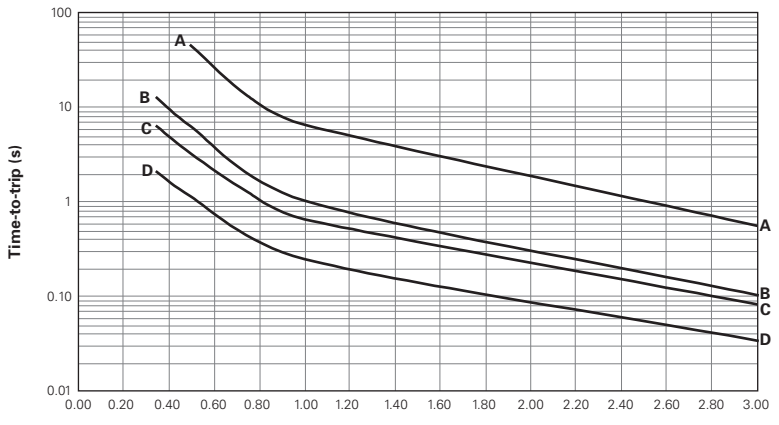

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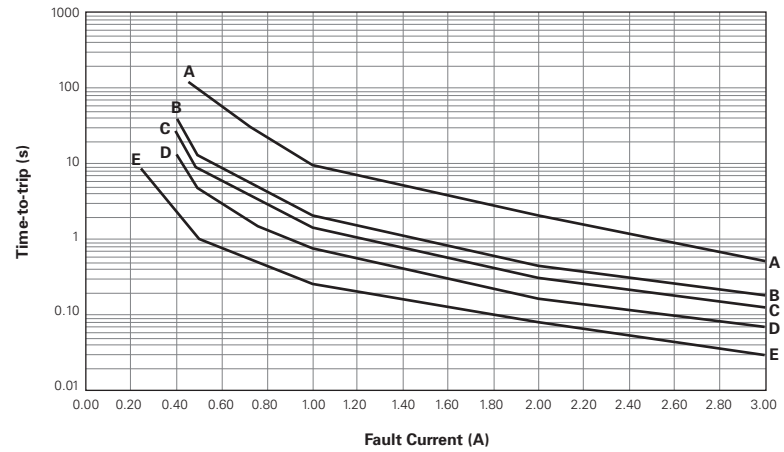
Figure T14-T17 Typical Time-to-trip Curves at 20°C for Telecommunications and Networking Devices ... Cont'd

TRF250

A = TRF250-180/183/184
B = TRF250-145/145U
C = TRF250-120/120U
D = TRF250-110U/120UT/120T
E = TRF250-080T/080U/080US

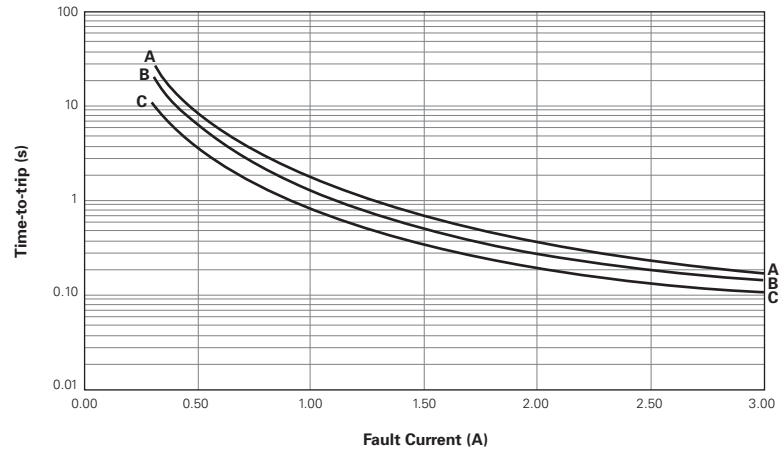
Figure T15



TS250/TSV250/TSL250

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

Figure T16



TRF600/TS600/TSM600

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

Figure T17

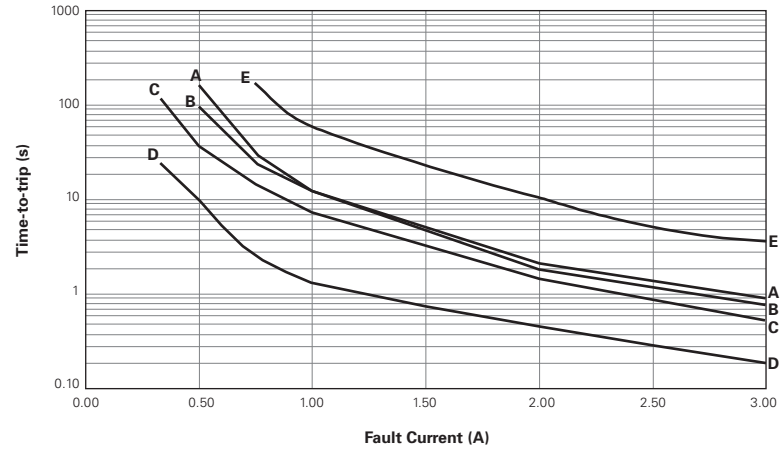


Table T5 Physical Characteristics and Environmental Specifications for Telecommunications and Networking Devices

[Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)]

TCF250*

Physical Characteristics

Terminal material	Nickel-plated copper foil

Environmental Specifications

Test	Conditions
Passive aging	60°C, 1000 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.

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.

* $250V_{AC}$ 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)]

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.

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	IPer 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.

* 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 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					
	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
	TRF250-110U-2	—	1,500	7,500	—	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
NEW	TRF250-183	500	—	10,000	83F	UL, CSA, TÜV
NEW	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
	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
NEW	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.

RoHS compliant, ELV compliant

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

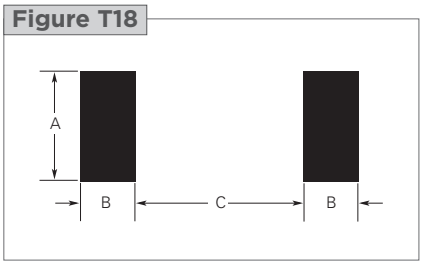


Figure T19

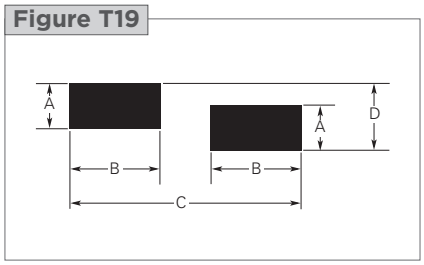
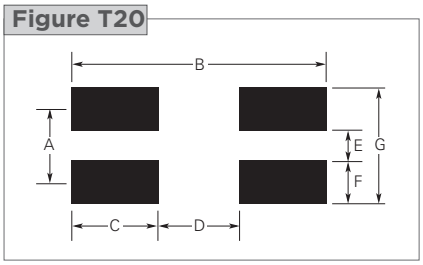


Figure T20

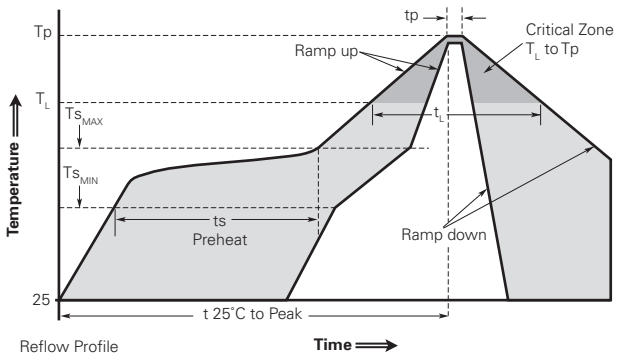


Solder Reflow and Rework Recommendations for Telecommunications Surface-mount Devices

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

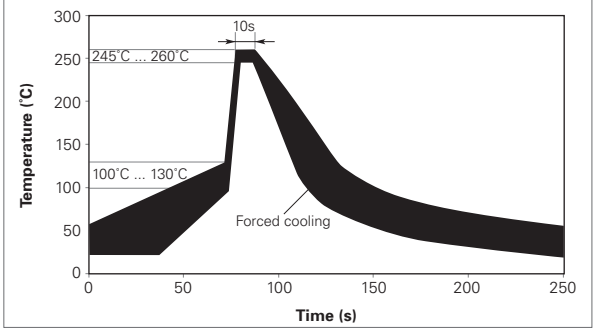


Table T8 TRF250/TRF600 Tape and Reel Specifications for Telecommunications and Networking Device

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.

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Figure T23 EIA Referenced Taped Component Dimensions for TRF Devices

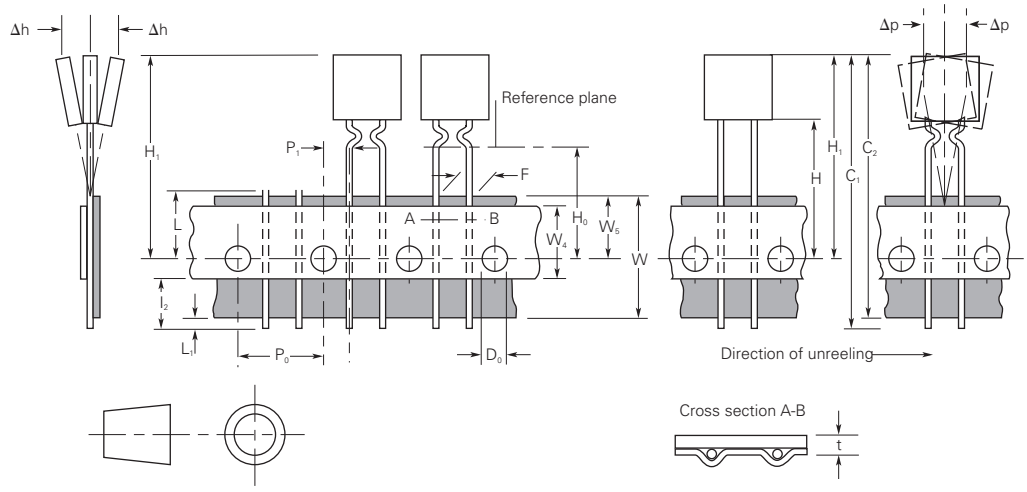

Figure T24 Reel Dimensions for TRF Devices

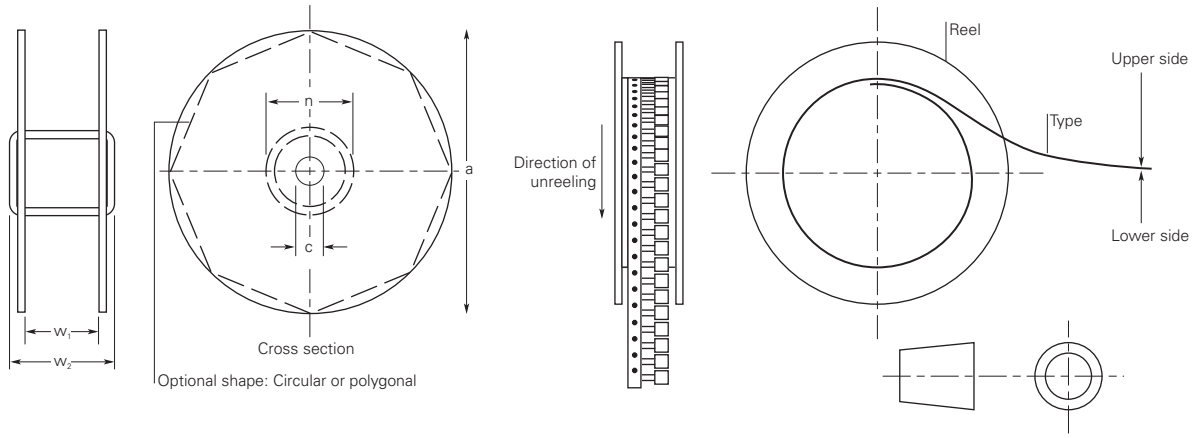

Table T9 TS Tape and Reel Specifications for Telecommunications and Networking Devices

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		TSV250		TSL250	
		Dimension(mm)	Tolerance(mm)	Dimension(mm)	Tolerance(mm)	Dimension(mm)	Tolerance(mm)
Carrier tape width	W	16	±0.30	16.0	±0.3	16	±0.3
Sprocket hole pitch	P_0	4.0	±0.10	4.0	±0.1	4.0	±0.10
	P_1	12.0	±0.10	8.0	±0.1	8.0	±0.10
	P_2	2.0	±0.10	2.0	±0.1	2.0	±0.10
	A_0	6.9	±0.23	5.5	±0.1	5.5	±0.10
	B_0	9.6	±0.15	6.2	±0.1	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	±0.1	3.70	±0.10
	Leader min.	300	—	390	—	390	—
	Trailer min.	300	—	160	—	160	—

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.

TS250/TSL250/TSV250

Dimension Description	EIA Mark	TS250		TSV250		TSL250	
		Dimension(mm)	Tolerance(mm)	Dimension(mm)	Tolerance(mm)	Dimension(mm)	Tolerance(mm)
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	

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	

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Figure T25 EIA Referenced Taped Component Dimensions for TS Devices

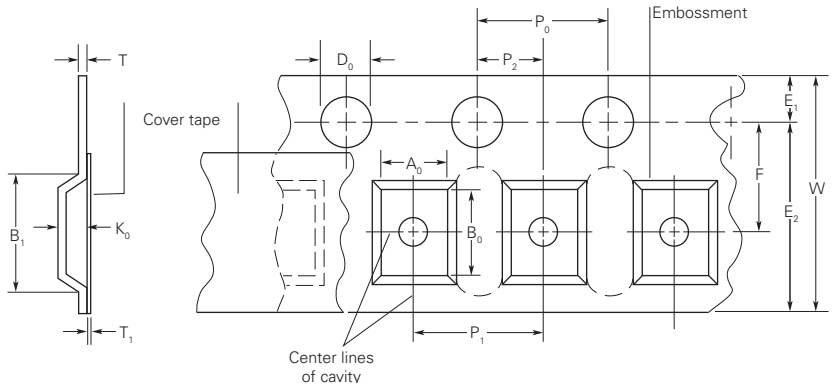
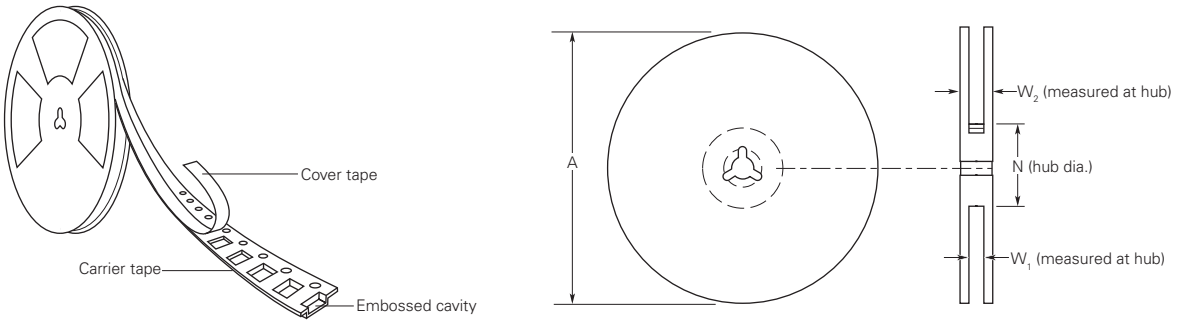


Figure T26 EIA Referenced Reel Dimensions for TS Devices



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.

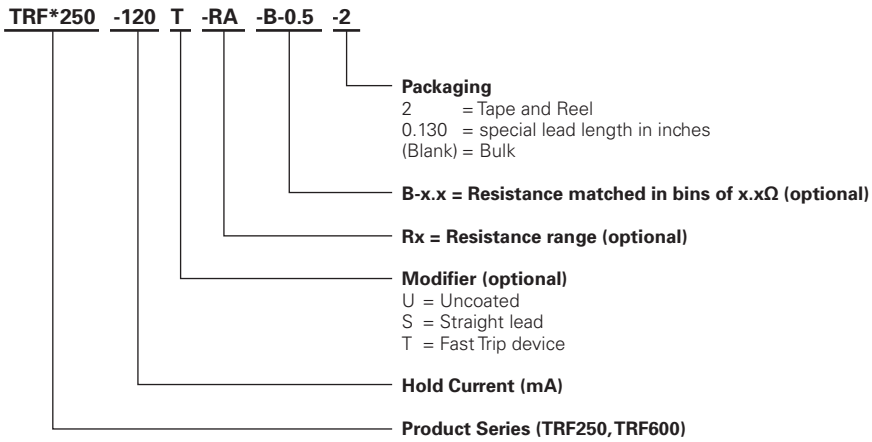
Feature

- Tighter resistance balance between any two parts in a package.

Benefits

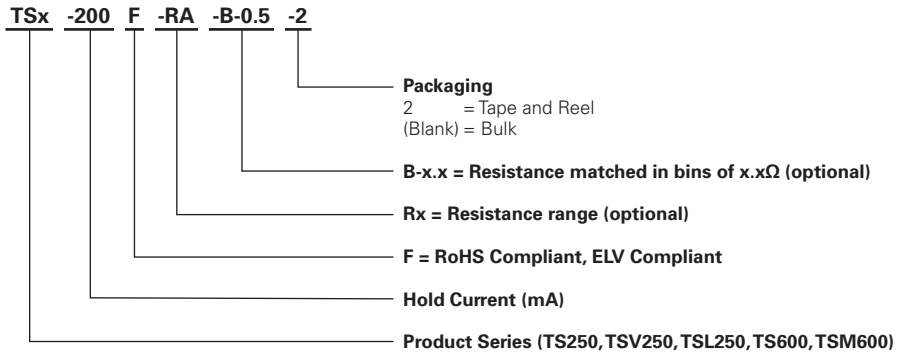
- Resistance-matched devices may reduce the tip-ring resistance differential, reducing the possibility of line imbalance.

Part Numbering System for Radial-leaded Telecommunications and Networking Devices

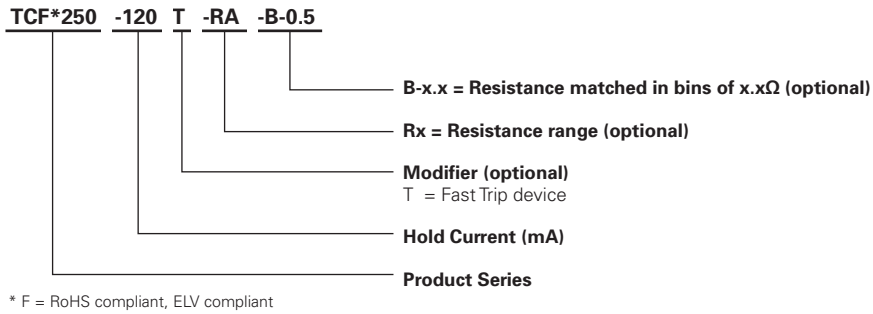


* F = RoHS compliant, ELV compliant

Part Numbering System for Surface-mount Telecommunications and Networking Devices



Part Numbering System for Chip Telecommunications and Networking Devices



* F = RoHS compliant, ELV compliant

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Fax : 33-1-34202324

Nordic / Baltic
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Fax : 49-89-6089394

Other Countries
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Fax : 49-89-6089394

ASIA / PACIFIC

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Fax : 81-44-900-5140

Korea
Tel : 82-2-3415-4654
Fax : 82-2-3486-1786

Taiwan
Tel : 886-2-8768-2788 x 211
Fax : 886-2-8768-1277

China, Beijing
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